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International Frameworks for Disaster Risk Reduction: Useful Guidance for Sustainable Mountain Development?

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In recent decades, a number of global frameworks have been developed for disaster risk reduction (DRR). The Hyogo Framework for Action 2005–2015 and its successor document, the Sendai Framework for Disaster Risk Reduction, adopted in Japan in March 2015, provide general guidance for reducing risks from natural hazards. This is particularly important for mountainous areas, but DRR for mountain areas and sustainable mountain development received little attention in the recent policy debate. The question remains whether the Hyogo and Sendai frameworks can provide guidance for sustainable mountain development. This article evaluates the 2 frameworks in light of the special challenges of DRR in mountain areas and argues that, while the frameworks offer valuable guidance, they need to be further adapted for local contexts—particularly for mountain areas, which require special attention because of changing risk patterns like the effects of climate change and high land-use pressure.

Keywords: *Mountain hazards; mountain risks; disaster risk reduction (DRR); policy debate; global framework.*

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Background

Mountain development and risk from natural hazards are inherently linked. Many mountain settlements are located on alluvial fans created over a long period of time by debris flows, mud flows, or floods. Such processes, although occurring only episodically, constitute a major threat to people's lives, livelihoods, and assets. Other life-threatening mountain events include landslides and rock and snow avalanches. The 2010 rock avalanche in Attabad, Hunza (Gilgit-Baltistan, Pakistan) killed 20 people, dammed the Hunza River, and created a 22-km-long lake (Iqbal et al 2014). This event not only caused direct damage (loss of life, destruction of houses, and submersion of settlements and agricultural land) but also had and still has major indirect effects, such as interrupted trade via the Karakoram Highway, which affects development in the area and intravalley mobility (Cook and Butz 2013).

Multihazard conditions prevail in virtually all mountainous areas. This is nothing new; however, many mountain areas have experienced a strong increase in population and economic development over the past decades as well as intensified human activity (eg Slaymaker and Embleton-Hamann 2009; Kohler et al 2014). This may coincide with the effects of climate change (eg Haeberli and Whiteman 2014). Mountain people and communities are particularly affected by those hazards if exposure and vulnerability are not properly managed. Whereas the characteristics of mountain hazards have been addressed for many decades, the other aspects of risk, exposure and vulnerability, have received attention in science and practice only for the past few decades (Papathoma-Köhle et al 2011; Gaillard and Kelman 2012; Le Masson 2015).

Efforts to understand and manage disaster-related risks have emerged relatively recently. The integration of disaster risk reduction (DRR; for a definition see Box 1) into sustainable mountain development (ex ante risk management, eg IRDR 2014), rehabilitation and recovery (ex post risk management, eg Zimmermann and Issa 2009), and overall resilience building remains episodic and is rarely addressed in the international policy debate. Nevertheless, DRR is presently high on the policy agenda, as the first and only globally adopted framework for DRR, the Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters (HFA 2005) has terminated. A post-2015 framework for DRR (the Framework for Disaster Risk Reduction 2015–2030, SFDRR 2015) was adopted by 187 states during the third United Nations (UN) World Conference on Disaster Risk Reduction in Sendai, Japan, in March 2015. Parallel to these discussions, the integration of DRR into the new Sustainable Development Goals is ongoing in early 2015; at present, disasters are mentioned in Goals 1, 2, 11 and 13 (https://sustainabledevelopment.un.org/sdgsproposal).

The aim of this article is to identify DRR challenges specific to mountain areas, investigate the extent to which the Hyogo Framework addressed these challenges, and assess the support provided in its successor document, the

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BOX 1: Defining terms related to risk and disaster risk reduction

Risk is the product of hazard, exposure, and vulnerability—or, in more economic terms and according to UN terminology (UNISDR 2009), "the combination of the probability of an event and its negative consequences." These 2 simple definitions describe a complex issue with natural, social, and economic aspects. A *natural hazard* is a "natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage," whereas *exposure* accounts for "people, property, systems, or other elements present in the hazard zones." The term *vulnerability* defines the "characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard." On the other side of the equation, *risk* may be defined as an average expected loss from a particular hazard, measured per event, annually, or otherwise. The materialized risk is often called a *disaster*, the "serious disruption of the functioning of a community or a society involving widespread human, material, economic, or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources." *Disaster risk reduction* is "the concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events" (all definitions according to UNISDR 2009).

