

High time for mountains: A program for sustaining mountain resources and livelihoods

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Here are the roots of all the life of the lowlands with all their wealth of vineyard and grove, and here more simply than elsewhere, is the eternal flux of nature manifested.

John Muir, 1872

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CHAPTER I: Mountains: A Global Resource Under Threat

A mountain becomes great as a human personality does: by extending its influence over the thoughts, words and actions of mankind.

R. L. G. Irving, 1940.

Introduction

1. Mountains cover one quarter of the Earth's land surface. They present monumental paradoxes:

- ❖ They dominate the landscape and inspire scared devotion and awe; their people are isolated and ignored.
- ❖ They are the font of fantastic wealth; their people live in poverty.
- ❖ They provide water for half of the world's people; their water and soil resources are among the most mismanaged of all their assets.
- ❖ They are the home of incredible variety and biodiversity; their ecosystems are fragile and easily degraded.
- ❖ Their people have learned vital lessons about sustainability; will anyone listen?

Altogether, the environmental goods, protection, and services provided by mountainous regions are critical to the survival of the human species, both upstream and downstream.

2. Mountain people live in remote, rugged, and hard to reach environments. Their dispersed settlement patterns make it difficult for them to form a political constituency; so they frequently lack access and voice in political systems. They are all too often ignored by governments (almost always based in lowlands), by traditional development agencies, and by most of the non-profit community. If we do not solve the challenges of conservation, poverty reduction, and sustainable development in mountains, there is little hope of solving the challenges of sustainability anywhere.

3. In recognition of the special challenges of conservation and sustainable development in mountain regions, the UN General Assembly declared 2002 the International Year of Mountains to call attention to the importance of mountain ecosystems and the role of mountain communities as stewards of these natural systems on which all life depends. The United Nations declaration states that this program "fosters the conservation and the sustainable development of mountain regions, thus assuring the welfare of mountain communities and those in the lowlands."¹

¹ United Nations, The Declaration of IYM Objectives.

4. This report has been prepared as a background paper for the 2003 World Development Report: Dynamic Development in a Sustainable World, which looks at sustainable development from a global perspective. Mountains play a critical role in many aspects of global and local sustainability, providing valuable resources and services to the environment and offering the knowledge and experience of mountain people in sustainable use of resources. Mountain communities have solved many of the most basic challenges of sustainability, and offer models for the rest of the world. Yet their remoteness and lack of political “voice”, together with new threats of development are undermining their present, as well as their future, livelihoods. What can we learn, and how can these lessons be applied to ensure a sustainable future for all?

5. The analysis below will support the key themes of the WDR, including how to reduce poverty, how to institute better common property management, how to assure the conservation and management of critical environmental assets indefinitely into the future, and how to ensure the fundamental economic and political equity that are at the heart of sustainability. The report will first address the physical and biological characteristics of mountains, and then look at the social and human aspects of mountain communities. A framework will then be presented for identifying key issues in different mountains areas, and implications for appropriate and effective policy will be discussed. Finally, the core elements of a program of action will be presented.

Characteristics of Mountains

6. Mountainous areas are generally characterized by their altitude, steepness of slope, accentuated relief, and prominence with respect to surrounding landscapes. They exist in Polar Regions and the temperate, sub-tropical, and tropical zones. Mountains constitute important and distinct areas in many countries and regions throughout the world. Looking at altitude alone, Messerli and Ives have calculated that 27% of the Earth’s total terrestrial surface lies above 1000 m above sea level (Messerli and Ives, 1997). The combination of slope, altitude, temperature, insulation, and rainfall make mountains one of the most highly variable and differentiated ecosystems in the world. Mountain issues have to be addressed on a highly local level, though there are common approaches that can be adapted to deal with this variety of circumstances.

Figure 1: Map of Global Terrain

QuickTime™ and a
GIF decompressor
are needed to see this picture.

Source: World Bank

7. For this analysis, we have identified mountain areas on the basis of two criteria: mean elevation above 1000m and significant 'disectedness' or roughness of terrain, based on recent studies published in Mountain Research and Development (MR&D) ². The MR&D analysis uses a relatively fine breakdown of mountain areas, from which water runoff, population, and population density are calculated. Eight altitude ranges and seven roughness ranges are aggregated into 15 relief classes.³ We have further aggregated these classes into: Lowlands (less than 1000m and low relief): Upland Plateaus (more than 1000m but low relief), Low Mountains (200-1000m with high relief), and High Mountains (more than 1000m and high relief). The latter three categories will be used for our analysis of mountains. See Table 1.

Table 1: Mountain Relief Classes

Aggregate Relief Classes	Total Area (Mkm ²)	Population (Mil)	Population density (p/km ²)	Runoff (km ³ /y)	Runoff depth (mm/y)
Lowlands	77.22	4353.3	56.38	20329	246.71
Upland Plateaus	4.39	96.1	21.91	645	111.98

² "A New Typology for Mountains and Other Relief Classes," Michel Meybeck, Pamela Green, and Charles Vorosmarty, Mountain Research and Development, February, 2001. This work is based on recent studies by WWF and by NASA which use units areas of 30 minutes by 30 minutes (roughly 30 miles square at the equator) for classification.

³ Not all the 56 cells contained entries. The 38 cells with significant entries were then grouped into the 15 relief classes.

Low Mountainous	28.96	1428.9	49.35	10626	416.54
High Mountainous	20.79	734.2	35.32	6545	338.59
<i>Mountain Areas</i>	<i>54.13</i>	<i>2259.2</i>	<i>41.74</i>	<i>17816</i>	<i>352.09</i>
Total	131.35	6612.6	50.34	38145	286.80
Shares of Relief Classes Total Area Population Population density^a Runoff Runoff depth^a (percent)					
Lowlands	0.59	0.66	1.12	0.53	0.86
Upland Plateaus	0.03	0.01	0.44	0.02	0.39
Low Mountainous	0.22	0.22	0.98	0.28	1.45
High Mountainous	0.16	0.11	0.70	0.17	1.18
<i>Mountain Areas</i>	<i>0.41</i>	<i>0.34</i>	<i>0.83</i>	<i>0.47</i>	<i>1.23</i>
Total	1.00	1.00	1.00	1.00	1.00
Source: Michel Meybeck, Pamela Green, and Charles Vorosmarty, Population figures updated to 2001 and resolution refined from 50km sq to 20km sq to improve allocation of populations by World Bank Staff.					
a. Relative to mean					

8. According to the altitude criteria, mountainous terrain comprises over half of the land area in 53 countries, while another 46 have 25-50% of their land area in mountains. See Table 2. Countries with significant mountain areas represent about half the total countries in the world. These countries also contain a large share of the world's population and cover a large share of its land area. They all face a number of important challenges to maintaining their mountain environments and assuring adequate livelihoods for their mountain populations. Other countries also have mountain areas facing many of the same problems. Even countries without mountains often depend on the mountains in neighboring countries for fresh water, climate moderation, and other benefits. Many countries with lower percentages of mountainous regions have part of their territory that is mostly or entirely mountainous. In such cases, there are often marked political, economic and social differences associated with these mountain regions. Interestingly, developing countries tend to be somewhat more mountainous than OECD countries, with 41.2% of their territory in mountain regions, compared to 35.6 for developing countries. In fact all 6 developing regions identified by the World Bank have a larger share of mountains than OECD, led by East Asia and Pacific with 70.9% and South Asia with 44.2%.

