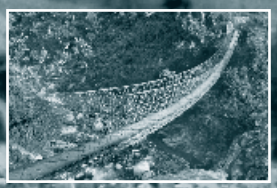
WHY INVEST IN SUSTAINABLE MOUNTAIN DEVELOPMENT?

Climate change, increasing natural disasters, food and energy crises, population growth, water scarcity and desertification, loss of biodiversity, degradation of ecosystems, migration, and growth of cities – the planet is currently facing a multitude of challenges. Mountain regions and their inhabitants are disproportionally affected, but also offer significant opportunities for solutions.

By providing key environmental services such as freshwater, biodiversity conservation and hydropower to more than half of humanity, mountain ecosystems play a critical role in world development. Mountain systems are essential building blocks for long-term sustainable global development, poverty alleviation and the transition to a green economy. In a world heading towards water, food and energy crisis, sustainable mountain development is a global priority.

Mountain people, who are among the world's poorest and hungriest, are key to maintaining mountain ecosystems and their role in providing environmental services to downstream communities. Mountain communities need to be empowered and their livelihoods improved, to enable them to take responsibility for the preservation of natural resources and to fulfil their role as mountain stewards.

In spite of the obvious importance of mountain areas, sustainable mountain development does not receive the attention and priority it deserves. Investing in sustainable mountain development is a global priority for addressing the current challenges. It reaches far beyond monetary terms to embrace increased attention to and support in all aspects of mountain ecology and society.



WHY INVEST IN SUSTAINABLE MOUNTAIN DEVELOPMENT?

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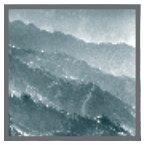

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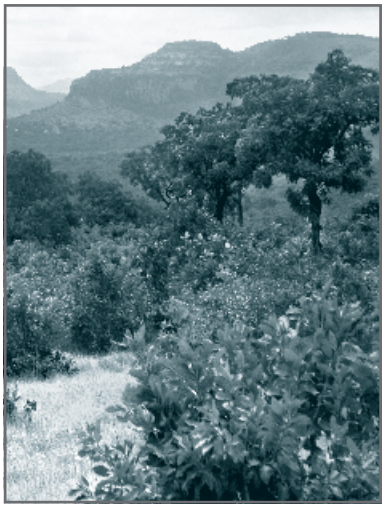
1 THE ISSUES

WHAT ARE THE CHARACTERISTICS OF MOUNTAIN ECOSYSTEMS?

Because of the importance of mountains and the many services they provide, sustainable mountain development does not only regard mountain communities, but is a global concern

Mountains cover approximately one-quarter of the world's surface and are home to 12 percent of the human population. They can be found on every continent and include impressive ranges such as the Himalayas, the Andes, the Alps and the Rockies, and less well-known highlands such as the Elburz Mountains in the Islamic Republic of Iran, the Cairngorms in Scotland and the Fouta Djallon Highlands in West Africa. Mountains are characterized by massive global diversity – from tropical rain forests to permanent ice and snow, from climates with more than 12 m of annual precipitation to high-altitude deserts, and from sea level to almost 9 000 m in altitude.

Mountains are complex and fragile ecosystems with marked topography, highly differentiated climatic conditions and vertical processes. They are the water towers of the world – providing freshwater to at least half of the world's people for domestic use, irrigation, industry and hydropower – and storehouses of global biodiversity. However, mountains are also high-risk environments; avalanches, landslides, volcanic eruptions, earthquakes and glacial lake outburst floods threaten life in mountain regions and surrounding areas, while fragile soils and vegetation cover make mountain areas vulnerable to environmental degradation.



Top: Mountains influence regional climates
Bottom: Mountain vegetation in the Fouta Djallon Highlands, Guinea
Opposite: Laguna Hedionda, near Uyuni, Altiplano, Bolivia (Plurinational State of)
Next: Mountain glacier, Canada

MOUNTAINS

The most commonly used definition of mountains was developed by the United Nations Environment Programme (UNEP) World Conservation Monitoring Centre (based on Kapos *et al.*, 2000). It divides mountain areas into seven classes, based on altitude, slope and the resulting environmental gradients:

Class 1
elevation > 4 500 m

Class 2
elevation 3 500–4 500 m

Class 3
elevation 2 500–3 500 m

Class 4
elevation 1 500–2 500 m and slope ≥ 2°

Class 5
elevation 1 000–1 500 m and slope ≥ 5° or local elevation range (7 km radius) > 300 m

Class 6
elevation 300–1 000 m and local elevation range (7 km radius) > 300 m

Class 7
isolated inner basins and plateaus less than 25 km² in extent that are surrounded by mountains but do not themselves meet any of criteria 1 to 6

According to this definition, the global mountain area is almost 40 million km², or roughly 27 percent of the earth's surface.

Mountains play an important role in influencing global and regional climates and weather conditions. By intercepting the global circulation of air, they have a decisive effect on wind, precipitation and temperature patterns.

Mountain climates vary considerably – from year to year, season to season and day to day, at different altitudes and on slopes with different exposures. Traditional land-use systems utilize these small-scale variations, and mountain people have developed sophisticated techniques for farming, livestock breeding, forestry and water use that are adapted to life on steep slopes and in harsh, unpredictable conditions.

In many mountain areas resources are limited. Mountain dwellers make the most of them by, for example, growing sun-loving plants on the warmest slopes and moving livestock to graze on high summer pastures after the snow has melted. Diversified and well-adapted traditional land-use systems protect the soil from erosion, conserve water and maintain a rich biodiversity.

SUSTAINABLE MOUNTAIN DEVELOPMENT

Price and Kim (1999) state that *"given the very different characteristics of the world's diverse mountain regions, even on one continent, it is probably best not to propose a precise definition of sustainable mountain development, but to recognize that it is a regionally specific process of sustainable development that concerns both mountain regions and population living downstream or otherwise dependent on these regions in various ways".*

The World Commission on Environment and Development (1987) defines sustainable development as *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs".*

In line with this general definition, sustainable mountain development therefore requires that mountain ecosystems be managed in ways that allow them to provide goods and services for local livelihoods and lowland people, now and in the future.

By addressing environmental, economic, social, cultural and political issues in a holistic manner, sustainable mountain development aims at improving the lives of mountain people and the life support systems of the surrounding lowlands.

Mountain people are among the world's poorest and most disadvantaged. Harsh climatic and environmental conditions, remoteness and often difficult access hamper development in mountain regions. Mountain people frequently face political, social and economic marginalization and lack access to such basic services as health and education.

Mountain communities live far from the centres of commerce and power, so they have little influence on the policies and decisions that affect their lives, and their voices often go unheard. Current global challenges such as climate change, economic developments and population growth exacerbate the hardships they face. Urbanization and migration processes have a significant impact on mountain environments and societies.

The fragility of mountain ecosystems makes the impacts of unsustainable development more severe and more difficult to correct than in other areas of the world. Sustainable approaches to development are therefore particularly important in mountain regions.

In East Africa, Mount Kenya is the only source of freshwater for more than 7 million people.

Mountains contain about one-third of all plant species and host 17 of 34 global biodiversity hot-spots.

Almost two-thirds (322) of all Biosphere Reserves and one-third (281) of all World Heritage Sites are fully or partially located in mountain areas.

WHAT SERVICES DO MOUNTAIN ECOSYSTEMS PROVIDE?

MOUNTAINS ARE THE DIRECT LIFE-SUPPORT BASE FOR ABOUT 12 PERCENT OF THE GLOBAL POPULATION. IN ADDITION, BY PROVIDING ENVIRONMENTAL SERVICES AND OTHER GOODS TO PEOPLE LIVING IN THE LOWLANDS, THEY INDIRECTLY BENEFIT MORE THAN HALF OF HUMANITY

Mountains play a decisive role in collecting and storing the most precious and threatened element for life on earth: freshwater. Rivers originating in mountains are living bonds that connect mountain and lowland communities and provide water for irrigation, food production and domestic use. Mountains in humid areas contribute up to 60 percent of total runoff in watersheds, rising up to 95 percent in arid and semi-arid zones.

Mountains host approximately one-quarter of global biodiversity and are often rich in endemic species – animals and plants that do not occur elsewhere. Mountains' altitudinal gradients, differentiated topography, changes in exposition over short distances and varying geology and soils offer a great diversity of habitats. Most of the world's major food crops, such as wheat, maize and potatoes, and a large portion of domestic animals, originated in mountain areas.

Mountain forests provide essential environmental goods and services such as timber, fuelwood, carbon storage and non-wood forest products. They capture and store precipitation, regulate surface and groundwater flows and ensure high water quality, as well as providing

Top: Mountains ensure the provision of fundamental environmental services
Bottom: Waterfall in mountainous forest
Opposite: Mountains provide water to downstream areas

MOUNTAINS WITH FAVOURABLE CONDITIONS

Some mountain regions in the tropics and subtropics are or have been more developed than the adjacent lowlands. For example, the Ethiopian Highlands have favourable climatic conditions and good, fertile soils, and the High Plateau is the country's most densely populated area, with more than 70 percent of the total population. Addis Ababa, Ethiopia's capital and Africa's fourth largest city, is 2 355 m above sea level.

The highly developed Inca civilization extended over much of the Andean mountain range, including parts of present-day Argentina, Chile, Colombia, Ecuador, Peru and the Plurinational State of Bolivia. This empire's organization and architectural achievements (e.g., Machu Picchu and the old city of Cusco) are impressive testimonies to a sophisticated mountain culture, and many of the region's capitals and other large cities are still situated in the mountains.

Reasons for settling in favourable mountain areas include fertile soils, better access to water and other essential natural resources, cooler climates, strategic and military advantages, the absence of tropical diseases such as malaria, retreat or refuge, and less rigorously applied political and religious restrictions.

Above: The Andean Mountains were the seat of Inca civilization, Machu Picchu

protection against natural hazards. Their diverse ground cover and highly developed root systems stabilize steep slopes and protect the soil from erosion.

Mountains are a key source of energy, including biomass fuels, such as wood, and other forms of renewable energy. Their marked altitudinal gradients and exposure to air circulation and high solar radiation provide solar, wind and, particularly, hydropower.

Mountain regions and communities offer a wide variety of high-quality products such as organic food, beverages, handicrafts, herbs and medicinal plants, whose labelling as mountain goods is an important tool for marketing. Mountain areas also provide raw materials such as timber, minerals and metals.

Throughout history, mountain peoples have tended to settle in individual valleys, and many mountain regions have been areas of retreat or refuge for indigenous peoples, ethnic minorities and other communities that have been forced to move.

Top: A farmer manually winnowing wheat in a field near Mazar, Afghanistan
Bottom: Indigenous experience and knowledge

The need to adapt to highly differentiated, fragile and inhospitable ecosystems has created a huge variety of indigenous experiences and knowledge. Mountain peoples are known for their unique traditions and practices, which contribute significantly to global ethnic, cultural, linguistic and religious diversity.

With more than 50 million visitors per year, mountains are some of the world's most important destinations for tourism. Beautiful landscapes, sporting and recreational possibilities and the unique traditions, cultures and lifestyles of mountain people attract increasing numbers of visitors, mainly from lowland cities. Tourism can be found in almost every mountain region and often dominates local economies, despite its seasonal character.

ELECTRICITY GENERATION

The Three Gorges Dam in China is an impressive example of mountain regions' huge potential for generating electricity, particularly hydropower. However, although large-scale electricity schemes may be necessary to supply growing urban and industrial centres, they often have significant environmental and social impacts: agricultural and forested land is lost; inhabitants of flooded areas are forced to move; and animals and plant species lose their habitats. Local people often derive no benefits, compensation or even electricity when energy from large power stations is exported from mountain areas.

For mountain areas with scattered settlements and difficult topography, decentralized, small-scale electricity generation is often more appropriate and cheaper than participation in large-scale schemes and networks. Hydropower is particularly promising, although solar and wind energy also offer attractive opportunities. Small-scale schemes minimize social and environmental impacts, are often more reliable, and can have positive effects on the development of remote areas. They reduce dependence on a single large infrastructure and diffuse the risk of damage and power cuts. By replacing fuelwood, such alternative energy sources can also help combat deforestation.

