

## MOUNTAIN HABITATS

# LIVING IN THE MOUNTAINS

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*Xu Jianchu and Greta M Rana,  
International Centre for Integrated Mountain Development, Kathmandu, Nepal*

*“Climb the mountains and get their good tidings. Nature’s peace will flow into you as  
sunshine flows into trees” – John Muir*

**D**IFFERENT PEOPLE INTERPRET mountains in different ways. Some see them as shrouded in mystery, a kind of frightening dungeon, with people living in a wilderness. Others describe a fictional Himalayan paradise, Shangri-la, which has become a synonym for Utopia in many languages and cultures.

Half a century from 1953, when Hillary and Tensing conquered Everest, our knowledge of mountains is still far from complete and our understanding of the relationship between human beings and the mountain environments remains rife with misconceptions.

Mountains are steep and high in relation to their surroundings. They include all areas with elevations greater than 2,500m, areas higher than 1,500m with slopes steeper than two degrees, and areas of any elevation with slopes of five degrees or more than 300m above their surroundings, including plateaus and valleys within mountainous terrain. Mountain habitats support living organisms, animals (including humans) and plants, and they cover about 24 per cent of the earth’s surface. Chapter 13 of Agenda 21<sup>1</sup> (1992) established mountains as a significant habitat (<http://www.un.org/esa/sustdev/agenda21chapter13.htm>).

Mountains can be formed in many different ways, including volcanic activity or by a tectonic plate rising as it collides with another. The Himalayas resulted from a collision of the Indian subcontinent with the Eurasian continent about 40 million years ago, and the process still continues. Mountain environmental changes occur through a combination of processes within the earth and others caused by the movement of air and water both on the surface and inside the earth. These include chemical and physical transformation of matter by weathering, destruction, transportation and redeposition of rocks, and life activities of organisms and vegetation. Hence, mountains move and change and are areas of hazard, vulnerability, and risk.

Most mountain areas in the world are found in the Northern Hemisphere and at temperate-subtropical latitudes. The Eurasian landmass has the largest area of mountains on earth: all 40 of the world’s mountains above 7,000m are in Asia, and all peaks above 8,000m are situated in the Hindu Kush-Himalayas (HKH) in central Asia. The Tibet Plateau (Qing-Zang) is the most extensive inhabited land area above 2,500m. Excluding Antarctica, South America has the second most extensive area of high elevation, and has the world’s highest point outside Asia, Aconcagua, at 6,962m.

Slope, aspect, and altitude determine the fundamental characteristics of mountain habitats. Topographic diversity adds to the small-scale variations in physical environment. Geographically, latitude (distance from the equator), continentality (distance from oceans), and topographic features (direction and altitude) affect climate and local weather patterns, rendering some mountains almost permanently wet, others dry, and yet others highly seasonal. Geological conditions add dimensions of diversity and influence soil development, soil type, erosion processes, and vegetation cover. Climates vary according to altitude and exposure, thus mountain habitats have a greater species richness than the lowlands when comparing similar areas. This richness decreases with increasing altitude, but isolation and environmental extremes restrict species’ habitats. Globally, there are 10,000 species of flowering plants in the alpine belt alone representing four per cent of all higher plant species even though the alpine belt covers only three per cent of the earth’s land area (Körner, 1995).



World mountain ranges

In the mountains, geography promotes cultural diversity in languages, belief systems, architecture, settlement patterns, and livelihood practices. People have adapted in ways that demonstrate their intimate relationship with the environment and knowledge about plants, wildlife, vegetation, and ecosystems. The mountains provide them with environmental services (water, biodiversity, climate modulation, and carbon storage) and useful products (food, medicine, other non-timber forest products, and rock building materials). Twelve per cent (or about 720 million) of the global human population live in mountains, half of them are in the Asia-Pacific region. Of the 10 per cent living above 2,500m, almost all — over 70 million — live in poverty and are vulnerable to food insecurity and mountain hazards, vulnerabilities, and risks.

Landscapes in mountain regions are mosaics of forests, home gardens, wetlands, crop lands, and high pastures: a range of habitats for all life forms and a diversity of livelihoods, from shifting cultivation in the humid tropics of Asia and South America to nomadic herding on the high Tibetan plateau, from rice terraces in the Philippines to tea gardens in the southern Himalayas. Different elevations lead to a combination of survival systems and earning patterns as mountain people rely on the whole landscape and its products for their livelihoods.