Table 2: Countries and territories of the world and their mountain areas

% area in mtns	Countries	no. of ctrys	% of land area
0-25	(Countries in this category are not listed)	101	4.4
25-50	Bolivia, Bulgaria, Colombia, Croatia, Cyprus, Czech Republic, Dominican Republic, Ecuador, Ethiopia, Fiji, French Polynesia, French Southern & Antarctic Lands,	46	9.5

	Greenland, Guatemala, Indonesia, Israel, Jamaica, Jan Mayen, Madagascar, Malawi, Malaysia, Mauritius, Mexico, Mongolia, Myanmar (Burma), Pakistan, Panama, Papua New Guinea, Peru, Philippines, Portugal, Puerto Rico, Romania, Russia, Sao Tome and Principe, Solomon Islands, South Africa, South Korea, Spain, St. Vincent and the Grenadines, Thailand, United States, Venezuela, Vietnam, Yemen, Zimbabwe		
50-75	Afghanistan, Albania, Antarctica, Austria, Azerbaijan, Burundi, Cape Verde, Chile, China, Comoros, Costa Rica, Djibouti, El Salvador, Eritrea, Greece, Haiti, Honduras, Iceland, Iran, Italy, Japan, Laos, Morocco, New Caledonia, New Zealand, North Korea, Norway, Serbia, Slovakia, Slovenia, South Georgia and the South Sandwich Islands, Svalbard, Swaziland, Taiwan, Turkey, Vanuatu, West Bank, Western Samoa	38	9.6
75-100	Andorra, Armenia, Bhutan, Bosnia and Herzegovina, Georgia, Kyrgyzstan, Lebanon, Lesotho, Macedonia, Montenegro, Nepal, Reunion, Rwanda, Switzerland, Tajikistan	15	0.5
0-100	Total	200	24
Source: Adapted from Kapos et al., 2000 and "Mountains and People: An account of Mountain Development Programmes supported by the Swiss Agency for Development and Cooperation (SDC)". Published by SDC, Berne, 2001.			

Physical Resources in Mountains and Their Threats

9. Mountains are a source of many of our most important resources. Some, such as minerals like gold and gems, are highly valued. Some, such as timber, coal, copper and quarry stones, are treated as commodities. Others, such as water and biodiversity, are critical to our well-being; but they are rarely valued economically at all. In addition to these kinds of goods, which are typically removed from mountains for use elsewhere, mountains provide essential services *in situ*. They provide water management, siltation control, and carbon sequestration. They offer magnificent views and landscapes as well as recreational challenges for climbers and rafters. Their eco-system diversity is an important source of different varieties of food crops, including disease resistant strains. For many cultures and place-based peoples, mountains are also locations of sacred value and spiritual renewal. One indigenous person has stated that “the visceral vocabulary of place” is an integral part of their personal and tribal identity, binding the routines of daily life and the practice of natural resource management.⁴

Water

10. It is estimated that nearly half of the world’s fresh water comes from mountains.⁵ Indeed, all of the major, and many of the world’s minor rivers originate in mountains. Nearly three billion people in India, Pakistan, Nepal, China and the Indochinese peninsula depend on flows of the great rivers originating in the Himalaya.⁶ The city of Los Angeles could not exist without water that has its source in the Rocky Mountains. The people of Australia and Japan depend on water from mountains. The Arabian Desert Peninsula is reliant on rivers that flow from the Jeman and Oman mountain chains. The Nile, which provides 95% of Egypt’s fresh water, has multiple tributaries in mountains, from Ethiopia to the Rhuengheri range of Rwanda. Almost all of South America relies on water that has its source in the Andes. This includes not only the traditional Andean countries of the Pacific Coast, but Brazil, whose great Amazon River has its source in the Andes. (Messerli and Ives, Chapter 7). In addition, 6% of the world’s energy and 15% of its electricity is produced from hydropower – water flowing out of mountains.

11. Mountains receive water from rainfall. Without the uplift of mountains, many clouds would not be forced to precipitate out their moisture. Rain falling in mountains is captured in glaciers, lakes, porous soils, and plant formations. These factors even out the flow over time and prevent or mitigate flooding, which would otherwise create problems of erosion and siltation. Initially, water is usually clean and potable and available for irrigation and drinking in downstream areas. However, various interventions are threatening these water sources. Increasingly, various forms of pollution, usually manmade from mining activities, land clearing, grazing, eco-

⁴ Enote, Jim, in *Sacred Mountains and Environmental Conservation: A Practitioner’s Worldshop*. The Mountain Institute, April, 1998.

⁵ Excluding the vast stores of fresh water in the polar ice caps. Little of the fresh water in polar ice will be available for human use due to its location. However, the glacial ice in arctic regions could become a significant factor in sea level rise due to global warming.

⁶ The Ganges, The Bhramiputra, The Yellow, and the Mekong Rivers being the largest.

tourism, and use of pesticides and fertilizers in upstream areas, is fouling the water and making it unsuitable for human consumption without additional treatment. Deforestation and road building contribute to increased run-off, siltation, and flooding. Many groups and countries are beginning to take action to preserve the purity and reliability of their water supplies from mountains.

Forests

12. A large portion of the world's forests grow in mountain areas. Due to steep slopes and remote locations, these forests have been less affected than lowland forests by logging and conversion to agricultural land. Mountains account for 38% of the world's forests and about 21% of all mountain areas remain in forests (28% of low mountains are in forests) compared to 23% in lowlands. However in developing countries, only 18% of mountains remain in forests, mostly in Eastern Europe and Central Asia. Many mountain countries and areas are consciously working to preserve their forests as a natural heritage. Bhutan has committed to keep at least 60% of its area in forest. China is committing to reversing deforestation in its remaining high forests, in part to reduce the large-scale flooding that has resulted from excessive deforestation in mountain areas. Costa Rica has passed strong legislation to preserve and protect its forests.

13. Mountains are increasingly becoming an important preserve of forest ecosystems and biodiversity. The large number of small eco zones over short distances contributes to the variety of species and genetic diversity. However, the more harsh and fragile climate of mountains means that when one of these areas is disrupted, it takes longer to recover, if it can at all. Switzerland has lost much of its mountain forest to early clearing, and it has not recovered. Threats to mountain forests stem primarily from more intense logging and from opening up areas to other uses. Building roads to mines or other locations creates access for logging or conversion to homes and other uses, and increases the danger of damaging forest fires. Homeowners in the United States are encroaching on National Parks, forests, and wilderness areas; and there has been increased opposition to controlled burning in the "red zones" of urban- wilderness interface areas. As a result, debris accumulates, and when ignited during drought periods, leads to more devastating fires than if controlled burns had been allowed in prior years. The US, in the summer of 2002 experienced its largest wildfires in over 100 years, almost entirely in mountain regions. Improved technology has also extended areas that can be logged. Even in a place as remote as the mountain forests of Solomon Islands, large areas once classified as 'unloggable' due to steep slopes are now being logged.

