



POLICY BRIEF

RISKS ORIGINATING IN MOUNTAINS AFFECT VAST AREAS
AND REQUIRE IMPROVED MANAGEMENT.

Towards systemic disaster risk reduction in mountains

Mountains are multi-risk areas due to complex interactions between natural and socioeconomic factors.

These multiple risks can manifest locally but can also have severe impacts in distant lowland areas, thus requiring coordinated approaches across sectors and regions. Moreover, mountain risks are embedded in the specific natural, cultural, social and economic contexts of mountains, which call for local knowledge and livelihood options that can adapt to and reduce exposure to these risks.

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Key messages:

- Disaster risk reduction and adapted disaster management in mountains is also of great importance for lowlands.
- Mountain communities are characterized by specific vulnerabilities, usually related to both the landscape's topography and the distance to centers of power and crucial services.
- Recognition and integration of challenges specific to mountain regions across all components of risk is critical for mountain disaster risk reduction processes.
- Processes leading to increased risks in mountain systems and livelihoods are anthropogenic and embedded in broader systemic processes, such as poverty, inequalities, poor governance, etc.
- Local knowledge on disaster risk, communities' risk perception and existing risk preparedness measures are relevant for disaster risk reduction processes and policies.
- Multi-hazard early warning systems (MHEWS) have proven to be an

adequate lifeline for people in mountainous regions. Gender-responsive, community-based MHEWS help individuals and communities to take timely action to reduce disaster risk when facing imminent threats.

Risk in mountains – an increasingly systemic challenge

Mountains are prone to natural hazardous processes that lead to multi-risk conditions. Hazards can cause disasters when they affect exposed elements (e.g., people or infrastructure) and when vulnerabilities reduce people's ability to manage risks. The interactions between these three factors (hazards, exposure and vulnerability) are complex and multidimensional. Unstable, steep terrain and extreme weather events can trigger a variety of hazards such as avalanches, floods, flash floods, debris flows, and landslides (1). Mountain areas in volcanic regions are additionally prone to specific geological hazards such as seismic events and volcanic eruptions. Depending on the exposure and vulnerability of local communities, coupled with other pre-existing drivers of vulnerability such as

poverty or inequalities, these hazards can result in adverse impacts and disaster risks such as loss of life or damages to settlements and infrastructure. Mountain communities are characterized by specific vulnerabilities related to their remoteness and distance from centers of power, often limiting their access to services and influencing their (lack of) resilience and capacities to respond to risks. Further, there is differential impact of disasters on women, children, and marginalized communities. For millennia, isolated mountain communities have established their livelihoods alongside these risks, developing their own strategies of adaptation and mitigation independent of overarching (or superordinate) governmental risk management. Addressing natural hazard risks and responding to their impacts, however, is further challenged by changes in the frequency and magnitude of sudden and slow-onset extreme events due to climate change, as well as being challenged by many other processes such as migration and globalization of markets.

The effects of climate change (and other) hazards are not gender neutral but rather reflect the socially differentiated drivers of vulnerability and resilience,

including gender bias. Very often women and girls experience the greatest impacts of climate change. Western approaches often do not account for specific Traditional Local Knowledge held (only) by women and girls' regarding climate change adaptation and mitigation and therefore may overlook women and girls' potential contribution to risk management strategies. Such a 'gender-blind' approach may in fact reinforce inequalities and inequities on the basis of gender.

The Intergovernmental Panel on Climate Change (IPCC) Cross Chapter on Mountains in the Sixth Assessment Report published in 2022 concluded that "climate-related hazards such as floods and landslides have contributed to an increase in disasters affecting a growing number of people in mountain regions and areas further downstream" (2). Additionally, interactions of hydro-meteorological and geological hazards can lead to cascading or compounding impacts which are greater than the sum of the impacts of the individual hazards (3). These multi-risk realities are influenced by a broad range of complex physical, social, and economic characteristics, for example remoteness to services or marginalization relative to centers of power (1,4).



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Multiple risk drivers and components converge and interact across different scales, connecting mountainous highlands with adjacent lowlands. Here: Highly degraded rural highlands of Lesotho administered by a complex system of dual governance.

