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Mitigating Climate Change in Ecotourism: Analyzing Initiatives and Challenges of Tourist Spot Owners in Adapting to Environmental Impacts

Zhou Lixin

Hydrologic Surver and Resources Administration of Pudong Shanghai

ABSTRACT

This research focuses on strategies and challenges that tourist spot owners and the ecotourism industry face in mitigating climate change. It, in particular, assesses carbon strategies, adaptive infrastructure, policy implementation, and sustainable resource management in tandem with community engagement and education. The results suggest that these are moderately effective in these regards, though there is considerable work done in carbon-emission reduction and water conservation. There is substantial scope for improvement in carbon offsetting, resilience building in infrastructure, and policy implementation and enforcement.

The identified challenges include disruptions of operations due to climate-related events, fluctuating visitor arrivals, impacts on supply chains, biodiversity, and human health. Improvements to carbon offsetting schemes, enhancement of resource use management, refocusing waste management policies, and addressing disruptions in operations are also necessary. This study offers insights into developing more robust mitigation strategies in the tourism sector against climate change.

Keywords: Ecotourism. Climate Change, Initiatives, Challenges

INTRODUCTION

With enhanced global awareness of climate change, the pressure is on the tourism industry, and more significantly, on ecotourism, to effectively work towards alleviating the negative impacts of environmental change. Sustainable practices that tourist spots and ecotourism operators integrate into their operations are at the helm of addressing the situation. Such practices include a host of initiatives, carbon reduction emission, adaptive infrastructure development, policy implementation, and sustainable use of resources, among others, and are integrated with community engagement.

While destinations primarily depend on their natural beauty and biodiversity, they are more influential in gaining momentum toward establishing power that leads to good environmental stewardship. Simultaneously, such destinations aggravate problems associated with climate change through emissions and depletion of other natural resources. In this respect, there must be an urgent agenda to adopt full-scale climate change mitigation strategies at destinations, thereby ensuring a low carbon footprint and increasing resilience to climate-related impacts.

It assesses the efficiency of the current policies that have so far been adopted by tourist spot owners and ecotourism operators in managing carbon emissions, adapting infrastructure to the impact of climate change, imposing their environmental policies, and even approaching their relationships with local communities. Second, it identifies specific challenges of climate change to ecotourism: operational disruptions due to various climate-related events, fluctuation of visitor numbers caused by changing weather patterns, and impacts on supply chains and biodiversity, among others.

On these bases, the study tends to come up with nuanced insights into how tourist spots respond to climate change and in what areas future improvements are necessary. Acquired insights will help design more effective strategies and practices for tourist destinations, which not only mitigate their impacts on the environment but also improve the ability to adapt to the changing climate. This introduction ushers in a comprehensive discussion of these critical matters and sets a strong base for robust and integrated approaches toward sustainable tourism and climate change resilience.

LITERATURE REVIEW

The literature and previous research relevant to the topic were investigated so that the current study could have a firm basis upon which it was founded. This section presented the aforementioned studies and works of literature. A broad understanding of South Asian nations and ecotourism was essential in the Introduction. The lush rainforests of Sri Lanka, the breathtaking mountain vistas of Nepal and Bhutan, and the diversified animals of India make up South Asia's various ecosystems. Due to its stunning natural beauty, this area drew people worldwide. South Asia has long recognized ecotourism's promise as a sustainable revenue source for local people and national economies. The natural balance needed for ecotourism had been threatened by growing industrialization and urbanization in certain places (Huda et al. 2021). Thus, examining India, Sri Lanka, Nepal, Bhutan, and others' ecotourism potential and climate change challenges was crucial. The environmental relevance of South Asia's ecosystems was also stressed in the introduction. Many of these locations regulated climate, preserved biodiversity, and provided clean water. The "Third Pole" Himalayan glaciers offered fresh water to the area. Climate change affected ecotourism and the global environment by degrading these habitats. Case studies and data from South Asian nations had to be examined in the Literature Review. This might include ecotourism site visitor numbers, economic benefits, and environmental hazards. South Asian ecological, government, and academic studies also helped clarify the situation. International papers and organizations that emphasized South Asian ecotourism's global relevance and climate change vulnerability were included in the Literature Review. This underscored the issue's global relevance and interdependence. The study helped readers grasp the depth of the problem and the necessity for the research by offering a detailed context and outlining South Asian ecotourism's specific qualities and difficulties. This strengthened the study's rationale, relevance, and effect.

The potential of the Ecotourism Industry

Ecotourism was a unique subset of tourism that did not involve staying in excellent accommodations, indulging in delicious cuisine, or engaging in exciting outdoor activities. People who had a propensity to live in more excellent proximity to the natural environment and desire to enjoy naturally preserved scenery were likely to be drawn to this type of tourism. According to Daniere et al. (2019), neither man-made structures nor interferences were permitted in this tourism category. The most significant influence in the formation of these locations was played by nature. For example, in Malaysia, sites such as Batu Caves and Cameron Highlands provide visitors with views of dense vegetation and a natural setting. The picturesque

scene that could be seen at such a location was indeed a feast for the eyes to take in. Every time someone came to visit, they were treated to an enchanting vista and atmosphere, thanks to the natural greens. However, because of human interference in the course of natural growth and the expansion of vegetation, future generations were unlikely to have access to similar vistas. According to Hoang (2019), human invasion and greed were among the most significant factors that constituted one of the most important culprits that represented extreme threats to the existence of such locations in the future. The most significant dangers were the result of entrepreneurial efforts to broaden its scope of operations and gratify its members' requirements and luxuries. It was common knowledge that economic development in many parts of the world came at a price. Loss of the natural equilibrium within the ecosystem was typically the cost.