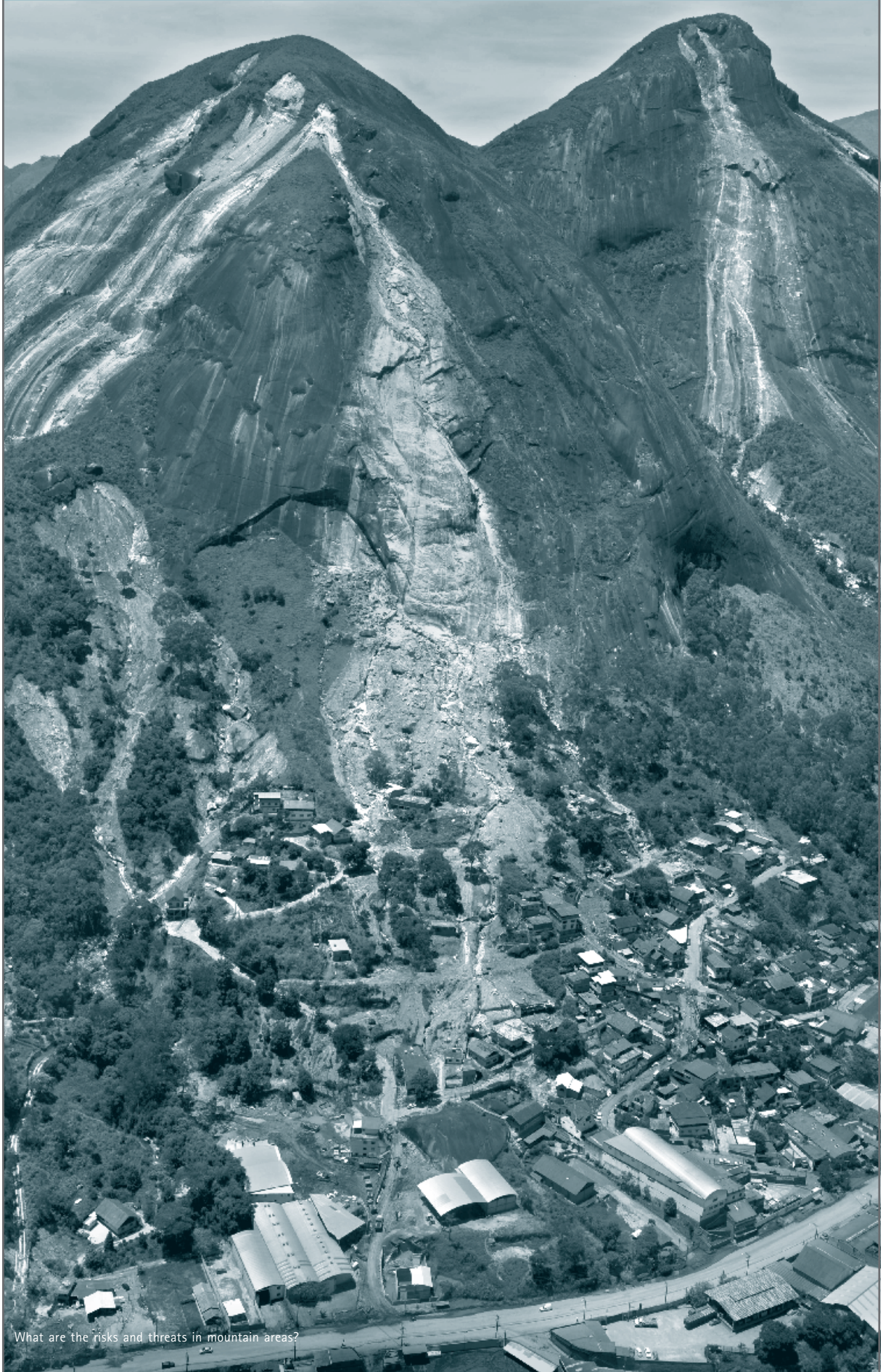
Top: Hydroelectric dam on Bhote Kosni River, Nepal
Bottom: Child drinking freshwater in Pakistan
Opposite: A prayer flag at a sacred site in Tibet

SACRED MOUNTAINS

Their soaring summits, the clouds, winds and storms swirling around their peaks, the life-giving waters flowing from their heights, and the powerful forces that form them give mountains an aura of mystery and sanctity. Throughout the world, mountains often embody and reflect people's religious and cultural values and aspirations.

For millions of Buddhists and Hindus, the remote Himalayan peak of Mount Kailas points the way to the realm of the gods and the highest level of meditation. Mounts Sinai and Zion are places of worship in Judaeo-Christian tradition, while the Hopi and Navajo peoples perceive the San Francisco Peaks of Arizona as a divine source of the water on which they depend. For many people throughout the world, Mount Everest is an inspiring symbol of the ultimate.

Mountains are perceived as the sites of revelation, inspiration, renewal and spiritual transformation, the sources of blessings such as water, life, fertility and healing, and the abodes of ancestors and the dead. Their association with deities and evil spirits makes them places of worship, ceremonial sacrifice and pilgrimage.

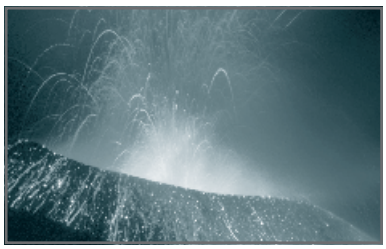


WHAT ARE THE RISKS AND THREATS IN MOUNTAIN AREAS?

Recent environmental, economic and social developments have made many mountain regions increasingly disaster-prone. Disasters in mountains not only harm mountain communities but also have great impacts downstream, affecting millions of people

Mountains are greatly affected by destructive natural processes. Shifting tectonic plates cause earthquakes and volcanic eruptions, while heavy rains and snow on steep slopes produce avalanches, landslides, debris and mud flows and floods. When combined with human interventions, particularly the construction of infrastructure and settlements in hazardous areas, such events turn into disasters causing damage, destruction, injury and death.

Over the generations, mountain people have learned how to live with the threat of natural hazards and have developed well-adapted and risk-resilient land-use systems. However, there is growing evidence that many mountain regions have become increasingly disaster-prone over the past few decades. Recent developments have significantly reduced mountain communities' resilience to natural hazards: population growth, the expansion of commercial agriculture and settlements, and increasing urbanization have reduced the availability of arable land; impoverished farmers are increasingly forced to clear marginal lands on steep slopes and reduce fallow periods; and more and more animals are grazing on mountain pastures and forested land.



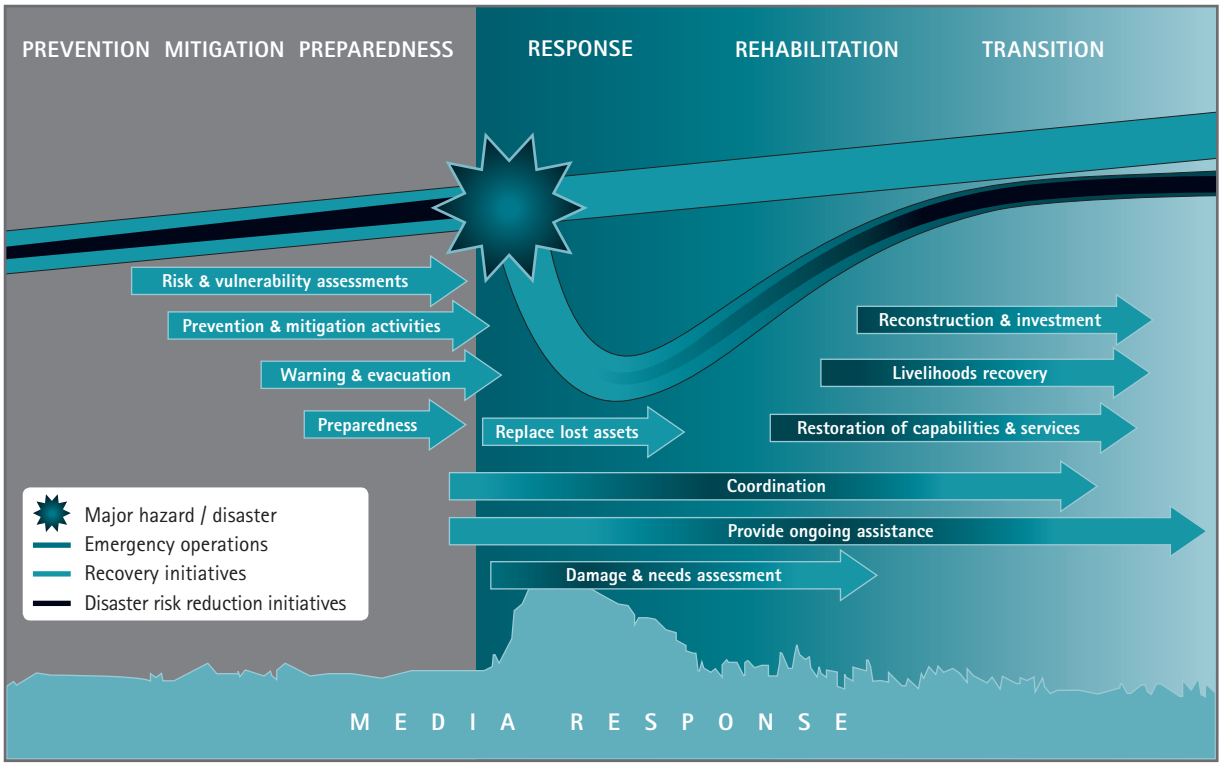
Top: Lonquimay volcano erupting, Chile
Bottom: Flood in Paznaun Valley in 2005, Austria
Opposite: Duas Pedras neighbourhood, one of the many areas affected by landslides in Nova Friburgo, Rio de Janeiro, Brazil, in January 2011

DISASTER RISK MANAGEMENT IN MOUNTAINS

Disaster risk management (DRM) in mountains requires particular attention. There is need for a risk culture that identifies the prevailing risks and the necessary protection, and for precautionary measures that ensure timely warnings and the efficient delivery of relief assistance.

DRM considers all the measures that reduce the occurrence and mitigate the effects of natural disasters, including those that diminish the vulnerability of a given setting – using such tools as hazard mapping and land-use planning, which are significantly cheaper than repair and rehabilitation works after an event, those that limit the extent of damage just after the occurrence of an event and those that provide efficient rehabilitation and reconstruction. The Disaster Risk Management Framework (DRMF) views DRM as an ongoing process of interrelated actions that are initiated before, during or after a disaster situation. It includes the concept of "building back better", meaning that repair and rehabilitation efforts should not merely restore the conditions that existed before the event, but should make significant improvements on them, including through activities to reduce vulnerability and increase preparedness for future events.

In developing countries, where the assessment, prevention and mitigation of possible disasters are often neglected, steps must be taken to avert or at least mitigate future disasters. This will contribute to the stabilization and overall sustainable development of affected regions.

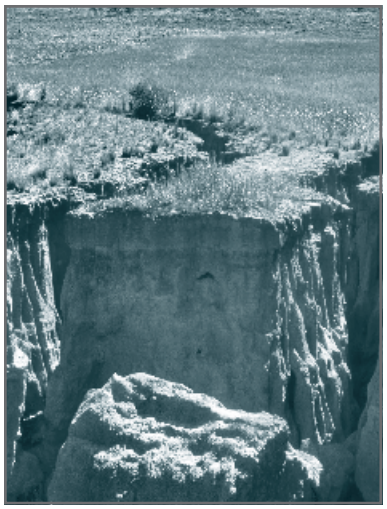


FAO. 2011. Introduction to Disaster Risk Management (e-learning module), adapted from TorQaid.

MOUNTAIN ROADS

Poor construction of mountain roads increases the likelihood of soil erosion and is one of the most important human-induced triggers of landslides. Roads tend to modify existing patterns of surface and groundwater drainage and increase the potential for instability, while high rates of surface erosion increase sediment production. On roads that lack drainage structures, surface erosion increases by about 40 percent. Sediments can greatly alter stream habitat and water quality and thus have serious effects downstream.

Greater investments in road construction and restoration, improved road design, and better maintenance practices are needed to limit the negative impacts of mountain roads. It is particularly important to stabilize the slope above and below the road cut, and road design should include adequate paving, more numerous drainage channels, vegetative filter strips, outsloping of the road surface to disperse runoff, and narrower road surfaces to reduce the road tread. Roads should be located outside riparian areas, and care should be taken to avoid hazardous terrain and protect sensitive slopes.



Previous: Mountain roads require careful design and continuous maintenance, Ecuador
Top: Soil erosion caused by inappropriate construction of roads, Nepal
Bottom: Soil erosion caused by unsustainable farming practices, Bolivia (Plurinational State of)
Opposite: Unsustainable mining can seriously affect mountain ecosystems, Kumtor mine, Kyrgyzstan

Inappropriate farming practices and the destruction of mountain forests aggravate the pressure on fragile mountain ecosystems – ground cover is destroyed, soils are compacted and erosion accelerates, reducing soil fertility and increasing the potential for natural hazards.

To participate in a wider market economy, mountain communities have had to alter their agricultural practices. Many mountain farmers have abandoned their traditional and diversified agricultural systems and rely increasingly on a single cash crop for their livelihoods. Indigenous knowledge about local foods and agricultural practices has been eroded, and agricultural diversity has declined. Such unsustainable development patterns exacerbate the pressure on natural resources and the problems of food insecurity and malnutrition in mountain areas, while mountain livelihoods lose their resilience and become increasingly vulnerable to external economic shocks.

The increasing exploitation of mountain areas by outside forces such as commercial agriculture, logging, mining and tourism enterprises puts additional dangerous pressure on these fragile ecosystems. Dams and roads can be hazardous if they are not properly constructed and managed.

Disasters in mountains, and the forces that trigger them, affect larger areas, sometimes entire watersheds or river systems. As a result, such events harm not only mountain communities but also livelihoods further downstream, affecting millions of people.

MINING IN MOUNTAIN AREAS

The forces that shaped the world's mountains also made them rich in minerals and metals, including gold, copper, iron, silver and zinc. Owing to increasing demand, mines are now being opened even in remote mountain areas, particularly in developing countries. Mining can bring large benefits, but it can also be devastating to fragile mountain ecosystems and local cultures, destroying the livelihood base of mountain communities.

Massive quantities of waste, surface dumps and slag heaps are only the most visible consequences.

Mining leads to atmospheric pollution and the loss of biodiversity and vegetative cover, which in turn destabilizes mountain slopes. Water contamination is especially serious because mountains supply most drinking- and irrigation water. In some mountain regions of Africa where mines are located, arsenic levels in water are 1 000 times the accepted standard.

Mining often also has serious social consequences as local communities are deprived of their land. Short-term investments and the presence of immigrant workers can lead to social disintegration and disruption; mine workers can also suffer from hazardous working conditions and, eventually, poor health.

The challenge is to balance mining opportunities with environmental and social responsibility, and to ensure that traditional mountain cultures are protected. Policies and legislation should be reflective of this challenge and oblige mining companies to respect environmental and social standards.

HOW IS CLIMATE CHANGE AFFECTING MOUNTAIN AREAS?

MOUNTAINS ARE AMONG THE REGIONS MOST AFFECTED BY CLIMATE CHANGE. IMPACTS SUCH AS DECREASING WATER FLOWS FROM MOUNTAINS WILL HAVE SERIOUS IMPLICATIONS FOR THE LIVELIHOODS OF BOTH MOUNTAIN AND DOWNSTREAM COMMUNITIES

Climate change is one of the most important global challenges affecting mountain ecosystems. Mountains host the most visible and sensitive indicators of climate change – the melting of glaciers – and many scientists believe that the changes occurring in mountain ecosystems may provide an early glimpse of what could happen in lowland environments. Mountains can therefore be considered as early warning systems.

