



# The Himalaya

*The Himalaya, an Asian mountain range that separates the Indian subcontinent from the Tibetan Plateau, is the world's youngest mountain range as well as its highest. The Himalaya faces sustainability challenges that include glacier retreat, biodiversity loss, urbanization and its accompanying pollution, and deforestation and soil erosion, among others. Many of these challenges are tied to local and international demand for the region's rich resources.*

**T**he Himalaya, an Asian mountain range whose name means “abode of the snows” in Sanskrit, divides the Tibetan Plateau of China from the Indian subcontinent to the south. It is an area of extreme biological, ecological, cultural, and linguistic diversity, which makes sustainability issues both urgent and challenging. The Himalayan mountain range covers an area of roughly 600,000 square kilometers, extending 2,500 to 3,000 kilometers in a roughly east–west arc. With its subranges and extensions, including the Karakoram, the Hindu Kush, and the Pamir, the Himalaya encompasses parts of Afghanistan, Pakistan, India, Burma, and China, as well as all of Bhutan and Nepal. Because of the difficulty in strictly defining this rugged transboundary region, as well as challenges in accurately counting the millions of farmers, herders, and traders dispersed through remote mountain settlements, human population estimates for the region range from 47 million people (Zurick et al. 2006) to 70 to 90 million (Ives 2004) to 210 million (ICIMOD 2011).

Verticality is the most significant feature of this region. Elevations in the Himalaya range from several dozen meters above sea level to 8,850 meters on top of Mount Everest (known as Sagarmatha in Nepali and as Chomolungma in Tibetan), the highest point in the world. The Himalaya is the world's youngest mountain range. The Indo-Australian tectonic plate collided with

the Eurasian plate 40 to 50 million years ago to create the Himalaya. Neither plate gave way; the pressure of the collision moved the rock upward, eventually into the form of the jagged Himalayan peaks, which are still increasing in height. This dynamism is evident today. Frequent earthquakes, landslides, and avalanches, together with extreme topography, make agriculture, travel, transportation, and infrastructure development challenging. Steep mountainsides and rushing rivers separate valleys into isolated enclaves, where disparate languages, cultures, and organisms have developed over thousands of years. Rich in cultural diversity, the Himalayan region is also a vulnerable landscape, subject to sustainability challenges in the form of climate change, biodiversity loss, deforestation and soil erosion, and urbanization and pollution.

## Climate Change and Water Supply

Climate change is the most significant sustainability issue for the Himalaya, “the water towers of the world.” The glaciers capture and store winter snows, releasing meltwater slowly throughout the year. This glacial and snow melt is an essential source of consistent water for farming, energy, and ecological stability. The fast-running rivers of the Himalaya feed hydropower plants that produce clean energy. The Himalaya supplies water to rivers across Asia, including the Amu Darya, Indus, Ganges, Brahmaputra (Yarlungtsanpo), Irrawaddy, Salween (Nu), Mekong-Lancang, Yangzi (Chang), Huang (Yellow), and Tarim (Dayan), on which 1.3 billion people, or one-fifth of the world's population, depend.

Temperatures in the Himalaya are increasing faster than the global average. Climate change has affected the timing of the Asian monsoon that brings summer rains to the Himalaya. Increased temperatures lead to glacial

melting, an unstable water supply, and erratic weather conditions, as well as challenges to human livelihoods. If current rates of glacier retreat continue, small glaciers below 5,000 meters of elevation are likely to disappear by the end of the century, while higher and larger glaciers will shrink (ICIMOD 2010). Glacial decline can lead to sudden surges in water—as in glacial lake outburst floods, when the moraine dams trapping meltwater suddenly release, inundating downstream valleys—followed by reduction in water supplies, as rivers and lakes dwindle. Glacial retreat threatens even India's sacred Ganges River. The glacier at Gaumukh-Gangotri, which supplies about 70 percent of the river's water, is shrinking by about 37 meters per year (Wax 2007). Without reliable water sources, mountain communities, as well as the hundreds of millions of downstream users who depend on river water, face an uncertain future.

