



Green Economy for Sustainable Mountain Development

A concept paper for Rio+20 and beyond

ICIMOD

FOR MOUNTAINS AND PEOPLE

Outcome of the
International Conference on Green Economy and Sustainable Mountain Development
Opportunities and Challenges in View of Rio+20

5–7 September 2011, Kathmandu, Nepal

Preface

The United Nations Conference on Sustainable Development (UNCSD or Rio+20) to be held in June 2012 will have green economy as one of its two main themes. This paper has been prepared to strengthen arguments for discussing mountain issues at Rio+20 and in other global discourses. Our aim is to ensure renewed efforts and commitment by the global community at Rio+20 to prioritise mountain issues in development agendas and processes dealing with poverty reduction, food security, climate change, and other issues that are critical to sustainable development in mountain areas.

This paper is the outcome of three days' deliberation among key stakeholders at the International Conference on Green Economy and Sustainable Mountain Development, jointly organised by the International Centre for Integrated Mountain Development (ICIMOD) and the United Nations Environment Programme (UNEP) in Kathmandu, Nepal from 5 to 7 September 2011. The conference brought together diverse stakeholders including scientists, policy makers, development practitioners, and civil society and private sector representatives from the Hindu Kush-Himalayan region, Central Asia, the Middle East and North Africa, Latin America, North America, and Europe. The conference put forward the Kathmandu Declaration on Green Economy and Sustainable Mountain Development, included in this document as an annex.

The initial text for this paper was prepared by Professor Gopal Kadekodi of India. It was further developed with input from staff of ICIMOD and UNEP. We recognise the strong commitment of UNEP in supporting the mountain agenda. The contributions of Mario Bocucci, Asad Naqvi, and Pier Carlo Sandei at UNEP have been particularly useful. The paper was presented at the conference to stimulate discussion. It was then thoroughly revised to integrate inputs and insights from the participants. The paper examines the role of mountain ecosystems in green economy; their contribution to national, regional, and global economy, environmental protection, and human wellbeing; upstream-downstream linkages; and emerging challenges, issues, and opportunities. It also briefly outlines relevant strategies, approaches, and options for promoting sustainable mountain development.

This paper will be further discussed at the Global Mountain Conference in Lucerne, Switzerland in October 2011 and subsequent global and regional events leading up to Rio+20. We believe that our joint efforts will contribute to discussion of mountain issues at Rio+20 and in future global policy initiatives and processes and will facilitate global action for sustainable mountain development.

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1. Introduction: Towards a Green Economy in Support of Sustainable Mountain Development

Mountains are an important source of vital ecosystem services and have a significant role in economic development, environmental protection, ecological sustainability, and human wellbeing. The international community recognised the importance of mountains at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil in 1992 through adoption of Chapter 13 in Agenda 21. Chapter 13 underscored the role of mountains in global sustainable development.

The adoption of Chapter 13 triggered a number of mountain-related initiatives including the declaration of 2002 as the International Year of Mountains by the UN General Assembly, a section on actions for sustainable mountain development in the Johannesburg Plan of Implementation, and the establishment of the Mountain Forum and the Mountain Partnership. Yet despite increased recognition of mountain issues, the incidence of poverty, vulnerability, and economic and social insecurity remains high in mountain regions. To achieve sustainable mountain development a number of key challenges remain such as protecting mountain ecosystems, eradicating poverty in line with the Millennium Development Goals (MDGs), and ensuring economic and social security.

The framework conditions for sustainable development have changed significantly since the Rio summit in 1992, with climate change, globalisation, increasing urbanisation, institutional evolution, and other changing conditions. The demand for goods and services from mountains is growing steadily. These pressures create new challenges and threats for mountain ecosystems and mountain people, such as natural disasters, food and energy crisis, increasing water scarcity, desertification, ecosystem degradation, and biodiversity loss. The impacts in the mountains also have serious economic, environmental, and social implications for large human populations living in the downstream areas. Although current global challenges have been affecting mountain regions and their inhabitants disproportionately, the ingenuity of mountain communities and their knowledge, experience, and capacity for managing fragile environments offer significant opportunities for addressing the problems.

The United Nations Conference on Sustainable Development (UNCSD or Rio+20) to be held in June 2012 will have green economy in the context of sustainable development and poverty eradication as one of its two thematic focuses. According to the United Nations Environment Programme (UNEP 2011), a green economy is one that results in improved human wellbeing and social equity, while significantly reducing environmental risks and ecological scarcities. The green economy agenda seeks to promote an economic system which increases human wellbeing over the long term while maintaining natural capital and environmental resources so that future generations do not face significant environmental risks and ecological scarcities.

While the green economy may bring new opportunities for investment in ecosystem services (e.g. freshwater, biodiversity conservation, and carbon sequestration), renewable energy, and creation of jobs, it also creates challenges. It must be pursued with a balanced approach of economic, environmental, and social development and appropriate policy and institutional measures to avoid increasing pressure on an already fragile environment and scarce resources. To this end it is necessary to revisit the mountain agenda. The Rio+20 conference offers an important opportunity to do so, taking into account recent developments and ongoing global challenges.

Against this backdrop, the International Centre for Integrated Mountain Development (ICIMOD), in collaboration with the United Nations Environment Programme (UNEP), organised the International Conference on Green Economy and Sustainable Mountain Development in Kathmandu, Nepal, from 5 to 7 September 2011. The conference brought together over 150 participants including international and regional scientists, policy makers, development practitioners, and representatives of civil society and the private sector from the Hindu Kush-Himalayan region, Central Asia, the Middle East and North Africa, Latin America, North America, and Europe.

This paper was presented at the conference and enriched and enhanced by the deliberations there. It examines the role of mountains in a green economy and their contribution to national, regional, and global economy and environmental protection. It discusses emerging challenges, issues, and opportunities to promote sustainable development in the mountains. Finally, it briefly outlines relevant strategies, approaches, and options. Its purpose is to support mountain stakeholders by

bringing mountain issues into the mainstream of global discussions and debate, with a view to ensuring renewed efforts and commitment by the global community at Rio+20 in 2012.

The paper emphasises the changes in the conditions influencing sustainable development in mountains, which bring new challenges and opportunities and demand urgent action for the benefit not only of mountain regions but also of lowland areas. It is founded on the following premises.

- Mountain systems support about half the world's human population by providing numerous goods and services including fresh water, food, life saving medicinal products, energy, a rich array of biodiversity, and associated traditional knowledge, as well as cultural diversity.
- Mountains are among the most fragile environments in the world; they are also among the ecosystems most vulnerable to climate change. If they become degraded or fail to generate services, the costs to the local, national, and global community could be severe. It is in the common interest of national, regional, and global communities to conserve and develop mountain ecosystems.
- Economic growth, coupled with increasing living standards and globalisation, increases the pressure on natural resources, creating new stress situations and potential conflicts. The pressure endangers the sustainability of mountain ecosystems and the multitude of services and products they provide.
- Mountain communities have traditionally had high adaptive capacity owing to their close contact with and intimate knowledge of the environment. Their adaptation processes and practices, including traditional technologies for soil conservation, watershed protection, and conservation of indigenous seed varieties, can generate positive externalities for global communities and can help address climate change impacts if adequate incentive mechanisms are developed that reward the mountain people for ensuring a sustained flow of mountain ecosystem services.
- The speed of change and the heavy impact of global externalities have changed the social fabric (e.g., feminisation of mountain agriculture) and increased the incidence of deprivation, poverty, food insecurity, and social conflicts in mountainous areas. New coping mechanisms and additional support from the global community are required
- To promote a global green economy, mountain ecosystems must be conserved and developed to ensure a sustained flow of resources and services. Conservation, adaptation, and climate change mitigation measures in mountains can support low-carbon economy in both mountains and lowlands.
- Sustainable mountain development is essential to achieving the Millennium Development Goals, and for this a sustained flow of services from mountains to lowlands is essential. Sustainable mountain development deserves a prominent place in Rio+20 decisions.

2. The Role of Mountain Systems in a Worldwide Green Economy

Mountains cover a quarter of the earth's surface area, are home to almost 20% of the world's population (Table 1), and provide goods and ecosystem services vital for the wellbeing of downstream populations – about half of humanity – and for sustaining our planet and its ecosystems. Providing habitat for unique species and for indigenous peoples of distinct cultures, mountains are a global commons and natural capital whose heritage value must be recognised and valued. The green economy model presents this opportunity.

Mountains are an important source of vital ecosystem services on which the regional and global environments and global economy largely depend and harbour a wide range of important natural resources (Box 1). They make important contributions to economic development, environmental protection, ecological sustainability and human wellbeing, as well as to economic and ecological resilience in the downstream regions. About half of the world's population depends on mountains for fresh water, clean energy, irrigation water, flood control, minerals, timber and non-timber forest products, recreation, and genetic resources. Half of the global biodiversity hotspots (17 of the 34) and one-third of all protected areas are in the mountains. Mountains are also home to more than a billion people, a substantial proportion of whom are indigenous ethnic communities whose livelihoods largely depend on natural resources available in mountain areas. Mountains are also a source of cultural, spiritual, and recreational resources for urban populations.

