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POLICYBRIEF
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Glacier Tourism in a Changing Climate: Balancing Conservation and Community Development

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Highlights

While glacier tourism can contribute to the development of local communities, glaciers are under increasing threat from climate change. Balanced policies that promote sustainable tourism can reduce glacier degradation and benefit local communities.

Recommendations:

- Promote eco-friendly glacier tourism by managing visitor behaviour and minimizing environmental impacts
- Invest in eco-tourism to secure ongoing funding for glacier conservation and local economic benefits
- Involve local communities in planning and conservation to strengthen tourism resilience and support equitable development
- Enhance monitoring and enforcement to ensure compliance with sustainable tourism practices
- Strengthen climate adaptation and resilience to safeguard glacier tourism from climate change impacts

Glaciers under Threat from Climate Change

Glaciers are indispensable for Earth and humanity. They provide freshwater for half of the world's population for drinking, domestic use, agriculture and power generation, acting as both indicators and sentinels of climate change. The 2019 Intergovernmental Panel on Climate Change (IPCC) Special Report on the Status of the Ocean and Cryosphere in a Changing Climate asserts that global warming has accelerated the mass loss from ice sheets and glaciers, leading to an increase in global mean sea levels. There are around 200,000 glaciers on Earth, distributed across all continents, though only a few are monitored (UNESCO 2022). Accelerated loss of glaciers has been observed in 40 countries, alongside rising global temperatures due to climate change since 1992 (WGMS 2023).

The rapid shrinking of the ice sheets and glaciers has had widespread negative consequences. Indigenous communities and developing countries are among the most affected, as glacier retreat and sea-level rises threaten their freshwater access, food security and livelihoods. For example, some Indigenous communities in the Arctic region are facing increasing disruptions to traditional subsistence activities and local ecosystems (IPCC 2019).

Glacier retreat can have severe effects on ecosystems and communities that depend on glacier-fed systems for their daily needs, disrupting water security and increasing natural hazards (Haeberli and Weingartner 2020). As glaciers shrink, short-term meltwater surges heighten the risk of glacial lake outburst floods, while long-term ice loss reduces dry-season water availability for drinking, farming and hydropower. Thawing slopes and unstable terrain pose increasing risks to settlements and infrastructure. Glacier retreat has devastating social, economic and environmental impacts on the health of the people in these regions. To highlight these challenges and the importance of glaciers, the United Nations General Assembly declared the year 2025 as International Year of Glaciers' Preservation and 21 March as Water Day for Glaciers (UN A/RES/77/158 2022).

Challenges in Glacier Tourism

Glaciers are also tourist destinations, with approximately 18,600 located across 50 UNESCO World Heritage Sites. Although a third of them are projected to disappear by 2050 (UNESCO 2022), glaciers continue to attract millions of tourists each year to their spectacular landscapes and adventurous terrain (Welling et al. 2015), providing opportunities for activities such as hiking, trekking, skiing, mountaineering and scenic flights.

Climate change has led to an increase in glacier tourism, driven in part by "last-chance tourism" (Salim et al. 2022). This growing demand places additional pressure on already fragile glacier ecosystems, as plants and animals lose their habitats due to the expansion of tourism into sensitive areas. Heavy foot traffic damages glaciers and nearby vegetation, and visitors often leave behind litter and pollution. The growing influx of tourists is also intensifying greenhouse gas emissions, mainly from air travel to remote glacier regions, as well as tourism infrastructure such as roads and hotels (Fieger, et al. 2021; Gossling et al. 2023). These emissions, in turn, contribute to global climate change and accelerate the melting of glaciers.

Furthermore, climate change diminishes mountain aesthetics and shortens snow seasons, reducing opportunities for skiing and other snow-based activities. It also increases the incidence of glacier disasters that threaten tourists' safety, such as avalanches, ice collapses, rockfalls due to permafrost warming and extreme weather or flooding (Purdie et al. 2015).

Glacier tourism often does not generate equitable benefits for local communities, as the associated environmental degradation undermines their long-term livelihoods.

Moreover, the economic benefits of tourism are not evenly shared. Large businesses take most of the profits, while local communities often gain little and face higher living costs, making it harder for them to thrive — while infrastructure development tends to prioritize the needs of visitors over those of the local community (Palomo 2017).

An integrated solution is needed, combining regulations with climate action and eco-tourism. Community projects that balance conservation and development, such as through seasonal closures and limiting visitor numbers, can reduce harm while allowing tourism to continue. Effective strategies for transitioning to sustainable tourism include itinerary maintenance — coordinated tourism planning, travel logistics and hospitality services — as well as mitigation and awareness raising for collective action, planning and implementation (Salim et al. 2021). Proactively engaging tourists encourages low-carbon and pro-environmental behaviour. Zoning sensitive areas for protection is another effective strategy, which requires more funding and effort but offers greater long-term benefits for the economy and the environment.

