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Climate Disasters and Sustainable Tourism in Vietnam: The Moderating Role of Adaptation Policies in the Case of Typhoon Yagi

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ABSTRACT: The research paper examines the impact of climate-related disasters, specifically Typhoon Yagi, on the process of achieving sustainable tourism development in Vietnam. Coming against the backdrop of the growing uncertainty of the climate, the study is based on three major themes, namely, the issue of the extent of the disasters, the success of community adaptability, and the effectiveness of governance policies on providing resilience. Methodologically, the study employing a quantitative method in a 5-point Likert scale survey utilizes a sound theoretical ground based on a combination of knowledge gained on sustainable tourism, disaster resiliency, and community-based adaptation. The research community obtained 368 responses in four stakeholder groups that included tourism businesses, government officials, academic researchers, and local community organizations in communities directly or indirectly affected by Typhoon Yagi. The findings indicate that the climate catastrophes have greatly impacted the tourism industry in terms of infrastructure, daily activities, and the livelihoods of the locals. The events have, however, also unleashed adaptive actions both at the policy and community levels. The research concludes that high local adaptation capacity is necessary in maintaining tourism, and proactive and well-coordinated government policies would mitigate the ill impacts of calamities. Based on a contrast, in the case of fragmented or top-down government support, a rather slower and less effective recovery is observed. The research provides a theoretical linkage between disaster research and sustainable tourism views. It is practical in the sense that it offers local knowledge of how communities and institutions can be engaged to adapt to climate change. It highlights the need for coordination at various levels, community empowerment, and regular policy promotion. All in all, the research sheds light on the present situation of Vietnam as a country lying somewhere between excessive vulnerability and being resilient to the threats of climate change, as it gives potential lessons to other developing nations with the same vulnerabilities in the aspect of tourism.

1. INTRODUCTION

Most people now agree that sustainable tourism development (STD) is a complex goal that necessitates striking a balance between social justice, environmental preservation, and economic viability (Elgin & Elveren, 2024). Pursuing this balance has grown more challenging in Vietnam, a nation rich in natural beauty and cultural heritage, because of its uneven infrastructure resilience and susceptibility to climate change. The national economy depends heavily on tourism, but unchecked development, environmental damage, and the marginalization of local communities pose threats to the industry's long-term viability (Baloch et al., 2022). These difficulties are especially acute in areas that frequently experience natural disasters, where typhoons and other similar occurrences frequently interfere with preparation and recovery activities (Neef, 2021).

Researchers have devoted extensive time to studying how tourism faces threats during climate-related disasters, especially in coastal island areas (Scott et al., 2012). Studies in Southeast Asia indicate that natural disasters repeatedly disrupt tourism development while resilience-building programs show inconsistent implementation (Nguyen et al., 2022). There is growing recognition of how resilient infrastructure protects tourism systems from climate impacts, but researchers lack empirical investigations of the link between this resilience and government adaptation measures (Xu et al., 2023). Existing research in Vietnam neglects the development of comprehensive frameworks that establish the link between infrastructure resilience systems and sustainable tourism outcomes in disaster situations. This study addresses this knowledge gap by investigating how government adaptation strategies impact the relationship between sustainable tourism development and infrastructure

resilience, with a particular focus on Typhoon Yagi while developing a purpose-specific model that enhances practical benefits and theoretical knowledge, especially for disaster-prone regions that wish to establish resilient and sustainable tourism industries.

In this research, the authors seek to explore three central investigative questions:

1. How does the severity of climate-induced natural disasters affect sustainable tourism development in Vietnam?
2. To what extent does the resilience of tourism infrastructure contribute to sustainable tourism development in disaster-prone regions?
3. How do government adaptation policies moderate the relationship between infrastructure resilience and sustainable tourism development?

This research examines the economics and structures of sustainable tourism in relation to climate change across the territories of Vietnam. The challenge of achieving a sustainable balance between environmental and cultural heritage protection and economic stimulation is difficult, especially for areas that are frequently affected by extreme weather events. The analysis builds on its findings on Typhoon Yagi, which examines how devastating natural disasters undermine sustainable development goals and damage tourism development plans. This study explores new knowledge by assessing infrastructure resilience as a potential tool to mitigate these consequences. The study shows that resilience includes technical aspects and active political support combined with participatory community programs and effective governance practices. In addition, it outlines disaster response by analyzing government adaptation policies, thereby contributing both the theoretical basis and practical significance for sustainable tourism development in a changing environment.

2. LITERATURE REVIEW

1.1 Sustainable Tourism Development

Sustainable Tourism Development (STD) represents tourism that facilitates current demands while ensuring future populations have enough to support themselves through proper environmental, economic, and socio-cultural management (Sharpley, 2009). According to Theoretical views, STD functions as a crucial approach to reduce tourism-generated environmental problems and keep both economic profit and cultural heritage stable (Butler, 1999). The model proves essential for climate change-prone locations by establishing varied economic sectors and job markets and increasing environmental understanding (Gössling & Hall, 2006). Developing nations face challenges with STD implementation due to ongoing institutional limitations that affect how these countries execute STD regulations (Becken & Hay, 2007).