This section examines the main mountain ecosystem services, their upstream-downstream linkages, and the potential they represent for the green economy and sustainable development.

Mountain Ecosystem Services

Downstream water availability and hydrological services

Mountain ecosystems play a significant role in regulating water quantity and quality. Almost all of the world's major rivers, and many of the minor ones, begin in mountainous regions, which supply a large percentage of the water resources of the entire globe (Bandyopadhyay et al. 1997). The high-altitude cryosphere stores huge amounts of water as snow and ice. These are unique reservoirs of fresh water which is released year round in perennial rivers serving as a lifeline for billions of people downstream (Barnett et al. 2005). For this reason mountains are often referred to as the 'water towers of the world' (Messerli and Ives 1997). The Hindu Kush-Himalayan region, for example – known as the 'third pole' because it contains the highest masses of cryospheric components found outside the two polar regions – is a source of ten major rivers and their numerous tributaries (Figure 1, Table 2).

Table 1: Mountain population by region and average mountain population density

Region	Population ('000)	Density (people/km ²)
Asia	597,714	65.2
Former Soviet Union	34,851	6.4
Latin America	173,549	37.7
Northern Africa	141,113	52.3
OECD	119,559	18.3
Sub-Saharan Africa	152,613	43.1
World	1,219,399	38.2

Source: MA (2005)

Figure 1: Major rivers arising in the Hindu Kush-Himalayas**Table 2: Principal rivers of the Himalayan region – basin statistics**

River	Annual mean discharge (m ³ /sec)	% of glacier melt in river flow	Basin area (km ²)	Basin population density (persons/km ²)	Population x1000	Water availability (m ³ /person/year)
Amu Darya	1,376	not available	534,739	39	20,855	2,081
Brahmaputra	21,261	~ 12	651,335	182	118,543	5,656
Ganges	12,037	~ 9	1,016,124	401	407,466	932
Indus	5,533	up to 50	1,081,718	165	178,483	978
Irrawaddy	8,024	not available	413,710	79	32,683	7,742
Mekong	9,001	~ 7	805,604	71	57,198	4,963
Salween	1,494	~ 9	271,914	22	5,982	7,876
Tarim	1,262	up to 50	1,152,448	7	8,067	4,933
Yangtze	28,811	~ 18	1,722,193	214	368,549	2,465
Yellow	1,438	~ 2	944,970	156	147,415	308

Source: ICIMOD (2009)

Box 1: Mountain ecosystem goods and services

Provisioning services that provide direct inputs to livelihoods and economy, including:

- fresh water and irrigation water
- food, including fish, wild fruits, herbs, honey, and others for local subsistence and trade
- medicinal plants and other plant products such as flowers and plant oils
- wildlife and rangeland products, such as wool
- raw materials such as bamboo, timber, non-timber forest products (NTFPs), minerals
- energy, especially hydropower

Regulating and supporting services, i.e., benefits from the regulation of ecosystem processes that sustain and fulfil human life, including:

- watershed services
- climate modulation
- supporting biodiversity
- carbon sequestration
- control of erosion and slope stability
- soil formation, soil fertility (from volcanic ash, carbon fixation), nutrient provision downstream
- regulation of extreme events and natural hazards such as floods and landslides

Cultural services, i.e., non-material benefits enhancing people's cultural, spiritual, and cognitive enrichment including:

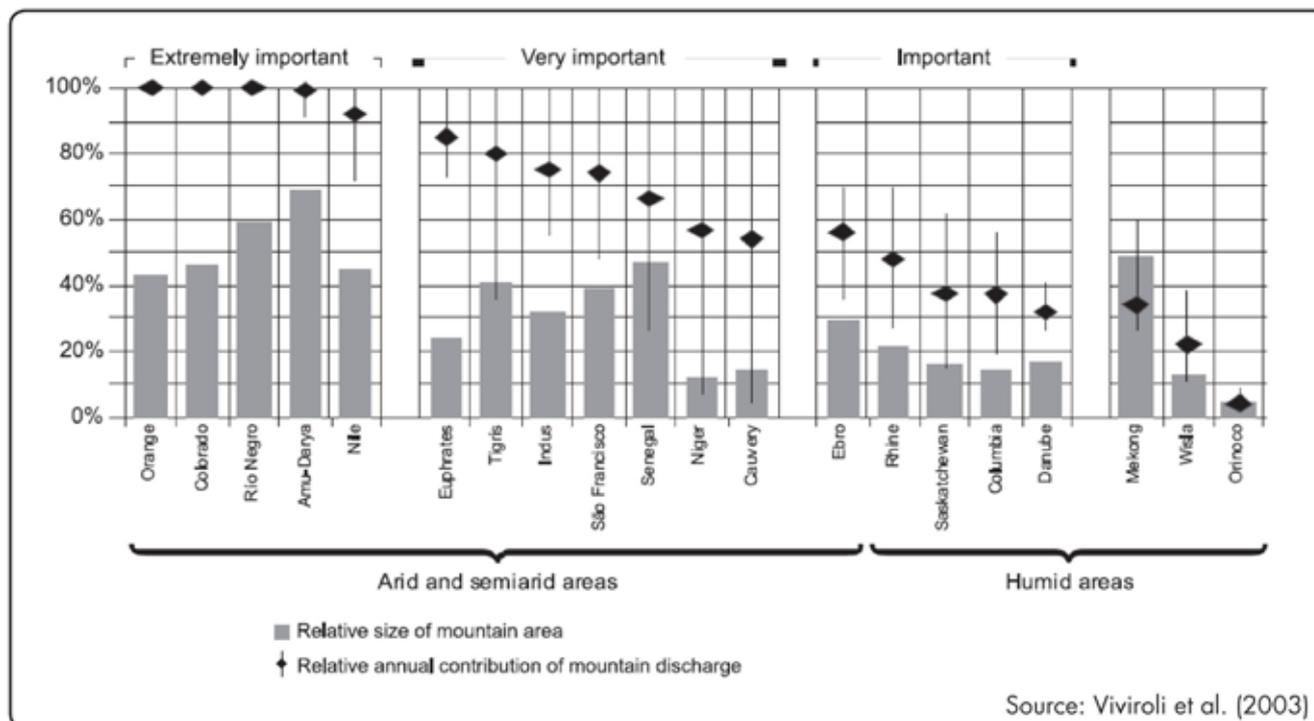
- aesthetic and spiritual renewal
- recreation
- mental health
- ethnological diversity
- tourism
- cultural heritage
- indigenous knowledge and customs
- inspiration for art and design

Adapted from MA (2005)

More than half of humanity relies on freshwater from mountains to grow food, produce electricity, sustain industries, and provide drinking water (MA 2005). Mountain hydrological services are also essential for groundwater recharge and related functions that maintain hydrological balance in downstream areas. Thus, water availability downstream – whether for domestic consumption or agriculture – is an essential service provided by mountain systems. In Central Asia, for example, it is estimated that more than 50% of the population depends on the water and runoff of the large rivers that originate in mountains, such as the Amudarya, Ili, Shu, Syrdarya, and Talas (Avishek, 2011). Based on detailed case studies, Viviroli et al. (2003) reported that the mean annual mountain contribution to total discharge in river basins varies between 32% and 63% (Figure 2). In some arid areas, mountains are estimated to supply as much as 95% of the total annual outflow from catchments (Viviroli and Weingartner, 2004).

The Hindu Kush-Himalayan region alone has an estimated total ice cover of 114,800 km², found in glaciers and high altitude lakes (33,050 km²) and ice areas of adjacent mountain ranges: the Karakoram (16,600 km²), Tien Shan (15,417 km²), Kunlun Shan (12,260 km²), and Pamirs (12,200 km²) (Dyurgerov and Meier 2005). The Tibetan Plateau contains 36,800 glaciers, with a total glacial area of 49,873 km² and a total glacial volume of 4,561 km³ (Yao et al. 2007). The glaciers that feed the Ganges, Brahmaputra, and Indus in the dry season, for example, cover more than 32,000 km² (Table 3). The contribution of snow and melt ice to Himalayan streams is conservatively calculated to be between 500 and 515 km³ per year from the upper Himalayas alone.

Figure 2: Mean contribution of mountain discharge in water flow



Source: Viviroli et al. (2003)

Table 3: Glaciated areas in the Himalayan range

Drainage basin	No. of glaciers	Total area (km ²)	Total ice reserves (km ³)
Ganges River	6,694	16,677	1,971
Brahmaputra River	4,366	6,579	600
Indus River	5,057	8,926	850
Total	16,117	32,182	3,421

Source: Eriksson et al. (2009)

Hydropower and clean energy

Hydropower and other forms of clean energy, such as wind and solar energy, are becoming increasingly important all over the world to meet growing energy needs, particularly those of countries with developing economies such as China and India. Clean energy is needed to maintain economic growth in a sustainable way and to improve the living standards of the vast number of people who still depend on woodfuels. Mountains are important sources of hydropower – which provides more than 15% of the world's energy – and other forms of clean energy. Swift flowing rivers of mountains are cost-effective sources of hydropower all over the world. However, this source of energy is not fully exploited. The Himalayan region, for example, has the potential to generate over 300,000 MW of hydropower and only 9% of this potential is developed (Tariq 2011). Properly managed, mountain water can contribute significantly in the generation of clean energy and contribute to economic development of downstream communities.