Table 3: Distribution of Mountain Areas and Forests by Region

Terrain Type	Total Area	Lowlands	Upland Plateaus	Low Mountains	High Mountains	All Mountains
OECD Countries						
Area of terrain type (km2), %total surface	31,367,932	15.4%	0.3%	5.4%	2.8%	8.5%
Area of forest per terrain type (km2), %total surface	8,567,611	4.1%	0.0%	1.6%	0.8%	2.5%
Percentage of terrain type in forests		26.4%	4.8%	30.3%	29.6%	29.0%
Europe and Central Asia						
Area of terrain type (km2), %total surface	23,940,841	11.6%	0.0%	5.0%	1.6%	6.6%
Area of forest per terrain type (km2), %total surface	6,717,459	3.2%	0.0%	1.6%	0.3%	1.9%
Percentage of terrain type in forests		27.4%	23.5%	32.7%	18.5%	29.3%
East Asia and Pacific						
Area of terrain type (km2), %total surface	16,080,927	3.6%	1.0%	3.1%	4.6%	8.7%
Area of forest per terrain type (km2), %total surface	3,084,562	0.8%	0.0%	1.2%	0.4%	1.5%
Percentage of terrain type in forests		22.5%	2.1%	37.9%	7.8%	17.8%
Middle East and North Africa						
Area of terrain type (km2), %total surface	10,570,856	5.1%	0.2%	1.4%	1.3%	2.9%
Area of forest per terrain type (km2), %total surface	179,601	0.0%	0.0%	0.0%	0.0%	0.1%
Percentage of terrain type in forests		0.9%	1.1%	3.3%	3.4%	3.2%
South Asia						
Area of terrain type (km2), %total surface	4,831,721	2.1%	0.0%	0.9%	0.7%	1.6%
Area of forest per terrain type (km2), %total surface	228,685	0.1%	0.0%	0.1%	0.0%	0.1%
Percentage of terrain type in forests		3.6%	1.0%	8.4%	3.8%	6.2%
Latin America and Caribbean						
Area of terrain type (km2), %total surface	20,356,212	9.5%	0.2%	3.3%	2.5%	6.0%
Area of forest per terrain type (km2), %total surface	7,158,055	3.9%	0.0%	1.0%	0.5%	1.5%
Percentage of terrain type in forests		41.1%	8.1%	31.0%	20.1%	25.8%
Sub-Saharan Africa						
Area of terrain type (km2), %total surface	24,198,529	11.5%	1.6%	3.0%	2.3%	6.9%
Area of forest per terrain type (km2), %total surface	3,628,937	1.9%	0.1%	0.5%	0.2%	0.8%
Percentage of terrain type in forests		16.8%	7.4%	16.1%	9.8%	12.0%
Developing countries						
Area of terrain type (km2), %total surface	99,979,085	43.4%	3.0%	16.7%	13.0%	32.7%
Area of forest per terrain type (km2), %total surface	20,997,300	9.9%	0.2%	4.4%	1.5%	6.0%
Percentage of terrain type in forests		22.9%	5.2%	26.6%	11.2%	18.5%
World						
Area of terrain type (km2), %total surface	131,347,017	58.8%	3.3%	22.0%	15.8%	41.2%
Area of forest per terrain type (km2), %total surface	29,564,911	14.0%	0.2%	6.1%	2.3%	8.5%
Percentage of terrain type in forests		23.8%	5.2%	27.5%	14.4%	20.7%
Source, World Bank						

14. Table 3 shows the distribution of forests in various parts of the world by mountain region. As noted above, globally 21% of mountain terrain is under forests, compared to 24% of lowland terrain. Because lowlands are larger in total area, their

total area in forests is half again as large as forests in mountains. However, rates of deforestation are higher in lowland areas, such as the Amazon and low areas of Indonesia, so the balance is shifting. Comparing developed and developing countries, developed countries have a larger share of lowland and particularly mountain land in forests. For OECD countries, 29% mountain land is in forest, compared to 20.7% for developing countries, and most of that is in Eastern Europe, Central Asia, and in Latin America. Some reforestation is happening in the developed countries, and may continue as their populations are expected to stabilize in the intermediate future. Developed countries, on the other hand are expected to add another 2 billion (40%) to their populations by 2050. This will add even more pressure on forest resources in mountains as well as lowlands.

Minerals

15. Mountains are a prime source of most minerals - precious and other metals, gems, construction materials (limestone, marble, etc.), and to a lesser extent coal. While specific data on output shares coming from mountains are not available, review of the location of mines shows a high concentration in mountainous areas. The data shown in Figures 2 illustrate that mines tend to follow mountain ranges. See Annex II for detailed maps of Africa, Asia, and Latin America that overlay mine locations on the mountain areas shown in figure 1. They are clustered in the Rocky Mountains and Appalachians in North America, in the Andes in South America, in the mountain areas of Northern and Southern Africa, in the Caucasuses in Western Asia, along the Annamite chain and the Pacific archipelago in Southeast Asia. Interestingly, the one major mountain area not yet cluttered with mines is the Himalaya. These mountains are - so far -- too high and remote and too far from markets to justify mine operations. However, China is expanding exploration in some areas on the northern side of the Himalayan range.

Figure 2: Location of Mines in the World

QuickTime™ and a
GIF decompressor
are needed to see this picture.

Source: US Bureau of Mines, World Bank, Note that the accuracy of data is much higher in the US than other continents, where only the larger mines are shown.

16. Mountains are natural locations to find many minerals. The tectonic movements that create mountains fold and force up minerals normally found deep below the earth's surface. They are closer to the surface and more easily accessible in mountains, so it is to be expected that most mining would occur there. Minerals are an important source of income for many mountain countries. Mineral exports account for 45% of the exports of Chile, 49% of those of Peru, 64% of Zambian exports, and 62% of those of Papua New Guinea. Mining tends to be highly localized compared to forestry, but its impacts often are more profound - both more widespread, and more enduring. The Grasberg gold and copper mine in Indonesia literally converted a huge mountain into a hole in the ground over a period of less than 20 years.

17. In addition to direct impacts, mining poses other threats to mountain environments. The roads required to bring equipment to mines and to extract ores disrupt large areas, contribute to erosion and open new areas for access. Mine operations can also cause significant impacts over larger environmental areas. Most extraction processes use toxic chemicals (e.g. cyanide, arsenic) that create poisonous run-off. Tailing ponds try to contain the toxins, but have been notorious in their frequent failures over time causing serious downstream damage to land, water and people.

Biodiversity

18. Mountains contain much of the world's biodiversity. UNESCO'S Man and Biosphere program aims to conserve the most critical of the Earth's ecosystems; and nearly half of its Biosphere reserves are in mountains. Conservation International has identified 20 "Hot Spots" where there is high endemic biodiversity and where this biodiversity is actively threatened. Half of these are in mountain areas. The varied

climate and geography of mountains contributes to this biodiversity. Also the relatively harsher climate encourages hardier varieties of common species. Pharmaceutical companies focus on prospecting in mountain areas, recognizing their potential for medicinal plant material. Both the pharmaceutical and cosmetic industries often prefer high altitude crops for the greater potency of active ingredients.

19. Various groups have tried to estimate the diversity of biodiversity in different areas and the extent of uniqueness or fragility. One of the most complete studies has been conducted by the World Wildlife Fund for Nature (WWF). Their exercise identified hundreds of specific eco-regions, which we have overlaid on altitude and ruggedness data corresponding to the mountain groups used in this study. Not all areas have been categorized, and somewhat less in mountains than lowlands. The results for distinctiveness, potential threat, and priority for ecosystems all show mountains disproportionately represented. They constitute about 40% of the critical biodiversity surface areas, and they rank higher in biodiversity indicators of both interest and threat, particularly in developing countries.

20. To the extent that incursions impact the fragile mountain environments, there is a threat of loss of biodiversity, with unknowable long-term impacts. For example, much of the world's corn crop was threatened recently by disease. A wild variety of corn resistant to that disease was discovered in a mountain valley in Mexico. It provided the disease-resistant genetic material that was cross-bred into commercial corn seed, saving much of the world's corn crop. That valley was flooded a few of years later when the dam downstream was completed, eliminating forever the natural habitat of that particular variety of corn. In the Andes, it has long been recognized that seed potatoes harvested from higher altitude are more disease-free, yielding healthier crops than seeds from lower elevations. There are many other cases of wild varieties of domesticated crops saving the domesticated version, reinforcing the importance of preserving biodiversity in mountains and other places.