The World Bank (2006) reports that Hoi An, Vietnam, utilizes heritage preservation and eco-tourism initiatives to restore its economy and improve community pride, which demonstrates a successful model for implementing heritage-based resistance. The STD functions both as a primary objective and a leadership method for developing an equitable and sustainable tourism structure of the future.

1.2 Anchoring Theoretical Framework

1.2.1 Resilience Theory

The dynamic aspects of Resilience Theory enable destination managers to understand preparedness and reaction and recovery processes from disruptions that primarily stem from climate change. Resilience emerged through ecological science before social scientists and environmental scientists used it to analyze both social and environmental systems, including tourism, which determines how places adapt to shocks without losing their core functions (Folke, 2006). Tourism resilience contains two main components: the structural elements of buildings and the operational procedures guiding community and governmental actions in response to disasters, including typhoons and floods, and rising ocean levels. The disaster zones of Vietnam require resilience beyond durable buildings to establish proper linkages between physical frameworks and emergency preparedness systems with government supervision (Hall et al., 2017). Typhoon Yagi demonstrated that different Vietnamese tourist areas demonstrated varying levels of resilience recovery during the storm, while exposing fluctuations in their ability to adapt and sustainability problems of tourism operations in disaster-prone environments.

Systems require three essential functions to implement Resilience Theory according to its central principle: learning abilities and adaptive capabilities, alongside the capability to transform themselves during times of change. Sustainable tourism particularly requires frequent evolution because climate risks continue to escalate. Strong tourism infrastructure acts to prevent economic losses yet simultaneously promotes smarter, sustainable recovery for the sector (Biggs et al., 2012). The components of adaptable tourism systems utilize adaptive infrastructure structures alongside community involvement and decentralized management choices, which convert disaster responses into opportunities for substantial betterment rather than simple reconstruction practices.

The analysis of sustainability-supported projects through disaster-resistant tourism infrastructure receives beneficial guidance from Resilience Theory. The method promotes destinations to transition from reactive post-disaster recovery to prescriptive development planning, which uses resilience to create competitive, sustainable destinations. The framework connects social, environmental, and institutional risk management aspects needed for effective disaster control in Vietnam, where official government approaches work together with local community action.

Tourism systems operate as complex, adaptable systems as per Resilience Theory, so they can realign their structure and undertake transformation during external pressures. All destinations display different levels of capability to build resilience. The ability of a place to handle disruptive events and recover from such occurrences depends on social and economic elements alongside infrastructure quality characteristics. A tourism system combining strong connections and substantial funds with adaptability tends to adapt more successfully based on this model. Innovation combined with flexible design and prepared backup systems allows places to recover. The process of building resilience continues indefinitely because it directly depends on institutional backing and local community engagement (Biggs et al., 2012).

1.2.2 Institutional Theory

The Institutional Theory provides a useful framework for studying both official rules and social norms as they affect organizational conduct and sectoral transformation in the tourism industry. Tourism research uses Institutional Theory as an effective tool to monitor how policy frameworks, together with governance systems, along with external pressures influence sustainable practices (Scott, 2013). The Vietnamese government actively steers national policy as well as decides the distribution of infrastructure funding because of its authoritative position. Institutional Theory shows how political entities can use their adaptation policies to affect the connection between sustainable development targets and resilient tourism infrastructure, specifically after natural disasters such as Typhoon Yagi. Tourism systems experience adaptive and recovery support through institutional frameworks, which may help or hinder their processes.

As Institutional Theory teaches, there are three foundational pillars which determine institutional operations: regulative (rules and laws), normative (social and stakeholder expectations), together with cultural-cognitive (shared beliefs and ways of thinking) (DiMaggio & Powell, 1983). The Vietnamese tourism industry unifies these elements by applying national climate strategies to establish local operational practices. Tourism areas are required to perform disaster risk evaluations through regulatory elements because laws mandate such assessments, while government spending on flood-resistant infrastructure illustrates another method. The expectation of better disaster preparedness emerges from diverse groups such as tourists and businesses, and local communities, as norms they impose on destinations. People demonstrate cultural-cognitive traits through their perceptions of climate risk and their mutual understanding about the necessity and attainability of sustainable tourism.

Through this approach, the research transcends basic policy existence assessments to study policy effectiveness regarding their actual implementation outcomes. A set of climate adaptation plans exists in developing nations, including Vietnam, though their success depends on institutional strength and policy implementation capabilities alongside their ability to match local requirements (Elbarky et al., 2024b). This analytical study incorporates adaptation policy as a moderating variable because pure infrastructure resilience stops short of success unless institutions properly execute policies within their regulatory framework while involving all stakeholder groups.