The Intergovernmental Panel on Climate Change (IPCC) predicts that by the end of the twenty-first century, human-incurred greenhouse gas emissions will lead to average global warming of between 1.1 and 6.4 °C. This will inevitably change the hydrological cycle and, particularly, alter precipitation and runoff patterns. The greatest impacts are expected in areas where snowmelt dominates the hydrology; the melting and disappearance of glaciers, reduced snow storage and earlier snowmelt have direct effects on the amount and seasonality of runoff.

For the more than 1 billion people who currently rely on runoff from melting snow and glaciers this will mean reduced availability of water when it is most needed, in the growing season.

Above: Maize wilts on a farm after severe drought caused by El Niño, southern Philippines
Opposite: Runoff patterns can vary owing to the melting of glaciers

IMPACTS OF CLIMATE CHANGE IN COTACACHI, ECUADOR

Cotacachi, on the western cordillera of the Andes, has lost its glacier because of climate change, resulting in modifications in runoff patterns. While the rapid melting of the glacier initially led to an abundance of water, research on streams and the glacial Lake Cuichoca has found that water flow and levels are declining. Local people also state that rivers are now more like rivulets and springs are drying up, while rainfall is decreasing and has become highly irregular. This is causing confusion over field preparation and planting times for local farmers, and has a strong impact on local livelihoods.

Climate change is likely to increase the occurrence and intensity of extreme weather events. Storms, heavy rainfall, heat waves and glacier melt will amplify hazards in mountain areas worldwide, while the melting of glaciers and the upward movement of permafrost will release loose rock and soil, aggravating the risks of rock falls, debris and mud flows, and glacial lake outburst floods. Prolonged periods of higher temperatures will increase the incidence of droughts and fires, leaving some regions prone to desertification.

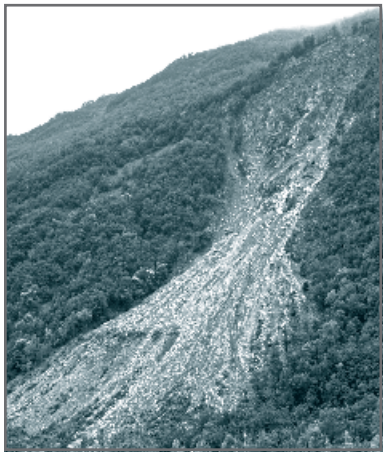
Top: The melting of glaciers influences water availability
Bottom: The upward movement of permafrost increases the risk of floods

PROJECT EXPERIENCE: *Proyecto Páramo Andino*

Mountain wetlands in the Páramos and Punas areas in the Andean highlands are crucial for the regulation of water flows. The impacts of climate change and the melting of glaciers in the tropical Andes has made the management of these delicate high-altitude landscapes increasingly important. In 2006, the Consortium for Sustainable Development of the Andean Ecoregion (CONDESAN), together with governments, research institutions, non-governmental organizations (NGOs) and the local population, started to implement the *Proyecto Páramo Andino*, whose objective is the conservation and sustainable use of the Páramos in the Bolivarian Republic of Venezuela, Colombia, Ecuador and Peru. It aims to find a balance between safeguarding water supplies for downstream areas and securing economic benefits for local communities.

Participatory environmental monitoring provides data that help farmers improve irrigation schedules and water supply systems, giving them a basis for negotiating compensation for environmental services. These payments diversify local incomes and make farmers more resilient to the anticipated effects of climate change.

In the Laguna de Fúquene basin in Colombia, farmers themselves have raised the money to buy crucial wetlands, reforest degraded areas, and decrease water loss in canals and pipe systems, while awareness campaigns encourage households to reduce their water consumption.



Previous: Dried dam reservoir, Pakistan
Top: Landslide on Mont Sec threatening infrastructure, France
Bottom: Mountains have a high biodiversity that is sensitive to climate change, Andean páramos in Ecuador
Opposite: Glacier retreat is an early indicator of climate change: Eiger glacier in 1900 and 2009

Warmer climates are already causing vegetation belts and the snow line to rise, which will have a serious impact on flora and fauna, increasing the number of species that can survive at higher altitudes. As a result, rare and fragile species and those adapted to the cold may become extinct through competition and habitat loss. Extreme weather events, droughts, fires and the incidence of insect-borne diseases are all likely to increase, further threatening the habitats of mountain organisms.

In some mountain regions, climate change may bring regional and local benefits. Higher temperatures could allow farmers to grow crops at higher altitudes and allow plants to produce higher yields – provided that water and soil conditions are adequate. An extended growing season and accelerated soil decomposition may lead to improved nutrient uptake by trees and other plants, which may in turn increase growth and productivity. However, for many mountain areas in the South, current models predict that water availability will decline and rainfall will become more erratic.

Climate change will worsen the living conditions of most mountain dwellers and will also have heavy impacts on the lives of people downstream. Crop failure and the loss of livestock will threaten the livelihoods of mountain farmers who are already vulnerable and food-insecure, while changes in snow patterns will affect the tourism industry and cause enormous economic losses. The likely increase in the number and dimension of disasters will require expensive measures to protect infrastructure and settlements. Finally, the expected changes in water availability will seriously affect upstream-downstream relationships and are likely to lead to conflicts.

2 THE MANAGEMENT

APPROACHES TO SUSTAINABLE MOUNTAIN DEVELOPMENT

Sustainable mountain development requires that mountain ecosystems be managed in ways that allow them to provide goods and services for local livelihoods and lowland people, now and in the future. By addressing environmental, economic, social, cultural and political issues in a holistic manner, sustainable mountain development aims at improving the lives of mountain people and the life-support systems of the surrounding lowlands

Mountain systems are complex, so any activity in mountain areas will have a number of environmental and socio-economic consequences. Different subsystems are closely interlinked; hence, management tools that tackle only a single component or segment will not be effective. To respond to the global challenges and threats, holistic, participatory and integrated approaches that address all aspects of sustainability are required. The specific needs and interlinkages of different aspects of sustainable mountain development, such as water, biodiversity, tourism and infrastructure, must be taken into account.

To achieve sustainable mountain development, it is essential that all concerned stakeholders are involved and that awareness is raised about mountain ecosystems, their fragility and prevalent problems, and about ways of addressing them. To ensure that all relevant ideas, experiences and contributions are considered in the search for sustainable solutions, participation should extend from the international or national to the local level, and should involve all stakeholder groups, including government officers, scientists,

Above: Volunteers working on an irrigation canal, Mexico
Opposite: Stakeholder participation in the planning process, Nepal

HUNGER AND MALNUTRITION IN MOUNTAIN AREAS

Harsh climates and difficult, often inaccessible, terrain, combined with political and social marginalization, make mountain people vulnerable to food shortages. FAO estimates that 78 percent of the world's mountain area is unsuitable or only marginally suitable for growing crops. In 2002, an FAO study found that 90 percent of the world's mountain people (nearly 325 million) were living in developing countries or countries in transition, and that 245 million of these people (more than 75 percent) were experiencing or were at risk of hunger. This figure is now likely to be even higher, given the global economic situation, soaring food prices and population growth.

Nutrition studies indicate that mountain populations suffer from high rates of micronutrient deficiencies. For example, inhabitants of the Andes, the Himalayas and mountain ranges in China are considered to be at the highest risk of iodine deficiencies. Data from the Andes and the Himalayas indicate a high prevalence of vitamin A deficiency.

Hunger and micronutrient deficiencies are contributing factors for the significantly higher infant mortality rates in mountain regions. As well as being a symptom of poverty in mountain communities, hunger and micronutrient deficiencies also perpetuate poverty by reducing people's ability to work and make a living.

technicians, local communities, the private sector and NGOs. Local livelihoods play a particularly important role, and inhabitants of mountain regions should be actively and continuously involved in the planning, implementation and follow-up of development activities.

Sustainable mountain development should take into account the experiences of indigenous mountain communities and should support traditional practices and land-use systems. New technologies and approaches such as conservation agriculture and soil and water conservation techniques need to complement and be integrated into local practices. To divert the pressure on land resources and improve the livelihoods of mountain inhabitants, alternative income-generating activities such as the production of high-quality products or ecotourism should be promoted.

The benefits of sustainable mountain development extend far beyond mountain regions. For example, well-managed mountain forests and the afforestation of degraded areas provide protection against natural hazards and help to regulate water flow and improve the quality of water – both of which are very important for lowland people. Yet, in general, the costs for implementing sustainable mountain development are borne by mountain communities, which creates an economic imbalance. Downstream users have to be made aware of these mechanisms and provide compensatory payments to mountain communities. These communities have to be compensated for the conservation efforts and the rational use of resources that ensure the provision of environmental goods and services to lowland areas. All stakeholders involved need to reach consensus on how to value and apportion the costs of sustainable mountain development. It requires a clear understanding and appreciation of upstream-downstream linkages and tools for the equitable sharing of costs.

THE SITUATION OF MOUNTAIN WOMEN

Mountain women face many of the same challenges as women throughout the developing world, with limited access to education and health care, and restricted involvement in, for example, policy- and decision-making. Women lack economic independence, rarely hold ownership and tenure rights to land and other natural resources, and usually have difficulty obtaining advance warnings related to natural disasters. Women also have heavier workloads than men. While agricultural and livestock tasks are shared fairly evenly, women are also responsible for the collection of water, fuelwood and fodder, the preparation of food, and the care of children. This situation is aggravated by the altitudes, steep terrains and isolation of mountain areas.

In mountain communities, men often have to leave their communities for short-term or seasonal trading and herding purposes, leaving women to maintain farms and households and participate in small-scale trade and income-earning activities. Increasingly, however, the outmigration of men to lowland cities or further afield is leaving women as the heads of households for longer periods. Even when they have these additional responsibilities, few women are given title to farmland, which is often a requirement for receiving bank loans, subsidies, other forms of assistance or access to agricultural extension services. This hampers women's efforts to improve or expand farm activities and earn cash income.

The impacts of climate change, environmental degradation and deforestation are increasing the hardship of mountain communities, particularly for women, who now have to travel greater distances to collect fuel and fodder, while crop failure is becoming more frequent. The reported consequences include food deficits, growing outmigration and even the trafficking of mountain girls and women to lowland cities.

Sustainable mountain development can be implemented at different geographical scales: from very small areas that cover only a few selected villages, to larger regions such as entire catchments, including those that cross international boundaries. Because of the fragility of mountain ecosystems, development activities should always be preceded by a careful assessment of local conditions and accompanied by impact monitoring. This is especially important when successful projects are scaled up to larger areas or applied in new settings with different characteristics.

Top: Woman carrying wood, Tibet
Bottom: Market scene, Guatemala

NATURAL RESOURCE MANAGEMENT

The wise and sustainable management of water, soils, pastures and forests is essential for avoiding environmental degradation in mountain areas. Integrated and diversified land-use systems have to be maintained and enhanced

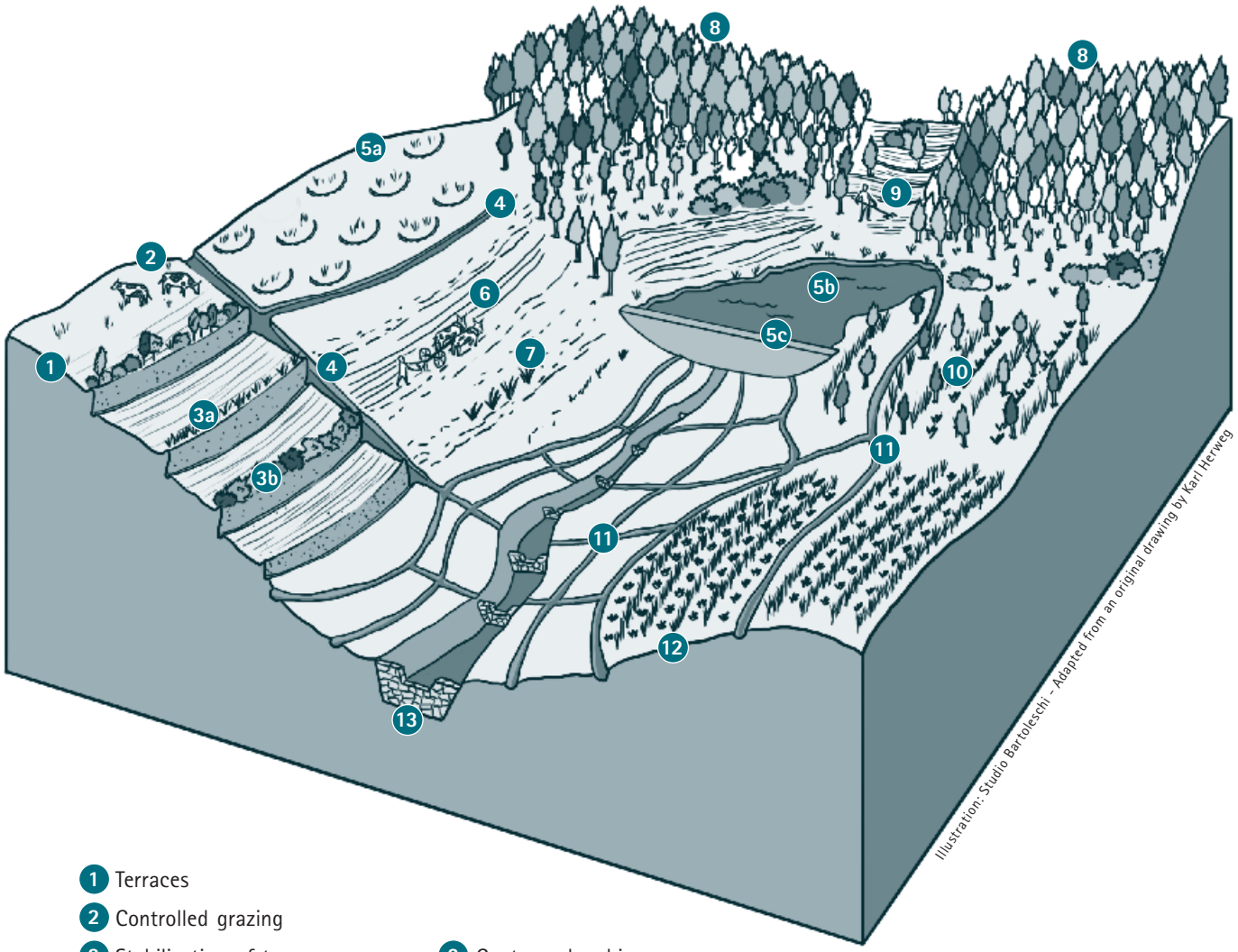
Harsh climates, marked topography and diversified geological and hydrological conditions make mountain ecosystems particularly vulnerable to inappropriate natural resource management practices and environmental degradation. Erosion rates are higher and the loss of fertility through the leaching of nutrients more accentuated than elsewhere. Owing to the low temperatures prevalent at higher altitudes, plant growth and soil formation are slower, and vegetation cover is significantly less than in lowland areas. As it is very difficult to reverse environmental degradation in mountain regions, timely action is required to prevent such processes and trends through long-term approaches that combine the management of water, soils, pasture and forests. All the stakeholders involved – mountain people, the private sector, politicians and other decision-makers – are responsible for using natural resources wisely and considering the particular characteristics of upland ecosystems.