Regional and global climate regulation

Mountain ecosystems contribute in regulating global climate through biogeochemical and biophysical processes that mediate the carbon, energy, and water balance at the land surface. Mountain climate regulation services extend beyond their geographical boundaries and affect all continental mainlands (Woodwell, 2004).

Because of the great depth, area and altitude of large glacier masses, mountains are some of the windiest places on earth. They modify air circulation and create their own winds by setting up regional and local pressure systems. Mountain and valley breezes interlock in diurnal circulation that can become strong enough to influence climate and temperature.

The Himalayas influence the climate of the Indian subcontinent by sheltering it from the cold air mass of Central Asia. They prevent frigid and dry arctic winds from blowing south into the subcontinent, keeping South Asia much warmer than other regions at corresponding latitudes around the globe.

The Himalayas also exert a major influence on monsoon and rainfall patterns. They serve as a barrier for the moisture laden monsoon winds, preventing them from travelling northwards, thus facilitating timely and heavy precipitation in the southern part of the region (INCCA, 2010).

Mountain ecosystems also have a significant role in carbon storage and carbon sequestration (Piao et al. 2006). Globally, mountain ecosystems at temperate latitudes are among the largest biotic carbon reserves. For example, mountains contribute 25 to 50% of the total United States carbon stock and up to 75% of the carbon stock in the western part of the country (Schimel et al. 2002).

Biodiversity

Mountain regions contain many different ecosystems and have among the world's highest species richness (e.g., Väre et al. 2003; Moser et al. 2005; Spehn and Körner 2005). Mountains support about one-quarter of the planet's biodiversity, and have nearly half of the world's biodiversity hotspots (Singh, 2011). Mountain systems provide niche habitats for many rare and/or endangered endemic species. In the Himalayas these include the blue sheep (*Pseudois nayaur*), snow leopard (*Panthera uncia*), ibex (*Capra ibex sibirica*), musk deer of the Central Himalaya (*Moschus chrysogaster*), red sheep or Ladak ural (*Ovis orientalis vignei*), rare birds, and fish found nowhere else in the world. Some 32% of global protected areas are in mountain regions – 9,345 protected areas covering about 1.7 million square kilometers (Singh, 2011). The Himalayan region alone has 488 protected areas covering 39% of the region's terrestrial area (Chettri et al. 2008). These areas provide habitats for many globally important endemic plant and animal species. However, mountain people bear a high opportunity cost in their conservation, owing to the restriction of economic activities in protected areas.

Because of the wide range of altitude (3 to 4 km) and variation in climate, mountains support many types of forests. The Himalayas have more forest types than even the Amazon (Singh 2011). Mountain forests cover just over 9 million square kilometres and account for 28% of the world's closed forest areas. They support biodiversity and have a globally significant assemblage of unique flora; some of these species are the basis for rare pharmaceutical products in the world market (Price and Butt 2000).

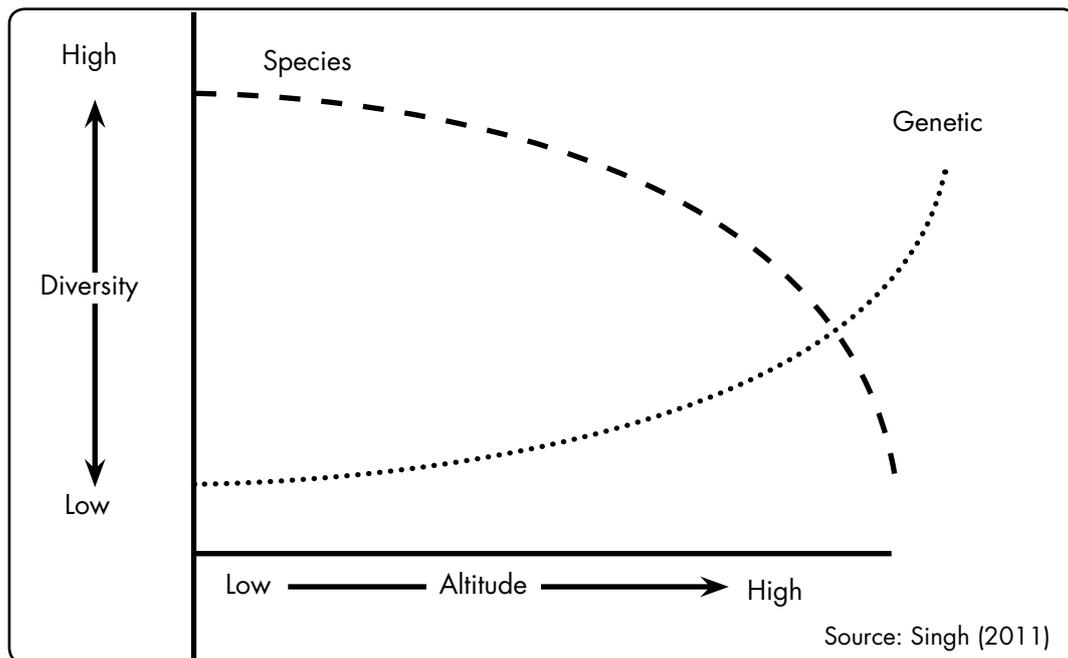
Tropical and subtropical mountains – in Costa Rica and Panama, Brazil (the eastern Andes), the Yunnan region of China (the eastern Himalayas), northern Borneo, New Guinea and East Africa – are known as plant species diversity centres (Kohler and Maselli 2009). The mountains of the tropical and subtropical Americas alone have over 90,000 flowering plant species. Mount Kinabalu of Malaysia (with altitude up to 4,101 m) has over 4,000 plant species (Kohler and Maselli 2009). The Himalayan region, in particular, is known for 'biodiversity hotspots'. The Indian Himalayan region has more than 8,000 species (IIRS 2003).

Mountain communities have long been custodians of agrobiodiversity. Six of the 20 plant crop species that supply 80% of the world's food (maize, potatoes, barley, sorghum, tomatoes, and apples) originated in the mountains. A number of domestic animals, such as sheep, goats, domestic yaks, llamas, and alpacas, also originated in mountain regions (Singh 2007).

The genetic diversity in mountains is particularly high, in part because of mountains' geographic isolation and in part because the many diverse mountain cultures have long traditions of protecting certain plants and animals. While plant species diversity decreases with altitude, genetic diversity increases (Figure 3). Remote mountain regions serve as the last sanctuaries of many species and their populations, facilitating speciation. Mountains also serve as a bridge between continents, and provide a refuge for species migrating under the influence of global temperature changes (Singh, 2011).

Biodiversity is globally and temporally significant. Species that at present have little human use might be important in the future. As an integral component of an ecosystem, biodiversity affects most ecosystem services. Thus, biodiversity conservation is important for a green economy and sustainable development.

Figure 3: Schematic representation of the relationship between altitude and diversity at species and gene levels



Cultural services

Mountains provide a setting for cultural, religious, and recreational activities such as hiking, wildlife viewing, bird watching, experiencing the beauty of the landscape, and observing and enjoying the unique lifestyle and culture of mountain communities. Mountains harbour a high degree of ethnic, cultural, and linguistic diversity. Some regions of particular diversity in this sense include the Caucasus, the Himalayas, and the mountains of New Guinea. More than 500 languages are spoken in the Himalayas, over 400 of which are spoken by less than 100,000 people, and most are in danger of extinction (Turin, 2007). Mountain populations also conserve vast indigenous knowledge about such subjects as agriculture, botany, medicine, and ecology.

In mountain ranges throughout the world, traditional cultures and natural resource conservation have evolved together over the ages. Sustainable natural resource management is driven by the beliefs and behaviours of human communities, and local cultures are strengthened by their intimate connections to the natural environment that sustains them. Sacred and spiritual values are thus integral to mountain cultures; more than 1 billion people consider mountains sacred (Bernbaum 1998). The spiritual values of local mountain cultures today have an important role in the continuing stewardship of watersheds and other mountain ecosystems.

Economic Contribution of Mountain Ecosystem Services

Mountain ecosystem services provide both direct and indirect contributions to mountain and downstream livelihoods and the economy.

In terms of direct contributions, mountains provide a large share of the world's resources for mining, forestry, water for drinking and irrigation, and hydropower, and they generate an increasing amount of wind power as well. Mountain products and services form the basis for many economic sectors – food, pharmaceuticals, and cosmetics; agriculture, forestry, and rangeland production; hydropower generation; tourism; and others. Mountain rangeland and forests provide economic benefits to local people and global communities through medicinal plants, nuts, fruits, timber, fuelwood, and minerals. A recent study shows that forest biodiversity in the Kanchenjunga Conservation Area of Nepal provides more than a billion dollars worth of income to local people. Timber, non-timber forest products, medicinal plants, fodder, and litter accounted for about 70% of the total household income, and each hectare of land fetched more than US\$ 400 per annum (Pant et al. 2011).