Institutional Theory provides an understanding of how climate-resilient procedures propagate across tourism organizations. Local tourism operations and authorities tend to duplicate successful adaptation practices observed elsewhere in coastal provinces when they experience pressure from both central officials and international organizations. To understand institutional aspects of learning and policy spread across time, we refer to this process as isomorphism. Adaptation policies develop into dynamic systems that combine local requirements with national development objectives, together with global climate agreements.

1.3 Determinants of Sustainable Tourism Development

2.3.1 The impact of Climate-Induced Natural Disaster Severity

Extreme weather events categorized as climate-induced natural disaster severity (CINDS) refer to the frequency and intensity of occurrences of dangerous meteorological phenomena throughout the year (IPCC, 2022). Such disasters lead to severe tourism because they break infrastructure and block transportation pathways while causing multiple environmental and social repercussions. Tourism systems go through tests based on outside stresses according to Resilience Theory, and these tests typically reveal fundamental flaws in structure (Biggs et al., 2012). The reaction capability of a system depends mostly on its regulatory strength, together with stakeholder coordination and problem definition alignment (Hall et al., 2017). The critical relevance of CINDS exists in developing nations since their tourism systems tend to demonstrate heightened vulnerability. Floods, earthquakes, and other catastrophic events destroy supply networks and elevate insurance premiums and deter investments, and wreck the

very environmental features that attract tourists (Becken, 2013). Tourism systems fail to adapt or recover because governmental institutions and organizations lack preparedness (Calgaro et al., 2014).

The research establishes that climate-related natural disasters (CINDS) act as a destructive force on Sustainable Tourism Development (STD). The continuous occurrence of disasters hinders destinations from achieving long-term sustainability results because emergency response programs consume funding that was originally allocated for sustainability initiatives, according to Gössling and Hall (2006). Coastal areas experience rapid environmental deterioration when these events occur, leading to reduced local community strength and job loss among tourism personnel. Following disasters, recovery teams dedicate their attention to rapid economic solutions, neglecting the fundamental sustainability principles (Lew, 2014). Researchers maintain that global interest exists in building resilience, yet confirm that positive changes in policies or governance reforms follow disasters only under special conditions. According to Calgaro et al. (2014), severe disasters usually lead to a decrease in and unsustainable reconstruction practices while also intensifying local social inequalities. Investigations together with observed field practices demonstrate that severe disaster events lead to increased difficulties in reaching sustainable tourism objectives.

The connection demonstrates Risk Society concepts proposed by Beck (1992) for describing the essential role modern development plays through institutionalized risks. Disaster economics demonstrates that harsh climate incidents regularly result in governments and business organizations reallocating their financial resources from future development initiatives, such as innovation and environmental protection, toward repairing the present. The modification of financial resources for long-term sustainable projects becomes an obstacle to sustainable development advancement (Romer 1990). Tourism systems facing unpreparedness continue to receive multiple impacts, which prevent them from sustaining long-term resilience and sustainability.

Typhoon Yagi tested Vietnam's tourism infrastructure through moderate conditions, although the recorded strength of the storm was below typical records. The disaster response infrastructure of Hội An experienced nominal losses from Typhoon Yagi because authorities and local people maintained continuous contact during recovery operations (Nguyen et al., 2024). The two lesser-known coastal provinces of Nam Dinh and Thanh Hoa suffered significantly more consequences as a result of Typhoon Yagi. The storm hit these areas with severe force, which damaged their infrastructure and harmed tourism operations while exposing extensive inadequacies in emergency readiness (Hien et al., 2022). Climate-related disasters (CINDS) demonstrate their capability to restrict progress in sustainable tourism because they influence different regions differently when inadequacies in disaster preparedness planning become evident.

Grounded in the combined theoretical foundations presented above, the initial hypothesis is articulated as follows:

H1: Climate-induced natural disaster severity negatively impacts sustainable tourism development.

2.3.2 The impact of Resilience of Tourism Infrastructure

Tourism infrastructure resilience is about the capacity of the physical systems that make up tourism, such as transport, hotel infrastructure, electricity, and water supply, to withstand disruptions due to climate-induced disasters, adapt, and bounce back from adversity rapidly. It requires a combination of strong structures as well as flexible management to maintain tourism during and after a crisis (Biggs et al. , 2012).

Resilience theory, which Holling (1973) advanced, provides one solution to understanding why systems that link people and nature, such as tourism, can absorb shock and not be shifted irrevocably into a different state. Managing a balance is not the key, from the perspective of the pragmatist, the resilience lies in the ability to adapt, learn, and provide an adequate response to any unanticipated challenges (Kelly & Adger, 2000). The resilient infrastructure is viewed in economic theory, particularly from a neoclassical standpoint, as a hedge to protect valuable assets and facilitate rapid reallocation of resources (after disasters), which can help to minimize economic losses and maintain activity (Cuaresma, 2010). But climate-induced natural disasters (CINDS)—more frequent and more intense floods, typhoons, and droughts—place a heavy strain on this resilience. These events not only destroy buildings and roads, according to Becken (2013). They also disrupt supply chains, increase the cost of insurance, and spoil the natural attractions of tourist places. Without great resilience, recovery slows and gets tougher, especially in developing countries where emergency systems and institutions are perhaps not adequately resourced to manage (Calgaro et al. 2014). Typhoon Yagi, which hit Vietnam in 2018, is a good example of what CINDs can cause. The storm caused widespread flooding and landslides in Thanh Hoa and Nghe An, which ruined the main engines of tourism by ruining roads, resort streets, and cultural sites, among others, and evacuated thousands of people from sinking households (Tran *et al.*, 2024). This event triggered a sudden decline in many tourists and a huge loss in terms of income for local humans, thus emphasizing the need for reinforced resilient infrastructure to face such shocks better.