BOX 1. THE SENDAI FRAMEWORK FOR DISASTER RISK REDUCTION IN MOUNTAINS

The Sendai Framework for Disaster Risk Reduction (7) provides guidance across four priority areas to reduce risk, increase resilience, and prevent the creation of new risk. Understanding disaster risk (Priority 1) is particularly important in mountain ecosystems. It is not uncommon for mountain social-ecological systems to face a combination of climate change impacts, population growth, urbanization and ecosystem degradation. This combination of pressures intensifies the competition for the limited safe space available in mountain regions, leaving the less-safe spaces more exposed to hazards and increasing the vulnerability of people and infrastructure. Mountain hazards can also be compound, mutually reinforcing, and cascading, meaning they can exacerbate each other, continue downhill, and result in greater impacts than the sum of the individual hazards across larger areas. This should all be considered when managing risks since mountains are part of larger connected systems. The Sendai Framework also highlights the need for strengthening risk governance, investing in resilience, and enhancing preparedness (Priorities 2, 3 and 4). While all four of the Sendai Framework Priorities for Action are critical for mountain disaster risk reduction, the interconnectedness of highlands and lowlands is not explicitly addressed and deserves more recognition. When addressing these priorities, it is critical to look into the interconnectedness of mountain social-ecological systems with other areas. An analysis of the Midterm Review of the Implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030 (<https://sendaiframework-mtr.undrr.org/>) and related official reports also reveals that the topic of DRR in mountain is rarely considered. The Adaptation at Altitude Issue Brief “Leave no mountain behind: disaster risk reduction for all” (1) further delves into the role of the Sendai Framework for risk reduction in the mountains and how these principles apply. The results of a workshop carried out at the International Mountain Conference in Innsbruck in September, 2022, which was dedicated to “Challenges in implementing the Sendai Framework in Mountain Environments” has been integrated into the United Nations University Institute for Environment and Human Security (UNU-EHS) “Contribution to the Midterm Review of the Sendai Framework for Disaster Risk Reduction” (8).

Addressing current & future challenges

Key messages and recommendations.

Disaster risk reduction in mountains must recognize and integrate the challenges specific to mountain regions across all components of risk and their interactions with one another and with external drivers and factors

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1. Disaster risk reduction and adapted disaster management in mountains is also of great importance for lowlands

The majority of hazard risks in mountain regions are linked to the specific characteristics of mountain social-ecological systems. This means that in mountain environments disaster risk reduction must deal with mountain-specific hazards, with more distinctive exposure situations and with communities that have particular strengths and vulnerabilities. At the same time, the way disaster risk is managed in mountain regions has a strong impact on the downstream areas, since the ecosystem services (provisioning, regulating, supporting and cultural) generated in upstream areas are all indispensable for downstream areas (5). Similarly, decisions taken in lowland areas can also have strong impacts on the regions uphill/upstream, for example influencing the flow of tourists and traffic or the (im)balance between protection and exploitation of natural resources.

Consequently, addressing risks in mountain areas must be addressed using a systems approach where

specific characteristics are considered together with their functional links to lowland areas.

The interdependencies between highlands and lowlands are particularly evident when considering water and energy demands as well as changes in the hydrological regime. One climate related risk that is rapidly gaining importance in mountain regions is water availability due to changes in highland precipitation schemes (rain and snow) leading to droughts and a rise of potential conflicts over water in the lowlands, coupled with other impacting factors such as water access and distribution. Likewise, water-related hazardous events originating in the mountains also affect downstream communities. Communities located downstream may be adversely impacted by their consequences, too. For instance, glacial lake outburst floods (GLOFs) caused by melting glaciers at higher elevations are increasingly threatening highland and lowland communities close to major mountain ranges worldwide (6) and pose potential for damage more than 100 km downstream. Often unequal economic- and decision-making power relations between lowlands and highlands can enhance risk; a widespread example of this

being natural resource extraction. Such activities can put pressure on the environment and societies, for example by causing deforestation and land degradation, ultimately also reducing the protective role of forests against numerous hazards (see Box 4).

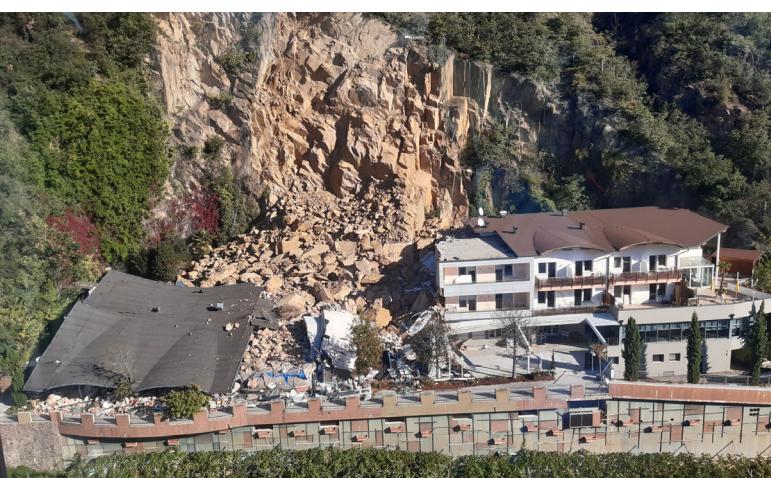
As the world and our societies become more globalized and interconnected, so are interdependencies between highlands and lowlands becoming even more pronounced resulting in a need for a holistic, systems-approach to DRR efforts to better meet the complex challenges of compound and cascading risks.