Mountains' decisive role in the global water cycle means that the management of water resources requires special attention. Water management needs to be adapted to different climatic zones: where water is abundant, any excess must be drained to avoid soil saturation and waterlogging on sloping lands, while in semi-arid and arid areas, structures such as micro-basins are used to harvest water.

Top: Planting quenua (Polylepis) in a community nursery, Peru
Bottom: A small mountain dam
Opposite: Sustainable practices: terracing in Trisuli area, Nepal

SOIL AND WATER CONSERVATION IN MOUNTAINS

Soil and water conservation is defined as activities at the local level that maintain or enhance the productive capacity of the land in areas affected by or prone to degradation. Soil and water conservation includes prevention or reduction of soil erosion, compaction and salinity; conservation or drainage of soil water; maintenance or improvement of soil fertility, vegetation cover and quality, etc. (www.wocat.net)



1. Terraces
2. Controlled grazing
3. Stabilization of terraces
   a) grass strips
   b) hedgerows
4. Water drainage
5. Water harvesting
   a) micro-basins
   b) retention reservoir
   c) dam
6. Contour ploughing
7. Nitrogen-fixing plants
8. Sustainable forest management, afforestation
9. Conservation agriculture (zero-tillage, mulching, crop rotation, composting)
10. Agroforestry
11. Irrigation, efficient water use
12. Intercropping
13. Checkdams (gully reclamation)

In many regions, sophisticated irrigation systems have been developed to overcome distance and difficult terrain between the water source (e.g., glacier or river) and the point where the water is being used (e.g., fields on mountain slopes). Water management must also consider upstream–downstream processes and interests. As water becomes increasingly scarce in many parts of the world, equitable distribution systems and improved water-use efficiency are indispensable.

The reduction of erosion and nutrient loss is an important priority in mountain areas. To manage mountain soils sustainably, conservation agriculture and soil and water conservation techniques need to be encouraged. Adequate ground cover and trees with dense foliage and extended root systems offer good protection. Other measures for preventing degradation and increasing the fertility of mountain soils include reducing slope lengths and angles through different forms of terracing; controlled grazing; diversified cropping systems; intercropping; zero-tillage; and the planting of nitrogen-fixing plants along contour lines. Diversified land-use systems protect natural resources, maintain or even increase agro-biodiversity, and make mountain farmers more resilient to climate variability or economic crises.

Many forest management approaches and techniques used in the lowlands are unsuitable for mountain forests. For example, the clear-cutting of large areas or the construction of access roads can destabilize entire mountain slopes and lead to high soil erosion rates. Mountain forests should be managed with an ecosystemic approach, taking into account the biological characteristics and different ecological functions of a forest. Diverse forest stands with a variety of species and a differentiated age structure should be maintained, and selective harvesting techniques applied. Such stands are much more resilient and therefore better able to fulfil their slope stabilization and soil protection functions.

Top: Returning home from volunteer work, Nepal
Bottom: Farming community working on the construction of an irrigation canal, Pakistan

Top: Soil and water conservation structures in Fouta Djallon Highlands, Guinea
Bottom left: Getting back to work after Hurricane Ivan, Grenada
Bottom right: Indigenous knowledge and experiences in soil conservation in the Indian Himalaya
Opposite: Ploughing, Tibet

The sustainable management of natural resources in mountain areas requires significant effort and investment and imposes a heavy workload on local people. Mountain people should therefore participate in the search for sustainable solutions, to ensure that they will be economically viable and socially acceptable.

Indigenous communities' knowledge and experience have to be fully considered and recognized, and the causes and impacts of unsustainable natural resource management carefully assessed. The ecological consequences of unsustainable natural resource management and land-use practices often have underlying causes of a social, political or economic nature that have to be considered.

CONSERVATION LANDSCAPES

In the last 40 years, protected areas have increased between six- and eightfold. Many are located in mountain areas, and often, they are inhabited and used by local people. Innovative approaches are needed to reconcile biodiversity conservation with development – two often conflicting goals – and local people must be engaged in the stewardship of their natural heritage. Conservation landscapes provide an opportunity for such an approach, as biodiversity sanctuaries are included within a pattern of agricultural and other land uses.

The potential for maintaining high levels of biodiversity in combination with intensive but diversified small-scale farming is particularly valuable in areas in which high population density inhibits the establishment or extension of protected areas.

For example, the Kigezi Highlands in southwestern Uganda is a conservation landscape that includes the Bwindi Impenetrable National Park, a World Heritage Site with exceptional diversity of flora and fauna, which is home to half the world's remaining mountain gorilla population.

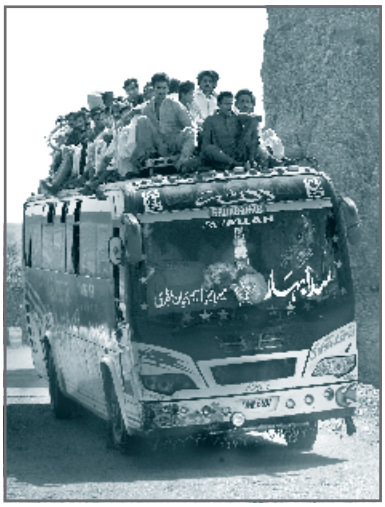
Despite intensive use and high population density of more than 250 people per square kilometre, the region's agricultural production system supports biodiversity management, based on a wide variety of crops and agroforestry. Nearly one-quarter of the 324 woody species found in the Bwindi Impenetrable National Park can also be found in the agricultural landscape, as farmers are planting trees on farms. Thus, the park's native tree species are enhancing farm tree diversity, wood cover and the livelihoods of local farmers.

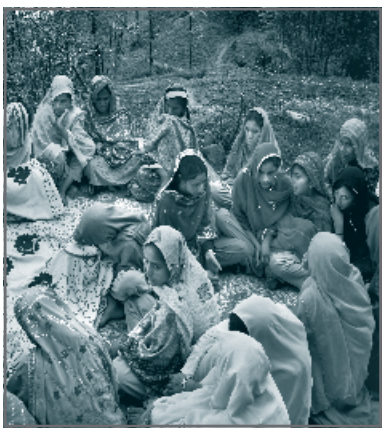
ECONOMIC OPPORTUNITIES

Mountain regions face significant challenges when interacting with the market. Tourism, the marketing of mountain products, payments for environmental services and the green economy offer opportunities for economic development

Because of environmental and climatic constraints, difficult terrain and high production costs, economic activities in mountains rarely achieve the scale and profitability of those in the lowlands. The amount of time needed and the costs of transportation pose major barriers to trade and hamper the export of perishable goods from mountain regions, while the isolated nature of mountain communities means they are cut off from information about markets and innovations. In mountain areas, the export of unprocessed goods at relatively low prices, such as timber or mining products, is frequently coupled with the import of expensive commodities that cannot be produced locally. In addition, mountain communities provide lowland areas with important environmental services – often without adequate financial compensation. An economic imbalance is created in which lowland societies gain most while mountain communities bear the environmental and social costs.

Most mountain households pursue several activities to generate income. This diversification of livelihoods makes socio-economic systems more adaptive and responsive to the fragility of mountain ecosystems, enhancing mountain communities' resilience and capacity to cope with environmental and global changes. Economic development in mountains should build on these diversified systems and should not promote reliance on a single, even if lucrative, economic activity.





Top: Mountain roads need to be improved, Pakistan
Bottom: Income generation for women, Pakistan
Opposite: Indoor fruit and vegetable market, Guatemala

Above: Women's saffron processing, Morocco

Certain high-quality niche products offer comparative advantages for economic development in mountain areas. In addition to traditional handicrafts, speciality products can range from farm products, such as fruits, vegetables, off-season products, cheeses and wool, to non-wood forest products, such as medicinal plants, herbs and native spices. To maximize returns, mountain communities need support in moving from the selling of raw materials (e.g., fruits) to the processing and marketing of goods (e.g., juices). Processing also increases the products' durability and facilitates their transport and sale in lowland markets. Local micro-enterprises, suitable financial institutions (e.g., for the provision of credit) and efficient marketing systems are essential for the development of mountain economies.

MOUNTAIN PRODUCTS

The globalization of markets offers important new opportunities for the producers of such products as coffee, cocoa, honey, herbs, spices and handicrafts, at the national, regional and international levels. Although many of these sought-after products and services come from mountain areas, mountain people rarely have the opportunity to exploit the market potential and reap the benefits. Instead, they are often still engaged in producing staple commodities for which prices are declining and markets are being squeezed. In every mountain region, there is potential for high-quality, high-value products to increase the incomes and improve the livelihoods of mountain farmers – and to be a motor for local sustainable development of mountain communities.

In 2003, the FAO Mountain Products Programme was launched in the context of the Mountain Partnership, with funding from the Government of France. This programme, which ended in 2008, undertook global surveys, analysis of promising products in different regions, and pilot projects. For example, a Technical Cooperation Project in the Anti Atlas Mountains of southern Morocco promoted the production of high-quality saffron and included a thorough analysis of the entire value chain in Morocco. This should lead to saffron making a much greater contribution to local incomes and development efforts in southern Morocco and, eventually, at the national level.

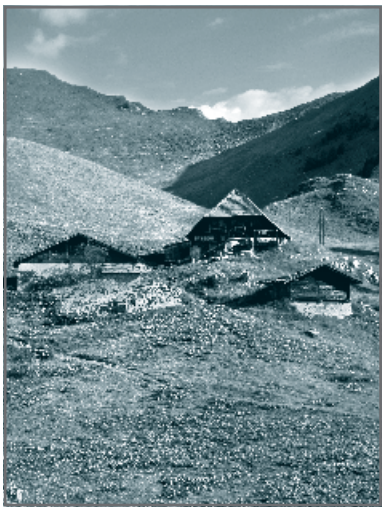
The Central Asian NGO Vista 360° linked local groups of women felt producers to the high-end fashion market in New York, United States of America, and elsewhere. In India, the co-founder of the Pan Himalayan Grassroots Development Foundation set up a cooperative of self-help groups providing sustainable livelihoods to more than 2 000 women in 150 hill villages of Kumaon. The women produce organic jams, pickles, honey, hand-knitted woollen garments and beeswax candles, which are marketed and sold through fair trade.

More information from:
www.mountainpartnership.org/mpp/index.html

Tourism offers great potential for improving mountain livelihoods, but the development of tourism is often concentrated in the hands of outside interests, with little of the benefit going to local communities. Mountain tourism can also have negative side-effects, such as environmental degradation and the disruption of local cultures. To avoid these adverse impacts, sustainable forms of tourism such as eco- or agritourism should be developed and promoted; mountain people's involvement and local ownership of tourism infrastructure are at the core of sustainable tourism development. Mountain tourism should satisfy the desires of tourists and enterprises, provide economic benefits to local communities and be environmentally sustainable.

Environmental services provided by mountain areas, such as high-quality freshwater, hydropower and disaster prevention, are often perceived as pure public goods, and their value is rarely expressed in monetary terms. This leads to an economic imbalance between downstream beneficiaries and upstream providers of the services. Financial mechanisms to compensate mountain communities for providing such services have to be developed and implemented. In much of the industrialized world, incentives, subsidies or direct transfer payments have become the norm, and where such financing mechanisms are not available, such as in many developing countries, payments for environmental services (PES) offer a promising alternative, particularly for the provision of drinking-water.

Current developments and the movement towards a green economy will increase the demand for environmental services. As long as adequate financial tools and policy instruments are put in place, this will open up new opportunities for mountain communities.



Top: Summer pasture in the Swiss Alps
Bottom: Ecotourism can improve mountain livelihoods, Ecuador

MOUNTAIN ENVIRONMENTAL SERVICES

Mountain rivers are increasingly used for the generation of hydropower. But unsustainable land management upstream has often led to resource degradation and elevated erosion rates, and hydropower plants are frequently reported to have lost large percentages of their capacity owing to sedimentation and siltation in dam reservoirs. Investments in watershed restoration and sustainable mountain development can offer a cheaper, more sustainable and longer-term solution than post-siltation dredging.

In 1985, increasing sedimentation of hydropower stations along the Feather River in California, United States of America, encouraged the Pacific Gas and Electric Company and other stakeholders to invest in watershed restoration to protect the dams.

Some of the reservoirs had lost more than 50 percent of their initial capacity, and the cost of dredging was estimated at USD 7 million. Further support came through public funds, owing to the potential for stimulating the local economy and creating jobs. In its first 26 years of operation, this initiative has established 69 watershed restoration projects on more than 1 620 ha, restoring 75.5 km of streams and contributing more than USD 10 million to the local economy, mainly through the creation of jobs. Sedimentation rates have been reduced by at least 50 percent.

