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Impact of Climate Change on Tourism Industry in Baltistan: Governance Challenges, Community Perceptions, and Sustainable Adaptation Strategies

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ABSTRACT
Gilgit-Baltistan, located in the northern region of Pakistan, and it is globally recognized for its glaciers, high mountains, natural landscapes, and cultural heritage, which making tourism a major source of socio-economic development for local communities. However, climate change has increasingly threatened the region through glacier retreat, glacier lake outburst floods (GLOFs), irregular weather patterns, flash floods, and environmental degradation. Baltistan, as one of the major tourism hubs of Gilgit-Baltistan, which is particularly vulnerable due to its dependence on mountain tourism and climate-sensitive natural resources. This research explores the impact of climate change on the tourism industry, local livelihoods, and environmental sustainability in Baltistan. The study adopted qualitative research using semi-structured interviews, focus group discussions, and secondary policy documents to examine institutional responses, climate-related risks, governance challenges, and adaptation strategies. The findings reveal that climate change is significantly affecting tourism activities, infrastructure, accessibility, and the socio-economic conditions of local communities. The study further highlights the importance of climate-resilient infrastructure, community engagement, sustainable tourism planning, and institutional coordination for the long-term sustainability of tourism in Baltistan.

***Keywords**: Climate Change, Gilgit-Baltistan, Tourism, Sustainable Tourism, Mountain Communities, GLOFs, Socio-Economic Development*

Introduction

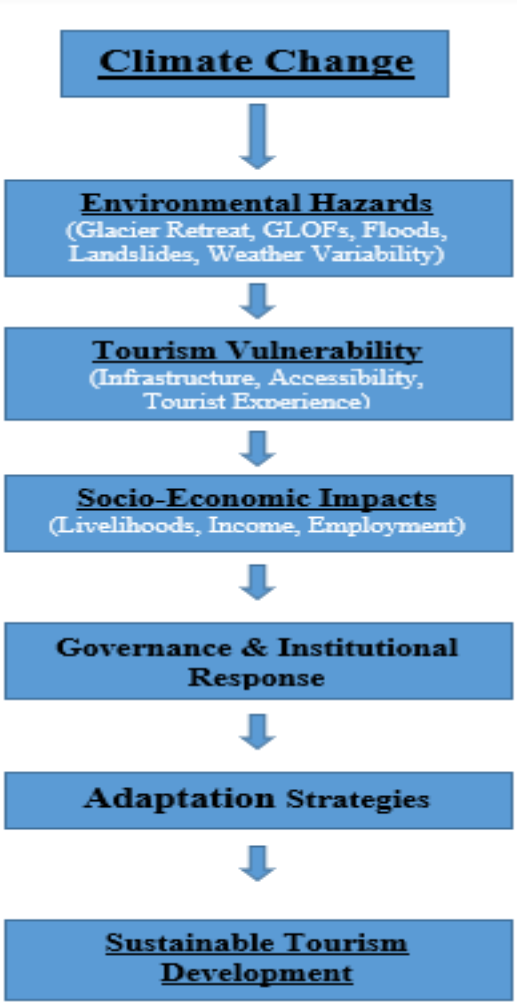
Climate change has emerged as one of the most critical global environmental challenges affecting ecosystems, livelihoods, and economic sector worldwide (IPCC, 2021). Mountain's regions are particularly vulnerable to climate change due to their fragile ecosystems, dependence on natural resources, and sensitivity to changing weather patterns (Papin et al., 2022). Rising temperatures, glacier retreat, irregular snowfall, flash floods, landslides, and Glacier Lake Outburst Floods (GLOFs) are increasingly threatening mountains communities and tourism-dependent economies across the world (Steiger et al, 2024).

Gilgit-Baltistan, located in the northern regions of Pakistan, is globally recognized for its glaciers, high mountain ranges, natural landscapes, biodiversity, and cultural heritage, making it one of the country's major tourism destinations (Ahmad. 2026).The region is administratively divided into three major divisions: Gilgit, Baltistan, and Diamer. Tourism plays a significant role in the socio-economic development of local communities, as many residents depend directly or indirectly on tourisim-releated activities for income generation and employment opportunities (Saqib et al., 2019). In recent years, many local residents have converted their homes into guest houses, resorts, restaurants, and tourisim-releated business to get benefit economically from the growing tourism industry (Ali & Sania, 2019).

However, climate change has increasingly threatened the natural environment and tourism potential in Baltistan (De Pryck, 2021). Rising temperature, glacier melting, changing season patterns, cloudbursts, floods, and landslides are affecting tourism infrastructure, accessibility, natural attractions, and the livelihoods of local communities. (Pepin et al., 2015; Pepin et al., 2022). Baltistan, in particular, is highly vulnerable because of its dependence on mountain tourism and climate-sensitive natural resources. (Hock et al., 2019). Environmental degradation and climate-related disasters are not only disrupting tourism activities but also creating serious socio-economic and governance challenges for the region. (Parveen et al., 2015).