Indirect contributions to national, regional, and global economies include the support and regulation of ecological functions and processes, such as carbon sequestration and storage, soil conservation, flood control, climate moderation, and wind and monsoon regulation.

Globally, the total value of ecosystem services is estimated at US\$ 33 trillion per year, almost double the global gross domestic product (GDP) (Costanza et al. 1997). However, few studies have looked at the value of ecosystem goods and services in the mountain context. Based on Costanza et al.'s (1997) approach, Singh (2007) estimated the total value of forest ecosystem services in Uttarakhand, India to be US\$ 2.4 billion per year (Table 4). The food production and raw materials that have market values constitute only a small proportion (18.7%) of the total value.

Similarly, Verma (2000) estimates the value of direct consumptive benefits from Himanchal Pradesh forests at about 1% of total benefits, while the value of indirect benefits from their ecosystem services counts for nearly 93%. The remaining 6% is from indirect consumptive benefits, e.g., tourism.

In highly forested mountain countries such as Myanmar (where forest areas cover about 52% of geographical area) and Nepal, or forested regions such as the Indian Himalayas (where more than 59% is under forest), protecting forest ecosystems will have considerable local as well as global environmental benefits. For instance, according to a Green India States Trust (GIST) (Gundimeda et al. 2006) study, the per hectare ecological value of soil nutrient conservation, flood control, and water recharge in dense forest is of the order of INR 5,860 (about US\$ 125) in Himachal Pradesh and about INR 6,255 (about US\$ 134) in Uttarakhand.

Role of mountain ecosystem services in feeding the world's growing population

By 2050, the global population is expected to increase to 9 billion. The challenge of feeding a growing population is daunting. While all economic sectors depend to some degree on ecosystem services, agriculture has the most intimate relationship with nature. Agriculture depends on healthy mountain ecosystems for water regulation and supply, pollination, erosion control, climate and wind regulation, groundwater recharge, and sustenance of wetland ecosystems. The genetic diversity preserved in mountain ecosystems helps to ensure the world's future food security. Thus a sustained flow of mountain ecosystem services is critical for feeding the growing population.

For example, the Hindu Kush-Himalayan mountain system is the major source of dry season water (surface and groundwater) for the basins of the Indus, Ganges, and Brahmaputra Rivers, which are the main source of rice and wheat in South Asia. The mountain system also regulates these basins' microclimates and wind and monsoon circulation, creating favourable conditions for agriculture (Rasul 2010: 96).

Economic benefits of mountains protecting against hazards

Mountain vegetation plays a significant role in reducing or mitigating risks from natural hazards – for example, in protecting against erosion, landslides and local flooding. Mountain forests, for instance, protect people and property from avalanches and rockfall, and their water-holding capacity reduces peak stream flow. The huge value of mountain ecosystems in protecting against hazards can be deduced from the economic and social costs of natural disasters in the eastern Himalayas and downstream (Table 5).

Table 4: Annual value of various forest ecosystem services of Uttarakhand Province, India

Ecosystem service	US\$/ha/yr	% of total
Climatic regulation	167.6	14.6
Disturbance regulation	2.3	0.2
Water regulation and water supply	5.2	0.5
Erosion control	114.6	10.0
Soil formation	11.6	1.0
Nutrient cycling	429.6	37.4
Waste treatment	102.7	8.9
Biological control	2.3	0.2
Food production	50.7	4.4
Raw material	164	14.3
Genetic resource	18.5	1.6
Recreation	78.6	6.8
Cultural	2.3	0.2
Total	1,150	100

Source: Singh, 2007

Table 5: Economic and social costs of natural disasters in the eastern Himalayas and downstream

Country	Mortality 1971–2008 (No. of people dying annually)	People affected per annum on average			Economic loss (annual average, 1971–2008)		
		Drought (‘000)	Floods storms (‘000)	Share of population (%)	Droughts (million US\$)	Floods and storms (million US\$)	Largest loss per event (% of GDP)
Bangladesh	5, 673	658	8, 751	9.1	0	445.6	9.8
India	2, 497	25, 294	22,314	7.2	61. 6	1,055.4	2.5
Nepal	137	121	87	2.0	.3	25.8	24.6

Source: Rasul (in preparation), based on World Bank (2010)

Climate-related benefits and the value of protecting mountains against climate change impacts

The economic impact of the climate-modulating function of mountains is considerable. Major changes in the ability of mountains to provide this environmental service would create potentially high costs.

Mountain ecosystems are also particularly sensitive to climate change. Changes in climate can have particularly strong impacts on the cryosphere: change in the snowline, change in duration of snow cover, increase in cryogenic hazards such as ice and snow avalanches, glacier recession, formation and break-out of moraine-dammed lakes, warming of perennially frozen ground, and thawing of ground ice. Implications of these impacts include direct effects on water resources and hydropower generation, on slope stability, and on hazards relating to avalanches and glacier lakes.

The reduction in glacier volumes is expected to have a strong impact on dry-season water flows in rivers fed largely by ice melt (Haeberli and Beniston 1998), which will very likely affect the provision of downstream water for drinking, hydropower, and irrigation. Over 65 countries use more than 75% of their available fresh water for agriculture. These include countries with large populations such as Egypt, India, and China, which rely heavily on mountain discharge (Viviroli et al. 2003).

Many of the Himalayan glaciers are receding at a rate faster than the world average. In many areas, a greater proportion of total precipitation appears to be falling as rain. As a result, snowmelt begins earlier and winters are shorter. This affects river regimes, ecosystem services including water supply, and livelihoods, as well as causing natural hazards.

Climate change is also increasing the frequency of glacial lake outburst floods (GLOFs). It is anticipated that such events could reach rates of one significant GLOF each year by 2010 (Kaeaeab et al. 2005), imposing a substantial risk to downstream communities and hydroelectric power schemes. For example, rehabilitation of roads damaged by the outburst flood of Zhangzambo glacial lake in Tibet in 1981 cost US\$ 3 million. The power supply was cut for 31 days, and the traffic flow was blocked for 36 days. Similarly, the outburst flood of Dig Cho glacial lake in Nepal in 1985 damaged property and infrastructure amounting to US\$ 4 million (Khanal et al. 2009).

Loss of mountain ecosystem function due to climate change can thus impose great economic, environmental, and social costs both to mountain and downstream populations and impede the goals of green economy and sustainable development of the world. Protection of mountain ecosystems from climate change is therefore critical for avoiding these costs and ensuring that mountains continue to provide global benefits and protect downstream regions from hazards.

3. Issues and Challenges in Mountain Regions

Although Chapter 13 of Agenda 21 recognised the value of mountain systems, with a few exceptions mountain issues are not yet sufficiently reflected in national, regional, and international policies and priorities. Sustainable mountain development has remained marginal in the international development agenda and in national and sectoral policies such as those for land, water, forest, and the environment (MA 2005; Jodha 2008). Twenty years after the Rio Earth Summit, many of the challenges remain. Mountain communities and their environments are still vulnerable to growing demand for water and other natural resources, expanding tourism, growing out-migration, disproportionate incidences of conflict, and the pressures of industry, mining, and agriculture in an increasingly globalised world.

To promote sustainable development in mountain regions these challenges will need to be addressed in the green economy framework.

Lack of Compensation for Mountain Ecosystem Goods and Services

Mountain ecosystems are important for national, regional, and global economic growth and human wellbeing. However, their services do not receive adequate recognition in national economic decision-making, including development planning and resource allocation. Mountain ecosystem services are often taken for granted, and the role of mountain communities in generating them receives little or no attention. GDP does not account for depletion of natural capital, which is the fundamental basis for all economic activities. Since the value of mountain ecosystem services is not captured in GDP, their contribution to national economies and to people's livelihoods is invisible.

Mountain communities bear a large part of the opportunity cost of providing essential ecosystem services to society at large, yet they receive inadequate incentives for conservation of mountain resources (see example in Box 2). This lack of compensation has accelerated unsustainable exploitation and rapid degradation of the mountains' natural assets. Although some models exist in developed countries, appropriate economic frameworks and mechanisms for providing adequate incentives to mountain communities need to be established in the developing world.

Difficulty of Valuating Mountain Ecosystem Services

The benefits of mountain ecosystem services are largely intangible, and there is no defined market for them, making it difficult to assign a monetary value to particular ecosystems and to demonstrate their value to national, regional, and global economies and to the environment.

Box 2: Undervalued ecosystem services: The case of Shivapuri-Nagarjung National Park

Shivapuri-Nagarjung National Park, located north of the Kathmandu Valley in Nepal, is a quintessential case of undervaluation of ecosystem services that benefit downstream populations. The park is an important water catchment providing 40% of the water supply to urban Kathmandu. Water from the park is also used in hydropower generation, irrigation, and water-based industries downstream. Upland watershed conservation in the park is provided at practically no cost to downstream water users, and with practically no compensation for those who carry out the conservation efforts. Local people's livelihoods depend on access to forest resources, which is limited by regulations. However, no mechanisms exist for the beneficiaries of the park's environmental services to pay for the sacrifices of the local people. As a result, park authorities face difficulties in enforcing conservation regulations, and local communities have no interest in conservation as they receive no tangible benefits.