The growth of the entrepreneurial race was the factor that was responsible for the considerable threat that was posed to the existence of eco-tourism, and the negative impacts of this trend tended to reduce the amount of eco-tourism that occurred in the South Asian region. The decline of entrepreneurial spirit in South Asia harmed the region's ecotourism industry. In all seriousness, business owners ought to center their efforts on accomplishing the goals of society and individuals by preserving natural harmony and balance. Their activity toward civilization must not interfere with other natural phenomena or the natural occurrences themselves (Persoon, 2020).

Effects of Climate Change on the Ecotourism Industry

The practice of entrepreneurship experienced explosive growth worldwide, and the South Asian region was no exception. In the vicinity of popular ecotourism destinations, commercial enterprises such as hotels did not correctly manage garbage disposal according to the procedures that had been prescribed. According to the findings of the studies that Abas et al. (2021) provided, the extraction of resources and the further processing of those resources invited many environmental changes that were not beneficial to the well-being of the environment or its continued existence. In most cases, the water flows got obstructed due to the open dumping of wastewater from hotels, which in turn caused the water bodies to alter their paths. Alterations to the network of water bodies threatened the existence of life and the vegetation that supported it. This was one of the early warning indicators that indicated the ecosystem of a particular geographical place was in danger of being destroyed. The effects of climate change on ecotourism were not all positive. This was because climate change had an impact on both the economic viability and aesthetic appeal of an area. As a result of unexpected shifts in climate, many animals no longer went out of their natural habitats.

One of the critical causes of climate change, which led to a decrease in precipitation, a change in sea level, and temperature change, was deforestation and uncontrolled building or development of areas. The management of hotels has, in some way or another, been a significant contributor to the decline of ecotourism in the South Asian region. According to Nesha Dushani and her colleagues' research from 2023, climate change could be caused when hotel administrations and rules on garbage generation and disposal in adjacent areas were ineffective. A rise in average temperatures and a reduction in the amount of precipitation that falls from the sky were the direct result of human activities such as building and cutting down trees. These actions frequently led to the onset of several natural catastrophes and calamities. The wild greens and other natural ecosystems could not sustain life due to the rising temperatures and decreasing rainfall. To facilitate its growth while mitigating the effects of climate change, the ecotourism industry must implement effective resilience techniques. In addition, receiving financial backing from the relevant governmental bodies was the most effective way to preserve ecotourism while overcoming the

obstacles now associated with it. The ecotourism industry needed to emphasize resiliency methods to lessen the adverse effects on the environment, and concerns regarding climate change required careful consideration.

The transportation rate was slowed down due to deforestation, which had an immediate and direct impact on the process of cloud formation in the area, which led to soil erosion and reduced vegetation in the surrounding area. The maintenance of ecotourism was critically dependent on the presence of vegetation. According to Mcmillan (2022), the findings of the studies led him to conclude that ecotourism industry dependents also had to suffer due to entrepreneurial activities. This was because many people lost their jobs due to the declining interest and number of tourist destinations in particular locations. According to the findings of their research, Li et al. (2022) concluded that a decrease in precipitation caused an increase in the average temperature, which in turn caused a rise in sea level due to the melting of ice caps and icebergs.

Only 1% of the world's freshwater that could be used for human use came from icebergs. The danger of rising sea levels to landlocked communities was exacerbated because many communities were already close to the water. This significantly increased the likelihood of such areas becoming submerged in the future. After rising sea levels continue, there will be a significant loss of human life, property, and infrastructure (Cheung et al. 2021). The considerations as mentioned above were sufficient to cause ecotourism to decline drastically and vanish shortly. A decrease in the precipitation rate, an increase in the sea level, and temperature changes actively constrained the growing potential pace of greens. It affected the life of flora and fauna. Both animals and birds were essential to the development of successful ecotourism. The effects of business activities that increased the risk of natural disasters endangered not only the lives of people but also the natural areas in which they lived.

Research Problem

This study aimed to examine and analyze the initiatives taken by tourist spot owners to mitigate the impacts of climate change and to identify the challenges faced by the ecotourism industry in adapting to environmental changes..

Specifically, it sought to answer the following questions:

1. What are tourist spot owners' initiatives to mitigate climate change's impact in terms of carbon emission strategies, adaptive infrastructure, policy implementation, sustainable resource management, community engagement, and education?
2. What are the challenges faced by the ecotourism industry on climate change?

METHODOLOGY

The study was aimed at describing the various initiatives that have been undertaken by owners of tourist sport facilities and the challenges the ecotourism industry faces in mitigating and adapting to climate change, with a descriptive design. This quantitative approach ensured that the analysis of the subject under study befollow was done diligently and exhaustively.