Mountain communities across the world are highly dependent on natural resources, agriculture, and tourism for their livelihoods. (Keller, 2018). According to previous studies, mountain ecosystems are highly sensitive to climate variability, while limited economic opportunities and weak institutional capacity increase local vulnerability to climate-related risks. (McDowell et al., 2013). In Gilgit-Baltistan, tourism has become one of the major alternative livelihood sources (Ali et al., 2020); however, the increasing impacts of climate change threatened the long-term sustainability of the tourism industry and local socio-economic development. (Hock et al., 2019). Although several international and regional studies have examined the relationship between climate change and mountain tourism, limited research has specifically focused on Baltistan from governance, institutional, and community-level perspective (Scott & McBoyle, 2001; Ullah et al., 2024). Existing studies often overlooked local adaptation strategies, stakeholder experiences, socio-economic vulnerabilities, institutional coordination, and climate resilient tourism planning within the region. Therefore, this study aims to explore the impact the impact of climate change on the tourism industry in Baltistan by examining environmental changes, livelihood vulnerabilities, governance challenges, and sustainable adaptation strategies.
The research further seeks to provide policy-relevant insights for government institutions, tourism stakeholders, and local communities to promote sustainable and climate-resilient tourism development in Gilgit-Baltistan.

Conceptual Framework of the Study



The conceptual framework illustrates the relationship between climate change and tourism sustainability in Baltistan, Gilgit-Baltistan. It assumes that climate change acts as primary driver of environmental hazards, including glacier retreat, Glacier Lake Outburst Floods (GLOFs), floods, landslides, and weather variability. These hazards increase the vulnerability of the tourism sector by affecting infrastructure, accessibility, and visitor experiences. Consequently, tourism-related livelihoods, income opportunities, and local employment are adversely impacted. The framework further recognizes the role of governance mechanisms, institutional responses, and adaptation strategies in addressing climate-related challenges and reducing tourism vulnerability. Ultimately, effective adaptation and coordinated stakeholder efforts contribute to the promotion of sustainable tourism development in the region.

Literature Review

Approximately, 319 million people are associated with tourism industry to earn money and contribution 10.4% the World's (GDP) Gross Domestic Product (CC Lee, et al., 2021).

Tourism is a main source of economic development in many countries, it help local people to improve their living standard through revenue generation and creating employment opportunities (Rasool H., et al., 2021). Mountains cover 22% of the Earth surface and 13% population of the world living in this region (FAO, 2015). Mountain communities depend on Natural resources, topography, alpine weather, vegetation, and season. However, climate change has affected and will further affect the lives of residents, economic and livelihood of the local community (Scott et al., 2012). Changes in climate are leading to temporal and spatial shifts

as well as ecological changes that will have an impact on natural resources for tourism (Scott et al., 2012). In winter tourism, particularly ski tourism stakeholders do not perceive an urgent need to take action concerning climate change (Hopkins, 2015; Thimm et al., 2019).They assume that the effects will be more on others rather than themselves. (Wolfsegger et al., 2008; Hoy & Matschullat, 2009; Heuchele et al., 2014). Mountain regions like Baltistan are super sensitive to environmental impacts. Rapid glacial melt in the Himalayas and Karakoram has been noted by IPCC (2021) with risks both on water security for the region and operations of adventure tourism. According to Ullah et al (2024), using the Tourism Climate Index (TCI), climate change will reshape tourism patterns in Baltistan, shifting high seasons from summer to spring or autumn. Broader studies like this often miss out on such pocket microclimates within numerously different valleys around Baltistan (Zaytseva et al., 2024). Physical impacts of climate change being witnessed at present include glacial lake outburst floods (GLOFs), inconsistent snowfall, and swings in temperatures that are already impacting accessibility and infrastructure related to tourism (Hassan, 2021).

It suggests ideas to make Skardu tourism more accommodative to climate change. The community-based attractive low environmental impact Eco-tourism pathway requires further evidence regarding its scalability, though currently perceived as a promising pathway (Hassan, 2021).

Other suggestions involve the adoption of new technologies including GLOF early warning systems and infrastructure development that can accommodate extreme weather (Ullah et al., 2024). Most importantly, experts advocate inclusive governance drawing on local knowledge and ensuring the meaningful participation of all marginalized groups in the governance process, which is found missing (Byrd, 2006; Hassan, 2021). Meanwhile, key gaps in information are identified by this study which includes the paucity of climatic data for Skardu, inadequate understanding of how different particularly female populations are impacted by climate change, and insufficient long-term studies regarding to what extent the ecology can sustain tourism (Zemp et al., 2014).

Glaciers and icecap covered a surface of about 500 thousand km sq. from all over the world not taking Greenland and Antarctica into account. Less glaciers mean less provision of clean water and energy to the community (Akhtar et al., 2008; Xu et al., 2010). Glaciers due to their natural beauty, attract tourism in three continents (Duffy, 2007). More than 1.5 and 1 million tourists visited Bashui Glacier China and Athabasca Glacier in Canada respectively (Wang et al., 2010, Lemieux et al., 2018). However, Icecap stated that around about ninety percent of the Icecap will be melted away. Glaciers' landscape is impacting climate change since it decreases scenic beauty and cultural values vanish (Wang & Zhou, 2019).

Researchers have proposed a coordination of all stakeholders to confront climate change that impacts different areas and sectors. Himalaya and Hindu Kush Mountain is more sensitive to climate change, locals are moving from agriculture to tourism which has both advantages and disadvantages. The local community is abandoning the indigenous and traditional agriculture which is also one of the reasons for attracting tourists in some places of mountains. Local people know about and fear the climate change that harms both living and nonliving things. Beside the attraction of tourists towards mountain, there is very risk of local people economy, culture and residents to due highly global warming causing the melting of glaciers, flood and cloud burst.

Approximately 13000 glaciers are in Pakistan, majority of them are located in Gilgit Baltistan (Glaciol, 2024). Siachen glacier is the second longest glacier of the world exclude the Polar Regions is present in Baltistan (Yaseen, et al., 2024). Similarly, K2 the second highest mountain in the world are also located in Baltistan (Ahmad, 2016). So, Baltistan remains the center of

attraction for tourists because of the mountainous adventures, beauty, natural landscape waterfalls, and cold weather (Ali et al., 2017).All these depend highly on climate while currently it is the rapidly changing climate that puts. Baltistan at risk in terms of loss of tourism, natural resources, livelihoods, and local businesses (Wang et al., 2019).