The infrastructure of resilient tourism is critically important for the STD (sustainable tourism development). Having strong infrastructure, in turn, allows destinations to withstand, adjust to, and adapt to, and rebound from disasters, maintaining a social, economic, and environmental equilibrium (Biggs et al, 2012). Similarly, research by Prayag (2018) also demonstrated the close

relationship between infrastructure resilience and sustainable tourism, resilience minimizes risk and enables communities to exist well.

Not everyone also believes that this relationship is always intense and reliable. According to Lew (2014), the influence of resilience in sustainable tourism can differ; a government can be weak or strong, or environmental practices might be good or poor, and the role of local communities can be minimal or high. Viewed from the perspective of institutional economics, resilience will succeed if governance systems have the flexibility to learn and change (North,1990). While constructivist thinkers such as Cote and Nightingale (2012) identify that the tendency to resiliency is socially and culturally dependent, and thus there is no universal response. The consequences of Typhoon Yagi revealed how weak Vietnam's tourism-dependent areas are. The demolition of the critical infrastructure led to continuous disruptions, which frightened tourists from coming back and imposed a great strain on the local economies (Tran *et al.*, 2024). This also goes to illustrate how critical the aspect of resilience is not only to sustain tourism but also to minimize people's jobs and incomes' exposure against increasing climate perils.

Based on the integrated theoretical perspectives discussed earlier, the second hypothesis is proposed as follows:

H2: Enhanced tourism infrastructure resilience results in improved performance in sustainable tourism development.

2.3.3 The moderating role of Government Adaptation Policies

Government adaptation policies (GAP) are formal plans, rules, and measures by governments to minimize the adverse impacts of climate change and natural disasters. Such policies also seek to enhance communities, economies, and ecosystems' capacity for adaptation and strength in changing situations (Biesbroek et al., 2011). In the tourism sector, GAP can refer to measures such as intelligent land-use planning, stricter standards for construction, emergency response systems, investment in climate resilient infrastructures, etc, that involve decision making of local stakeholders and are all aimed at reducing risks and building longer-term resilience. According to institutional theory (North, 1990), formal institutions, like Government Adaptation Policies (GAP), are an integral component in building adaptive capacity and determining the actions of businesses and communities. Philosophically, pragmatism emphasizes that adaptation should be context-specific and continuous, piecemeal learning and testing of new strategies (Kelly & Adger, 2000). As ecological economics suggests, the view on GAP as a necessary public good that corrects the negative side effects of climate risks (Tol, 2005) supports the tourism sector, for instance, to remain sustainable. The critical value of the GAP lies in their ability to enable coordinated, forward-looking actions that will mitigate risks and enhance overall resilience. Studies have revealed that proactive adaptation plans can minimize economic losses (protect livelihoods and long-term sustainability (Darjee et al., 2023). In the absence of these policies, even strong tourism infrastructure may not be adequate to offset pressing threats to climate in the sustainability front.

Asian development of such plans for climate adaptation has been significant in Vietnam due to the adoption of the National Adaptation Plan (and personalized plans for different sectors) (Tran *et al.*, 2024). Significant concerted effort has been made to implement climate adaptation in tourism development, coastal governance, and disaster response initiatives. Nevertheless, problems remain, including limited budget allocations, scattered administration systems, and ineffective local solutions (Ghimire and Chhetri, 2022). National policies do offer a good basis, but the gap between policy direction and its realization is also enormous, especially in coastal and mountain areas. Such misalignment has a negative influence on the success of the adaptation plans, particularly for the tourism industry.

A strong linkage between resilient tourism infrastructure and sustainable tourism development (STD) is critical, and this involves Governance and Adaptation Policies (GAP). Like in the socio-ecological systems framework, sound governance helps create stronger adaptability because it enables the coordination of institutional work with physical resilience (Folke, 2006). Carefully made and executed GAP reinforce the resilience value of infrastructure through the encouragement of coordinated risk response, assistance to stakeholders to collaborate, and provision of financial and technical resources (Becken, 2013). A prime example of this would be the way Vietnam reacted following Typhoon Yagi — rapid government action to restore coastal infrastructure and roll out early warning systems allowed for a rapid resurge of the tourism industry and guaranteed long-term sustainability (Tran *et al.*, 2024).