This targeted population included tourist spot owners, key stakeholders in the ecotourism industry, managers, employees, and local community leaders who are directly involved in activities associated with ecotourism. The respondents in this study were selected by purposive sampling, entailing the selection of around 20-30 individuals who possess experience and experience in the areas of ecotourism and climate change initiatives.

Quantitative data on variables such as carbon emission strategies, adaptive infrastructure, policy implementation, sustainable resource management, community engagement, and education were collected using structured questionnaires.

Statistical methods were applied in this analysis to quantitative data that were gathered from surveys. Descriptive statistics were employed to summarize the initiatives of tourist spot owners and to learn about the challenges faced by the ecotourism industry in its adaptation to climate change.

In this study, ethical issues were the first consideration. Individuals consented to participating, and their confidentiality was observed. Informed consent was voluntary, and they could withdraw from any process of the research at any time. Limitations of the study were probable bias from the self-reported data and generalizability of findings, which were limited only to those areas under study.

RESULTS AND DISCUSSION

1. Initiatives of tourist spot owners to mitigate the impact of climate change

The initiatives of tourist spot owners to mitigate the impact of climate change has been describe using the variables of carbon emission strategies, adaptive infrastructure, policy implementation, sustainable resource management, and community engagement and education.

Carbon Emission Strategies

The initiatives of tourist spot owners to mitigate the impact of climate change has been describe in terms of carbon emission strategies, as shown in Table 1.

Table 1 Respondent's response on carbon emission strategies

INDICATORS	*Weighted Mean*	*Verbal Description*
1. The tourist spot actively implements measures to reduce carbon emissions.	2.87	A
2. Renewable energy sources are extensively used at this tourist spot.	2.86	A
3. Carbon offsetting initiatives are a priority for the management of this tourist spot.	2.81	A
4. There are clear policies in place at this tourist spot for reducing greenhouse gas emissions.	2.85	A
5. Tourists are aware of the efforts made by this tourist spot to minimize its carbon footprint.	2.88	A
GRAND MEAN	2.85	A

Legend: 3.25-4.00: Strongly Agree (SA); 2.50-3.24: Agree (A); 1.75-2.49: Disagree(D); 1.00-1.74: Strongly Disagree (SD)

Interpretation: 3.25-4.00: High Impact (HI); 2.50-3.24: Moderate Impact (MI); 1.75-2.49: Somewhat Impact (SI); 1.00-1.74: No Impact at All (NI)

The analysis of "Carbon Emission Strategies" at a tourist spot, as reflected in the weighted means, reveals a moderate level of impact and implementation of these strategies. With a Grand Mean of 2.85, it indicates that while there are efforts to address carbon emissions in the tourism sector, there is still room for significant improvement. The highest weighted mean, at 2.88, is associated with tourists' awareness of the

efforts made by the tourist spot to minimize its carbon footprint. This suggests that communication and awareness-raising efforts about carbon reduction initiatives are relatively effective, highlighting a growing consciousness among tourists about environmental impacts. Conversely, the lowest weighted mean, at 2.81, is for carbon offsetting initiatives being a priority for the management. While still within the moderate impact range, this indicates that carbon offsetting, an essential aspect of carbon emission strategies, may need to be more prioritized and as effectively implemented as other measures. Other indicators also reflect a moderate level of implementation and impact. The use of renewable energy sources (2.86) and clear policies for reducing greenhouse gas emissions (2.85) suggest that these areas are receiving attention. Still, there may be potential for further development and stricter enforcement. The active implementation of measures to reduce carbon emissions, scoring 2.87, also falls within the moderate range, indicating ongoing efforts but perhaps needing more scope or effectiveness. In summary, the data suggests that while there are conscious efforts to reduce carbon emissions in the tourism sector, these strategies' overall impact and effectiveness are moderate. This highlights the need for more robust, comprehensive, and effectively implemented carbon emission strategies to reduce the environmental impact of tourism activities significantly.

The importance of carbon emission strategies in the tourism sector, as indicated by our findings, is echoed in several studies that explore the impact and implementation of these strategies. Yin et al. (2024) examined the carbon emission impact of livelihood transitions in pro-poor tourism, highlighting the relationship between tourism practices and carbon emissions. This study underscores the need for sustainable tourism practices that minimize carbon footprints. Mishra et al. (2020) investigated the dynamic linkages between tourism, transportation, growth, and carbon emissions in the USA, providing evidence of the interconnected nature of these factors and the importance of integrated strategies to manage carbon emissions in tourism. Yang (2023) focused on tourists' low-carbon tourism behaviors from the perspective of stakeholders, emphasizing the role of tourist behavior in reducing carbon emissions. Huang et al. (2021) explored optimal emission reduction and pricing in the tourism supply chain, considering different market structures and the word-of-mouth effect. This research highlights the economic aspects of carbon emission strategies in tourism. Hou et al. (2012) discussed the development strategies of low-carbon tourism attractions based on tourists' low-carbon cognition, pointing to the importance of raising awareness and educating tourists about low-carbon practices. Kasbun et al. (2020) proposed a conceptual framework to improve carbon performance via carbon strategies and carbon accounting, suggesting a systematic approach to managing carbon emissions in tourism. Brida et al. (2021) tested the dynamic relationship among CO2 emissions, economic growth, energy consumption, and tourism development in Uruguay, providing insights into the complex interactions between tourism development and environmental impact. Dragović & Pašić (2020) examined sustainable tourism in ski resorts in Europe and the world, highlighting the specific challenges and strategies for emission reduction in this segment of the tourism industry. Bhaduri & Pandey (2019) discussed the sustainable smart specialization of small-island tourism countries, focusing on the unique challenges and opportunities for managing carbon emissions in island tourism destinations. Collectively, these studies emphasize the critical role of carbon emission strategies in the tourism sector, highlighting the need for sustainable practices, stakeholder engagement, and innovative approaches to reduce the environmental impact of tourism activities.