Another reason for conducting detailed research on impacts of climate change on tourism is because this area has high vulnerability to climate change. Natural disasters include floods, landslides during hot extreme weather conditions with dust storms as well as glacial bursts placing Baltistan in danger concerning both biotic and abiotic elements.

This research explores the climatic impacts on the livelihoods of local people, local businesses, and the economic and social aspects of the region.

Research Gap

Although several international and regional studies have examined the relationship between climate change and tourism, limited research has specifically focused on Baltistan from governance, institutional, and community-based perspective. Existing literature largely emphasizes environmental impacts and tourism potential while giving comparatively less attention to local stakeholder experiences, climate-resilient tourism planning, socio-economic vulnerabilities, and institutional coordination in Gilgit-Baltistan. Furthermore, there is limited qualitative research exploring how climate change is reshaping tourism-dependent livelihoods and sustainable tourism governance in Baltistan. Therefore, this study attempts to fill this gap by examining the impact of climate change on tourism, local livelihoods, institutional responses, and sustainable adaptation strategies in Baltistan.

Research Objectives

1. To evaluate the effect of Climate change on mountain tourism in Baltistan, including changes weather pattern and tourist flow in different season.
2. To find weakness in tourisim industry that are realted to economy and the environment.
3. To assess the function of Government and local initiatives in mitigating climate related issues in the tourisim industry.
4. To give usefull suggestion and actionable recomendation to policy makers and stakeholders to improve the Baltistan tourism industry more adaptable.

Research Questions

1. How climate change is affecting mountain tourism in Baltistan?
2. What is social and economic loss due to climate change in tourism industry?
3. What are the major gaps that government and local policies unable to address the climate challenges in tourism sector?
4. What are the effective strategies and policies that help policymakers and stakeholders to develope climate resilient infrastructure and sustaianble tourism?

Methodology

Research Design

This study adopted a qualitative research approach to examine the impact of climate change on the tourism industry in Baltistan, Gilgit-Baltistan. A qualitative method was considered appropriate because the research aimed to explore stakeholder experiences, institutional perspectives, governance challenges, and community-level perceptions regarding climate change and sustainable tourism. The study focused on understanding the social, environmental, and economic dimensions of climate-related impacts on tourism through detailed participant responses and contextual analysis.

Study Area

The study was conducted in Baltistan, a mountainous region located in Gilgit-Baltistan, northern Pakistan. Baltistan is internationally recognized for its glaciers, high mountain peaks, lakes, valleys, and tourism attractions, including Skardu, Shigar, Khaplu, and surrounding alpine regions. The area is highly dependent on tourism for socio-economic development and is increasingly vulnerable to climate-related hazards such as glacier retreat, flash floods, landslides, cloudbursts, and Glacial Lake Outburst Floods (GLOFs). The selection of Baltistan as the study area was based on its environmental sensitivity, tourism significance, and growing exposure to climate change impacts.

Sampling and Participants

Purposive sampling technique was used to select participants with relevant knowledge and experience related to tourism, climate change, environmental governance, and disaster management in Gilgit-Baltistan. The study included government officials, tourism department representatives, environmental experts, NGO representatives, disaster management authorities, and local stakeholders. Participants were selected based on their professional involvement and understanding of tourism and climate-related challenges in Baltistan.

Data Collection Methods

Primary data for this study was collected through semi-structured interviews and informal discussions with relevant stakeholders. Semi-structured interviews allowed participants to express their experiences, perceptions, and institutional perspectives regarding climate change and tourism-related challenges in Baltistan. Secondary data was collected from research articles, policy documents, climate reports, government publications, and previous studies related to tourism, climate change, and sustainable development.

Data Analysis Method

The collected qualitative data was analyzed using thematic analysis technique. Interview responses were carefully reviewed, coded, and organized into major themes and sub-themes based on recurring patterns, concepts, and stakeholder perspectives. Thematic analysis helped identify key issues related to climate change impacts, tourism vulnerability, governance challenges, community adaptation, and sustainable tourism strategies in Baltistan.

Coding

Open coding and thematic categorization were used to identify recurring concepts and emerging patterns from participant responses.

Ethical Considerations

Ethical considerations were maintained throughout the research process. Participants were informed about the purpose of the study before conducting interviews, and their consent was obtained voluntarily. Confidentiality and anonymity of participants were ensured by using codes and pseudonyms where necessary. The study also respected participants' rights to withdraw from the interview process at any stage.

Trustworthiness and Validity

To enhance the credibility and trustworthiness of the study, data was collected from multiple stakeholders and institutions involved in tourism, environmental governance, and disaster management. Triangulation of participant responses and secondary sources helped improve the reliability and validity of the findings.

Data Analysis

Thematic Analysis

We were interviewed almost 15 key informants from different institutions for this research. Government officials for government related affairs, such as policies and their implementations, such as Gilgit Baltistan Disasters Management Authority (GBDMA) and Tourism Department of Gilgit Baltistan Skardu, and some different Environment related Institutions and NGOs, such as World Wide Organization (WWO), Environmental Protection Agency (EPA) and some Environmental Experts, Tour Operators, Hotel Owners and Shop Keepers, Drivers and some aware community members also.