In Indonesia, helped by the Rewarding Upland People for Environmental Services programme (RUPES), which started in 2004 in the Barisan mountain range, farmers have organized themselves into the River Care association and have learned about water conservation, including the reduction of sediments and the monitoring of water quality.

Good agroforestry practices have been introduced, and dams, drains and terraces constructed. River Care receives payments from a hydropower company according to the amount of sediment reduction that range from USD 250/year for up to 10 percent reduction to USD 1 000/year for 30 percent or more. With RUPES' support, farmers also prepared a proposal for obtaining access to a national forest devolution programme run by the Indonesian Government. The programme grants them conditional land tenure rights for five years (extendable to 25 years) for generating water conservation benefits.

Economic development in mountain regions must be backed by sound legislation and policies and a framework conducive to development that incorporates the development of adequate infrastructure, encourages investments from the private sector, and guarantees efficient knowledge and technology transfer to mountain areas. Educational and extension services must be set up to enhance the human capacity and skills of mountain people. Laws should oblige the external companies that extract resources such as timber and minerals to account for the social as well as the environmental costs and to pay adequate compensation to local people. Stakeholders from the local, district, national and international levels have to work together to integrate upland economies into broader regional and national economic systems. Greater mobilization of financial resources and more investments are needed to achieve real progress towards sustainable mountain development.

Top: Poor access roads in mountain areas are major constraints for economic development

MIGRATION

Migration has always played a prominent role in mountain livelihoods, particularly for young men, who migrate for trade or transhumance or to seek employment in nearby towns, and return home only during labour-intensive months. In today's globalized world, an increasing number of migrants move further and for longer periods. According to official statistics, in certain districts of Nepal, up to 40 percent of all the economically active men are abroad.

Migration offers significant economic opportunities, but also increases mountain people's dependence on remittances, which play an increasingly important role in their livelihoods. In developing countries, incoming remittances are often far higher than development aid. In 2006, official remittances and other external transfers accounted for 39 percent of the gross domestic product (GDP) of Tajikistan, with 40 percent of all households receiving remittances in cash or in kind, rising to more than 70 percent among the poorest. In general, remittances increase household income and reduce poverty, but they must be invested carefully to make households more secure in the long run.

Migration to distant places for long periods can change people's attitudes and ways of thinking, which is likely to lead to conflicts when migrants return home. Migration often leads to risky sexual behaviour and, hence, contributes to the spread of diseases such as HIV. When men migrate, those left behind – mostly women, the elderly and children – face heavier workloads at home, which can lead to the neglect of labour-intensive and time-consuming activities such as maintaining agricultural terraces or irrigation channels. The subsequent collapse of such infrastructure has serious impacts on local livelihoods.

MOUNTAIN POLICIES AND GOVERNANCE

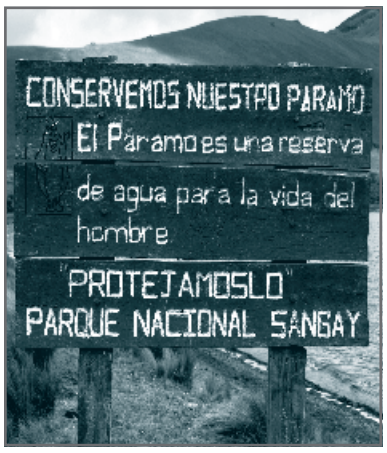
An important challenge for sustainable mountain development is the eradication of political marginalization found in many mountain regions. There is need to develop and enforce mountain-specific legislation and policies that allow mountain people's participation in decision-making, the integration of upstream and downstream interests and the consideration of transboundary issues

Most mountain regions share a long history of political marginalization. Mountain people have limited access to policy- and decision-making beyond the local and district levels, and their development is often externally driven. In many countries, mountain people lack political clout and voice; language differences, physical isolation and limited access to transportation and communication facilities constrain their participation.

So far, only a few countries have adopted mountain-specific policies or laws. Instead, mountain issues are commonly addressed through sectoral legislation related to agriculture, forestry, land or water. Such policies and laws are normally developed and negotiated with a lowland focus and pay inadequate attention to the fragility and specificities of mountain ecosystems and the needs and interests of mountain people. Decision-makers based in lowland centres tend to perceive mountains as hinterlands that supply resources, and fail to consider the specific challenges of mountain development.

To achieve political, economic and social integration, mountain people's voices have to be heard and mountain communities be recognized as equal partners in policy- and decision-making.

Top: Local communities participate in activity planning, Bolivia (Plurinational State of)
Bottom: A village meeting to decide which kind of trees to plant
Opposite: Women participate in decision-making, Nepal



Decentralization is one of the best ways of empowering mountain inhabitants, reducing costs and increasing efficiency, but local administrations often lack the necessary resources and expertise to fulfil their new functions, especially in developing countries. In many places, it is necessary to establish new institutions, strengthen existing ones and enhance the capacity of local stakeholders. Sufficient monetary resources must also be transferred from the central to the local level.

The sustainable development and protection of mountain regions and the improvement of local livelihoods should be at the core of mountain legislation. Policies and laws must take into account the specific characteristics, needs and challenges of mountain areas, while also considering the broader political context, including downstream interests. Key aspects to be addressed are the improvement of infrastructure and the enhancement of public services, particularly in the health and education sectors. To meet such objectives, legislation has to provide adequate financial instruments and resources.

Legislation needs to address the protection of ethnic minorities and the cultural heritage of mountain people, and to recognize community-based property rights. In many countries, failure to recognize the traditional land-use rights of mountain communities has opened the way for inequitable extraction and use of natural resources and led to disputes. With secure land titles and access to local resources, mountain people have greater interest in managing them sustainably, and are in a better position to negotiate compensation payments, such as for the extraction of timber or mining products, or the establishment of PES schemes.

REGIONAL AND SUBREGIONAL MECHANISMS FOR SUSTAINABLE MOUNTAIN DEVELOPMENT

Existing regional and subregional mechanisms cover a broad range of approaches: the International Centre for Integrated Mountain Development (ICIMOD) was set up in the Himalaya-Hindu Kush; the Consortium for Sustainable Development of the Andean Ecoregion (CONDESAN) provides a platform for cooperation in the Andes; the Andean Community is a customs union involving Colombia, Ecuador, Peru and the Plurinational State of Bolivia that aims at achieving more rapid and better balanced development and deals with environmental, social and political issues; and international conventions for the Alps and the Carpathians provide the legal frameworks for cooperation in Europe's two largest mountain ranges. All of these approaches are based on the principle of multisectoral integration and cooperation.

Regional mechanisms play an important role in implementing global agreements: the United Nations Convention on Biological Diversity (UNCBD) stresses the need for strengthening regional cooperation and calls explicitly on the Alpine Convention, the Carpathian Convention, CONDESAN, ICIMOD and other relevant initiatives. To ensure efficient communication and regular exchange of information among these initiatives, tools for promoting the sharing of experiences are required.

Successful regional cooperation can inspire similar activities in other mountain regions. Efforts are under way to establish legal instruments in mountain regions such as the Balkans, the Caucasus and the Dinaric Arc.

Strong institutions, networks and better transboundary cooperation will be indispensable for the future of sustainable mountain development.

Above: Local government office in the Fouta Djallon Highlands, Guinea

Many mountain ranges are transboundary, so sustainable mountain development requires international cooperation. Several global and regional bodies, networks and mechanisms are in place, but with the exception of a few institutional mechanisms, such as the Alpine and the Carpathian Conventions, no legally binding international instrument specifically relates to sustainable mountain development. A number of global concerns make the need for international cooperation particularly pressing; the impacts of climate change, environmental degradation and conflicts over natural resources use do not stop at international borders and call for closer collaboration among nations. Most of the major rivers originating in mountains flow through two or more countries, emphasizing the need for international regulations. Sustainable solutions require multi-stakeholder approaches that allow mountain people to participate, integrate the interests of upstream and downstream users, and build partnerships among countries.

Previous pages
Top: Member of a farming association attending a training workshop
Centre: Negotiations with ethnic minorities are prerequisites for sound governance
Bottom: Protection of mountain ecosystems: Sangay National Park, Ecuador
Opposite: Ngolok nomads on horseback in the Amdo Valley, formerly Tibet

CONFLICTS IN MOUNTAINS

Mountains often constitute geopolitical borders, while their rich natural resources and strategic relevance can make them sites of tension or even conflict. Many regional conflicts are fought in mountain areas, with mountain people becoming helpless hosts to the combatants and suffering the consequences. Inaccessible and remote mountain regions also often harbour opposition groups, which is likely to cause tensions within a country's borders. In 1999, 23 of 27 major armed conflicts in the world were being fought in mountain regions.

The chaos created by armed conflict is one of the greatest causes of poverty and hunger in mountain regions. People cannot carry out life-sustaining tasks, such as planting and harvesting crops, and roads, schools and other infrastructure are destroyed. To make things worse, poverty also causes conflict – ethnic and religious issues, social inequality, political marginalization and environmental stress are all important causes of conflict, and all are commonly faced by the poor. As a result, poor countries and poor mountain regions become locked in a vicious circle, where poverty causes conflict and conflict creates more poverty.

Predicted increases in water shortages will have serious impacts on mountain areas. At present, 45 countries with more than 750 million people face water stress. In 2025, these figures will be 54 countries and more than 2.8 billion people. Upstream–downstream relationships are at the root of many conflicts, as both sides seek to ensure that they have adequate water. Without agreements that are advantageous for all riparian countries, and strong transboundary and regional collaboration, conflicts will be unavoidable.

On the other hand, mountains also offer opportunities for transboundary cooperation and the promotion of peace. As part of a broader regional cooperation agenda, the Aga Khan Development Network has built and rehabilitated four bridges over the Pyanj River connecting the mountainous areas of southeastern Tajikistan with Afghanistan's Badakhshan Province. For Afghans, this has improved food security, access to emergency medical treatment at Tajik hospitals and the delivery channels for humanitarian aid. Cross-border markets draw more than 1 000 traders a week.

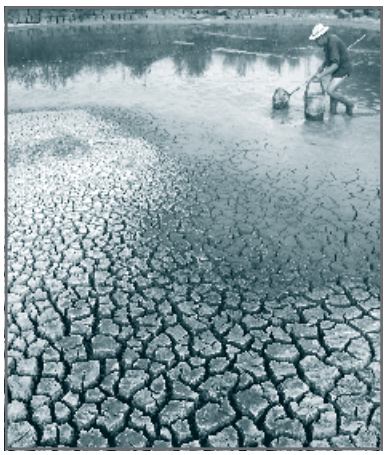
3 THE WAY FORWARD

SUSTAINABLE MOUNTAIN DEVELOPMENT: OPPORTUNITIES AND CHALLENGES

Mountains are of strategic importance in the response to global challenges

The world is currently facing a multitude of global challenges: climate change and increasing natural disasters, food and energy crises, a growing population (predicted to reach 9.2 billion people by 2050), increasing water scarcity and desertification, deteriorating water quality, loss of biodiversity, overall ecosystem degradation, financial crises, political instability, migration, and the growth of cities. These challenges disproportionally affect mountain regions and their inhabitants, particularly in developing countries. Moreover, owing to the relevance of mountain goods and services, changes occurring in mountain areas reach far beyond the mountains. On the other hand, the global importance of mountains as water towers, biodiversity hot-spots, indicators of climate change and hubs of traditional indigenous knowledge means that mountain regions also offer strategic opportunities in the search for solutions. Sustainable mountain development is key to addressing these global challenges and to overall sustainable development.

Migration flows have reached an unprecedented scale. Many mountain regions are faced with labour outmigration, mainly of young men, whose remittances to their homes change local economies, livelihood options and social structures. Worldwide, cities are growing at an often uncontrollable pace, and although the vast majority of mountain people live in rural settings, urbanization has reached 60 to 80 percent in some areas of the Andes.



Top: Sustainable mountain development is threatened by water scarcity
Bottom: Sustainable irrigation system
Opposite: Mountains are an increasingly important source of freshwater

WHY INVEST IN SUSTAINABLE MOUNTAIN DEVELOPMENT?

Sustainable mountain development is essential for achieving food security, poverty alleviation and overall sustainable development.

In particular, investing in mountain areas helps to:

- reduce poverty and improve the livelihoods of mountain people;
- preserve and protect natural resources;
- ensure the provision of mountain environmental services of global importance, such as freshwater, biodiversity, renewable energies, hazard mitigation, and erosion and sedimentation control;
- ensure the provision of raw materials and high-quality products;
- preserve cultural heritage and indigenous knowledge;
- maintain and enhance mountains as important destinations for recreation and tourism;
- promote political stability and peace;
- limit migration trends and urbanization;
- build resilience and capacity for climate change adaptation and mitigation.

Opposite: Protection forest against rock fall and avalanches above Pontresina, a mountain resort in the Swiss Alps

Cities put heavy pressure on the environment, resulting in deforestation and degradation of their surroundings and pollution of rivers, some of which have become unusable for those living further downstream. Investing in improving the livelihoods of rural mountain communities, for example through the development of PES schemes, will reduce the rates of outmigration from and urbanization in mountain areas.

Climate change will compromise the role of mountain ecosystems as the world's water towers. Decreasing water flow from mountains will seriously affect agricultural production and food security, not only for mountain communities but also for the millions of people who live in lowland areas and depend on irrigation water from mountain streams. Decreasing water flow from mountains will also threaten the supply of water to large urban centres in the lowlands and the production of hydropower. In arid and semi-arid areas, which are particularly dependent on mountain water, increased water scarcity may even lead to conflict. Water shortage has also been associated with a decline in water quality, which may increase the risk of water-borne diseases. Investing in the sustainable management of mountain regions and the careful, wise and efficient use of mountain water is a global priority in a world heading towards a water crisis.

The demand for goods and services from mountains has grown considerably and will continue to do so. Particularly in the context of the green economy, new opportunities for investment by both the private and public sectors are emerging, for example in renewable energy and ecosystem services. This offers scope for economic development, but also puts increasing pressure on already fragile environments and scarce resources.