## Biodiversity Loss

Ecologists believe that the Earth is undergoing a mass extinction event, in which a large number of species are lost in a short amount of geologic time (Barnosky et al. 2011; Pereira et al. 2010). They observe this massive decline most sharply in areas like the Himalaya that have high biological diversity and a high degree of endemism, that is, a large number of species found only in a particular area. Located at the interface between the temperate Palearctic realm of Eurasia and the tropical Indo-Malayan realm of the Indian subcontinent, the Himalayan region hosts remarkable diversity. Nepal is home to sixty-one globally threatened species and subspecies, including the Bengal tiger (*Panthera tigris tigris*), greater one-horned rhinoceros (*Rhinoceros unicornis*), and musk deer (*Moschus chrysogaster*). The rare and beautiful snow leopard (*Uncia uncia*, or *Panthera uncia*), believed to have a population of only several thousand individuals left in the wild, ranges throughout the high Himalaya, from Pakistan and Ladakh, India, in the west, through Nepal, Bhutan, China, and northern India in the east. Their beautiful pelts make snow leopards a target for poachers, while climate change and human encroachment destroy their high elevation habitat and lead to more frequent human-wildlife conflicts when snow leopards prey on livestock.

Healthy ecosystems provide habitat for vulnerable species and resources for rural livelihoods. They also provide a wide variety of essential ecosystem services—waste decomposition, nutrient cycling, flood prevention, water purification—that support life far beyond their boundaries. The Himalaya supports a tremendous diversity of medicinal plants, many of which are still used by rural people. Less than 25 percent of the original vegetation of

the Himalayan landscape, however, remains in pristine ecological condition (Conservation International 2007). Erosion, deforestation, and conversion of lands to agricultural use have reduced the forests of the eastern Himalaya by about two-thirds. For these reasons, the global environmental organization Conservation International identifies the Himalaya as one of twenty-five global biodiversity hotspots. It has based this designation on the area's exceptionally rich plant endemism—nearly one-third (3,160) of the estimated 10,000 species of plants found in the Himalaya are endemic—and increasing human demands for natural resources. Immigration, population growth, connections with global markets, poaching, extraction, grazing, agriculture, urbanization, pollution, and war threaten this biological diversity.

Bhutan has taken strong measures to counter the deforestation and biodiversity loss. Recognizing the opportunity to maintain its reservoir of biodiversity, the National Assembly mandated in 1974 that Bhutan's forest cover must never drop below 60 percent. The constitution adopted in 2008 requires that 60 percent of the country remain under forest cover in perpetuity. Thirty-six percent of the country was under direct conservation protection through parks and protected areas in 2008. Nearly two-thirds (64 percent) of Bhutan was under forest cover in 2009. When the total includes the biological corridors (another 9.5 percent of Bhutan's land area) running between the protected areas, Bhutan has almost half of its land area under protected area status, among the highest proportion of any nation.

Large tracts of uninterrupted, high-quality habitat are necessary for the survival of many wildlife species. Often, appropriate habitat spans international boundaries, making transboundary cooperation essential for biodiversity conservation. The governments of Bhutan and India have discussed creating a biodiversity protection area known as Greater Manas, which would span the existing Bhutanese Royal Manas National Park and adjoining Manas National Park and Tiger Reserve in Assam, India. Together, these two parks comprise an area of more than 1,500 square kilometers that encompasses one of the largest tiger populations in South Asia. Transboundary cooperation has been important in monitoring the rare black-necked crane (*Grus nigricollis*) which breeds on the Qinghai-Tibetan Plateau in China, and in Ladakh, India, and then migrates south to winter in Bhutan, Arunachal Pradesh, India, and the low elevation areas of the Qinghai-Tibetan and Yunnan-Guizhou plateaus in China. Since 2003, many of the major wintering areas have been protected as national parks and reserves. Another ambitious plan involves creating a tri-national peace park around Mount Kanchenjunga, which would encompass the Kanchenjunga Conservation Area of Nepal, a community-based biodiversity conservation

project; the Kanchendzoga National Park of Sikkim, India; and an extension of the Quomolungma Nature Reserve in the Tibet Autonomous Region of China.