While these matters are important, there are questions about the extent to the GAP have effects on their intended effects. There are those researchers who argue that active government participation is necessary to fully exploit adaptive infrastructure and facilitate sustainable tourism growth. According to their view, governments do so much by setting policies, sequestering resources, and creating a viable institutional climate (Darjee et al., 2023). Instead, critics note that poorly done, overly convoluted, or community-unresponsive GAP could lead to limited or even negative outcomes (Biesbroek et al., 2011). Philosophically, constructivists believe that the success of adaptation policies in this respect depends solely on how these policies are interpreted and accepted by those they impact (Cote & Nightingale, 2012). Economically speaking, institutional scholars have focused on the

fact that policy efficiency rests heavily on the strength of governance mechanisms upon which transparency, accountability, and broader stakeholder engagement depend (North, 1990).

Supported by the theoretical and empirical background, the study formulates the third hypothesis below.

H3: Implementing government adaptation policies leads to a more powerful influence of robust tourism infrastructure on the sustainable development of travel and tourism.

Rooted in robust theoretical foundations, this study enhances its academic contribution by presenting the following conceptual framework:

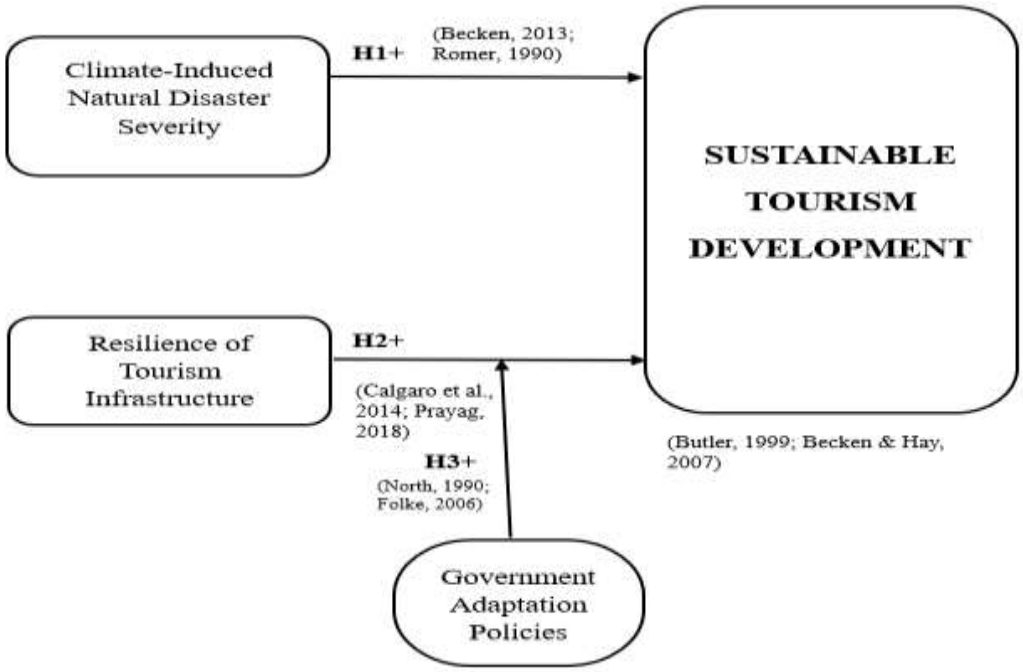

Figure 1: The Paper's Conceptual Framework

2. METHODS

This study employs a quantitative methodology, enabling systematic data collection and analysis to uncover and validate underlying trends (Creswell & Creswell, 2017). Furthermore, this approach applies statistical methods to evaluate the data objectively and produce quantifiable results (Babbie, 2020).

The validity of the data and its relevance to the case of Vietnam were ensured in this study by employing a stratified probability sampling method. Those involved in tourism operations, building strong infrastructure, responding to disasters, and adapting to climate change were deliberately sampled in places affected by Typhoon Yagi. There were four major groups of participants chosen because they were important to the research: Tourism operators and hotel owners from the destination made up 32% of those interviewed. Before, during, and after disasters, they handled tourism services and shared what it means for service-based firms to recover successfully; the second group consisted of public servants and local and provincial government officials (24%). Their activities in climate adaptation, development of infrastructure, and tourism added valuable input from an administrative point of view; there were 21% of respondents in this group, who were academic researchers and students studying at universities or institutions dedicated to research. Because of their experience in tourism planning, writing about climate policy, disaster risk management, and sustainable development, the research gained an academic basis. The last group (23%) brought together community stakeholders and civil society, which included NGO workers, people working for the environment at a grassroots level, and neighborhood residents. Climate disasters were a common experience for many, and they were involved in projects related to tourism for their communities or adaptation strategies.

Researchers collected data via face-to-face interviews in affected provinces and also by online questionnaires on Google Forms. Associations, tourism discussion boards, academic groups, and social media channels like "Quản lịch Du lịch Bền vững" and "Ứng phó Thiên tai và Cộng đồng" were all part of the distribution channels used. For the survey, respondents were asked to rank from 1 ("Strongly Disagree") to 5 ("Strongly Agree").

