Sustainable Mountain Development Revisited

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Source: Mountain Research and Development, 31(3) : 237-241

Published By: International Mountain Society

URL: https://doi.org/10.1659/MRD-JOURNAL-D-11-00069.1

Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
published by the International Mountain Society (IMS)
www.mrd-journal.org

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Mountains occupy 24% of the global land surface area and are home to 12% of the world's population. About 10% of the world's population depends directly on the use of mountain resources for their livelihoods and wellbeing, and an estimated 40% depends indirectly on them for water, hydroelectricity, timber, biodiversity and niche products, mineral resources, recreation, and flood control (Schild 2008). Despite their important contribution, mountains are still marginalized in the development agenda. Although the importance of ecosystem services arising from mountains is recognized, approaches to economic valuation of services and payment mechanisms in mountain areas, which are needed to comprehend and realize the benefits, have not yet been greatly developed (Rasul et al 2011).

The Hindu Kush–Himalaya (HKH) range spans more than 4.3 million km^2. It is often referred to as the "third pole" and "water tower of Asia," regulating the flow of 10 major river systems. The region is home to many diverse ethnic communities that speak about 1000 languages and dialects and have enormous socioeconomic and cultural diversities. It is endowed with a variety of farming practices and rich natural resources, including global biodiversity hotspots that form the source of ecosystems directly servicing more than 200 million people living in the HKH and indirectly servicing 1.3 billion people living in the downstream areas. Moreover, countries totaling a population of 3 billion people benefit from food and energy produced in the HKH river basins (Schild 2008).

Ecosystems are capital assets that provide a range of services. These include supporting services that maintain the conditions for life; provisioning services that provide direct inputs into livelihoods and the economy; regulating services that provide, among other things, flood and disease control; cultural services that provide opportunities for recreational, spiritual, or historical sites; and supporting services that sustain and fulfill human life (MA 2005). Increasing demands on ecosystem goods and services are putting more pressure on natural resources.

Climate change has emerged as a most prominent force of global change; however, it is embedded in a matrix of drivers, including globalization, population growth, and local land use cover change. Climate change is the product of globalization, and mitigation implies global norms and measures. Mountain systems prove highly fragile and particularly sensitive to climate change. Mountains contribute only in a modest way to the production of greenhouse gases but are particularly affected. Adapting to climate change calls for specific and tailor-made measures (Schild 2008).

This paper revisits the mountain agenda. The basic hypothesis is that the challenges of today should encourage us to particularly include socioeconomic, demographic, and ecological factors. For the first time in 20 years, the climate change and green economy debates have created the possibility of mainstreaming sustainable mountain development in the international development agenda.

The 1992 Rio conference and its impacts

The global community recognized the importance of mountains at the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil, in 1992, which led to the inclusion of Chapter 13 in UN Agenda 21. Chapter 13 sets the scene by stating the role of mountains within the global ecosystem and expresses serious concerns about the decline in the general environmental quality of many mountains (UN 1992). The Rio conference delivered a framework for the future orientation of policy-makers and planners.

As the 20th anniversary of the Rio conference is approaching, the questions that need to be revisited are (1) What has been the impact? and (2) How far has Chapter 13 managed to influence action and national and international agendas? An impressive number of initiatives followed the Rio conference. Every 2 years, the UN General Assembly voted a declaration in favor of mountains. The World Summit on Sustainable Development in Johannesburg focused on the "operationalization of Chapter 13" (WSSD 2002). The "International Year of Mountains" in 2002 was a highlight with the Adelboden Conference and finally culminated with the Global Mountain Conference held in Bishkek, Kyrgyzstan.

These impressive initiatives did not succeed in shaping the international development agenda, which remained dominated by globalization and macroeconomic stability related to structural adjustments, human rights, the debt crisis, and the millennium development goals. The policy instruments (eg poverty reduction strategy papers) strengthened countrywide approaches without considering ecoregional specificities. Industrialized countries expressed growing concern about the consequences of growth and environmental hazards due to industrialization. Nevertheless, the

 http://dx.doi.org/10.1659/MRD-JOURNAL-D-11-00069.1

prevailing global concerns focused on economic growth, macroeconomic stability, trade liberalization, communication, privatization, deregulation, and structural reform.

Mountain agenda–specific issues experienced increasing isolation. Development programs basically applied the same recipes for mountain and nonmountain areas. Sustainable mountain development remained largely the concern of a small group of professionals and mainly the scientific community. The politicians and the development agenda did not follow science.