Source: ICIMOD, unpublished

Furthermore, mountain ecosystems are dynamic and multifunctional, and their components interact in complex ways. Different ecosystem services are interlinked and highly interdependent (Ring et al. 2010), and natural processes are variable over space and time. This also poses a challenge to their valuation (Rasul et al. 2011). Ecosystem services are generally supplied to buyers in bundles, not alone. For example, mountain forests sequester and store carbon, thus mitigating climate change, but at the same time they prevent erosion; protect watersheds, soil, and biodiversity; and provide hydrological services.

Another challenge to demonstrating the contribution of mountain ecosystems in the production, consumption, and wellbeing of national, regional, and global communities is the dearth of mountain-specific disaggregated data. Although some progress has been made recently in the valuation of mountain ecosystem services, the value of regulation and support services remains especially difficult to quantify.

Unclear Property Rights with Regard to Mountain Ecosystem Services

With markets emerging for carbon, watershed services, and biodiversity, these are now saleable resources, as they were not in the past. However, there are no clear property rights for these resources; the concept of property rights applies largely to assets and products. Without clear property rights, mountain farmers cannot negotiate and benefit from voluntary markets for environmental services such as carbon sequestration and storage, biodiversity, and water protection. To negotiate and exchange these resources in the market requires new regulations, including clear property and use rights and access and benefit sharing, among others.

Nascent Market for Mountain Ecosystem Services

While markets for mountain niche products are growing, markets for mountain ecosystem regulation and support services are not yet well developed. Complex rules and regulations, precise measurements, and rigorous verification requirements at different stages bar mountain communities managing small plots of forest land from enjoying the benefits of the global carbon market, for example.

Fragile Mountain Ecosystems

Geographic and climatic features make mountain systems extremely fragile. This condition is further exacerbated by pressure from both anthropogenic and biophysical factors and, with some notable exceptions, mountain ecosystems shows symptoms of deteriorating health (MA 2005).

The mountain regions of the world have, overall, been experiencing loss of biodiversity, degradation of forests (Box 3) and rangelands, loss of soils, increased extraction of minerals, rising temperatures, and increased incidence of extreme events such as flash floods, massive flooding, and landslides. For example, 10 of 14 major disasters in 2008 took place in the HKH region.

Furthermore, mountain regions are already experiencing three times more warming than the world average, with temperatures likely to go up by 2.1°C to 3.2°C by 2055 (IPCC 2007; ICIMOD 2010). Climate change is an overarching concern that complicates and further exacerbates other unfolding crises (e.g., the financial crisis, the energy and water crises, among others). The threat to water flows from faster glacier meltdown in the mountains, for example, will have serious short- and long-term consequences downstream.

Box 3: Degradation of tropical montane forests

The fastest forest loss rate is in the tropical montane (mountain) forests, at 1.1% per year. Around 90% of mountain forests have already disappeared from the northern Andes. Tropical montane cloud forests are one of the most threatened ecosystems. Most of the 600 existing sites are fragmented. These forests are particularly important for 'stripping' water from clouds, contributing about 15% of rainfall in humid climates, and up to 100% in areas with low rainfall. They have high levels of biodiversity, with very high proportions of endemic species including tree ferns (Cyatheaceae), bromeliads (Bromeliaceae), and orchids (Orchidaceae). These forests provide local people with fuelwood, building materials, food, and medicine. Because of their dependence on the stable position of clouds, they are particularly threatened by climate change.

Source: Price and Butt 2000

The fragility of mountain ecosystems represents a considerable challenge to a green economy and sustainable development. The impacts of unsustainable development in the mountains have been more rapid, have taken a heavier toll, and have been more difficult to correct than in other ecosystems (MA 2005). The lowlands are also heavily influenced by undesired changes in mountain areas, because of their dependency on mountain resources and ecosystem services.

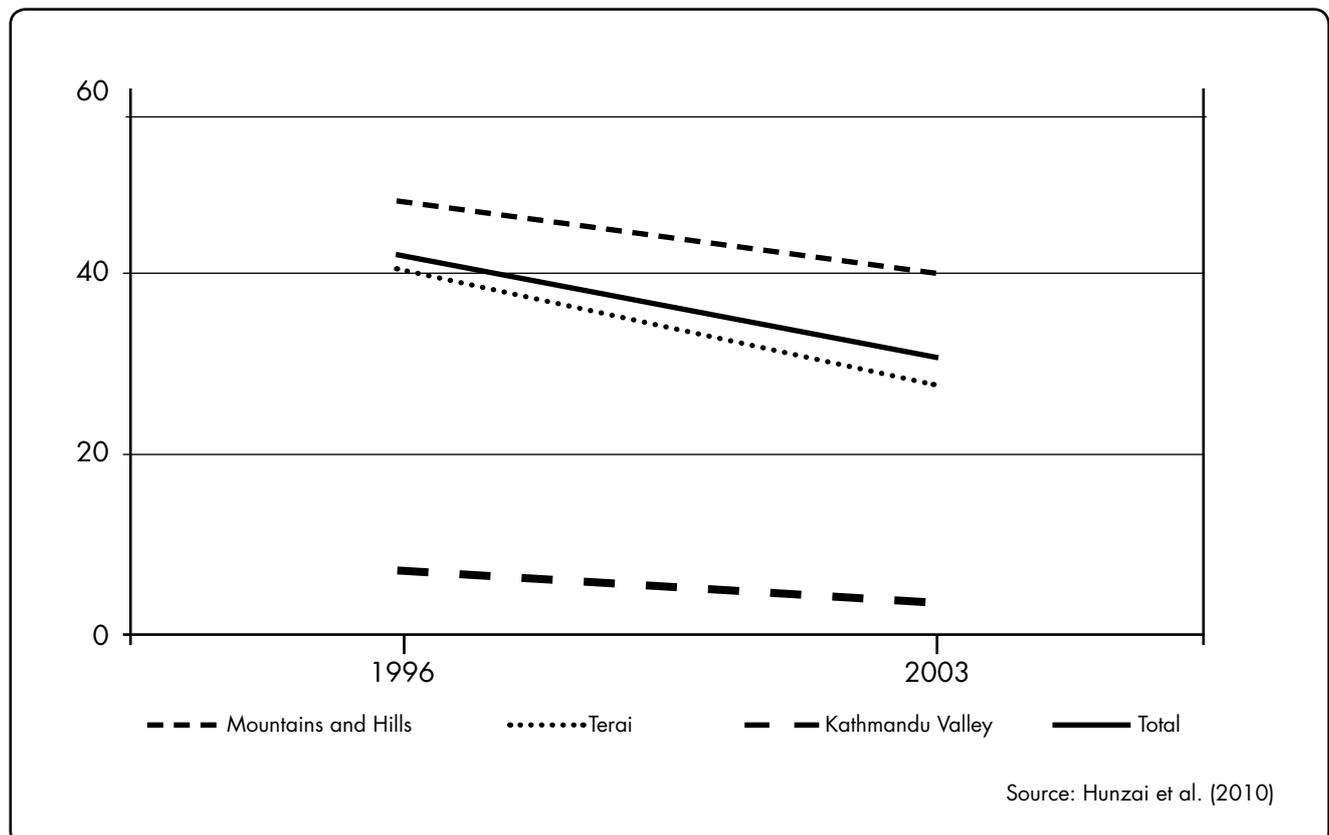
Persistent Poverty and Marginalisation of Mountain Areas

Livelihoods in mountain areas are considerably more susceptible to environmental and economic changes than those in lowlands because of rough topography, remoteness, and poor socioeconomic infrastructure. The incidence and severity of poverty and vulnerability are disproportionately high in many mountain regions of the world. Figure 4, for example, shows the difference in poverty levels in the mountain and lowland regions of Nepal. Worldwide, some 270 million mountain people live in dire poverty and are considered especially vulnerable to food insecurity. Poverty reduction rates are also lower in mountain regions (Hunzai et al. 2010).

According to FAO (2003), only about 22% of mountain lands are suitable for agriculture. The pressure on land for agriculture and other uses, combined with forest destruction, overgrazing, and inappropriate cropping practices, results in irreversible loss of soil and ecosystem functions that increases environmental risks to both mountains and downstream areas. Hardships in the mountains, along with low economic opportunities in rural areas, have driven large-scale outmigration from mountain areas (Banerjee et al. 2011), increasing the difficulty of maintaining traditional conservation measures such as terracing. Continuing soil erosion, loss of biodiversity, deforestation and land degradation, black carbon accumulation, increasing floods, and the impacts of climate change (among them, snow and glacier melting and recession, temperature rise, receding forest tree line) have further increased the vulnerability of mountain livelihoods.

Economic deprivation, long negligence, and isolation have contributed to the alienation of mountain communities from mainstream societies and have triggered conflict, violence, rebellion, political radicalisation, and terrorism in many mountainous areas. Livelihood security, economic growth, and equity in mountains are prerequisites for peace and stability.