Table 4: WWF Biodiversity Indicators for Mountain Areas

	% Area in Highest Classification		% Area in Second Highest Classification		% of area classified	
WWF Category	World	Developing countries	World	Developing countries	World	Developing countries
Biological Distinctiveness Index	46.7	50.0	44.6	44.3	59.0	57.1
Threat Index	44.2	51.5	42.7	46.3	37.6	29.3
Priority Status	52.5	52.3	41.2	44.2	58.8	56.9
Biological Distinctiveness Index (1-4 categories)	A biogeographic scale-dependent assessment of the biological importance of an ecoregion based on species richness, endemism, relative scarcity of biome, and rarity of ecological phenomena.					
Threat Index (1-3 categories)	An estimate of the future (10 year) cumulative impacts of all threats, specifically habitat conversion, habitat degradation, wildlife exploitation, and exotic species.					
Priority Status (1-5 categories)	The priority status of ecoregions for conservation action based on an integration of biological distinctiveness with future status.					
Source, WWF, World Bank						

Arable lands and unique crops

21. Mountains support a large number of people, despite difficult land conditions. Only a fraction of the land in mountains is arable, however. It is typically broken up into small plots and often requires extensive terracing. Mountain farmers have often preferred multiple small, dispersed plots, which enable them to plant many varieties of crops to take advantage of the varied growing situations and reduce their risks. Mountains are also the source of many valuable crops that do not grow as well or at all in lowlands. These include coffee, tea, many spices and fruits, herbs and medicinal plants. Mountain plants are sensitive indicators of climate change as well, and their range and dispersion are used to monitor adaptation to change.

Amenity values

22. Mountains are held sacred in many cultures, constituting a core source of spiritual and cultural heritage. While modern western culture places less spiritual values on mountains, they are still revered and sought as a source of recreation and rejuvenation. Mountains are the second most popular tourist destination after beaches. They offer unique adventures from climbing and rafting to skiing, simple hiking and relaxation. As the wild and pristine nature of mountain environments are diminished, even by too much tourism, this important amenity value is lost.

Mountain People and Their Conditions

23. Based on the definition of mountains outlined above, some 2.3 billion people live in mountain areas.⁷ This is 34% of the world's total population. About 1.4 billion -- more than half -- of these are in Low Mountain areas that include valleys and foothill areas near mountains, based on the resolution of the data. However, that leaves well over 800 million people in high plateaus and high mountains. The Upland Plateaus, which tend to be quite isolated and arid, have low population densities. Population densities in Low Mountain areas, however, are nearly as high as those in lowlands and about equal to the global average. High Mountain areas have somewhat lower population densities, but above those of the High Plateaus. These figures include populations of a few high mountain urban areas. See Table 1.

24. At various times in the past, the characteristics of mountains have generated increased political power and dominance for mountain communities. The natural resources (gold and silver) of mountains, the security provided by their geography, the strength of their warriors, their situation astride important trading routes, and the lack of a number of diseases contributed to their domination of lowland areas (Incas, Berbers, Tibetans, Mongolians). With the advent of the industrial revolution and modern economic structures, the relative advantages of mountains as centers of power have been eclipsed, and they have been marginalized. Extensive sedentary agriculture in lowlands, manufacturing based on economies of scale, easier

⁷ In these estimates the individual zones are based on mean altitude. Much of the population in high altitude zones is probably living in valleys. They are nonetheless affected by the isolation of these high relief areas and highly dependent on their immediate mountain surroundings.

transportation and trade, and the broader reach of common language and culture in lowland areas enabled them to grow much more rapidly than mountain areas in modern times, and become predominant. In nearly all parts of the world, mountain areas came to be regarded as backward if not feared, their people and cultures inferior, and their resources fair game to support lowland economies.

25. As a result, lowland governments often applied lowland-based institutions of governance and resource management to mountain regions, usually to the disadvantage of mountain people. Control of natural resources tended to be appropriated by governments or lowlanders, and mountain people became dependent on wages from the exploitation of the natural resources for their livelihoods, while the asset values and rents tended to be allocated elsewhere. These factors help explain why almost everywhere, mountain areas have a much greater incidence of poverty and lower levels of development. According to Fred Starr, "Poverty has long been a feature of life in many high altitude communities. But the poverty that prevails in many mountain areas today is of a peculiarly modern sort, in that it arises from a growing dependence on lowland metropolitan centers rather than from age-old self-sufficiency in a harsh environment."⁸

26. This concentration of people in such rugged areas has implications for their subsistence and the sustainability of mountain production systems. Moreover, caloric requirements increase with altitude, as more energy is required to live in colder climates and/or thinner atmosphere. In most mountain areas, there is more poverty, the people are more marginalized than are downstream populations, and there is a marked vertical gradient to poverty. One exception to this is the low mountain areas in some tropical regions, particularly in Africa and the terai, or middle hills of the Himalayas. Higher areas tend to offer more productive land and less exposure to diseases such as malaria and river blindness; and they benefit from high-value crops, such as tea and coffee that do not grow well at lower elevations.

27. Agricultural potential in mountains is limited by the small size of arable plots, climatic variability, and more difficult growing conditions, typically including shorter growing seasons due to altitude. Rugged terrain limits the potential for extensive agriculture with large-scale irrigation and mechanization -- factors which have greatly increased the productivity of lowland agriculture over the last century. These areas are unlikely to be as productive of basic food crops as lowland areas. Climate and geographic variations also require a larger variety of crops to be planted across more fragmented land areas in mountains, partly to reduce risks. While the average Andean peasant grows 40-50 varieties of potato in the course of a year, the International Potato Center has documented a number of cases of farmers who grow well over 100 varieties of potato and other tubers.

28. Mountain populations tend to be much more widely dispersed than in lowlands and live in small communities or settlements. Communications are often difficult in mountain areas and travel is time consuming. People tend to form local groups and clans, which are tight-knit and often suspicious of outsiders. Such fragmentation is

⁸⁸ Starr, 2002

often associated with language differences that further prevent mountain people from forming larger groups and cooperating in larger scale activities which are increasingly important to improve standards of living in the modern world. It is estimated, for example, that there are over 800 different languages in the mountain areas of Papua New Guinea.

29. Estimates of global poverty are improving, and the characteristics of poverty are becoming better understood.⁹ Led by the WDR 2003, efforts are only now beginning to understand the spatial dimensions of poverty, beyond the rural urban breakdown available in most countries. There are no systematic data on spatial distributions of poverty. Careful observation suggests that many mountain areas are disproportionately poor, from the Appalachians in the United States to the Amerindians in the Andes, to the inhabitants of the Pamirs and Caucuses in Asia. ILRI in Kenya has begun to do some mapping globally at a relatively low resolution, and mountain areas tend to be relatively high in poverty, though it is not possible to draw any strong conclusions. More detailed spatial analysis is now being undertaken in Latin America, and results will be available next year. Early analysis suggests that the correlation between mountain peoples and poverty will be upheld.

30. The Aga Khan Rural Support Programme has begun analysis of mountain poverty in Central Asia.¹⁰ They have found that the status of people in mountains reflects the overall level of income of the country. The higher the national income, the higher the income of mountain people. And in some areas and instances, mountain averages for some health indicators may be better than lowlands. But in most available within country studies, mountain people do less well than their lowland compatriots. Some exceptions exist in foothills and low mountains, which may have more healthy climates and access to the rest of the country. Isolated mountain areas still suffer more poverty.

31. Communications in mountain areas are much more difficult to provide. Roads are more expensive to build and maintain. They generally serve relatively fewer people per mile due to the dispersion of populations. Traditional electronic communications and power are hard to supply for similar reasons. Installation of the distribution network is more expensive and the users are more spread out, significantly raising costs per unit served. The recent advent of wireless communications and of distributed power sources (wind, solar, micro hydro) offer new opportunities to bring better services to isolated mountain areas. The question is, how rapidly they can be applied and at what cost?