Over the centuries, people have used barter systems to exchange goods and services, maintaining genetic diversity and food security within the parameters of their traditional cultures. Merchants from Yunnan in the eastern Himalayas travelled the Tibetan plateau, South-east Asia and South Asia for a thousand years. Caravans served as market structures and formed a socio-cultural network among mountain and lowland communities. Mountains were as much pathways of migration and trade as barriers between highlands and lowlands. In the European Alps, migration into and out of the mountains shaped land-use patterns and social relations from the time the upper Alpine valleys were first settled.

Today, mountain habitats create employment such as tourism. Tourism in Nepal generates about US\$170 million annually, providing direct and indirect employment for over 300,000 people. St Lucia and New Zealand amongst other countries take advantage of their active volcanoes to draw in tourists. Other livelihood successes include taking advantage of the mountain ecology to produce and process 'niche' products for sale in lowland markets. To add market value to wine and dairy products, European mountain areas use 'appellation contrôlée', a

system which designates the geographic origin, distinctive production processes and standards for specific products. In Himachal Pradesh, India, a women's co-operative has built a thriving enterprise by producing pickles from non-timber forest products. Other mountain communities are learning to draw on their ecological and cultural settings to enter and compete in lowland markets.

Nevertheless, historical upland-lowland linkages were shaped by political ideologies about land use and property rights centered on lowland urban areas. In the past, mountain areas were perceived by lowland people as sources of strategic resources for lowland development such as hydropower, timber, non-timber forest products, and minerals. Logging, mining, and power generation have been operated by state-owned enterprises. Construction of huge hydro dams has directly caused the loss of mountain biodiversity and has many negative social impacts. Millions have been resettled or displaced from their original homes. It could take generations for resettled people to adapt to an alien environment, meaning that mountain people are marginalized even further and poverty reigns. Meanwhile, the private sector receives state-resource concessions for real estate, tourism resorts, and cash crop plantations.

Thus, whereas lowlanders have profited from mountain resources, mountain people have resorted to selling their labour in the plains and in foreign countries. In some mountain areas, male out-migration is so widespread that women are now de facto heads of households managing forests and farms.

Male out-migration places extra responsibilities on mountain women, yet can also relieve them of frequent pregnancies. The high fertility rate is conventionally seen as a factor holding mountain areas in the grip of poverty. Sometimes, however, women are exploited sexually, even being trafficked out of their homelands. This is the tragedy of the mountains: Isolation has meant that mountain people are masters of their own habitat, but easily become prey once they or the main breadwinners leave it.

One pervasive change in human and social characteristics in the mountains over the past decades is the number of armed conflicts taking place. In December 2001, at the UN opening of the International Year of the Mountains 2002, it was announced that 23 violent conflicts worldwide were in mountain regions. Even in 1993, of 34 major armed conflicts taking place in 28 countries, 22 were primarily in the mountains, and another eight included such areas. Remote mountains appear to be the stage for many of the world's most violent and intractable conflicts. Despite the high value of mountain resources, some states are willing to sacrifice their mountain people and environments to the battlefield.

In the mountains, vulnerability, hazard, and risk are omnipresent. Intense seasonal precipitation during monsoons in the Himalayas can trigger hazard events at different elevations. While snow avalanches and glacial lake outburst floods (GLOFs or jökulhlaups) predominate at very high elevations (more than 3,500m), landslides, debris flows, and flash floods are common in the middle mountains (500-3,500m). Diverse volcanic hazards, from ash fall to lava and from acidic gasses to mudflows, have damaged farms and cities around the world. Mountains are not easy places to live, even in the richest countries.

Floods are the principal hazards in the lower valleys and plains. In 2004, floods in China killed more than 1,029 people, affected about 114.7 million people, and caused US\$7.8 billion in direct economic losses, mostly in upstream mountain regions. The intensity, amount, and locations of rainfall are the key hazard elements determining the extent and magnitude of disaster



Photo: UNEP/Topfoto/Nong Tu Tuong

damage along with local geology, land use, and topography, particularly slope steepness.

Mountains are also subjected to two powerful hazard-triggering factors — earthquakes and climate (Beniston 2000). Of these, climate affects the environment regularly and more intensely, resulting in annual loss of life and property due to floods and landslides or rock falls associated with abnormal and normal weather conditions. Those extremes might be increasing in frequency and intensity. Drought is occurring more frequently and on a larger scale too. For example, during the drought of 2000-2001 in India, 146 million people and 99 million cattle were affected.

Earthquakes can be devastating too. In addition to the impact from the shaking, causing major landslides, rock falls, and floods, geological forces can also trigger explosive volcanic eruptions. A 1990 earthquake in the Philippines, for example, likely resulted in the cataclysmic eruption of Mt. Pinatubo in June 1991. This eruption led to mudflows over the following decade which destroyed several towns and rendered extensive areas of agricultural land unusable.