## Deforestation and Soil Erosion

Deforestation for commercial exploitation, expansion of agricultural land and human settlements, and military security have changed the face of the Himalaya. Mismanagement of forests and land tenure policies, corruption, smuggling, and livestock grazing in forests have decreased the quality of remaining forest cover as well. The dynamics of deforestation and erosion vary greatly throughout the range; the western reaches are much drier and less forested than the moist, monsoon-fed eastern Himalaya. England exploited Indian forests for commercial purposes starting in the early 1800s. Indian teak supplied the lumber for the shipbuilding needs of deforested England during the Napoleonic wars and subsequent maritime expansion. The English later built plantations for the export of tea to world markets, replacing forests in some parts of the Indian foothills. During the period of the British Raj, the British decimated forests, particularly in Garwhal and Kumaon, to build the railroad, and began exploiting the sal (*Shorea robusta*) and deodar (*Cedrus deodara*) forests of the Himalaya for commercial use in the 1850s and 1860s. The Indian government established the Imperial Forest Department in the 1860s to oversee sustained yield from these forests, but some never recovered.

The forces leading to overexploitation of Nepal's forests were different. Under the Shah monarchy, government tax policies before 1950 gave rural peasants strong incentives to clear forests and convert lands to agriculture. In the 1970s, as foreign experts observed the erosive force of monsoonal rains that sent soil into churning rivers, they assumed that the clearing of hillside forests for farming had led to excessive erosion. The theory of Himalayan environmental degradation purported that downstream flooding and siltation in the plains of Bangladesh and India resulted from deforestation and poor farming practices that caused erosion in the Himalaya (Blaikie 1985; Ives and Messerli 1989). According to this theory, modernization of the farming practices could slow erosion and bring greater stability to the region. The theory ignored the Himalayan farmers' long-term experience with the steep hillsides and the traditional knowledge, such as terrace building, they had developed for effective farming. The theory also neglected the role of government policies and incentives in creating a climate that misused natural resources. Recent empirical work suggests that the theory of Himalayan environmental degradation was based on unreflective paradigms

and convenient explanations (Ives 2004; Hofer and Messerli 2006). Ecologists in the 1990s and early-twenty-first century saw firewood harvesting as a significant threat to the forests of Nepal and India.

Local resource mismanagement is not the sole cause of deforestation and soil erosion in developing countries, however. State structures and activities, economic factors, and the uneven generation and deployment of knowledge add to the problems. Deforestation is a serious concern in southwestern China (an area that encompasses the southeastern Tibet Autonomous Region, western Sichuan, northern Yunnan, southwest Gansu, and southeast Qinghai provinces), where estimates suggest that 50 percent or more of forest cover in some areas has been destroyed (Cui and Graf 2009; Karan 2009). In the 1950s, the Chinese government designated the forests of this area as China's "second timber production base" and instituted large-scale timber extraction to support China's growing economy and rapid infrastructure development (Studley 1999). Reforestation has not kept pace with timber extraction, and the resulting deforestation contributes to soil erosion and river siltation. Expansion of the road network allows timber to be extracted from remote areas, while agricultural development, fuelwood needs, and urbanization also contribute to loss of forest cover. Degradation is thus linked to problems of structural social inequality, suggesting that governments need to effect fundamental social change to manage environmental dilemmas.

## Urbanization and Pollution

Historically, the narrow valleys of the Himalaya limited the development of urban areas to a few broad valleys, such as Kathmandu, Nepal, and Srinagar, in northwestern India. Although much of the region's populace lives in dispersed villages and towns, with many rural villagers still engaged in subsistence agriculture and pastoralism, the Himalaya is not exempt from the global trends of urban expansion that have resulted in more than half the world's human population living in cities. Both "pull" factors, such as better employment opportunities, access to education and health care, and improved roads and infrastructure, and "push" factors, such as rural poverty, discrimination, wildlife conflict, and environmental degradation, draw migrants to urban areas. Simultaneously, urban areas expand their footprints into the surrounding rural areas to accommodate their growing populations. The capital of Bhutan, Thimphu, became one of the fastest growing cities in Asia in the early years of the twenty-first century, growing at a rate of 7–10 percent annually (RGOB 2006). Similarly, the Leh District of Ladakh, in the western Indian Himalaya, experienced an annual