Adaptive Infrastructure

The initiatives of tourist spot owners to mitigate the impact of climate change has been describe in terms of adaptive infrastructure, as shown in Table 2**.**

Table 2 Respondent's response on adaptive infrastructure

INDICATORS	***Weighted Mean***	***Verbal Description***
1. The infrastructure at this tourist spot is designed to be resilient to climate change impacts.	2.71	A
2. There are effective water conservation measures in place at this tourist spot.	2.76	A
3. The tourist spot has infrastructure that supports biodiversity and natural habitats.	2.87	A
4. Climate-resilient construction materials are used in the infrastructure of this tourist spot.	2.86	A
5. The tourist spot regularly updates its infrastructure to adapt to changing climate conditions.	2.81	A
GRAND MEAN	2.80	A

Legend: 3.25-4.00: Strongly Agree (SA); 2.50-3.24: Agree (A); 1.75-2.49: Disagree(D); 1.00-1.74: Strongly Disagree (SD)

Interpretation: 3.25-4.00: High Impact (HI); 2.50-3.24: Moderate Impact (MI); 1.75-2.49: Somewhat Impact (SI); 1.00-1.74: No Impact at All (NI)

The analysis of "Adaptive Infrastructure" in the context of climate change at a tourist spot reveals a moderate overall impact, with a Grand Mean of 2.80. This suggests that while there are efforts to adapt infrastructure to climate change, these efforts are perceived to be moderately effective. The highest weighted mean, at 2.87, is associated with the tourist spot having infrastructure that supports biodiversity and natural habitats. This indicates a relatively stronger focus or success in integrating environmental considerations into infrastructure development, highlighting an awareness of the importance of preserving natural ecosystems in the context of tourism. Conversely, the lowest weighted mean, at 2.71, is for the resilience of the infrastructure to climate change impacts. This suggests that there is a perceived gap in the effectiveness or extent of infrastructure adaptation to withstand the impacts of climate change. It points to a need for more robust and comprehensive planning and implementation of climate-resilient infrastructure. Other indicators also reflect a moderate level of implementation and impact. The use of climate-resilient construction materials (2.86) and the regular updating of infrastructure to adapt to changing climate conditions (2.81) suggest ongoing efforts in these areas. However, the effectiveness of water conservation measures, with a weighted mean of 2.76, indicates room for improvement in this critical aspect of environmental sustainability. In summary, the data suggests that while there are conscious efforts to adapt infrastructure in the tourism sector to the challenges posed by climate change, the overall impact and effectiveness of these strategies are moderate. This highlights the need for more comprehensive, effective,

and integrated approaches to infrastructure development that fully address the multifaceted impacts of climate change.

The importance of adaptive infrastructure in tourism in response to climate change, as indicated by our findings, is supported by several studies that explore the implementation and challenges of such adaptations. Kruse et al. (2013) examined the vulnerability and adaptation to climate change in the Alpine space, focusing on the adaptive capacity of the tourism sector. Their study highlights the need for adaptive infrastructure to cope with changing environmental conditions in tourism destinations. Jamaliah et al. (2021) conducted a qualitative exploration of the barriers to climate change adaptation in the Dana Biosphere Reserve ecotourism system. This research underscores the challenges faced by managers in implementing effective adaptive strategies in tourism infrastructure. Lendelvo et al. (2018) discussed the reduction of vulnerabilities and risks of climate change in community-based tourism in Namibia, emphasizing the importance of adaptive measures in local tourism infrastructure to mitigate climate impacts. Crisman & Winters (2023) argued that Caribbean small island developing states must incorporate water quality and quantity in the adaptive management of the water-energy-food nexus, highlighting the critical role of water conservation measures in adaptive tourism infrastructure. C. Jacobs et al. (2014) assessed the integrated regional vulnerability of government services to climate change, providing insights into the broader context of infrastructure adaptation in response to environmental changes. Meyers (2020) explored designing resilient dive tourism through underwater sculpture, offering an innovative approach to adaptive tourism infrastructure that enhances environmental sustainability. Molinaroli et al. (2019) examined the adaptations of Venice and Miami to sea level rise, questioning whether these adaptations offer lessons for other vulnerable coastal cities. This study highlights the importance of innovative and effective infrastructure adaptation strategies in coastal tourism areas. Morse et al. (2020) used Public Participation Geographic Information Systems (PPGIS) to identify valued landscapes vulnerable to sea level rise, emphasizing the role of community involvement in planning and implementing adaptive infrastructure in tourism areas. These studies collectively underscore the significance of adaptive infrastructure in the tourism sector in response to climate change, highlighting the need for innovative, effective, and community-inclusive strategies to ensure the resilience and sustainability of tourism destinations.