32. The fragmentation in mountain areas makes it very difficult to provide basic social services such as education and health. In mountain areas, most people are far from clinics or schools. It is hard to achieve critical numbers of students for adequate teaching or locate adequate health services close to widely dispersed populations. Bhutan has made extensive efforts and done far better than average for small, low-income countries in terms income growth and human development indicators, but still

⁹ See the WDR 2000 on Poverty and the updated material in the WDR 2003.

¹⁰ Rasmussen, Stephen F. and Safdar Parvez, *Sustaining Mountain Economies: Sustainable Livelihoods and Poverty Alleviation*, 2002

more than half the population lives more than half a day's walk from the nearest paved road.¹¹ This makes it hard for those people to attend school or to get to health centers. As the modern world becomes more complex and interconnected, the relative isolation of mountain areas will become a greater burden.

33. The key to achieving sustainable and acceptable standards of living in mountains is improving local institutions to give local people more control over mountain assets and the means of negotiating more equitable allocations of their benefits. In part this will involve improving the provision of education and health services so that mountain people will be able to manage their assets better in the modern world.¹² This will in turn depend on building more equitable relations with the political institutions of the lowlands and assuring a more equitable distribution of public services. Such a rebalancing of economic and political power should be based on greater recognition of the importance of services mountains provide, and on the expanded role that mountain dwellers can play in assuring continued provision of these services. A certain degree of enlightened self-interest on the part of lowland institutions and well coordinated actions on the part of mountain people are required to achieve progress in this area.

Mountain Conflicts

34. Mountains are often seen as sacred places and locations for contemplation and repose. Unfortunately, in the real world, they are frequently sites of conflict and combat. More than half of wars and armed conflicts in recent decades have taken place in mountain regions, according to data maintained by the University of Hamburg's Unit for the Study of Wars. Many of these conflicts have been determined to be consequences of environmental changes linked to natural resource degradation, poverty, and related social and cultural strife (Libiszewski and Balcher, in Messerli and Ives, 1997). Ecological vulnerability inherent in mountain areas plays a major role; and this is exacerbated by competition for mineral reserves, biological resources, and water.

35. While often isolated physically, mountain peoples have gained enough information about the progress of lifestyles and standards of living in the rest of their countries and the world through modern communications and travel. They increasingly understand that many of their resources contribute to these high standards of living, that they receive little if any of the benefits from the use of their resources, and that too often they are harmed by the side effects of mining, logging or dams for hydro-power. These cases of exploitation and inequity contribute to violence and conflict in mountains and to incentives for mountain people to produce profitable, but illegal substances such as drugs, further contributing to violence. A

¹¹ And the paved roads available are rarely more than one and a half lanes wide.

¹² In improving education, it is important not to lose critical local knowledge and skills possessed by mountain people.

failure of governments to handle the mountain concerns in peaceful manners adds to the tension.¹³

¹³ Starr, 2002

36. Moreover, the inaccessibility of mountains makes them particularly attractive to use by guerrillas and terrorist groups, such as the Shining Path in Peru, the Maoists in Nepal, and more recently, the Al Qaeda network in Afghanistan, the Philippines, and elsewhere. Other factors that have been analyzed as contributory include ethnic and cultural conflicts related to niche settlement patterns in mountains; political and economic marginalization of mountain people; and hardship-driven migrations both to and from mountainous regions. Mountain ranges often form national boundaries, another factor that figures in the high incidence of conflicts.

CHAPTER II: Sustainability for Mountains and their Peoples

I can only speak of what I feel among mountains. It is very unpleasant. I cannot feel happy where I see everywhere weary men and their exhausting labour, which a harsh earth refuses to repay. The mountaineer who feels his trouble ...calls the plain "the good earth" and does not pretend to believe that the rocks he vainly moistens with his sweat is the better part allotted by Providence.

Chateaubriand in "A Journey to Mt.

Blanc"

What constitutes sustainability in mountains?

37. Arriving at a comprehensive definition of sustainability in mountains, particularly one that is universally accepted, is itself a mountainous task and not likely to be a productive effort. More useful is to identify areas that merit protection and the characteristics and attributes that contribute to sustainable use of mountain resources for human needs, broadly defined, and for alleviation of poverty. Then policies and other means of preserving and enhancing these characteristics can be identified and pursued in practical, results-oriented efforts.

38. Sustainability does not mean cessation of all change. Mountains are subject to continual natural change. They were created by massive forces, and violent upheaval -- earthquakes, tectonic plate movement, and volcanic action. And they are being torn down by natural forces of erosion and mass wasting. New species have evolved in mountains, and others have gone extinct. Despite their seeming power and dominance, mountain ecosystems are fragile, and can degrade rapidly in certain circumstances. Natural risks and hazards are unusually prevalent in mountain regions. In 1979, 17,000 people were buried within a few minutes in Yunquay, Peru by a massive landslide triggered by an off-shore earthquake. Soyuz Lake in Tajikistan was formed by an earthen dam created by mass wasting; creating a hazard that threatens downstream communities and contributes substantially to the drying of the Aral Sea. Mount St. Helen's in the U.S. Pacific Northwest erupted destroying thousands of acres of high quality forest cover; and volcanic eruptions from Mounts Etna in Italy, Pinatubo in the Philippines, La Soufriere in Guadeloupe, have forced evacuations and economic disruption, and in many cases tragic loss of life. There is little that can be done to affect these natural developments.

39. What are of concern to us are the impacts and changes due to human interventions, actions over which we can exercise some control. It is not possible to stop all change in mountains. Rather, the goals are to:

- ❖ better manage human introduced change so that it generates positive benefits for current and future mountain inhabitants, and for those living downstream;
- ❖ preserve and enhance the long-term value of resources in mountains;

- ❖ eliminate or minimize disruptive, damaging, and polluting aspects of human interventions; and most important
- ❖ assure that mountain dwellers receive full benefit from their mountain resources so poverty can be substantially reduced.

40. The extent of human impacts on mountains is large and varied. Forest conversion, mineral extraction, and hunting are local actions that have local impacts - changing water flows and increasing siltation, eliminating both animal and plant species, and increasing local risks of flooding and landslides. Global influences, such as climate warming, also affect mountains, leading to glacial retreat, rising tree lines, and species and ecosystem eradication that have local as well as transnational impacts. Other actions, such as creating national parks, help preserve mountain ecosystems and contribute to their sustainability.

41. The goal of both direct and indirect human interventions has generally been to generate income and contribute to overall economic growth. The questions are: who really benefits from these actions? What are the costs and who pays? And is it worth it to the long term interests of the society as a whole or just to some individuals? We are concerned with an integrated set of issues relating to the sustainability of mountain ecosystems, their production of important goods for human development, and the equity of allocation of benefits.

42. In looking at sustainability, it is important to recognize that there are several time spans to consider. Obviously, many occurrences in mountains take place in geological time, which is beyond our scope. But our concerns should extend over both short and long time spans from a human society point of view and take into account some of the potential long term consequences.¹⁴ Short-term impacts in this analysis would occur over the coming 20 years, medium term impacts over 20-50 years, and long-term impacts over a longer horizon, extending to centuries. In this time frame, it is important to recall that while fires, landslides, and erosion can wipe out large areas of forest and other ecosystems in a very short period of time, it takes 50-100 years for a forest to re-grow in mountainous areas, if it does so at all. Roads, mines, and other construction last 20-50 years and their impacts longer so the decision to undertake such activities has long-term implications.

43. For short-term impacts, we have seen deforestation in mountain areas lead to severe flooding in subsequent years, in the US Appalachians in the early part of the 1900s, in the early 1990s in Southeast Asia, in 1997 in China, and elsewhere. Mines in Papua New Guinea, Indonesia, Peru, the U.S and elsewhere have severely damaged downstream areas through toxic run-off within a few years of beginning operations. These threats to sustainability manifest themselves quickly, but remedial action takes a long time.

