Green Economy and Institutions for Sustainable Mountain Development: From Rio 1992 to Rio 2012 and beyond

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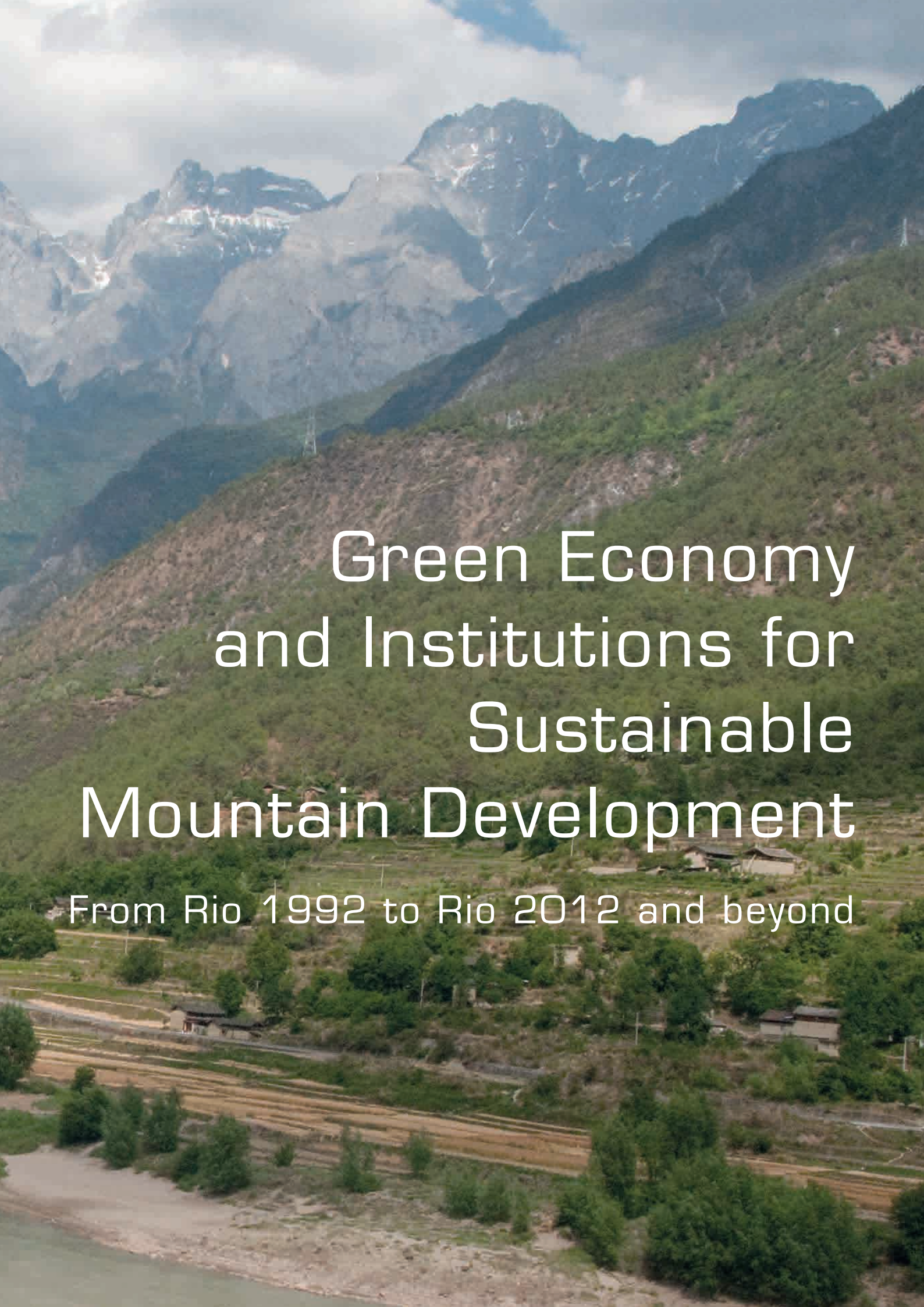

Green Economy and Institutions for Sustainable Mountain Development

From Rio 1992 to Rio 2012 and beyond

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Green Economy and Institutions for Sustainable Mountain Development

From Rio 1992 to Rio 2012 and beyond

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Bernard Debarbieux, D. Jane Pratt, Daniel Maselli

Contents

Foreword

Mountains make up a quarter of our planet's land surface and are home to 700 million people. They hold close to 80 percent of all fresh surface water and more than 23 percent of the Earth's forest cover. But mountain regions are fragile ecosystems that are coming under increasing pressure from human activity and climate change. Their fate matters to us all because they provide tremendous ecological and socio-economic value.

This is why sustainable mountain development was included as a key priority in the so-called "Agenda 21", the United Nations action plan that emerged from the United Nations Conference on Environment and Development (UNCED) in 1992, better known as the "Rio Earth Summit". Since then, many different actors have played their part to promote the goal of sustainable mountain development at global, regional and national levels.

Twenty years later, world leaders gathering at the Rio+20 United Nations Conference on Sustainable Development in 2012 renewed their commitment to fostering sustainable development of the world's mountain regions, most of which are located in developing and transition countries. This global commitment was enshrined in the outcome document, *The Future We Want*, and followed up with steps to turn political aspirations into concrete action.

As a mountain country with experience in developing its own rugged terrain responsibly, Switzerland has been at the forefront of efforts towards a global agenda for sustainable mountain development. Together with partners from around the world, the Swiss Agency for Development and Cooperation (SDC) has been championing the cause of mountain communities in many of the world's poorest regions. Among its many activities in this field, the SDC helped establish the global Mountain Pavilion at the Rio+20 Summit, commissioned a series of regional reports together with partners from all continents and mandated a team of international experts to produce an in-depth study on themes related to the green economy and institutions for sustainable development, with a focus on mountain regions.

The findings of their analysis and consultations are synthesized in this report. They show that sustainable mountain development is not just a goal in and of itself. Rather, good stewardship of mountain resources is absolutely vital to achieving many of the global Sustainable Development Goals (SDGs), especially in the areas of water, food and energy. The report also highlights the adverse impact of climate change on people living in mountain areas: many of them become entrenched in poverty or have no other choice but to leave their homeland. These challenges underscore the importance of building strong institutions to secure and advance the sustainable development of mountain communities.

The stakes are high, but so are the potential gains. Achieving them will no doubt require concerted efforts at all levels and by all relevant stakeholders – in government, business and from civil society. We hope that this report will stimulate further reflection among key decision-makers and inform policies that effectively put the development of mountain regions on a more sustainable path and make it an integral part of the global green agenda.

Manuel Sager
Director-General of the SDC, Ambassador

Key Policy Messages

View of the Harpan River valley, with Phewa Lake and Pokhara in the background, Kaski District, Nepal (S. Jaquet)

The need for action

Mountains provide vital goods and services for the benefit of all humankind, for supporting sustainable development at the global level and for moving the world towards a greener economy. More than 20 years after the 1992 Rio Earth Summit, the challenge of sustaining the provision of these goods and services has never been greater. The global community must act – a new agenda and strengthened institutional frameworks for mountain development are urgently required.

Guiding principles

This new Mountain Agenda should be based on the following policy principles:

Mountain-specific strategies: Mountains hold specific challenges and opportunities for global sustainable development relating to green economy and institutions. Targeted strategies are thus required for effective action, especially at the national level. Global and regional institutions, conventions and frameworks such as the UN Framework Convention on Climate Change, the UN Convention on Biological Diversity and the UN Convention to Combat Desertification need to include specific programmes for mountain regions.

Transboundary cooperation, upstream–downstream linkages and rural–urban linkages: Many mountain ecosystems and the services they provide transcend national borders, with the majority of benefits accruing to lowland regions. Strengthening transboundary and upstream–downstream collaboration will increase the effectiveness of interventions. Increasing economic interdependencies between rural and urban areas within mountains, as well as between mountains and lowland cities and metropolitan regions also provide opportunities for partnership and collaboration.

Governance and institutions: Agenda 21 as a key reference for future action requires the involvement of all relevant stakeholders. Specifically, mountain populations must be involved in all decision-making stages from planning to implementation.

Compensation for ecosystem goods and services: Ensuring that mountain populations receive full compensation for the provision of ecosystem goods and services will enhance local livelihoods, reduce poverty and ensure a sustained flow of these goods and services for the benefit of all, including those downstream.

Balance conservation and development: Mountain ecosystems are often fragile, and conservation to safeguard their integrity is important. But mountain regions frequently also lag behind in development for reasons beyond their control. Balancing conservation and development is thus important; sound local and regional knowledge and targeted investment can help achieve this aim.

Coherence with principles of international cooperation: Collective action in support of mountains must be consistent with existing and evolving principles and norms of international cooperation. These include, among others, the principle of common but differentiated responsibility, intra- and intergenerational equity, the precautionary principle, duty to prevent transboundary harm, human rights of women, men and children, and protection of traditional knowledge.

Community-based tourism, Chimborazo area, Ecuador, with Chimborazo (6267 m) in the background (S.-L. Mathez-Stiefel)

Policy action

Sustainable Mountain Development Goals: Specific strategies are required for effective policy action, including investments in green economy and institutions. We invite countries and regional bodies to design specific Sustainable Mountain Development Goals (SMDGs) within the framework of national SDGs, indicating priority objectives and implementation plans which include green investment and institutional development.

Water resource management: Given the key role of mountains in providing water for domestic and commercial use, food security and green energy, we invite countries and regional bodies to develop integrated water resource management strategies. These strategies should be based on a multidisciplinary approach, which embeds sectoral policies and action within the overall goal of sustainable development; combines top-down and bottom-up approaches; and secures long-term planning and financing, capacity development and institution building. Sound planning depends on ground-based monitoring of water resource availability and demand, and on sharing these data at watershed or basin level.

Green investment: Mountain regions have a high potential for greening economies within and beyond mountains. In order to make full use of this potential, countries are invited to tap existing international finance mechanisms, to explore partnerships with the private sector and to prepare green investment plans for mountain regions. Priority areas include green energy with a focus on sustainable hydropower generation; responsible mining and resource extraction; and promotion of small and medium-sized industry, tourism, agriculture and biodiversity.

Disaster risk management: Mountains are particularly vulnerable to the effects of natural disasters, with consequences far beyond mountain regions. We therefore invite countries to prepare mountain-specific disaster risk management plans, which integrate risk assessment, prevention, response and recovery. These plans could contain elements of a green economy such as sustainable forestry. They should also help revive or establish institutions capable of successfully dealing with hazards and risk management.

Regional centres of competence: Lack of mountain-specific knowledge hinders informed policy-making and effective action at all levels of decision-making. Technologies and institutions that work well in lowland areas are often ill-adapted to mountain realities. There is thus a need to promote regional centres of competence to advance research and green technology development, capacity and institution building for green development and policy advice tailored to mountain areas.

Mountain stream in the Peruvian Andes (C. Devenish)

1

Mountains and Green Economy

Rice fields of Damdame village near Pokhara, Nepal (S. Jaquet)

Mountains are important for moving the world towards a green economy

Mountains provide much of the world's freshwater, minerals and genetic resources, supporting food security and clean energy production also in the lowlands. Mountain farming is inherently greener than lowland agriculture due to its small scale and low external input. A global green economy depends on mountain communities' stewardship of the rich natural resources mountain environments have to offer.

Small-scale farming in the Mount Kenya area, Kenya (HP. Liniger)

A green economy supports economic growth, mitigates and adapts to climate change, creates employment and promotes poverty eradication [1]. In a green economy, economic growth is characterized by reduced carbon emissions and pollution; enhanced energy and resource efficiency; and maintained ecosystem services including biodiversity (Box 1.1).

Mountains are critical for a global green economy. Providing 60–80 percent of the world's freshwater resources for domestic consumption, irrigation, hydropower generation and industrial use, mountains are important for food security and clean energy production. Mountains supply important minerals as well as genetic resources for major food crops. In addition, mountain farming is inherently greener than much of lowland agriculture due to its small-scale character and low external input. Home to 17 of the 34 recognized global biodiversity hotspots, mountains play a pivotal role in conserving and harnessing biological diversity for a green economy. One-third of all protected areas worldwide are in mountainous areas and include watersheds that secure water supplies for many of the world's largest cities. Mountains provide opportunities for recreation and tourism in an increasingly urbanized world. Mountains are among the regions most sensitive to climate change, acting as early warning systems. Finally, mountains contribute to the global human, cultural and social capital that humankind has to draw on for the transition to a green economy. These points all represent critical assets for a world striving for a greener economy within the framework of sustainable development [2; 3].

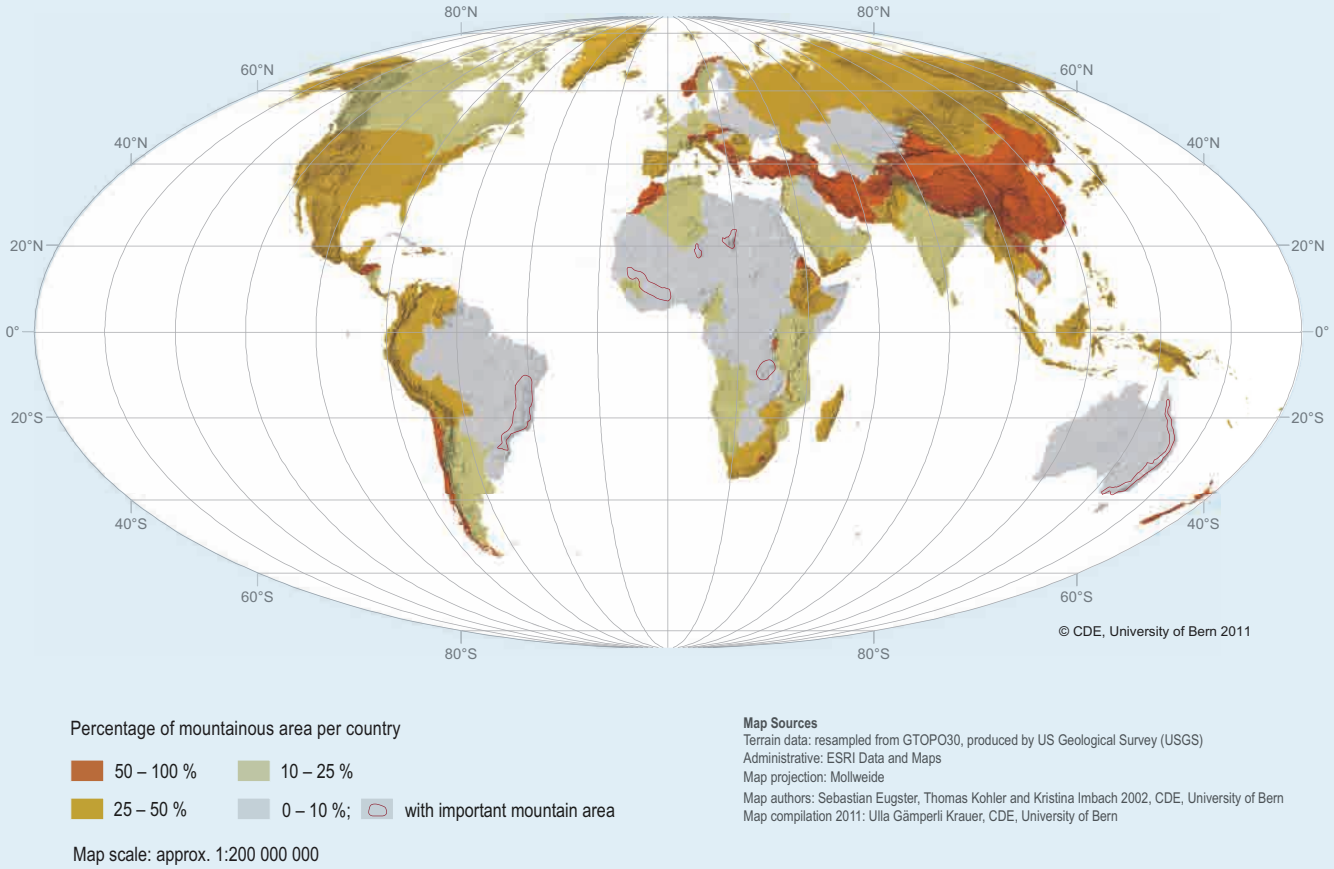
Since Rio 1992 – the United Nations Conference on Environment and Development (UNCED), also known as the Earth Summit – an impressive set of institutions and organizations have drawn attention to the important position of mountain regions. At the global level, Chapter 13 of Agenda 21, numerous UN resolutions, international conventions and creation of the International Mountain Partnership have helped mountains secure a permanent place on political agendas. As a result, the range of actors engaged in mountain development and research has

broadened significantly; while many established institutions have renewed interest in mountains, numerous new institutions are focusing on mountains to mobilize resources. From regional to local levels, mountain institutions as diverse as international treaties, networks of non-governmental organizations (NGOs), municipalities, and researchers, farmer cooperatives, resource user groups and tourism operators have demonstrated a commitment to sustainable mountain development. Experience gained since Rio 1992 has highlighted the specificity and complexity of development issues in mountain regions, as well as the many linkages to the development of downstream areas. This has shown the need for integrated development approaches to complement sectoral ones. Experience has also shown a deplorable lack of data on mountain regions and resources, especially in the developing world, including data on such critical fields as climate and climate change, water resources and biodiversity. This is a great hindrance to informed decision-making.

Mountains must be moved up on the development agenda

Despite their resource endowment, many mountain areas are neglected in terms of infrastructure development. They are also subject to political agendas set by far-off centres of decision-making for the benefit of lowland centres of growth. Poverty and hunger are widespread. The Food and Agriculture Organization of the United Nations (FAO) found that 290 million people, i.e. 40 percent of the 720 million living in mountains, are vulnerable to food insecurity; of these, half are chronically hungry [4]. Caloric needs are greater at higher altitudes, yet growing seasons are shorter. Global change and globalization are even felt in distant mountain valleys, leading to outmigration, road construction and increased integration

Figure 1.1: Global mountain territory



into regional and global markets. Extractive industries such as mining, timber and massive hydropower projects often damage ecosystems and their services, and drain resources from mountains while providing few benefits to upland dwellers. However, remoteness remains a feature of life in many mountain areas and means that mountain families in such regions have no access to any of the social services enjoyed by even the poorest of lowlanders: health clinics, elementary schools and connections to markets. But without the stewardship of natural resources provided by these mountain communities, both they and the millions of downstream users who depend on mountain resources cannot achieve sustainability.

The coincidence of high priority conservation areas and abject poverty in many mountain areas should have led development organizations and governments to target these areas more effectively long ago. Sadly, they remain neglected in many ways. Our world faces a growing population and increasing pressure from global change and economic growth (Box 1.2). If we intend to move towards more sustainable development and a greener economy, our dependence on mountain goods and services can only increase.

Box 1.1 | What is a green economy?

According to the definition proposed by the United Nations Environment Programme, a green economy is one where economic growth is accompanied by reduced carbon emissions and pollution; enhanced energy and resource efficiency; and maintained ecosystem services including biodiversity. Such an economy could address important global economic and development issues. A green economy supports economic growth while decoupling it from increasing use of natural resources. It also mitigates and adapts to climate change; creates employment; and promotes the Millennium Development Goals and poverty eradication.

The green economy concept is not uncontested, with critics addressing four main angles. A first and fundamental point of criticism relates to the concept's narrow perception of nature and the environment, which reduces nature to a provider of ecosystem services. A second point raised by critics relates to the rebound effect, according to which gains resulting from resource use efficiency are nullified by increased demand. Third, critics say the green economy masks power relations and exploitation as it is based on technological fixes, and that it disregards the question of whose interests are served by resource-efficient technologies. Finally, critics point out that the development agendas of industrialized countries, countries in transition and developing countries differ considerably. Industrialized countries are mainly concerned with overcoming the economic crisis, creating jobs and, by a majority, addressing climate change. Countries in transition have increased investment in energy-efficient economies, but their growth targets may outweigh green priorities and achievements. Green economy in developing countries is mainly linked to poverty eradication, social security and food security. Achieving a global green economy will require harmonizing these agendas and the concept itself. Relating to mountain development, contextualizing action will be important, especially at the national level: Mountain specificities such as particular resource endowments and services and their vulnerabilities must be taken into account, as well as socio-economic inequalities between mountain regions and lowland areas. This calls for revisiting national policy priorities and for improving highland–lowland cooperation.

Source: [1]

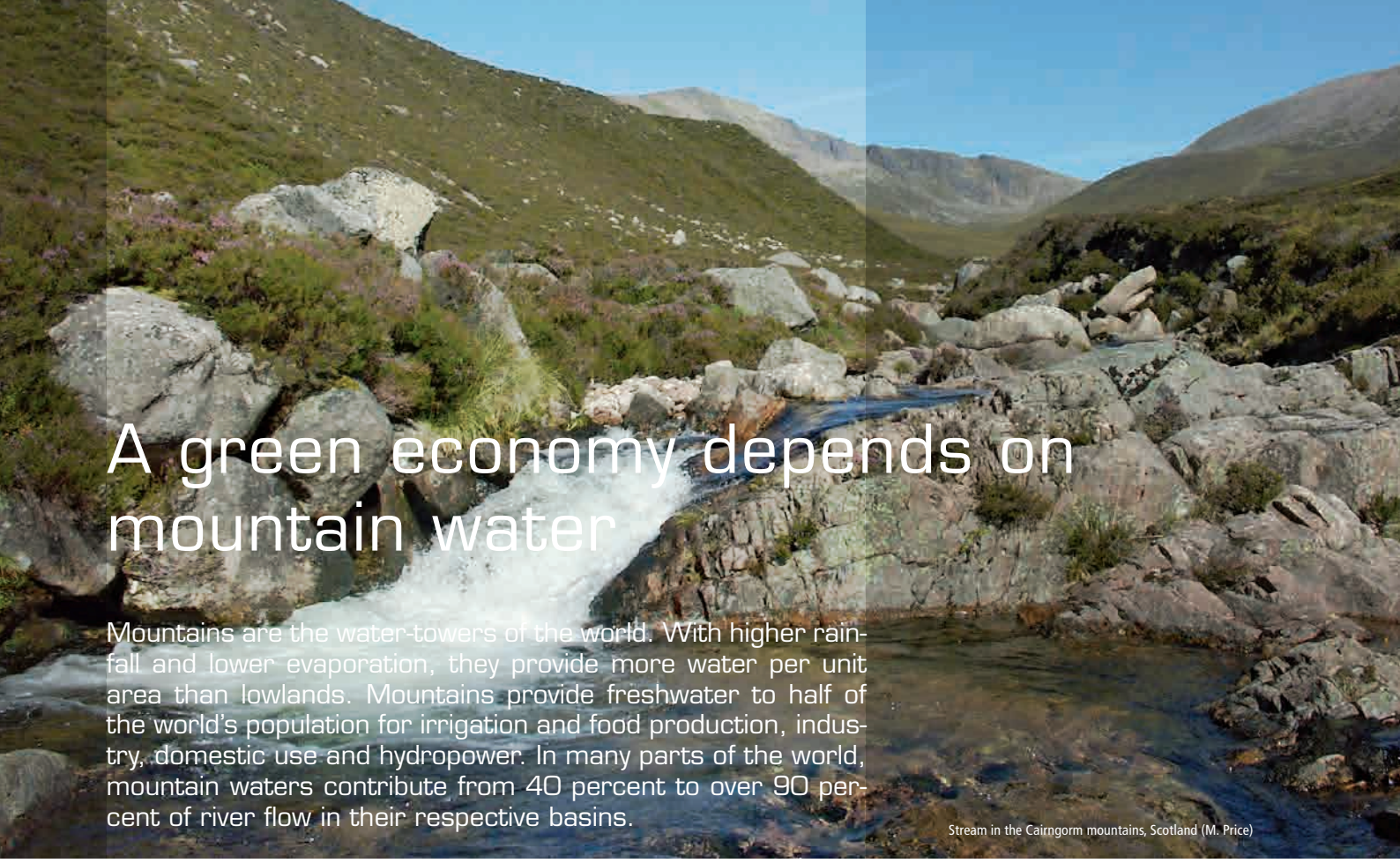
Box 1.2 | Legacies of the past: Environmental change and its drivers in the twentieth century

Human population	grew 4-fold
Irrigated land	grew 5-fold
Energy use	grew 13-fold
CO_2 emissions	grew 17-fold
Industrial production	grew 40-fold

"*Nothing like this has ever happened in human history. The mere fact of such growth, and its unevenness among societies, made for profound disruptions in both environment and society.*"

Source: [5]

Terraced fields in Siddhing, Kaski District, Nepal (S. Jaquet)



A green economy depends on mountain water

Mountains are the water-towers of the world. With higher rainfall and lower evaporation, they provide more water per unit area than lowlands. Mountains provide freshwater to half of the world's population for irrigation and food production, industry, domestic use and hydropower. In many parts of the world, mountain waters contribute from 40 percent to over 90 percent of river flow in their respective basins.

Stream in the Cairngorm mountains, Scotland (M. Price)

Mountain waters are critically important on every continent. In South Asia, Southeast Asia and southern China, about 1.3 billion people – close to 20 percent of the global population – depend on water from the Himalayas, Karakoram and Tien Shan massifs and from the Tibetan plateau. The Rocky Mountains, Andes, Atlas Mountains, the mountains of the Near East, Eastern and Southern Africa and around the Mediterranean are also among mountains that play a key role in regional and lowland water supplies, providing as much as 60–100 percent of the total [1].

The importance of mountain waters is shown by the wealth of past and present water infrastructure and governance systems that regulate the use of water in all parts of the world. Many installations and rules for water management relate to local contexts, but many have a regional and transnational reach and may involve intra- as well as interbasin water transfers and sharing arrangements, altering natural water regimes substantially for the benefit of overall development. California is a case in point: Interventions in the water sector since the late nineteenth century have been so massive that California has been called the most hydrologically altered land mass on the planet. On the other side of the Pacific, an estimated 1.3 billion people rely on the waters of the Hindu Kush Himalayas for domestic use, industry, irrigation and hydropower generation. The number of people depending on these waters will increase substantially over the next 20–30 years, as will the projects planned to serve the needs of these growing populations. China has a huge project under way for the transfer of water from the water-rich, mountainous part in the southwest to the drier, densely populated northeast – the country's breadbasket with Beijing, the capital. The project will link four of China's main rivers, among them the Yangtze and the Yellow River. It will require the construction of three major diversion channels with a total length of about 3 000 km, dams, tunnels and pumping stations, and the relocation of several hundred thousand people in its way. Total costs are twice as high as for the Three Gorges Dam

completed in 2006. India has its own plans for massive transfers of water from the Himalayan rivers in the north and east to the drier southern and western parts of the country. Both projects have been criticized for their social and environmental impacts [2; 3]. The contribution of such transfers to a green economy will depend on whether they are technically feasible, economically sound, socially equitable and ecologically sustainable. Mountain waters are also important for domestic and industrial use in more humid zones such as the eastern United States or western and central Europe, at least for the drier and warmer seasons of the year.

Box 1.3 | Mountain waters: high on the global agenda

The importance of mountains as headwaters and sources of water for the often densely populated surrounding lowlands has moved up on political agendas. In 2007, the United Nations (UN) General Assembly adopted Resolution 62/196 on Sustainable Mountain Development, stating that "The UN General Assembly notes with appreciation that a growing network of governments, organizations, major groups and individuals around the world recognizes the importance of the sustainable development of mountain regions for poverty eradication, and recognizes the global importance of mountains as the source of most of the earth's freshwater ..."

Source: [4]

Gullfoss, one of the many waterfalls in Iceland (E. Schneeberger)

Mountain waters for global food security and poverty alleviation

Global food security and poverty alleviation, let alone eradication, will not be achieved without an adequate flow of mountain water. Many of the intensively used lowland agricultural regions critically depend on mountain waters for irrigation for at least part of their growing seasons. In drier lowland areas where irrigation is needed for most of the growing season, this dependency can reach between 75 and 100 percent of water needs. Rivers which derive more than 90 percent of their annual flow from mountains can be found on every continent, including industrialized and developing countries (Figure 1.2). [1]

In Africa, for example, Egypt depends almost completely on the waters of the Nile when it comes to domestic food production. The country's 81 million people live on 1 percent of the country's territory in close proximity to the river. Nearly 100 percent of the Nile water in Egypt comes from the mountains of Ethiopia and around the Greater Lake Victoria Basin. Egypt has been called a gift of the Nile. In turn, the Nile can be seen as a gift of the mountains of the Horn of Africa and East Africa. In the United States, the Colorado River originates in the Rocky Mountains and is the principal water source for seven states. California, the eighth largest economy in the world and a leading agriculture and food producer, obtains the bulk of its water from various mountain systems including the Rocky Mountains, the Sierra Nevada and coastal ranges [5].

The countries of Central Asia – Tajikistan, Kyrgyzstan, Turkmenistan and Uzbekistan – with a combined population of around 50 million, depend entirely on waters from the Tien Shan and Pamir mountains for their water supplies, economic development and largely irrigated food production. In Pakistan, the Indus River generates 23 percent of its gross domestic product (GDP). It feeds one of the largest irrigated areas in the world, which ensures the food supply for the country's more than 180 million people, most of them living in the lowlands; 80 percent of the water that feeds this irrigation system comes from the mountains and forelands of the Hindu Kush Himalayas. Northwestern India relies on the waters of the Ganges and

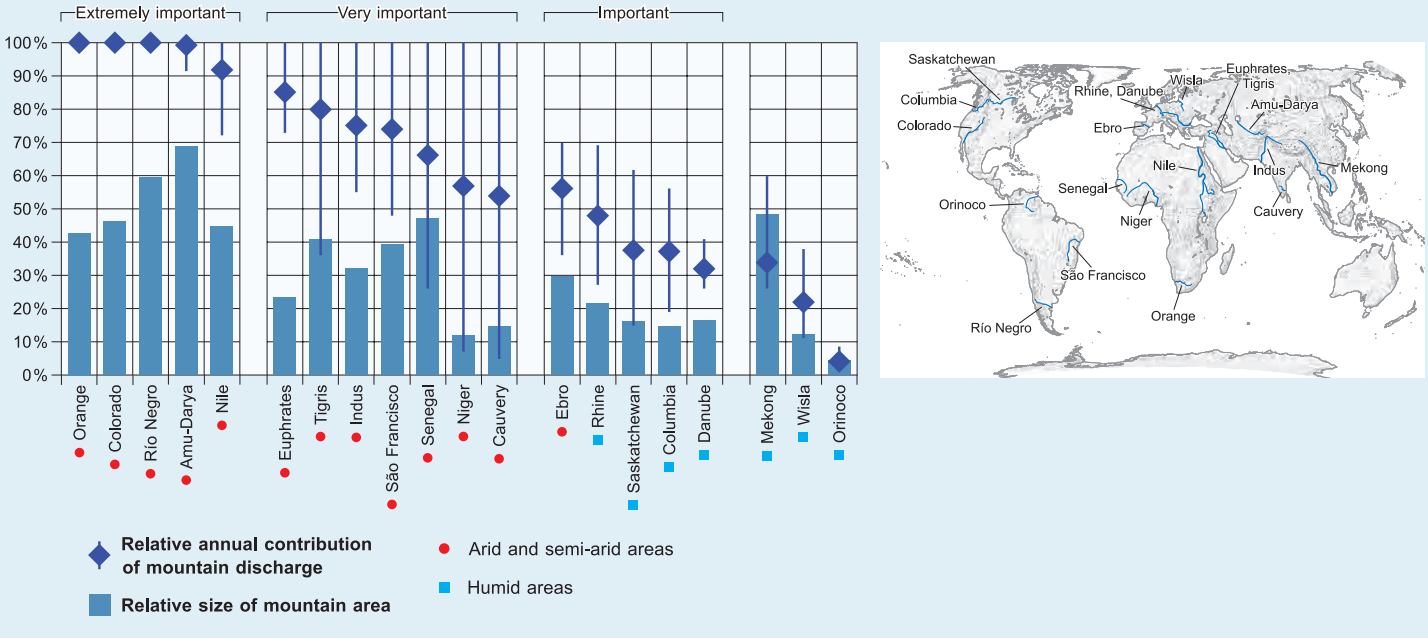


Figure 1.2: Contribution of mountain area to total discharge, and size of mountain area as compared to total basin area for selected rivers worldwide.
Source: Adapted from [6]

Irrigation in the foreland of the Tien Shan, Kyrgyzstan (C. Hergarten)

Indus tributaries from the same mountain range for irrigation and food security [1]. In Pakistan, India, Nepal and Bangladesh irrigation has continuously expanded over recent decades. Since 1965, it has risen by 60 percent in Pakistan, more than doubled in India and increased almost fifteenfold in Nepal [7] (Table 1.1). As a result, about 90 percent of water withdrawals are now used for irrigation in the countries of South Asia compared with a global average of 70 percent [8]. Water demand for irrigation is thus likely to rise in this region in future, also because possibilities for expanding the area for rainfed agriculture are almost exhausted.