Sendai Framework, for mountain DRR and sustainable mountain development. It points out what mountain-specific elements still need attention.

Mountain-specific issues in DRR

Mountain areas are characterized by high geodiversity, steep gradients, and high variability in hydroclimate systems, topography, and ecosystems. Accordingly, societies in mountain areas are prone to geophysical processes (earthquakes and volcanic eruptions), mass movements, and glacial and snow hazards as well as floods and other hydrometeorological hazards, including drought and forest fires (Beniston 2003). The main drivers of natural hazards are the high relief and the hydroclimate, exacerbated by climate variability and change and human activity (Slaymaker and Embleton-Hamann 2009; Keiler et al 2010). Socioeconomic factors, particularly population growth and widespread poverty in many developing countries, influence vulnerability and exposure of mountain communities (Keiler et al 2006; Gardner and Dekens 2012; Kohler et al 2014). A number of other particularities of hazards, risks, and risk reduction challenge sustainable mountain development:

- **A multihazard environment** prevails in many mountain areas. One community or location can be affected by floods, debris flows, and snow avalanches, which may influence each other (Kappes et al 2010). Many mountain areas are also prone to earthquakes, which may trigger other geomorphological processes, as clearly demonstrated by the October 2005 Kashmir earthquake (see EERI 2006).
  - Most existing hazard and risk analysis approaches neglect the possibility of secondary and cascading hazards (Kappes et al 2010); however, their thorough consideration is required for risk and disaster management in mountain areas.
- **The proximity of safe and hazard-prone areas** is typical of mountain settlements. In the European Alps, for example, the old village center with the church is often located in a relatively safe place, whereas new housing estates and recreational developments are often found farther from this center in locations where hazards occur (Zimmermann 2004).
  - Assessing and mapping hazard and risk zones (eg Espizua and Bengochea 2002) is indispensable for sustainable mountain development and can prevent future losses if the results are well integrated in planning decisions.
- **Climate variability and change** may intensify hazard conditions in mountainous areas (Haeberli and Whiteman 2014). Climate warming can cause glaciers to melt or permafrost to degrade, thus altering the sources of rock avalanches, landslides, and debris flows. It may even create hazard conditions with no historic parallels, such as flood hazard from newly formed glacial lakes (cf. eg Bajracharya and Mool 2009) or the development of debris flows of unparalleled size originating in a periglacial environment, as observed in the European Alps during the 1987 flood disasters (Zimmermann and Haeberli 1992). According to Beniston (2003), mountain regions might also be severely affected by prolonged drought and related fire hazards.
  - Assessing risks without considering the effects of climate change is no longer an option in mountainous areas, which are particular sensitive to climate change.
- **Living space is extremely limited** in mountain areas. According to Tappeiner et al (2008), only about 17% of the total area of the European Alps is suitable for permanent settlement. The mountain population has more than tripled in the past 3 decades (Slaymaker