44. In the medium term, deforestation resulting in erosion and siltation can fill dams and shorten their useful life spans (e.g. the Aswan Dam in Egypt). In many

¹⁴ Certainly this time horizon should be longer than a human life span – covering the future of our societies and cultures. If the US can be worried about the impacts of storing nuclear wastes 10,000 years into the future, we can certainly look at the impacts of actions on mountains over the coming centuries.

parts of the world, deforestation in mountain areas has contributed to lasting changes in land productivity. Reservoirs behind dams in mountain areas displace people and lead to changes in ecosystems over the medium to longer term. Reservoirs may become centers of recreation and tourism. Roads have a similar impact, opening areas, increasing erosion, etc. It is important to remember that many infrastructure investments, while they take only a few years to build, last a lifetime. Their direct effects are important, as are the other activities that they induce.

45. It is often harder to determine the longer-term impacts, but evidence is available. Large areas of European mountain forests were cut centuries ago, and have not yet grown back due to changes in land use and soil loss. Mountain areas in Africa have been stripped of vegetation by agricultural development and overgrazing and are no longer capable of supporting sustainable livelihoods at current population levels and intensity of use. Glacial retreat due to global warming is likely to occur over a period of 50-100 years until nearly all mountain glaciers are melted. During this transition period, downstream flows are likely to increase, encouraging increased dependence on those flows, which will diminish rapidly once the glaciers are gone.¹⁵ Land conversion (deforestation) and species depletion and extinction can easily produce impacts spread over time spans longer than a normal human life, so impacts may not be perceptible.

46. Finally, it is important to recognize that some of these changes are irreversible. It is not possible to undo some changes and reverse the impacts that turn out to be undesirable. Some forest areas have not been able to regenerate, and those that do come back are different. Glaciers are not likely to reform, in a warmer world. Land and topsoil washed away in a flood may not be recovered. Land poisoned by toxic run-off may never become productive again. The fact of irreversibility means that the risks of degradation in mountain areas, perhaps more than elsewhere, have to be taken very seriously because their impacts will be felt both locally and by everyone living downstream.

47. Achieving environmental and human sustainability in mountains means finding ways to manage mountain resources and systems so that they can provide their critical goods and services indefinitely into the future. While we cannot predict exactly what the future will look like or what goods and services will be in demand, it is clear that mountains provide many essential goods that will be valued for a long time (water, timber, hydropower, minerals, etc.), and others that may increase in value. The opportunity cost of foreclosing the longer-term availability of renewable resources must also be taken into account. Since such future values cannot be known, conventional discounted present value calculations are not always feasible. Nor can such calculations account for irreversible losses of resources critical for human use. More broad-based judgments of values of the integrated mountain systems are needed.

48. The objective of promoting sustainability is not to stop change in mountains, but to manage mountain resources in ways that provide livelihoods for mountain

¹⁵ Without normal glacial functions of storing winter snows, there will be greater variability in water flows as well. – more runoff in winter and spring, less in summer and fall.

dwellers as well as the goods and services valued in lowland areas - and to do so in ways that protect the long-term capacity of mountains to continue to provide such goods and services. Clearly past experience suggests that management of mountain assets has not been entirely successful either for sustainability or for alleviating poverty and providing equitable political or economic benefits for mountain peoples. Innovative approaches incorporating more holistic methods will have to be applied.

Valuing sustainable mountain goods and services

49. People can be convinced to make the efforts to assure sustainability in mountains if they understand the value of doing so. Value can be expressed and understood in terms of economic or monetary value. It can also be understood in terms of social, cultural, or common property values. Economic values are the easiest to quantify and translate across different groups in the modern world, hence their prevalence. But they are often not the fundamental values of mountain people, who find more important values in their connections to place and the grandeur of the mountains themselves. These views have to be taken into account in valuing mountain goods and services. Understanding the complex set of values associated with mountains will be important in developing more effective methods of managing the "portfolio" of mountain assets.

50. Mountain goods and services provide value on several levels: local (within mountain communities), national (between mountains and related lowlands),¹⁶ and global (between mountain environments and the rest of the earth). Some of these goods have market prices when they can be converted into commodities or services that can be traded. Others provide benefits that are valued, but not priced in markets because they are not readily converted into tradable goods and services. When mountain goods and services were plentiful, they could be had for the taking, and no prices were needed. As they became scarce, various systems emerged to set prices and reap gains from that scarcity. Market based price systems are often the most effective ways to manage these resources, but not always, as we shall see below. For other mountain goods and services, appropriate mechanisms have yet to be developed to ensure their sustainable use and continued availability. Many of these goods and services are not readily converted into discrete items that can be priced in markets; but they have value for individuals, for communities, and for the functioning of economies. Management regimes may need to combine economic and social value systems to be effective in mountain areas.

Fresh water

51. Fresh water is perhaps the most important product of mountains for economic well-being. Mountains provide fresh water for over half the world's population directly. Not only is water provided, but it is usually clean and safe for human

¹⁶ Recognizing that often such natural ecological relations do span natural borders, which does complicate a number of issues.

consumption in its natural state.¹⁷ Mountain environments modulate the rate of flow of water between wet and dry seasons, and reduce siltation downstream.¹⁸

52. Clean and regular water flows are being increasingly recognized as a valuable service worth paying for. There are growing numbers of cases where the downstream users are finding ways to compensate upstream users to take actions that mitigate the negative downstream impacts. Innovative programs have been developed in both developed and developing countries to manage water resources from mountains in a more sustainable way by making use of community agreements and markets. Box 1 describes a recent experience in America of downstream users compensating upstream users to assure cleaner water. This kind of arrangement is also occurring in developing countries, as described in Box 2. Protecting water resources can be important for local use and for national consumption.

Box 1: New York City, USA: Watershed Agricultural Program

Failure to protect upland watersheds and forests of upland regions from run-off of dairy and other farms resulted in a serious threat to the water quality and quantity available to over ten million downstream users in New York City, USA. Residents were faced with the looming need for massive new investments in water treatment, estimated to cost over US\$ 6 billion. A partnership between New York City and the upstate farmers of the Catskill Mountains to protect 1,900 square miles of watershed from further degradation while allowing for the growth of upstate communities was signed in January 1997.

New York City agreed to fund \$35.2 million for farmers in the Catskills to purchase or build pollution abatement devices. Because success (and payment) depends on participation of at least 85% of the upland farmers, the program was designed to be voluntary, and to be run entirely by the farmers themselves. They meet as a decentralized, 21 member, democratically elected Watershed Agricultural Council to decide on priorities for allocation of the city funds. On average, a farm will receive \$75,000 for improvements such as cement manure pipes, fencing to improve cattle feeding, and riverside tree planting. Equally important, the sustainability of farming systems in the upland watershed has been enhanced, and long-standing distrust between upstate farmers and the city of New York is being replaced by new bonds of trust and understanding, leading to more equitable political decision making in other areas.

Source: The Mountain Institute. 1997.

¹⁷ Unfortunately all too often, other human activities contaminate normally fresh mountain water before it reaches downstream users – mine tailings, fertilizer runoff, etc.

¹⁸ Flow regulation per se is more important in local watersheds, where deforestation can increase the risk of severe flooding and landslides. Over larger watersheds, these effects are less pronounced as the effects of the increased runoff are spread over a larger area.

Box 2: Quito, Ecuador: Watershed Agricultural Program

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

In 1999, the water users of Quito through the municipal government and the hydroelectric companies agreed with private and state conservation organizations to create a fund that collects a water consumption fee from the water users to support environment-friendly land use practices and reforestation in the ecological reserves upstream. The goals of the program are to maintain stream flow and water quality and to protect biodiversity by a change in land use practices. The municipality and its partners collect the money and either undertakes compensation measures themselves or pay upstream land owners, who represent the third party at the scheme, for changing land use practices.