All the interviews was first transcribed and then coded in excel sheet and then further analysis was done in the word document from all data's we have been collected from different sources, different multiple major themes and subthemes were emerged during Thematic Analysis, which is following.

Multiple major themes were emerged including, Climate Change, Disaster Management and Preparedness, Capacity Building, Institutional Integration and Cooperation, Policy Framework and Strategic Planning, Community Engagement and Governance Challenges, Sustainable Tourism Planning, Climate Hazards, and Environmental Protection etc.

The detailed Analysis of all these themes are following below.

Climate Change

Under the broad theme climate change, there were many more subthemes emerged during the thematic analysis including Threats, Regional Focus, Sustainable Tourism Planning, , Flood & GLOF Risks, Temperature Rise, etc.

Different respondents had different views about these themes. On the subtheme of threat, one respondent (HG1), who was serving as assistant director at public department (GBDMA), he mentioned that, the biggest risks to Gilgit-Baltistan's tourism industry is now climate change.

Similarly, on another subthemes of the climate change, climate hazards, a respondent (MH1), who was serving as a deputy director at Environmental Protection Agency Skardu Branch, he mentioned that, flash floods and Glacial Lake Outburst Floods (GLOFs) have become more dangerous due to climate change, especially in the vicinity of Sadpara, Deosai Plains, and Shigar Valleys and Some other Tourist places in Gilgit Baltistan.

The Respondent (JA1), who is serving as an *Assistant Director Climate Change Adaptation* Pakistan Red Crescent Society (PRCS), said that, in response to climate change impacts in Gilgit-Baltistan's rugged mountain terrain, the Government has strengthened early warning systems, risk monitoring, and community-based preparedness for tourism areas.

While on another subtheme of Climate change, temperature rise, the another respondent (SK1), who has serving as a Research Assistant at (EPA Skardu) as well as an Environmental Experts, she mentioned during interview, she said that "Over the past ten years, the Skardu region has seen a notable temperature increase of over 1.5°C, which has accelerated the melting of glaciers.

Similarly, on another subtheme of Climate change, which is Glacier Retreat, the same respondent (SK1), mentioned, that seasonal weather patterns have become more erratic, and glaciers in the Glacier Rich regions in Gilgit Baltistan are retreating at an unpredictable rate never seen before.

She explain that the seasonal weather pattern changes due to Climate changes disturb both tourism activities as well as ecosystem of the region.

Disaster Management & Preparedness

Another major theme which is Disaster Management, under this major broad theme several subthemes are emerged. i.e.: Strategic Shift, Community Based Initiatives, Strategic Planning and Early Warning System etc.

Most of the respondents emphasized about the shift focus on Disaster Management Practices in the Region.

The respondent (JA1) mentioned that, the Government supports the installation of weather and glacial lake monitoring networks in vulnerable valleys and coordinates with local authorities to improve road safety and evacuation planning during extreme events. Additionally, the Government promotes climate-resilient tourism infrastructure by enforcing sustainable construction practices and regulating development in high-risk zones.

Under the subtheme of Strategic shift, and other sub themes, a respondent (HG1), who is serving as an Assistant Director in (GBDMA) Skardu region, argued that the department of (GBDMA) has now transformed and updated, by moving from reactive disaster response to proactive approach for reduces risk of Harm in region, and he also said that this proactive approach, which means a strategic shift promote the protection of main tourism areas in the regions before disaster through proactive approach and prepared unexpected hazards and its shaping how a tourist attraction places make a pre prepared for unexpected hazards and ready to face.

Furthermore, on Community-Based Initiatives, the same respondent (HG1), shared that CBDRM projects have been launched in Skardu, Hunza, Ghizer, and Shigar to prepare communities as first responders in disaster situations.

Capacity Building

Another important theme Capacity Building, which is focused on Training and Awareness, Volunteer Training, and Waste Management Awareness.

Under the subtheme of Training & Awareness, one of the respondent which is serving as an Assistant Director in GBDMA, (HG1), mentioned that the Government of GB has been multiple training sessions with Tour Operators, Hotel Owners, and Tourism Guiders to ensure the understanding of early warning signs and safety protocols during extreme weather.

While the another subtheme Volunteer Training, the same respondent (HG1) mentioned that nearly 2500 volunteers have been trained under (CBDRM) Community Based Disaster Risk Management Program to effective respond when facing emergencies such as Floods, or Landslides. And these volunteers often become the 1st line of response in remote areas.

Similarly under the Subtheme Training and awareness on waste management and climate adaptation, the another respondent which is serving as Deputy Director at (EPA) Environmental Protection Agency in Skardu mentioned that more than 200 local individuals were trained in waste management, climate adaption, and eco-friendly practices to build long term resilience within the tourism sector.

Institutional Integration and Cooperation

Institutional Cooperation is another strong theme. Under the subtheme of Tourism Safety Integration, the respondent (HG1), mentioned that tourism safety modules are now being included in District Level Contingency plans.

Under the Subtheme of Partnership, same respondent (HG1), mentioned that GBDMA nearly collaborates with UNDP's GLOF-II project to develop the early warning systems and strengthen climate resilience.

These collaborations especially high risk valleys like Guanche, Kharmang and other some areas in Baltistan where GLOF incidents have increased in recent years.

Policy Framework & Strategic Planning

Another important major theme was policy Framework and strategic development, which is about policy development. Under the subtheme the Legal Basis, the respondent HG1, clarified that while Gilgit Baltistan follow the National Disaster Management Act 2010, and it has formulated their own GBDMA Strategic Framework 2020-2030 focusing on building resilience in tourist zones.