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2010), and urbanization is also visible in mountain areas (eg Romero and Ordenes 2004; Zhang et al 2004). Inevitably, settlements, infrastructure, and agricultural land are exposed to natural hazards. The urban poor, in particular, are often pushed onto steeper terrain that is only marginally suitable for housing. From 1950 to 2010, the majority of urban population growth occurred in hilly or mountainous areas between 500 m and 1500 m (Kohler et al 2014: 63).
  - DRR needs to be integrated into relevant sectors, such as land-use planning, infrastructure development, health, and mountain agriculture. Risk-informed planning will help to make new land uses, and intensified existing land uses, more hazard proof.
- **Highland–lowland interdependence** is highly relevant in mountain areas; very often highlands are seen as the main source of intensified hazardous conditions in the lowlands. However, such interdependencies are not always obvious and are sometimes misinterpreted—for example, as outlined by Ives and Messerli (1989) for the highland–lowland systems in the Himalaya. These challenging upstream–downstream interdependencies are often accompanied by political tensions. In the Fergana Valley, for instance, strong land-use pressure (overgrazing, deteriorating vegetation cover, and climate-change effects) in the upland areas of Kyrgyzstan are linked to riverbed changes and flooding in the Uzbek lowland irrigation zone (see Stucker et al 2012).
  - Hazardous processes do not stop at borders. Cross-border cooperation encompassing whole watersheds is necessary for early warning and other precautionary measures.
- **Local traditional knowledge,** while available in many rural areas, is often much better preserved in stable mountain communities than in the lowlands, where there is greater mobility. Mountain people are more accustomed to disasters because of the higher frequency of hazardous events and people's direct dependence on natural resources, and in many cases they have developed strategies to cope with them (see eg Wisner et al 2012).
  - Local knowledge from mountain societies must complement scientific and technical knowledge.
- **Remoteness** and difficulty of access are often features of mountain communities. As a consequence, during disasters these communities are cut off from the outside world more often and for a longer time than lowland areas (see eg Ehsan-ul-Haq 2007).
  - The capacity to respond to a disaster is especially important in mountains.

The integrated management of hazards and risks and the prevention (or at least mitigation) of future losses requires particular attention in mountain environments because of emerging risks (eg effects of climate change) and changing risk patterns (eg land-use pressure). Systematic procedures for hazard and risk assessment and the consideration of assessment results in development plans are essential to avoid future losses.

International DRR policy frameworks

Mountains have thus far received little attention in the major DRR guidance documents, which are described in the sections that follow.

The Yokohama Strategy

As disasters (with huge human and economic losses) such as earthquakes, floods, and storms increased globally in the 1970s and 1980s (eg Munich Reinsurance Company 2010: 37), so did awareness of the need for efforts to reduce the effects. The UN General Assembly proclaimed the International Decade for Natural Disaster Reduction from 1990 to 1999. Mountains were not in the forefront when this decision was taken. Nevertheless, initiatives emphasized aspects relevant to mountain environments, like geological hazards assessment, vulnerability of ecosystems, and climate change and natural disasters (IDNDR 1999). Although many activities addressed hazards and hazard reduction alone, resilience was also a focus in discussions of disaster reduction and sustainable development. This paved the way for the change from a reactive to a more proactive prevention approach, which was promoted in the Yokohama Strategy for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation (United Nations 1994), adopted during the first World Conference on Natural Disaster Reduction. In this strategy, the close links between risk, disaster reduction, sustainable development, environmental protection, and poverty alleviation became apparent. However, the strategy remained generic and did not mention mountains.

The Hyogo Framework

Ten years later, during the second World Conference on Disaster Reduction in 2005, 168 states adopted the first global framework for DRR. The core of the Hyogo Framework for Action 2005–2015 (HFA 2005) consists of 3 strategic goals, a number of guiding principles, 5 priorities for action (PAs), and considerations for implementation and follow-up. Each PA (Box 2) is associated with 10 to 15 activities to be pursued by states and communities.

The Hyogo Framework is a global document; as such, it addresses DRR issues in all types of environments and settings. However, mountains remain a marginal element in this document. PA4, paragraph 19 (q) calls on signatories to "incorporate disaster risk assessment into rural development planning and management, in particular with regard to mountain and coastal flood

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BOX 2: The 5 priorities for action of the Hyogo Framework for Action

PA1: Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation.
PA2: Identify, assess, and monitor disaster risks and enhance early warning.
PA3: Use knowledge, innovation, and education to build a culture of safety and resilience at all levels.
PA4: Reduce the underlying risk factors.
PA5: Strengthen disaster preparedness for effective response at all levels.
Source: HFA 2005

plain areas, including through the identification of land zones that are available and safe for human settlement." Although the midterm review of the framework (UNISDR 2011) did not mention mountain areas explicitly, environmental issues in general were given more space.