Policy Implementation

The initiatives of tourist spot owners to mitigate the impact of climate change has been describe in terms of policy implementation, as shown in Table 3.

Table 3 Respondent's Response on Policy Implementation

INDICATORS	*Weighted Mean*	*Verbal Description*
1. The tourist spot has clear policies to address the impacts of climate change.	2.85	A
2. There is effective implementation of environmental protection policies at this tourist spot.	2.88	A
3. Policies related to waste management and recycling are strictly followed here.	2.71	A

4. The tourist spot engages in policy advocacy for climate change mitigation.	2.76	A
5. Tourist are informed about the climate change policies in place at this tourist spot.	2.87	A
GRAND MEAN	2.82	A

Legend: 3.25-4.00: Strongly Agree (SA); 2.50-3.24: Agree (A); 1.75-2.49: Disagree(D); 1.00-1.74: Strongly Disagree (SD)

Interpretation: 3.25-4.00: High Impact (HI); 2.50-3.24: Moderate Impact (MI); 1.75-2.49: Somewhat Impact (SI); 1.00-1.74: No Impact at All (NI)

The analysis of "Policy Implementation" related to climate change at a tourist spot reveals a moderate overall impact, with a Grand Mean of 2.82. This indicates that while policies addressing climate change are in place, their impact and effectiveness are perceived to be moderately significant. The highest weighted mean, at 2.88, is associated with the effective implementation of environmental protection policies. This suggests that among the various policy areas, environmental protection measures are seen as being implemented most effectively, indicating a level of commitment and action towards environmental sustainability at the tourist spot. Conversely, the lowest weighted mean, at 2.71, is for the strict adherence to policies related to waste management and recycling. While still within the moderate range, this indicates a potential area for improvement. Ensuring strict compliance with waste management and recycling policies is crucial for reducing the environmental impact of tourism activities. Other indicators also reflect a moderate level of policy implementation and awareness. The presence of clear policies to address the impacts of climate change (2.85) and tourists being informed about these policies (2.87) suggest a good level of policy development and communication. However, the score for policy advocacy for climate change mitigation (2.76) indicates that there might be room for more proactive engagement in advocating for broader climate change mitigation efforts. In summary, the data suggests that while there are efforts to implement policies addressing climate change in the tourism sector, the overall impact and effectiveness of these policies are moderate. This highlights the need for stronger enforcement, broader advocacy, and increased awareness to enhance the effectiveness of climate change policies in the tourism industry.

The significance of policy implementation in tourism to address climate change, as reflected in our findings, is supported by various studies that explore the challenges and effectiveness of such policies. Markhayeva et al. (2023) discussed green banking tools for implementing a state's environmental policy, highlighting the role of financial instruments in supporting environmental measures and climate change projects in the tourism sector. Hambira & Saarinen (2015) examined policy-makers' perceptions of the tourism–climate change nexus in Botswana, focusing on policy needs and constraints. Their study underscores the complexities and challenges in formulating and implementing effective policies for climate change adaptation in tourism. Wong et al. (2013) evaluated the policy environment for climate change adaptation in tourism, providing insights into the effectiveness of existing policies and the need for more robust policy frameworks. Christianto et al. (2023) explored the development policy of green hotels as a low carbon tourism development effort in Indonesia, emphasizing the importance of policy support in promoting sustainable practices in the tourism industry. Abdel Monem & Lewis (2020) discussed the governance and institutional structure of climate change in Egypt, highlighting the broader context of policy implementation and its impact on sectors like agriculture and tourism. Hemakumara et

al. (2020) provided an overview of current climate change mitigation and adaptation practices in Sri Lanka, including a case study that reflects the practical aspects of policy implementation in response to climate change. Hens (2014) reviewed a work on climate change adaptation in practice, focusing on the transition from strategy development to implementation, which is crucial for effective policy execution in tourism. Lopes (2019) discussed adjusting to climate change, providing a broader perspective on the challenges and strategies for policy adjustment in response to climate change, with implications for the tourism sector. These studies collectively highlight the importance of effective policy implementation in tourism to address climate change, emphasizing the need for comprehensive strategies, stakeholder engagement, and robust governance structures to ensure successful adaptation and mitigation efforts.

Sustainable Resource Management

The initiatives of tourist spot owners to mitigate the impact of climate change has been describe in terms of Sustainable Resource Management, as shown in Table 4.