The respondent (JA1) mentioned that the Gilgit-Baltistan Disaster Management Authority (GBDMA) has developed zoning and land-use regulations to restrict construction in flood, landslide, and glacier-prone areas, particularly along rivers and near glaciers. Key tourism sites such as Upper Kachura Lake and Shigar Fort have been included in monitoring and risk-assessment networks to improve early warning and preparedness. However, enforcement remains uneven due to limited resources, rapid tourism expansion, and challenging terrain.

Under the subtheme of Hazard Mapping, the same respondent (HG1), mentioned that vulnerability assessments had been completed in key tourist destination in different districts of Gilgit Baltistan, such as Skardu, Hunza, and Nagar. These maps identify areas where hotel constructions should be avoided.

(HG1) also mentioned that over 35 tourist destinations have been geotagged for continuous monitoring by using drones and satellite technology.

Community Engagement

One of the important theme which is Community Engagement, many respondents emphasized the importance of community engagement and their participation.

Under the subtheme of Local Participation, one respondent which is serving as an Assistant Director in GBDMA department in GB, highlighted that community engagement is at the core of GBDMA's climate response strategy.

The respondent (JA1) highlighted that, through community-based organizations in villages, the Government and partner organizations conduct seasonal training on evacuation routes, early warning signals, and first aid. Local volunteers are trained to assist during emergencies, using traditional knowledge of mountain routes and seasonal weather patterns. Traditional community systems like Jirga and local wardens are integrated into formal disaster response to improve coordination and timely action.

While the respondent (JA1), who is serving as an Assistant in Pakistan Red Crescent Society (PRCS highlighted that, the Government engages local communities and tourism stakeholders in awareness campaigns to reduce environmental pressure, manage waste, and ensure safer, more sustainable tourism in fragile mountain ecosystems.

The Village Disaster Risk Committees (VDRCs) also have been formed in various valleys to enhance the Local Level Preparedness.

While, another respondent (MH1) official of EPA Skardu also discussed their collaborations with local councils, hotel, and tourism operators for awareness sessions on waste management and climate adaption.

Governance Challenges

The most important theme was, Governance Challenges. Governance related issues emerged strongly across interviews.

Under the sub theme of Financial Constraints, respondent (MH1), who is serving as an Assistant Director of Environmental Protection Agency (EPA), noted that limited finances, lack of coordination among departments, and unplanned tourism growth collectively make climate and tourism management more difficult.

Unsafe Construction is emerged as a subtheme within broad theme Governance Challenges, the respondent (MH1), emphasized that all those tourism infrastructure, such as hotels, restaurants and other tourist attraction places are more vulnerable during flood which is near to the river.
Similar respondent also emphasized to avoid the construction in near the rivers Areas and highlighted weak enforcement, limited metrological data, and urgent need of coordinated (CRTF), Climate Resilient Tourism Framework

Environmental Governance & Sustainable Tourism

Another important theme, which is Environmental Governance and Sustainable Tourism, under this broad theme some important subtheme also emerged, which is Environmental assessment, Legal Framework, Compliance Monitoring and Sustainable Tourism Planning.

The Respondent (MH1), who served as a Deputy Director at Public Department, Environmental Protection Agency in Skardu Region, shared a detailed insights under this broad theme, he said that, Environmental Protection Agency (EPA), enforces the Skardu Master Plan for tourism development, ensuring all new hotels pass the Environmental Clearance Certificate (ECC) system. He further described how Initial Environmental Examinations (IEE) and Environmental Impact Assessments (EIA) are mandatory before approving any tourism project.
Another respondent, (SB1) highlighted that EPA continuously monitors sensitive sites such as Sadpara Lake, Deosai National Park, Katpana Desert, and Shigar Valley, especially during peak tourist seasons, to prevent further degradation.

Climate Friendly Tourism Strategies

One of another main important theme Climate Friendly Tourism Strategies, under this theme, there were many sub themes emerged when thematic analysis, including Integration of climate adaptation into tourism planning, Promotion of eco-tourism and sustainable design, Incentives and training for environmental compliance, Sustainable operations and emissions monitoring.
Under all above mentioned theme, one of the respondent which is serving as an Environmental Expert in the Region as well as serving as EPA official as a Research Scientist respondent (SB1),consistently emphasized the urgent need for integrating environmental considerations into tourism development. She underlined the necessity of including climate adaption into tourism planning, stressing that effective tourism policies in Gilgit Baltistan must be grounded in adaptive approaches capable of responding to the regions, evolving climatic challanges.
Under the subtheme of Promotion of eco-tourism and sustainable design, same respondent (SB1) further highlighted that the importance of promoting eco-tourism and sustainable design, by recommending the adoption of eco-tourism principles, the encouragement of green building design, and incorporation of renewable energy systems — particularly solar and micro – hydro technologies – within tourism infrastructure. She argued that, these measures would contribute significantly to reducing the environmental footprint of the tourism sector.
Similar respondent (SB1) also pointed out under the subtheme, Incentives and training for Environmental Compliance, by suggesting that the rewards should be provided to stakeholders who consistently adhere to green standards. Further she suggested that mandatory environmental training should be introduce for hotel owners and tour guides or tour operators, to ensure that the sustainability practices become fixed across all levels of the industry.
Under another subtheme Sustainable operations & emissions monitoring, similar respondent (SB1), further emphasized that sustainable operations and emissions monitoring as a central pillars for maintaining climate resilient tourism sector in Gilgit Baltistan. According to (SB1), transitioning towards sustainable transportation, improving waste recycling practices, and closely monitoring emissions will be essential step in securing the long term environmental sustainability of the region's tourism activities.