Climate change and biodiversity on the global agenda

While sustainable mountain development remained marginal and never reached the desired impetus on the global agenda, 3 UN conventions—the UN Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD), and a convention on combating desertification—moved forward substantially. The UNFCCC became gradually more prominent with an important secretariat, the Intergovernmental Panel on Climate Change (IPCC). The IPCC's fourth assessment report brought a common view of the scientific community (IPCC 2007) to the limelight for the first time. The Kyoto Protocol put forward an internationally agreed framework for the reduction of greenhouse gases. The follow-up Conferences of Parties in Bali, Copenhagen, and Cancun did not achieve any international breakthrough; however, they created financial instruments for the promotion of mitigation and funding of adaptation to climate change.

In the assessment reports and previously mentioned conferences, mountain systems are mentioned only randomly, if at all. The HKH region receives hardly more than journalistic coverage, despite its importance in providing global goods and services. Only scarce research has been done in the Himalaya. The unavailability or inaccessibility of reliable data has its consequences to the present day. The lack of scientific certainty led to a controversy on glaciers in 2009, for example: whereas the IPCC's fourth assessment report mentions 500,000 km^2 of glaciated surface in the HKH region (IPCC 2007), the most published area coverage is about 110,000 km^2; however, a recent detailed study by the International Centre of Integrated Mountain Development (ICIMOD) shows glaciated area coverage of 60,000 km^2 (Bajracharya et al 2010).

The CBD was more discreet in developing the Programme of Work on Mountain Biodiversity (PoWMB) in 2004. The PoWMB invites the Conferences of Parties participants to the CBD to adopt outcome-oriented targets for mountain biodiversity. In the process, many international legal instruments relevant to conservation, benefit sharing, and the protection of the rights of indigenous local communities have evolved. Although there are still unresolved issues associated with rights and responsibilities, the CBD has made it difficult to ignore the enormous challenge of biodiversity conservation and the crucial role of local knowledge and local custodians in maintaining and managing natural resources. An analysis conducted by ICIMOD on the paradigm shift in the policy on biodiversity management and the HKH provides an understanding to guide the mountain biodiversity agenda in the future (Sharma et al 2010).

The concept of biodiversity corridors received prominence in the 10th Conference of Parties in 2010 in Nagoya, Japan. During this conference, mountain biodiversity, including the use of natural resources, received the attention of global players, which led to declarations on making the use of environmental goods part of the national accounting. In addition, the idea of creating an international CBD panel will give a new impetus to biodiversity-related global agendas.

The debate on the consequences of climate change has created a new awareness of the role and importance of mountain systems. However, science has not managed to fill the gap in guiding the political agenda.

Economic development and relevance to mountains

What has brought about the changes? The last 20 years have been characterized by economic growth, with increasing demand and pressure on ecosystems and resources. A number of national economies, particularly in Asia, have brought a new dimension to the equation of North–South equaling rich–poor. India and China in particular have emerged as new global economic powerhouses.

Mountain systems have benefitted only marginally from this situation. Policies—also in mountain countries—were focusing on natural resource–based growth. Yet with the growing awareness of the scarcity of resources (especially freshwater), the effects on the climate and the relevance of mountain ecosystem services have become a focus of attention. Valuation of ecosystem services and their payment will be essential for assessing benefits and designing policies (Rasul et al 2011).

Recently, awareness has been growing that a stronger differentiation is required for mountain areas. Whereas changes in mountain systems in the subtropical zones (in Asia, Africa, and Latin America) have a direct influence on the livelihoods and food security of millions of people, changes in mountains of industrialized countries are perceived more in categories such as tourism and recreation. Mountain systems in subtropical zones brought new criteria for the relevance of