Badly designed and constructed infrastructure can lead to mountain disasters, especially dams built near seismic faults or on volcanic moraine. When floods and erosion or landslides occur, mountain farmers are blamed at times for cutting forests or for poorly-constructed terraces. Often, these events are a result of bad planning, for example roads blasted through mountains in clouds of dynamite, dust and fire (Deoja et al 1991). Similarly, the infrequent nature of volcanic eruptions means that settlements are often developed without thought to the possibility of volcanic hazards.

In the mountains of the world, people live at great risk. Floods, earthquakes, landslides, and volcanic activity destroy precious agricultural land and hunger and famine ensue. When disaster

strikes and help is needed, mountain areas are among the most difficult to access.

Certain risks cannot be eliminated by human ingenuity, but human beings can reduce the possibility of occurrence and the potential consequences. Floods depend upon precipitation, but also upon banking of rivers, drainage, bio-stabilisation of slopes, and proper retaining walls and terracing of fields. If implemented appropriately, such measures can also help lessen damage from landslides, rock falls, and mudflows. Certain mountain plants and shrubs can be used to anchor unstable mountain slopes and to control landslides and soil erosion. Folklore and customs have systems in place to cope with these hazards, consisting of rotating periods of guardianship in which certain groups are charged with protecting or warning the community.

Mountain trails are cared for by communities who understand the hazards inherent in shepherding flocks and herds along the high precipices. These same trails used by traditional livelihood processes that had adequate responses to impacts become hazardous when used by modern tourism. Tourism is seen as a big earner but it comes with the risk of environmental pollution from waste that is hard to reduce, reuse, or recycle. Mountain people today not only have to cope with the disasters that they expect and for which they have traditional coping mechanisms, but also with an era of rapid change which includes mountain people leaving their homes to seek more opportunities. Living with risk in the mountain regions of the world can be as much from the social as from the physical environment.

Mobility and social networks are examples of adaptations. Seasonal migration occurs when risks are greatest. Transhumance, the ancient practice of moving herds from summer to winter pastures ensured that pastures were not overgrazed, thereby preventing erosion. Indigenous knowledge of plant species capable



Photo: UNEP/Topfoto/Chen Yajiang

of anchoring unstable soils (such as Seabuckthorn) has led to more modern practices of bio-technical stabilisation of slopes.

The old wall building techniques and patterns that farmers and herders used to hold back possible landslides and rock falls can be found today in the skills of engineering geologists who practice mountain risk engineering. Remote sensing and global positioning systems assist in mapping landslides, monitoring glacial lakes, calculating the probability of GLOF events, and assessing ground uplift and volcanic gas emissions which could portend an eruption.

These assist, but do not replace the watchfulness of mountain communities and their knowledge of environmental signs of impending disaster; nor do modern warning systems replace entirely their traditional means of communication. Ancient guardian groups have become the forest user groups, the water user groups, and the waste management groups of today. In the mountains, there is a convergence of ancient and modern knowledge that strives to make the highest places on earth safer places to live.

Mountain habitats have always been subjected to both positive and negative impacts of human activities, with consequences for human civilization and well-being. Valued not only for the goods and services received downstream, but also for their economic, livelihood, cultural and spiritual values, mountains capture the imagination — and often the mountain environment more than the people. Yet mountain dwellers have adapted and

are adapting to habitats, hazards, vulnerabilities, and risks in the some of the most difficult and violent terrain on earth.

However, capacity to respond to drivers and different scales of environmental change is limited. Support is needed from lowland and urban decision-makers. Local resources must be made securely accessible to mountain people for sustainable use and conservation. Livelihood strategies and opportunities locally for the mountain poor must take pressure away from the limited land resources. The impacts of large-scale cash crop, livestock, timber, hydropower, and mining need careful control.

Through integrated research and careful development interventions, systems such as environmental impact assessment are being used more frequently before undertaking large infrastructural or resource exploitation in mountain areas. Environmentally-friendly enterprises such as beekeeping with indigenous bees, the production of silkworms and silk, off-season vegetable and fruit farming, and medicinal herbs and spices are well-suited to mountain areas and can be handled without heavy infrastructure that increases disaster risk.

The topic of mountain risk has only had its surface scratched, because mountain areas and their people are marginalized. Mountain people and their traditional methods of addressing risks need to be the focus of concerted and genuine research and ingenuity to alleviate the vulnerabilities inherent in the mountain environment.