I retained 368 responses after a careful review of the 527 completed surveys to check for exactly 368 met all criteria; only those were kept.

3. RESULTS

3.1. Reliability analysis

Table 1: Reliability analysis of the dependent variable "Sustainable tourism development". Source: (The authors, 2025)

Reliability Statistics

Cronbach's Alpha	N of Items
.684	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
STD1	7.717	8.056	.518	.603
STD2	6.939	7.236	.568	.598
STD3	8.564	7.522	.604	.652
STD4	8.722	8.903	.609	.614

Where STD1 to STD4 are coded for survey questions 1 to 4 of sustainable tourism development (STD) respectively.

As presented in Table 1, all dependent sub-variables recorded adjusted item-total correlation coefficients of no less than 0.3. The overall Cronbach's alpha reached 0.684, surpassing the widely recognized minimum threshold of 0.6 and exceeding the values that would have resulted from removing any individual item. Furthermore, each dependent sub-variable maintained a Cronbach's alpha above its corresponding adjusted item-total correlation, even in scenarios where specific items were excluded. As a result, all items were retained for further analysis. Comparable consistency patterns were observed in the Cronbach's alpha values for the other variables.

3.2. Exploratory factor analysis (EFA)

Table 2: Rotated Component Matrix. Source: (The authors, 2025)

Rotated Component Matrix[a]			
Component with loading factors			
1	2	3	4
STD1 .633	CINDS1 .570	RTI1 .515	GAP1 .630
STD2 .577	CINDS2 .580	RTI2 .508	GAP2 .585
STD3 .546	CINDS3 .606	RTI3 .612	GAP3 .672
STD4 .647	CINDS4 .676	RTI4 .682	GAP4 .645
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 7 iterations.			

Where survey items CINDS1 to CINDS4, RTI1 to RTI4, and GAP1 to GAP4 correspond to questions 1 through 4 designed to measure the moderator variable and the two independent variables, respectively.

As indicated in Table 2, the rotated component matrix successfully categorized the 16 sub-variables into four distinct factors, aligning with the dependent variable, two independent variables, and the moderator variable. All sub-variables demonstrated factor loadings greater than 0.5, and no items were removed during the factor analysis process.

3.3. Multiple linear regression model

Table 3: Coefficients[a]. Source: (The authors, 2025)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7.305	.667		4.102	.000

	CINDS	.637	.919	.620	3.551	.039
	RTI	.782	.642	.770	3.124	.011

a. Dependent Variable: STD

Where **STD**: mean of STD1 to STD4; **RTI**: mean of RTI1 to RTI4;
CINDS: mean of CINDS1 to CINDS4

As shown in Table 3, the significance (Sig.) values derived from the t-tests are .039 and .011, both of which are below the conventional alpha threshold of 0.05. This confirms that the independent variables, climate-induced natural disaster severity and resilience of tourism infrastructure**,** exert a statistically significant impact on the dependent variable, namely sustainable tourism development. Therefore, both hypotheses are supported.

3.4. Moderator analysis

Table 4: Results analysis of "Government adaptation policies". Source: (The authors, 2025)

Model : 1
Y : STD
X : RTI
W : GAP
Sample Size: 385

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OUTCOME VARIABLE:
STD

Model Summary

R	R-sq	MSE	F	dl1	dl2	p
.740	.729	.813	5.551	3.000	381.000	.000

Model

	coeff	se	t	p	LLCI	ULCI
constant	7.334	.453	60.590	.000	7.111	7.101
RTI	.656	.637	4.936	.000	.643	.625
GAP	.577	.881	4.952	.000	.596	.583
Int_1	.580	.902	4.810	.000	.579	.560

Where **GAP**: mean of GAP1 to GAP4

As shown in Table 4, the p-value for the interaction term (Int_1) is 0.000, significantly below the standard significance level of 0.05. This demonstrates a statistically meaningful interaction between government adaptation policies and resilience of tourism infrastructure in influencing sustainable tourism development. The interaction coefficient of 0.580 indicates that greater government adaptation policies enhance the positive effect of resilience of tourism infrastructure on sustainable tourism development. Consequently, hypothesis H3 is confirmed.

4. DISCUSSION

4.1 Result summary

The linear regression findings reveal that resilience of tourism infrastructure (RTI) have the most substantial impact on sustainable tourism development (STD), demonstrated by a high coefficient of 0.77. While climate-related natural disasters (CINDS) also makes significant contributions, its influence is relatively weaker, marked by a coefficient of 0.62. Furthermore, government adaptation policies (GAP) serve as a moderating factor that moderately shapes the relationship between resilience of tourism infrastructure and sustainable tourism development, with a moderation coefficient of 0.58. This analytical framework was employed to thoroughly investigate the research questions and elucidate the dynamic relationships among the primary variables.