Figure 4: Trend of people living under the poverty line in different regions of Nepal (%)



Lack of Disaggregated Mountain-Specific Data

Mountain ecosystems and production systems are closely interrelated, and geographically referenced data are essential to their sound management and planning for sustainable development. Disaggregated economic and social data on mountains are difficult to obtain and, in many cases, not available. Unclear definition of what constitutes a mountain, with differences in national and global standards, compounds the problem.

4. Opportunities for Development in Mountain Regions

Although mountain regions in developing countries face numerous challenges in the context of a green economy, the green economy development model opens windows of opportunity to rectify earlier development models which have tended to exclude the concerns and interests of mountain regions. The green economy can provide the framework for valuing and compensating critical services of mountain regions that benefit downstream communities, and in the process encourage conservation and address mountain poverty. The green economy paradigm of development can hence unlock the potentials of mountains while preserving mountain values towards sustainable development. A number of opportunities for developing mountain regions in the context of a green economy are explored below.

Realising the Value of Mountain Ecosystem Services

Conventional economics does not take into account depletion and degradation of natural capital and the value of ecosystem services which used to be regarded as 'free public goods'. The green economy recognises the value of the ecosystems in the production of goods and services for downstream economies and for securing overall human wellbeing at local, national, regional, and global scales. This recognition provides an opening for mountain people to be duly compensated and rewarded for stewardship of mountain ecosystems and their services. Assuring that people living in the mountains receive the full benefits from their mountain resources would encourage these communities to keep the mountains green for global benefit, while the compensation they receive would substantially reduce poverty – a green economy goal – and provide a disincentive for migration away from mountain areas.

A Growing Market for Niche Mountain Products

Mountain goods and products such as medicinal and aromatic plants and other non-timber forest products, mountain crafts, and ecotourism hold special values and have niche markets. Enabling policies and supporting rules and regulations for marketing mountain products can benefit mountain regions and help them get value for their products and efforts. Distinctive features and values of mountain products can be highlighted in novel ways such as through green certification and eco-labelling, access and benefit sharing initiatives, green marketing, and fair trade of mountain products.

Conserving Ecosystem Services to Fight Poverty and Enhance Livelihood Security

Rural poor people depend heavily on natural resources. Around 350 million people who live within or adjacent to dense forests, for example, depend on them for a high degree of subsistence and income (World Bank 2004, cited in Gundimeda 2011). By linking natural resource based livelihoods to production of ecosystem services, the green economy can help reduce poverty and enhance environmental sustainability. For example, many mountain people currently depend on collection of fuelwood, fodder, and litter from forests to sustain their livelihoods and wellbeing. Yet their efforts to conserve forest resources for their livelihoods at the same time also contribute to the generation of environmental services such as improved forest carbon sinks and enhanced species diversity. Ensuring that mountain communities receive full benefits for providing these services can thus enhance and secure livelihoods in mountain areas while bringing environmental benefits.

Government Policy Innovations for Conservation and Development of Ecosystems

Many innovative policy options that are emerging to provide incentives for conserving and developing ecosystem services have potential for mountain regions. For example, the Government of India has established fiscal transfer from the central government to the states for forest ecosystem services (Box 4). Other initiatives in India include the Green India Mission to enrich forest cover, the National Rural Employment Guarantee Act 2005, and the Economics of Ecosystems and Biodiversity (TEEB) initiative to value and compensate ecosystem services. Similarly, China is promoting conservation of fragile ecosystems and a green economy through ecological compensation (Table 6), the 'Grain for Green' initiative for afforestation of marginal agricultural land, and a large investment in the renewable energy sector. Brazil and Portugal have introduced fiscal instruments for enhancing ecological services in municipal areas (Box 5).

Box 4: Fiscal transfers for internalising spatial externalities: the case of India

Provision of mountain ecosystem services involves spatial externalities. The costs of generation of such services are borne at the level of provision, but the benefits are realised at larger scales. To internalise environmental externalities across the different states, the Indian Government allocated INR 10 billion (about US\$ 200 million) for the conservation of forests. The thirteenth Finance Commission was given the mandate to make recommendations for helping to manage ecology, environment, and climate change in a way consistent with sustainable development.

Source: Kumar and Managi (2009)

Box 5: Ecological fiscal transfers: the case of Brazil

In Brazil, some states have introduced ecological fiscal transfers (Imposto sobre Circulação de Mercadorias e Serviços [ICMS] Ecológico) to compensate municipalities for the opportunity costs of conservation areas and for protecting watersheds that benefit other municipalities. So far 16 of the 26 Brazilian states have introduced the ICMS Ecológico in their states' constitutions and 13 have implemented ecological fiscal transfers. In 1991, the state of Paraná implemented a law that awarded 5% of ICMS revenue to municipalities in proportion to their protection of watersheds and conservation areas that benefited other municipalities, to compensate municipalities for their opportunity costs.

The fiscal transfers to municipalities are determined by indices. In the case of protected areas for biodiversity conservation, these indices consider the size of the protected area, the size of the municipality, and the protected area's management category. Paraná has also decided to add a protected area 'quality index' to the calculation. This has created an incentive for conservation, and the quality of protected has increased.

Source: Ring et al. (2011); Farley et al. (2010)

Table 6: Ecological compensation: the case of China

Scale	Compensation type	Compensation contents	Compensation means
International compensation	Ecological and environmental issues at global scale between region or countries	Global forest and biodiversity protection, pollution transfer, emission of greenhouse gases, transboundary rivers	Global buying under multilateral agreements Compensation under regional or bilateral agreements Market trading between regions and countries
Domestic compensation	Compensation between regions	Compensation by eastern areas to western areas	Financial transfer payments Local government mediation Market trading
	Watershed compensation	Trans-provincial and local watershed compensation	Financial transfer payments Local government mediation Market trading
	Ecosystem compensation	Services from ecological systems such as forests, grasslands, wetlands, oceans and farmlands	National (public) compensation of financial transfer payments Eco-compensation funds Market trading Participation of enterprises and individuals.
	Resource exploitation compensation	Mining, land reclamation, vegetation restoration	Payments by beneficiaries, destroyers, and exploiters

Source: Tian (2011)

Introducing Incentive-Based Mechanisms for Mountain Ecosystem Services

Ongoing global and national efforts to develop policies, strategies, and regulatory frameworks for better ecosystem services are creating emerging markets for mountain ecosystem services. Incentive-based mechanisms such as payment for ecosystem services (PES) and Reducing Emissions from Deforestation and Forest Degradation (REDD+) are emerging opportunities for financing conservation and development of mountain regions. Other examples are given in Box 6.

While many countries have recognised the contributions of ecological services from their hill regions to the domestic economy, the introduction of REDD++ (which includes agriculture, forestry, and other land uses) as one of the most important climate change mitigation tools offers an entirely new opportunity for the global community to recognise the continuing contribution of mountain people to the health of the globe.

A larger opportunity for incorporating the mountain agenda within the framework of a green economy is in creation of markets for a large number of mountain ecosystem goods and services in addition to carbon. Multi-layer PES schemes (something like the international carbon trading system, but for multiple ecosystem services) could be developed to transfer financing between industrialised and mountainous developing countries in exchange for emission reductions, and from national to local forest managers and communities. Clearly, the green economic model provides opportunities to create markets for water, biodiversity, and carbon sequestration services in mountain regions.

Bangladesh, China, and India already have some experience with introducing PES for irrigation water into their national forest policies, on a selected case basis.

New Investment and Employment Opportunities

Shifting investment from the brown or industrial sector to a green sector may create interest and bring opportunities in green investments and transfer of green technology. Mountain regions can benefit from green investments in areas such as:

- enhanced production and processing of mountain ecosystem goods and services;
- appropriate pricing and reward or payment systems for proper valuation of mountain goods and services;

Box 6: Models of PES for forests in developed and developing countries

Mountain regions of the developing world can draw from a few examples of practices in payment for ecosystem services (PES) in mountain regions of developed countries and elsewhere.

Compensation for protective services of forest in Switzerland

In Switzerland, where 80% of forests are in mountains, the government pays forest owners US\$ 25 million to US\$ 35 million per year for managing their forests, mainly for protection against natural hazards such as avalanches and landslides (Mountain Agenda 2000).

PES legislation in Costa Rica

The environmental services provided by mountain forests to society are recognised by legislation in some countries. In Costa Rica, where forests cover 40% of the country's area, and where 60% of these are private, the 1996 Forestry Law requires hydroelectricity corporations to pay forest landowners for reforestation and forest management and conservation, valued at US\$ 5 to US\$ 70 per hectare per year. Different companies pay US\$ 10 to US\$ 40 per hectare per year to the landowners (Price and Butt 2000).

PES payments in Nepal

In Kulekhani, Nepal, villages in the upland catchment area receive part of the hydropower royalties paid by the power company to the government. The PES payments are channelled through District Development Committees to the recipient villages and managed under an Environment Management Special Fund. The money is used for conservation and development activities (Joshi 2011).