As mentioned before, China also depends to a large extent on the waters of the Hindu Kush Himalayas and other mountain areas for irrigated food production, industry and hydropower. In Africa, single mountains such as Kilimanjaro or Mount Kenya provide water for millions of people living in their vicinity. Throughout the Andes, populations concentrated in coastal areas, including large urban centres such as Lima, depend entirely on water from the mountains.

Table 1.1: Expansion of irrigation in South Asia 1965–2002. Source: [7]

Expansion of irrigation 1965–2002 in countries of South Asia								
	Bangladesh		**India**		**Nepal**		**Pakistan**	
	1965	2002	1965	2002	1965	2002	1965	2002
Irrigated area in 1 000 ha	500	4 510	25 500	57 180	80	1 135	11 140	17 810
Irrigated land as % of total arable land	6	56	16	35	4	36	63	83

Figures rounded.

Nairobi, East Africa's largest city, depends on mountain water (N. Harari)

Mountain waters for an increasingly urbanized world

Today, just over half of the global population lives in urbanized areas – a proportion that will continue to increase. Many of these urban areas critically depend on mountain waters for a large part of their freshwater supplies. This is especially true of the millions of people living in towns along the eastern and western coasts of the Pacific Ocean, in the foreland of the European Alps and along the Mediterranean coast and its hinterland. Many of the world's largest cities on all continents depend on mountain waters. Examples include Rio de Janeiro, New York, Jakarta, Tokyo, Delhi, Los Angeles, Barcelona, Nairobi, Addis Ababa, Melbourne, Bogotá, Lima, La Paz, Quito and Mexico City. Sustainable development that aims to eradicate poverty, provide green jobs and increase well-being for all those living in these urban areas and in many others, is simply not possible without a reliable supply of freshwater from mountain areas [9].

The challenges of more efficient water use

Demand on water resources for irrigation and food production, industrialization, hydropower generation and urbanization is increasing, caused by economic development and population growth. The added pressure from effects of climate change will be greatest in semi-arid regions and in the monsoon belts, especially during seasonal deficits previously mitigated by water supplies from mountains. These changes will give new impetus to the construction of dams and water transfer systems, as shown above by the examples of India and China.

In a world of growing water scarcity it is urgent to improve our knowledge of present and future mountain water resources and freshwater supplies. This necessitates

Taking stock of water resources, Mongolia (HP. Liniger)

investment in long-term high-altitude observation, especially in the developing world, where the density of data is much lower than recommended by the World Meteorological Organization [10]. The current trend of closing down monitoring networks to save operating costs must thus be reversed. However, while monitoring is essential, it is not enough. Public and free access to data on water resources must be improved, and current restrictions imposed for strategic reasons must be reconsidered. Investment in infrastructure, technology, international collaboration and a shift in water management from the supply side to the demand side will be necessary to manage water resources sustainably and share them equitably.

The above looks at a world in peace. But current geopolitical security discussions are rife with concerns regarding the potential for conflict over water within and between states as populations grow, economies expand and water demands increase. Contrary to expectations, history provides many examples where countries have been able to come to terms over water uses and rights. Since the early 1950s, 37 acute international disputes relating to water have occurred, mostly in the Near East, while 150 treaties were signed worldwide over the same period [11]. Nevertheless, the potential for conflict over water might increase in future, and mountains as water-towers will likely be at the epicentre of problems. Appropriate technologies and new institutions might be needed at all scales, from local to international, in order to share mountain waters peacefully for the benefit of all.

Water, war and peace

"If there is a political will for peace, water will not be a hindrance. If you want reasons to fight, water will give you ample opportunities."

Source: [12]

The potential of mountains for greening the energy sector

Mountains have a key role to play in greening the world's energy sector by providing renewable energy – especially in the form of hydropower, but also solar, wind, geothermal and biogas power. Hydropower provides 16 percent of all electricity worldwide and is by far the most widely used form of green energy, representing over 80 percent of green energy currently produced [1].

Lake Grimsel with dam, Switzerland (M. Price)

Hydropower

While industrialized countries have harnessed most of their potential, developing countries are currently using only a small share of theirs. The situation in mountain countries – countries with over 50 percent of their land in mountain areas – highlights this exploitation gap. For example, Switzerland has developed 85 percent of its potential. Most of the large dams are in the Alps, where the four major regions (i.e. the cantons of Valais, Grisons, Bern and Ticino) generate over two-thirds of annual hydropower and 80 percent of the electricity used during peak hours [2]. Other industrialized countries like Norway and Japan have developed close to 90 percent of their potential. In contrast, China as a transition country has developed just over 30 percent; Tajikistan and Kyrgyzstan less than 10 percent; and Ethiopia, Nepal and Bhutan between 2 and 7 percent [3].

With their relative abundance in water resources, mountain regions are likely to play an increasingly important role in hydropower generation in future. In many places around the globe, this future has already begun, especially in transition and developing countries. Endowed with the largest potential worldwide, China is prioritizing hydropower in its new energy agenda and aims to increase its capacity from 230 GW in 2012 to 270 GW by 2015 and 330 GW by 2020 [4]. This will result in a massive highland–lowland energy transfer, since more than two-thirds of the hydropower resources are located in the mountains and uplands of the southern and western parts of the country, while the users are found in the densely populated coastal areas and plains of the north and east.

On the southern side of the Himalayas, developments are equally massive. India is developing its hydropower capacity within the framework of its national "50 000 MW Initiative", with the aim of increasing the share of hydropower in the national energy mix and reducing dependency on energy imports. Again, energy transfers

from mountains and highlands to the plains are at the core of the initiative. The mountainous states in the north are seen as the country's powerhouse of the future. In the mountains of Himachal Pradesh, for example, the installed hydropower capacity is planned to be increased threefold between 2007 and 2017, from 6 000 MW to 17 000 MW, and the number of large hydropower plants from 22 today to 47 [5].

Smaller countries are no less active in developing their potential. Bhutan, with the support of India, plans to increase its capacity by a factor of eight by 2020, from currently 1 500 MW to over 11 000 MW [3]. In Lao PDR, where 14 dams are currently in operation, over 100 dam projects for hydropower generation are in various stages of planning, most of them in the mountains and uplands. If these plans materialize, they would lead to the relocation of over 100 000 people, or 2.5 percent of the rural population, 47 percent of them poor [6; 7]. Nepal also plans to expedite investments in hydropower to harness its unexploited potential. Most of the future electricity production will be exported to neighbouring countries: India in the case of Bhutan and Nepal, and Thailand and Viet Nam in the case of Lao PDR. The same pace and pattern of development appears in Africa and in South America. In Africa, plans to increase hydropower production are ambitious, especially in countries with a higher share of mountain areas, or with water from mountain regions. The countries of the Nile Basin are a case in point (Table 1.2).

Table 1.2: Current and future hydropower capacity in African countries. Source: [8]

Country	Currently installed capacity (MW)	Planned additional capacity by 2040 (MW)
Rwanda	85	174
Burundi	45	407
Tanzania	562	3 487
Kenya	750	486–686
Uganda	630	4 368
Ethiopia*	1 840	16 188

*Excluding Renaissance Dam

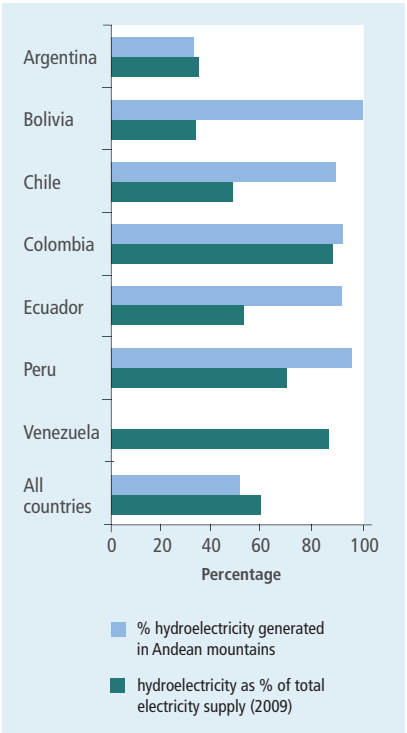
Ethiopia has significant untapped water resources: Blue Nile Falls, Bahar Dar, Ethiopia (V. Roth)

A dam in the Colombian Andes: Hydropower accounts for approximately 60 percent of the total electricity supply in Andean countries (C. Devenish)

In South America, Bolivia is working with Brazil on a huge facility of close to 4 000 MW capacity in the Amazon region. The mutual dependency resulting from such collaboration may give rise to increasing cooperation or conflict, and possibly both. For the Andean states, mountain regions are the powerhouses of hydroelectricity generation. In Bolivia, 100 percent of the country's hydropower is generated in the mountain regions; in Chile, Colombia and Peru, the share of mountain hydropower is about 95 percent. Ecuador follows in fifth place, generating about 85 percent of its hydroelectricity in the mountain regions [9] (Figure 1.3).

In the industrialized world, hydropower is increasingly being reconsidered as a source of energy for the future, marking a policy shift away from fossil fuels and nuclear energy prompted both by the climate debate and the Fukushima nuclear disaster. In Switzerland, for example, the Federal Office of Energy has identified 14 new sites for hydropower generation, most of them in the mountains, including sites in protected landscapes of national importance. Austria and Germany are also opting for renewed hydropower development, also in the mountains. As these countries, like many others in the industrialized world, have harnessed most of their potential, there are indications that the issue of safe and clean energy supplies might in future overrule other green agendas such as the conservation of protected landscapes. In common with other development projects, large water projects illustrate that trade-offs rather than win-win situations are proving to be the rule in the pursuit of greening the economy within the framework of sustainable development.

Figure 1.3: Hydropower generation in the Andean countries. Source: [9]



Controversial large hydropower schemes

Large-scale hydropower development has been a controversial issue in recent decades in the industrialized as well as the developing world, fuelled by the debate over its environmental and social costs and the question of who would benefit from the energy generated. Hydropower development has disrupted livelihoods and habitats through loss of land, siltation and involuntary displacement of populations without adequate compensation, rehabilitation or prospects of alternative livelihoods, often leading to increased or new poverty, especially among minority groups. In mountain regions, the impoundment of large water reservoirs has also created a special risk of induced seismicity in susceptible regions, including greater risk of earthquakes, dam ruptures and flash flooding. Finally, large-scale dam projects have frequently incurred substantial cost overruns and have been notoriously troubled by large-scale corruption [10].

Although global standards for large-scale hydropower development have been established (Box 1.4), they must be adhered to and their application enforced and monitored, before such schemes can be supported as a pathway to advancing green energy generation. As private investors increasingly overshadow public bodies and international donors, the need for incorporating the guidelines instituted by the International Finance Corporation (IFC) of the World Bank will become even more important. Experience shows that, if developed well, hydropower facilities can have multiple benefits as multipurpose water infrastructures (Box 1.5). Apart from providing clean energy, they can support water conservation, irrigation, help manage floods and droughts, and improve water allocation across a complex set of users [11]. They can be a source of income for mountain regions if these receive a share of the tariffs collected from concessions and of the proceeds of power sales, or if industries and services emerge in the wake of hydropower development – in short, if downstream benefits are shared with mountain regions and peoples by arrangements that really improve mountain livelihoods.

Toktogul reservoir, for hydropower and irrigation, Kyrgyzstan (HP. Liniger)

Box 1.4 | Seven principles to guide large dam development

Large dams have become a synonym of development and progress in the last 100 years. Globally, construction peaked in the 1970s, when two or three large dams were commissioned daily somewhere in the world. By 2000, there were more than 45 000 such dams in over 140 countries [10]. As their number increased, so did the debate on their costs and benefits. The main issues were dam economics, environmental impacts, disruption of livelihoods, relocation of people and neglect of their rehabilitation after displacement.

Summarizing this debate, the World Commission on Dams, in a global report published in 2000, proposed seven principles that should guide large dam construction in future. These principles build on international recognition of human rights, the right to development and the right to a healthy environment, as follows:

(1) Gaining public acceptance by recognizing rights, addressing risks, safeguarding the entitlements of affected groups, in particular indigenous groups and ethnic minorities, and ensuring that decision-making processes enable informed participation;

(2) Assessing options broadly, including alternatives to dam construction, and assigning the same significance to social and environmental aspects as to economic and financial factors;

(3) Optimizing existing dams with regard to their technical potential, as well as to social and environmental issues;

(4) Sustaining rivers and livelihoods by avoiding undesirable impacts and mitigating harm done to the river system and the people who depend on it;

(5) Recognizing entitlements and sharing benefits, with states and facility developers responsible for ensuring that dam projects improve the livelihoods of all affected people, and with accountability ensured through legal means such as contracts and the possibility of legal recourse;

(6) Ensuring compliance during planning, construction and operation of a dam, through a regulatory framework that includes incentives and sanctions; and

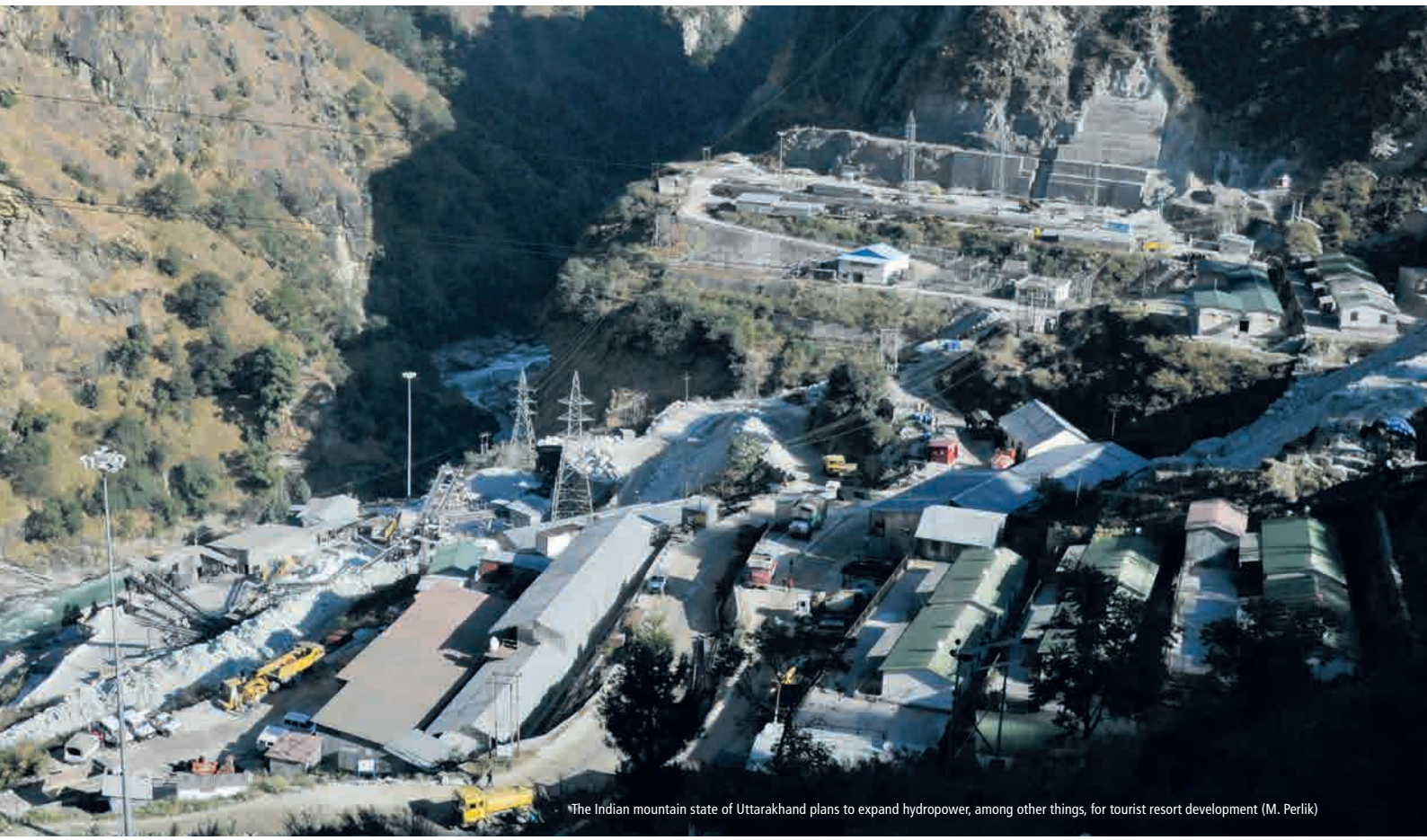
(7) Sharing rivers for peace, development and security, especially in the world's 263 transboundary rivers, by inviting states to cooperate in joint management instead of appropriating rivers.

Source: [10]

Box 1.5 | Moving towards more sustainable hydropower development: the Nam Theun-2 dam, Lao PDR

For the Nam Theun-2 dam and hydropower scheme in Lao PDR, 6 300 people from 15 villages had to be relocated. In an evaluation study carried out one year after completion of the facility, 87 percent of the resettled people said their situation was better than before resettlement. Key for this positive response was a comprehensive compensation arrangement, which in addition to relocation helped rebuild the livelihoods of the people resettled. Under the auspices of the World Bank, the private investors of the power facility from France and Thailand invested millions of US$ in this compensation scheme, which also included mitigating social and ecological effects of the dam. The scheme led to a series of laws and regulations that also apply to future projects. In the words of a World Bank representative: "At the end of the day, a sustainable hydropower project needs a responsible investor with a long-term view, and a government willing to monitor implementation and compliance with such laws and regulations."

Source: [7]



The Indian mountain state of Uttarakhand plans to expand hydropower, among other things, for tourist resort development (M. Perlik)

The merits of small hydropower

Small hydropower schemes have shown their value for providing green electricity, especially in mountain areas with their complex topography and dispersed settlements. The electricity is used for lighting, pumped irrigation and telecommunication, and as motive power for appliances and small industry. Small schemes are low-carbon/low-cost, less environmentally damaging than large projects and can be independent of grids. If a grid is available, excess power can be fed into it to create additional income through feed-in tariffs. Small hydropower schemes generally do not involve displacement of people. If embedded in a regional development framework based on sustainability considerations, competition for water between upstream and downstream uses and ecological damage can be prevented or minimized.

There is abundant experience relating to installation and management of small hydropower schemes in many mountain areas worldwide (Box 1.6). China leads the world in large- as well as small-scale hydropower development. By the end of 2006, the country had established about 40 000 small stations mostly in the mountainous west of the country. With close to 30 000 MW, their aggregate capacity was higher than two Three Gorges schemes, benefiting more than 300 million people living in economically underdeveloped regions. Based on over 50 years of experience in the country, small-scale hydropower development in China forms part of an integrated development approach that increases its effectiveness. It includes an array of different funding schemes; construction of local grids; cost-effective equipment produced domestically; trained human power for construction and management of the power plants; and, importantly, promotion of rural industries run on electricity [1].

Small hydropower as seen by a buddhist monk, Nepal (Courtesy ITECO)

Nepal and Pakistan have rich experience in developing small hydropower facilities in the Hindu Kush Himalayas with community involvement in planning, construction and operation. They also have an industrial base that produces the electrical and mechanical equipment and the in-country expertise to install it, thereby adding value by providing a variety of green jobs in the secondary sector. In the remote mountain areas of Northern Pakistan, for example, small hydropower schemes were introduced in the 1990s, supported by community-based initiatives by non-governmental organizations such as the Aga Khan Rural Support Programme. By 2005, the Programme had built 240 small plants with a total capacity of more than 10 MW. A Clean Development Mechanism project was registered in 2009 to construct 103 new plants with a total capacity of 15 MW [12].

Box 1.6 | UN system supports small-scale hydropower development

UNIDO, the United Nations Industrial Development Organization, is currently implementing small-scale hydropower projects in China, India, Indonesia, Sri Lanka, Zambia, Tanzania, Uganda, Kenya, Nigeria, Ghana, Rwanda and Mali. The agency is also developing a large umbrella programme with a focus on South–South collaboration, to establish about 100 small hydropower projects in Africa between 2012 and 2014, and replicate them in other regions such as South America and Asia. Technical support is provided by the International Centre for Small Hydro-Power (ICSHP) in China [13].

Small-scale hydropower is much less controversially discussed than large-scale hydropower. Its merits extend across all three dimensions of sustainability:

Environmental merits: Replacing fossil fuel-based power generation with hydropower leads to a reduction in greenhouse gas emissions. Biodiversity loss is also reduced, as there is less deforestation, degradation of natural habitats and related loss of rare plant and animal species threatened by excessive cutting of wood and shrubs for cooking and heating in cold seasons.

Economic merits: Small-scale hydropower provides rural households with electricity for both domestic and productive applications, including motive power for milling, small enterprises and other needs. It creates opportunities for expanding livelihood options and for poverty alleviation, through value-added services in agricultural production, farm-forestry products, local industry including handicrafts, and tourism services. It also helps communication with the wider world in supporting the spread of television, computers and mobile phone networks. Experience in rural areas of Nepal has shown that per-household kerosene consumption declined substantially following the installation of small hydropower schemes. Time spent by women for fuelwood collection decreased by half [14]. Small-scale hydropower also generates significant savings at a national level by eliminating the need for national power utilities to construct expensive transmission lines to remote or topographically difficult areas such as mountain regions.

Social merits: Electrification reduces the drudgery of women and children carrying fuelwood and provides night-time lighting. Reduced use of fuelwood and kerosene also means less indoor smoke pollution and related respiratory diseases, and lower incidence of in-house fires. Electrification has made it easier to carry out labour-intensive domestic activities such as washing clothes, as pumped water is more readily available.

A proven option for mountain development with a large potential for scaling up

Based on experiences across the mountain world, small-scale hydropower development appears to be an ideal option for remote mountain regions where human populations are scattered and difficult terrain makes it costly to extend and maintain a national grid. Public funds can be leveraged to raise community equity, in addition to funds from capital and carbon markets. The ownership of smaller units can be community-based, whereas larger units can be designed to operate as formal power utilities, providing economic gain, infrastructure improvement and environmental protection. The potential to scale up is substantial, if supported by enabling government policies and incentives, for example by building and maintaining local grids and allowing local investors and community organizations to generate and be paid for clean hydroelectricity which they feed into such grids. In many countries, policies on rights to exploit local water resources for hydropower are either non-existent or ambiguous. Widespread policy reform as well as mechanisms for dealing with competing water uses will be needed to effectively exploit the potential of small hydropower schemes.

Wood is the dominant source of energy for the majority of mountain people – in this case in Tajikistan (B. Wolfgramm)

More green energy options

In addition to hydropower, there are many other green energy pathways for mountain regions. Biogas has proven effective in regions as diverse as Nepal and Peru; improved wood stoves contribute significantly to household energy needs in many countries; and wind and solar installations are in operation in mountain ranges from Appalachia in the United States to the Tien Shan mountains of Central Asia.

There are many options for the use of solar energy in mountain areas (Figure 1.4). Mountains with dry climates, especially in subtropical and tropical zones, are among the regions with the highest solar energy potential per unit area worldwide. Examples include the Andes in Bolivia, Peru and Ecuador; Northern Mexico; the mountains and uplands of South Africa and the Horn of Africa; and the Arab Peninsula. Solar power is also an option for mountains beyond the tropics and subtropics. With values between 1 600 and 2 200 kWh per m^2, Tibet has one of the highest levels of annual solar radiation per unit area in East Asia [15]. The Southern Rocky Mountains in the United States and the Alps in Switzerland also benefit from higher solar radiation than their lowland surroundings. Lighting and cooking with solar-powered home systems has been successful in many mountain areas where isolated solutions are more cost-effective than centralized ones because of remoteness, difficult topography and low population densities. Solar power also has great potential for telecommunications, television, radio and computer operation; almost all remote airports and telecommunication facilities in Nepal, for example, are powered by solar energy. The use of solar energy is not limited to power generation. Solar water heaters are used in many mountain areas for producing warm water for use in homes, tourist lodges or small enterprises. Space heating using passive solar building technologies such as insulation has been used to retrofit buildings in Central Asia, Tibet Autonomous Region of China and Ladakh, India.

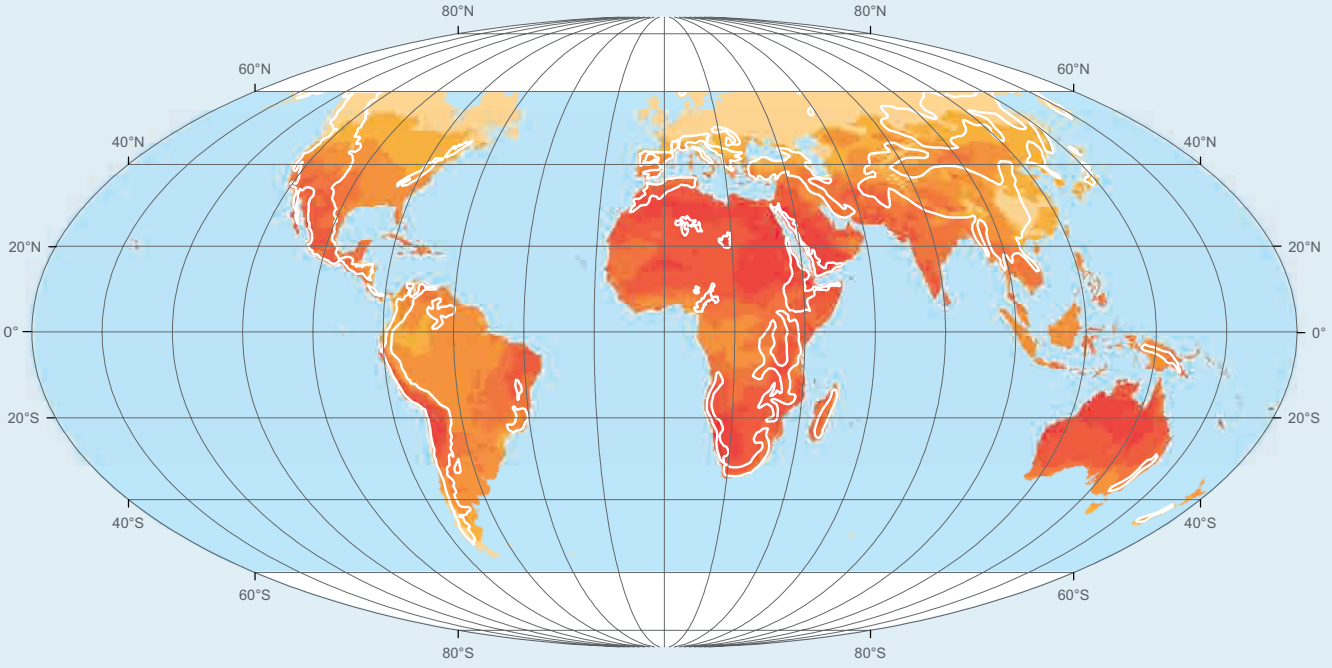
Geothermal energy is used in parts of the world, and mountain regions are important centres of production. Cases in point include the Philippines, Iceland and El Salvador, where geothermal plants produce 25 percent or more of electricity. Also in the United States, the highest geothermal capacity is in the mountainous west, especially in California, where more than 40 geothermal plants contribute about 5 percent to the state's electricity production [16].

More efficient stoves for greening mountain livelihoods

When discussing the potential of new alternatives for power generation, it is important to recall that the large majority of the mountain population – at least 650 million people – live in the mountains of developing countries, where the greatest source of energy by far is woody biomass. Improved access through road construction, increased incomes through remittances from migrants and availability of alternative fuels for cooking and lighting have decreased dependence on wood fuel in many places, but wood remains the dominant energy source especially in most countries of Africa and many in Asia, where it meets more than 80 percent of total energy requirements [8; 17]. The effect of high altitude means that people in mountains require more wood for cooking and heating than those living at low altitudes. In the Hindu Kush Himalayas, for instance, per capita fuelwood consumption by people living at altitudes above 2 000 m was found to be 2.6 times higher than that by people living below 500 m, mainly due to the need for space heating at higher altitudes [18]. As a result, wood for cooking and heating is becoming increasingly scarce in many mountain areas.

There are ways to reduce or alleviate this problem, though. The Aga Khan Development Network, for example, engaging in a programme for increasing energy efficiency in northern Pakistan, installed fuel-efficient stoves with chimneys, water heaters and wall and floor insulation, in close collaboration with local communi-

Figure 1.4: Global potential for solar power generation. White lines indicate mountain areas.



Map sources:
Meteotest, Meteonorm 7.0, July 2012
Map projection: Mollweide
Map compilation: Elias Hodel, Thomas Kohler
CDE, University of Bern, November 2012

ties. By 2007, the programme had reached 27 000 mountain households, benefiting about 250 000 people in close to 300 villages. The products were built by local artisans. The programme has improved the well-being of households while at the same time reducing the regional carbon footprint. It thus represents a significant contribution to greening local livelihoods: Biomass consumption was reduced by up to 60 percent, saving 100 000 tonnes of wood and preventing annual CO_2 emissions of 160 000 tonnes. Lower in-house air pollution has led to an improvement in villagers' health, especially that of women and children. In turn, lower expenditure on fuel and health has led to a rise in household disposable income by 25 percent on average [19].

Similar programmes have been established by governments and civil society organizations in many developing countries over the last decades. There are dozens of stove models devised to serve the specific needs and demands of their local users, including aesthetic and cultural aspects. Many of these models are in use in mountain areas in such diverse countries as Peru, Nepal, Kenya, Kyrgyzstan, Ethiopia and Eritrea. In Eritrea, a government-led programme supported by external donors has been successful in establishing several thousand stoves in the country's highlands. The stoves reduce fuel consumption by 50–60 percent, which is important in these areas where forests cover less than 1 percent of the land, and where people have resorted to using dung for fuel, thereby burning fertilizer that could otherwise be used to improve the fertility of the land and hence food security. In-house air quality and human health have also improved – and so has the status of the women. In the words of one local woman: "We are no longer looked down upon when travelling by bus to the market in town because our clothes smell of smoke" [20].

Improved stoves save up to 50 percent of fuel – here in Kyrgyzstan (HP. Liniger)

Enhancing and securing mountain ecosystem goods and services

Across the globe, a number of benefit-sharing mechanisms have been developed over the last decades. These mechanisms aim to compensate populations for resource management practices that maintain or enhance important ecosystem goods and services.

Cotopaxi (5,897 m) in Ecuador is considered the world's highest active volcano (C. Devenish)

Mechanisms vary widely according to political, social and environmental conditions as well as the ecosystem services and goods in question. Compensation can include financial as well as non-financial benefits such as access to better educational or health facilities. Financial compensation is referred to as Payments for Environmental Services (PES). Currently, compensation schemes typically take into account three main ecosystem services: provision of water; conservation of biodiversity; and reduction of carbon emissions from deforestation and forest degradation (REDD, and REDD+ if payments aim to enhance forest carbon stocks).

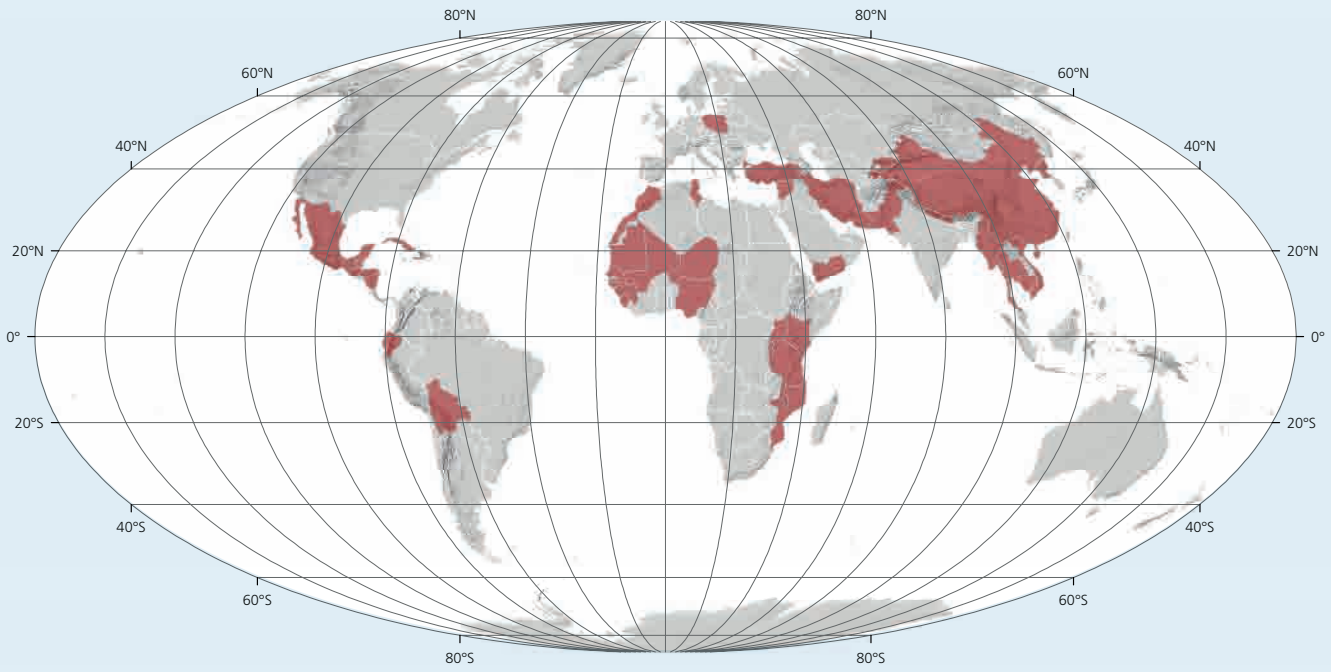
Provision of water and watershed management

Since mountains play a crucial role in the supply of freshwater, securing this resource is critical for all aspects of development. Watershed management is a tool to achieving this end. In many parts of the world, humankind has altered water flow and terrain since ancient times to support cultivation of crops, reduce erosion, secure the provision of water and control floods. Today, most national governments address watershed management through policies and concrete measures in different sectors, often combined with compensation for specific land management practices for securing ecosystem services. On the international development agenda, watershed management appeared in the 1970s. It moved to centre stage in Chapter 13 of Agenda 21, in which the promotion of integrated watershed development and alternative livelihood opportunities was one of the two main programme areas. Many countries and numerous national and international agencies, including UN institutions, bilateral donors, non-governmental organizations and research institutions have since engaged in watershed management programmes, typically in mountain regions or highland–lowland contexts.