Climate Change & Environmental Shifting:

(Zahid Hussain, Assistant Director WWF, Baltistan Region, ZH shows Zahid Hussain and Rahat Karim, Assistant Director, Tourism Department Gilgit-Baltistan Skardu, RK shows Rahat Karim)

The climatic change is impacting the environmental shifting in Gilgit Baltistan, like the snowfall was happened during the mid of November or first week of December. But now the snowfall is occurred in mid of January or first week of February. According to the regional director of World Wildlife Fund (WWF) "ZH" is recognized that glaciers melting rates is increased 60-70% in Shigar, Khaplu and Hunza over 20 years. This means the climatic change putting Baltistan regions in a vulnerable area. 13000 glaciers are present in Gilgit Baltistan, out of these 33 glaciers are hazardous (UNDP–WWF GLOF II data). Similarly, winter seasons become shorter, warmer and changing the pattern weather. The melting of glaciers is very fast, in Skardu there was no any fan used during summer but now people use fans in their homes and offices.

Livelihood and Local Economy in Danger:

Mr. ZH observed that the Decline of Tourism Income, Infrastructure Damage, Loss of Tourist Attraction and Natural Beauty in Baltistan. Around 25% of tourist decline in post GOLF, similarly due to heavy flood and land sliding causing the destruction of roads, infrastructure, hotels and tourist spots. Most of the people shift their livelihood on tourism, but climate change can put their economy in coming years.

The Environmental expert, (GA2) highlighted that, Glacier melting and GLOF events damage access roads to key tourist destinations like Fairy Meadows and Deosai Plains, increasing travel disruptions and safety risks. These events also force sudden route changes and cancellations, harming local tourism revenue. Additionally, melting glaciers reduce the scenic value of attractions like Satpara Lake, reducing visitor interest over time.

Community-Based Adaptation and Water Management:

With the help of WWF Mr. ZH take Water Stewardship Initiatives, and community engagement. WWF train community and empower the local people to sustain the project. "Water Stewardship for Resilience" help whole community to rely on groundwater. Local community is trained to handle the water crises to by improving water channels. He said that to make the project more sustainable he charged some amount of money on local people so the think of belongingness for the project. In this way they protected the project and do work volunteer for the community.

Spread awareness about High Risk Areas

RK said that tourism is a big source of economic growth and protect the cultural by promoting its beauty. He emphasized to promote sustainable tourism in Baltistan, the department of Tourism conducted various sessions in different schools and colleges. The young people can influence the sustainable tourism by promoting its benefits and adverse effect on the society.

The respondent (JA2) highlighted that, Several key tourist sites in Gilgit-Baltistan face high environmental risks due to climate change. Fairy Meadows is increasingly threatened by accessibility issues from landslides, while Passu Cones and the Shisper Glacier area are vulnerable to glacial floods and GLOF events. Additionally, lower Baltistan valleys are experiencing intensified riverbank erosion, putting nearby tourist facilities and communities at risk.

Increasing extreme weather events:

In this theme he said that Cloudburst is starting frequently in Baltistan region in 2022 and 2025, it causes heavy flood like in Gamba Skardu and Rgayul village. Cloudburst is happened due to rapidly change of weather. Gilgit Baltistan (GB) is a perfect place for cloudburst. GB is surrounded with tall mountains. This makes it more attractive for cloudburst that is why the flood is occurred in Ggayul Valley. Some of the main areas are highly effected due to cloudburst are Shigar Valley and some parts of Kharmang.

The respondent (JA2) who is serving as an Environmental Expert in Gilgit Baltistan mentioned that, in recent years, Skardu has experienced noticeable glacial retreat across the Karakoram region, affecting water availability and overall landscape stability. Snowfall patterns have become increasingly erratic, with shorter winters and sudden heavy snow events. The frequency of flash floods and GLOF events has increased, resulting in human losses and damage to property and local economies. Additionally, landslides along the JSR have become more frequent, disrupting transportation and posing serious safety risks.

Growth of Tourism and Need for Sustainable Development:

Rahmat Karim (RK) said that tourism is rapidly increasing in Gilgit Baltistan due to social media visibility attracting both national and international tourist. Due to the rapid expansion of tourism without any rule and regulation causing environmental, economic and social issues in Skardu. He said that in 2025, people in down cities were thinking that the whole skardu is drowned in flood. They were making their perspective that the skardu is totally destroyed by flood. These things were showed by the local people by uploading videos without any proper knowledge and information about those areas. This causes a big financial crisis in Baltistan. So, by proper training and information may attract more tourist towards Baltistan.

The another respondent (JA1) mentioned that, in Gilgit-Baltistan, the rapid growth of tourism often leads to visitor numbers exceeding the ecological carrying capacity of fragile mountain valleys, glaciers, and alpine meadows. This overburdening, combined with rugged topography and climate change impacts such as glacier retreat, erratic snowfall, floods, and landslides, accelerates environmental degradation and increases disaster risks. At the same time, heavy economic dependence on tourism pushes unregulated infrastructure development, intensifying pressure on limited water, energy, and waste management systems. Limited funding, weak institutional capacity, and unpredictable weather further complicate long-term, climate-resilient tourism planning in this sensitive region.

Institutional Collaboration for Environmental Compliance:

RK think that the collaboration of different institutions may achieve the goals to protect the environments and the flow of tourists towards GB. Multi-institutional cooperation is enhancing enforcement and accountability. He gave an example that the blockage of road at Baghicha Bridge and Stak Nala road were created a big issue for GB government. By collaboration GBDMA, Administration of Roundu, Tourism Department, Local government worked together and open the road within 24 hours. Without collaboration it may took 3-4 days. Joint monitoring increases transparency and strengthens the control of unsustainable practices and unexpected situations.