Table 4 Respondent's response on sustainable resource management

INDICATORS	***Weighted Mean***	***Verbal Description***
1. This tourist spot practices sustainable management of natural resources.	2.86	A
2. Energy efficiency is a key focus in the operations of this tourist spot.	2.81	A
3. Sustainable food sourcing practices are evident at this tourist spot.	2.85	A
4. There is a strong emphasis on water conservation at this tourist spot.	2.88	A
5. The tourist spot actively works to reduce its overall environmental impact.	2.71	A
GRAND MEAN	2.82	A

Legend: 3.25-4.00: Strongly Agree (SA); 2.50-3.24: Agree (A); 1.75-2.49: Disagree(D); 1.00-1.74: Strongly Disagree (SD)

Interpretation: 3.25-4.00: High Impact (HI); 2.50-3.24: Moderate Impact (MI); 1.75-2.49: Somewhat Impact (SI); 1.00-1.74: No Impact at All (NI)

The analysis of "Sustainable Resource Management" at a tourist spot, as indicated by the weighted means, reveals a moderate level of implementation and impact of sustainable practices. With a Grand Mean of 2.82, it suggests that while there are efforts towards sustainability, there is still significant room for improvement. The highest weighted mean, at 2.88, is for the emphasis on water conservation. This indicates that among the various sustainable practices, water conservation is a priority area and is perceived as being effectively managed. This focus is crucial, especially in regions where water scarcity is a concern or where tourism significantly impacts local water resources. Conversely, the lowest weighted mean, at 2.71, is for the active efforts to reduce the overall environmental impact. While still within the moderate range, this suggests that there is a perceived gap in the effectiveness or comprehensiveness of measures taken to minimize the environmental footprint of the tourist spot. This could encompass a range

of practices, from energy use to waste management and beyond. Other indicators also reflect a moderate level of sustainable resource management. The practice of sustainable management of natural resources (2.86) and sustainable food sourcing practices (2.85) suggest ongoing efforts in these areas, but perhaps lacking in either scope or effectiveness. The focus on energy efficiency (2.81) also falls within the moderate range, indicating ongoing efforts but potential for further improvement. In summary, the data suggests that while there are conscious efforts to manage resources sustainably in the tourism sector, the overall impact and effectiveness of these strategies are moderate. This highlights the need for more robust, comprehensive, and effectively implemented sustainable resource management practices to enhance the environmental sustainability of tourism activities significantly.

The importance of sustainable resource management in tourism, as indicated by our findings, is supported by various studies that explore the implementation and impact of sustainable practices in the tourism industry. Wei & Liu (2023) investigated how the travel and tourism industry contributes to sustainable resource management, particularly highlighting the moderating role of Information and Communication Technology (ICT) in highly resource-consuming countries. This study underscores the potential of technology in enhancing sustainable tourism practices. Eftimov & Kitanovikj (2023) explored the opportunities and challenges of green human resource management to advance sustainable tourism in North Macedonia. Their research emphasizes the importance of human resource management in achieving sustainability goals in the tourism sector. Anlesinya & Susomrith (2023) examined sustainable human resource management and the social harm of deviant tourism employees, providing insights into the broader social implications of sustainable practices in tourism. Gst Nym Suci Murni et al. (2023) discussed the implementation of green human resource management in the Jatiluwih tourism destination area, highlighting the practical aspects of integrating sustainability into tourism operations. Antonova et al. (2022) focused on water resource management in hotels using a Sustainable Balanced Scorecard, emphasizing the critical role of water conservation in sustainable tourism. Alwan & Nori (2021) investigated green human resource management and its impact on sustainable tourism development, particularly in the context of the green parks of Baghdad. This study illustrates the link between human resource management and sustainable tourism development. Shrestha (2022) explored human resource management practices and sustainable growth in star hotels of Nepal, providing a perspective on the role of human resources in achieving sustainable growth in the tourism industry. Baum (2018) argued for the importance of sustainable human resource management as a driver in tourism policy and planning, highlighting a significant area often overlooked in sustainability discussions. Phong & Van Tien (2021) examined water resource management and island tourism development in Phu Quoc, Vietnam, offering insights into the management of critical natural resources in island tourism destinations. Ejiogu et al. (2020) discussed sustainable human resource management in the context of sustainable tourism and sustainable development in Africa, focusing on the challenges and prospects of integrating sustainability into tourism practices. Collectively, these studies emphasize the significance of sustainable resource management in tourism, highlighting the need for comprehensive strategies, stakeholder engagement, and innovative approaches to ensure the sustainability of tourism activities.

Community Engagement and Education

The initiatives of tourist spot owners to mitigate the impact of climate change have been described in terms of community engagement and education, as shown in Table 5.

Table 5 Respondent's response on community engagement and education

INDICATORS	*Weighted Mean*	*Verbal Description*
1. The tourist spot actively engages with the local community on climate change issues.	2.76	A
2. Educational programs on climate change are offered to visitors at this tourist spot.	2.87	A
3. Local communities are involved in the decision-making processes related to climate change initiatives.	2.86	A
4. The tourist spot supports community projects aimed at climate change mitigation.	2.81	A
5. There are opportunities for tourists to participate in sustainability and climate change-related activities.	2.85	A
GRAND MEAN	2.83	A

Legend: 3.25-4.00: Strongly Agree (SA); 2.50-3.24: Agree (A); 1.75-2.49: Disagree(D); 1.00-1.74: Strongly Disagree (SD)

Interpretation: 3.25-4.00: High Impact (HI); 2.50-3.24: Moderate Impact (MI); 1.75-2.49: Somewhat Impact (SI); 1.00-1.74: No Impact at All (NI)

