

## **Climate Change Adaptation Strategies—An Upstream-Downstream Perspective**

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Source: Mountain Research and Development, 37(2) : 240-241

Published By: International Mountain Society

URL: <https://doi.org/10.1659/mrd.mm207>

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## Climate Change Adaptation Strategies—An Upstream-Downstream Perspective

Edited by Nadine Salzmann,  
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Nussbaumer, and Gina Ziervogel.  
Heidelberg, Germany: Springer,  
2016. x + 292 pp. US\$ 129.00.  
ISBN 978-3-319-40771-5. Also  
available as an e-book.

Climate change is one of the world's major environmental challenges for the 21st century. In the face of climate change, mountain regions are particularly vulnerable for a number of reasons. First of all, their geographic setting makes them sensitive to physical perturbations. Steep slopes erode easily, trigger landslides and rockfalls, and provide only thin substrates for the vegetation layer. Strong gradients in temperature and precipitation create precarious balances and natural tipping points, such as the mass balance of glaciers, ecosystem boundaries, and suitability zones for agriculture. At the same time, climate change is expected to be more severe in mountain regions than in lowlands. Basic thermodynamic principles dictate that the relationship between air temperature and altitude (the lapse rate) depends on the moisture content. As global warming will increase global evaporation and thus the air moisture content, this will decrease the lapse rate and reinforce warming at higher elevations. Lastly, as a result of their remoteness, harsh physical conditions, and lower availability of infrastructure, mountains are often socioeconomically less developed. This is particularly acute in developing and emerging economies, where mountains often host "poverty pockets" where human development lags behind.

In this context, it is paramount to study the options for mountain

regions to adapt to climate change and to minimize its impacts at both local and more regional scales. Indeed, one particularly outstanding characteristic of mountain regions is their ability to influence ecosystem services well beyond their geographical region. This is especially the case for water resources, as the timing and magnitude of river flows originating in mountain regions are determined by mountain hydrologic processes such as soils, wetlands, and glaciers well downstream of their geographical extent.

This volume is a very fine contribution to the quest to find adequate and locally tailored climate adaptation strategies for mountain regions. As the title implies, the book focuses specifically on upstream-downstream linkages. This inevitably implies a strong focus on water resources and water-related risks. The book starts off with 2 chapters that give an overview of the current scientific thinking about climate adaptation and the issue of geographic scales. This is followed by a set of 10 case studies, which are diverse in both their geographical focus and local challenge, ranging from forest management in Nepal to irrigation on Mount Elgon in Uganda and managing glacier lake outburst floods in Peru. The last 3 chapters reflect on some more general aspects of economic development in the context of climate change, resilience building, and the science-policy interface.

The book does not pretend to be a systematic overview of climate adaptation in mountain regions. Indeed, the geographic distribution of the case studies shows quite a bit of clustering, with 3 case studies from Nepal and 3 from Peru. This leaves some clear gaps on the world map, such as the rest of the Andes beyond Peru, Central Asia, and the Rocky Mountains. Similarly, the heterogeneity of approaches does not allow for the drawing of direct parallels between regions or grand synthesizing conclusions. But this is

not the ambition of the book, and it would probably be futile for a "wicked" problem as this, for which a silver bullet does not (yet) exist. Instead, the strength of the book lies in highlighting the geographic and social-ecological diversity of mountain systems as well as the need for tailored solutions rooted in the local social and physical context, ideally developed and implemented using bottom-up and participatory approaches. From that perspective, the book presents some enthusiasm-generating stories and great examples of community-based approaches. The local community vision for ecosystem-based adaptation on Mount Elgon (figure 9 of chapter 7) or the combined seasonal weather and seasonal activity calendar of the Hindu Kush Himalayas (figure 3 of chapter 10) are just some examples of methods to capture local perspectives and to leverage expert knowledge. I also found the case study of the Carpathian Mountains particularly interesting, as this is a region that receives limited attention in the scientific literature.

From this perspective, collecting case studies in an edited volume is also a way to highlight the opportunities for cross-fertilization, exchange of experiences, ideas, and information between case studies in mountain regions. Despite, or perhaps because of their diversity, a lot can be gained from sharing successes and failures of particular methods to collect and process data, and to discuss and communicate the extracted knowledge with stakeholders. Such an approach is often championed as "South-South exchange" in the global development literature, and while the term may not fully cover the content, it does highlight the increasing recognition that adaptation science needs to embrace diversity and make much better use of situated knowledges. The book itself does not go into much detail on how to do this, and the theoretical chapters are quite high

level in this regard, but it is a very useful starting point.

One aspect of the book I found somewhat surprising is that the first chapter identifies the scarcity of reliable, spatially and temporally continuous data series as one of the major challenges for climate adaptation. Yet the book provides very few clues on how to alleviate this issue. Most of the case studies surely try to make the best out of the available data and take due care in highlighting uncertainties (even if the book as a whole does not present a systematic approach to dealing with

uncertainties). The conclusions of the last chapter again pick up the issue of data scarcity. But these conclusions go little beyond the observation that the gap still exist and seem to call mostly on the established structures, such as national and international authorities, to fill the gap. This is surely welcome but bypasses novel approaches such as participatory monitoring and citizen science, which are emerging trends that feature prominently in the current policy debates, such as the Sendai Framework for Disaster Risk Reduction. Lastly, the book is well

presented and most of the chapters have plenty of color graphics, maps, and photographs.

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