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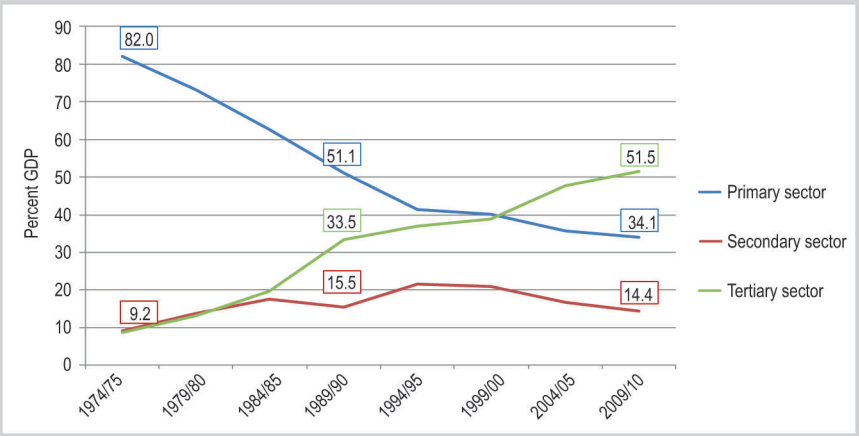
FIGURE 1 Changes in the economic structure of a mountain country (percentage of the gross domestic product, 1974–2010). (Data from GoN 2010)



mountains: increased vulnerabilities and reduced food security in the downstream areas have impacts on the livelihoods of more than 1 billion people in the case of the HKH.

Mountain systems: challenges and opportunities

Enormous economic growth and the dynamic development of communications and transport with globalization of international relations have influenced mountains; they have taken place in relation to dynamics in urban centers (Figure 1). Rapid urbanization, a rural–urban continuum, and migration are leading to increased marginalization.

At the same time, the relevance of the availability of freshwater, the importance of biodiversity, and "in a world of globalization," the relevance of identification with local values have given mountains a focus of attention that they previously had not had in modern times. Melting glaciers, intensification of floods, and extended droughts are the most visible and alarming signs. Compared to the situation during the Rio conference in 1992, mountain systems are now seen more as the providers of strategic ecosystem services, which are a prerequisite for food security and poverty reduction, and a central argument for sustainable development.

The growing awareness of the importance of mountain systems, particularly of the Andean and HKH ranges, gives new significance to upstream–downstream relations. The question is how services from the mountains provided to downstream areas can be compensated; in other words, what are the policies and strategies that make the services sustainable in the interest of regional development? The river systems that have their origin in the HKH have their footprint in the food security of 1.3 billion people. For energy security, the footprint extends to up to 3 billion people.

Climate change, mitigation, and adaptation

Climate change is increasingly recognized as an additional driver of change, particularly for mountain systems. Mountains are considered particularly fragile, and the vulnerabilities of mountain population are increasing. But increased awareness also creates new opportunities. Of particular importance are the mechanisms and the instruments being discussed at the international level to reduce global warming and the impact on climate change.

Simplifying the discussion associated with mitigation, we often exclusively focus on greenhouse gases, whereas adaptation is associated with water. The reduction of greenhouse gases requires a long-term effort with global dimensions. Mountain systems can be largely seen as suffering from factors generated elsewhere. Glaciers serve as an excellent indicator for measures directed toward reducing climate change. Glaciological research in the Himalaya therefore not only is in the interest of countries in this region but also is a global concern.

Although mitigation needs global agreements, adaptation urgently calls for tailor-made ecosystem-specific measures, because the development agenda has been globalizing for the last 30 years. For the first time, there is political and diplomatic support for specific programs for mountain systems in the interest of sustainable mountain development and in the interest of sustainable ecosystem services for downstream populations.

Increasing evidence shows that the clear separation between mitigation and adaptation is not possible anymore. Black carbon and tropospheric ozone are hazardous to health, influence agricultural productivity, and contribute to glacier melt. These short-lived aerosols (contrary to greenhouse gases) can be reduced with appropriate measures. According to the present status of research, such measures could contribute substantially to the slowing of Earth warming in the coming 30–40 years, namely, before global mitigation measures kick in. Reduction of the emission of black carbon is a mitigation measure. Black carbon is also produced locally by households through the burning of biomass, wild fires, etc. Reducing black carbon therefore calls for action also in mountain areas.