The Sendai Framework

Discussions to prepare the successor document to the Hyogo Framework started early. In 2013 and 2014, numerous consultations, conferences, and workshops took place. The *Synthesis Report on Consultations on a Post-2015 Framework on Disaster Risk Reduction* noted that "consultations yielded broad calls to address mismanagement of the environment, enhance social and environmental vulnerability assessments and account for ecosystem services. Others noted the significance of trans-boundary cooperation in the management of shared watersheds, deltas and mountain systems" (UNISDR 2013: 15). Mountains received little attention, but the frequent mention of the environment and ecosystems provided opportunities for the integration of ecosystem services or the management of natural resources for the reduction of risks and the resilience of mountain communities.

The Sendai Framework for Disaster Risk Reduction aims to achieve, over the next 15 years, a substantial reduction of disaster risks and loss of lives, livelihoods, and health and the economic, physical, social, cultural, and environmental assets of people, businesses, communities, and countries by preventing new disaster risks and reducing existing ones through the implementation of integrated and inclusive measures that strengthen resilience (SFDRR 2015). This goal calls for a strong integration of DRR into development, including mountain development. Four priorities for action are identified:

Priority 1: Understanding disaster risk
Priority 2: Strengthening disaster risk governance to manage disaster risk
Priority 3: Investing in disaster risk reduction for resilience
Priority 4: Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation, and reconstruction (SFDRR 2015)

The main gaps identified in implementing the Hyogo Framework are the underlying risk factors, the need to foster a shared responsibility for disaster resilience at all levels, and the need to ensure adequate means of implementation. The gaps indicate a need to develop an action-oriented framework that governments and other stakeholders can implement in a supportive and complementary manner and that helps to identify disaster risks to be managed and guides investment to improve resilience (SFDRR 2015: paragraph 9). On a general level, these gaps have been addressed; however, many uncertainties remain on how to implement the framework.

The new framework, which is nonbinding (as the Hyogo Framework was), presents 1 goal and 7 explicit targets. Unfortunately, coherence with other global policy frameworks is relatively weak. During negotiations it became clear that a number of states and institutions considered the new framework to be independent of these other global policy frameworks, while others held that the Sustainable Development Goals should define the goals the global community should achieve and frameworks like the Sendai should provide solutions for how to achieve these goals. Discussions of the new DRR framework clearly showed the difficulty of achieving coherence among the various policies and their stakeholders.

Application of the DRR frameworks to mountain environments

The generic character of the Hyogo and Sendai frameworks permits their use in various geographical settings, such as cities, coastal areas, flood plains, and mountain environments; however, little is said about how to implement them in these specific contexts, and they need to be adapted to local conditions.

The Hyogo Framework has supported the formulation of DRR policy and strategy in mountainous countries, such as Pakistan's 2013 National Disaster Risk Reduction Policy and Tajikistan's National Disaster Risk Management Strategy for 2010–2015. Unfortunately, the new (Sendai) framework does not provide guidance on whether such countries should adapt the national policies and strategies or can further proceed with policies developed under the Hyogo Framework.

The particularities of DRR in mountain areas (assessment of risks, management of risks, management of disasters), as outlined earlier, require clear guidance on a number of aspects. These challenges are addressed

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TABLE 1 Mountain-related DRR challenges and their representation in the Hyogo and Sendai frameworks.