INVESTING IN MOUNTAINS: THE EXAMPLE OF SWITZERLAND

Approximately 70 percent of Switzerland is covered by mountains – 60 percent by the Alps and 10 percent by the Jura Mountains. Today, Switzerland is one of the wealthiest countries in the world: even in remote areas, standards of living are comparatively high. A well-developed infrastructure and public transport system makes most mountain villages easily accessible.

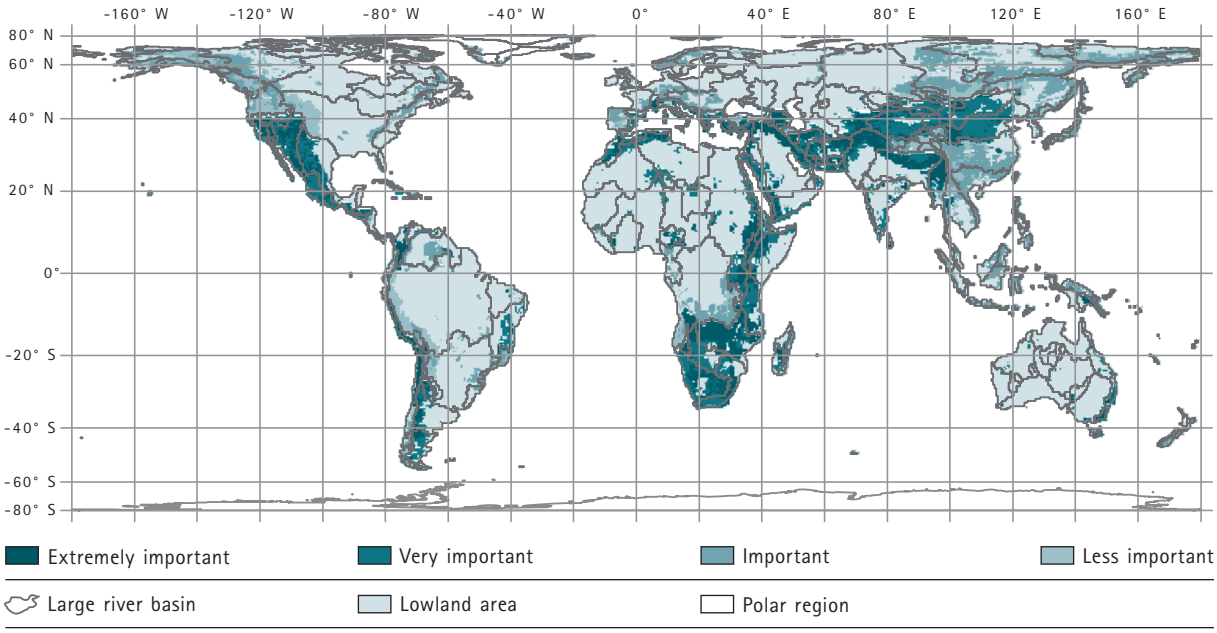
Because of the decentralized and federalist political system and because numerous provinces are completely or partly located in mountain areas, the development of mountain regions is an important priority on Switzerland's political agenda. Mountain areas are strongly anchored in and shape Swiss culture, although Switzerland, too, has had to learn some lessons. In the nineteenth century, mountain areas were seriously affected by deforestation and unsustainable development, and a number of catastrophic landslides and floods provided the impetus for the first federal forestry law, which came into force in 1876. Politicians realized that investments in mountain areas are necessary to ensure the country's overall development and social cohesion.

Today, laws, policies and a complex system of fiscal equalization schemes, transfer payments, subsidies, tax reductions, etc. contribute to the sustainable development of mountain regions and reduce disparities between them and economic centres in the lowlands. Financially strong cantons are obliged to make transfer payments to financially weaker mountain cantons.

Interest-free loans from the State encourage investments in mountain areas. Mountain farmers receive significantly higher agricultural subsidies than their lowland counterparts, with calculations based on specific mountain parameters such as slope angle and altitude, to compensate mountain farmers for their additional work. Switzerland pays about USD 150 million per year to ensure the sustainable management and protective function of mountain forests.

Such policies encourage local initiatives and provide an attractive basis for involving both the public and the private sectors in mountain areas. The tourism sector and industrial developments such as the watch industry in the Jura are examples.

IMPORTANCE OF MOUNTAIN AREAS FOR LOWLAND WATER RESOURCES



Scale: about 1:200 000 000; Map sources: Daniel Viviroli *et al.* 2007, Institute of Geography, University of Bern; Map compilation 2011: Ulla Gämperli Krauer, CDE, University of Bern; Terrain background: USGS GTOPO30; Projection: Behrmann; Map design adapted from Giulio Marchi / John S. Latham (FAO – NRL, Land and Water Division).

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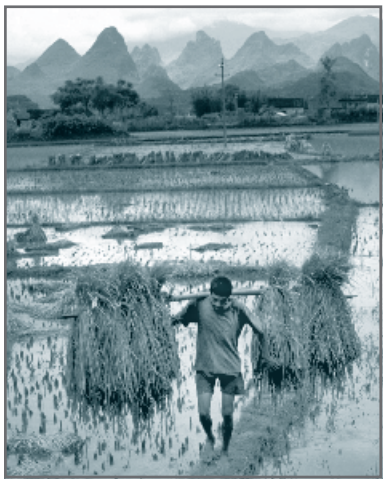


Above: Carrying the harvest from rice paddy fields in the Valley of Guilin, China
Opposite: A view across the city of La Paz, Bolivia (Plurinational State of)

The implementation of institutional arrangements that ensure the balanced development of social, ecological and economic capital is essential to ensure that new opportunities bring benefits and do not perpetuate the degradation of mountain socio-ecological systems. Suitable tools and methods that allow the valuation of mountain goods and services and adequate compensation mechanisms have to be put in place.

To respond to global challenges, do justice to the strategic importance of mountains and achieve sustainable mountain development, there is need to invest in enhancing the knowledge base about mountain ecosystems' functioning and interactions with lowland areas.

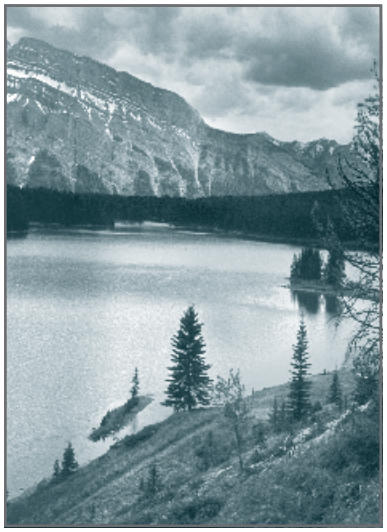
MOUNTAIN CITIES

Not all mountain people live in remote, rural areas. Many live in large, even capital, cities, such as Kathmandu, with more than 2 million inhabitants, or Quito, with almost 1.5 million. At 3 640 m above sea level, La Paz is the highest capital in the world and has almost 900 000 inhabitants. Owing to increasing migration from rural areas, these cities grow larger every day. Mountain cities are generally constrained by surrounding steep land, so people – especially those who are poor and have arrived relatively recently – are often forced to settle on steep slopes and marginal land on the city's periphery, where the risks of floods and landslides are greatest.

Inhabitants of mountain cities depend largely on environmental services such as wood and water from the surrounding highlands. This leads to serious deforestation and increases the likelihood of local landslides and floods. In the absence of adequate sewage systems, wastewater (including industrial litter) is dispersed into rivers and streams, which are generally heavily polluted after passing through mountain cities. This seriously affects the inhabitants of mountain cities and all those who live further downstream.

Unsustainable sprawl and poverty in mountain cities can only be addressed by long-term urban planning and significant infrastructure investments. Interventions for economic growth in rural areas are also needed to reduce high migration rates to the cities.

In the mountain areas of more developed countries, urbanization is mainly a result of the development of tourism and transport infrastructure, so it poses different problems. Huge resorts and the construction of roads, railways and transport systems for winter sports are often developed without regard for nature and local cultures. Approaches to planning that integrate economic developments with ecological and socio-cultural aspects are required.



Top: A young girl drinks water in a camp after a flood, Pakistan
Bottom: Climate change affects water resources
Opposite: Atmospheric monitoring station in the mountains

Many processes in mountain regions are still poorly understood, and very few disaggregated data from mountain areas and statistics are available. Climate change and the increasing incidence of natural hazards call for new types and sources of information. Improved understanding of the socio-cultural and institutional framework and of policy- and decision-making processes is necessary to direct development efforts and tap the potential for innovations; more interdisciplinary and applied research, information exchange and the use of synergies are required to fill existing knowledge gaps; monitoring systems for specific mountain parameters have to be established and data made available to a broader public in order to identify future trends, for example of freshwater supplies; research findings have to be translated into user-friendly, operational and practical products to ensure effective communication with decision-makers.

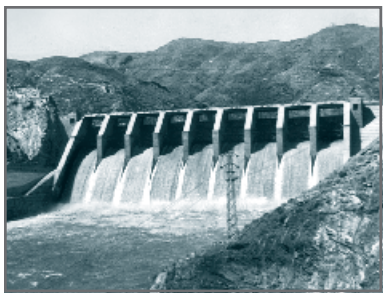
THE FUTURE OF SUSTAINABLE MOUNTAIN DEVELOPMENT

Sustainable mountain development must be given a prominent place on the global development agenda

There is evidence that water, energy and food will be increasingly scarce resources in coming decades. Mountains will play an increasingly important role in the provision of freshwater for a growing global population, and of energy and biodiversity conservation. Without sustainable mountain development, the world will not be able to solve the global problem of increasing water scarcity. Mountain systems are essential building blocks for long-term sustainable global development, poverty alleviation and the transition towards a green economy, and play a crucial role in global efforts for climate change adaptation and mitigation. Sustainable mountain development therefore needs a prominent place on the international agenda.

In 1992, the adoption of Chapter 13 of Agenda 21 "Managing Fragile Ecosystems: Sustainable Mountain Development" at the United Nations Conference on Environment and Development was a milestone in the history of mountain development. Two decades later, awareness about the global importance of mountain ecosystems, the fragility of their resources and the difficult living conditions of many mountain people has increased significantly. Nevertheless, sustainable mountain development does not yet receive sufficient attention on the international agenda, and there are still significant constraints

Top: More than half of the world's population relies on freshwater stored in mountains
Bottom: Mountain waterfall bringing freshwater to the lowlands
Opposite: Mountain landscape



Top: International Mountain Day, held since 2002 on 11 December to raise awareness on global mountain issues
Centre: Warsak Dam provides hydroelectric power and water for irrigation, Pakistan
Bottom: Waterfall in Yosemite National Park, United States of America
Opposite: Volcanic lake, Ecuador

to alleviating poverty, mitigating environmental degradation and attaining sustainable development in mountain regions.

In 2000, the international community committed itself to achieving the eight Millennium Development Goals (MDGs) by 2015. Since then, it has become clear that most targets will not be met within the envisaged timeframe and that additional efforts are needed. Sustainable mountain development contributes to three MDGs in particular.

As many hungry and food-insecure people live in mountain areas, investing in sustainable mountain development contributes to MDG 1, the eradication of extreme poverty and hunger; by promoting the economic integration of mountain regions and enhancing the availability and efficient use of land and water resources for food production, sustainable mountain development improves the livelihoods of upstream and downstream people. The sound management of mountain ecosystems is essential for meeting MDG 7, ensuring environmental sustainability; in particular, it addresses the three targets of reversing the loss of environmental resources, reducing the loss of biodiversity, and halving the proportion of people without sustainable access to safe drinking-water. As sustainable mountain development requires strong collaboration and partnerships among all the stakeholders involved, it also contributes to MDG 8, achieving a global partnership for development.

The Rio+20 process provides an excellent opportunity to emphasize the global importance of sustainable mountain development, enhance awareness and increase investments. The United Nations Convention on Biological Diversity (UNCBD) Programme of Work on Mountain Biological Diversity, the United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations Convention to Combat Desertification (UNCCD) also provide important mechanisms for promoting sustainable mountain development.

GLOBAL ATTENTION TO MOUNTAIN AREAS

Despite their importance, mountains have received little attention in global discussions of environmental and development issues. This changed in 1992 with the adoption of Chapter 13 of Agenda 21 at the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil (UNCED). Chapter 13 promotes the sustainable development of mountain regions, points out the need for better understanding of the ecology of mountain ecosystems, and clearly acknowledges mountains' importance for humankind. For the first time, sustainable mountain development was placed on a similar footing to other major global issues.

In 1998, the United Nations General Assembly proclaimed that 2002 would be the International Year of Mountains (IYM). This year provided a catalyst for long-term and effective actions for implementing Chapter 13. It contributed significantly to raising awareness about mountain issues, supported the establishment of 78 national committees, and strengthened partnerships among different stakeholders, culminating in the launch of the Mountain Partnership at the World Summit on Sustainable Development, in Johannesburg, South Africa, in 2002. The IYM also led to the designation of 11 December as International Mountain Day, which has been celebrated since 2003 with a different theme each year, and provides an apt occasion for events that highlight the importance of sustainable mountain development.

Chapter 13, the Johannesburg Plan of Implementation and the Millennium Development Goals form the overall policy framework for sustainable mountain development at the regional and global levels. Mountain issues are addressed in Chapter 24 of the Millennium Ecosystem Assessment (2005) and in the UNCBD Programme of Work on Mountain Biological Diversity. Since 2005, prompted by the IYM initiative, the United Nations Secretary-General has made a biennial report to the United Nations General Assembly on the status of sustainable development in mountain regions.

Numerous global and regional networks have been set up, and international and regional conferences and workshops have been organized. Compared with two decades ago, mountain issues have clearly gained momentum on the global agenda. Action is needed to translate this into relevant regional and national programmes and local initiatives, and existing institutions, partnerships and policy frameworks offer important platforms for promoting and intensifying sustainable mountain development and for concrete action on the ground.