- reducing mountain fragility and the impact of disasters;
- creation of green employment opportunities (e.g., in agriculture and horticulture) in mountain regions.

Examples of government investments in the green sector can be seen all over the world. Box 7 gives an example from China.

Alternative energy technology: improving lives and reducing carbon footprint

People in mountain areas mostly use fuelwood for cooking and heating, which can have detrimental effects on the environment, air quality, and human health. In the Hindu Kush-Himalayan region, there are also indications that aerosols containing large amounts of black carbon are contributing to regional climate change and glacier melt. Investments in alternative, cleaner forms of energy to replace fuelwood and fossil fuels would reduce carbon emissions, improve human health, and secure mountain livelihoods by conserving mountain forest resources.

Simple, novel, and affordable energy production technologies appropriate to mountain areas and renewable energy resources that emit fewer or no greenhouse gases are available in mountain regions. Notable examples in the HKH region include the diffusion of hydropower in Bhutan, solar energy and biogas applications in China, biodiesel and wind energy in India, and biogas and micro-hydropower in Nepal (Box 8). The green economy presents a unique opportunity to explore and invest in these greener, cleaner alternatives and to develop landscape and ecologically linked alternative energy technologies.

Green practices in water management

Water for human consumption, irrigation, and hydropower development constitutes a premium resource of mountain regions. There is ample scope for investments in scaling up green practices in water and watershed management.

Scaling up represents both an opportunity and a challenge in the mountain regions. Promotion of more efficient use and conservation of this precious resource will require investment in technical innovations (e.g., simple mountain-appropriate snow and water harvesting and water conservation technologies, management of glacier lakes) and will also require water governance measures (e.g., access and benefit sharing).

Diversification and value addition in mountain agriculture

Despite sloping land generally unfavourable to cultivation, agriculture is the main economic sector in many mountain regions of developing countries, accounting for between 30% and 60% of gross domestic product (GDP) and employing up to 80% of the workforce. The market for mountain agriculture is largely organic and is therefore likely to grow, providing opportunities for mountain regions to diversify their agricultural sector. The green economy can help shift agriculture away from subsistence levels through promotion of organic farming, horticultural development, herbal and traditional medicine, and value-added products such as handmade paper, tea, bamboo-based handicrafts, floriculture, horticulture, and mushroom processing, among others. Organic products from mountain agriculture can be marketed for their health values.

Box 7: Government Investments in the Green Sector: Carbon Reduction Benefits in China

For the past decade, 90% of the World Bank's energy investments in China have supported the development of renewable energy such as wind power, biofuels, and the acceleration of energy efficiency. With this, China has, over the past five years, increased its renewable energy generation to 8.8% of total primary energy consumption, becoming one of the world's leading producers. This development has enabled an increase in employment and income of 15% in rural China.

Source: World Bank (2011)

Box 8: Investments in Biogas Systems in Nepal

In Nepal, the government has transferred the management of the Khata Corridor to local communities after together developing strategies for sustainable forest management. Groups of forest users charge membership fees, sell non-timber forest products, and levy fines. The income has been used to purchase biogas systems for the production of gas from manure. When gas is used for cooking, less fuelwood is needed. Reduction in fuelwood use has reduced forest degradation and reduced exposure by women and children to indoor smoke pollution and the consequent acute respiratory infections. The new fuel also saves women time and effort, allowing them to increase their income from trading non-timber forest products.

Source: WWF (2011)

5. Framework for Action: Strengthening Sustainable Mountain Development and Achieving the Millennium Development Goals Through Promotion of a Green Mountain Economy

General Conclusions

The global importance of mountains

The foregoing analysis shows how the nearly one-fifth of the world's people living in the mountains depend on mountain ecosystem resources for their sustenance and wellbeing, while billions more living downstream benefit from these resources indirectly. Economic growth and sustainability in the lowlands depend highly on mountain ecosystem services, directly and indirectly. Mountain ecosystems are therefore global natural capital and have a special role in the green economy and in the sustainable development of the world. Sustainable mountain development therefore deserves a prominent place in the decisions of the Rio+20 conference. Ensuring the sustainability of mountain ecosystem services is a global concern.

Ensuring that mountain systems and populations thrive

Mountains are part of the planet's ecological wealth and provide services of global significance. To maintain the flow of these services, it is essential to promote positive framework conditions to motivate mountain communities to continue and enhance their efforts in conserving the ecosystem services required to address the current global challenges. The international community must recognise and reward the mountain populations for the benefits and services generated through their interaction with the environment.

The rapidly changing global environment and growth in demand for mountain resources and services influence mountain systems in both positive and negative ways. The growth in demand for natural resources threatens to exceed the adaptive capacity of mountain communities, the carrying capacity of mountain systems, and the sustainability of strategic natural resources such as clean water, biodiversity, fresh air, genetic resources, and intact landscapes. Additional efforts must be made to ensure that subsequent generations continue to benefit from the mountain environment and the services it provides. Therefore, comprehensive policies and institutional frameworks are needed to build mountain concerns and specificities into the framework of the green economy.

Rio+20 is an opportune occasion to highlight the role of mountains, to make sure that they receive appropriate attention during the negotiations, and to push for concrete action frameworks and mechanisms to promote the sustainability of mountain systems and the wellbeing of their people.

Where Action is Required

Recognition of benefits deriving from mountain regions

As mountain ecosystem services contribute to sustaining and enhancing the Earth's sustainability and prosperity, the green economy framework and Rio+20 need to recognise the benefits arising from mountain ecosystems and should set principles and policies for global, regional, and national actions in support of sustainable mountain development. Principles for full-cost pricing of resources and services from mountain areas and mechanisms for granting mountain communities a fair share of the benefits derived from the use of mountain resources should be established.

Improved governance mechanisms

To provide incentives for mountain populations to protect the ecosystem, environmental governance systems must frame the mountain agenda in environment and development policy. Strengthened governance is needed at all levels, national, regional, and global. National governments have a central role in putting in place policies, strategies, and instruments to create enabling conditions for investment in mountain ecosystem conservation and to attract other actors such as the private sector to finance conservation. The international policy framework needs to recognise the value of mountain ecosystems and the needs of mountain people, and to support international, regional, and country-level implementation of the mountain agenda. Attention needs to be paid to strengthening the institutional framework at all levels for decentralised resource governance, efficient functioning of markets, well defined property rights, and fair access and benefit sharing for local resource users.

Enhanced economic security and poverty alleviation to facilitate peace and stability in mountain areas

Governments must ensure that the green economy contributes to eradicating poverty, ensuring livelihoods, and promoting social equity and security, in line with the MDGs. Promotion of green economy must be based on equitable access to resources, well defined property rights, and inclusive growth. Governments must take steps to ensure that benefits reach poor and marginalised people including women, indigenous people, and ethnic minorities.

Institutional strengthening and capacity building

Achieving and maintaining a low-carbon economy requires substantial changes in policies, priorities, and strategies, the increased application of market-based instruments for conservation and development, and the use of new technologies. It therefore requires more holistic approaches, a longer-term perspective, and new skills and expertise. Institutions in mountainous developing countries may lack the required capacities and capabilities to design and implement these changes effectively. For effective application of new policy instruments and technologies and for coordination of actions among diverse stakeholders, the capacities and capabilities of national, regional, and global institutions need to be strengthened.

Transboundary cooperation

Many of the mountain ecosystems and their services are transboundary in nature; thus their conservation and management demands regional cooperation. Strengthened networks and regional conventions like the Alpine Convention may enhance coordination of activities and assist in raising mountain concerns in international governance and protocols.

Mountain-specific knowledge and disaggregated data

Systematic research and capacity building for generation of mountain-specific knowledge and collection of disaggregated data are necessary to improve economic and scientific analysis to inform policy and guide action for sustainable mountain development.

Financial instruments

Conservation of mountain ecosystem services and the transition towards a more low-carbon path of development require financial resources. The international community must provide the necessary support to leverage financial resources, for example through establishment of dedicated funding windows for mountains in existing funding mechanisms (such as the Global Environment Facility [GEF]), insofar as they link to other global priorities such as climate change, water, and biodiversity. International and regional payment for ecosystem services (PES) schemes may be introduced to stimulate the provision of vital non-marketed ecosystem services at the global and regional levels.

Indicators of progress

Mountain-specific indicators need to be developed for measurement of progress towards a green economy, such as investment in mountain ecosystem conservation, resource allocation in mountain regions, and stock and health of mountain ecosystem resources such as water, biodiversity, and the cryosphere (e.g., river flow, sedimentation control).

Operationalising the Framework: Recommendations

The above elements may be pursued in a three-pronged policy approach focused on global responsibilities, regional interests, and national tasks. The following are some proposed institutional approaches at the three levels.