4.2. Theoretical implication

This new study confirms earlier work by Gössling and Hall (2006) and Calgaro et al. (2014), which stated that frequently occurring climate-induced natural disasters (CINDS) are a big threat to sustainable tourism development (STD). Because of

disasters, tourism relies less on existing plans, is forced to spend important funds immediately, and experiences damage both to its infrastructure and the community. The study found a strong link between the rising number of CINDS and negative effects on STD, in line with Becken's (2013) claim that disasters harm important aspects of sustainable tourism. Still, this analysis offers a different viewpoint than Lew's (2014) hypothesis that disasters can bring about positive and lasting changes. Most of the steps taken after Typhoon Yagi were based on emergency actions instead of lasting, informed changes. Though Beck's (1992) argument is that risks can prompt new institutions, the research here found little evidence of such changes, especially in Nam Dinh and Thanh Hoa. Consequently, while parts of risk adaptation are noticeable in the findings, the results mostly point to ongoing and unresolved issues in the system, not progress or changes.

Biggs et al. (2012) and Prayag (2018) found that resilient infrastructure is key in making tourism sustainable when disasters hit, and this research reinforces that point. The strong and positive connection seen between tourism infrastructure resilience (RTI) and STD underlines the vital part that resilience plays in sustaining tourism. Whereas Lew (2014) wondered if resilience always makes a difference in all areas, this study shows that stronger systems play a major role in Vietnam's tourism success. In opposition to what Cote and Nightingale (2012) suggested, the study found that, in this case, the strength and management of infrastructure are more important than culture in resilience to crises. Even though community characteristics matter, what matters even more in extreme situations is good infrastructure for recovery and sustainability.

Also, the findings point out how government adaptation policies (GAP) can help build a stronger link between infrastructure resilience and sustainable tourism. It underlines institutional theory, particularly Scott (2013) and North (1990), who believe that rules and systems guide the transformation of the affected areas. This is in line with the research from Darjee, Neupane, and Köhl (2023) that organized government assistance increases both the capacity of communities to cope and the long-term recovery chances. But the study disagrees with Biesbroek et al. (2011) by saying fragmented methods can be beneficial. Even with good policies, uneven implementation and patchy budgets at the local level in Typhoon Yagi-affected areas indicate that something else is missing. The success of the system depends heavily on how well enforcement and coordination happen locally. Most importantly, the results oppose the main focus of Cote and Nightingale (2012), which mainly on local interpretation and negotiation for making policies effective. It shows that making progress requires the right resources, cooperation among institutions, and functional governance mechanisms, rather than just talk or opinions. Basically, the study believes that understanding institutional change is best achieved through strong governance, rather than using only community-related or symbolic perspectives.

4.3. Practical implication

These findings provide three main lessons for Vietnamese policymakers, departments of tourism and members of local communities living in disaster areas.

Results from hypothesis 1 point out that many climate disasters damage the tourism industry, both financially and in terms of tourism infrastructure (Becken, 2013; Calgaro et al., 2014). That points out a key issue: solely handling emergencies after they happen is not adequate. Alternatively, local tourism authorities should focus on early actions, for example, evaluating disaster risks, putting in place contingency plans, and setting funds for handling climate emergencies. With this system, money for sustainability won't keep being diverted whenever disasters occur (Gössling & Hall, 2006).

The findings from hypothesis 2 highlight that improved infrastructure and enhanced management are essential for protecting tourism's sustainability. As Biggs et al. (2012) argue, infrastructure needs to last during disasters and be useful for fast rebuilding. Among the steps are increased investment in drainage, improved roads, and extra service for tourists, as well as developing strong emergency preparedness, training employees, and making communication systems more reliable. If both sides are not considered, it will take more time and cost a lot more, as shown in the case of Typhoon Yagi (Tran et al., 2024).

Supporting hypothesis 3, results demonstrate that updating action plans by the government (GAP) greatly contributes to a closer relationship between infrastructure sustainability and sustainable tourism. Yet, according to Biesbroek et al. (2011), policies only succeed when they are executed well, not only when they exist in documents. It is necessary to use an approach to GAP that focuses on local areas and features active involvement, clear ways to apply rules, and measurable results. Besides, effective joint work between different departments, associations, and groups from society can improve responsibility and guarantee that changes in infrastructure are in line with government policies (North, 1990; Scott, 2013).

The research results suggest that it is important to have a governance structure that joins solid infrastructure development with flexible and coordinated institutions. Thriving sustainable tourism in areas likely to experience climate disasters requires a change to proactive, funded, and community-focused actions.

4.4. Limitation

There are certain limitations in this study. Being based on a snapshot survey, the study does not take possible future changes in infrastructure or policies into account, as it looks only at views at a single time. Even though the study gathered input from various groups, it might miss or reduce the voices of short-term tourists and informal members of the tourism sector, who are significantly affected by disasters. Examining Typhoon Yagi helps provide clearer results, but it happens at the expense of applying those conclusions to other kinds of problems such as droughts or heatwaves. Since the information comes from self-reports, it is possible that people's opinions might be biased when answering about government and infrastructure.