population growth rate of 5.92 percent in the urban areas in the years 1981–2001, well above the average urban population growth rate of 2.95 percent for India as a whole (Goodall 2004). At these rapid growth rates, it is difficult for municipal and national governments to keep pace with the ever-expanding need for urban services, such as sanitation, hygiene, garbage collection, pollution control, and land-use planning. In Gilgit-Baltistan, Pakistan, wood burning for winter heating causes a pall of smoke to hang over urban areas (Mir 2011). Rapidly growing cities tend to expand their geographical footprints in an uncontrolled manner. For example, with a population of 1.4 million, Srinagar, the capital of Kashmir, has encroached on surrounding agricultural land and wetlands, degrading water quality, and threatening the area's famous lakes (Fazal and Amin 2011).

The sustainability challenges of rapid urbanization and pollution can be seen in the case of the Kathmandu Valley of Nepal, which was for centuries a trading crossroads between India and Tibet. This example suggests some of the challenges that rapidly growing towns of the Himalaya may have ahead of them.

Economic expansion in the 1980s brought a significant increase in the material living standards in Kathmandu. Drawn by hopes of better health care and education, migrants flooded into the city, quadrupling the population to 414,000 between 1951 and 1991 (Liechty 2003, 53). Along with material exuberance, however, came uncontrolled pollution of air, urban waterways, and public spaces. During the Nepal Civil War, which lasted from 1996 to 2006, when Maoist rebels faced off against government forces, villagers streamed into Kathmandu to avoid being conscripted to fight for the warring parties. By 2001, the population of an overcrowded and chaotic Kathmandu had more than doubled again, reaching 1.1 million, according to the United Nations Environment Programme.

This rapid growth overtaxed solid waste and wastewater management systems. Households, factories, and slaughterhouses left solid waste to decay on the streets or indiscriminately dumped it in waterways. Wastewater and industrial effluent often ran directly into the Bagmati and Bishnumati rivers that thread through the valley. The historically pristine views of the Himalaya's snow-covered peaks disappeared into a haze of exhaust fumes that represented some of the worst urban air quality in Asia and took a toll on human health. Most people lacked safe drinking water or even adequate water for washing and hygiene. Waterborne diseases, such as diarrhea, dysentery, giardiasis, and cholera, were widespread. As residents and tourists complained about the abysmal conditions, government agencies and international aid organizations began studying the challenges rapid urbanization brought. Lack of urban environmental management

policies, of consistent implementation strategies, and of a stable government hampered the ability to make major inroads on Kathmandu's urban problems.

## The Future

As these examples show, the Himalayan region faces complex and interconnected sustainability challenges closely tied to the unique social and physical geography of the region. These “wicked problems” have no single correct answer and no defined conclusion. These challenges are tied to social conditions: poverty; war and unrest; population growth, both regionally and globally; and the status of women. Improvements in these social indicators, together with well-planned and implemented national and international environmental policies, may slow the environmental degradation of the Himalaya. Governments have made efforts to improve the lives of rural residents through, for example, the promotion of the community forestry concept that builds on traditional communal land management practices. Governments have developed compensation programs that reimburse farmers who lose livestock to wildlife predation. The development of satellite cities or regional towns takes pressure off the major urban areas and slows rural-urban migration by providing the health care, education, communication, government, and cultural services that people seek in moving to urban areas. Some ecotourism projects bring much needed cash income to rural areas. As governments acknowledge the sustainable practices and traditional ecological knowledge that long-term residents of the region have developed, they may discover ingenious indigenous strategies for increasing sustainability.

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*See also* Biodiversity Conservation Legislation (China); China; Ganges River; Genetic Resources; Huang (Yellow) River; India; Indigenous Peoples; Mekong-Lancang River; Parks and Preserves; Public Health; Reforestation and Afforestation (Southeast Asia); Rural Development; Rural Livelihoods; Tibetan Plateau; Traditional Chinese Medicine (TCM); Transboundary Water Issues; Water Security; Yangzi (Chang) River

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