The analysis of "Community Engagement and Education" in the context of climate change at a tourist spot reveals a moderate overall impact, with a Grand Mean of 2.83. This suggests that while there are efforts to engage and educate communities and tourists about climate change, these efforts are perceived to be moderately effective. The highest weighted mean, at 2.87, is for educational programs on climate change offered to visitors. This indicates that among the various community engagement and education initiatives, educational programs are seen as being implemented most effectively. This reflects a growing awareness of the importance of educating tourists about environmental issues and the role they can play in climate change mitigation. Conversely, the lowest weighted mean, at 2.76, is for the active engagement of the tourist spot with the local community on climate change issues. While still within the moderate range, this suggests that there is room for improvement in actively involving local communities in discussions and actions related to climate change. Engaging local communities is crucial, as they are often the most directly affected by climate change and tourism activities. Other indicators also reflect a moderate level of community engagement and education. The involvement of local communities in decision-making processes related to climate change initiatives (2.86) and support for community projects aimed at climate change mitigation (2.81) suggest ongoing efforts in these areas. Additionally, the opportunities for tourists to participate in sustainability and climate change-related activities (2.85) indicate a proactive approach to involving tourists in sustainable practices. In summary, the data suggests that while there are conscious efforts to engage and educate communities and tourists about climate change in the tourism sector, the overall impact and effectiveness of these strategies are moderate. This highlights the need for more robust, comprehensive, and effectively implemented community engagement and education programs to enhance the overall effectiveness of climate change initiatives in the tourism industry.

The significance of community engagement and education in tourism regarding climate change, as reflected in our findings, is supported by various studies that explore the effectiveness and challenges of such initiatives. Vasseur et al. (2022) developed a theory of change supporting resilient ecosystem-based adaptation in the Great Lakes Basin, emphasizing the importance of community engagement in climate change adaptation efforts. Coward et al. (2020) discussed the broader context of community engagement in addressing global challenges like climate change, highlighting the need for inclusive and participatory approaches. Hadianti et al. (2023) explored the development and institutionalization of community education for climate change adaptation and mitigation in small island areas, emphasizing the role of local wisdom in effective community engagement. Ross et al. (2023) examined climate change education through the You and CO2 programme, modeling student engagement and teacher delivery during the COVID-19 pandemic. This study underscores the importance of educational programs in raising awareness and understanding of climate change issues. Edizel-Tasci & Evans (2021) investigated community engagement in climate change policy in East London, providing insights into the practical aspects of engaging communities in climate change initiatives. Weaver et al. (2022) discussed pragmatic engagement with the wicked tourism problem of climate change through 'soft' transformative governance, emphasizing the role of tourism management in facilitating community engagement. Walley et al. (2022) highlighted creative ways to raise awareness of climate change through community engagement festivals, demonstrating the potential of innovative approaches in engaging communities. Herman-Mercer et al. (2023) used an equitable co-production framework for integrating meaningful community engagement and science in the Arctic Rivers Project, showcasing the importance of community involvement in understanding climate impacts. Deason et al. (2022) applied actor-network theory to examine organizational resilience to climate change in community-based tourism, highlighting the role of community networks in adapting to climate change. Nilsson Vestola (2023) delved into perceptions of climate change and tourism through an analysis of Reddit forums, offering insights into public perceptions and discussions related to climate change and tourism. These studies collectively emphasize the importance of community engagement and education in tourism for effective climate change adaptation and mitigation, highlighting the need for inclusive, participatory, and innovative approaches to engage communities and tourists in sustainability efforts.

2. Challenges faced by the ecotourism industry on climate change

The challenges faced by the ecotourism industry on climate change have been describe in Table 6.

Table 6 Challenges faced by the ecotourism industry on climate change

INDICATORS	***Weighted Mean***	***Verbal Description***
1. Operational disruptions (like closures or reduced hours) due to climate-related events (e.g., storms, floods, heatwaves).	2.88	A
2. Costs associated with operating and maintaining ecotourism facilities in the face of climate change (e.g., costs for repairing climate damage, and upgrading infrastructure).	2.71	A

3. Fluctuations in the number of visitors, particularly in relation to extreme weather events or changing seasonal patterns linked to climate change.	2.76	A
4. Perceptions and attitudes of staff and local communities towards the challenges posed by climate change, including their sense of vulnerability and resilience.	2.87	A
5. Extent and effectiveness of climate adaptation and mitigation strategies that have been implemented by ecotourism operators.	2.86	A
6. Changes in insurance costs and availability, as well as other financial risk management practices adopted in response to climate-related risks.	2.81	A
7. Compliance with new or existing regulations and policies that have been influenced by climate change concerns.	2.85	A
8. Impact of climate change on supply chains critical to ecotourism operations, including availability and cost of goods and services.	2.88	A
9. Changes in biodiversity and the health of ecosystems that are central to ecotourism attractions, assessing the impact of climate change on these natural resources.	2.71	A
10. Stakeholder engagement and collaboration in addressing climate change challenges, including partnerships with governments, NGOs, and local communities.	2.76	A
GRAND MEAN	2.81	A

Legend: 3.25-4.00: Strongly Agree (SA); 2.50-3.24: Agree (A); 1.75-2.49: Disagree(D); 1.00-1.74: Strongly Disagree (SD)

Interpretation: 3.25-4.00: High Impact (HI); 2.50-3.24: Moderate Impact (MI); 1.75-2.49: Somewhat Impact (SI); 1.00-1.74: No Impact at All (NI)