Mountain-related challenge	Requirements	Hyogo Framework (2005–2015) [a)]	Sendai Framework (2015–2030) [b)]
Multihazard environment	• Understanding of multiple hazards, vulnerabilities, and risks • Consideration of cascading events during preparedness and response planning	• Paragraph 13c: Overall approach • PA2, paragraph 17i: Considered for assessment	• Paragraph 7/19g: Overall approach • Paragraph 15: Scope of framework • Priority 1, 24k: Research • Priority 1, 25a/33b/34c: Early warning • Priority 1, 25b: Assessment
Proximity of safe and hazard-prone areas	• Comprehensive assessments and mapping of hazards, vulnerabilities, and risks	• PA2 assessment: 15 recommendations	• Priority 1 assessment: 24 recommendations
Climate change	• Assessment of consequences of extreme events and gradual changes	• Mentioned in 5 paragraphs for assessment and adaptation	• Mentioned in about 15 paragraphs
Limited living space	• Comprehensive assessment and mapping of hazards, vulnerabilities, and risks • Mainstreaming of DRR into sector planning, particularly land-use planning	• 13c/k: General considerations • PA1, 16a/b/f: normative frame • PA4, 19p/q: land-use planning	• Paragraph 19h: Guiding principle • Priority 2, 26, 27a/g: Mainstream DRR within and across all sectors • Priority 3, 30f: land-use planning (urban) • Priority 3, 30g: land-use planning (rural)
Highland–lowland interdependence	• Comprehensive assessment of hazards • Consideration of transboundary, basin-wide, and ecosystem approaches	• PA2, 17n: Assessment of transboundary hazards • PA4, 19a/b: Sustainable use of ecosystem	• Priority 1, 24b: Assessment of ecosystems • Paragraph 19a, PA2, 28a/d: Transboundary • Priority 3, 30g/n: Ecosystem services
Integration of traditional local knowledge	• Integration of local knowledge into assessments and management strategies	• PA3, 18a: Use of indigenous knowledge	• Priority 1, 24i: Use of indigenous knowledge • Paragraph 36a: Role of stakeholders
Remoteness of mountain communities	• Comprehensive assessment of risks • Strengthening of local disaster-response capacity	• PA5 Disaster preparedness: 6 recommendations	• Priority 4: Disaster preparedness: 24 recommendations

[a)]HFA 2005.
[b)]SFDRR 2015.

in both framework documents with only slightly different weights. Table 1 provides an overview of the challenges and their treatment in the 2 framework documents.

Overall, both documents provide guidance on the main challenges of DRR in mountain areas. An important aspect of sustainable mountain development is information about prevailing hazards, vulnerabilities, and risks. Both documents prominently address this requirement and provide guidance on taking climate change into account. PA2 of the Hyogo Framework and Priority 1 of the Sendai Framework focus on the identification, assessment, and monitoring of disaster risks. However, the recommendations remain rather generic—for example: "Develop, update periodically and widely disseminate risk maps and related information to decision-makers, the general public and communities at risk in an appropriate format" (HFA 2005: paragraph 17a).

In order to be more specific, scientists and practitioners have to provide the approaches, techniques,

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and tools needed to carry out assessments and produce risk maps. Research has contributed to the development of various tools to assess flash floods, debris and mud flows, and rock falls and landslides (eg Horton et al 2013), or for multihazards (Kappes, Gruber, et al 2012), but the knowledge and skills needed to assess vulnerability and risk are less well developed (Papathoma-Köhle et al 2011; Gaillard and Kelman 2012; Kappes, Papathoma-Köhle, and Keiler 2012; Papathoma-Köhle et al 2015). On the practical side, many international agencies and nongovernmental organizations (NGOs) have in recent years developed guidelines and tools for the assessment and management of risks in a mountain environment (eg FOCUS 2008). Many of these documents emphasize the need to develop knowledge of risks through participatory approaches and to produce community-based hazard and risk maps for use in emergency management (eg evacuation routes). Unfortunately, these measures are not underlined sufficiently as important for risk-conscious land management, land-use planning, and investment in disaster-proof infrastructure.