Policy Recommendations

1. Promote eco-friendly glacier tourism by managing visitor behaviour and minimizing environmental impacts.

Policymakers should introduce strict visitor caps for ecologically sensitive areas and allocate funding to transition local transport fleets to low-emission alternatives, such as electric buses in high-tourism zones. Promoting education and pro-environmental behaviour can positively influence visitors' low-carbon behaviour. Climate communication materials should emphasize actionable hope and stewardship, rather than solely highlighting threats. Recent research on last-chance tourism ethics shows that only a small proportion of visitors are willing to offset their carbon emissions, reflecting a weak sense of moral responsibility toward destinations affected by climate change. Building a stronger emotional connection and sense of responsibility among visitors is essential for promoting more ethical glacier tourism.

Moreover, it is important to prevent concentrated pressure on sensitive areas and to minimize ecosystem damage; therefore, zoning regulations and seasonal closures are crucial. Elevated boardwalks should be installed in high-traffic glacier areas to physically protect glacier surfaces while enabling access for visitors.

2. Invest in eco-tourism to secure ongoing funding for glacier conservation and local economic benefits.

Maintaining ecological capital requires financial support, yet only a small portion of revenue generated from nature-based tourism is reinvested in protected area management. Glacier managers should actively make the case for eco-tourism as a sustainable source of ongoing funding for conservation and management efforts. Examples of eco-tourism initiatives include interpretive centres — educational facilities that help visitors to understand and appreciate the natural, cultural and historical significance of a site — along with cultural tours and virtual reality experiences, which can reduce pressure on glaciers by drawing the interest of visitors and raising environmental awareness.

Tourism managers should also charge visitors modest fees to support conservation. Policymakers must consider implementing carbon-offset programmes as a funding mechanism that aligns tourism with broader climate action.

3. Involve local communities in planning and conservation to strengthen tourism resilience and support equitable development.

Local communities play a key role in sustainable tourism, and must be included in the planning of tourism projects to ensure that their needs and values are addressed. Governments should establish both formal and informal consultation mechanisms, such as community advisory boards and participatory planning workshops, integrated in all stages of tourism development. This would build trust, promote cooperation and improve the legitimacy of tourism governance.

Supporting local ecotourism fosters a more equitable distribution of economic benefits within communities, and governments should allocate adequate financial resources for this purpose. Policymakers should also invest in capacity-building programmes to enhance local participation in decision-making and disaster preparedness.

Community-based tourism strengthens local economies, creating more job opportunities while safeguarding the surrounding environment. Tourism policies should incorporate community-led environmental monitoring and climate adaptation plans. When communities are actively engaged, tourism becomes more balanced, delivering benefits to both visitors and the host community, thus supporting long-term sustainability.

4. Enhance monitoring and enforcement to ensure compliance with sustainable tourism practices.

Effective monitoring is essential to ensure compliance with sustainable tourism policies. Policymakers must invest in educational initiatives, institutional support and advanced technology. Glacier monitoring systems must be strengthened to detect retreating trends and assess potential hazards, such as avalanches, to improve tourist safety. Smart and green technologies should be adopted to enhance real-time monitoring. Drones can be deployed to track visitor behaviour and glacier conditions, supporting responsible tourism and the protection of fragile environments.

Remote sensing and geographic information systems should be used to map ecologically sensitive areas, such as alpine meadows and glacier lakes, and define clear boundaries to restrict access. These technologies also enable continuous monitoring of long-term changes in glacier coverage and density, facilitating informed decision-making for sustainable tourism management. Trained personnel must be deployed to manage visitor activities, enforce regulations and teach eco-friendly practices. Monitoring biodiversity is also essential for assessing and mitigating ecological impacts.

5. Strengthen climate adaptation and resilience to safeguard glacier tourism from climate change impacts.

Climate adaptation strategies should be embedded in tourism planning. This includes diversifying tourism offerings, such as promoting off-season and low-impact activities, investing in climate-resilient infrastructure and enhancing early warning systems for glacier-related hazards like avalanches and glacial lake outbursts. Promoting geotourism could also reduce risks, by encouraging a shift in interest from glaciers' aesthetic appeal to their scientific significance, as well as applying virtual reality technology to glacier tourism. These strategies could help to protect glaciers from the impacts of overtourism. Public–private partnerships can support financing for adaptation measures, ensuring that tourism remains sustainable while minimizing risks to both visitors and local communities. By proactively addressing climate change impacts, glacier tourism can contribute to broader climate resilience efforts and reduce vulnerabilities in mountain regions.

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