4.5. Future direction for Research

Researchers could investigate how systems related to tourism evolve in the long run when climate-related matters repeat themselves. It would let us know if today's adaptation policies truly make the environment more secure and stable. Talking with tourists, owners of small businesses and local officials, in addition to surveys, could reveal how things are managed in tourism centers. Studying the outcomes of provinces with different levels of disaster risk could indicate how a local government's capacity impacts the results. There are also opportunities to study in more detail how real-time alerting systems and special dashboards for tourism affect destinations' readiness and ability to adapt. It is still mostly ignored by current studies on resilience.

4.6. Conclusion

The study brings both useful and meaningful contributions to the growing field of climate resilience and sustainable tourism. It concludes that disasters greatly affect tourism, well-built infrastructure can help and changes by governments are very important. Based on the results, even when disasters disturb the industry, strong infrastructure and help from government can assist in resuming tourism activities. Yet, according to the study, infrastructure changes don't matter much if societies are not also managed well. Thus, the research proves that Resilience Theory should take into account both the state of infrastructure and its operations. It supports Institutional Theory by proving that tailored local policies are important. Climate-related problems are becoming more serious for Vietnam which makes these results even more important. By uniting efforts and preparing for possible emergencies by developing flexible infrastructure, strengthening the government's response and including everyone in the tourism industry, a country will be able to grow its tourism sector after facing challenges.

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Table 6. Survey Questionnaire

Background information

1	Which stakeholder group best describes your current role or affiliation?	Local tourism operator or hospitality business owner	Government official or public-sector staff	Academic researcher or postgraduate student	Community member, NGO staff, or civil society representative	Others
2	Have you or your organization been directly affected by a climate-related disaster such as Typhoon Yagi?	Yes – direct impact (e.g., property damage, loss of revenue, evacuation)	Yes – indirect impact (e.g., reduction in tourists, operational delays)	No direct impact	Not sure	
3	In which province or region are you currently operating or affiliated with tourism activities?	Quảng Ninh / Hải Phòng	Thanh Hóa / Nghệ An	Quảng Bình / Quảng Trị / Thừa Thiên Huế	Đà Nẵng / Quảng Nam	Other (please specify):
4	How frequently do you or your organization engage in activities related to climate adaptation or sustainable tourism planning?	Very frequently (monthly or more)	Occasionally (a few times per year)	Rarely (less than once a year)	Never	

No.	Variables	Coded Sub-variables	Content
1.	Climate-Induced Natural Disaster Severity	CINDS1	The increasing intensity of natural disasters has significantly disrupted tourism operations in my region. (Becken, 2013; Calgaro et al., 2014)
		CINDS2	Implementing flood-resistant materials or drone-based monitoring enhances disaster preparedness (Miao and Popp, 2014).
		CINDS3	Technological innovation bridges the gap between human vulnerability and environmental unpredictability (Rokhideh et al., 2024).
		CINDS4	Governments and private firms are increasingly investing in AI-driven disaster risk assessment tools (Lukacz, 2024).
2.	Resilience of Tourism Infrastructure	RTI1	The physical tourism infrastructure in my region can effectively withstand severe climate-induced disruptions. (Biggs et al., 2012; Becken, 2013)
		RTI2	Emergency systems in our tourism sector are well-equipped for rapid recovery after disasters. (Kelly & Adger, 2000; Calgaro et al., 2014)

		RTI3	Infrastructure resilience helps reduce economic losses and supports continuity in tourism operations. (Cuaresma, 2010; Prayag, 2018)
		RTI4	Investments in resilient tourism infrastructure promote sustainability and long-term competitiveness. (Biggs et al., 2012; Lew, 2014)
3.	Sustainable Tourism Development	STD1	Sustainable tourism development in my region balances environmental, social, and economic interests. (Sharpley, 2009; Butler, 1999)
		STD2	Heritage preservation and eco-tourism initiatives support sustainable tourism in disaster-prone areas. (World Bank, 2006; Elgin & Elveren, 2024)
		STD3	Our local tourism strategy aims to minimize environmental impact while maximizing cultural value. (Becken & Hay, 2007; Gössling & Hall, 2006)
		STD4	Efforts to promote sustainability in tourism are often undermined by recurring natural disasters. (Gössling & Hall, 2006; Calgaro et al., 2014)
4.	Government Adaptation Policies	GAP1	Government adaptation policies in my region provide effective guidance for building climate-resilient tourism infrastructure (Biesbroek et al., 2011; Darjee et al., 2023)
		GAP2	Climate-related policies are supported by financial and technical assistance from national institutions. (North, 1990; Scott, 2013)
		GAP3	There is strong collaboration among local authorities, communities, and institutions when applying government adaptation plans. (Folke, 2006; Ghimire & Chhetri, 2022)
		GAP4	The success of government adaptation policies depends on their local relevance and implementation effectiveness." (Cote & Nightingale, 2012; Elbarky et al., 2024b)

Survey link: https://docs.google.com/forms/d/e/1FAIpQLSf6_wLVWcdIPIG_raTN0OCGVf7y-Bv2pAKa_wcaV3rSfGTTIQ/viewform?usp=header