With its UN mandate for food security and agricultural development, FAO, for example, has been engaged in watershed management since the 1970s. Together with other UN agencies, governments, non-governmental organizations and research institutions, and across its technical departments, FAO supports countries through its normative work, field programmes and support in international policy processes. Since the 1992 United Nations Conference on Environment and Development in Rio, FAO has implemented 53 field projects in 45 countries in Asia, Latin America, Africa, the Near East and Europe (Figure 1.5). Of these, 17 were mountain watershed projects, benefiting over 60 000 people. This figure seems low in light of the scale of the problem but the programme also supported norm setting and the generation and sharing of experience and expertise across a wide range of sociopolitical and ecological systems worldwide. In general, the projects combined measures in local resource management such as afforestation or terracing with activities for improving local livelihoods and with policy advice, for example in the field of national legislation.

The need for technical assistance, institutional support and policy advice related to watershed management is likely to increase in future, as is the need for monitoring outcomes. Experience shows that it is crucial to link natural resource management with activities that improve local livelihoods and with work at the policy level, including issues of good governance, decentralization and specific sector policies. A common impediment to effective management is that government jurisdictions, and also social and cultural divisions, frequently do not follow watershed boundaries. The inclusion of key stakeholders concerned by a specific watershed programme across administrative, sectoral and sociocultural boundaries is important.

Figure 1.5: Countries with FAO projects related to watershed management implemented since 1992



Soil and water conservation structures for watershed management, Eastern Amhara, Ethiopia (T. Lemann)

Old approach	New approach
Integration of socio-economic issues within watershed management programmes	Emphasis on watershed natural resource management as part of local socio-economic development processes
Focus on "local people's" participation, with an emphasis on bottom-up, participatory planning	Focus on multistakeholder participation, linking social, technical and policy concerns in a pluralist, collaborative process
Programme design overestimates central government capacity to enforce policies, and lacks institutional arrangements at the local level. Short-term planning and financing	Programme design adjusts to local governance processes and includes new forms of governance (associations of villages/municipalities within watersheds). Long-term planning and financing
Implementation by "heavy" institutional set-ups, such as donor-assisted programmes for government watershed authorities	Implementation by "light" institutional set-ups such as watershed management fora, consortia and associations, with authorities playing a facilitating and subsidiary role
Focus on short-term effects. Small-scale projects with little watershed or basin-level coordination	Focus on upstream–downstream linkages and long-term impacts. Local-level processes coordinated at the watershed or basin level
"Quick-and-dirty" participatory assessment and evaluation (e.g. participatory rural appraisal), with little or no linkage to natural and social evidence	Dialogue between local and scientific knowledge in "fairly-quick-fairly-clean" action research processes, involving a variety of stakeholders
Belief that access, tenure and social conflicts in watersheds can be solved by technically sound interventions	Awareness that most access, tenure and social conflicts in watersheds are rooted in society and politics and must be managed through negotiation

Table 1.3: Old and new approaches to watershed management. Source: [1]

Payments for Environmental Services (PES)

Ecosystem services are benefits people obtain from ecosystems. They include provisioning services such as food and water; regulating services such as flood control; cultural services such as sacred places; and supporting services that maintain conditions for life on earth, such as nutrient cycling and many others [2]. Payments for environmental services (PES) offer incentives, generally financial, to farmers or other resource users for managing their resources in a way that a desired flow of ecosystem services is provided [3]. PES schemes achieve this aim by a system of conditional payments to voluntary providers [4]. However, a range of critical points must be solved for a workable PES scheme (Box 1.7).

Box 1.7 | Elements of workable PES schemes

- Clear definition of the environmental services to be provided, as well as solid understanding of the market where these services will be sold
- Clear and consensual evidence of the link between land use and service provision
- Acceptable value assigned to environmental services, based on sound economic analysis and extensive consultation with beneficiaries
- Payments high enough to compensate the costs to land users, but acceptable to beneficiaries
- Payment mechanisms designated to deliver monetary and non-monetary benefits such as infrastructure or capacity development for land users
- Low transaction costs through collective negotiations and contracts that guarantee equity (i.e. solid cooperative institutions and local associations)
- Low transaction costs and effective monitoring of compliance and provision of services
- Stable and continuous flow of revenues to ensure long-term sustainability of the system, including access to start-up financing
- Establishment of a governance structure that oversees, gathers and manages the funds from beneficiaries

Adapted from: [5]

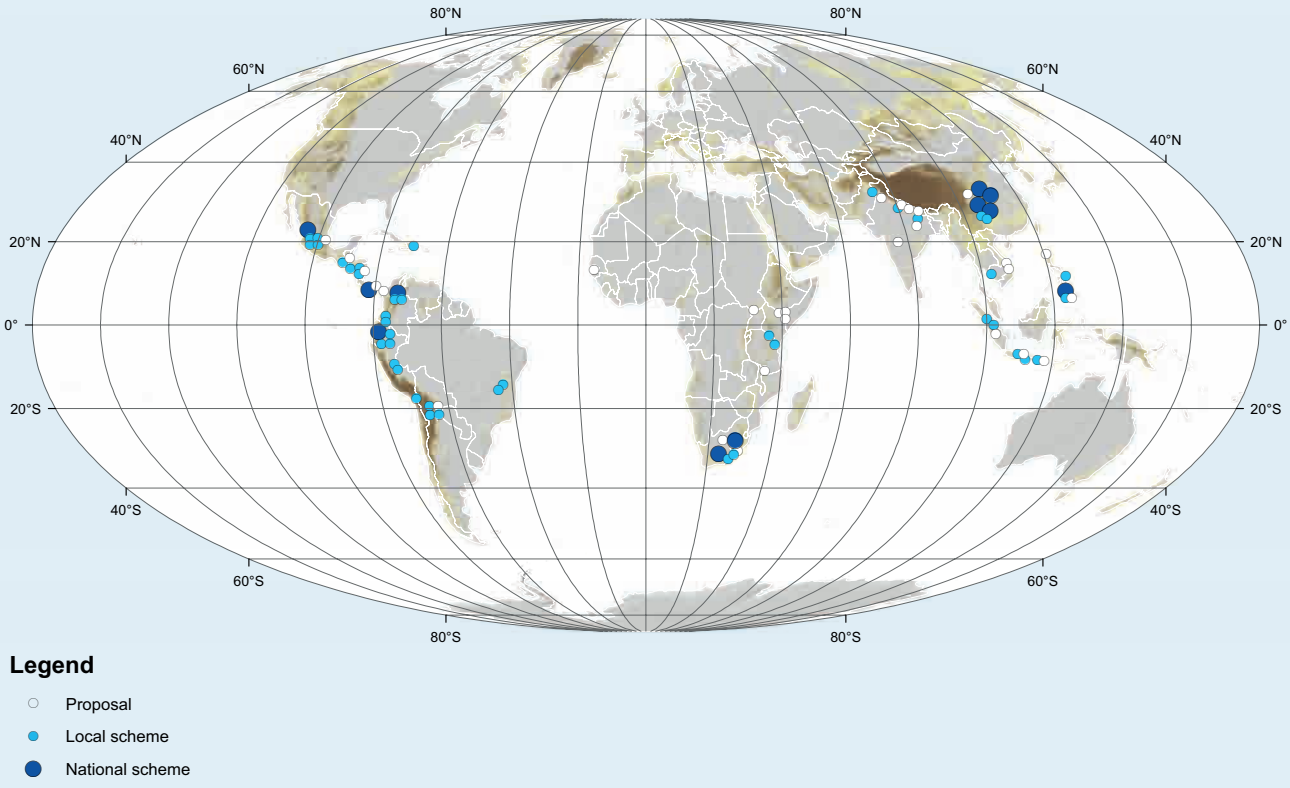
Environmental goods and services are generally perceived as public goods, meaning that their value is not expressed in monetary terms. This leads to an economic imbalance between downstream beneficiaries and upstream providers of these goods and services. But above all, there is no market for them which would set prices on which to orient payments. Mechanisms to identify and valuate these services in monetary terms and to compensate mountain communities for their provisioning have thus to be developed and put in place. In many industrialized countries, compensation takes the form of subsidies or direct transfer payments. Generally, these are not based on an economic valuation of the services sought after, but on general welfare criteria such as a desirable level of income. Where such mechanisms are not affordable, as in many developing countries, PES schemes offer an alternative. Ideally, the value assigned to environmental services is based on economic analysis of the value of a service, as well as on consultation with service providers and service users.

Payments for Environmental Services: the example of Watershed Services (PWS)

Payments for Watershed Services (PWS) schemes feature prominently among PES initiatives, which is not surprising given the importance of mountain waters (Figure 1.6). PWS schemes provide payments for watershed services, with the ultimate goal of securing a reliable supply of clean water. Payments come from different sources such as direct water users, local and national governments and the international community. What sets PWS apart from a classic conservation and development approach, such as watershed management, is its conditionality: Service providers sign a contract agreeing on specific activities in exchange for a payment, which can be in cash, in kind or a combination of these. NGOs have often played a lead role in the design, preparation and implementation of PWS projects and programmes [6].

A considerable body of experience exists on how PWS programmes should be established and operated so that they are successful and sustainable, mostly from South and Central America. The PWS programmes in Costa Rica have garnered 12 years of experience at national level. In these programmes, payments come largely from hydropower facilities and breweries [7]. Proposals for national programmes in Panama and El Salvador have met with resistance, but many small-scale initiatives are emerging in the region. The water fund in Guatemala, for example, has engaged several beverage companies and irrigation groups. In 2011, water fund representatives conducted negotiations with hydroelectric and agro-industrial companies, with support from Worldwide Fund for Nature (WWF) and CARE. Mexico began payments for hydrological services in 2003, and since then has included other services as well. The programme has established a monitoring system based on change in forest cover using geographic information systems and satellite technology [8].

Figure 1.6: Global mountain regions and countries with Payments for Watershed Services schemes (map by Ina Porras, IIED; mountain areas by CDE, University of Bern)



Box 1.8 | Payments for Watershed Services help secure water for Quito, Ecuador's capital

Ecuador's capital Quito receives its water supply from the Andean mountains, in particular from two ecological reserves in the mountains (Cayambe-Coca and Antisana Reserves), which are inhabited by 27 000 people. Both areas are used for agriculture and livestock grazing, which threaten the quality and quantity of water available for drinking, irrigation and power generation downstream.

In 1999, the water users of Quito through the municipal government and the hydroelectric companies agreed with private and state conservation organizations to create a fund that collects a water consumption fee from water users to support environmentally friendly land use practices and reforestation in the ecological reserves upstream. The goals of the programme are to maintain stream flow and water quality and to protect biodiversity through appropriate land use practices. The municipality and its partners collect the money and either undertake compensation measures themselves or pay upstream landowners for proper land use.

The fund is managed by an asset management company; decisions are made by a Board of Directors, which is made up of representatives of the creators of the fund and private and public users of the watershed. The fees are calculated based on the costs of patrolling the reserve. About 1 percent of the revenue from hydropower generation and water use fees goes into the fund.

Source: [9]

In Asia, China has the largest government-led programmes for environmental services: By 2008, China had a total of 47 programmes, with many overlaps in terms of aims and regional extent, but mostly including PWS components. Payments have grown from an estimated US$1 billion in 2000 to about US$7 billion in 2008, covering 270 million hectares. Most of these payments are for forest-related activities, including the Sloping Lands Conservation Programme, which converts cropland into forests and is the largest land retirement programme in the developing world. Other programmes are dealing with grassland improvement, mainly in

Quito, Ecuador (O. Chassot)

African mountains are the continent's water-towers: Mount Ruwenzori seen from the Ugandan side (T. Kohler)

the mountain regions in the West. Yet other programmes aim at reducing the risk of dust storms that affect the densely populated northeastern parts of the country including Beijing and Tianjin, but these are less concerned with mountain areas [8; 10].

South and Southeast Asia has been a key player in ecosystem service initiatives, although few larger ones have been implemented. One example is the IFAD-supported RUPES programme (Rewards for Use of Shared Investment in Pro-poor Environmental Services) [11], which works largely in mountain areas in Indonesia, the Philippines, Viet Nam, India and Nepal. The region has been at the forefront of PWS research and tool development. For example, the Rivercare Project in the Bukit Barisan mountain range in Indonesia links rewards to measured sediments, creating a whole set of experiences in community monitoring and ecosystem service delivery.

There is plenty of interest in PWS schemes in Africa among the international community. The World Agroforestry Centre has created an African counterpart to RUPES, concentrating on the East African Highlands. The Global Environment Facility (GEF), the World Bank and other donors have promoted several scoping studies, including the Green Water Credits scheme in Kenya. The longest experience on the continent so far has been gained with the Working for Water scheme in South Africa, and a few pilot schemes in Tanzania and in Kenya. Overall, however, a majority of schemes still await implementation [8].

Extensive soil conservation for watershed management in the Loess Plateau, China (HP. Liniger)

Lessons learned from PWS

There are a number of challenges when it comes to planning and implementing PWS schemes. One of these challenges is targeting. Experience shows that it is generally easier for local schemes than for larger ones to target areas crucial for water supply. The need for improved targeting was also an issue in China, where experience from the Sloping Land Conversion Programme showed that 38 percent of the area converted from agriculture to forestry in Gansu Province was low slope area and hence at lower risk of causing erosion. Nevertheless, the conversion of 62 percent of high slope lands under this programme is an impressive achievement [8].

In general, it is easier to target point sources that are a threat to water supply, such as mining, industrial or timber operations. Addressing non-point sources such as farming is more difficult, and may entail a complex array of actions in livestock and pasture management, erosion control, selective logging and forest management, improved agriculture and careful building construction.

Two other concerns in PWS schemes are monitoring and sustainability. Most PWS monitoring is focused on contract compliance rather than on measuring ecosystem impacts – although there are important exceptions, such as the New York City scheme, which ties payments to water quality. Sustainability of the impact has been shown to be linked to the nature of the incentive: Low-value in-kind benefits were found to have better acceptance than low-value cash benefits, as recipients are more likely to view in-kind transfers as compatible with reciprocal exchange. Timing and payment periods can also affect permanence. In Costa Rica and Ecuador, farmers are now only requested to protect the forest for the length of their contracts; initial arrangements requesting protection for 20–99 years were rejected by farmers because they did not give them sufficient flexibility to adapt to changing personal circumstances [7; 8].

Robledal, Costa Rica (Montas)

REDD: Reducing Emissions from Deforestation and Forest Degradation

Mountain ecosystems and watersheds are important in global efforts for climate change mitigation, since 28 percent of the world's forests are located in mountain areas and most watershed projects include afforestation and management of forests [12]. Mountain watersheds thus have an important potential for carbon storage and sequestration, and should be considered for funding mechanisms such as REDD and REDD+ in developing countries. REDD stands for Reducing Emissions from Deforestation and Forest Degradation; REDD+ also includes enhancement of forest carbon stocks, mostly through afforestation (www.un-redd.org).

REDD is an important emerging tool for conservation and sustainable development. It corresponds to a PES scheme focusing on forests, using financial incentives to reduce greenhouse gas emissions from deforestation and forest degradation. The basic concept of REDD is simple: Since standing forests store carbon that can be measured and monetized, the monetized value of carbon can be used as an incentive for preservation. As with many other instruments, complexity emerges during programme implementation, particularly in ensuring that amounts of carbon are accurately measured, the rights of indigenous people are safeguarded and the transparent and equitable sharing of benefits from carbon sales is guaranteed. Additional complexities concern the selection of markets for selling carbon credits, with choices ranging from "sales" to donors, utilizing compliance markets or selling directly to corporations in capital markets. Further challenges arise from identifying appropriate monitoring tools to determine an agreed-upon and verifiable rate of deforestation that is prevented by REDD and not merely shifted to another area, which is essential for determining how much carbon can be sold.

Poverty alleviation is commonly considered to be an important and desirable side-effect of REDD schemes [13]. While this may be true in locations where population densities are low and forest areas abundant, REDD is not a panacea for fighting poverty at regional or country level. This was illustrated by a recent study in Laos which found that close to 60 percent of the poor live in areas with low carbon stock mitigation potential (Figure 1.7). The potential for combining carbon stock management with poverty alleviation is thus site-specific and has to be evaluated on a case-to-case basis. In general terms, poverty alleviation needs a specific and broader set of tools that include economic, sociocultural, political and infrastructural measures.

There is also a risk that the large offerings of lowland forests in countries like Brazil and Indonesia will capture the bulk of the opportunities that REDD provides. High mountain forests, even when carbon-rich and despite the other co-benefits in terms of biodiversity conservation, may be too small in scale to capture significant investor interest. Moreover, REDD schemes have until now limited their radius of action to forests. As stated above, other mountain habitats such as paramos, moorlands and agricultural and pastoral lands, if well managed, can also sequester significant amounts of carbon, but efforts to include them in REDD-like schemes is only at an incipient stage.

Despite these difficulties and limitations, REDD offers an additional opportunity for conservation and sustainable development. One of the major advantages of REDD is that the mechanism requires a minimum project life of 20 years – preferably, 30 years. This requirement for long-term commitment contrasts with the usual donor cycle of 3–5 years and is a more realistic time frame for creating lasting changes in difficult and remote environments, which are more likely to be areas with large tracts of intact forests.

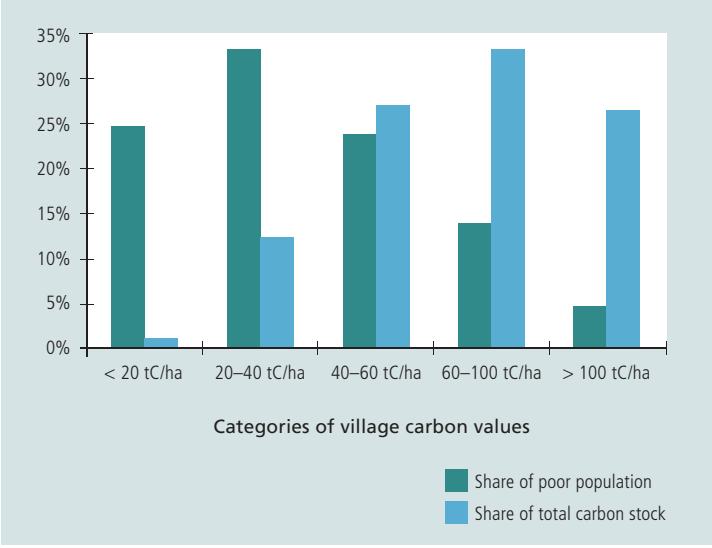


Figure 1.7: Shares of carbon stock and poor people in Lao PDR along a gradient of village carbon values. Source: [14]

Natural hazards, extreme events and climate change

There is evidence that many mountain regions have become increasingly disaster-prone in recent decades and that a disproportionately high number of natural disasters occur in mountain areas [1], causing damage, destruction, injury and death, and disrupting the flow of ecosystem goods and services on which a green economy critically depends. Mountains are more frequently affected than other environments by destructive natural processes such as earthquakes and volcanic eruptions; hazards such as avalanches and landslides occur almost exclusively in mountains.

Flood in Muminabad, Tajikistan, a hazard exacerbated by unsustainable land use upstream (HP. Liniger)

Susceptibility to earthquakes is due to the fact that mountains are often located in tectonically active zones [2]. On global average, 36 percent of non-mountain areas are susceptible to destructive earthquakes, but for mountain areas, this share is 55 percent; for the Andes it is as high as 88 percent and for the mountains of Southeast Asia, inhabited by almost half of the global mountain population, it is 71 percent [3]. An earthquake in Kathmandu, for example, could displace more than 1.8 million people, kill over 100 000 and injure another 300 000; 60 percent of buildings could be destroyed [4]. These figures may seem high, but the threat is real: In April 2015, an earthquake with a magnitude of 7.8 hit parts of Nepal, including Kathmandu. It killed thousands of people and rendered many more homeless. The destruction of buildings was extensive, also affecting historic sites, temples and monuments.

Moreover, relief and reconstruction operations in mountains are often hampered because roads and other important supporting infrastructure are lacking or were destroyed by the event. Human activity can also trigger hazards or exacerbate their impact. Forest degradation or removal, or inappropriate farming practices such as expansion of cultivation onto steeper slopes are cases in point, as are improperly constructed dams, roads or mining facilities. Encroachment of urban and rural settlement into risk-prone areas such as steep slopes or flood-prone valley bottoms can also have disastrous effects on local people, infrastructure and economies. At the same time, hazards and disasters can be seen as opportunities to promote development beyond reconstruction, sustain or even increase the flow of ecosystem services and move affected regions towards a greener pathway of development, benefiting upstream as well as downstream populations. The response to an earthquake in Pakistan exemplifies a case of development beyond reconstruction which is much in line with the tenets of green economy (Box 1.9).

Box 1.9 | After the earthquake: greening the mountains of Pakistan

In October 2005, an earthquake struck the mountain regions of northeastern Pakistan, affecting between 3 and 4 million people and killing over 80 000. The resulting flash floods in downstream areas caused hundreds of landslides and widespread destruction.

The relief and reconstruction programme that followed was a joint effort by civil society and international organizations as well as the government and the army. It included damage mapping, establishment of local Watershed Management Committees (WMCs), development of watershed management plans and implementation of prioritized activities. Prioritized activities included bioengineering (waddling, brush-layering and palisades) for stabilizing areas prone to or affected by landslides, forest regeneration and controlled grazing. Tree nurseries and fruit tree orchards were established to support local afforestation and improve local incomes. Institutional innovation was part of the programme: While before, the District Forest Offices did the planning and implementation of forestry-related interventions, these were now prioritized and planned by the WMCs, with the District Forest Offices providing technical support. The bioengineering methods for the stabilization of areas against landslides, an inherently green approach and found to be very effective, have the potential for replication and scaling up. The floods of July 2010 again created significant damage in the northeastern mountains. First assessments showed that the communities in the project area were better prepared to cope with this new disaster, and that flood damage was comparatively low.

Source: [5]

Outdoor class after destruction of school building in the 2005 earthquake, Chham, Pakistan (M. Zimmermann)

Changing snow and ice cover due to climate change will affect mountain waters – here a stream in the Peruvian Andes (S.-L. Mathez-Stiefel)

Mountains and climate change

Mountains are among the regions most sensitive to climate change, and the effects of this change are likely to be felt beyond mountain areas. Climate change will increase hazards linked to melting of glaciers and permafrost, such as rockfall, debris flows and glacial lake outburst floods that have the potential to affect people and infrastructure in mountains as well as in adjacent lowland areas. Effects are more far-reaching especially in regions where snow- and ice melt provide an important share of river runoff such as in Central Asia (Box 1.10 and Figure 1.8). Melting of glaciers in the Andes over the next few decades may lead to water shortages for millions of people in Argentina, Bolivia, Chile, Ecuador and Peru, where glaciers feed rivers, either seasonally or all year round. On the Pacific side of Peru, 80 percent of the water resources originate from snow- and ice melt in the Andes. In addition, climate change has shifted the timing of seasonal melting. At the same time, precipitation totals have not changed or tended to decrease, reducing the storage of frozen water in glaciers [6]. In the short term, increased runoff has caused greater water availability in some areas, while other areas have suffered from drought. This has led farmers to expand agriculture (and water use) into new high-altitude areas, and has provided water supplies for vast mining operations that cannot be sustainable in the longer term. Most troubling, drought has led to the increased use of high-altitude wetlands – paramos – for grazing, threatening the water storage capacity of these ecosystems.

While mountain glaciers have become an icon of global warming and climate change, changes in snowpack appear to have greater consequences for water supplies, especially in the northern hemisphere. In Switzerland, snowmelt contributes 40 percent to overall annual runoff, compared with 2 percent from glacier melt at the country level. Snow cover storage is projected to decrease by 20–35 percent

Box 1.10 | Glacier retreat and freshwater availability in the Tien Shan Mountains, Kyrgyzstan

The rate of glacier retreat in Central Asia has been among the highest in the world in recent decades. The countries of the region use the greatest share of their freshwater for irrigation; in the case of Kyrgyzstan, this share is 94 percent. Glaciers contribute 5–40 percent to annual runoff of the main rivers in their lower reaches, and up to 70 percent in their upper basins. River flow is characterized by major runoff in spring and summer, during which glacial meltwater accounts for much more of the river flow than the above annual figures suggest (Figure 1.8) and coincides with peak demand for irrigation water. In the short term, snow- and glacier melt might increase water flows during the critical summer months, sending a wrong signal to investors and water users in the region as, in the longer term, less water may be available once glaciers have disappeared. This is likely to affect economic development, specifically irrigated farming, food security and hydropower generation.

Source: [7]

by 2035, resulting in higher flows in spring, and lower flows in summer when the water is most needed [8]. In the Rocky Mountains and the rest of western North America, a widespread increase in rain over snow has been identified from 1949 to 2004. Less snow means reduced stream and river flows in spring and summer, and therefore less drinking water for towns and cities that derive 75 percent of their water supply from the snowpack. Earlier spring and warmer temperatures also mean longer summers, creating drier conditions for a longer period and increasing the hazard of wildfires. As the forests of the west account for 20–40 percent of the carbon sequestration in the United States, burnt forests will lose their function as carbon sinks for several years before they begin to recover; depending on local conditions, forests may not re-establish at all [9].

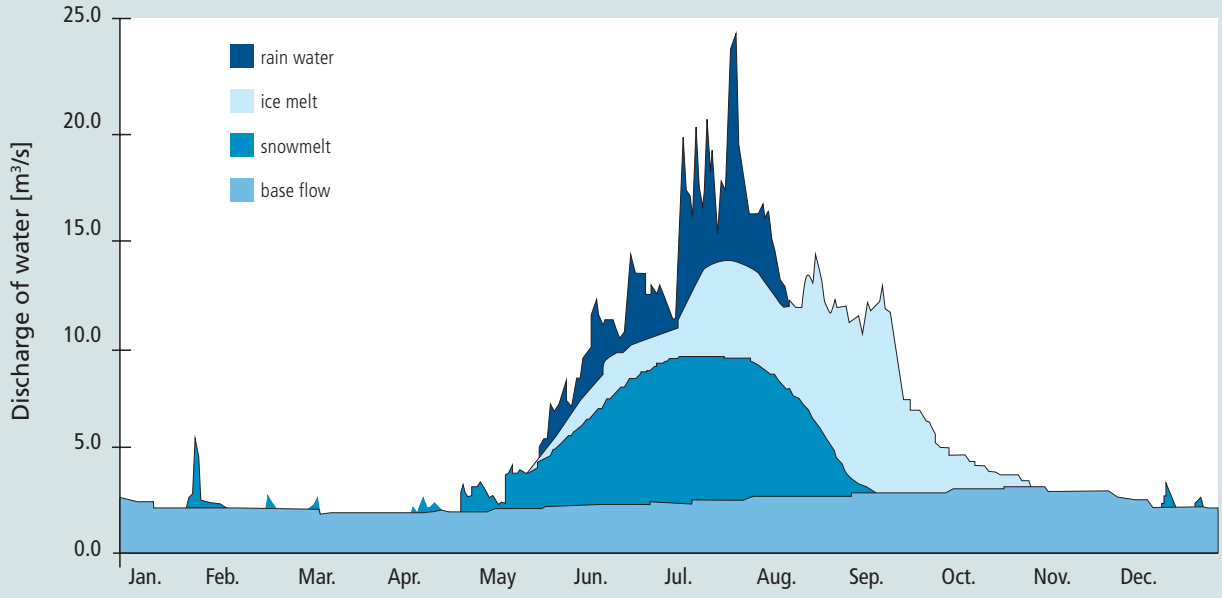
For the Hindu Kush Himalayas, current scientific evidence suggests that glacier retreat and the contribution of glacier melt to river discharge might be lower than indicated in the 2007 Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), and that the importance of glacier melt differs largely between and within the region's river basins. Glaciers feeding the Ganges and Brahmaputra do not provide a significant contribution to downstream annual discharge, as the summer melting period coincides with the monsoon rains, which provide a much larger volume of runoff [10]. Especially in the case of the Ganges River, overdraft of groundwater, more intense water use due to rising living standards, urbanization and industrialization are likely to have an earlier and much larger impact on water supplies than changes in the supply of glacial meltwater due to climate change [11]. For the Indus Basin, models suggest that glaciers provide a significant contribution to annual discharge in the lower reaches, because of persistent snow cover, a larger glaciated area at high altitudes, weaker monsoon rains and greater aridity at lower altitudes [12]. Overall, the Hindu Kush Himalayas span a large and complex region; in order to reduce current levels of uncertainty associated with the effects of climate change on river discharge, better data on high-altitude precipitation, quantification of the spatial variation in glacier and snowmelt, and regional climate models across different emission scenarios are needed [10].

Climate change will also have implications for mountain tourism, especially so in Europe and in North America. Due to rising snow lines, for example, the number of naturally snow-reliable ski areas in the European Alps will drop from about 600 to 400 under a 2 °C warming scenario [13]. Resorts at lower altitudes with a focus on winter tourism will thus have to rethink their portfolio.

Climate change projections: the paucity of reliable data

Climate change projections as well as the impacts of projected change vary greatly between different mountain regions. Even within the same mountain area, variations are considerable over very short distances owing to marked and complex topography and altitude. Change projections are therefore difficult to make; unfortunately, reliable long-term and high-altitude records that would allow verification of models are available only for very few areas such as the European Alps. Existing climate change models do not yet adequately represent complex topographies, especially for mountains in the developing world such as the Andes, the mountains of Central Asia and the Hindu Kush Himalayas [14]. For example, simulations for the Upper Indus Basin based on satellite imagery interpretation show that rainfall at high elevations may be over 2.5 times higher than the amounts recorded by the current rainfall stations located in the valley bottoms [15]. There is thus an urgent need to establish a long-term recording network along altitudinal gradients in the mountains of the South; to engage in transboundary collaboration and make climate and runoff data available across borders; and to develop more accurate regional climate models for these regions, for policy- and decision-making.

Figure 1.8: Discharge of Sokuluk River, Northern Tien Shan, Kyrgyzstan: Snow- and ice melt provide most of the flow during the dry summer months. How will climate change and disappearing glaciers affect the discharge? Source: [16]



Mountain agriculture is green agriculture

Worldwide, mountain agriculture already displays the traits of a green economy – often owing to circumstances rather than choice: Difficult topography makes it impossible to carry out industrialized, large-scale production that depends on extensive external input.

View of Pshav-Khevsureti Range from a ridge near Datvisdzhvari Pass, Great Caucasus, Georgia (M. Thibault)

Remoteness or lack of access mean use of fossil fuels, mineral fertilizers and pesticides is typically lower or less widespread than in lowland areas. Due to its small-scale character, mountain farming is overwhelmingly family-based, providing livelihoods and employment for millions of people. Moreover, mountains are hotspots of global biodiversity including agrobiodiversity [1], which mountain farmers and pastoralists help maintain. A large proportion of the world's most precious gene pools for agriculture and medicine are preserved in mountains. Of the 20 plant species that supply 80 percent of the world's food, six originated and have been diversified in mountains (maize, potatoes, barley, sorghum, tomatoes and apples) [2]. Coffee and tea, with their roots in Ethiopia and the Eastern Himalayan region, are also mountain crops that have found a global market. Potatoes, originating from the Andes, are the world's third most important food crop for human consumption after rice and wheat (Box 1.11). Because potatoes supply more food value per drop of water than any other major crop, they play an important role in the fight against hunger and poverty. Today, potatoes are grown in more than 100 countries – from Southern Chile to Greenland and from sea level to 4 700 m altitude [3]. Until the early 1990s, in addition to the Andes, the crop was grown mostly in Europe, the former Soviet Union and North America. Since then, production and demand have increased substantially, especially in Asia and Africa. In 2005, production in developing countries for the first time exceeded that in the developed world; in 2007, China and India alone produced one-third of all potatoes harvested at the global level. In the Andes, where the crop was originally domesticated, Peru has now created a register of native potato varieties with the aim of conserving the crop's genetic diversity, which is the building block for breeding new varieties for the world's evolving needs [3].