Top: Mountain forests can contribute substantially to carbon storage and sequestration
Bottom: Mountains are hot-spots of global plant and animal biodiversity

With 28 percent of the world's forests, mountain areas have huge potential for carbon storage and sequestration and should be considered for Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD) or REDD-plus (enhancement of carbon stocks) programmes. The green economy and global financing mechanisms, such as the Kyoto Protocol's Adaptation Fund, which includes a specific clause favouring proposals with a mountain component, offer new opportunities for investments in mountain regions.

Increased investments and funding are needed to make sustainable mountain development a reality. Although there may be more profitable opportunities in the lowlands, investments in mountain regions are an essential and rational approach, particularly when taking into account not only short-term economic returns, but also long-term ecological and social benefits. Mountain people contribute the least to global greenhouse gas emissions but are among those most affected by the adverse impacts of climate change.

THE MOUNTAIN PARTNERSHIP

The Mountain Partnership is an international, voluntary alliance dedicated to improving the lives of mountain people and protecting their environments around the world. Launched at the World Summit on Sustainable Development in 2002, the Mountain Partnership taps its members' wealth and diversity of expertise to promote results-based collaboration, projects and information exchange on mountain issues at the national, regional and global levels. It is also a mechanism for networking and advocacy to support the cause of sustainable mountain development in relevant international processes and United Nations Conventions.

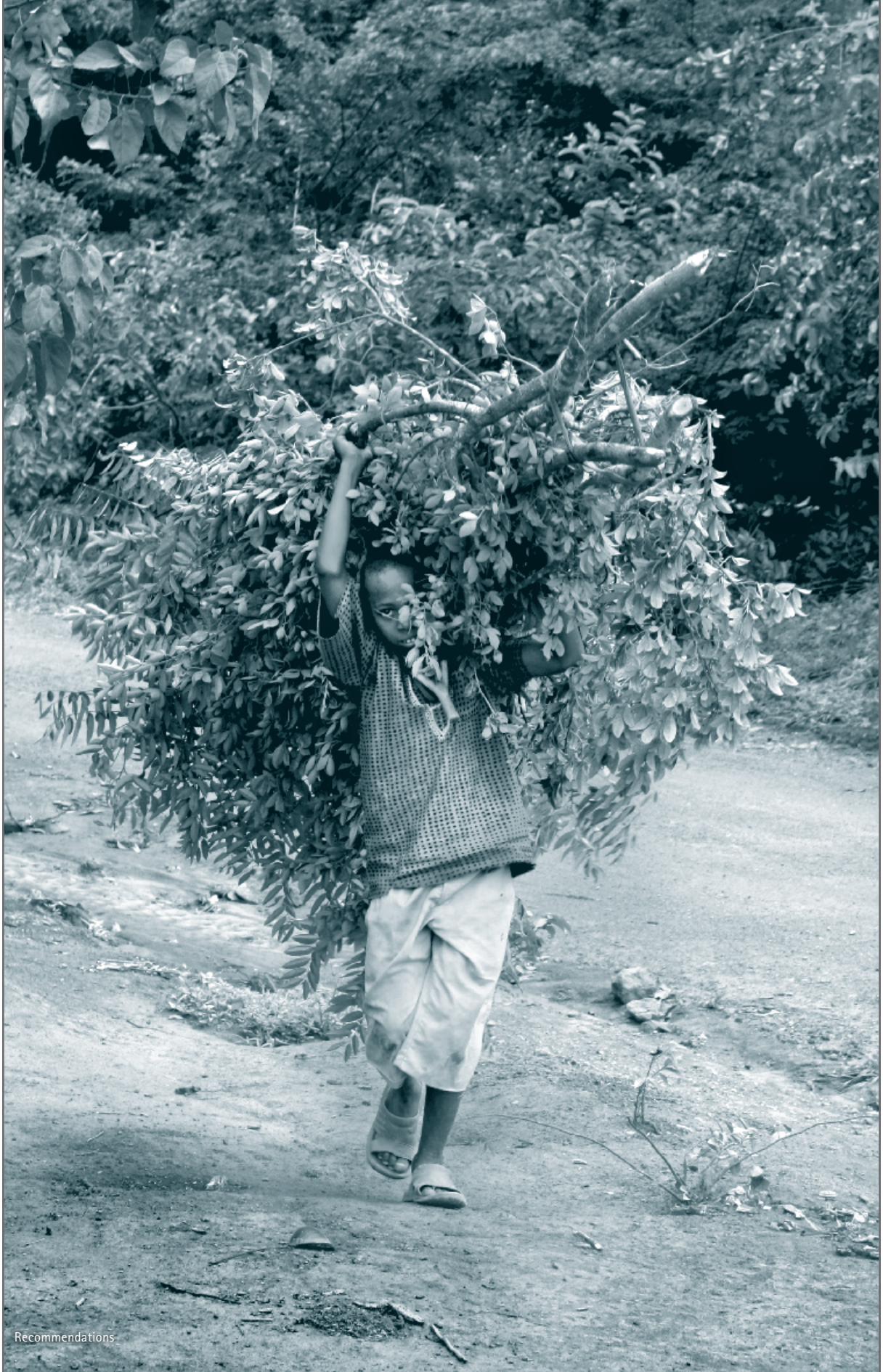
Currently it has about 180 members from governments, civil society, intergovernmental organizations and the private sector. Its Secretariat consists of a Central Hub, hosted at FAO, and three decentralized hubs: the Central Asia Hub at the University of Central Asia in Kyrgyzstan, the Latin America Hub at CONDESAN in Peru, and the Asia Pacific Hub at ICIMOD in Nepal. UNEP's Environmental Reference Centre in Vienna is responsible for ensuring adequate attention to environmental concerns.

More information from:
www.mountainpartnership.org

They need support to meet the new challenges and to benefit from emerging opportunities such as the green economy. Innovative financial mechanisms for the valuation of mountain goods and services have to be developed. Closer financial linkages between upstream and downstream areas and among the private sector, government institutions and local entrepreneurs are also required. The local potential for innovations should be explored and promising initiatives supported. There is clear need for a stronger enabling environment with more supportive laws, policies and institutions, and countries with mountain systems should join forces to make their voices heard.

Food security, poverty alleviation and overall development are critically linked to mountain ecosystems and the processes in mountain regions. Sustainable mountain development is therefore essential for the well-being of not only mountain people but of all humankind.

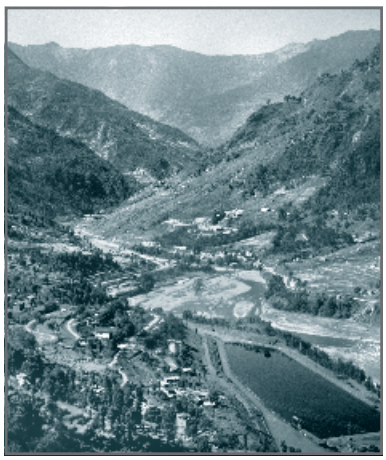
Top: Mountains are earth's water towers: Amazon headwater region, Ecuador
Bottom: Pastoralists are key actors in sustainable mountain development



RECOMMENDATIONS

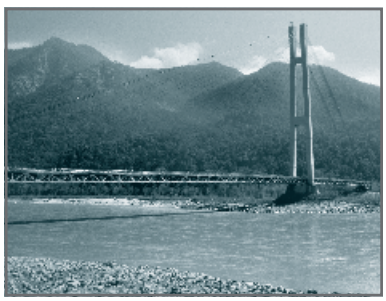
Sustainable mountain development requires a long-term vision and holistic approaches that integrate political, economic and environmental aspects, multi-stakeholder cooperation and forward-looking institutions.

To achieve sustainable mountain development, both national and international actors may wish to consider the following recommendations.



Policy and governance

- Strengthen existing and establish new and innovative national, regional and international institutions and mechanisms that deal specifically with mountain issues and ensure intersectoral collaboration.
- Formulate and implement strategies, programmes, policies and laws that explicitly address mountain issues and are able to respond adequately and urgently to current challenges such as climate change and soaring food prices.
- Increase attention to disaster risk management in mountain areas through the development of measures, approaches and policies for prevention, mitigation and rehabilitation of natural disasters.
- Enhance public services, particularly in the health and education sectors, and improve transport and communication infrastructure in mountain areas in an environmentally friendly manner.



» Through mountain people's active engagement in decision-making processes, ensure that indigenous cultures, traditions and knowledge are fully recognized and included in development policy and planning in mountain regions and that access and agreed-to rights to land and natural resources are respected.

» Strengthen mountain women's role in planning and decision-making processes that affect their communities, cultures, livelihoods and environments.

Financial mechanisms and economic development

» Increase levels of investment and funding for sustainable development in mountain regions at the global, regional, national and community levels, including through international funding mechanisms such as REDD and REDD-plus programmes and through better integration of the private sector.

» Integrate sustainable mountain development into green economy strategies and ensure that institutional arrangements are in place to allow mountain communities to benefit from these emerging opportunities and to protect mountain resources from increasing demand.

» Improve the economic situation of mountain communities through innovative financial mechanisms and approaches such as payments for environmental services.

» Provide a supportive and enabling environment for the promotion of high-quality products and services from mountain areas as a means of improving livelihoods and protecting mountain environments, and facilitate mountain areas' access to national and international markets.

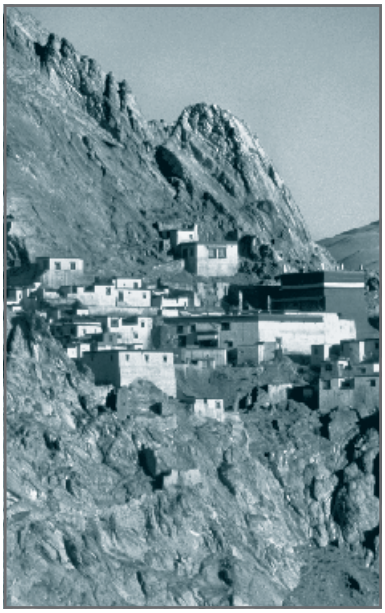
Natural resource management

» Promote the conservation and sustainable use of increasingly scarce resources from mountain areas that are of global importance, such as water, biodiversity, forests, grasslands and soils.

» Implement innovative management approaches, strengthen institutional mechanisms and support forward-looking political decisions that safeguard the natural resources in mountain areas for future generations.

» In view of climate change and the increasing occurrence and threat of natural hazards, increase awareness, prudence and efficiency in the use and management of natural resources in mountain areas, and implement specific measures for adaptation and mitigation.

International cooperation and processes

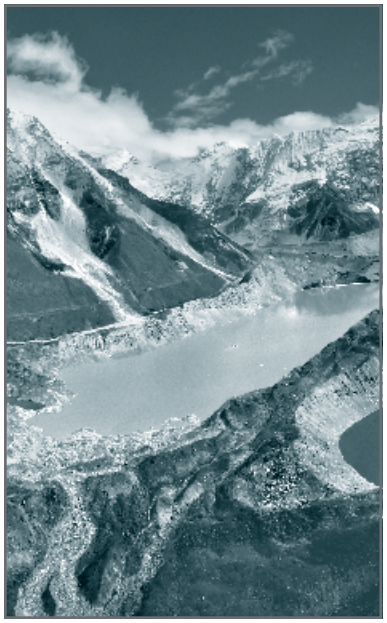


» Promote initiatives for transboundary cooperation, with particular attention to upstream–downstream linkages.

» Support developing countries and countries with economies in transition in their efforts towards sustainable mountain development, through bilateral, multilateral and South–South cooperation.

» Support the collaborative efforts of the Mountain Partnership and encourage the active involvement of its members.

» Increase efforts to include and mainstream mountain issues in international discussions and negotiations, particularly regarding the three main relevant United Nations Conventions (UNCBD with its Programme of Work on Mountain Biological Diversity, UNCCD and UNFCCC), UN-Water and the World Water Forum.



» Increase efforts to ensure that mountain issues are prioritized within development agendas, and that sustainable mountain development plays a prominent role in the Rio+20 process.