2. Processes leading to increased risks in mountain systems and livelihoods are anthropogenic and embedded in broader systemic processes

Bio-physical hazard processes are often the focus of DRR activities, but they represent only one component of risk, and must be considered together with the equally important aspects of exposure and vulnerabilities when attempting to reduce harmful impacts. The components of exposure and vulnerability of communities and their livelihoods are

strongly linked and driven by societal processes and the social frameworks that influence how hazards affect people. Therefore, their consideration is a pre-requisite for successful disaster risk reduction worldwide (and has accordingly been recognized and is reflected in all major recent disaster risk reduction strategies and guidelines – see 7, 9). Among the factors that particularly contribute to exacerbating risks in mountain regions are: elevation-dependent climate change, ageing population and outmigration, remoteness from services and centers of power, and inaccessibility in case of hazardous events. Most of these aspects are strongly linked to large-scale anthropogenic processes - accelerated and intensified by globalization - such as greenhouse gas emissions, land use change, demographic change, surface material extraction or urbanization (10). Consequently, efforts to reduce disaster risk could in fact be counterproductive (i.e. lead to maladaptation) or even exacerbate power imbalances, inequalities and poverty if the abovementioned anthropogenic processes are not adequately considered. A systemic approach explicitly includes the integration of climate change adaptation with disaster risk reduction at all levels of decision making of climate-resilient development (2)

Mountain disaster risks are often a result of complex socio-ecological interactions, whose dynamics need to be investigated to reduce vulnerabilities. Here: Hotel destroyed by a rock fall in South Tyrol / Alps, that did not cause any casualties thanks to COVID-19 conditional closing of the infrastructure



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BOX 2. MOUNTAINS IN THE GLOBAL ASSESSMENT REPORT ON DISASTER RISK REDUCTION 2022 REPORT

A key message of the Global Assessment Report on Disaster Risk Reduction 2022 (GAR2022) (11) - which also addresses the systemic risks of the future – emphasizes humans' role in generating and exacerbating risk. Decisions about how we live, what and where we build, and in what we invest have a huge influence on the creation of disaster risk. Such dynamics can potentially hamper sustainable development and resilience, as well as our ability to adapt to climate change. Therefore, conducting research, policymaking, and decision-making should not be done in silos, or in isolation. GAR2022 offers recommendations on how to reduce risk and prevent disasters by addressing the way governments, businesses and individuals make decisions about risk. It indicates which decisions and actions are necessary to break the vicious cycle of risk-creation and build long-term resilient communities. Particularly - but not exclusively - in mountain areas, integrated disaster risk management must urgently be included in development planning. This implies that to have a sustainable planet where people and society flourish, we must transform the way we think and act, the way in which territories are governed, and the management of resources, in order to avoid amplifying the drivers and impacts of disaster risk

3. Local knowledge on disaster risk, communities' risk perception and existing risk preparedness measures should be translated and integrated into DRR processes and policies

Development activities in mountains are still too often dominated by Western narratives that sometimes obscure indigenous, local knowledge and ignore the cultural and spiritual importance of specific mountain areas. Therefore, "localization" of research, development and policy-making activities is fundamental to transformative resilience in

mountain regions, and local actors must take the lead in re-designing existing governance structures (11). Decisions for and about mountains are often taken outside of mountains by people unfamiliar with the specificities of mountain systems (13). Good governance instead requires the inclusion of mountain people and mountain expertise (3). Throughout centuries of interactions with their environment, global mountain communities have developed critical local knowledge that should be considered when developing policies and taking action towards disaster risk reduction. Such knowledge can influence communities' risk perception (14), and provides an

understanding of context-specific changes and events which often intertwine natural elements with ecological knowledge, culture, and religion. Traditional interpretations of risks and disasters are embedded in the everyday cultural expressions of local knowledge by mountain communities; such interpretations are critical to understanding community needs and managing internal resources. Focusing on the cultural dimension of risk also represents an opportunity for developing measures that not only allow communities to build resilience, including the preparedness to adequately respond to hazards, but also to maintain cultural traditions that are embedded in particular geographical spaces, thereby maintaining a sense of place and cultural identity for communities

throughout changes.