Box 1.11 | The potato story

The potato story begins about 8 000 years ago in the Andes, on the border between Bolivia and Peru. Research indicates that communities of hunters and gatherers who had first entered the South American continent at least 7 000 years earlier, began domesticating wild potato plants that grew in abundance around Lake Titicaca, 3 800 m above sea level.

Some 200 species of wild potatoes are found in the Americas. But it was in the Central Andes that farmers succeeded in selecting and improving the first of what was to become, over the following millennia, a staggering range of tuber crops. In fact, what we know as "the potato" (*Solanum species tuberosum*) contains just a fragment of the genetic diversity stored in the seven recognized potato species and 5 000 potato varieties grown in the Andes. Although Andean farmers cultivated many food crops – including tomatoes, beans and maize – their potato varieties proved particularly suited to the *quechua* or "valley" zone, which extends at altitudes between 3 100 and 3 500 m along the slopes of the Central Andes. Among Andean peoples, the *quechua* was known as the "zone of civilization". But farmers also developed frost-resistant potato species that survive on the alpine tundra at 4 300 m.

Source: [3]

Despite its green merits, mountain farming is not free of concerns. These include encroachment of monocultures in response to national and global market demand, as shown by the rapidly expanding rubber plantations in Southeast Asia; overexploitation of land resources due to population pressure; lack of economic alternatives; insecure land tenure; increased use of subsidized chemical fertilizers and pesticides; and loss of genetic diversity in agriculture crops. Many regions face the problems of rural outmigration, land abandonment and decay of key farm infrastructure such as terraces – a loss of cultural heritage with as yet unknown effects on the provision of environmental goods and services. Finally, mountain farmers and pastoralists are embedded in local communities, and the norms and

Peeling potatoes, Khumbu, Nepal (R. Garrard)

rules governing these communities may also set limits to change and innovations that might help improve the situation of farming households in mountain regions and retain green economy assets [4].

Strengthening mountain farming livelihoods

Successful approaches in supporting mountain farming livelihoods share important commonalities. Generally, they increase diversification – either by providing jobs in the industry or services sectors, preferably within commuting distance, or by identifying economically rewarding niches within the realm of farming. Often these niches consist of high-value products that link specific upland products to downstream urban markets. Examples include speciality fruits; off-season vegetables; wine, spices and medicinal plants; animal products such as cheese and honey; materials and clothes made from animal products; timber and non-timber forest products; and mountain crafts. There are many others, including services such as farm-based tourism. For a global overview of successful initiatives in promoting mountain niche products, see [5].

The potential of niche products from mountain areas can be illustrated by the Mountain Products Programme launched by FAO in 2003 with funding from the Government of France. Following a global survey, promising products were analysed and pilot projects carried out in selected mountain regions. These included the African mountains (coffee, macadamia and honey in the Mount Kenya region); the Andes (coffee and cheese in Peru); Central Asia (medicinal plants and honey in Kyrgyzstan); the Hindu Kush Himalayas (wild mushrooms, silk and handmade paper); and the Near East and North Africa (olive oil, saffron and rural tourism in the Anti-Atlas Mountains of Morocco). The pilot projects engaged governments, growers and private companies, with the aim of increasing production, processing and marketing. The programme also set up regional web-based knowledge platforms that provided information on products, policies and laws, and successful examples of engaging in higher-value markets [6].

Harvesting tea in the highlands of Kenya (HP. Liniger)

Preparing saffron for sale, Morocco (O. Migliore)

Promoting high-value niche products: saffron, medicinal plants and mohair

The saffron promotion programme provides an example of how the Mountain Products Programme worked. Also known as "red gold", saffron is an important source of income for approximately 3 000 smallholder farmers in the Anti-Atlas Mountains of Morocco, who sell the product on local markets as cash needs arise. The production of the crop is deeply embedded in local culture and constitutes an integral part of the local agro-ecological system characterized by fodder crops, vegetables and olive and almond trees. A project involving the Government of Morocco, FAO, a local NGO and saffron producers was initiated in 2006 to support this high-value product. Following market studies, the project started in 2008 with the goal of increasing mountain farmers' income by enhancing the capacity of saffron producers for safe storage; packaging and labelling; identification of niche markets; linkage to buyers; management of cooperatives; improved negotiation skills; and certification including organic, fair trade and origin-based product schemes. Upon conclusion of the project in 2009, saffron producers had improved the quality of saffron and, due to higher market prices, increased their incomes [6].

The potential of medicinal and aromatic plants in strengthening farming livelihoods can be shown in an example from Nepal, where poor mountain farmers harvest wild medicinal plants to earn enough to get through the harsh winters. Their practice is often unsustainable and has led to serious environmental degradation. Many organizations, governmental and non-governmental, have become engaged in improving medicinal plant collection and marketing. Since 2001, for example, the Mountain Institute, a United States-based NGO, has trained mountain farmers in the cultivation of medicinal and aromatic plants. At the start of the project, programme staff conducted a market survey, which helped establish demand, identify existing trade routes and traders, and reduce farmers' risk at the

Coca leave and flower offering to the Pachamama (Mother Earth), Pitumarca, Peru (S.-L. Mathez-Stiefel)

start-up stages of the project. Programme staff also interviewed farmers to understand their level of knowledge about the plants and their reproductive biology, to ensure some degree of familiarity with plants that were initially promoted for cultivation. This also helped reduce risks. As farmer confidence increased, cultivation of additional medicinal plant species was promoted to reduce risks of monocultures, unexpected disease and pest problems, and market fluctuations. Finally, working closely with government authorities, the programme introduced a government-approved system to certify that plants have been grown on private lands, which reduces taxation and allows local growers to retain more of the benefits. The potential of medicinal and aromatic plants for improving mountain farming livelihoods is also documented by a programme run by the International Centre for Integrated Mountain Development (ICIMOD) and implemented in Nepal and in Himachal Pradesh, Northern India from 2005 to 2009. The programme provided training in planting and domestication of plant material, and harvesting. It also advised on storage and processing, and supported marketing by facilitating the formation of cooperatives and the development of a certification mechanism. Programme monitoring suggests that improved production and better prices obtained for the produce have led to a 15–21 percent increase, on average, in household incomes depending on the project region [7].

Animal products also have much potential for strengthening mountain farming livelihoods. Native mountain ungulates like vicuñas in the Andes and the Tibetan antelope (*chiru*) produce some of the world's most valuable fibres, but overharvesting is a problem to be addressed. In the mountains of northern Tajikistan, Angora goat production and mohair marketing are vital for rural households. Yet, poor access to global markets and inadequate services threaten the long-term viability of the sector. A project of the International Center for Agricultural Research in the Dry Areas (ICARDA) that has trained women spinners in processing kid mohair into luxury yarns for export, and farmers in improving goat breeding and

Women's group spinning mohair for export, Tajikistan (L. Brent)

fibre quality, has greatly increased local income. For the rural women, spinning mohair into yarn is the most important source of income. For historical reasons, Russia still buys over 70 percent of Tajikistan's mohair produced by adult goats. But Russia has no processing capacity for the kid mohair used for luxury yarns and textiles that are highly prized on the world market. The isolation of rural Tajik women effectively cuts them off from these markets. And unlike farmers in South Africa, Australia and Argentina, they are not supported by breeding and extension services and have no marketing infrastructure. The project started in 2006 with the aim of adding value along the entire market chain. To begin with, livestock scientists worked with farmers to create breeding goats that produce finer mohair. Farmers learned how to manage their flocks, improve feeding regimes and keep the animals in good condition. The project collaborated with local and international breeding experts to create breeding nuclei on selected farms, which then sold or lent the animals to other farmers. The project also tested mohair samples and evaluated mohair based on international standards, and linked the farmers with local spinners' groups willing to pay higher prices for quality mohair.

Professional knitters in the United States tested samples of the yarn and provided feedback to the Tajik women. While quality yarn takes longer to produce than the yarn the women had made before, it can be sold for a much higher price. Women were taught how to knit items such as shawls and sweaters that sell well on global markets – an eye-opener for the women, as they had never seen high-quality yarn or luxury goods before. Producing for the Russian market, they made US$4 per kg from spinning mohair into yarn, but US$52 when producing fine yarn for the United States market. The Tajik women now train women from other areas in Tajikistan and from Iran, and are receiving further training in how to set up businesses to expand their nascent cottage industry. This will involve linking women's groups with buyers in the United States and Europe, and setting up ordering and shipping systems [8].

Grazing sheep, Great Caucsus, Georgia (M. Thibault)

From mountain farms to urban supermarkets

In Peru, the International Potato Center with funding from the Swiss Agency for Development and Cooperation, the Ministry of Agriculture, indigenous producers, retailers, processors and supermarkets have worked together to develop and market a line of native potatoes in Lima, the country's capital and largest urban market with a population of 9 million. Launched in 2004, the initiative packs and markets specially selected Peruvian native potatoes under the brand name T'ikapapa. It aims to put native potato varieties onto urban markets and thus create new business opportunities. The project has helped boost the income of about 500 farming families from the high plateaus of the Peruvian Andes, who now receive 30 percent more for their potatoes. Today, two Lima supermarket chains sell the potatoes that are supplied by the farmers' organizations and sold under the T'ikapapa label [9]. The vast majority of potatoes in Peru are cultivated above 3 800 m where other crops cannot grow. However, potato consumption has decreased as consumer preferences have shifted to imported rice and noodles. This has hurt the incomes of potato producers in mountain communities, many of which are food-insecure. T'ikapapa cultivation was established to increase and stabilize the incomes of potato farmers; alleviate rural poverty in mountain areas; raise consumer awareness about the nutritional value of native potatoes, for example by encouraging people to eat bread that includes potato flour; and promote food security by relying on domestic products. The government has acted also by reducing costly wheat imports.

The promotion of mountain products can also be successful in industrialized countries, especially if retailers and supermarkets are engaged. For example, Coop, one of the large retailers in Switzerland, has launched a product line called Pro Montagna ("for the mountains"). Initiated in 2007 with 23 products, the line grew rapidly with over 200 products in 2013, mostly in the food segment. Mountain regions benefit in three ways from product sales: First, the raw material must originate from the mountains, which brings income to mountain producers. Second, processing and production must take place in the mountains so as to retain value added in the mountains. Third, a share of the selling price, declared on the package, flows back to mountain regions in support of concrete local development projects (www.coop.ch/promontagna). In 2011, Pro Montagna sales reached a total of CHF 32 million (US$35 million), 7 percent up from the 2010 figure. This generated some CHF 840 000 (US$900 000) for investment in mountain development, mostly in upgrading farm houses, stables or local infrastructure [10].

Rangelands and pastoralists – forgotten realms in mountain development

Rangelands cover 40–50 percent of the world's land mass. They support the livelihoods of over 200 million pastoralists often living in poverty [11]. In mountain regions, rangelands cover extensive tracts of land, with a total area much larger than that of cropland [12]. In industrialized countries, mountain rangelands are managed by ranches or by systems combining crop and hay production in lower zones with summer grazing in upper zones. In most parts of the world, though, mountain rangelands are managed by pastoralists, especially in Asia – from Turkey and the Caucasus in the West; to Iran, Afghanistan and Central Asia; and Western China and Mongolia in the East.

While ranching and combined systems have their own challenges (Box 1.12), pastoral systems have all been exposed to rapid and fundamental change in recent decades, relating to the availability of resources, management, marketing and institutional settings. The harsh mountain environment forces pastoralists to make specific husbandry and management choices to cope with seasonal contrasts in resource availability. They adjust their use of resources seasonally and vertically, by using alpine high-altitude pastures in summer and lowland pastures in winter, and by storing fodder for winter. Mountain pastoralists may choose to minimize costs to ensure their animals' survival through the winter without necessarily giving priority to sales maximization, especially in remote areas where access to markets is limited. They face high uncertainties due to weather extremes such as drought and severe winters as well as natural hazards that can devastate herds, land, dwellings and infrastructure like roads and bridges that connect remote pastures (Box 1.13).

Box 1.12 | Challenges of mountain ranching in Colorado, United States

Mountain ranchers in Colorado have intensified their husbandry practices. Hay cropping has been supported by advanced irrigation systems and winter pasture management to maintain their livestock. Nevertheless, with time, access to water became more limited because of tighter regulations following the privatization of water resources or environmental legislation. As a result, smallholders sold their ranches, joined cooperatives or diversified their sources of income. Mountain ranchers in Colorado have adjusted by marketing more attractive and environmentally responsible products while offering on-farm recreational services.

Source: [13]

Box 1.13 | Mountain pastoralists – a precarious livelihood

Pastoralists in the Altay Mountains of Hovd Province in Mongolia face recurrent drought and extreme winter events (called *dzuds*). Animals having endured a drought in summer are usually unfit to withstand such harsh winters. During socialist times, animal losses were compensated by the state. Today, herding is a private business activity with climate shocks borne by the herders themselves. Even where assistance is available, it fails to reach remote areas when routes are blocked by snow. Currently, various schemes are opening up in Mongolian mountains and steppes with the aim of diversifying income opportunities for herders. Many of these schemes are based on carbon payments.

Source: [14]

Although mountain pastoralists' resilience to climate variability and natural hazards is high, their capacity to adapt to today's rapid changes is limited. Their exposure to these changes, coupled with a lack of awareness of the merits of pastoralism in the wider world, are important drivers of their marginalization [15]. Increasing demand for meat in emerging and developing markets, tenure systems geared to settled agriculture, changes in the expectations of pastoralists' children and demands for supplying educational, health and modern amenities are profoundly affecting pastoral systems and can provoke localized overgrazing and land degradation. This reaffirms those voices in policy and development circles who perceive pastoralism as environmentally harmful, unproductive and obsolete in a modern world.

But mountain pastoral systems deliver substantial societal benefits [16]. They supply regional markets with high-quality meat, dairy products and wool. They also make productive use of marginal lands barely suitable for other uses, typically with low external inputs and hence with a green mode of production. They provide substantial landscape services valued by a growing tourism industry. Under proper grazing regimes, pastoral systems preserve plant biodiversity, build up carbon in soils and prevent soil loss. Mountain pastoralists are also the custodians of indigenous breeds that play an essential role for food security, agrobiodiversity and poverty alleviation [17].

The green economy offers mountain pastoralists an array of opportunities, including financial mechanisms that reward good practices in land management. While the potential of these mechanisms is widely exploited in industrialized countries, it is only just emerging in the developing world. Globally, there is an increasing number of voices convinced that the future of mountain ecosystems is directly related to the well-being of pastoralists because they can safeguard the aesthetic values of these landscapes and make a difference with their sustainable use. Appreciating these roles is the first step towards helping pastoralists cope with the changes to which they are subjected.

Greening industry and mining

Mountain economies are undergoing a rapid transition from traditional agrarian to more service and industry-based economies. Over the past several decades, mountain regions have been integrated into the global economy through the global mining boom, urbanization, increasing demand for timber products and the growth of mountain tourism.

The Grasberg Mine, Papua New Guinea (Courtesy Rio Tinto)

In many remote areas, primary resource extraction often generates the highest economic returns for mining and timber companies. However, these returns fail to account for the environmental and social costs of extractive operations as well as the unequal distribution of benefits derived from primary resource production as shown in the Andes, the Appalachian Mountains, the Tien Shan and the uplands and mountains of Southeast Asia (Figure 1.9) and Oceania (Box 1.14). Extractive industries have been held up for centuries as the worst-case examples of "how not to do" green economic development in mountains. Clear-cutting of timber has caused widespread landslides, soil erosion, water contamination and flooding in areas as disparate as Indonesia and Alaska. Large-scale mines were – and many will remain for centuries to come – infamous for the devastation they have caused to local communities, ecosystems and cultures.

Large mining operations pose significant challenges for development largely due to their extensive environmental and social impacts, and the recent expansion of global mining activities. Rapid growth of mineral prices as of the early 1990s spurred a surge in mineral prospecting across the mountain ranges of the planet. Aided by the development of new refining technologies, the use of massive earth-moving machinery and open-pit mining, operations are now able to profitably extract minerals from very diffuse ores that were not economically viable in the past. Mountain environments are generally more suitable for these types of mining activities because mineral deposits are often exposed or closer to the surface and therefore require less overburden removal. Large mining companies often excavate billions of tonnes of earth during the average life of a mine, which can last for several decades.

Artisanal mining based on cooperatives, Potosi, Peru (G. Bill)

The environmental impacts of most large-scale mining operations are often extensive, largely due to the enormous size of many open-pit mines and the volume of earth excavated over the course of the operation. Large-scale mining activities thus generate long-term and persistent negative environmental impacts on surface water resources and subterranean aquifers through generation of toxic acid mine drainage and release of heavy metals and sediments. In addition, tailings failures, landslides and atmospheric releases of wind-borne contaminants also pose significant downstream risks. Even so-called "artisanal" mining can cause extensive damage to water sources due to unregulated storage and use of heavy metals such as cyanide, arsenic and mercury.

The social impacts of mining can be similarly extensive due to the scale of most mineral extraction operations. Open-pit mines require large amounts of land; water for ore processing; and extensive energy and transportation infrastructure to support mine operations. These requirements frequently lead to the displacement of large numbers of people. Acquiring access to sufficient water resources and the necessary land and water rights from governments and local communities is often contentious. In addition, while mining companies do create new employment opportunities in local communities, most physical labour has been replaced by massive machinery in large-scale mining, meaning that employment growth is much lower than during previous periods of mineral expansion. Social tensions are often exacerbated when there are fewer employment opportunities than local communities expect. Overall, the past decade has seen a significant increase in social conflicts related to the expansion of mining in mountain areas: In Peru, for example, such conflicts have increased more than 300 percent.

Other social impacts of mining include risks to human health through exposure to environmental contaminants and mine safety incidents. Human health risks from

exposure to toxic heavy metals and other contaminants can be severe and very long-term. A recent World Health Organization study [1] conducted in Peru suggests that approximately 1.6 million people in the country have been exposed to lead contamination from several centuries of mining. In terms of mine safety and accidents, the drama of mine rescues from Chile to China in recent years emphasizes the continuing dangers to local miners, for whom mining is often the only job available.

Historically, most mining operations have left behind environmental degradation and ghost towns in the familiar "boom–bust" cycle that has long typified this industry. "Mountain top removal" in America's Appalachian range exemplifies this process. Massive explosions and huge machinery literally remove entire mountain tops to reach the coal seams underneath. The overburden is dumped into adjoining valleys and streams, causing permanent damage. When the coal deposits are depleted, companies simply move on to the next location.

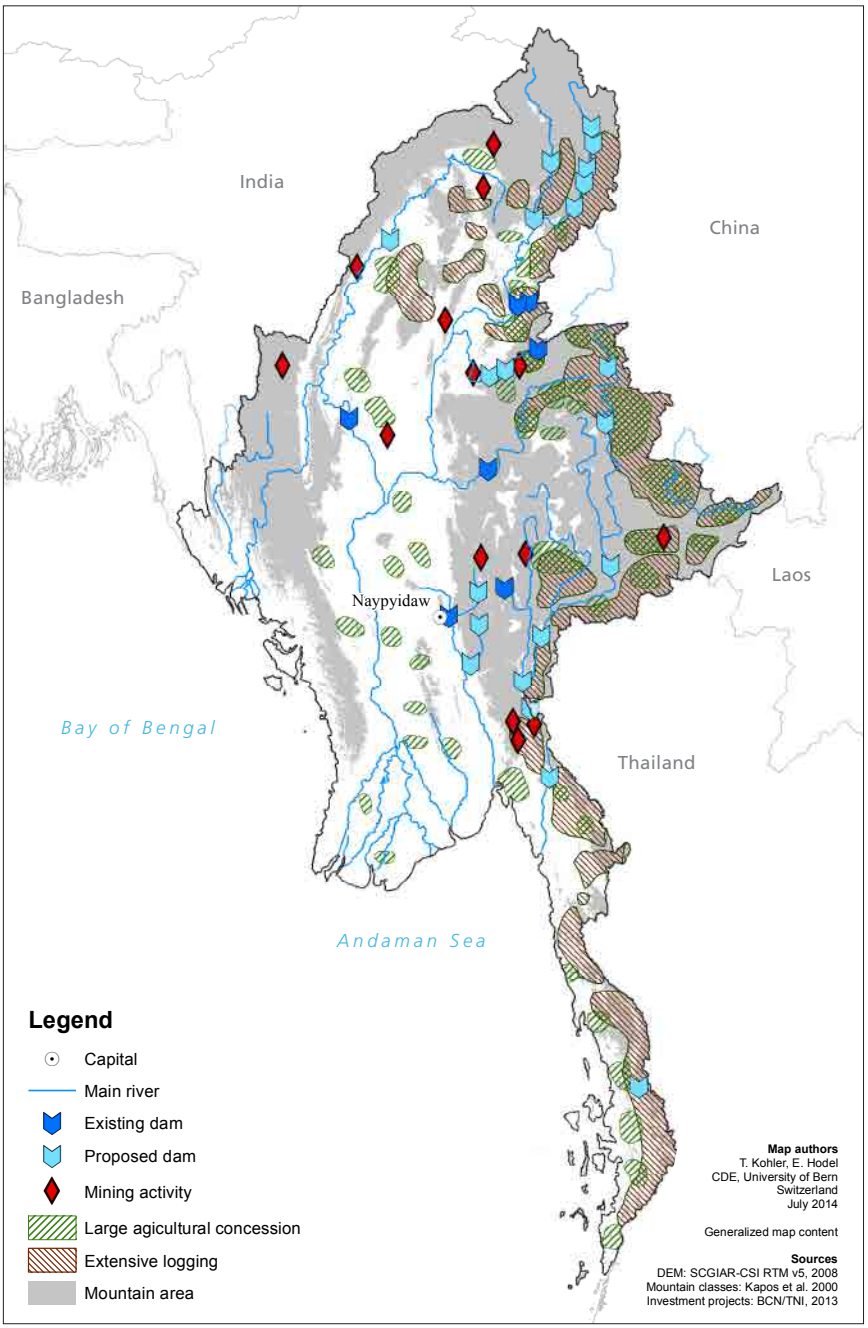


Figure 1.9: Resource extraction and mountain areas show a large overlap in Myanmar, as in many other mountain countries

Establishment of rubber plantations for export, Laos (K. Hurni)

The negative economic, environmental and social effects of extractive industries' activities have often been described as a "resource curse". However, there are examples to show that there are other options. Community-based forestry and selective logging practices have fostered positive change for both conservation and economic development. There are now a large number of forest and timber certification programmes worldwide, with the largest run by the Forest Stewardship Council and the Programme for the Endorsement of Forest Certification, a collaborative initiative of environmental NGOs, forest product companies and civil society groups. A major factor in the growing success of such schemes is the commitment of governments and major private industries such as publishing and packaging to use sustainable paper sources – in large part responding to public pressure. In many countries, public procurement policies, adoption of green building standards and more onerous penalties for illegal logging have lent additional support to efforts in greening forest management and timber extraction.

The vicious cycle of environmental degradation and human harm caused by mining is highly problematic but not inevitable. While no country in the world has developed effective environmental remediation plans for large-scale mining, mine reclamation efforts have improved significantly over the past few decades. In addition, increased social pressure has significantly affected the behaviour of many of the world's largest mining companies. Many companies have created Corporate Social Responsibility Advisory Boards, publish annual Sustainability Reports and have joined voluntary environmental and social reporting initiatives such as the Global Reporting Initiative (GRI), the Extractive Industries Transparency Initiative (EITI) [2] and the International Council on Mining and Metals (ICMM) [3; 4].

Mountaintop removal coal mining on Williams Mountain, West Virginia, USA (Vivian Stockman, ohvec.org; flyover courtesy SouthWings.org.)

Mining companies have also begun to provide substantial resources to local communities and have developed regional collaborations with other mining companies, international aid agencies and NGOs to respect free, prior and informed consent and enhance integrated and more sustainable development efforts. For example, in 1998 a consortium of mining companies including BHP Billiton, Xstrata, Teck and Mitsubishi Corporation agreed to invest US$2.5 billion over three years in Peru to construct the Antamina Mine. The mine would operate for 20 years and produce about 1.3 million tonnes of copper/zinc concentrate each year. Originally, the consortium planned to truck the ore to a port on the Pacific Ocean through the Cordillera Blanca range, which is an International Biosphere Reserve, a World Heritage Site and a key component of Peru's rapidly growing tourism sector. Local communities and NGOs entered into a dialogue with the mine and it eventually chose to circumvent most of the reserve. This demonstrated to local communities that Antamina was willing to engage in collaborative dialogue.

For such corporate–community–NGO partnerships to work from each partner's respective strengths and to mutual advantage, however, mechanisms are needed to allow the non-corporate partners to be compensated for their legitimate contributions to avoiding and mitigating adverse environmental and social impacts. Following the initial negotiations on transporting the ore, NGOs worked with Antamina and local communities to create an innovative "Consortium for Mining and Environment" (CME). The CME unites NGOs and civil society representatives through a participatory planning process in order to identify and support the environmental and social priorities of local communities. With funding from Antamina and several other mining interests in the area, the CME is providing technical capacity of development efforts, empowering stakeholder dialogue and enhancing Antamina's opportunity to meet its sustainability objectives in a more effective and equitable manner.

Box 1.14 | The plight of indigenous communities

Many mountain areas are home to indigenous peoples who have been particularly affected by timber, mining and other extractive industries. Their misfortune has been the wealth of their lands in terms of water, minerals and forests, but also biodiversity, scenic beauty and the close relationship between place-based cultures and the resources that sustain them. Historically, their lands have been managed under traditional systems and thus have not been registered with official land titles. Coupled with their remoteness and lack of connection to downstream governments, this has led to extensive exploitation that sidelined local interests, jeopardized local livelihoods and destroyed local environments, often beyond recovery. The 1992 Earth Summit in Rio recognized the important role of indigenous peoples in global sustainable development. Ten years later, the situation of indigenous peoples worldwide was characterized as one of centuries of deprivation, assimilation and genocide (Kimberley Declaration 2002). Today, there is little indication that this has changed for the better on any larger scale: Indigenous communities in mountains have suffered from the negative impacts of large dams, while often being excluded from sharing in the benefits. The same is true of mining, commercial forestry, oil-palm and rubber plantations, and often also of conservation areas. Conservation areas alone cover as much as 18 percent of mountain lands on global average, and especially in recent decades, many of them were established without the consent of local inhabitants and following the Western wilderness concept, according to which protected areas should be free of people and land use – in some cases prohibiting sustainable land management practices going back decades or centuries.

Source: [5]

China, an important mining country, has incorporated protection and restoration of the environment of mines into its *Nationwide Mineral Resources Planning* (2008–2015), which contains control measures to mitigate the negative impacts posed by the development and utilization of mineral resources in accordance with the principle of prevention before mining, control in mining and restoration after mining. It has established a funding system for the restoration of mining environments so as to improve the living and production conditions of mining areas. China has also carried out pilot projects for building green mining units and made efforts to make exploitations more resource-efficient, enterprise management more standardized and production processes more environmentally friendly. For example, Kunyang Phosphate Plant in Yunnan, a pilot unit in the national green mining project along with 36 other mines, has stepped up efforts to reclaim land and restore vegetation since 2004, building on experience in land reclamation and re-vegetation that had begun in the 1980s. By 2011, the plant had afforested about 900 hectares, and re-established about 500 hectares of grassland. However, much remains to be done to make mining socially and environmentally friendly in the country [6].

Greening mountain tourism

Mountain tourism often results in unsustainable development that displaces local people and undermines the local environment and livelihoods for the benefit of outsiders. In the United States, people who work in ski resorts such as Aspen, Colorado can no longer afford to live in town, and a similar development can be observed in many mountain resorts around the world.

Abandoned tower-houses in Parsma, Tusheti, Georgia (M. Thibault)

While tourism accounts for 5 percent of the global GDP, it also contributes 5 percent to global greenhouse gas emissions. The greening of tourism involves improvements in energy, water and wastewater efficiency. Green tourism can also offer opportunities for sustainable livelihoods in mountain areas, as it is expected to generate employment and income that is high compared with alternative sources (Box 1.15). Well-designed green tourism also takes care to integrate local culture and tradition and to safeguard and validate the natural environment [1].

The Great Inca Road project, for example, helps poor communities in the high Andes by restoring landscapes, biodiversity and cultural assets along portions of the 9 000 km Inca trail. Different organizations including UNESCO and IUCN have been working together to protect this ancient route, in collaboration with the governments and communities of the countries through which the Road passes. The project promotes community-based tourism in three of the six countries traversed by the trail: Ecuador, Peru and Bolivia. The preservation of the regional ecosystem; reintegration of functional connections of Andean cultures that existed in pre-Columbian times; preservation of indigenous art, culture and religion; and poverty alleviation were integral to the design of the project. With support of the Andean Community of Nations and the Government of Spain, the project widely used participatory approaches, including the involvement of grassroots individuals and institutions in support, design and implementation.

Since its inception in 2003, the Great Inca Road project has resulted in numerous positive achievements. These include developing participatory management plans, preparing maps and baseline surveys, reinforcing protection of existing well-con-

Box 1.15 | Tourism – a dynamic economic sector – what prospects for mountains?

Over the past six decades, tourism has experienced continued expansion and diversification. It has become one of the largest and fastest growing economic sectors in the world, increasing from 25 million international arrivals in 1950 to 842 million in 2006, an increase of more than thirtyfold. Many new destinations have emerged alongside the traditional ones in Europe and North America. Growth has been particularly fast in the world's emerging regions: The share in international tourist arrivals in emerging and developing economies has steadily risen from 31 percent in 1990 to 47 percent in 2010. No disaggregated data are available on mountain tourism at a global level, but its potential in an increasingly urbanized world is highlighted by the European Alps, which have over 540 million overnight stays per year, making them the second most important tourist region in the world after the Mediterranean coast. At a global level, the importance of tourism varies greatly among different mountain regions. It is also unevenly distributed within the same region, also in the European Alps. In many mountain areas of the developing world, the contribution of tourism to income generation and welfare is still very limited. Globally, there is increasing evidence that tourism cannot be regarded as a panacea for regional or national overall development. The question of what would constitute green forms of tourism is also much debated.

Sources: [2; 3; 4; 5]

served areas and restoring degraded areas (Box 1.16). Projects such as ecotourism, weaving and improved agricultural production were undertaken to enhance incomes of local communities, with methodologies developed to implement these projects in the specific cultural contexts of each area.

Gerlach peak (2655 m) is the highest peak in the High Tatras, in Slovakia and in the whole Carpathian mountains (J. Švajda)

Box 1.16 | Integrating conservation and livelihoods

The paramo ecosystem, located at roughly 3 500–4 100 m above sea level, is a mosaic landscape that forms an archipelago of wetlands along the crest of the Andes from Venezuela through Colombia and Ecuador to the northern frontier of Peru. Some 60 percent of the 3 000 vascular plants in the paramos are endemic and it is the habitat of highly threatened species like the spectacled bear and mountain tapir. Cultural traditions of many Andean communities consider these regions sacred. Moreover, the paramos are critical natural water-towers for the whole of the north central and northern Andes, storing and slowly releasing water to the 70 percent of these nations' populations that live downstream. However, modern intrusions such as mining and roads have threatened the paramos in recent years. In addition, expansion of agriculture change has led to increased use of these high-altitude grasslands by local people for crop production and livestock grazing.

Nevertheless, Andean villagers were determined to protect their paramos. A large transboundary Conservation Corridor project was envisaged with support from the Global Environment Facility (GEF). Communities established their own vision and goals, and mapped out opportunities and responsibilities. They worked hard to strengthen their skills in everything from farming or ecotourism to giving public presentations to lowland officials. In some cases, they organized successful collaborations to oppose mining operations that would have imperilled the fragile wetlands. They also learned new livestock management approaches to improve what they already had, stopping the practice of moving agriculture upwards into the paramos and developing low-impact ecotourism alternatives for added income.

Source: [6]

Paramo landscape in the Andes (W. Buytaert)

Machu Picchu – the highlight of the Inca trail, Peru (T. Kohler)

The Great Inca Road project is just one example of tourism development based on old routes: Historic trails, pilgrims' ways and trading routes abound in mountain areas around the world, with El Camino de Santiago being one of the best-known. And new trails are being added or recreated, such as the Great Himalayan Trail or the medieval trails across mountain passes in Switzerland. At IUCN's 2012 World Conservation Congress, steps were taken towards establishing a global network of "great mountain trails" which would focus not only on recreation but even more on bringing benefits to mountain communities all along these routes at a time of major global change. The Great Inca Road project was inspired in part by an exchange of visits by mountain experts working on the Andes and the Appalachian Mountains of the eastern United States. While the Appalachian Mountains are one of the oldest ranges on earth, visitors are often surprised to find they share many characteristics of developing countries: rich culture in the midst of remote, rural poverty.