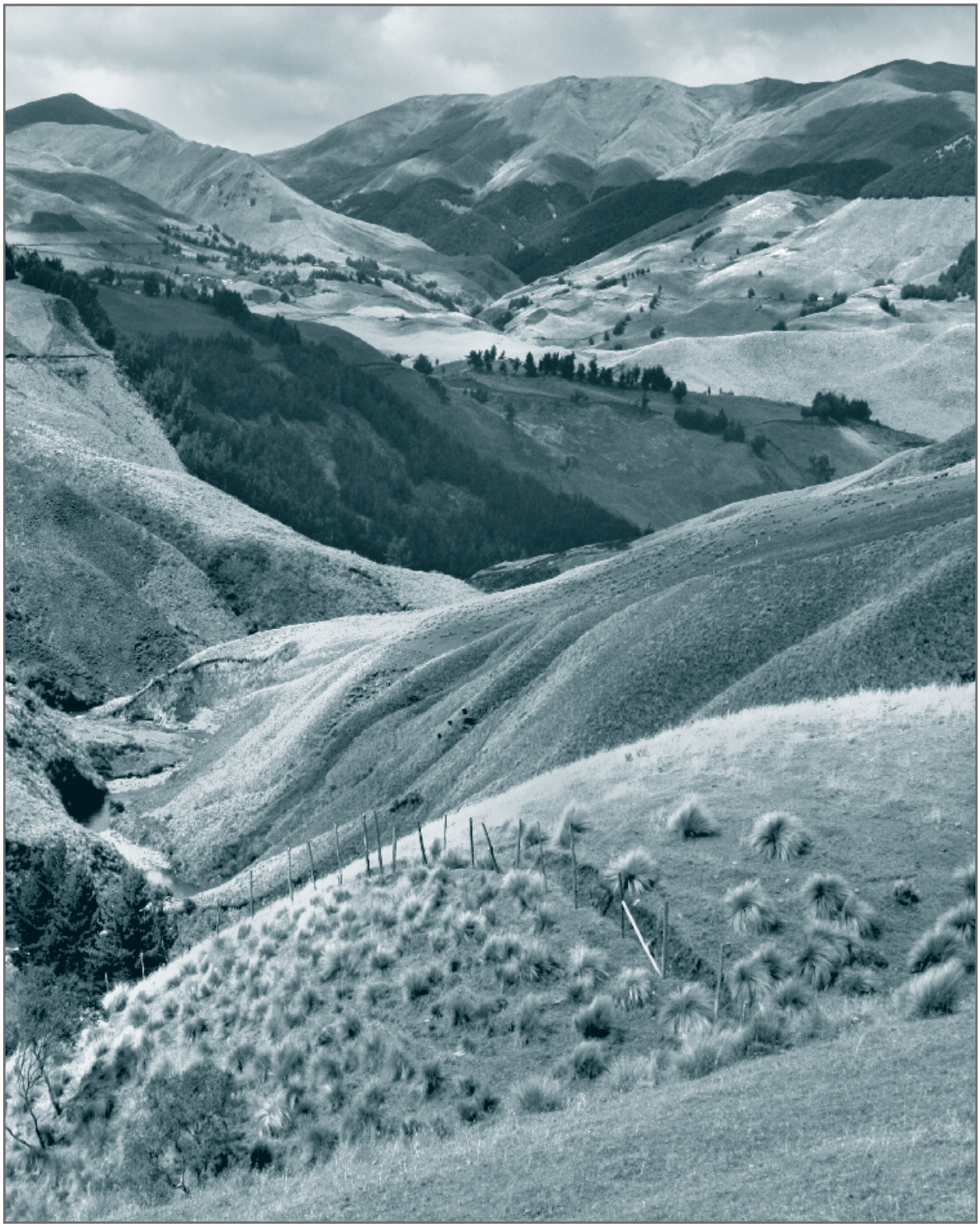
Knowledge, capacity and awareness

» Support research efforts to improve understanding of the drivers of change affecting mountain regions, and promote the collection of disaggregated data from mountain areas as the basis for informed decision- and policy-making.

» In the context of climate change, increase efforts to monitor glaciers and runoff patterns in mountain areas, to assess future water availability.

» Support capacity-building and extension programmes targeting different stakeholder groups, to promote sustainable mountain development at all levels.

» Develop and implement communication and advocacy programmes for sustainable mountain development at all levels, for example by organizing events on International Mountain Day on 11 December.



CONTACTS

Key global and regional mountain institutions and networks

Alliance of Central Asian Mountain Communities (AGOCA)
www.camp.kg

Alpine Convention
www.alpconv.org/home

Andean Mountain Association (AMA)
www.amandinas.org

Carpathian Convention
www.carpathianconvention.org/index.htm

Centre for Mountain Studies (CMS)
www.perth.ac.uk/specialistcentres/cms/pages

Consortium for Sustainable Development of the Andean Ecoregion (CONDESAN)
www.condesan.org/portal

Euromontana
www.euromontana.org

European Association of Elected Representatives from Mountain Areas (AEM)
www.promonte-aem.net

Ev-K2-CNR Committee
www.evk2cnr.org/cms/en

Global Mountain Biodiversity Assessment (GMBA)
www.gmba.unibas.ch

International Centre for Integrated Mountain Development (ICIMOD)
www.icimod.org

International Commission for the Protection of the Alps (CIPRA)
www.cipra.org/en

International Mountaineering and Climbing Federation (UIAA)
www.theuiaa.org

International Scientific Committee on Research in the Alps (ISCAR)
www.iscar-alpineresearch.org

Mountain Forum (MF)
www.mtnforum.org

Mountain Partnership (MP)
www.mountainpartnership.org

Mountain Research Initiative (MRI)
mri.scnatweb.ch

Mountain Research and Development (MRD)
www.mrd-journal.org

Regional Environmental Centre for Central Asia (CAREC)
www.carec.kz

Regional Environmental Centre for the Caucasus (REC Caucasus)
www.rec-caucasus.org

The Mountain Institute (TMI)
www.mountain.org

University of Central Asia (UCA)
www.ucentralasia.org

World Mountain People Association (WMPA)
www.mountainpeople.org

Global and regional institutions with mountain-specific activities

Andean Community
www.comunidadandina.org/endex.htm

Centre for Development and Environment (CDE)
www.cde.unibe.ch

Dipartimento di Valorizzazione e Protezione delle Risorse Agroforestali (DIVAPRA) dell'Università di Torino
www.unito.it/unitoWAR/appmanager/dipartimenti5/D039?_nfpb=true

Food and Agriculture Organization of the United Nations (FAO)
www.fao.org/forestry/mountains/en

International Potato Center (CIP)
www.cipotato.org

International Union for Conservation of Nature (IUCN)
www.iucn.org

Secretariat of the Convention on Biological Diversity (UNCBD)
www.cbd.int/mountain

Secretariat of the Convention to Combat Desertification (UNCCD)
www.unccd.int

United Nations Educational, Scientific and Cultural Organization (UNESCO)
www.unesco.org/new/en/unesco

United Nations Environment Programme (UNEP)
www.unep.org

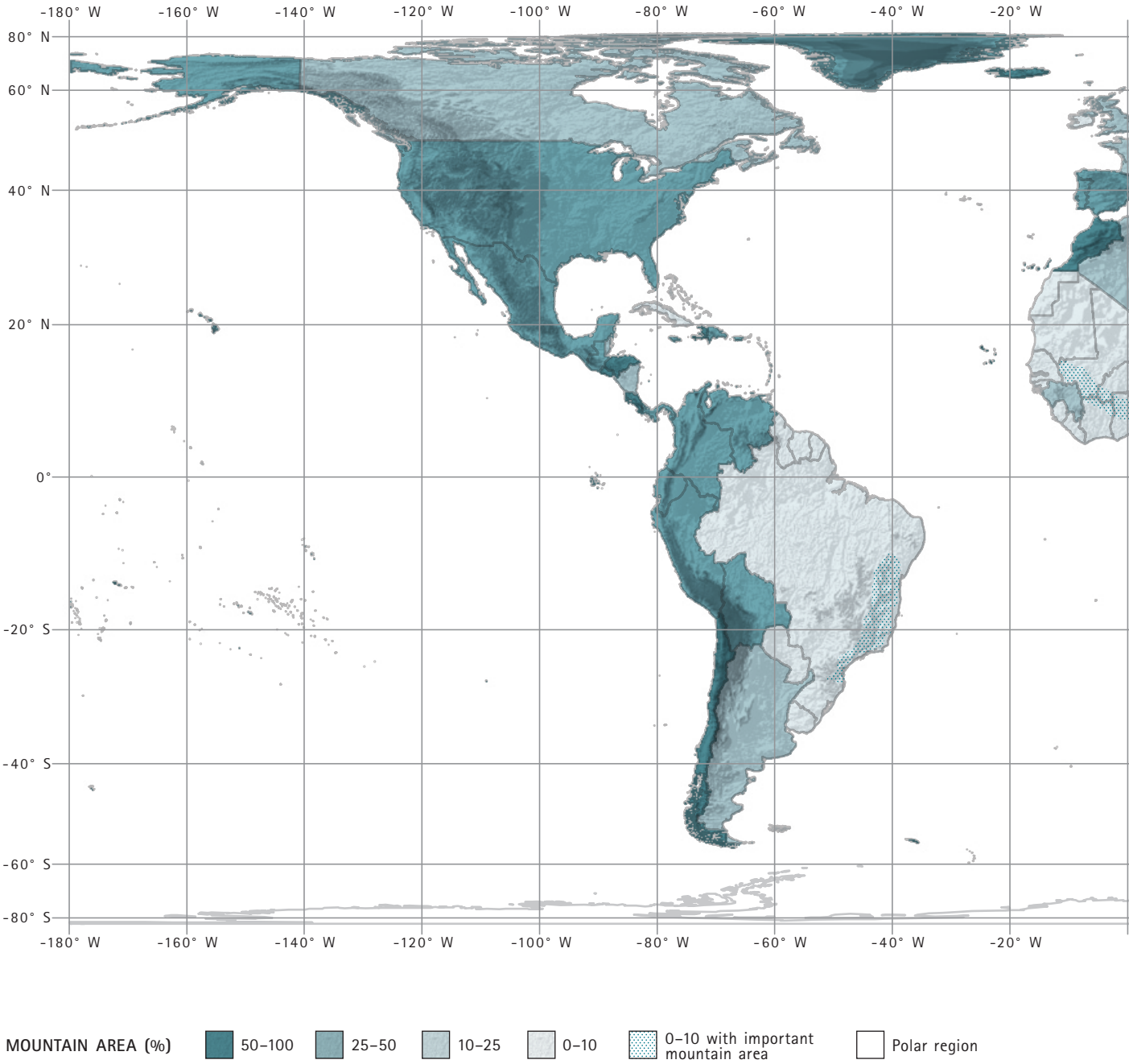
United Nations University (UNU)
unu.edu

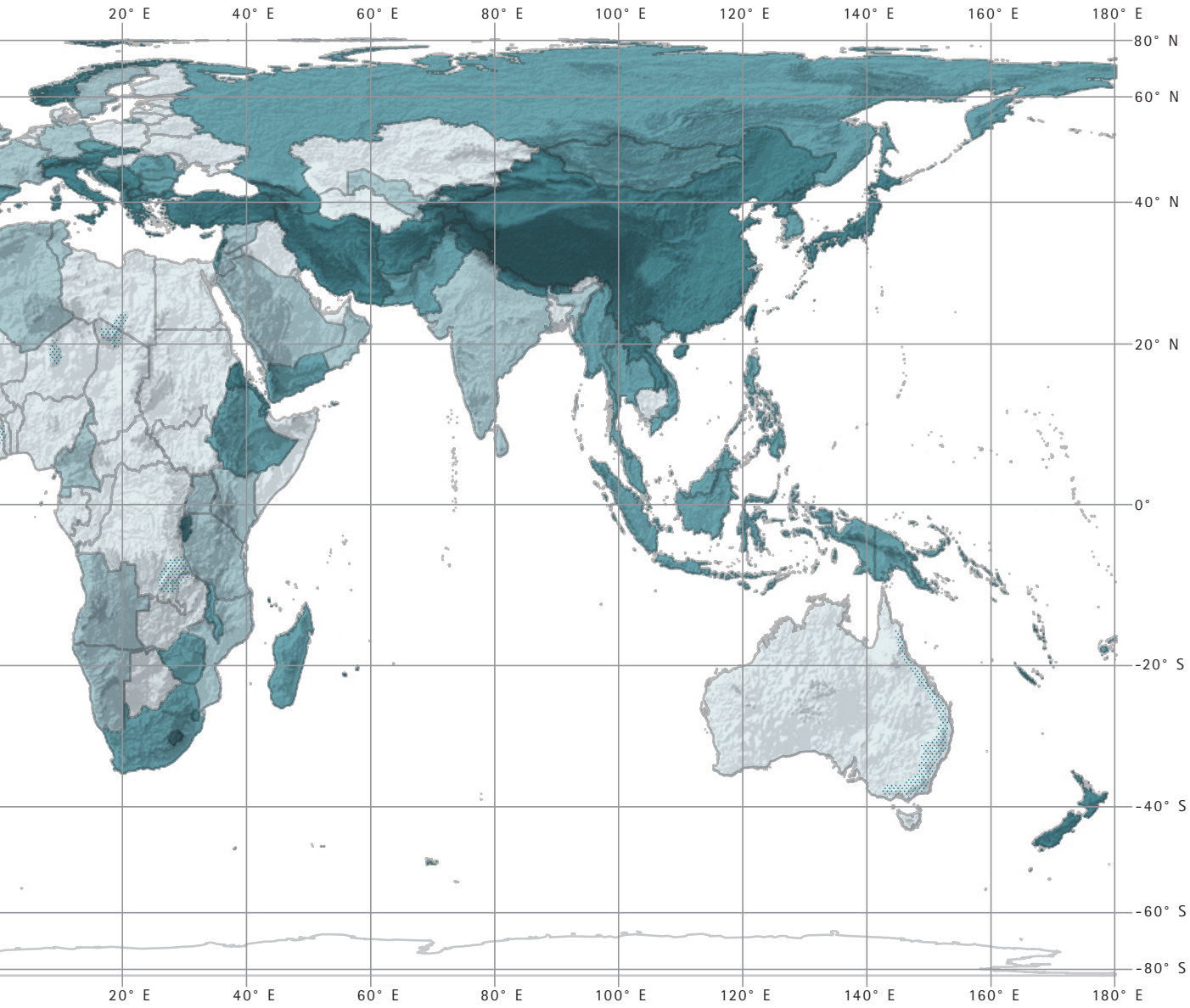
Women Organizing for Change in Agriculture and NRM (WOCAN)
www.wocan.org

World Wildlife Fund International (WWF-International)
wwf.panda.org

Please note that only institutional arrangements with a global or regional focus are included in this list. For a more extensive list and for details about national institutions dealing with mountain issues, visit the Web site of the Mountain Partnership: www.mountainpartnership.org.

MOUNTAIN AREAS OF THE WORLD





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www.fao.org/forestry/site/forestsandwater

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Mountains cover approximately one-quarter of the world's surface and are home to 12 percent of the human population. By providing freshwater and other key environmental services to more than half of humanity, mountain ecosystems play a crucial role in the development of the planet and contribute significantly to the well-being of human societies. This booklet summarizes state-of-the-art information on the characteristics of and threats to mountain ecosystems, the environmental services they provide and the impacts of climate change; it explains approaches to sustainable mountain development, including natural resource management, economic opportunities, and mountain policies and governance; and it describes the way forward and provides recommendations for addressing sustainable mountain development at the global and local levels.

The booklet is addressed primarily to those policy- and decision-makers who are responsible for finding a balance between socio-economic development and environmental conservation thrusts. It shows that sustainable mountain development plays a fundamental role in addressing current global challenges, and therefore requires and deserves a prominent place on the international agenda.

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