

# MOUNTAIN GLACIERS: VANISHING SOURCES OF WATER AND LIFE

Mountain glaciers are among the most visible and emblematic indicators of climate change. Worldwide, glaciers are losing mass at unprecedented rates – a process that has accelerated in recent decades, with record losses in the 21st century. As an effect of widespread glacier shrinkage, the high mountains of the world are currently experiencing a historically unparalleled, large-scale environmental transformation, with profound and far-reaching impacts for landscapes, ecosystems, and people.

Glaciers provide important ecosystem services. In the tropical Andes, for instance, glacier meltwater offers critical support to sensitive ecosystems such as high-mountain wetlands. Ongoing glacier retreat therefore gives rise to ecosystem changes, and the eventual disappearance of glaciers in future will ultimately disrupt these ecosystems and their service functions. Glacier retreat also impacts water provision for people and economies downstream. Central Asia, several regions in South Asia, and the tropical Andes are global hotspots in this regard; small-scale and large-scale agriculture, hydropower production, rural communities, and urban centers crucially depend upon glacier meltwater during the annual dry season. Moreover, for many people – and indigenous people in particular – the continuous retreat of glaciers represents a significant cultural loss because they maintain a close relationship to mountains and glaciers as a part of their lives.

Continuous glacier retreat also leads to extreme events and new and evolving disaster risks for downstream populations and vulnerable transport and energy infrastructure, such as massive glacier lake outburst floods or enhanced sediment flux. Countries and people are facing evolving and insufficiently recognized challenges and risks that urgently require adaptation solutions.

New studies now demonstrate that the difference in impact between low and high greenhouse gas emission pathways on 21st century glacier retreat and its related effects is enormous. In the Andes, as one example of an important region affected by glacier retreat, low-emission pathways could safeguard 50 percent of present glacier areas. High-emission pathways, meanwhile, would result in an almost complete disappearance of glaciers by the end of this century – with dramatic consequences. The glaciated mountains of the world are therefore not only icons of climate change, but are also tangibly showcasing the tremendous importance of both climate change mitigation and adaptation efforts.

## SUSTAINABLE MOUNTAIN DEVELOPMENT FOR GLOBAL CHANGE (SMD4GC)

The objective of SMD4GC is to contribute to sustainable development in mountain regions and to increase the resilience of vulnerable mountain people who are increasingly exposed to the impacts of global change. The programme works through partner organizations in the Andes, Africa, the Hindu Kush Himalaya, Central Asia, and Switzerland. Funded by the Swiss Agency for Development and Cooperation (SDC), the programme was initiated in 2014 and draws on Switzerland's long tradition of supporting sustainable development in mountains.



**CONDESAN**  
Consentium for the Sustainable Development  
of the Andean Ecoregion



**FDDM**



**UNIVERSITY OF CENTRAL ASIA**  
GRADUATE SCHOOL OF DEVELOPMENT  
Mountain Societies Research Institute



**UNIVERSITÄT  
BERN**

**CDE  
CENTRE FOR DEVELOPMENT  
AND ENVIRONMENT**



**University of  
Zurich**



**UNIVERSITÉ DE Fribourg  
UNIVERSITÄT FREIBURG**

Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

**Swiss Agency for Development  
and Cooperation SDC**



# MOUNTAIN GLACIERS: **VANISHING** SOURCES OF WATER AND LIFE

UNDER LOW EMISSION PATHWAYS UP TO 50% OF CURRENT GLACIER ICE WILL REMAIN IN SOME REGIONS. HIGH EMISSION PATHWAYS WILL LEAD TO **LARGE-SCALE DEGLACIATION**.

AS GLACIERS DISAPPEAR, SENSITIVE AND UNIQUE **ECOSYSTEMS ARE BEING DEGRADED** AS A RESULT OF THE LOSS OF CRITICAL WATER SOURCES.

GLACIERS HAVE IMPORTANT SPIRITUAL MEANING FOR MANY MOUNTAIN COMMUNITIES. THE DISAPPEARANCE OF GLACIERS IMPLIES A SUBSTANTIAL LOSS OF CULTURAL ECOSYSTEM SERVICES AND **IMPACTS MOUNTAIN PEOPLE'S LIVES AND LIVELIHOODS**.

A DECLINE IN WATER RESOURCES DUE TO MELTING GLACIERS IS EXPECTED TO RESULT IN **GREATER COMPETITION FOR WATER**.

MELTING GLACIERS AND THAWING PERMAFROST CREATE NEW HAZARDS AND INCREASE THE **RISK OF DISASTER LOSSES**.

ADAPTATION TO CHANGING WATER AND RISK REALITIES IN GLACIATED MOUNTAIN BASINS IS KEY FOR SUSTAINABLE DEVELOPMENT AND THE AVOIDANCE OF **CONFLICT OVER SCARCE RESOURCES**, BOTH WITHIN AND ACROSS TERRITORIAL BOUNDARIES.

THE DISAPPEARANCE OF GLACIERS RESULTS IN THE **IRREVERSIBLE LOSS OF UNIQUE ARCHIVES** OF HUMAN, ENVIRONMENTAL, AND CLIMATE HISTORY.

UNPRECEDENTED RAPID GLACIER RETREAT IS MODIFYING LANDSCAPES AND GIVING RISE TO NEW LAKES AND ECOSYSTEMS. **ADAPTATION ACTIONS ARE NEEDED** TO CAPTURE OPPORTUNITIES AND REDUCE RISKS.

ACROSS MANY REGIONS OF THE WORLD, **LIVELIHOODS AND THE ECONOMY** STRONGLY DEPEND ON GLACIER WATER RESOURCES.

TROPICAL MOUNTAIN WETLANDS CAN STORE A MEAN AMOUNT OF 1,200 TONS OF CARBON PER HECTARE. HOWEVER, LOSS OF GLACIERS AND ACCESS TO VITAL WATER FROM GLACIER-FED STREAMS DEGRADES THESE ECOSYSTEMS - POTENTIALLY **TRANSFORMING THEM FROM CARBON SINKS TO CARBON SOURCES**.