National level

- **Adopt mountain-specific strategies in national development plans and programmes** to achieve the twin goals of conservation and poverty reduction.
- **Internalise the costs and benefits of conserving mountain ecosystems in national wealth accounting, resource allocation, and development plans.** The costs of producing environmental goods and services need to be factored into the design of policies, strategies, programmes, and projects. In this way the costs and benefits of mountain ecosystems will be integrated into actual prices, markets, and incentive structures.
- **Promote markets for mountain ecosystem services.** Encourage the private sector through appropriate policy and regulatory support such as clear property rights and access and benefit sharing frameworks so that the market can become an option for financing mountain ecosystem management.
- **Develop policies for institutionalising incentives and compensation for mountain ecosystem services,** and make mountain ecosystem conservation central to economic decision making.
- **Modify and correct policy, institutional, and market failures** related to undervaluation of mountain ecosystem services or failure to recognise them in national economic decision making.
- **Invest in mountain regions** to unlock their potential in a green economy and sustainable development, e.g., for energy, water, high-quality mountain agricultural products, and nature-based and organic products. Investment in mountain regions will generate long-term benefits. Owing to positive externalities, investment in mountains brings high welfare gains. To attract green investment in mountain areas, governments may grant financial support such as low-interest loans or exemption from certain regulations, to build economies of scale and competitiveness. Generating new public-private partnerships is equally important in the overall approach to unlocking the potential of mountains; they can be an important source of revenue to ensure the long-term sustainability of mountain ecosystems while relieving pressure on public budgets.
- **Create a conducive environment for investment in mountains and green infrastructure,** and provide incentives for promoting industry and business for the benefit of mountain and rural communities. As the returns from green sectors (e.g., conservation and management of forests, watersheds, soils, rangelands, and glaciers) comes only after some time, government support (direct or indirect) is necessary at least in the initial stages to attract private investment.
- **Adopt alternative forms of energy such** as hydropower, wind power, biogas, and solar energy to reduce negative impacts from the use of fossil fuels and fuelwood.

Regional level

- **Promote and strengthen networks and partnerships** among mountain regions. International and regional development and research organisations should facilitate transfer of knowledge and experience as well as capacity building for key mountain institutions.
- **Promote regional mechanisms for the compensation of ecosystem services** provided by upstream communities.
- **Strengthen value chains** to benefit mountain communities, for example through branding of mountain goods and services.
- **Strengthen the information and knowledge base** on sustainable mountain development and make it accessible to all concerned.
- **Use transboundary approaches and facilitate regional cooperation** to address issues of water management, biodiversity, and protected areas, and establish regional funds for management of transboundary ecosystem resources.

Global level

- **Create compensation mechanisms and markets for globally significant mountain ecosystem services** such as biodiversity and carbon sequestration. Establish institutional mechanisms for providing economic incentives to conserve mountain ecosystems and improve the lives of mountain communities.

- **Remove trade barriers and price distortions** on green goods and services of mountain regions.
- **Enhance international and regional cooperation** on mountain issues.
- **Pursue a global commitment** to conservation and low-carbon development of mountain ecosystems. Provide adequate financing targeted to the mountain regions of developing countries for conservation and development of globally significant ecosystems. Support technology transfer and capacity building for institutions engaged in development of mountain regions.
- **Strengthen and expand alliances** of mountain stakeholders to lead and undertake the process of sustainable mountain development beyond Rio+20. Strengthen cooperation and networking among the different mountain regions. Regional conventions in mountain regions might be pursued following the example of the Alpine and Carpathian Conventions.
- **Strengthen international support for research** on mountain systems of global relevance.

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Annex 1

Kathmandu Declaration on Green Economy and Sustainable Mountain Development

7 September 2011, Kathmandu, Nepal

Preamble

Following the invitation of the International Centre for Integrated Mountain Development (ICIMOD) and the United Nations Environment Programme (UNEP), 120 participants including scientists, development practitioners, policy makers, and civil society and private sector representatives met in Kathmandu from 5 to 7 September 2011 to deliberate on the role of mountains in green economy. Recalling the recognition of the importance of mountains at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil in 1992 through adoption of Chapter 13 in Agenda 21, and realising the need to revisit the mountain agenda in the upcoming United Nations Conference on Sustainable Development in June 2012 (commonly called Rio +20), the participants put forward the following declaration.¹

Declaration

Recognising that:

- mountain systems support about half of the earth's human population by providing numerous goods and services including fresh water, food, life-saving medicinal herbs, energy, rich biodiversity and associated traditional knowledge, as well as cultural diversity;
- global drivers of change such as growing human population, increasing urbanisation, industrialisation, globalisation, other socioeconomic changes, and climate change put increasing pressure on the available natural resources of the world and the mountains in particular;
- mountain ecosystem goods and services have therefore to respond to an increasing demand, while prevailing policies have not adequately prepared mountain populations and regions for the new challenges, and global dynamics create strong externalities for mountainous areas;
- mountain communities are characterised by their resilience, and their adaptation efforts have produced promising solutions relevant not only locally but also to the global community at large;
- promoting the sustainability of mountain ecosystems and services for future generations and for the continued prosperity of both upstream and downstream areas requires targeted actions and the concerted efforts of local, national, regional, and global institutions, calling for a joint effort of all sectors of society;
- the call for a low carbon economy has the potential to strengthen sustainable mountain development and help to create the conditions necessary for achieving the Millennium Development Goals in mountain areas;
- mountain economies are characterised by their low carbon footprint and by their potential to contribute low-carbon products to the local and global markets;
- however, the low carbon footprint is accompanied by a high incidence of poverty;

the participants formulate the following recommendations.

General

- The Rio+20 conference should recognise the contribution of mountain systems and their ecosystem goods and services to a green economy, sustainable development, and human wellbeing and should set principles and policies for global, regional, and national actions in support of sustainable mountain development.

¹ This declaration was formulated and approved by the conference participants. It considers the 37 comments received from participants after draft circulation. The declaration expresses the opinions of the participants and has not been formally negotiated. It therefore does not commit the institutions and governments represented.

- Considering the increasing importance of mountain ecosystems for downstream communities, the high incidence of poverty and unequal access to resources in mountain areas, the growing vulnerability of upstream and downstream populations, and the threats to the availability of mountain ecosystem services, global stakeholders should revisit the criteria of the mountain agenda and Chapter 13.
- International organisations and national governments are implored to favour policies and all possible efforts to strengthen the efforts of mountain communities to ensure a continued availability of fresh water, biodiversity (including agrobiodiversity), cultural diversity, and space for tourism, recreation, and spiritual renewal, as well as to cope with the consequences of climate and environmental change.

Recognition, valuation and capture of benefits deriving from mountains

- More focused research, reliable data and information, dissemination of positive experiences, applicable knowledge, and good practices, and systematic efforts to create awareness among grassroots communities, civil society, and government institutions are required.
- Considering the ecological, economic, and cultural diversity of the global mountain systems, regional centres of excellence and knowledge should be created and strengthened.
- Approaches to green economy in mountains shall be designed according to local conditions and must be context appropriate, taking into account mountain specificities such as environmental fragility, vulnerability, and low economies of scale.

Appropriate policy frameworks

- International efforts to include the use and value of natural resources in gross domestic product (GDP) are commended and should be adopted at the national level.
- Concrete mechanisms, customised for mountain areas, must be promoted at the global, national, and local levels to reward and compensate mountain communities for conservation and provision of ecosystem services.
- Governments should create incentives and provide support for market-driven investments and flow of financial resources (including remittances) for low-carbon production and sustainable development in mountains.
- Development of services for mountains (e.g., knowledge, technology, business development, and infrastructure) should be low carbon, environment friendly, and mountain adapted.
- International organisations, intergovernmental organisations, and the private sector should contribute to the promotion of niche products and services of mountains through mechanisms such as mountain branding, labelling, and standards.
- Approaches must be promoted to improve markets for ecosystem services, to simplify processes of international instruments such as REDD+, and to develop and improve methods for valuation of environmental services.
- The transboundary aspects of mountain ecosystem services call for regional cooperation, collaborative institutional partnerships, and a strengthening of upstream-downstream linkages.

Ensuring equity

- Promotion of green economy in mountains needs to be based on equitable access to resources and property rights, inclusive growth, and ensuring that benefits reach poor people including women, men, and children, indigenous people, and ethnic minorities.
- Marginalised groups must have a role in resource governance and a voice in decision making.
- Traditional knowledge and practices need to be documented, evaluated, and built upon to solve problems at the local level and beyond, and to conserve and develop mountain ecosystem services.
- A dynamic green economy and society must be supported so that mountains become attractive to youth and to emigrants from the mountains.

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About ICIMOD

The International Centre for Integrated Mountain Development, ICIMOD, is a regional knowledge development and learning centre serving the eight regional member countries of the Hindu Kush-Himalayas – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and based in Kathmandu, Nepal. Globalisation and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. ICIMOD aims to assist mountain people to understand these changes, adapt to them, and make the most of new opportunities, while addressing upstream-downstream issues. We support regional transboundary programmes through partnership with regional partner institutions, facilitate the exchange of experience, and serve as a regional knowledge hub. We strengthen networking among regional and global centres of excellence. Overall, we are working to develop an economically and environmentally sound mountain ecosystem to improve the living standards of mountain populations and to sustain vital ecosystem services for the billions of people living downstream – now, and for the future.





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