Sustainable Practices and Policy Recommendations:

This theme covered the “Green Tourism Policies, Eco-Friendly Practices, Capacity Building, Infrastructure Resilience”. ZH said with the collaboration of Environmental Protection Agency (EPA) and department of Gilgit Baltistan Tourism will achieve the green hotel guidelines. Strict rule regulation and heavy fine on illegal construction of hotels, harming the society and environment. Use solar energy to fulfill their daily life energy. Similarly, train hotel owners and guides in waste segregation of greywater, black water and energy efficiency. Build hotels, restaurants and houses far away from the highly risk zone. Try to adopt traditional ways to construction building like the using the sand brick that help to warm in winter and cold in summer. Mandatory EPA clearance for hotels and eco-literacy to local people and tourist.

Respondent (JA2) emphasizing that, tourism in mountain areas can be made more climate-friendly by promoting low-impact trekking and nature-based activities that minimize environmental disturbance. Strict enforcement of carrying capacity limits at fragile sites is essential to reduce pressure on glaciers, alpine meadows, and water resources. Additionally,

developing solar-powered lodges and supporting community-led homestays can lower emissions while spreading tourism benefits more sustainably.

RK suggested that tourism department is crafting sustainable policy and strategy to make the tourism benefit socially, economically, and environmentally to the local people. There is strict rule regulation that do not allow to build any hotels, restaurants, or building near the flooded areas, rivers, lakes. Gilgit Baltistan's government is working to minimize the pollution, resource misuse, and harming the life of local people.

DISCUSSION

This chapter interprets the findings of the study in relation to the research objectives and existing literature. The discussion moves beyond description to explain how climate change is reshaping tourism dynamics, livelihoods, and governance structures in Baltistan. The findings indicate that climate change is no longer a future risk but a present and intensifying challenge for mountain tourism in Gilgit-Baltistan.

Climate Change and Tourism Patterns in Baltistan

The findings reveal that global warming, climate change, rising temperatures, irregular snow fall and extreme weather are impacting the tourism industry in Baltistan. Tourists do not know the weather, in summer the temperature is at peak, which never happened in Baltistan. Baltistan regions are experiencing Punjab and Sindh weather during summer. This shows the mountain tourism experience the changes in tourists' comfort, accessibility, and entertainment. In Baltistan regions, the summer shifts towards autumn and autumn shifts towards winter. So, the snowfall delay in winter and caused the disturbance of natural beauty.

Frequently land sliding in Juglot Skardu Road (JSR), is a major issue for tourists to enter Skardu. Similarly, glacial lake outburst floods (GLOFs) and cloudbursts disrupt tourism by destroying infrastructure and connectivity. Damage roads, bridges, and hospitality put bad impact on tourist and reduce their flow towards Baltistan.

Socio-Economic Vulnerabilities and Livelihood Impacts

The study highlights that livelihoods in Baltistan are highly vulnerable due to strong dependence on tourism. Respondents emphasized that post-disaster declines in tourist inflow lead directly to income losses for households, tour operators, and small businesses. The shift from traditional agriculture to tourism has increased exposure to climate risks, as reduced diversification limits coping capacity during tourism downturns.

Local people converted their homes into resorts and restaurants to earn money. They are highly dependent on tourism. The study shows that their livelihood is at the peak of danger due to climate change. Small business, hotels and restaurants, tour operators, travel agencies are directly impacted by climate change. These people will lose their livelihoods due to climate change. The findings suggest that tourism has improved living standards but on the other hand climate change endangers the livelihood. So, adopting climate resilient approaches and infrastructure local people can sustain socio-economic development and long-term tourism.

Governance and Institutional Challenges

Governance related issues are a big challenge in Baltistan. Although institutions like GBDMA, EPA and Tourism Department are working on reducing the disaster risk, environmental regulation, and building climate resilience infrastructure but respondents highlighted that their efforts are weak due to poor collaboration, limited fundings, and less involvement of local stakeholders. However, tourism safety plans are included at every district level with the collaboration of international organizations to protect the tourist from any accidents and climatic impact. But the lack of climate resilient tourism policy hinders the growth of tourism and effective response of the government institutions.

Community Engagement and Adaptive Capacity

Community-based adaption is highly effective policy that gain the maximum outcomes of the aims of the policy. Engagement of local people to sustain the project is very important. Programs like Community-Based Disaster Risk Management, water stewardships project, awareness session of climate impact is creating a sense of ownership among the people. People protect environment and follow the regulation rules by involving them in decision making. Similarly, training tour operators, hotels owner and tourists' civic responsibility improve the sense of responsibility, understanding the early warning system, and protect the environment. Despite these gains, respondents highlighted that lack of involvement of local communities and less awareness related to climate change indicating short term goals rather than long term planning.

Climate-Friendly and Sustainable Tourism Strategies

The findings strongly support the adoption of climate-friendly tourism strategies, including eco-tourism, green building practices, renewable energy use, and emissions monitoring. Enforcement of environmental impact assessments and zoning regulations was identified as critical for preventing unsafe construction in high-risk areas.

The findings show that by adaptation of climate friendly approaches like eco-tourism strategies, renewable energy, green building practices and climate resilient infrastructure help to sustain the socio-economic development and reduction of the climate impact on local communities. Government institutions like EPA and Tourisms Department is enforcing environmental policies, zoning regulation, restricting hotels and restaurants at risk areas and the strictly regulations on the separation of grey and black water discharge in canals and rivers.