The Fund is managed by an asset management company; decisions are made by a Board of Directors, which is made up of representatives of the creators of the fund and private and public users of the watershed. The fee amounts are calculated based on the costs of patrolling the reserve. About 1 % of the revenue from hydropower generation and water use fees goes into the Fund. That small sum is used to maintain the upstream Cayambe-Coca and Antisana Ecological Reserves. It is planned to expand the program to the rest of the Condor Biosphere reserve and to determine the actual costs of water protection

Source: Maritta Koch-Weser & Walter Kahlenborn

Forests

53. Forests are probably the second most important good provided by mountains, with varying distributions across mountain regions. Timber is a mountain resource that is readily converted to a marketable commodity through logging, and it is at least notionally priced for its economic value. Since most logging is done in natural forests, little if anything is paid for the tree production costs, which should determine the minimum price, together with the costs of cutting, extraction, and processing.¹⁹ However, standing timber also provides valuable services - stabilizing water flow, protecting biodiversity, providing amenities, and generating other products.²⁰ Studies in a number of areas (California, New York City, Ecuador, Indonesia) have placed economic values on these services that often exceed the value of the timber extracted. Because many of these services are not traded, they lack market prices, and the timber extractors are not charged for destruction of these services, which are

¹⁹ In some cases, governments charge stumpage or royalty fees for cutting timber on public land (which constitutes a large part of mountain forests), but these are rarely based on the opportunity costs of the trees and rarely transferred back to forest dwellers. Few public or private owners practice sustainable forestry when natural forest is available. In Indonesia, recent reforms have required creation of more plantations for wood sources. In practice, most timber comes from natural forests, many of which are being illegally logged.

²⁰ In some cases, it is the extraction process - roads, slides, compacted loading areas - that contribute to the erosion, siltation, etc associated with logging. But that is part of the process and must be counted in estimating costs. Both process and extraction rates can be managed far more sustainably than is typically the case.

valuable to the public. See Box 3 where the service values have been evaluated as greater than the extraction values in Indonesia.

Box 3: Indonesia: Forest Valuation

Indonesia has established an extensive system of national parks to protect its environmental resources. To justify the maintenance of these parks, efforts have been undertaken to estimate the value of the services provided by the parks. In 1999, Conservation International sponsored a study of the Mt. Gede-Pangrango National Park located in central Java. This park is among the oldest in Indonesia and encompasses more than 15,000 ha. of forest reserve. It is surrounded by several hundred thousand ha. of buffer (production forests), transition (agriculture) and watershed zones that benefit from the services of the park.

Careful monetary estimates were made of the benefits provided by sound park management due to tourism, water supply for agriculture, water for household use, and sediment control. Benefits were also recognized but not measured for non-timber forest products, biodiversity, air quality, carbon sequestration, risk management, research and education, and existence or option values. The quantified benefits were compared to the costs of park management and the opportunity costs of foregone timber extraction in the park. The quantified benefits were nearly one and a half times the costs of management and foregone timbering. The total would have been even larger if the other benefits could have been quantified.

This exercise demonstrates that environmental services of an ecosystem can be very valuable in terms of improved production (water for rice, sediment control) and improved quality of life (water for households, tourism). However, in many cases, these services are not treated as market goods and sold, as for example timber would have been. Although the Mt. Gede-Pangrango National Park is not in danger of being exploited, the calculations demonstrate that for many unprotected areas, the benefits from timbering, which accrue to very few, are probably outweighed by the costs imposed through loss of water, sedimentation, etc. creating negative results and increasing local poverty.

Source: *Valuation of Mt. Gede-Pangrango National Park*, Conservation International (Indonesia), Natural Resource Management Program, 1999.

54. Timbering often disrupts local cultures and production patterns. It may provide short-term income at low wages for loggers, but as an area becomes logged out, the timber companies move on and leave the local people deprived of their logging wages and stripped of their traditional sources of livelihood in the now-depleted forests. This often leads to more destructive cutting of remaining wood, and conversion to other uses, which often are not sustainable. Unless forest dwellers control their own resources and gain the revenue from their exploitation, timber generally does not raise mountain incomes and often contributes to impoverishment of mountain people over the medium term. Almost always, it is the downstream exploiters who benefit, usually over the medium term until wood is depleted in a given area. Box 4 summarizes the experiences of West Virginia, USA. Similar examples can be found in Indonesia, Cameroon, and other mountain forest areas. In many if not most countries, timber concessions and licenses are granted by central governments, far from the sites where logging takes place. Mountain people whose

resources are destroyed lack political access and voice in these decisions. Yet the impact of such resource extraction affects them forever. Restoring forests in mountain areas can be a long-term proposition.

Box 4: West Virginia, USA: Resource Extraction and External Investment

In the mid nineteenth century, West Virginia comprised a nearly unbroken forest covering more than 15.5 million acres. Between 1880 and 1920, the state was almost completely deforested by absentee landowners abetted by a corrupt state government. The influence of large absentee landowners continues today both economically and politically. External capital is still employed to exploit natural resources. Almost none of the profits have been reinvested in improving conditions of mountain people, only in more exploitation. Once the forests were cleared, local West Virginians were left with a state ravaged by severe water pollution, flooding, fires, and landslides. Fish, game, and other non-timber forest resources important to family well-being were depleted or lost. Much of the employment in logging was temporary and transient, and opportunities were few after the timber was extracted. The expansion of coal mining offered additional employment opportunities, at further cost to the environment and local health.

Extractive industries, such as mining and timber, still provide employment opportunities within the state, but the advance of technology has eliminated many jobs previously performed by human labor. A major mountain-top removal coal mine employs only 70-90 workers in total, many from out of state. As of 1998, West Virginia ranked 50th in the nation in terms of median household income and 3rd in terms of the percent of population below the poverty line, with a rate of 17.8% as compared to the national average of 12.7%.

Source: US Census Bureau. <http://www.census.gov/statab/www/states/wv.txt> and Lewis, 1998.

Minerals

55. Minerals are another major good provided by mountains. Like timber, minerals are distributed unevenly among mountain areas and usually extracted by enterprises from outside mountain areas who gain access to the resource through licenses granted by decision-makers in lowland capitals, providing little or no payment to the mountain people affected. The payments of mining companies to governments are based on taxes and royalties (and sometimes on corruption as well) and are rarely returned to mountain areas. Ores enter markets once they are processed, converted to commodity metals, priced, and sold. The impacts of mining on local mountain areas are more localized than logging, but usually more intense. Tailings and run-off from mines can cause severe damage to nearby land and toxic pollution to water sources. The value of the lost clean water and health damage are rarely included in the costs of the mining company. See Box 5 for one of the most egregious examples. But such conflicts are not uncommon in mining areas.

Box 5: Indonesia: The Grasberg Mine

The Grasberg mine, located in eastern Indonesia, is the world's largest open-cut gold and copper mine. The mine is owned and operated by PT-Freeport Indonesia, with approximately 80% of the shares owned by Freeport McMoRan and 10% by the Indonesian government. Mineral rights were granted by the government to the mine with no recognition of the rights or livelihoods of the local people who had lived in the area for centuries and depended on its agricultural and animal resources for their livelihoods. The extensive mining practices destroyed many of their sources of livelihood and forced many, often entire villages, to relocate with little or no compensation. Neither locals nor environmental experts were consulted on how to run the mine to minimize social and environmental impacts. PT Freeport has been involved in grievous human rights violations, the death of local people, the destruction of local water quality and a sacred mountain, and serious long term environmental threats posed by mining activities. The local inhabitants, represented by LEMASA, the Amungme Tribal Council, have been vocal and insistent in protesting their treatment by PT-Freeport. After decades of protesting the company within Indonesia, the Amungme have brought their case for redress against the abuses of PT Freeport to New Orleans, Louisiana, the home of the parent company. In response to the change of power in Indonesia in combination with pressure from communities and activists, PT-Freeport has made some policy changes, although Amungme tribal leaders accuse Freeport of merely making policy without implementing it.