The Appalachian Trail was conceived as early as 1921, but it took decades of hard work before it was formally established in 1968 as part of the National Trails System Act, which created a new class within existing public lands. Eventually, the Trail grew to encompass more than 100 000 hectares, extending more than 3 500 km from Maine to Georgia. In addition to challenging "thru-hikers" who attempt the entire Trail, local sections of the Trail serve as hubs for economic development and cultural preservation. An example is presented by HandMade in America, a local NGO founded in 1993 by residents of North Carolina who realized that the region was home to many craft and folk artists preserving traditions from woodworking to musical instrument making. Following a survey of local artisans, the group developed guided heritage craft trails and guidebooks that have been effective in attracting tourists and helping the craft makers avoid onerous trips to craft fairs to sell their goods. Today, the programmes have expanded

to include assistance for women entrepreneurs interested in creating or growing home-based businesses; a small town revitalization programme that applies participatory methods to improving the physical and civic infrastructure of local communities; a "Craft Across the Curriculum" collaboration that brings teachers and local craft artists together to continue craft traditions across generations; and a Craft, Architecture and Design programme that connects craft artists to home design professionals. Consulting services, workshops and conferences fill out the range of offerings of this organization that is making significant contributions to regional conservation and sustainable livelihoods [7].

One key to success, highlighted in the above example, is identifying the special characteristics and assets of each region. In Kyrgyzstan, tourists are lodged in traditional yurts, and given opportunities to experience the thrill of hunting small game from horseback with trained eagles. Costa Rica, Mexico and other countries with mountainous rain forests have discovered the potential of attracting tourists for bird watching, hiking or the sheer fun of zip lines. These activities typically are run by private companies, but the best of them involve local community members as guides, or participants in cultural enhancements that are integrated into tours. In many mountain areas, wildlife (game) watching has tourism potential, as mountain wildlife includes some of the most iconic species on earth, such as giant pandas, snow leopards, vicuña, Tibetan antelopes, various mountain sheep and goats, condors and some of the world's largest amphibians. These species already draw tourists, but under improved management and with recovered populations could bring in even more, while contributing to the maintenance of healthy functioning ecosystems.

Tourists on an excursion near Erzurum, Turkey (T. Kohler)

Box 1.17 | Elements of community-based tourism

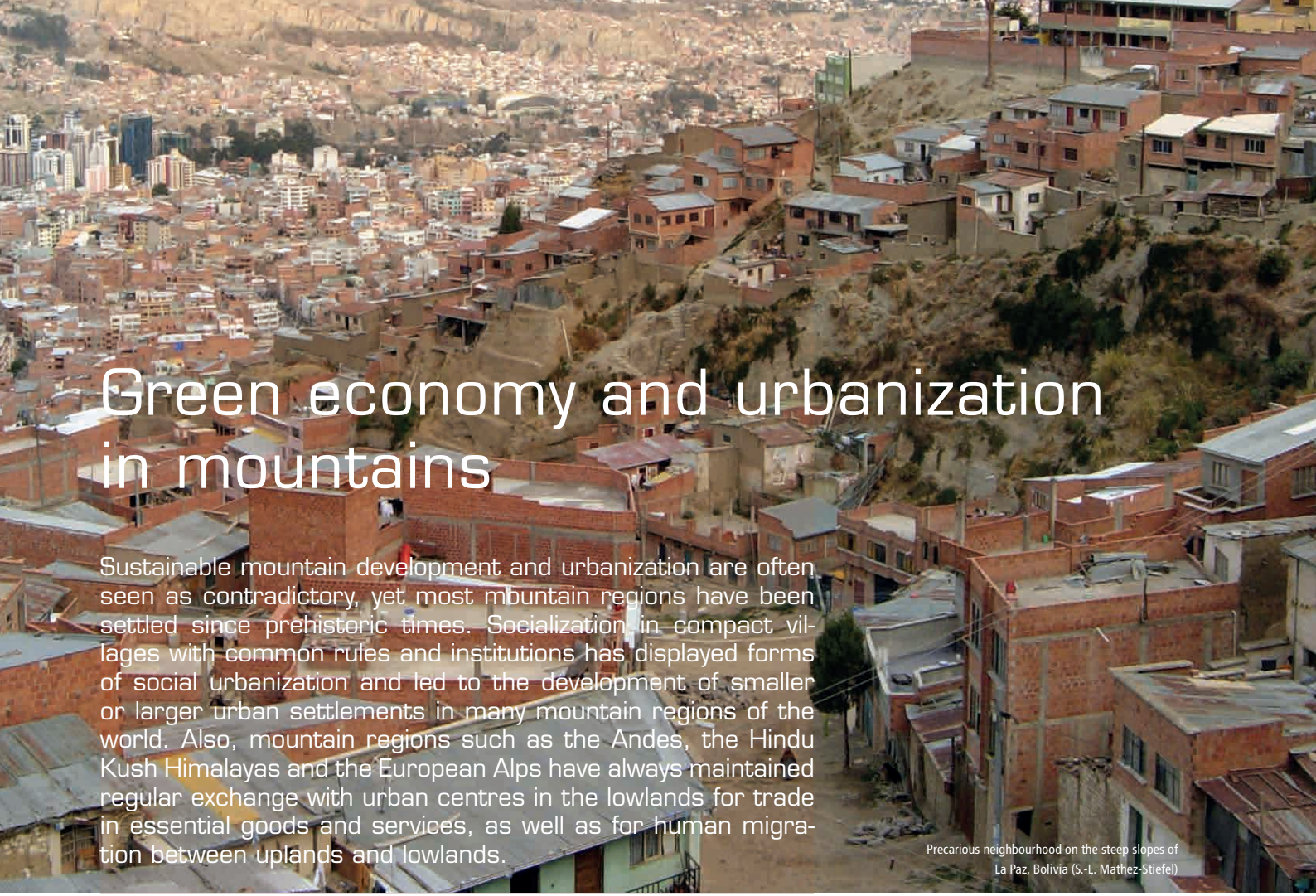
- Integrated management strategies and programme design, with natural, cultural and social components given the same weight as economic benefits
- Balanced highland–lowland resource flows and decision-making, to ensure that local communities participate actively in decision-making and have incentives for conservation as well as income generation. Such frameworks require supportive policy as well as legislative and regulatory support.
- Integrating local knowledge with external expertise
- Infrastructure development appropriate to fragile mountain environments
- Equitable distribution of ecotourism benefits and opportunities, including reinvestment of tourism revenues into conservation
- Capacity building for local organizations and skill-based training for local people, including full integration of women
- Partnerships, and continuing exchange of experience, ideas, learning and best practice

Source: D. Jane Pratt, and [8]

Mountain climbing has been a major windfall for high mountain countries such as Nepal or the Tibet Autonomous Region of China, where the payment of large climbing fees generates significant foreign exchange. Bhutan has enhanced its ecotourism income by limiting supply: There are visitor quotas and each tourist is required to sign up with one of the country's certified tour agencies. These agencies coordinate with each other to ensure that facilities are not overcrowded, and everyone shares the revenue. By 2011, mountain tourism in Bhutan had 65 746 tourists, contributing a minimum daily tariff of US$250 during peak season, and US$200 during low season, totalling almost US$48 million [9]. Trekking in Nepal, which was almost entirely unregulated for many years, has recently begun to generate more local benefits, as NGOs have helped train local lodge owners in food preparation and hygiene, and use of kerosene and improved stoves to reduce unsustainable harvesting of fuelwood, thus providing income and environmental benefits to local communities. Special programmes, often initiated by NGOs, have educated tourists by establishing trekking guidelines that cover everything from fuel use to limits on the size of loads porters may carry. Tourists pay a small charge for tags they hang on their parkas, with large print summarizing the pledge to support sustainable tourism with specific measures.

In these and many other cases, tourism is successful when it contributes simultaneously to the conservation of ecosystems and sustainable livelihoods for local people. Often, successful tourism as defined above is community-based, even though this form of tourism has its own issues, such as local power imbalances, overambitious plans and local visions of development that are not necessarily environmentally friendly (Box 1.17). Community-based tourism does not exclude mass tourism, as illustrated by many destinations across the mountain world. The Swiss resort of Grindelwald, for example, which forms part of the UNESCO World Heritage Site Swiss Alps Jungfrau-Aletsch, typically community-based, records about one million overnight stays per year.

The Matterhorn near Zermatt, Switzerland: a unique selling position for Swiss mountain tourism (C. Körner)



Green economy and urbanization in mountains

Sustainable mountain development and urbanization are often seen as contradictory, yet most mbuntain regions have been settled since prehistoric times. Socialization in compact villages with common rules and institutions has displayed forms of social urbanization and led to the development of smaller or larger urban settlements in many mountain regions of the world. Also, mountain regions such as the Andes, the Hindu Kush Himalayas and the European Alps have always maintained regular exchange with urban centres in the lowlands for trade in essential goods and services, as well as for human migration between uplands and lowlands.

Precarious neighbourhood on the steep slopes of La Paz, Bolivia (S.-L. Mathez-Stiefel)

More than a quarter of the global mountain population of over 720 million people live in towns and cities. Some of these cities are national capitals, including Kathmandu with more than 2 million inhabitants, Quito with 1.5 million and La Paz, the highest capital in the world at 3 640 m, with close to 2.3 million people in its greater metropolitan area. Others are megacities such as Mexico City at 2 240 m, which has a population of about 8.9 million in the city proper and 21 million in the wider metropolitan area, making it the fourth largest in the world in 2013. In global comparison, the rate of urbanization is highest in South America and the Caribbean, where 47 percent of the total mountain population of 53 million lives in towns. In the mountains of industrialized countries, 36 percent of the mountain population or 20 million people live in urban areas. The urbanization rate in mountain areas is lowest in Asia and the Pacific with 14 percent, representing 46 million people [1].

Towns and cities in most mountain areas continue to grow rapidly, as a result of natural population growth and migration from rural areas. At the same time, their development is often constrained by mountain-specific factors such as lack of space. Those living at the periphery – often the poor – are forced to settle on steep slopes, riverine areas and other marginal lands, where the risks of landslides or floods are greatest. Many mountain regions have a higher seismic risk than lowlands; earthquakes in urban areas would have particularly devastating effects given the high number and density of population. Mountain cities used to depend on timber and fuelwood from surrounding areas, which led to deforestation or forest degradation. Now road infrastructure and alternative fuel sources have reduced this pressure but brought attendant air pollution. Often, water and electricity supplies cannot keep pace with urban growth, shortages are common, and many urban supply systems are in dire need of upgrading to increase their effec-

tiveness and reduce losses. Moreover, in the absence of adequate sewage systems, wastewater from residential and industrial areas is released into rivers, leading to pollution that affects all those living further downstream.

Drivers of global metropolization and their effects on mountain towns

Just over half of the current global population lives in urban areas. Urbanization includes not only the growth of cities *per se*, but also the spread of peri-urban residences and leisure areas from urban agglomerations located at the foothills into mountainous rural hinterlands. This results in a metropolization process that transforms mountain societies through the diffusion of urban values and consumption patterns. Metropolitan regions, most of which are located in the lowlands, not only set trends relating to sociocultural values, they are also the centres of decision-making power. Given their political, demographic and economic weight, the interests of metropolitan centres very often dominate local and regional mountain development agendas, undermining the capacity of mountain dwellers to influence decisions that affect them.

The main driver of global metropolization is the specific advantages offered by large agglomerations, including dense personal and professional networks and employment dynamics. Such agglomeration economies are fuelled by intensifying global market relations, powerful transport systems and the multiplication of socio-economic interactions in cities, which create opportunities and hope for all

Shimla in the Indian Himalaya – a regional capital and university town (M. Perlik)

Zurich, Switzerland – an important area of origin for amenity migration to the Swiss Alps (M. Perlik)

groups of actors. Metropolises offer high-performing services and jobs as well as low-skilled activities. Although urban life is marked by uncertainty, especially for the poor, it offers more interactions and more opportunities than life in rural areas. The hope for a better life attracts migrants. For this reason, mountain economies often suffer from draining effects such as depopulation – particularly of able-bodied men – and weakened local economies and institutions. Global metropolization processes increase demand on resources, which in turn accelerates large-scale mining and dam construction – processes which very often create serious economic, social and environmental problems in mountain areas.

However, there is also movement in the opposite direction – upland – in a phenomenon known as amenity migration. Amenity migrants, comprised of a growing and increasingly wealthy lowland urban population, set up seasonal or permanent residence in mountain areas. They value intangible mountain resources such as beautiful scenery, clean air and pleasant temperatures. However, while these new residents bring purchasing power, their valuation of mountains is very selective. Their presence may consolidate existing power asymmetries between mountains and lowlands. In addition, the sustainability of this trend is doubtful, as it is space- and energy-consuming and relies on increased private mobility and transport infrastructure. Moreover, real estate investments in the wake of this new move into mountains may displace autochthonous local economies and populations.

Taxco, Mexico (O. Chassot)

Mountain towns for greening mountain economies

Greening mountains is not at odds with mountain urbanization. On the contrary, the development of mountain towns provides opportunities for supporting green mountain development if it is based on economic and cultural potential known as territorial capital [2] at all levels of the urban hierarchy:

- Strengthening small towns and centres as local economic and administrative nodes may facilitate the emergence of locally embedded entrepreneurs and the generation of a more diversified local economy. This in turn can lead to new forms of cooperation between different local actors and help create local jobs. Although such nodes will be integrated in wider national or global economies, they may reduce rural depopulation and prevent rising dependencies from global sourcing by maintaining and developing local value chains for goods and services that are adapted to local needs – and to mountain conditions. This can contribute to an overall reduction of mobility, energy consumption and transport.

- Strengthening medium-sized towns as centres of larger mountain regions could provide equivalent living conditions and a reasonable diversity of jobs in the mountains. This would secure or enhance the political and economic standing of the mountainous region, thus counterbalancing the dominance of lowland interests and helping avoid greater social and spatial disparities.

- In mountain metropolitan areas, safeguarding ecological integrity, securing critical ecosystem services and reducing exposure to hazards of all kinds are important goals for greening such areas. Equally important is the provision of water supply and sanitation, support for environmentally friendly transport systems to reduce pollution, and energy-efficient buildings. Furthermore, it will be necessary to moderate metropolitan dynamics by reducing the incentives of agglom-

eration economies. It is doubtful that this will be feasible by the spontaneous dynamics of market mechanisms: It will require political regulations which include lessons learned from the past, and which are based on democratic and participatory processes in favour of more diversity, resource savings and risk avoidance. Such regulations will consider ecology as well as social and spatial justice, i.e. the equitable distribution of resources, services and access [3] in order to avoid depopulation of the hinterlands and to cope with latent and aggravating disadvantages of agglomeration like urban congestion, crime and overuse of resources.

There are many examples of towns in mountains with a diversified and well-functioning economy, which play an important role as regional nodes for a larger mountain region. Cases in point are cities in the European Alps such as Grenoble or Bolzano (which are located in valleys), Shimla in the Indian Himalayas or the small town of Nuoro in Sardinia/Italy. These towns have benefited from political decisions taken at different times in history that resulted in protection of their urban markets by national borders, specific tax regulations, "protection by distance" due to the limited and slow transport facilities in the pre-industrial eras, or assignment of specific higher administrative functions. The persisting effects of such decisions can thus impede and, to some extent, counteract the current concentration process relating to global metropolization.

A mountain-specific polycentric urban development strategy that is legitimated by transparent political processes might clear the way for a greener economy, facilitate participatory processes and promote socio-economic diversity. Strengthening small towns and centres in this way also has the potential to avert the polarization between highly productive lowland and coastal metropolises on the one hand, and mountain regions dominated by consumptive activity on the other.

Rapid urban growth in Tbilisi, Georgia's capital (T. Kohler)

Green economy, poverty and food insecurity in mountains

Two decades after the Earth Summit, the United Nations Conference on Sustainable Development (UNCSD) Rio+20 concluded that eradicating poverty is the greatest global challenge facing the world today and an indispensable requirement for sustainable development. The Summit's final document mentions "green economy" as an important tool for poverty eradication. In 2012, over 1 billion people or 20 percent of the global population still lived in extreme poverty, many of them food-insecure.

Looking at the diversity of native potatoes, Pitumarca, Peru (S.-L. Mathez-Stiefel)

Harsh climates, difficult terrain and access, and political and economic marginalization make mountain people particularly vulnerable to food insecurity. In 2002, 90 percent of the world's mountain population, or over 660 million people, were living in developing countries or countries in transition, and more than half were found to be vulnerable to food insecurity [1]. People living at high altitudes have higher metabolic needs, yet growing seasons in mountains are shorter and many communities in these areas suffer from chronic hunger. Nutrition studies indicate high rates of micronutrient deficiencies among mountain populations, such as iodine deficiencies among inhabitants of the Andes, the Himalayas and mountain regions of China; data from the Andes and the Himalayas also suggest a high prevalence of vitamin A deficiency. Hunger and micronutrient deficiencies are among the factors that contribute to the significantly higher infant mortality rates in mountains [2]. They also help perpetuate poverty by reducing people's ability to work and cope with their daily chores.

While food insecurity is relatively well documented, there is a lack of reliable data on poverty in mountains at the global level. Research indicates that the economic status of people in mountain areas reflects the overall level of income of the country in which they live [3]. But poverty is not limited to the mountains of developing countries, as shown by the case of the Appalachians in the United States or the mountains of Central Asia. For other important mountain regions such as the Hindu Kush Himalayas, home to 30 percent of the global mountain population, a recent study reveals that in four of the six countries covered – Pakistan, Bangladesh, Afghanistan and Nepal – poverty rates in mountains are above the national average (Table 1.4). India is the exception to this rule. For Bhutan, there is one single poverty rate as the whole country lies practically within the mountains. China and Myanmar were excluded from the study as no reliable figures were available [4].

Poverty is widespread in many mountain areas. Scene from Syangja District, Nepal (S. Jaquet)

The study also identifies the key determinants of poverty in the region. Although varying in importance from one country to the other, these determinants are household composition, i.e. a high dependency rate as well as a lack of assets, basic facilities, accessibility and connectivity to wider markets. Low population densities and settlement dispersion make it difficult to provide basic services such as medical care or schooling; roads are expensive to build and maintain, and generally serve few people per kilometre. Dispersed settlement also inhibits cooperation on a larger scale that could help improve living standards. In sum, mountain areas are poorer because they combine common factors of poverty with mountain-specific factors of poverty. Hence, poverty in mountains needs to be addressed by specific programmes which include both groups of factors.

Table 1.4: Poverty profiles of countries in the Hindu Kush Himalayas. Source: [4]

	Total population (millions)		Population below poverty line (millions)		Population below poverty line (percent)	
	Whole country	Mountain part	Whole country	Mountain part	Whole country	Mountain part
Afghanistan 2010	24.5	15.1	8.0	6.3	33	42
Bangladesh 2009	162.0	1.3	59.9	0.6	37	46
Bhutan 2009	0.7	0.7	0.2	0.2	23	23
India 2009	1 155.0	72.3	415.0	24.0	36	34
Nepal 2009	29.3	11.8	9.0	4.7	31	40
Pakistan 2009	169.7	39.3	42.4	12.5	25	32
Regional total / average	1 540	140	535	48	26	31

Mountain poverty: a political dilemma

The example of the Hindu Kush Himalayan countries mentioned above shows that while the poverty rate is often higher in the mountains, the absolute number of poor people is much greater in lowland regions. The six countries of the Hindu Kush Himalayan region have a total of 535 million poor people, of which fewer than 10 percent live in the mountain areas. In the countries with the largest populations (China, India, Bangladesh and Pakistan) the poor in mountain regions are an even smaller fraction of the total number of the poor. The same picture appears in the mountain countries of mainland Southeast Asia. In Viet Nam, the poverty rate practically reflects the country's topography. The national average of the poverty rate in the mountain areas is 61 percent, almost twice as high as in the lowlands (35 percent). But the number of poor people is over 10 times higher in the lowlands – 25.7 million compared with 2.2 million in the mountains [5; 6].

This presents a dilemma for policy-making, or more precisely for resource allocation towards poverty eradication: Should poverty be addressed where the poverty rate is high, such as in mountains, or where poverty density is high, such as in the lowlands, especially in urban areas? Policy-makers, administrators and donors often tend towards the second option, as it means reaching a greater number of poor people within a given perimeter, at lower cost per person, soliciting higher media interest and public acceptance. The art of policy-making lies in how best to invest scarce resources so as to reach as many of the poor as possible without neglecting those at the spatial margins, including mountains. The task is still more demanding as each poverty context calls for specific measures. Where mountain populations are more important in terms of numbers of people, as in the countries of the Central Andes, high poverty rates and high poverty density coincide in space; but as the case of Bolivia shows, there is an important difference between rural areas and urban centres, the latter having much lower poverty rates [7]. The political dilemma here is to balance poverty eradication efforts between rural and urban areas within the mountains. In many mountain regions, poverty is also associated with the exclusion of social and ethnic groups. The need for targeted policies of inclusion for women and excluded groups will be critical to reducing overall poverty rates and enlisting all mountain peoples in improving their livelihoods.

The challenge of modern poverty

In addition to the above dilemma, policy-makers also face the specific challenges of a "peculiarly modern sort" of poverty (Box 1.18), which is increasingly making its appearance in many mountain areas, and which is linked to extractive industries such as large-scale mining, timber operations and hydropower development. Policies addressing this modern form of poverty will have to combine classical poverty alleviation measures with legal and regulatory measures such as mountain communities' resource entitlements, compensation for extractive use, as well as acceptable standards relating to employment conditions, salaries and environmental care such as post-operation restoration.

Box 1.18 | Mountains and modern poverty

"*Poverty has long been a feature of life in many high altitude communities. But the poverty that prevails in many mountain areas today is of a peculiarly modern sort, in that it arises from a growing dependence on lowland metropolitan centres rather than from age-old self-sufficiency in a harsh environment.*"

Source: [8]

Migration – a key trait of mountain regions worldwide

Throughout history, outmigration has played an important role as a poverty-alleviating strategy in many mountain areas, particularly for young men who have migrated seasonally or permanently in search of employment and income. Today, an increasing number of people are on the move, and they move for longer periods and further away – an expression of increasing interdependence of mountains and lowland regions, including urbanized areas. The growth of remittance flows is impressive. According to World Bank estimates, they increased from about US$50 billion in 1991 to US$401 billion in 2012. The share of this amount that was sent to developing countries was approximately three times the sum these countries received through official development aid [9]. In contrast to foreign direct investment, remittances are much less volatile, as shown during the economic crisis 2007–2008. The effect of remittances on household incomes is significant: According to a World Bank study, the increasing flow of remittances contributed one-third to one-half of the reduction of the poverty rate in Nepal, which went down from 42 percent in 1995–1996 to 31 percent in 2003–2004 [9]. In Tajikistan, 40 percent of all households, and as much as 70 percent of the poorest households, received remittances in cash or kind in 2006 [10]. The importance of remittances for mountain countries is reflected in global statistics. Countries with a high share of mountain areas dominate the list of those receiving the highest remittances in relation to their gross domestic product (GDP): In 2012, as in the years before, 8 of the top 10 of these countries had between 51 and 94 percent of their territory in mountains, while the global average stands at 24 percent [11] (Table 1.5). However, remittances should be seen as a complement rather than a substitute for official development aid; as private money, they are not invested in public projects such as infrastructure. They also may increase income inequality, as not all households in need receive remittances.

Whether migration and remittances support a more sustainable, greener economy in mountain regions remains open. Investment patterns are crucial [9]. On the one hand, new skills, knowledge and incomes derived from migration may enable people to invest in specific green technologies such as solar power or community-run small hydropower plants as well as small local industries that are run on a sustainable basis. On the other hand, investment in livestock may lead to overuse and degradation where pasture is already in short supply. In the absence of men, women are left with additional responsibilities and a higher workload as heads of household and farm managers. While this may prompt new forms of collaboration and cooperation between them and enhance their position in the local community, it can lead to the neglect of time-consuming and arduous activities such as maintaining terraces and irrigation channels.

Country	Remittances in US$ as percent of country GDP (2012)	Share of mountain area as percent of country area
Tajikistan	52	94
Kyrgyzstan	31	90
Nepal	25	78
Moldova	25	0
Samoa	24	51
Lesotho	22	88
Armenia	21	78
Haiti	21	55
Liberia	20	5
Kosovo	17	90

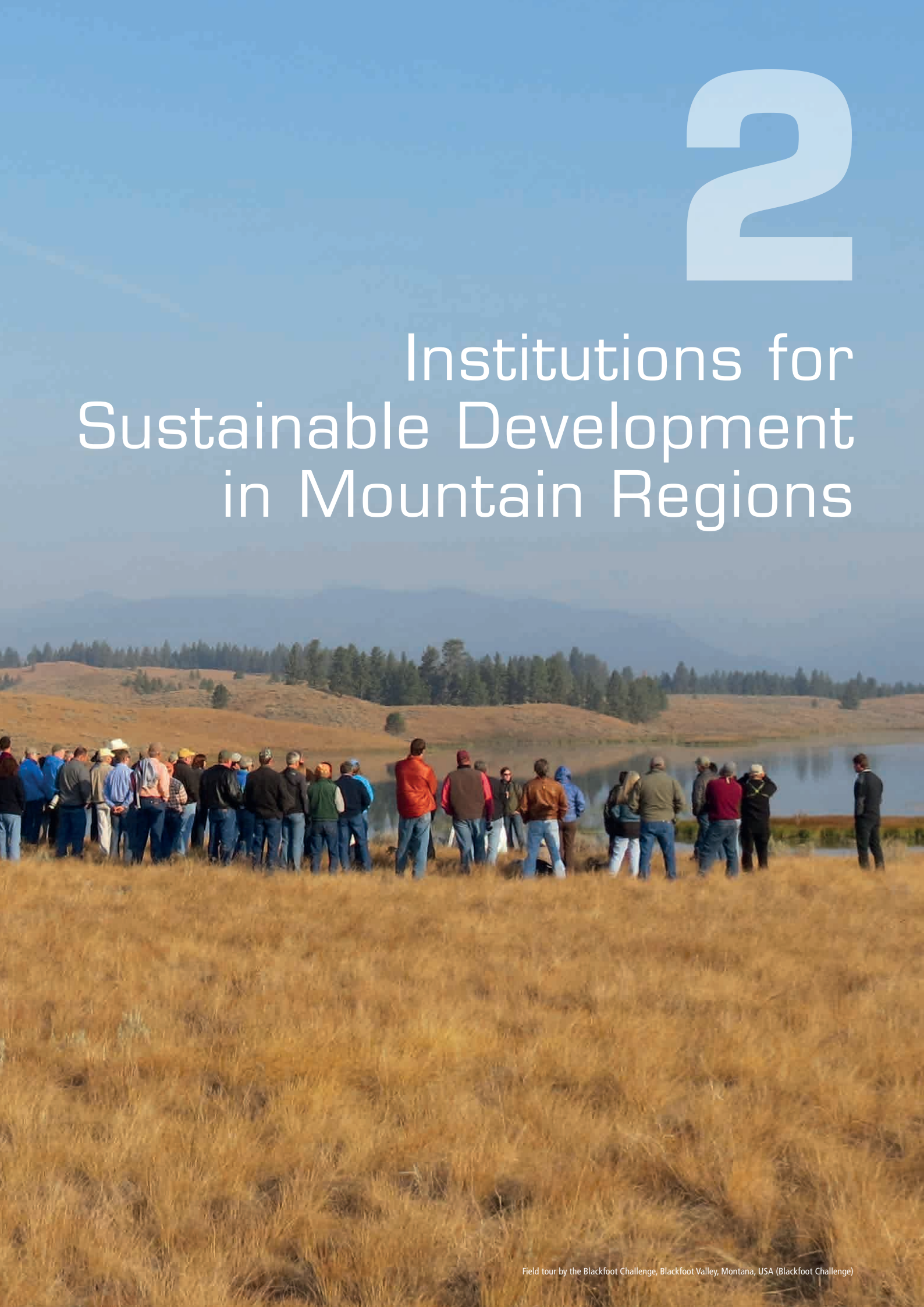
Table 1.5: Countries with a high share of mountain area dominate the list of the top 10 remittance-receiving countries. Sources: Mountain area by country according to [11], remittances according to [12]

GPS mapping of community borders organized by the NGO Fundación Tierra, Contorno Bajo Aymara community, near La Paz, Bolivia (L. Lerch)


SCHOOL BUS
STOP

2

Institutions for Sustainable Development in Mountain Regions



Field tour by the Blackfoot Challenge, Blackfoot Valley, Montana, USA (Blackfoot Challenge)

Institutions, organizations, diversity and linkage

More than two decades after the 1992 Earth Summit (UNCED), reform of the institutional framework for sustainable development remains a major challenge on the global agenda. Since the 2002 World Summit on Sustainable Development (WSSD), UN Member Governments, stakeholder groups and academics have actively debated perceived shortcomings and proposed improvements.[1]

Rio de Janeiro, location of the Earth Summit 2012 (T. Kohler)

The institutional framework for sustainable development (IFSD) was one of the two central themes at the United Nations Conference on Sustainable Development (UNCSD) in 2012. Discussions at Rio+20 led to widespread agreement on the need for various improvements. Current sustainable development institutions need to be strengthened at all levels. Treaties, financing and authority are too fragmented. The three pillars of sustainable development should be better integrated in the UN system and in global, regional and national policies. The science–policy interface must be improved. Last, shortcomings in monitoring, data collection and assessment, accountability and enforcement capabilities need to be addressed.In sum, improvements are required across the entire governance spectrum.[3]

"Good governance at the local, national and international levels is perhaps the single most important factor in promoting development and advancing the cause of peace."

Kofi Annan, 2002[2]

The task ahead is immense, but there is no need to reinvent wheels. For several millennia, human societies have demonstrated remarkable ingenuity in crafting institutions for dealing with all kinds of challenges. This is particularly the case in culturally diverse mountain regions, where challenging and hazard-prone physical environments often compound political, economic and social marginalization. Indeed, collaborative problem solving under uncertainty has become a hallmark of mountain institutions. This is reflected, for example, in the widespread existence of common property regimes. In recognition of their special significance, a diverse set of institutions has emerged in support of mountain regions.

IFSD reformers have much to learn from the diversity of mountain institutions. To this end, this report presents almost thirty examples of such institutions; while

[1] This section has benefited from research carried out in a number of projects, including "European Regional Mountain Initiatives: From Pyrenees to the Caucasus (ERMI)" (funded by the Swiss National Science Foundation), "Mountlennium: Reaching Millennium Development Goals through Regional Mountain Governance" (funded by the Swiss Network for International Studies) and "Ecoregional Territoriality: Rescaling Environmental Governance (Eco-TREG)" (funded by the Swiss State Secretariat for Education, Research and Innovation).

[2] Kofi Annan, former Secretary-General of the United Nations, commenting on the Johannesburg Plan of Implementation.

[3] Numerous analyses of the institutional framework for sustainable development (IFSD) and proposals for its reform can be found at www.uncsd2012.org/ifsd_publications.html.

the focus is almost exclusively on recently established institutions, it is recognized that social organization in mountain regions predates these institutions. Although the choice of examples is necessarily selective, it offers a broad overview of specific achievements and some key challenges that can serve as a source of inspiration for IFSD reform. The examples are organized in sections according to their principal focus of operation – global, regional, national and local. Each section is introduced by a summary of the overall significance and interlinkages of corresponding institutions.

Institutions and organizations

Institutions exist in many forms. Although the term is often used as a substitute for organizations, the two are not the same. Institutions comprise sets of norms and expectations that coordinate the interactions of individuals and groups. Many familiar institutions are formally established: the state, political parties, legislatures or courts. Other institutions are all around us yet much less visible, including markets and property. No matter how visible they are, institutions are important because they embody ideas about how to accomplish goals generally recognized as important in society. In mountain regions, numerous local institutions shape the conservation and sustainable use of natural resources, often relying on grassroots customs and traditions. At the global level, institutions such as international conventions help coordinate efforts that benefit nature and society in mountain regions and beyond.