Overall, the discussions highlighted that Baltistan is highly vulnerable due to climate change. Strong institutions, integrated planning and policy of climate, environment and livelihoods, and empower of the local communities can sustain tourism and socio-economic development. Without knowing about the governance issues, and livelihoods vulnerabilities, sustainable tourism is not possible in Baltistan regions.

CONCLUSION

This study examined the impact of climate change on the tourism industry in Baltistan, Gilgit-Baltistan, with particular focus on tourism vulnerability, socio-economic impacts, governance challenges, and sustainable adaptation strategies. The findings reveal that climate change is increasingly affecting mountain tourism through glacier retreat, irregular weather patterns, flash floods, landslides, and Glacier Lake Outburst Floods (GLOFs). These environmental challenges are disrupting tourism infrastructure, accessibility, natural attractions, and local livelihoods that are heavily dependent on tourism on tourism-related activities.

The study further highlights that tourism has become a major source of socio-economic development in Baltistan, where many local communities rely on hotels, restaurants, transport services, and tourism business for income generation. However, the increasing frequency of climate –related disasters has intensified livelihood vulnerabilities and environmental risks across the region. Institutional challenges, including weak coordination, limited climate-resilient planning, and insufficient community participation, further complicate sustainable tourism management in Baltistan.

The research emphasizes the urgent need for climate-resilient infrastructure, sustainable tourism policies, environmental regulation, and integrated institutional coordination to protect both local livelihood and natural environment. Community participation, eco-tourism strategies, renewable energy adoption, disaster risk management, and environmentally responsible tourism practices are essential for long term-tourism sustainability in Baltistan.

Overall, the study concludes that sustainable tourism in Gilgit-Baltistan cannot be achieved without addressing climate vulnerability, strengthening governance mechanisms, and promoting environmentally sustainable development practices. A collaborative approach involving government institutions, local communities, environmental organizations, and tourism stakeholders is necessary to ensure the future resilience of tourism in Baltistan.

RECOMMENDATIONS

1. Climate risks should be integrated into tourism planning and infrastructure development at regional and district level in Gilgit-Baltistan. Roads, hotels, and tourism facilities should be developed using hazard assessments and climate-resilient planning approaches.
2. Government institutions should enforce strict environmental regulations regarding the construction of hotels, restaurants, and tourism infrastructure in flood-prone and environmentally sensitive areas.
3. Environmental Protection Agency (EPA) and Tourism Department should jointly monitor tourism-related bussiness to ensure complience with environmental standards, waste mangement practices, and sustainable tourism policies.
4. Community participation should be strengthened in tourism planning and environmental decision-making process to enhance local ownership and long-term sustainability.
5. Awareness program regarding climate change, environmental protection, disaster risks, and sustainable tourism should be conducted in schools, colleges, and local communities across Baltistan.
6. Government institutions NGOs, disaster management authorities, and tourism stakeholders should improve institutional coordination for effective climate adaptation and tourism governance.
7. Climate-resilient and environmental sustainable infrastructure should be promoted in tourism-dependent areas to reduce vulnerability to floods, landslides and extreme weather events.
8. Renewable energy source, including solar and hydropower technologies, should be encouraged in hotels, restaurants and public institutions to promote environmentally sustainable tourism development.
9. Early warning system and weather forecasting mechanism should be strengthened in high-risk areas vulnerable to floods, GLOFs, landslides, and cloudbursts to improve tourist safety and disaster preparedness.
10. Improvement of internet and communication infrastructure in Baltistan is essential for tourism promotion, emergency communication, digital connectivity, and sustainable tourism growth.

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APPENDICES

Figure 1: Table regarding the details of participants in interviews

S. No	Name	Department	Region	Designation	Concern Taken	Mode of Interview	Code
1	**Anonymous**	GBDMA	Skardu, GB	Assistant Director	Yes	Face to face interview	(HG1)
2	**Anonymous**	(EPA) Skardu	Skardu, GB	Deputy Director	Yes	Face to face interview	(MH)
3	**Anonymous**	EPA & Env Expert	Skardu, GB	Research Scientist	Yes	Face to face interview	(SK1)
4	**Anonymous**	(WWF)	Skardu, GB	Director	Yes	Face to face interview	(ZH1)
5	**Anonymous**	Tourism Department	Skardu, GB	Assistant Director	Yes	Face to face interview	(RA1)
6	**Anonymous**	PRCS	Gilgit Region,	Secretary	Yes	Face to face interview	(JA1)
7	**Anonymous**	Social Worker, (NGO Sector)	GB	Environmentalist	Yes	Online	AK
8	**Anonymous**	Tourism sector, Private Tourism Agency	Gilgit Baltistan	CEO	Yes	Online	AS
9	**Anonymous**	Tourism Sector, Resort Owner		Owner	Yes	Online	MK
10	**Anonymous**	Tourism Sector Tour Guide		Tour Guide	Yes	Online	AM
11	**Anonymous**	Tourism Hotel Manager		Manager	Yes	Face to Face	GH
12	**Anonymous**						
13	**Anonymous**						
14	**Anonymous**						

15	**Anonymous**						

Figure 2: Findings Summary Table

Theme	**Key Findings**
Climate Risks	Glacier retreat, GLOFs, floods
Tourism Impacts	Infrastructure damage, reduced inflow
Livelihood Vulnerability	Tourism dependency
Governance Challenges	Weak coordination
Adaptation Strategies	Eco-tourism, renewable energy