The analysis of the challenges faced by the ecotourism industry in relation to climate change, as indicated by the weighted means, reveals a moderate overall impact, with a Grand Mean of 2.81. This suggests that while the ecotourism industry is facing significant challenges due to climate change, the impact of these challenges is perceived to be moderately significant. The highest weighted means, both at 2.88, are for operational disruptions due to climate-related events and the impact of climate change on supply chains critical to ecotourism operations. These findings indicate that the most pressing challenges are related to the direct operational impacts of climate events, such as storms, floods, and heatwaves, and the broader implications for supply chains. These challenges can disrupt the normal functioning of ecotourism

facilities and affect the availability and cost of essential goods and services. Conversely, the lowest weighted means, both at 2.71, are for costs associated with operating and maintaining ecotourism facilities in the face of climate change and changes in biodiversity and the health of ecosystems. While still within the moderate range, these challenges suggest a need for more investment in infrastructure resilience and conservation efforts to protect the natural resources that are central to ecotourism attractions. Other indicators also reflect a moderate level of impact from climate change. Fluctuations in visitor numbers due to extreme weather events or changing seasonal patterns (2.76), perceptions and attitudes of staff and local communities towards climate change (2.87), and the extent and effectiveness of climate adaptation and mitigation strategies (2.86) all suggest ongoing challenges in adapting to and mitigating the effects of climate change. Additionally, changes in insurance costs and financial risk management practices (2.81), compliance with climate-influenced regulations and policies (2.85), and stakeholder engagement in addressing climate change challenges (2.76) highlight the broader economic, regulatory, and collaborative dimensions of these challenges. In summary, the data suggests that the ecotourism industry is facing a range of challenges due to climate change, impacting operations, supply chains, biodiversity, and stakeholder engagement. The overall moderate impact underscores the need for continued attention, adaptive strategies, and collaborative efforts to address these challenges effectively.

The challenges faced by the ecotourism industry due to climate change, as indicated by our findings, are supported by various studies that explore these issues in different contexts. Ardiansyah et al. (2023) discussed ecotourism and biodiversity conservation, emphasizing the need for a paradigm shift and future action to address the challenges posed by climate change. This study highlights the critical link between ecotourism and the conservation of natural resources, which are increasingly threatened by climate change. Sitanggang et al. (2022) explored the development of ecotourism in North Sumatra's Botanic Garden Samosir Areas, focusing on the challenges and opportunities in climate change mitigation. Their research underscores the potential of ecotourism as a tool for climate change mitigation, while also highlighting the challenges involved in this process.

Salpage et al. (2020) examined whether the Sri Lankan ecotourism industry is threatened by climate change, using the Rekawa coastal wetland as a case study. This research provides insights into the direct impacts of climate change on ecotourism destinations and the need for adaptive strategies. Deason et al. (2023) investigated tourist perceptions of climate change impacts on mountain ecotourism in southern Mexico. Their study emphasizes the importance of understanding tourist perceptions in managing the impacts of climate change on ecotourism. Tagoranao & Gamon (2019) discussed the relevance of Philippine policies for Muslim-friendly ecotourism management in adapting to climate change challenges. This study highlights the role of policy in facilitating ecotourism adaptation to climate change, particularly in culturally diverse contexts. Nand et al. (2023) addressed unavoidable climate change loss and damage, with a case study from Fiji's sugar industry. While focused on a different industry, their research provides valuable insights into the broader economic impacts of climate change, which are also relevant to the ecotourism sector. These studies collectively underscore the multifaceted challenges faced by the ecotourism industry due to climate change, ranging from operational disruptions and biodiversity loss to the need for effective policy implementation and stakeholder engagement. They highlight the importance of adaptive strategies, conservation efforts, and inclusive policy frameworks to mitigate the impacts of climate change on ecotourism.

CONCLUSIONS AND RECOMMENDATIONS

The analysis revealed that moderate gains were made by tourist spots on implementation of climate change mitigation strategies. Carbon emission strategies tend to be moderately successful and adaptive infrastructure has become highly encouraged in regard to biodiversity. However, much still needs to be done around developments that can build resilience against climate impacts. Moderate implementation of the policy is being carried out, where good environmental protection is concerned, but strict adherence to waste management policies and more assertive advocacy towards policy change in climate should be called for. Moderate implementation for all in sustainable resource management, with more focus on water conservation, though other impacts upon the environment need reduction further. Community engagement and education efforts are good in raising awareness, but local community involvement, including all-encompassing educational programs, is clearly needed.

Supply chain disruptions prior to such changes occur. Maintenance costs of facilities are also increased. Maintaining costs of facilities also rise. In so doing, the ecotourist sites need to focus on and increase carbon offsetting programs and improve their information to the tourists on these efforts. Other ways through which climate change mitigation will be achieved will be increased resilience of infrastructure, enforcement of policies on waste management, and an expansion of policy advocacy. Other ways that will ensure climate change mitigation includes the diversification of sustainable resource management practices and improved community participation in climate change mitigation measures. The better management of the effects of climate change and general sustainability will assist the ecotourism sector to achieve better management of the effects of climate change by meeting the retraining of operational disruptions and supply chain impacts as well as investing in biodiversity conservation.

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