In addition, the effects of climate change (and other) hazards are not gender neutral but rather reflect the socially differentiated drivers of vulnerability and resilience, including gender bias. Very often women and girls experience the greatest impacts of climate change. Moreover, the Western conceptualization of the gender neutrality of Indigenous Knowledge Systems tends to marginalize the specific roles, experiences and contributions of women's knowledge systems to climate change adaptation and mitigation, in their specific cultural and ecological communities. Consequently, gender-blind approaches to risk reduction and response may in fact reinforce inequality on the basis of gender and inclusion.

BOX 3. COVID-19 IN MOUNTAIN REGIONS

The COVID-19 pandemic highlighted the systemic and compound nature of risks in mountain areas. On the one hand, it reconfigured the dynamics of mountain communities worldwide by deepening specific structural weaknesses. On the other hand, it also fostered opportunities based on collective governance structures, food production and distribution systems, solidarity, and local and indigenous knowledge. Three cases in the Andes (Ecuador), Maloti-Drakensberg (South Africa) and Kurdistan (Iraq) show that mountain environments as remote locations may entail both advantages and disadvantages in the context of health crises: while they provide space and distance from other people, they also have particular vulnerabilities since they are isolated and far from adequate health services (12). Each case is however extremely context-specific, revealing that mountain regions are not independent but heavily influenced by their surrounding environments, challenges, and pre-existing vulnerabilities.

Even though long-term consequences of COVID-19 are not yet fully understood, affected governments and communities in all three study regions mentioned above must develop forward-looking solutions to mitigate current threats to their economies, security, and health care systems, particularly in mountainous regions. The global experience of this pandemic also provides opportunities for sustainable, equitable, and climate-resilient recovery from COVID-19.

BOX 4. NBS FOR DISASTER RISK REDUCTION AND ADAPTATION IN MOUNTAINS

Nature-based Solutions (NbS) is an umbrella term used to refer to those practices that make use of ecosystem services to benefit the stability of social-ecological systems. Many of the NbS implemented in mountains such as terracing and water harvesting methods are usually based on local, traditional knowledge (5). NbS is well-suited for mountain areas as it typically considers local, bottom-up approaches by integrating communities as well as local knowledge, which supports the integration of the unique physical and social-ecological features of mountains. Ecosystem-based Disaster Risk Reduction (Eco-DRR) is a specific type of NbS and systematically employs protecting and regulating ecosystem services, for example provided by forests, wetlands, and mangroves to mitigate, prevent, or buffer against disasters. The adoption of such approaches can enhance the renewal of mountain ecosystem services, while providing social and economic benefits and thereby increasing both social and ecological resilience (5, 15). Eco-DRR is frequently applied in forest management, biodiversity protection and soil protection to avoid landslides, avalanches and rockfalls, but also for the regulation of water resources and for flood prevention. Eco-DRR implemented in mountain areas has recently gained attention as it represents a cost-efficient way to address arising challenges due to climate change related risks.

NbS are internationally recognized as an alternative to engineering solutions. They often evolved from non-institutionalized, ad-hoc measures developed by local people over centuries as response to context-specific challenges in mountains. For this reason, NbS in mountains are highly contextual. Knowledge transfer of NbS across regions is nonetheless useful, and planners and communities should invest more in NbS as a valid adaptation and risk reduction option for mountain regions.



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Local knowledge-based land management and disaster risk reduction practices in mountainous regions are gaining visibility as tool to increase community resilience to disaster risk and climate change. Here: Tadami (Japan) local management cutting sick trees to reduce cascading risks in case of storms

Recommendations

- Risk management in mountain regions should not be limited to administrative units (e.g. municipality, province) and should consider the interactions and cascading impacts between highlands and lowlands with gender responsive approaches.
- Especially when addressing mountain risks, countries need to cooperate more extensively and effectively by sharing data, information, and scientific and indigenous knowledge, and by fostering transboundary disaster risk reduction practices.



- There should be increased investment in NbS for adaptation and disaster risk reduction in mountains as a solution to integrate local knowledge and to address systemic risks.
- Measures for climate change adaptation and disaster risk reduction in mountain areas should be planned, managed and implemented by considering multiple goals.
- Institutions and governments urgently need to adopt a standardized, multi-hazard risk assessment approach that can explicitly account for mountain-specific vulnerabilities and resilience. Such an approach should address primary, secondary, and cascading hazards as well as direct and indirect impacts.
- Greater inclusion of risk perception and social aspects should be integrated in disaster risk reduction processes and policies in mountains, which allows for the development of more comprehensive measures combining scientific and local knowledge.
- People-centered, impact-based Multi-Hazard Early Warning Systems (MHEWS) and related Early Action or Anticipatory Action (AA) must be tailored to the specific conditions in mountainous regions to become effective instruments of DRR and resilience-building.
- Ensuring equitable risk reduction in mountain regions requires an understanding of how risk perceptions vary between gender and social groups.



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