Campesinos in discussion (W. Silva)

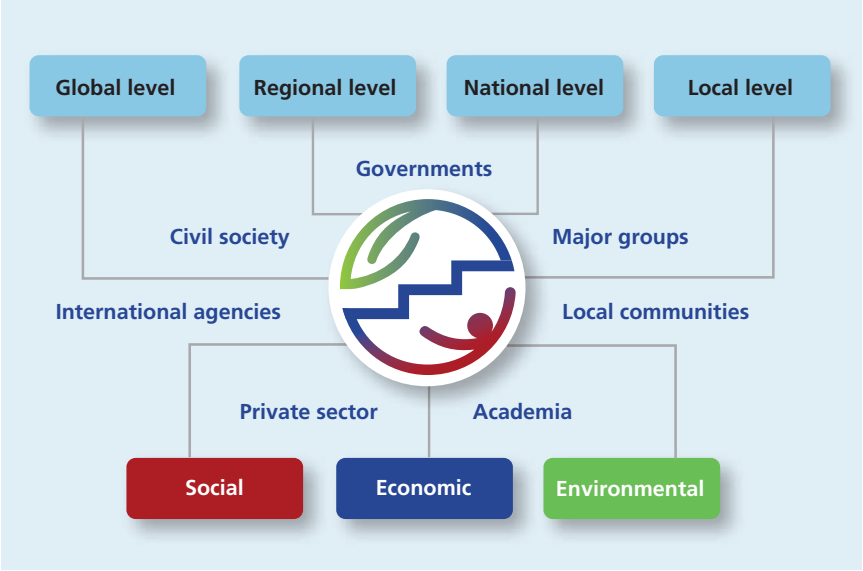


Figure 2.1: Institutional context for sustainable mountain development

Institutions are also useful because they provide stability during times of rapid change. This is crucial for mountain regions, where momentous environmental and socio-economic changes are occurring as a result of human-induced climate change and the accelerated restructuring of global, regional and local economies. Institutions facilitate the creation, transfer and use of traditional and new knowledge from one place to another and from one generation to the next. In mountain regions, such knowledge has long been a pivotal asset for adaptation, hence institutional failure can have grave consequences.

Organizations, by contrast, are collectivities in pursuit of specific objectives. They typically have staff, offices and different kinds of resources. Many of the examples presented on the following pages are organizations. They include the global Mountain Partnership, the Alpine Convention or the University of Central Asia. These organizations also represent institutions. For instance, the Mountain Partnership is one of many Type II Partnerships that emerged from the WSSD. As an institution, a Type II Partnership involves a set of norms and expectations about how public and private actors ought to collaborate in the pursuit of sustainable development.

Why does the difference between institutions and organizations matter? Organizations come and go. Institutions and the norms they embody are more long-lived. They are also more difficult to change because change comes about gradually through the repeated application – by individuals and organizations – of new or improved practices. Institutions are influential across an entire range of organizations, especially when they are linked together in an *institutional framework*. As organizations face new challenges and learn to address new problems, lessons learned can become anchored in new institutional frameworks. The advantage of focusing reform efforts on institutional frameworks is that their effects are felt far and wide.

Navigating institutional diversity

Mountain regions are highly diverse. Their topographical and climatological complexity, as well as their distribution across the globe have produced a striking range of opportunities and challenges for societies. Because mountain ranges often transcend state borders, mountain institutions are shaped by many different political traditions and ambitions. Natural and social heterogeneity also combines with a multitude of cultural and symbolic meanings of mountains. The result is a fertile ground for the evolution of institutional and organizational diversity.

The examples of institutions and mountain organizations in this report can be distinguished by three features: their constituents; the comprehensiveness of goals and objectives; and the reach of operations.

Constituency

Many institutions are of a highly public character because the problems they seek to address involve public goods and services: clean air and water; knowledge and education; transportation; security. For this reason, the constituency primarily consists of public actors, such as states that are signatories to the Convention on Biological Diversity or the Carpathian Convention. Others are strictly private and deal with landownership or the manufacturing and sale of products. Conservation land trusts work with private property owners to preclude commercial development of sensitive watersheds in return for tax advantages. Between the public and private exist countless combinations. The "commons", for instance, is an important institution that combines public and private characteristics. The Mountain Partnership is an organization that unites public and private actors. Local resource user groups manage public goods such as forest ecosystem services in Nepal, but also operate as private actors in timber markets. Panchayats (forest village councils) in India are among the oldest participatory natural resource management institutions. Moreover, many formal and informal mountain institutions have emerged from – and in turn contribute to – strengthening organizations of mountain people, including ethnic groups, federations, indigenous "nations" or social and political movements. Constituency make-up matters for institutions and organizations, because it directly influences the range of knowledge and experiences that can be mobilized.

Goals

Sustainable development is the balanced consideration of the economic, environmental and social aspects of well-being for current and future generations. Many institutions enable such balanced consideration and many organizations designate it as their overarching goal. Examples include the Consortium for Sustainable Development in the Andean Ecoregion (CONDESAN), the Sierra Nevada Conservancy and numerous national mountain policies around the world. However, not all components of the institutional framework for sustainable development currently relate to such a broad mandate. International treaties often specialize in one aspect, such as trade in endangered species or transboundary water management. Nor do all organizations focus their work on each aspect of sustainable development. Instead, many pursue specialized goals. The University of Central Asia is active in education and training. Payment for Ecosystem Services (PES) schemes in Costa Rica relate almost exclusively to forests. The mountain institutions and organizations presented on the following pages show that effective work has emerged from comprehensive as well as specialized orientations.

Operational reach

The third feature that distinguishes institutions and related organizations concerns the reach of operations. Numerous institutions have clearly delimited political jurisdictions. Most institutions that are tied to states are included in this category. Even where states have specific mountain policies, mountain regions are often delimited on the basis of subnational entities (e.g. provinces, counties, regions, cantons). For other institutions, the primary reference is not jurisdictional but ecoregional. A mountain range can be the overarching referent, but mountains are also home to so-called functional regions: watersheds, metropolitan systems, protected areas or linguistic regions. Such delineations always emerge from social and political processes. As such, they are often subject to debate. This is one reason why attention to the operational reach of institutions and organizations is significant. Where functional regions overlap with established jurisdictions, multiple institutions come into contact. The result can be synergy or conflict. A transboundary institution such as the Andean Community of Nations can raise awareness of issues best addressed collectively. But overlap can also have negative consequences, for instance where ethnic groups are marginalized because their mountainous origin is split by state boundaries.

Institutions and organizations found in mountain regions combine these features in countless ways, from local to global levels. The resulting diversity is an important asset for a number of reasons. When similar problems are addressed in different institutional and organizational contexts, various problem-solving approaches emerge. Similarly, learning processes are accelerated when effective solutions can be identified and transferred. In this respect, organizations such as CONDESAN, the International Centre for Integrated Mountain Development (ICIMOD) and the Mountain Research Initiative (MRI) have developed significant expertise.

Linking across levels

The examples presented in this report are testimony to the rich and diverse institutional landscape that has evolved in and around mountains. Most of these institutions and organizations focus on one level: local, national, regional or global. However, many mountain institutions and organizations have also developed extensive links across these levels, or explicitly polycentric structures. The Mountain Partnership primarily works through regional initiatives. Regional mountain institutions and initiatives in the European Alps, the Caucasus and Central Asia are linked to national levels through state public administration officials, and to local levels via networks of municipalities. Conversely, local-level institutions are often linked to actors at the regional and global levels through development assistance and the implementation of international treaties.

These linkages serve many purposes: information exchange, knowledge dissemination, collective learning, resource mobilization and sharing, and policy development. With the growing recognition that multilevel governance arrangements are imperative for sustainable development, mountain institutions and organizations are well placed to make a significant contribution to the post Rio+20 sustainable development agenda. The following pages offer a glimpse of the diversity of efforts in and for mountain regions.

Institutions at the global level

At the 1992 Earth Summit, mountains were recognized for the first time as a global priority for collective and coordinated public action in the interest of nature conservation and sustainable development.

Excursion during Mountain Partnership Global Meeting 2013, Erzurum, Turkey (T. Kohler)

Natural scientists had suggested their special relevance since the turn of the nineteenth century, yet mountains were absent from global governance deliberations until the heads of state or government at the Summit approved a specific Agenda 21 chapter devoted to them (Chapter 13, "Managing Fragile Ecosystems: Sustainable Mountain Development"). Ten years later, the importance of mountains was confirmed in the World Summit on Sustainable Development (WSSD) Plan of Implementation. It noted that "mountain ecosystems support particular livelihoods and include significant watershed resources, biological diversity and unique flora and fauna" and that "many are particularly fragile and vulnerable to the adverse effects of climate change and need specific protection" (Article 42). Also in 2002, the organization of an International Year of Mountains (IYM) made a significant contribution to worldwide awareness of the importance and contribution of mountain regions to global diversity.

In the two decades after the Earth Summit, the "globalization of mountain issues" co-evolved with rising global concerns for climate change and biodiversity loss, global initiatives for poverty alleviation and efforts to recognize cultural minority rights. The world's numerous mountain regions and societies appeared both to be unique and to share a common need to address these challenges. For this reason, mountains (alongside other regions) have been specifically identified in international treaties such as the Convention on Biological Diversity (1992, see portrait on pp. 92–93), and in global research programmes (see portrait of the Mountain Research Initiative on p. 98). Additionally, numerous international organizations have provided extensive support to mountain regions. Some of them make their mountain focus explicit; many

more do not, yet they address important dimensions of sustainable mountain development such as adaptation to climate change, hazard prevention, poverty alleviation, water resource management and biodiversity conservation. For example, the World Bank invested more than US$70 billion in mountain regions of Latin America, Central Asia and Africa between 2000 and 2010; in its first decade of existence, the Global Environment Facility (GEF) leveraged more than US$2 billion in support of mountain-related projects in 64 nations; FAO's Watershed Management and Mountains Programme has been active in over 40 countries since 1992.

Following the 2002 WSSD, a global partnership for mountains (see portrait on pp. 89–90) was created to mobilize actors in support of global governance for a wide array of thematic issues more or less specific to mountain regions. The ascent of the global level in the framing of mountain issues has also generated initiatives by mountain people themselves. The World Mountain People Association (see portrait on pp. 94–95) was created in 2002 to offer people from mountain areas the opportunity to make their own voices heard and be represented at international conferences.

Participants in the globalization of the Mountain Agenda have always emphasized that knowledge and governance should be organized at all levels. Indeed, the diversity of natural and human conditions in mountain areas and the heterogeneous status of mountain regions in national contexts and policies have required that global awareness and action be combined with the development of local, national and regional initiatives.

The Lötschenlücke (3170 m), a mountain pass in the Swiss Alps that enjoys great popularity among hikers (C. Lardelli)

Event at the Mountain Pavilion, Rio+20 Summit, 2012, Rio de Janeiro, Brazil (T. Kohler)

Accordingly, the Mountain Partnership (see portrait below) and the Mountain Research Initiative have developed regional approaches to account better for the specificity of regional circumstances. IYM and WMPA activities largely focused on the national level in order to reach and involve states more effectively. In some cases, global initiatives related to mountain issues consist of networking among local or regional institutions: Some decades after having designated the first biosphere reserves, UNESCO developed a specific project for connecting Mountain Biosphere Reserves (see portrait on p. 94) in a network aimed at optimizing the exchange of knowledge and experiences, and at transferring scientific knowledge into policy.

The heterogeneity of mountain regions is a key resource at a time of unanimously celebrated biological and cultural diversity. Any attempt to globalize issues and institutions has to take this heterogeneity into account. At times, the staggering diversity makes it difficult to design instruments at the global level. During the last few years, interested parties periodically discussed the possibility of promoting an international convention for sustainable mountain development (SMD), especially during the 2010 Global Change and the World's Mountains conference in Perth, Scotland. However, the proposal has faced an uphill struggle against the high diversity of regional and national contexts.

Mountain Partnership

A global instrument for multistakeholder cooperation

The Mountain Partnership (MP) is one of the most important outputs of the sustainable mountain development agenda between the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro and the 2002 World Sum-

mit on Sustainable Development (WSSD) in Johannesburg. Emerging ten years after the adoption of Chapter 13 of Agenda 21 (the mountain chapter), the MP is one of many so-called Type II partnerships developed at the WSSD. It aims to enhance stakeholder collaboration on a variety of thematic and regional sustainable development agendas. The Food and Agriculture Organization of the United Nations (FAO), Italy and Switzerland have provided substantial funding; FAO hosts the MP Secretariat.

The MP comprised about 40 members when it was first launched in 2002, and has grown to 236 members, of which 53 are governments, 14 are intergovernmental organizations, and the majority are major groups from civil society, NGOs and the private sector. With the financial support of its donors, two Global Meetings were held in Italy (2003) and Peru (2004). These meetings were instrumental in setting priorities and in defining the modus operandi of the alliance.

In the following years, the MP prioritized a regional focus leading to the establishment of decentralized hubs for mobilizing existing actors and networks and for providing services and support to members at the regional level. Important regional and international organizations have developed strong ties with the MP, benefiting from political and technical support as well as knowledge exchange. At the international level, mountains have been represented at high-level meetings and events during the Conferences of Parties of the three Rio Conventions (biodiversity, climate change and desertification), in deliberations of the UN Commission for Sustainable Development, and at other global events such as the World Forestry Congress and major FAO conferences. An open dialogue is maintained between the Secretariat and MP members.

In 2011, the World Bank – also a member – financed the MP Secretariat to promote a better understanding of climate change impacts in mountainous countries. In the run-up to the Rio+20 Summit, the Secretariat actively mobilized its members to ensure that mountains were represented in the summit documents, and the MP joined the organizing committee of the Rio+20 Mountain Pavilion, where answers that mountains can provide to the challenges of our times were showcased. As part of an overall restructuring exercise, the MP is now seeking to make collaboration more coherent, coordinated and synergistic.

Further information
Mountain Partnership — www.mountainpartnership.org

Mountain Forum

The first NGO consultation on the Earth Summit's Mountain Agenda took place in Peru in 1994, producing a list of priorities and establishing strong connections among organizations and individuals working on and in mountains. Recognizing an urgent need to continue the dialogue, the 110 participants decided to create a Mountain Forum (MF) to promote conservation and sustainable development in the world's mountains. An organizing committee met the following year to establish a forum for mutual support and the exchange of ideas and best practices. With the support of the Swiss Agency for Development and Cooperation and the FAO, a secretariat and five regional nodes were established (Africa, Asia, Europe, Latin America and North America), with initial responsibilities shared among The Mountain Institute, the International Centre for Integrated Mountain Development and CONDESAN. Some regional nodes later created subregional nodes to accommodate multiple linguistic groups.

Workshop at the 2010 mountain conference in Perth, Scotland (C. Drexler)

The vision of the MF is to be an innovative and integrative bridge between diverse organizations and individuals that will empower all participants to raise mountain issues at local, national, regional and international levels, and promote policies and actions for equitable and ecologically sustainable mountain development.

From a small core, the MF has grown to over 7 600 individual members working in almost every mountain range in the world, and over 200 institutional or organizational members that share MF information among their own large group of scientists, policy-makers, practitioners, technical and other staff. Today, the MF provides connections through its large base of users. Joining is free, but users must consent to abide by agreed behavioural norms for electronic communications.

Among other services, the MF pursues its goals through:

- promoting membership and user databases, and raising funds to support the network;
- electronic and traditional exchange of information and best practice, responding to priorities of users;
- conducting periodic e-conferences on issues of interest to users; and
- maintaining a digital repository or online library of mountain publications, including grey literature.

The Mountain Forum's active and successful networking provides timely information about upcoming events, grant opportunities, scientific developments, news and events; it also serves as a resource for practitioners.

Further information
Mountain Forum — www.mtnforum.org

Rhododendron bloom, Yunnan, China (Yi Shaoliang)

Convention on Biological Diversity

Promoting the conservation and sustainable use of mountain biodiversity

The 1992 Convention on Biological Diversity (CBD) is an international treaty with three main goals: conservation of biodiversity; sustainable use of biodiversity; and fair and equitable sharing of the benefits arising from the use of genetic resources. Mountains are specifically mentioned in Article 20 of the Convention. It states that, with regard to funding and transfer of technology, developed country Parties shall take into consideration "the special situation of developing countries, including those that are most environmentally vulnerable, such as those with arid and semi-arid zones, coastal and mountainous areas". Since mountains are cross-cutting in nature – they contain forests, dry and subhumid lands, inland waters, agricultural biodiversity, some are on islands or in protected areas – all other articles of the Convention and many Decisions of the Parties apply to mountain biological diversity.

In its eighth and ninth meetings, the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) considered the status, trends and threats to mountain biological diversity, as well as measures for the conservation and sustainable use of mountain biological diversity. It proposed the structure, elements and goals of a work programme on mountains. The Programme of Work on Mountain Biological Diversity was adopted by the seventh Conference of Parties in 2004 (Decision VII/27).

The implementation of the Programme of Work aims to make a significant contribution to poverty alleviation in mountain ecosystems and in lowlands that depend on the goods and services produced in mountain ecosystems, thereby contributing

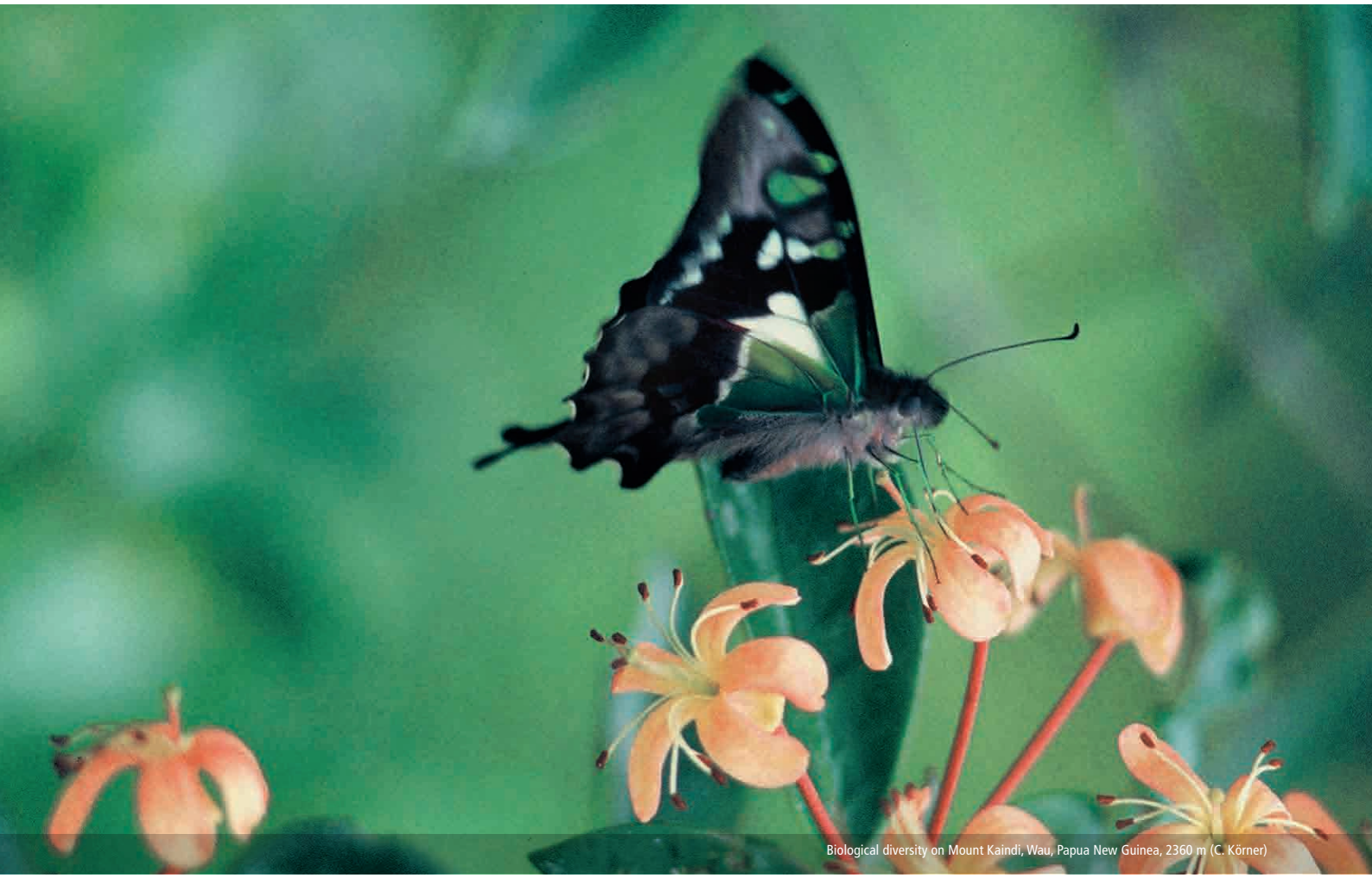
to the objectives of the Strategic Plan of the CBD, the Plan of Implementation of the WSSD and the Millennium Development Goals.

The Programme of Work is intended to assist Parties in establishing national work programmes with targeted goals, objectives and actions, and with specific actors, time frames, inputs and expected measurable outputs. It consists of three interlinked elements – direct actions, means of implementation and supporting actions – and focuses on addressing characteristics and problems that are specific to mountain biological diversity:

- The particularly high concentration of biodiversity hotspots in mountain regions;
- Cultural diversity and the key role of indigenous and local communities in the conservation and management of mountain biological diversity;
- The fragility of mountain ecosystems and species and their vulnerability to human and natural disturbances; and
- The upland–lowland interactions that characterize mountain ecosystems.

In 2010, Parties to the CBD adopted the Strategic Plan for Biodiversity 2011–2020, a ten-year framework for action by all countries and stakeholders to safeguard biodiversity and the benefits it provides to people. The Strategic Plan confirms mountain biodiversity as the focus of one of seven thematic programmes of work.

Further information
Convention on Biological Diversity — www.cbd.int



Biological diversity on Mount Kaindi, Wau, Papua New Guinea, 2360 m (C. Körner)

UNESCO's Mountain Biosphere Reserves

Mobilizing local assets to tackle global issues

The United Nations Educational, Scientific and Cultural Organization (UNESCO) launched the Man and the Biosphere (MAB) programme in 1971. As an Intergovernmental Scientific Programme, the MAB programme promotes interdisciplinary approaches to the conservation and rational use of natural resources. One of its essential features is the designation of Biosphere Reserves, where conservation and sustainability strategies are implemented. In 1977, a World Network of Biosphere Reserves was established to encourage cooperation through experience sharing between the reserves.

Mountains are now the focus of one of the MAB programme's eight ecosystem and theme-specific networks. From 1972 to 1991, a specific subprogramme (MAB-6) addressed the impact of human activities on mountain and tundra ecosystems. This interdisciplinary research programme fostered the organization of science devoted to mountains at the global level. Additionally, UNESCO has assisted in the development of international expertise on mountains through support given to research activities, conferences and publications, and two university chairs in sustainable mountain development (University of the Highlands and Islands, Scotland; International University of Kyrgyzstan, Kyrgyzstan). A key outcome of the UNESCO support to mountain issues has been the drafting of the Global Change in Mountain Regions research strategy (see portrait of the Mountain Research Initiative on p. 98).

Over the past decade, the MAB mountain programme has begun to address global environmental change, especially human-induced climate change. A number of Mountain Biosphere Reserves are being used as study and monitoring sites to assess the impacts of these changes on mountain ecosystems. This is a good illustration of the cumulative knowledge gained locally in these Biosphere Reserves to tackle global issues. More recently, UNESCO launched a research programme to develop strategies of adaptation to global climate change in Mountain Biosphere Reserves.

Further information

Biosphere Reserves — *www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/*

Schaaf, T. 2006. UNESCO's role in the conservation of mountain resources and sustainable development, *Global Environmental Research*, 10(1): 117–123.

The World Mountain People Association

Bringing the voice of mountain people into global arenas?

The rise of mountain issues at the global level since the early 1990s has been widely fuelled by the intention of many to improve the living conditions of people in mountain regions. Some NGOs, such as the Panos Institute, and some IGOs, such as FAO, have been especially active in domains as different as the collection of cultural testimonies, the recognition of traditional ecological knowledge in mountain forest management and the diffusion of improved models of domestic furnaces.

For some actors, however, merely mentioning mountain people's needs and expectations in a global Mountain Agenda was not enough. Their alternative was to become active participants in the decision-making process and to build political institutions liable to be recognized by other institutions. This took place in many contexts at the local (thanks to democratic and decentralized processes of consultation and decision-making in many countries) and regional levels (see case studies on pp. 105–108). National associations of politicians elected in mountain regions have been

The Carpathian Biosphere Reserve, Ukraine (J. Fall)

created throughout the twentieth century, first in Western Europe (see case studies on Switzerland and France, pp. 115–116 and 118–119) and later in many other regions. In 2000, some of these national associations launched the World Mountain People Association (WMPA), officially created in 2002 during a global meeting in Quito, Ecuador. It aimed at lobbying and ensuring a presence of representatives of mountain regions in global conferences and institutions devoted to mountains.

The WMPA has developed national sister associations, such as WMPA Morocco or WMPA Madagascar, to optimize its capacity for reaching national administrations and governments. It organizes regional workshops when specific issues (illegal crops in Mediterranean mountains, labelling of mountain products in the Himalayas, etc.) are of common interest to communities in different countries. From time to time, local and national representatives gather in global meetings to facilitate the exchange of knowledge and experiences.

The WMPA is certainly not as strong as many global NGOs, nor does it have as many members as some indigenous confederations. Its annual budget is modest and its capacity to develop a worldwide network is, at present, limited. However, it illustrates the persistent need to challenge and improve inadequate political representation of so-called mountain people.

Further information
World Mountain People Association — www.mountainpeople.org

Agricultural terraces near the village of Al Ain, Al Jabal Al Akhdar, Oman (M. Price)

Mountain Scientific Journals

The institutional framework for sustainable mountain development has benefited significantly from scientific insights, and scientific journals are one of the principal venues through which new knowledge is communicated.

Revue de Géographie Alpine / Journal of Alpine Research

The *Revue de Géographie Alpine / Journal of Alpine Research* (RGA) was founded in 1913 by the French geographer Raoul Blanchard. Since 1968, it has been managed by the Association of Alpine Geography at the University Joseph Fourier in Grenoble, France. The RGA is an international, multidisciplinary and bilingual (French/English) journal that publishes scientific papers on regional and environmental problems concerning the Alpine Arc and European mountain areas; comparative analyses relating to other mountain areas of the world are frequently included in special thematic issues.

Mountain Research and Development

Founded in 1981, *Mountain Research and Development* (MRD) was part of pioneering efforts to foreground mountains on the world's sustainable development agenda. In 2000, MRD was handed over to the Centre for Development and Environment, University of Bern. An enhanced concept differentiated more clearly between research and development. The International Mountain Society (IMS), the institutional base of the journal, was re-established as an association under Swiss law. Since 2009, MRD has been fully peer-reviewed and open access, with a 5-year impact factor for 2013 of 1.061 and a worldwide audience from over 120 countries. Many authors are from the global South. MRD's International Editorial Board and extensive editorial services guarantee high-quality articles cited by high-ranking journals. Focus Issues take up emerging sustainable development themes. A further particular value of MRD is its book review section; since 2002, over 200 reviews have been published.

Journal of Mountain Science

The *Journal of Mountain Science* (JMS) was started in 2004 as an international English-language journal on mountain sciences that introduces mountain research achievements of developing countries to interested parties worldwide. It publishes research and technical papers on mountain environment, mountain ecology, mountain hazards, mountain resources and mountain development. The bimonthly JMS is supervised by the Chinese Academy of Sciences and sponsored by the Chengdu Institute of Mountain Hazards and Environment. The journal's editorial board and reviewers represent some 18 countries and regions on five continents; the United Nations University participates in the editorial work and supports subscriptions for institutions in developing and transition countries.

eco.mont

The *Journal on Protected Mountain Areas Research and Management* (eco.mont) publishes peer-reviewed articles on research within protected mountain areas or of potential interest for protected area management; its geographic focus is on protected areas in the European Alps and in other mountain areas of Europe (and worldwide). Since 2009, eco.mont has been published twice a year; each issue also includes reports on management issues and showcases one protected area. The journal's editorial board consists of the members of the Working Group "Protected Area Research" of the International Scientific Committee on Research in the Alps.

Further information
Revue de Géographie Alpine / Journal of Alpine Research — http://rga.revues.org
Mountain Research and Development — www.mrd-journal.org
Journal of Mountain Science — www.springer.com/earth+sciences+and+geography/journal/11629
eco.mont — www.oeaw.ac.at/ecomont

Near Skogafoss, Iceland (E. Schneeberger)

Mountain Research Initiative

Networking mountain scientists and policy-makers around the world

The Mountain Research Initiative (MRI) is a global scientific promotion and coordination effort that recognizes the importance of dialogue between science and policy. MRI emerged during preparations for the 2002 International Year of Mountains, when three international research programmes (IGBP, IHDP and GTOS[5]) proposed a joint initiative to "achieve an integrated approach for observing, modelling and investigating Global Change phenomena and processes in mountain regions, including the impacts of these changes and of human activities on mountain ecosystems".

The Initiative's governance structure consists of a Scientific Advisory Board (SAB) and a Coordinating Office with an Executive Director. Additionally, the MRI Global Commission (the SAB augmented with leading researchers) meets periodically to discuss the strategic direction of the mountain research community and suggest ways for MRI to support corresponding efforts. Since 2007, MRI's Coordination Office has been hosted by the Institute of Geography at the University of Bern, Switzerland.

MRI's vision is a global change scientific programme that detects signals of global environmental change in mountain environments; defines the consequences of global environmental change for mountain regions and lowland systems dependent on mountain resources; and informs sustainable land, water and resource management for mountain regions at local to regional scales.

These goals are pursued through four types of action at global and regional levels:

- initiating the formation of networks of researchers, engaging organizations with the issues and developing research activities;
- implementing actions that enhance the profile of global change research in mountain regions and otherwise help networks implement that research;
- integrating and synthesizing the results of research; and
- informing stakeholders of the nature and implications of global change processes in mountain regions.

MRI's commitment to facilitating science–policy dialogue is evident from its extensive networking activities. For instance, together with other partners, it played a key role in the recent project "Mountain Sustainability: Transforming research into practice" (Mountain.TRIP), which translated scientific results into guidance for practitioners of sustainable mountain development in Europe. Numerous "Key Contact Workshops" held at scientific conferences provide targeted opportunities for exchanging information and initiating interdisciplinary collaboration. Finally, MRI maintains an extensive multimedia archive of written resources, video presentations and project briefs.

Further information
Mountain Research Initiative (MRI) — http://mri.scnatweb.ch
Mountain.TRIP — www.mountaintrip.eu

[5] IGBP: International Geosphere-Biosphere Programme; IHDP: International Human Dimension Programme; GTOS: Global Terrestrial Observing System

Institutions at the regional level

For the last two decades, major UN conferences, commissions and agencies have promoted mountains as a major asset for global biodiversity, cultural and landscape diversity. However, given the countless differences among mountain ranges at various latitudes, regional approaches are essential, especially in terms of political institutions for coordinating environmental management and sustainable development strategies.

Workshop on wildlife management, Kavok, Tajikistan (S. Henriod)

Chapter 13 of Agenda 21 commits its signatories "[t]o improve coordination of regional efforts to protect fragile mountain ecosystems through the consideration of appropriate mechanisms, including regional legal and other instruments" (Paragraph 5.e). As noted above, the Mountain Partnership, soon after its creation at the WSSD (2002), focused most of its initiatives on regional events and projects. It is now becoming clear that if mountain stakeholders are to effectively raise global awareness of mountain issues and of the many goods and services of global value produced by mountain environments and societies, a broad range of challenges need to be addressed at the regional and transnational level. Tellingly, it has become commonplace to refer to mountain issues in the context of ecoregions (ranges, cordilleras, massifs, etc.) and transboundary cooperation, many international borders having been drawn with reference to mountains.

Institutional arrangements at the regional level are numerous, though there are only two transboundary international conventions to date: the Alpine Convention and the Carpathian Convention (see case studies). Committing several states and the European Commission (in the case of the Alpine Convention) to deal with many different issues and overarching sustainable development strategies, these treaties are probably the most ambitious institutions for mountain regions in the world. Drawing on these experiences, discussions to pursue similar initiatives elsewhere – including the Altai, Balkan Mountains, Caucasus and Dinaric Arc – have been or are currently being held. Also, in 2002, Kyrgyzstan, Tajikistan and Kazakhstan signed a Central Asia Mountain Charter, and in 2010, China, India and Nepal established a transboundary initiative for conservation and sustainable development in the Greater Mount Kailash Region.

Where international treaties have been difficult to negotiate or are poorly adapted to the circumstances, other kinds of institutions are implementing programmes and projects at the regional level. Among these, ICIMOD in the Himalayas and CONDESAN in the Andes (see case studies) are well-known organizations devoted

The Carpathian Biosphere Reserve, Ukraine (J. Fall)

to transnational coordination in applied research on mountain issues. In Europe, several types of institutions – INTERREG regional frameworks, Euroregions, European Grouping of Territorial Cooperation setups, transboundary working groups (Alps, Pyrenees, Jura) – have actively promoted transboundary cooperation. Finally, mountain issues are periodically addressed under the auspices of regional economic integration organizations such as the Andean Community of Nations (see portrait on pp. 101–102) and the Association of Southeast Asian Nations, or regional indigenous peoples' organizations such as the Asia Indigenous Peoples Pact.

Regional governance for sustainable mountain development need not always be intergovernmental. Indeed, many regional initiatives are implemented by non-state actors. Some of these, including the Yellowstone to Yukon corridor (see portrait on pp. 111–112), are ecoregional initiatives established by environmental organizations seeking to improve connectivity among protected areas in large mountain ecosystems. Others primarily focus on social issues. The Aga Khan Foundation is presently funding the creation of a tri-state university in Central Asia, with a focus on specialized training in environmental management, social development and health care (see portrait on pp. 109–110).