DRR can be viewed not only as a targeted subject but also as a cross-cutting theme for development, including mountain development. Many development agencies promote the full integration of DRR into sector policies and programs (eg GFDRR 2013). Both the Hyogo and Sendai frameworks underline that DRR is not just an issue for a single agency (such as emergency management) but should also be integrated into development efforts to avoid creating new risks. Although sustainable mountain development is not explicitly addressed, it benefits from the new framework, particularly under Priority 2 (strengthening disaster risk governance to manage disaster risk) and Priority 3 (investing in DRR for resilience). DRR is clearly considered a multistakeholder and cross-cutting issue.

The Hyogo Framework's PA4 (reducing underlying risk factors) lists as the first action encouraging the sustainable use and management of ecosystems, including through better land-use planning and development activities to reduce risk and vulnerabilities (HFA 2005: paragraph 19a). Ecosystem-based measures provide various benefits through support for livelihoods—for example, improved mountain pastures reduce erosion and provide fodder and other resources for local communities—and are often less costly (Estrella et al 2013). Priority 3 of the Sendai Framework calls on signatories to "strengthen the sustainable use and management of ecosystems and implement integrated environmental and natural resource management approaches that incorporate disaster risk reduction" (SFDRR 2015, paragraph 30 n).

The Hyogo Framework underlines the need for communities and local authorities to be empowered to manage and reduce disaster risk by having access to the necessary information, resources, and authority to implement DRR actions. As mountain communities are often cut off from the outside world, these priorities and actions are of particular importance in this environment and require a focus on the community level (Dekens 2007; Ehsan-ul-Haq 2007). The Hyogo Framework further details these requirements in PA3 (using knowledge, innovation, and education to build a culture of safety and resilience at all levels) and PA5 (strengthening disaster preparedness for effective response at all levels). The Sendai Framework is slightly less specific in this regard but also calls several times for involvement of local-level actors and explicitly states: "Train the existing workforce and voluntary workers in disaster response; strengthen technical and logistical capacities to ensure better response in emergencies" (SFDRR 2015, paragraph 33 f). As outlined in numerous practical DRR programs, many development organizations and NGOs stress capacity development at the (mountain) community level to address existing and emerging risks and to adapt to the effects of climate change (eg FOCUS 2008; CBT 2013).

Concluding remarks

Mountain communities are threatened by numerous risks from natural hazards and a changing risk pattern. DRR is of particular importance in mountain areas for several reasons, such as the multihazard environment, land-use pressure, and the effects of climate change. Sustainable mountain development requires a systematic and integrated risk management approach in order to avoid or reduce future losses. The comprehensive assessment of hazards, vulnerabilities, and risks as well as the full integration of risk information into sector planning are indispensable for any kind of development (including projects focused on settlements, livelihoods, and infrastructure). The global policy frameworks developed over the past 2 decades provide general guidance on addressing these challenges. However, neither the Hyogo Framework nor the Sendai Framework can be implemented without adaptations. A step forward is the link, although not very deeply elaborated, with other frameworks (eg the Sustainable Development Goals policy) presently being debated, the focus on resilience building, and the focus on the local level and the forward-looking development realm (ie on how to prevent the buildup of new risk). Guidance on how to do the job in general and in specific environments is still missing; in this regard, there has been little progress from the Yokohama Strategy to the Hyogo Framework and the Sendai Framework.

Mountain societies need to translate these recommendations into practical steps appropriate to local conditions. In the long run, an international strategy for DRR in mountain areas might be considered based on

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an integrated, multihazard approach. Any such strategy should address policies, planning, and programming related to sustainable development, relief, rehabilitation, and recovery in disaster-prone countries. Proactive steps to reduce future losses and build resilience are more cost-efficient than purely reactive responses to disasters. As such, DRR has to be considered as an investment in sustainable development and not as an extra burden for investors. This is true both globally and in mountain environments in particular.

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