Rio+20: an opportunity for the mountain agenda

The 2012 Rio conference will have 2 main topics: green economy and governance in the frame of sustainable development. Green

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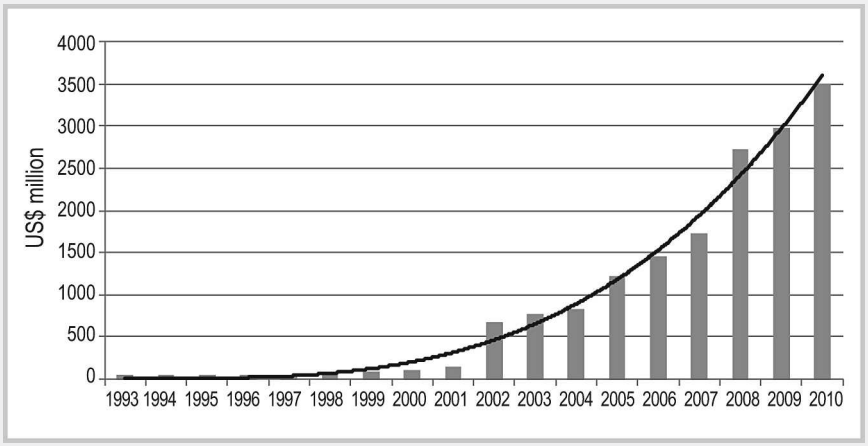
FIGURE 2 Annual inflow of remittances to Nepal, 1998–2010. (World Bank 2010)



economy aims at a low carbon economy. It will be essential that we do not just consider the high-level polluters. Mountain economies are largely green. They have a right to grow but should not increase the carbon output. However, mountain areas provide a series of ecosystem services essential to urban downstream areas. We see a high potential for mountain systems should we succeed in arguing in a smart way and building the rationale in a consistent and convincing way. We see a unique opportunity to put the mountain agenda in the frame of CBD and UNFCCC and in view of the Rio+20 conferences.

The challenge is to determine what it costs to keep the green economy (in mountains) green, considering the principles of equitable and sustainable development. Two hurdles need to be addressed: (1) Do we have a robust science base and knowledge to make the case? (2) Who is going to defend the mountain agenda?

Reducing scientific uncertainty: responsibilities for scientists

Some thematic areas in the context of the HKH region need to receive urgent attention:

- Climate trends: changing behavior of the monsoon, role of the westerlies, role of heating of the atmosphere (Tibetan Plateau), scaling down, and customizing the global climate change scenario;
- Mitigation: black carbon and tropospheric ozone and reducing emissions for deforestation and degradation ($REDD^{+}$ and $REDD^{++}$);
- Cryosphere: mass balancing, hydrological balancing, behavior of glaciers (sweep and debris covered), role of Karakorum glaciers, glacier lakes as risks and potentials, snow melt, and monsoon discharge;
- Water: hydrological balance, discharge modeling, water storage, water availability and demand, changing discharge pattern due to climate change, and consequences for debris flow;
- Livelihoods: vulnerabilities, disaster risks, adaptation (herders, below the tree line), adaptation or sustainable mountain development, labor migration and remittances, how to build resilience in a changing social fabric, changing gender patterns and role of women, and new opportunities and forms of livelihoods;
- Biodiversity: changes in biodiversity due to climate change (biodiversity corridors versus crowding out), changes in plant sociology and soils stability, invading species and soil stability, management of biodiversity as a source of livelihoods, and market-driven biodiversity management; and
- Green economy: costs of green to remain green, mechanism to assure sustainability of marginal and fragile areas, valuation of ecosystem services, payment for ecosystem services, and use of national resource as part of the national accounts.

Defending the mountain agenda

Are we ready to take up the challenge? The deficit in reliable and consistent research has been signaled previously in this paper. The example of glaciers is representative for this situation. Research has been done largely by nonregional researchers. This has hardly enriched regional academia and has led to controversies that are not in the interest of anyone. We have to ask ourselves also whether we are ready to propose well-targeted adaptation measures. We are presently experiencing a rebranding of development measures because in practice we do not make the distinction between sustainable development and adaptation.

Who is going to defend the mountain agenda? We have to assume that industrialized countries have other priorities. They are likely to be supportive but will not take a leading role. The question of combining the defense of the mountain agenda with an international debate is dominated by the need of international regulation for mitigation; it is not evident that industrialized countries are ready to push this agenda. Issues of food security, increasing vulnerability, poverty, migration, and the quest for new livelihood strategies, which are the relevant issues not only in the HKH but also in the Andean countries and Africa, need more attention if sustainable mountain development is to lose its marginality (Figure 2).

In the framework of climate change and biodiversity, the relevance of mountain systems in the South has increased. This means also that adaptation to climate change and the sustainability of ecosystem services should be articulated in the

interest of the South, especially mountains in the South. We therefore have to assume that the mountain agenda has to be defended by the riparian countries of the subtropical zones, where these systems are preeminently important.

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