The institutional framework for sustainable mountain development has a very strong regional dimension, with numerous active institutions and organizations. Given the diversity of their structure, legal status and set of stakeholders, a wide array of models is already available. Such models can facilitate the building of new initiatives, in mountain areas and elsewhere.

Community organization, Chimborazo, Ecuador (S.-L. Mathez-Stiefel)

The Andean Community of Nations

Embracing mountains in the context of regional economic integration

The Andean Community of Nations (CAN; previously known as Andean Pact or Andean Group) was created in 1969 by Bolivia, Chile, Colombia, Ecuador and Peru, to jointly improve the living standards of their populations through integration and economic and social cooperation. Although the 8 000 km long Andes serve as the nominal reference point for this regional agreement, some parts of the range are not included (Chile withdrew in 1976, Venezuela in 2006).

During its early history, the Andean Group created subregional customs and trade agreements and established several common institutions. Since 1983, Community decisions, agreements and legislation have been directly applicable in Member States. The 1990s witnessed the formation of a free trade area, as well as efforts to expand and integrate the social, economic, cultural, environmental and political spheres in CAN's areas of action. This integrality is the main characteristic of CAN and has permitted, among other achievements, the free movement of citizens and the development of a supranational legal system.

Although the perimeters of CAN are defined by the nation state borders of its members, the mountain range they share has been the subject of specific attention for many decades. Already in the 1980s, several international organizations joined the Andean Pact in an initiative on the management and development of freshwater basins in high mountains. The institutional framework for supporting

sustainable mountain development evolved with the creation of the Andean Committee of Environmental Authorities in 1998 and the Council of Environmental Ministers in 2004. In 2002, CAN approved the Regional Biodiversity Strategy for the Tropical Andean Countries, the first of its type to be adopted by countries that are individually signatories of the Convention on Biological Diversity. Four years later, the Council of Environmental Ministers adopted a five-year Andean Environmental Agenda.

The Andean Community's initiatives are of significance both to the continent in general and to the mountain range in particular. Many undertakings make direct reference to the economic, social and environmental assets of the mountains, including the Strategy for Disaster Prevention and Relief, the establishment of a Consultative Council of the Andean Community Indigenous Peoples, and the Andean Charter for the Promotion and Protection of Human Rights. Many projects with international partners have focused on specific mountain challenges, such as a recent undertaking to monitor and adapt to the retreat of glaciers.

The Andean Community is an important illustration of sustainable mountain development. Compared to other regional mountain initiatives, CAN's activities have focused much more on socio-economic development than on environmental protection. Corresponding initiatives have also typically spanned highlands and lowlands, often emphasizing the interdependency of the two. In spite of direct applicability, however, implementing CAN norms at the national level and securing the political will for regional integration remains a significant challenge.

Further information
Andean Community of Nations — www.comunidadandina.org/endex.htm

CONDESAN

Linking research, practice and policy throughout the Andes

For over two decades, the Consortium for the Sustainable Development of the Andean Ecoregion (CONDESAN) has made invaluable contributions to sustainable mountain development. The organization was created in 1992 as a partnership of groups promoted by the International Potato Center and the International Development Research Centre. Three years later, CONDESAN became an ecoregional programme of CGIAR (Consultative Group on International Agricultural Research). Since 2009, CONDESAN has been an independent organization that serves as a regional platform for research for development. Headquartered in Lima, Peru, it is governed by a General Assembly of international associates and an Executive Director.

CONDESAN's institutional history reflects the importance of resilience and adaptation in mountain areas. With the support of international partners, the organization initially focused on linking researchers, development practitioners and stakeholders, and on identifying appropriate means for promoting the development of Andean agro-ecosystems. Over time, CONDESAN's mission and institutional structure turned to mobilizing the wealth of the Andes in order to overcome poverty and social exclusion. In the process, the organization faced difficult challenges related to the international funding environment and regional and subnational polarization.

Today, CONDESAN's objectives are to generate and share information and knowledge concerning sustainable development and environmental management in Andean rural societies; to promote policy dialogues with local actors, national governments and regional organizations; and to strengthen Andean human and

Bolivia's capital, La Paz (J. Voss)

institutional capital in order to promote new leaders for sustainable development. CONDESAN works in seven regional initiatives, involving 100 diverse organizations in nearly all countries of the Andean region.

Through its work, CONDESAN has obtained a reputation for providing spaces for reflection and consultation among Andean stakeholders; generating and positioning regional views of the cross-cutting challenges in environmental management on the public agenda; and contributing to concrete political change (e.g. territorial planning in Cajamarca, water rights laws in Bolivia or the conservation of paramos in Colombia, Ecuador and Peru). Some of its activities are internationally renowned, including InfoAndina, created in 1996, which has been recognized by international organizations as a leader in the management of information on sustainable development in the Andes.

Like many organizations of its type, CONDESAN is well connected. It is a member of the Mountain Partnership, the Mountain Forum and the International Mountain Society. It also represents the Mountain Forum and the Mountain Partnership Secretariat in Latin America, coordinates the CGIAR Challenge Program on Water and Food in the Andes, and acts as the focal point for the FAO Sustainable Agriculture and Rural Development in Mountains programmes.

Further information
Consorcio para el Desarrollo Sostenible de la Ecoregión Andina (CONDESAN) — www.condesan.org

International Centre for Integrated Mountain Development

Serving the countries of the Hindu Kush Himalayan region

Concerns for environmental degradation and the resulting ecological and economic problems in the Himalayas led to the establishment of the International Centre for Integrated Mountain Development (ICIMOD) in 1983. It was founded through an agreement between UNESCO and the Government of Nepal and with funding assistance from Switzerland and Germany. The establishment charter was later endorsed by seven additional countries – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar and Pakistan. Today ICIMOD is one of the largest intergovernmental organizations with a regional focus and has global outreach on environment and development research and knowledge sharing. It has more than 150 staff at its Kathmandu headquarters and a strong partnership with its eight member countries.

ICIMOD has emerged as the first international organization to focus on the complex and multiple problems facing the mountain areas in the Hindu Kush Himalayan region. With a mandate to provide scientific and technical advice and backstopping to its members, ICIMOD assumed a central role in the region. It promotes the Mountain Agenda regionally and globally, facilitates regional cooperation through knowledge exchange, enables information and data sharing on new and emerging aspects of mountain environment conservation and management, and helps reduce scientific uncertainties and gaps. ICIMOD has supported cross-country learning in adapting to and mitigating against climate change effects, accessing and adapting global knowledge to regional needs, and building strategic partnerships within and beyond the region.

ICIMOD owes its position within the region to four factors. First, congruity between its strategies, approaches and activities as well as those of member countries increases the quality and frequency of interaction and leads to meaningful joint decisions and actions. Second, ICIMOD strengthens regional collaboration through the implementation of regional programmes, for example in addressing climate change impacts in river basins, ecotourism and landscape conservation. Third, it has helped improve regional data and information sharing, and promoted the required information and communication technologies. Last, ICIMOD has benefited from the fact that globalization and climate change have increased awareness of the key role mountains play in the provision of ecosystem goods and services – especially water – beyond mountain regions.

Several important lessons inform ICIMOD's evolution. Regional ownership of ICIMOD's programme needs to increase because member countries carry out an increasing number of similar tasks, many of which are initiated by the same international donors, scientists and development practitioners who are also associated with ICIMOD. As knowledge solutions developed by ICIMOD have to be useful for solving the problems faced by its member countries, the organization has to shift its focus from the delivery of routine project outputs to strategic and policy-related products and move from a techno-centric to a people-centric approach. To this end, ICIMOD is becoming a regional think tank for mountain development and environmental issues and has been broadening its partnership and deepening its impacts.

Further information
ICIMOD — www.icimod.org

Swiss Alps Jungfrau-Aletsch UNESCO World Heritage Site, Switzerland (M. Eugster)

Alpine Convention

Developing a network of multilevel networks

The Alpine Convention is an international treaty on the protection and sustainable development of the European Alps. It was signed in 1991, entered into force in 1995 and counts eight Alpine countries and the European Union among its Parties. The project of creating a regional political institution at the level of the Alps began in 1952, when national representatives of nature protection and mountaineering organizations and the International Union for Conservation of Nature founded the International Commission for the Protection of the Alps (CIPRA) to promote the protection of the range under a single institution. CIPRA was thus one of the first organizations to introduce an ecosystemic approach at the level of a mountain range and to mobilize Alpine states for the international project. As the first international treaty for a mountain region, the Alpine Convention has become a source of inspiration for many other regional initiatives (see case study on pp. 107–108).

The initial decade of the treaty's existence saw the development and signature of thematic protocols on spatial planning and sustainable development, conservation of nature and countryside, mountain farming, mountain forests, tourism, energy, soil and transport, as well as a protocol on conflict resolution. The protocols provide common guidance for public policies in the Alps.

Pasture in Queyras, France (G. Rudaz)

During the last ten years the Parties to the Convention focused on implementation. A Permanent Secretariat was established in Innsbruck (Austria) and Bolzano (Italy), and a Compliance Committee was set up to review progress in applying the framework convention and protocols. More recently, the Alpine Convention began to address new challenges by means of non-binding Ministerial declarations (population and culture, climate change), ad hoc working groups (e.g. transport, demography and employment) and platforms (e.g. water management, large carnivores), guidelines (e.g. use of small-scale hydropower) and the production of scientific reports (e.g. sustainable rural development and innovation).

Despite its achievements as a pioneer in regional mountain cooperation, drawbacks have also been identified and consequently a broad discussion on how to improve the effectiveness of the Alpine Convention has been launched. This refers in particular to the level of implementation of the protocols, the involvement of regional and local stakeholders and the scope of the policies beyond the environmental dimension. At the same time, it should not be forgotten that the Alpine Convention has been developing significant transnational territorial policies. It has also fostered several networks of stakeholders that anchor its spirit in the daily activities of constituents, including a network of scientists representing national or subnational academic institutions (International Scientific Committee on Research in the Alps); the Alpine Network of Protected Areas; the Club Arc Alpin, founded by national Alpine Clubs to coordinate action at the level of the range; and networks of municipalities and other parties (Alliance in the Alps, Alpine Town of the Year, Pearl of the Alps) that promote sustainable development and showcase good practices in their localities. The rise of these Alpine networks has lent substance to the idea that the Alps are becoming a political entity of a new kind. This entity is empowering a wide range of actors, some of them professing to be driven by a common "Alpine identity".

Further information
Alpine Convention — www.alpconv.org

Participants of the Forum Carpaticum, 2012, Stará Lesná, Slovakia (Forum Carpaticum)

Carpathian Convention

Adapting from Alpine experience

The Carpathians extend 1 500 km across seven Central and Eastern European States (Czech Republic, Hungary, Poland, Romania, Serbia, Slovak Republic and Ukraine). In 1998, the WWF Danube-Carpathian Programme Office (DCPO) established the Carpathian Ecoregion Initiative as a partnership of 50 environmental organizations, which started promoting pan-Carpathian environmental cooperation. The first concrete step towards institutionalizing such cooperation was taken at the Summit on Environment and Sustainable Development in the Carpathian and Danube region in Bucharest in 2001. Organized by the Romanian government in cooperation with the WWF DCPO, fourteen representatives of governments from the region attended the Summit alongside numerous international organizations and the European Commission. The Carpathian countries adopted the 'Declaration on Environment and Sustainable Development' in the Carpathian-Danube region, which encouraged and supported "activities for developing new intergovernmental regional instruments for conservation and sustainable development in the Carpathian region".

Soon after the Bucharest Summit, the Government of Ukraine officially requested that the Regional Office for Europe of the United Nations Environment Programme (UNEP/ROE) facilitate an intergovernmental process of regional cooperation towards the protection and sustainable development of the Carpathian region. Additional support was provided by the Italian Presidency of the Alpine Convention. In May 2003, the environment ministers of the seven Carpathian countries signed the Convention on the Protection and Sustainable Development of the Carpathians (Carpathian Convention) in Kiev, Ukraine. The Convention "provides the framework for cooperation and multi-sectoral policy coordination, a platform for joint strategies for sustainable development, and a forum for dialogue between all stakeholders involved". The Framework Convention defines general objectives and is implemented through thematic protocols. One of these has already entered

into force (Protocol on Conservation and Sustainable Use of Biological and Landscape Diversity), while two more were signed during the Third Conference of the Parties in Bratislava, 2011 (Protocol on Sustainable Tourism, Protocol on Sustainable Forest Management).

Since the signing of the Convention, numerous pan-Carpathian projects have been launched. To this end, the Interim Secretariat of the Carpathian Convention, hosted by the Vienna Office of UNEP/ROE, has played a central role. Concrete outcomes to date include the establishment of the Carpathian Network of Protected Areas (2006), the Carpathian Environmental Outlook (2007), the Carpathian Wetland Initiative (2007) and the formulation of "Visions and Strategies in the Carpathian Area" (2009). More recently, two transnational projects were initiated to support the implementation of the Convention's biodiversity protocol and to contribute to European Union policies on adaptation to climate change.

The European Academy of Bolzano, Italy, has also played a key role in providing scientific and technical expertise, based on its Alpine experience. Following up on an Alpine–Carpathian partnership launched in 2002, a Memorandum of Understanding between the Alpine Convention and the Interim Secretariat of the Carpathian Convention was signed in 2006. The connection between the two mountain ranges became even more tangible through the EU project "Alps–Carpathians Corridor" (2009–2012), which aims to facilitate ecological connectivity between the Alps and the Carpathians. The collaboration between the two mountain ranges was recognized as a model during the World Summit for Sustainable Development in Johannesburg.

Further information
Carpathian Convention — www.carpathianconvention.org

High Tatra Mountains seen from Strba, Slovakia (J. Švajda)

Box 2.1 | Science for the Carpathians (S4C)

S4C is a regional scientific network that facilitates, coordinates and enhances collaborative research across disciplines and national boundaries in the Carpathian mountain region. It advocates a Carpathian research area for pan-Carpathian research. Created in 2008 in collaboration with MRI, S4C brings together scientists from Carpathian countries, as well as scientists worldwide working on the Carpathians. Through its activities, S4C provides scientific support to sustainability initiatives in the Carpathian region. The Forum Carpaticum is the main event organized by S4C. Its objective is to integrate different fields of expertise, link research and practice, and stimulate networking between researchers. The first Forum Carpaticum took place in Krakow, Poland, in 2010. In 2011, the network published the Research Agenda for the Carpathians. At the second Forum Carpaticum in Stará Lesná, Slovakia (May 2012), S4C signed a Memorandum of Understanding with the Carpathian Convention to improve coordination between research agendas and political needs.

Further information
Science for the Carpathians (S4C) — mri.scnatweb.ch/mri-europe/carpathians/

University of Central Asia

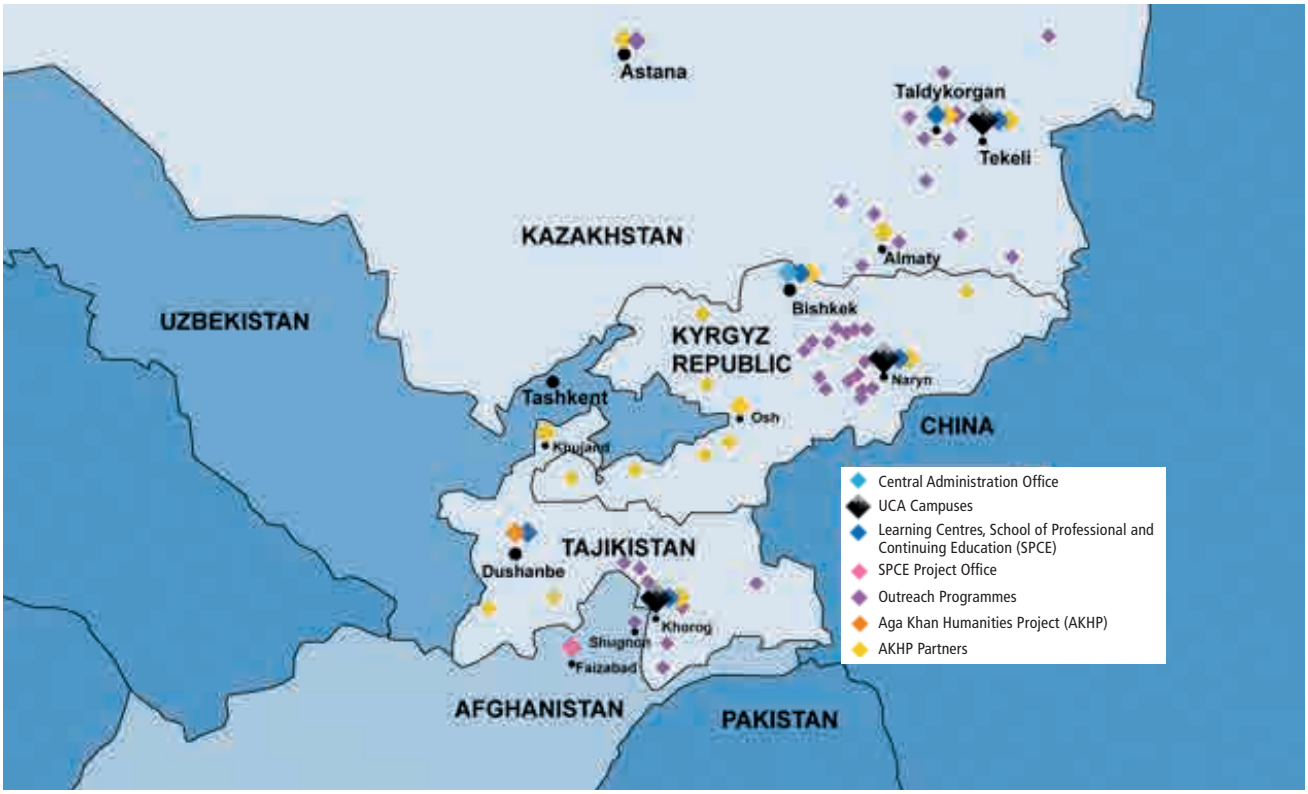
The "Mountain University"

The University of Central Asia (UCA) was founded in 2000 by a treaty between the governments of Kazakhstan, Kyrgyzstan, Tajikistan and His Highness the Aga Khan. UCA's mission is to promote the social and economic development of Central Asia, particularly its mountain societies, while at the same time helping the different peoples of the region to preserve and draw upon their rich cultural traditions and heritage as assets for the future. An innovative public–private partnership, and the world's first internationally chartered institution of higher education, UCA is a single university operating across three campuses. These are located intentionally in remote mountain areas to deliver high-quality education to local communities, while also serving as a springboard for investment and entrepreneurship, and as the front line for regional social cohesion.

UCA's commitment to regional development is reflected in its approach to starting a new university. The approach begins with community-based, market-relevant, short-term educational and training programmes. It is followed by rigorous research initiatives that bring together regional and international scholars to establish UCA as a centre of knowledge to address complex regional problems. Based on these programmes, UCA is developing undergraduate and graduate degree programmes, to be launched in 2016 when campus construction is complete. Campus architecture and parks will incorporate materials and elements of surrounding mountain environments.

UCA's focus on mountains can be traced back to the long-term commitment and experience of the Aga Khan Development Network, in which UCA is embedded, and its various programmes in the mountain regions of Central Asia. In 2011, UCA launched the Mountain Societies Research Centre (MSRC), a university-wide, interdisciplinary research centre dedicated to supporting and enhancing the resilience and quality of life of mountain societies through sound research on the sustainable development and management of their physical, social, economic and cultural assets.

In addition to providing unique opportunities for Central Asian and international researchers and practitioners, MSRC serves as a regional focal point for key in-



The University of Central Asia is a regional development university with facilities and activities in mountain areas of Kazakhstan, Kyrgyzstan, Tajikistan and Afghanistan (map by UCA)

ternational networks such as the Mountain Partnership and has an expanding network of partnerships, including with the University of Bern's Centre for Development and Environment. Other initiatives at UCA include the Institute of Public Policy and Administration, which aims to improve evidence-based public policy in the region through research, policy analysis and active engagement with stakeholders in government and civil society. UCA's Cultural Heritage Publication Series supports Central Asian scholars who conduct original, high-quality research, and publish and disseminate their work to regional and international audiences, highlighting the unique and endangered cultural traditions of mountain and other communities of Central Asia.

UCA has achieved an extensive reach in the region during its pre-operational phase. Since 2006, the School of Professional and Continuing Education has reached over 40 000 learners. Through programmes of the Aga Khan Humanities Project, 172 university faculty from regional institutions have been trained by UCA to implement its innovative multidisciplinary humanities curriculum reaching 6 000 students. To develop UCA's future faculty, 42 Central Asian students are pursuing graduate studies at international universities under the Central Asian Faculty Development Programme. UCA is among the largest direct and indirect employers at its campus locations, and is the leading educational publisher in Central Asia.

Further information
University of Central Asia — www.ucentralasia.org

Box 2.2 | Alliance of Central Asian Mountain Communities (AGOCA)

Created in 2003, with inspiration from the Alliance in the Alps, AGOCA is an association of mountain villages of Kazakhstan, Kyrgyzstan and Tajikistan. Members are 'Territorial Public Self-governance Bodies', citizen associations that carry out development projects and communicate needs, ideas and visions to state representatives at the local level, and negotiate with them. AGOCA seeks to improve the living conditions of mountain communities. It mainly focuses on awareness raising and capacity building. The Alliance is involved in training villagers and fostering exchange of experiences among its members. AGOCA has 37 members (18 in Kyrgyzstan, 14 in Tajikistan and 5 in Kazakhstan).

Further information

AGOCA — www.camp.tj/index.php?page=agosa&language=eng

Nikonova, V., Rudaz, G. & Debarbieux, B. (2007). Mountain communities in Central Asia: Networks and new forms of governance. *Mountain Research and Development* 27(1): 24–27.

Yellowstone to Yukon Conservation Initiative

Connecting habitats

The Yellowstone to Yukon Conservation Initiative (Y2Y) targets a vast region of more than 1.3 million km^2. Measuring 3 200 km in length and 500–800 km in width, it encompasses five US states (Montana, Idaho, Wyoming, Oregon and Washington), and four Canadian provinces (Alberta and British Columbia) and territories (Yukon and Northwest Territories). The region comprises three main mountain ranges: the Rocky Mountains, Columbia Mountains and Mackenzie Mountains.

Teton Mountain Range in Wyoming, USA (W. Francis)

Y2Y promoters characterize the region as "the last intact mountain ecosystem in the entire American Cordillera, outside of Alaska". The idea of "wilderness" is a key driver of the initiative because the region faces various pressures caused by human activities: resource extraction (mines, oil, gas, timber, hydroelectric power generation), industrial development, road construction and urban expansion.

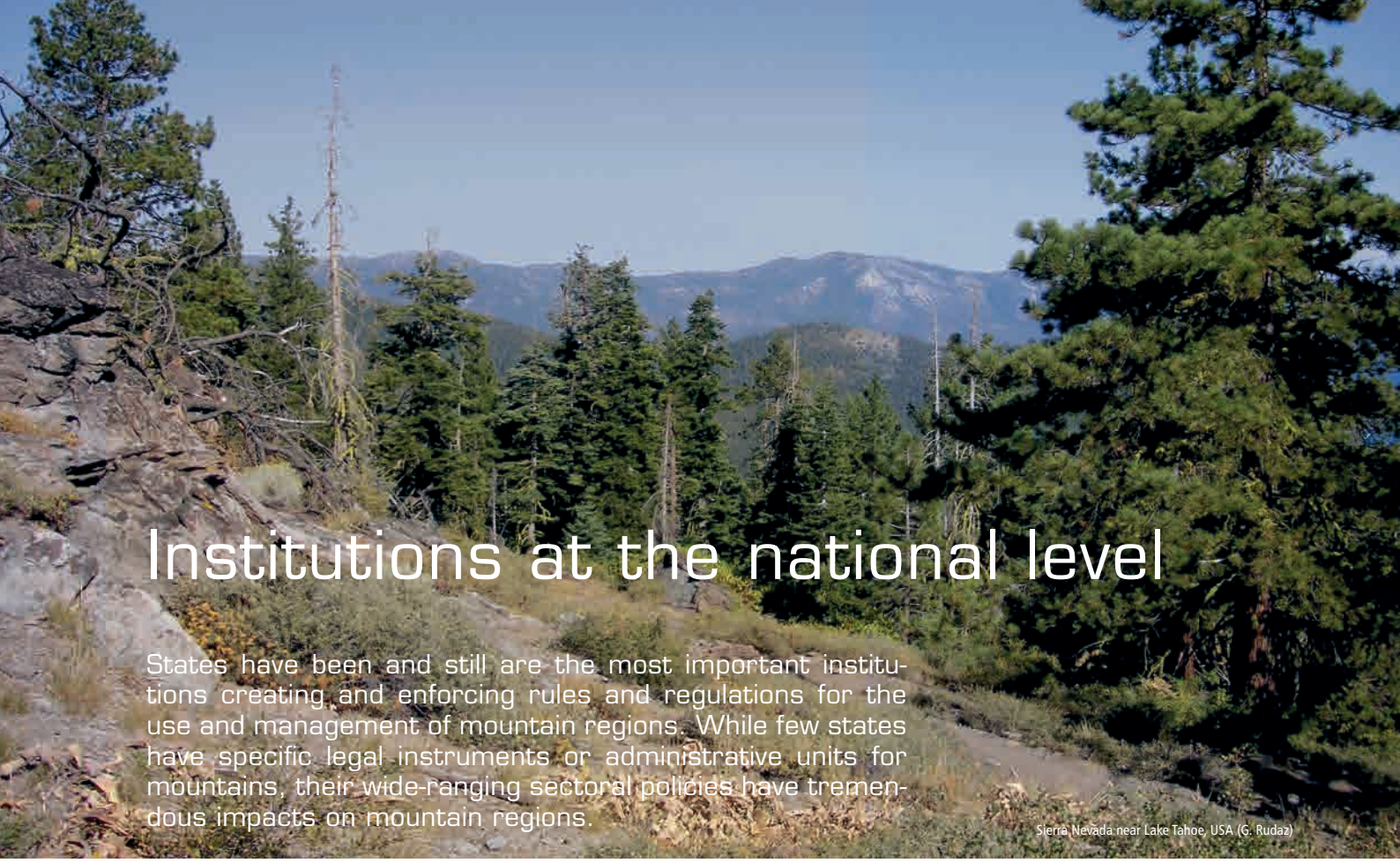
To address these pressures, a group of US and Canadian scientists and conservationists met in 1993 to develop a regional vision stretching from Wyoming to the Yukon. This vision led to the creation of the Y2Y Initiative in 1997. Y2Y is organized as a not-for-profit organization with offices on both sides of the international border. Funding for its work comes from grants from foundations and governments, donations from individuals, corporate sponsorships and periodic fundraising events.

Y2Y plays an important role in catalysing and facilitating local conservation action by a large number of partners throughout the region. Y2Y supporters include local grassroots and community groups; government agencies; funders (both institutional and individual); Native American and First Nations communities and organizations; scientists and researchers; businesses; and concerned citizens. In the first ten years of its existence, Y2Y helped channel US$45 million to support biodiversity conservation efforts in the region.

Nature preservation in the North American Rocky Mountains has a long history. Yet the Y2Y promoters view themselves as "one of the first groups to apply large-landscape conservation principles to a mountain environment". Y2Y is all about connectivity, a concept used by conservation biologists. It refers to a system of connections between ecosystems for sustaining habitats and populations, for instance of large predators such as the emblematic grizzly bear. Connectivity-oriented conservation is suited to the Y2Y region, where different kinds of protected areas have increased significantly in number and area and now account for 20 percent of the land.

Further information
Y2Y Initiative — www.y2y.net

Grizzly Bear in action, USA (F. Schulz)



Institutions at the national level

States have been and still are the most important institutions creating and enforcing rules and regulations for the use and management of mountain regions. While few states have specific legal instruments or administrative units for mountains, their wide-ranging sectoral policies have tremendous impacts on mountain regions.

Sierra Nevada near Lake Tahoe, USA (G. Rudaz)

Trade liberalization, privatization, agriculture and forest policies, energy development, cultural minorities, tourism development and many other specific themes or sectors have various consequences in mountain areas and for the people who live there. Quite often these consequences are more or less anticipated and taken into account.

During the last 150 years, many states (mostly in Europe) have progressively assigned mountain areas a special role in sectoral policies. In almost all Alpine and Mediterranean countries, policies for agriculture, forestry, tourism and nature conservation included specific mountain provisions. Starting in the 1960s, Italy, Switzerland and France (see case study on pp. 115–116) have also created regional multisectoral laws that determine the goals and modes of development and conservation in mountain regions. During the 1980s and 1990s these approaches came under heavy criticism and were gradually reoriented towards self-reliance and endogenous development. In some countries such as Switzerland, recent legislative reforms have weakened the special role of mountain regions (see case study on pp. 118–119).

The global recognition of mountain issues, which major events and documents made possible during the last two decades, highlights the importance of the national level in defining the legal status of mountain regions and in ensuring their place in sectoral policies. During the International Year of Mountains (IYM), states were not only the principal actors in the celebration of mountain assets, but also the targets for calls to formally recognize the value of mountain environments and the rights of the people who live in them. Almost 80 countries officially contributed to the IYM agenda. Many of them used the opportunity to place mountain issues on national policy agendas. However, many states have yet to follow this trend. In some countries, mountain laws and institutions at national level are considered unnecessary. In the United States, for instance, most mountainous land is administered by the federal government under sectoral policies (but see case study

Dry pasture, Tibet (D. Maselli)

on pp. 119–120); socio-economic issues are seen through the lens of rural–urban differences, rather than upland–lowland dynamics. In many developing countries, such as Ecuador, Bolivia and Nepal, the main advocates of mountain populations include federations of indigenous movements.

In centralized countries such as China, Viet Nam or Morocco, where mountain regions are home to cultural minorities, the national government is often reluctant to give official recognition to mountain regions and people. In such contexts, states may commit themselves to regional centres of competence and development programmes, such as ICIMOD in the Himalayas. Regional activists or representatives of cultural minorities in mountain areas may also join transnational or even global organizations in order to gain international recognition and argue for autochthonous rights. In Morocco, for example, a minority of Berber activists has mobilized transnational Berbers and mountain people's associations.

States continue to be major protagonists in facilitating (or undermining) the making of institutions for mountain regions. Since the early 1990s, however, global and transnational initiatives have greatly influenced state action in this field. Accordingly, institutional frameworks for sustainable development strategies in mountains and beyond are increasingly organized in complex and multilevel arrangements.

View from Jura, France (G. Rudaz)

Mountain Policies in France

The building of a mountain-specific institutional architecture

France has a long tradition of specific public policies for mountain areas. It was one of the first countries to pay close attention to mountain forests when, in the second half of the nineteenth century, it passed national laws to improve forest and water management. In the 1960s and 1970s, a second generation of laws was adopted in the context of various sectoral policies. Specific measures were taken to maintain mountain agriculture, which, for the first time, required the delineation of mountains in 1961. National parks have been created since the 1960s, most of them in mountain regions. Policies were adopted for promoting mountain tourism infrastructure, then gradually modified due to growing concern for environmental and landscape protection that emerged in the mid-1970s. Parallel developments in many other countries, especially in Europe, illustrate similar sectoral approaches.

More original and innovative approaches entailed the regionalization and the so-called territorialization of policies related to mountain areas. After 1973, the application to mountain regions of many national policies came to be organized at the level of massifs. As a result, it became common to distinguish regional entities (Pyrenees, Vosges, Jura, Northern Alps, Southern Alps, etc.), where the distinctiveness of problems was considered sufficient to warrant regional adaptations of national policies. The national government appointed a commissaire for each of these massifs, and a *comité de massif* consisting of socio-economic actors started discussing regional issues and advising the national administration. Following the onset of decentralization in the 1980s, most subnational governments (*Régions* and *Départements*) with mountain areas were invited to adopt mountain policies

and to develop inter-regional conventions for each massif aimed at securing public funding for coordinated regional programmes.

The importance of massifs was further strengthened with the 1985 Mountain Law. Its objective was to combine multisectoral issues and promote endogenous development at the level of each officially delimited massif. That same year, a national association of elected representatives from mountain areas (ANEM) was set up. ANEM quickly became an effective national lobby in the defence of mountain people and regional interests.

French public institutions have also been highly involved in several transfrontier institutions that coordinate national and subnational initiatives in mountain areas. Since the mid-1980s, regional governments have set up working groups for the Pyrenees (Andorra, France and Spain) and the Jura (France and Switzerland). Since 1991, the French State has been a party of the Alpine Convention alongside eight other signatories. These transboundary and regional initiatives illustrate how French institutions have promoted policies and cooperation at the massif level beyond the national borders, while at the same time encouraging the European Commission and EU Member States to promote a mountain policy at the EU level. During the last few decades, France has been building one of the most ambitious and systematic institutional architectures for specifying policies for mountain regions and organizing public debate related to mountain issues.

Further information
French National Association of Elected Representatives from Mountain Areas — www.anem.org

Georgian National Mountain Policy

Legal framework for socio-economic development and self-governance

More than two-thirds of the country of Georgia is covered with mountains. The 1995 Constitution recognizes their specificity: "The state shall take care of the equal socio-economic development of the whole territory of the country. With a view to ensuring the socio-economic progress of the high mountain regions, special privileges shall be determined by law" (Article 31). This constitutional recognition led to the adoption of the 1999 Law of Socio-economic and Cultural Development of High Mountain Regions ('the mountain law'). In addition, the 2005 Organic Law of Georgia on Self-Government recognizes mountains as specific regions by stating the necessity "to ensure legislative provision for the peculiarities of exercising self-governance in high mountainous regions and other territories of Georgia specified by the Georgian legislation". A Parliamentary Committee for Regional Policy, Self-Government and Mountainous Regions has been set up to overview the mountain and self-governance laws. Despite these efforts and the otherwise successful reform of self-governance, actual implementation in mountain regions has lagged behind.

The mountain law seeks to prevent outmigration from mountain areas through mechanisms such as preferential loans for investment in mountain areas. However, synergies between the law and other legal instruments and national policies are lacking. As a result, the mountain law is largely ineffective. Current development policies focus on general economic growth of the country, with little consideration for the specificity of mountain territories. For instance, the 2010–2017 State Strategy on Regional Development of Georgia only refers to mountains in a statement relating to infrastructure development for internal flights and one relating to tourism development.

View of the village of Shatili, Georgia (V. Grigolashvili)

Recent governmental programmes have supported development in mountain areas (e.g. the rebuilding of tourism infrastructure in Svaneti), road and hospital construction, and the rehabilitation of schools in mountain regions. Yet there is a crucial need to establish specialized adaptive management regimes for sustainable mountain development. Socio-economic, environmental and cultural conditions vary greatly across Georgia's very diverse mountain regions. Hence legal provisions and policy measures should be both flexible and supportive of local populations.
For more than a decade, mountain development in Georgia has been promoted by several NGOs, including the Georgian Union of Mountain Activists, the Georgian Mountain Federation, and the Regional Environmental Centre for the Caucasus. With support from international development agencies, these organizations implement projects and programmes promoting sustainable mountain development with a focus on local mountain communities. To date, NGOs have to rely on donor initiative and lack the capacity to institutionalize the results of their activities.

Further information
Castelein, A., Thuy, V.D.T., Mekouar, M.A. & Villeneuve, A. 2006. *Mountains and the law: Emerging trends.* Rome: Food and Agriculture Organization of the United Nations.

The town of Brig-Naters, Rhone Valley, Switzerland (C. Andereggen)

Swiss National Mountain Policies

A changing focus on mountains

Switzerland has a long tradition of policies for its mountain regions. A national policy was first elaborated in the late nineteenth century to halt deforestation in mountain areas. In the first two decades of the twentieth century, members of parliament repeatedly pointed to the risk of depopulation as a rationale for financial support to mountain areas. Although federal support continued to focus on agriculture, some funds were earmarked for infrastructure development. Lobbies and organizations were created in the middle of the twentieth century to support mountain populations (see Box 2.3). Since most mountain inhabitants were farmers, the majority of policies have focused on mountain farming. However, in the second half of the twentieth century, agriculture policy measures were no longer considered sufficient to address the numerous challenges faced by mountain communities. In response, a more comprehensive policy was formulated in 1974. The Law on Investment in Mountain Regions (LIM) aimed to close the increasing economic gap between the mountain areas and the rest of the country by fostering infrastructure development through low-interest loans to mountain municipalities. The LIM established 54 mountain regions, each of which was required to create an intermunicipal organization and elaborate a common regional development plan.

The national mountain policy regime has gradually changed since the 1990s. In 1997, the LIM was revised to focus on adding value through investments. In 2008, Switzerland's overall approach to regional development changed completely with the launching of the New Regional Policy. Rather than seeing mountain areas as

Box 2.3 | Swiss Centre for Mountain Regions (SAB)

Created in 1943, the Swiss Centre for Mountain Regions (SAB) contributes to the improvement of living conditions and the enhancement of development potential in mountain communities and regions. To achieve these goals, the organization lobbies on behalf of mountain regions, provides expertise to its members and informs the general public about mountain issues and mountain communities, especially regarding new political developments. The members of this mountain lobby are: mountain states (cantons), hundreds of mountain municipalities, agricultural and tourism organizations, and any organization or concerned citizen involved in mountain issues. SAB plays a decisive role in keeping mountain issues on the Swiss political agenda.

Further information
SAB — www.sab.ch

regions with handicaps that need to be compensated, they were now viewed as areas with assets that need to be valorized. It was argued that existing policies were ineffective for improving the economic attractiveness and competitiveness of mountain regions. Hence emphasis was placed on strengthening competitiveness and innovation in mountain areas, so they could position themselves in a globalized economy. Furthermore, mountain regions were no longer the only regions that could receive support under regional development policy; special programmes began to target metropolitan regions. At the same time, sectoral policies, mainly in agriculture and forestry, evolved to stress the multifunctionality of mountain farming and the need for financial support for cultural landscape preservation and biodiversity conservation. At the time of writing, a new national strategy for mountains and rural areas is debated.

For more than a century, policy support for mountain regions remained unquestioned. In a context of budgetary tightening, such support faces growing opposition. The future of mountain areas will depend on how they can position themselves to meet the expectations of an urbanized Swiss society. In this context, highland–lowland linkages will play a decisive role.

Further information
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Rudaz, G. & Debarbieux, B. 2014. *Die schweizerischen Berggebiete in der Politik*. Zurich: vdf Hochschulverlag.

Sierra Nevada Conservancy

Channelling investment for the Range of Light

The Sierra Nevada Conservancy (SNC) is a public agency of the state of California, created in 2004 with the primary purpose of allocating funding for environmental preservation and supporting economic sustainability across the Sierra Nevada mountain range. The SNC region consists of all or part of 22 counties covering a quarter of the state's territory. The Sierra Nevada is the state's principal watershed, supplying 65 percent of the developed water supply to residents, agriculture and other businesses and industries across the state. The range is one of the most significant natural and biologically diverse regions in the world, home to 60 percent of California's animal species and almost half of its plant species. It hosts more than 50 million recreational visits per year and is home to more than 600 000 residents.

As California's largest conservancy, the SNC provides grants to local governments for environmental protection, resource conservation, recreational opportunities and economic growth. The SNC is governed by a 16-member board, with voting members divided almost evenly between state-level appointments and local seats filled by members of County Boards of Supervisors; federal agencies are represented by non-voting liaison advisers. The Board's small staff includes the SNC Executive Officer and Assistant Executive Officer.

In its first five years, the Conservancy awarded approximately US$40 million in grants for projects including fuel reduction, conservation easements and acquisitions, and watershed and habitat restoration in partnership with local government, non-profit organizations and tribal entities. Unlike many government programmes for mountain regions around the world, the SNC receives no general fund tax dollars. Instead, funding for projects comes mainly from Proposition 84, a bond act for safe drinking water passed by California voters in 2006. Additionally, the SNC may receive funds and interests in real or personal property by gifts, bequests or grants.

All activities supported by the SNC contribute to seven legislatively mandated programme areas across the spectrum of sustainable mountain development: increasing opportunity for tourism and recreation; protecting, conserving and restoring physical, cultural, archaeological, historical and living resources; aiding in the preservation of working landscapes; reducing the risk of natural disasters such as wildfire; protecting and improving water and air quality; assisting the regional economy; and enhancing public use and enjoyment of lands owned by the public. Specific recent initiatives include the development of a Climate Action Plan, the Sierra Nevada Forest and Community Initiative and the Sierra Nevada Geotourism MapGuide Project.

A recently adopted three-year strategic plan establishes five areas of focus: healthy forests; preservation of ranches and agricultural lands; watershed protection and restoration; promotion of sustainable tourism and recreation; and long-term effectiveness of the SNC.

Further information
Sierra Nevada Conservancy — www.sierranevadaconservancy.ca.gov

Institutions at the local level

Local institutions have always been a mainstay of life in mountain regions. On many continents, water, forests or pastures have been, and still are, owned and managed collectively. Collective ownership and management are often seen as a local tradition and, more generally speaking, a mountain tradition.

GPS mapping of community borders, Contorno Bajo Aymará Community, near La Paz, Bolivia (L. Lerch)

Institutions for water management around Kilimanjaro (see case study on pp. 130–131) illustrate this widespread approach. Other well-known examples include collective alpine pastures found in many highlands such as the European Alps, the Carpathians, the Himalayas, the Atlas Mountains and on the very top of the Australian Alps. In the Indian Himalayas, statutory village councils (panchayats) charged with participatory forest management have existed since the 1930s.

The privatization of common land in Europe between the seventeenth and twentieth centuries has weakened some of these institutions, but mountain regions have generally been less affected by this trend; exceptions include the Scottish Highlands. In response, models of development built on the successful tradition of collective institutions have been promoted and adopted in various contexts: community-based tourism in Kyrgyzstan (see case study on pp. 123–124), southern Mexico, the Moroccan Anti-Atlas and many other mountain regions; community forestry initiatives in South and Southeast Asia (see case study on pp. 125–126) have been similarly built on this model.

Since the importance of mountains was enshrined in Agenda 21 in 1992, a number of innovative local institutions have attracted attention, in mountain areas and beyond. In Latin America and elsewhere, many institutions and programmes have been established to organize payments for ecosystem services between upland communities providing services such as water, and those who benefit from them downstream (see case study on p. 129). Another type of institution has become popular in North America: conservation land trusts, which provide the landowner with financial benefits, in return for a commitment to maintain land for nature conservation in perpetuity (see case study on pp. 127–128).

This revitalization of local institutions is often encouraged by global or regional institutions, ensuring that links between these levels can act as channels for communicating knowledge and experiences. Some of these institutions focus their efforts

Preparing food for a community festivity, Pitumarca, Peru (S.-L. Mathez-Stiefel)

on the promotion of sustainable mountain development. Since 2004, for example, the Local Governance Programme of the Aga Khan Foundation's Mountain Societies Development Support Programme has sought to strengthen the capacities of Central Asian local government and civil society organizations in the planning and implementation of local development initiatives in mountain communities. In the European Alps, the cooperation of eight countries within the Alpine Convention has directly or indirectly led to active networks of local institutions – for example protected areas, municipalities, ski resorts – that exchange sustainable development experiences and spread best practices among the inhabitants. Experience shows that sustainable development strategies are more effective (and sometimes more efficient) when cooperation involves institutions at various levels. The rise of global awareness of mountain issues during the last two decades has encouraged innovative forms of cooperation between mountain communities in the North and the South; many of these emerged in the context of the International Year of Mountains. This growing attention paid by people from European and North American mountains to their counterparts in the developing world indicates that, in many mountain regions around the world, collective identities based on mountain images are becoming more important.

Group of tourists in front of a yourt, Tash Rabat, Kyrgyzstan (KCBT)

Community-Based Tourism in Kyrgyzstan

Development through Community-Based Tourism

With 94 percent of its national territory above an altitude of 1 000 m above sea level, mountains cover most of the Kyrgyz Republic. They are major assets for tourists visiting this Central Asian country. Since a significant share of tourists is attracted by the country's nature and culture, community-based tourism (CBT) has great potential for income generation among local communities.

CBT represents an innovative institutional development whereby local communities retain control of tourism development and management. In 1999, the Swiss Association for International Cooperation (now called HELVETAS Swiss Intercooperation) launched the Community Based Tourism Support Project in Kyrgyzstan to support capacity and institution building, notably through training in managing projects, conflicts and organizations. Under the project, 15 CBT groups have been created since the villagers of Kochkor launched the first one in 2000. CBT groups are self-governing non-commercial organizations that provide tourist services. They are constituted by several family-based enterprises. Additionally, five "shepherd's life" associations include shepherd families who offer tourist lodging in traditional yurts while spending the summer in their mountain pastures (*jailoos*). The number of families involved in CBT has steadily increased from 38 in 2000 to 140 in 2002 and 288 in 2011, when total turnover reached some US$200 000.

Kul-i Kalon lake in the Fan mountains a climbers paradise, Tajikistan (Y. Weidmann)

To consolidate the success of CBT, the Kyrgyz Community Based Tourism Association "Hospitality Kyrgyzstan" (KCBTA) was created as a national CBT Association in 2003. KCBTA serves as the umbrella association of CBT groups and shepherd's-life associations. Its stated objective is "to improve living conditions in remote mountain regions by developing a sustainable and wholesome ecotourism model that utilizes local natural and recreational resources". KCBTA markets the products and services of its members worldwide. For this purpose, the Association attended 2012 ITB Berlin, the leading international travel trade show. In 2011, KCBTA also joined the European Union project "Strengthening Tourism Business Intermediary Organizations for Sustainable Economic Development of Central Asia", which aims to promote regional marketing of Central Asia in a globalized tourism market.

Further information
Kyrgyz Community Based Tourism Association / Hospitality Kyrgyzstan. 2006. *Community Based Tourism Guidebook*. Bishkek, Kyrgyzstan, KCBTA.
KCBTA — www.cbtkyrgyzstan.kg

Community Forestry in Nepal

Community initiative for global sustainability

Community forestry (CF) in Nepal can be considered a successful community-led process that has enhanced the re-greening of degraded hills and mountains and improved the livelihoods of forest-dependent mountain dwellers. This is a nation-wide programme covering all seventy-five districts and three physiographic regions of Nepal. Nepal's community-based forest management programme is probably one of the largest and longest ongoing participatory forest management initiatives in the world. It involves approximately 40 percent of the population and 25 percent (1.25 million hectares) of the country's forest areas. Since 1978, the Government of Nepal has been implementing CF with the support of various international technical partners and key donors. Initially more than 60 percent of CF budgets came from donor-funded projects, mainly to pay for the handing over of management responsibilities and training activities. Following the transfer of forests, however, donors gradually pull out.

CF was promoted after decades of standardized application of centrally designed and implemented national policy that had led to the breakdown of centuries-old traditional forestry governance systems. Throughout the 1960s and 1970s, despite the imposition of stringent forestry rules, the quality and quantity of forests declined drastically. Widespread concern over Himalayan environmental degradation and shifts in the global forestry paradigm stimulated the recognition of the role of people in sustainable forest management.

Today, Nepal is recognized for one of the most progressive forest policies in the world and considered a leader in participatory forestry. Starting as an environmentally focused subsistence-based forestry practice, the CF programme has evolved into an example of good green governance and contributed to local democracy and sustainable rural development.

Forests and terraces, Bhadaure Tamagi, Kaski District, Nepal (S. Radzikowski)

Collection of non-timber forest products, Yunnan, China (B. Shakya)

The impacts of CF are impressive and multidimensional. The Nepalese Department of Forests claims that CF has been successful in restoring degraded forest land; increasing water flow; increasing and conserving biodiversity; increasing the supply of forest products; empowering rural women, the poor and disadvantaged groups; promoting income generation and community development activities; and improving the livelihoods of forest-dependent people in rural areas. The CF programme can be considered as a vehicle for community development, environmental stabilization and contribution to the sustainable development of this mountainous country. Moreover, the initiative proved to be instrumental in promoting democratic governance and social inclusion, contributing to Nepal's social transformation.

Despite wider appreciation, acceptance and impressive outcomes, CF in Nepal has its weaknesses, controversies and complications. So far no comprehensive CF monitoring and evaluation system exists; as a result distortions are appearing. Some also argue that the success of CF has been uneven. Forest bureaucracy often resists the devolution of power to communities. Timber harvesting in community forests has been below the production capacities of the forests. Elite domination persists and CF benefits are not distributed equally. Gender issues and pastoral needs are posing additional challenges. On the other hand, the diversification of actors during the last decade has made CF a multistakeholder process rather than the concern only of the government forestry department and forestry users. The emergence of forestry for the sequestration of carbon (REDD+) has introduced new opportunities and at the same time added challenges.

All these factors are making CF management more complex. Linking CF programmes to the larger interests of market and environmental governance will demand complex, formal and externally dominated institutional arrangements. Furthermore, when subsistence-oriented CF moves into an enterprise-oriented mode,

the concerns of equity, gender and good governance become more critical, and new challenges of enterprise management and marketing, commercial production of forest products and biodiversity conservation emerge. Under the planned federal political structure, Nepal should ensure that adequate skills, capacities and institutional frameworks at all levels help build on the local success stories of CF, and derive benefits from new opportunities while adequately safeguarding gains already made.

Further information
ICIMOD — www.icimod.org

Land Trusts

Mobilizing landowners for sustainable mountain development

In the institutional framework for sustainable mountain development, land trusts and the instrument of conservation easements represent an innovative approach for combining public and private interests. A land trust is a non-profit organization that conserves land by undertaking, or assisting in, land or conservation easement acquisition, or by its stewardship of such land or conservation easements. Land trusts operate throughout Canada, the United States, Mexico and other countries. In the United States alone, there are 1 700 land trusts that have more than 100 000 volunteers and 5 million members. These land trusts have conserved nearly 150 000 km^2 of land. While most land trusts operate at the local level, a small number of land trusts are active worldwide.

Haying on the Mannix Brothers Cattle Ranch, Ovando, Montana, USA (Mannix Brothers Ranch)

Although land trusts are not specific to mountain areas, their goal of preserving sensitive natural areas, farmland, ranchland, water sources, cultural resources or notable landmarks in perpetuity is well suited for mountains. Land trusts that focus on mountains include the Mountain Area Land Trust (Colorado), White Mountain Land Trust (Arizona), Coastal Mountains Land Trust (Maine), Blue Mountain Land Trust (Washington), Mountain Conservation Trust (Georgia) and Sierra Foothills Conservancy (California). Land trusts typically work with landowners and local communities to conserve land by accepting donations of land, purchasing land, negotiating private voluntary conservation agreements on land and managing conserved land for future generations.

Most land trusts make use of conservation easements. In the United States, a conservation easement is an encumbrance – sometimes including a transfer of usage rights – that creates a legally enforceable land preservation agreement between a landowner and a government agency (municipality, county, state, federal) or a qualified land protection organization (such as a land trust), for the purposes of conservation. A conservation easement generally restricts real estate development, commercial and industrial uses and certain other activities to a mutually agreed-upon level. Although a conservation easement prohibits certain uses by the landowner, such an easement does not make the land public. The restrictions of the easement, once set in place, "run with the land" and are binding on all future owners of the property.

Protection is thus achieved primarily by separating the right to subdivide and build on the land from the other rights of ownership. The landowner who gives up these "development rights" may receive significant tax advantages for having donated and/or sold the conservation easement. In accepting the conservation easement, the easement holder is responsible for monitoring the use of the land, for ensuring compliance with the terms of the easement and for enforcing the terms in cases of non-compliance.

Further information
Land Trust Alliance — www.landtrustalliance.org

Mammoth National Park, Sierra Nevada, California, USA (J. Krauer)

Payments for Ecosystem Services in Costa Rica

Compensating mountain stewardship through innovative financing mechanisms

Payment for ecosystem services (PES) approaches seek to mobilize economic incentives for protecting natural resources while accommodating agricultural production, forestry, tourism and drinking water supply. Hundreds of PES schemes are now being implemented around the world, covering four main ecosystem services – water provisioning, carbon sequestration, landscape amenity and biodiversity conservation – that are of significance in mountain areas. Watershed PES programmes involve direct payments to compensate upstream resource users for their natural resource stewardship and changes in land use that generate ecosystem services to downstream beneficiaries. While most current schemes are spontaneous private market-type arrangements at the local level, large PES schemes tend to be government-driven. In many places, PES approaches have been found to be cost-effective means for resource conservation and sustainable ecosystem management.

Costa Rica is a leader among Latin American countries in the design and implementation of PES approaches. Since 1996, a national Payments for Environmental Services programme known as PSA has provided payments to thousands of farmers and forest owners for reforestation, forest conservation and sustainable forest management. The programme emerged from a new forestry law, which took into account the value of carbon fixation, hydrological services, biodiversity protection and the provision of scenic beauty. The law prompted a reform of the National Forestry Finance Fund, a decentralized organization mandated to collect and administer the financial resources of the forest sector, including those of the PSA programme.

One example of a project under the country's PSA scheme concerns a cooperation mechanism between La Esperanza Hydropower Project (downstream water user) and the Monteverde Conservation League, a conservation NGO that owns most of the upper watershed serving the hydropower plant. The objective of the mechanism was to conserve forest cover where it already existed, since forests are perceived to provide a range of downstream hydrological services for which the hydropower producer was willing to pay. Under the mechanism, a 99-year contract was signed, committing the hydropower producer to pay the forest owner for maintaining the forest cover on its property. The payment increased through the first five years of the contract; since then, the amount of power produced and the tariff at which the power is sold have been factored into the calculation of payments.

PES schemes represent a significant institutional innovation that can contribute to sustainable mountain development. Around the world, they have been designed specifically to compensate the stewards of upstream areas for ensuring that downstream users benefit from hydrological and other services.

Further information

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Mount Kenya, a regional water-tower (N. Harari)

Water User Associations in Kenya

Improvement of water management and peace keeping

Mount Kenya, Africa's second highest mountain, is the water-tower for over seven million people living around it. All the region's rivers originate from this mountain. Water resources have come under increasing pressure in recent decades, especially in Laikipia, the semi-arid region northwest of Mount Kenya. In the upper reaches of the watersheds, massive immigration has increased the population from 58 000 in 1962 to over 300 000 in 1999. Large-scale irrigated horticulture for European markets has experienced a boom since the early 1990s. As a result of these developments, water is becoming increasingly scarce, and is in ever greater demand. The potential for open and violent conflicts over water use has become real.

In a bid to prevent such conflicts, the authorities, together with researchers, started focusing on effective and equitable water use as early as 1984. One result of this initiative was the emergence of Water User Associations (WUAs). These include the main users along a river, such as large-scale horticulturists, small-scale farmers, urban populations, pastoralists and tourists. WUAs have provided a platform for negotiating resource-sharing arrangements and conflict resolution mechanisms with clearly defined rules and enforcement procedures.

Although the creation of WUAs took some time, subsequent progress was rapid. The first WUA in Laikipia was formed in 1997. By 2003, 13 associations were in place, increasing to 38 in 2011. And they were effective: Of the 52 cases of water-related conflicts between 1997 and 2003, 48 were resolved by WUAs, while only four were referred to the courts. Though WUAs as institutions have not increased the overall availability of water, it is now shared more equitably in the region. Moreover, there are unexpected benefits: WUAs have also raised funds for effective

Members of a water user association removing an illegal water diversion dam, Mount Kenya area (Courtesy CETRAD)

water use through drip irrigation, rainwater harvesting and improved river water storage, as well as for catchment protection through afforestation. Unexpectedly, but possibly owing to the inter-ethnic alliances resulting from long-term resource-sharing negotiations facilitated by WUAs, the region northwest of Mount Kenya was never affected by the post-election violence experienced in Kenya in 2008.

In 2004, WUAs were formally recognized in Kenya's new Water Law as institutions dealing with local water management; previously they had been merely tolerated or, at times, considered illegal. However, the law does not grant them explicit legal power and their potential remains limited due to the lack of financing, technical skills, logistical support and limited managerial and leadership capacities.

Further information
CETRAD — www.cetrad.org

Conclusion

Elections during the 2005 General Assembly of the Alliance of Central Asian Mountain Communities, Bishkek, Kyrgyzstan (G. Rudaz)

The world has experienced considerable changes since the mountain chapter of Agenda 21 was adopted in 1992. Earth's human population has increased by more than 30 percent. The global gross domestic product has more than doubled, trade and financial interdependence have mushroomed, yet the gap between rich and poor remains significant. As reported in the mountain chapter of the Millennium Ecosystem Assessment, numerous vital life-supporting functions are under stress. Multiple and linked environmental, economic, financial, food and energy crises present unprecedented challenges for the pursuit of sustainable development.

Mountains coming together

These challenges have had an extensive and varied impact on mountains around the world. In response, an impressive set of local, national, regional and global institutions has drawn attention to the unique position of mountains: as water-towers, homes of dynamic cultural heritage, hotspots of biodiversity and locations with important natural resources and ecosystems. Organizations around the world have given life to these institutions, building bridges between them and demonstrating profound commitment to sustainable mountain development. In light of the three features of institutions and organizations (constituents, comprehensiveness of goals and objectives, reach of operations) proposed above, we highlight several key trends between 1992 and 2012.

Broadening the constituency

Since the Earth Summit, mountains have gained a global following. Chapter 13 of Agenda 21; the International Year of Mountains; the creation of the Mountain Partnership; and the explicit mentioning of, or attention to, mountains in various UN resolutions and international conventions have ensured that mountains remain on the political agenda. While the alliance of scientists, development professionals and selected national governments played the most important role in setting the agenda, the range of actors implementing sustainable mountain development has broadened.

On the one hand, this diversification resulted from the emergence of new institutions and organizations such as regional mountain conventions and initiatives, networks of non-governmental organizations or alliances of municipalities. On the other, the new legitimacy of mountains as a platform for mobilization has generated new interest in established institutions such as mountain farmer cooperatives, resource user groups or mountain tourism operators and promoters. Today, the institutional framework for sustainable mountain development is an example of multistakeholder governance.

Integrating regional development

In tandem with the growing range of mountain actors, the consolidation of sustainable mountain development as an international norm has brought the economic, environmental and social dimensions more closely together. In the past, mountains were largely the focus of sectoral policies in forestry, agriculture, energy development or tourism. During the last 20 years, regional development strategies and programmes for mountains have encouraged policy integration and promoted sustainable development as an overarching principle.

Despite this institutional turn in mountain regions, however, mostly sectoral approaches at multiple scales still continue to shape developments in mountain ranges. Some of these are embedded in international and regional conventions for biodiversity, water management or economic integration. Where such approaches fail to distinguish between mountain and lowland areas, core–periphery relations can be magnified. At the same time, the policies and programmes of regional economic integration organizations have begun to recognize the special roles of mountains.

Finally, concerted efforts to address the impacts of human-induced climate change are being developed in mountain regions worldwide. In particular, strategies and action plans for climate change adaptation are being developed from California's Sierra Nevada to the European Alps, Carpathians, Himalayas and mountains of Scandinavia. Due to the particular challenges that climate change poses for mountain regions, the corresponding actions have the potential to strengthen the institutional framework for sustainable development by bringing together multiple goals.

Transcending political boundaries

The creation of a multitude of transboundary mountain conventions and initiatives constitutes a hallmark in the evolution of institutions for sustainable development since 1992. These initiatives are at various stages of development and institutionalization, which has allowed extensive cross-fertilization and learning. What is common to many of them is that their participants have sought to align the initiative's operational reach with a mountain ecoregion. Increasingly, however, territorially defined mountain regions such as the European Alps or the

Carpathians are being placed in the larger regional context of urban–rural links. These links are reinforced by economic interdependencies between mountains and metropolitan areas, as well as the growing trends of multilocal dwelling and labour migration.

At national and local levels, many institutions and mountain organizations have broadened their operations towards ecoregional entities. The most evident manifestation of this trend involves institutions for watershed or river basin management. These often cut across mountain regions. In many cases, synergies can emerge, such as the initiatives surrounding the Danube-Carpathian region, or the river basins linking the Himalayas with the South Asian coastal areas. A final example of the changing reach of operations is seen in the widening use of payments for ecosystem services. These mostly national or local approaches can similarly bring together mountain and non-mountain areas in synergetic ways.

The road from Rio to Rio+40

The institutional framework for sustainable development in mountain regions has made great strides since 1992. Many key lessons have been learned, including the importance of integrating science, policy and practice; the need to enhance comprehensive strategy development by including adequate participation and representation of stakeholders; and the value of long-term perspectives. The examples presented in this report illustrate these lessons around the world. Above all, they have shown how building bridges between the local, national, regional and global levels has been an asset.

Just as awareness of mountain issues has grown since 1992, the challenges to mountain areas are greater than ever. For this reason, the institutional framework for sustainable development with regard to mountains has never been more significant. Learning the lessons from institutional and organizational experiences gained in mountains over the last 20 years will be useful to support adaptation in mountains and ensure that their sustainable development remains a central concern of current and future generations both in the mountains and across our planet.

Aletsch Region, Switzerland (R. Schwitter)

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Woman at Nam Co Lake in Tibet Autonomous Region of China, at 4700 m (E. Spehn)

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Unfortunately, we must end this publication on a sad note: Dr. Jane Pratt, who contributed several sections to this report, passed away on 12 August 2013. We will remember her as a highly dedicated advocate for mountains, mountain communities, and sustainable development in mountain regions.

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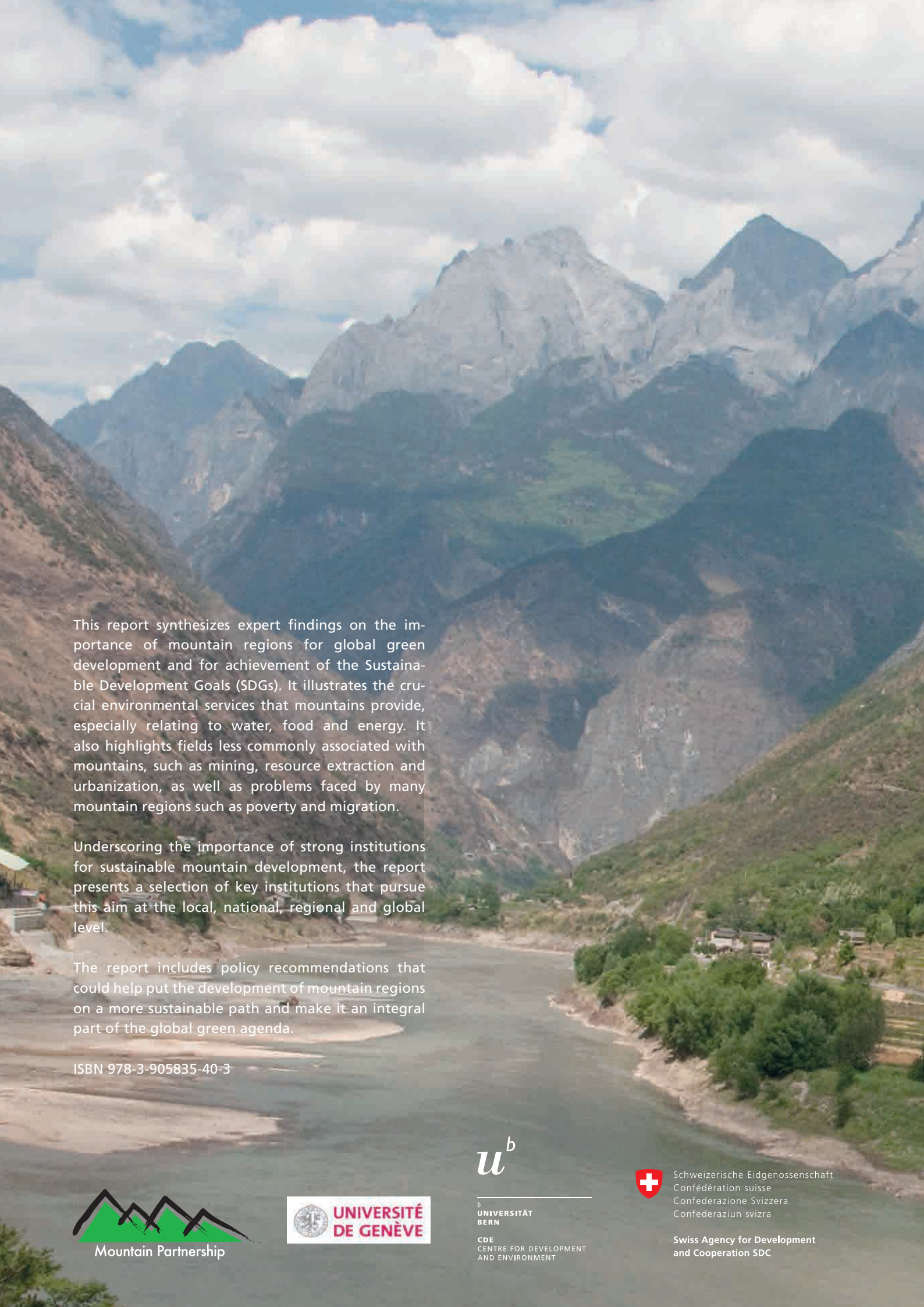

This report synthesizes expert findings on the importance of mountain regions for global green development and for achievement of the Sustainable Development Goals (SDGs). It illustrates the crucial environmental services that mountains provide, especially relating to water, food and energy. It also highlights fields less commonly associated with mountains, such as mining, resource extraction and urbanization, as well as problems faced by many mountain regions such as poverty and migration.

Underscoring the importance of strong institutions for sustainable mountain development, the report presents a selection of key institutions that pursue this aim at the local, national, regional and global level.

The report includes policy recommendations that could help put the development of mountain regions on a more sustainable path and make it an integral part of the global green agenda.

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