Source: Kennedy, D, 1998

56. Mining can offer employment to local people in mountains, but it is often highly dangerous and risky work. In many developing countries, mining towns are a major factor in spreading HIV/AIDS.²¹ The introduction of the mining economy severely disrupts traditional societies over relatively long periods and leaves only wasted lands when a mine is closed. An operator has no market incentive for remediation once the minerals are exhausted, unless regulatory systems are effectively enforced, with penalties for non-compliance. Local communities have often revolted against the exploitation of mining, and such cases are becoming more common.²² In some cases, protecting employment of miners is used as an argument for subsidies to mining activities, but the miners are rarely the real beneficiaries of such subsidies. In a few cases, as we shall describe below, enlightened mining companies and their partners have developed innovative approaches to deal with the environmental and social impacts of their activities.

Biodiversity

57. Biodiversity and amenity benefits are among the most widespread of mountain values, and among the most difficult to assign market prices. Although there are specific species (charismatic mega-fauna) that attract attention and other exotic species that have high value for collectors --despite CITES-- most biodiversity and amenity benefits stem from the integral functioning of mountain environmental systems. These integral systems also provide important and sustainable sources of

²¹ Miners typically are brought to the mine away from their families for several months or longer. Sex workers, often infected work the area. When the miners return home, they spread the disease.

²² One of the most striking cases is that of Bougainville in Papua New Guinea, where local opposition to the operation of a very large copper mine has forced its closing for many years, at considerable loss of income to the mining company, the islanders, and the government of PNG.

livelihood for mountain dwellers. Revenue may be earned from sustainable use of forests and other mountain products, sometimes from tourism and recreational uses, including parks that preserve the more healthy and satisfying environment of the mountains themselves, and those that provide sacred and inspirational value to local people or visitors.

58. Integral mountain systems have benefits of global value. Protecting biodiversity is important for preserving genomes for food crops, for developing new medicines, and for maintaining aesthetic values. Preserving mountain forests and related vegetation systems intact helps reduce the risk of landslides. Mountain forest areas can also be important for sequestration of CO₂. It is very difficult to translate these benefits and values into market prices and transactions, but there have been some promising initiatives. See Box 6. While there are often short and medium term aspects to these actions, they typically run over very long time frames, in which public interventions are more critical, as markets rarely function well with such horizons.

Box 6: Bolivia: The Noel Kempff Climate Action Project

The Noel Kempff Mercado National Park, Bolivia, covers over 1.5 million hectares in one of the most biologically diverse areas in the world. Since 1997, almost half of this area is managed through the *Noel Kempff Mercado Climate Action Project*, the largest forest-based carbon project in the world. Project participants include the Government of Bolivia, Fundación Amigos de la Naturaleza (FAN), the Nature Conservancy, and three U.S.-based energy companies. The project has been given \$9.6 million (U.S.) for the first 10 of 30 years, including a permanent endowment of \$1.5 million.

Project activities have contributed to biodiversity protection through park expansion, and improved soil, water, and air quality through the cessation of logging on two million acres of land. The most recent mid-term estimates indicated a potential net carbon benefit of 6-8 million metric tons of carbon over 30 years. Carbon offsets generated from this project are shared among the Government of Bolivia and the three energy company investors. In the case of the government offsets, proceeds are to be allocated to specified biodiversity priorities in Bolivia.

Local participation is emphasized in this project. FAN has hired approximately half of the park guards from the local communities and established revolving funds for microenterprises such as heart-of-palm plantings, to help take pressure off of the forest lands. In addition, the project is assisting the local communities in their efforts to attain legal status as indigenous peoples and to secure land tenure.

Carbon benefits from the project are expected to last in perpetuity, considering both that the site lies within the National Park and a permanent endowment has been established to fund protection activities beyond the 30-year life of the Project. Project developers have shown that logging concessionaires would have continued harvesting timber on the property and much of the land in the project site would have been cleared in the absence of the project.

Source: The Nature Conservancy, 2000

Common Pool Assets

59. Mountain goods and services are “common pool” assets. Trying to value mountain assets in conventional economic terms highlights their special characteristics. The most important mountain resources can be characterized as common pool assets.²³ By this we mean that the resources represent a large integrated system that benefits many different people in different ways. Trying to assign conventional private property rights to specific components and allowing unfettered exploitation of certain resources by private owners -- without due regard and compensation for the loss of other benefits -- results in sub-optimal results, and often serious losses to third parties.²⁴ Many mountain goods and services are part of, or the result of, interactive systemic relations. They cannot be separated from the fabric of the mountain ecological systems. Water management depends on the kinds of forest and ground cover, the extent of roads, the kinds of construction used on waterways, etc.

60. Similarly, protection of biodiversity depends on changes in land use, demands for rare and endangered species, competition for food sources and other factors. In this kind of environment, activities that extract resources have systemic effects. Logging can have major impacts on water flows and siltation. Mining can have an impact on downstream pollution. Roads built to take out those products can have a major impact on mountains, opening up areas to further settlement, increasing erosion, and degrading ecosystems.

61. As a result, management of mountain environments requires more elaborate consideration of secondary effects and their systematic impacts than is often the case in lowland areas. These common-pool assets are more effectively managed through community governance where various interested parties can express their view and joint benefits can be maximized. This kind of management of resources is not easy, but can be accomplished. Experiences in South Asia offer hope that such management arrangements can be worked out. See Boxes 7 and 8. It is particularly important in many mountain areas because of the complex and integrated nature of the ecosystems and the existence of multiple and spatially separated benefits and beneficiaries. As population pressures and scarcity increase, so will the disruptive pressures - unless there is better recognition of the need for community management.

Box 7: India: Community Forest Project in Madhya Pradesh

In the province of Madhya Pradesh, India, local communities (with financial support from the government and the World Bank) undertook a joint forest management project that included a transfer of timber harvest rights from the state to community management. Nearly half a million families now participate and receive 100 percent of the value of non-timber forest products (and revenues from sustainable harvest of the timber), estimated in total to be worth \$125 million per year, or about \$280 per household per year. Migration has declined, local investment has increased, and numerous environmental benefits have resulted. Some

²³ Ostrom, 1999

²⁴ The opposite possibility is the overexploitation discussed in the Tragedy of the Commons, where unfettered access to exhaustible resources also leads to degradation and dramatically sub optimal results.

5.5 million hectares of forests are being protected from grazing and unmanaged forest use. Villagers have reported an increase in the water table, as well as in wildlife populations and biodiversity. In this example, both the environment and local inhabitants have benefited

Source: Arnold, J.E.M. 1998,

Box 8: Nepal: Community Forest User Groups in the Makalu Barun Conservation Area

In 1978, the Government of Nepal embarked on a program to transfer limited property rights from previously nationally managed forestlands to community forest user groups. Within the Makalu Barun Conservation Area, the Mountain Institute aided the government to transfer 6,250 hectares of forestland from government control to 71 community user groups. Although the government still retains title to the land, the transfer of control gave locals a legal means to increase their revenue from natural resources.

In order to receive management authority, user groups were required to show that the forest resources would be sustainably managed. Before the change in ownership, local people paid a high price to the central government to use the forests. In addition, villagers had high incentives to illegally extract forest resources both due to lack of personal consequences and the nonactive stewardship role of the government. Consequentially, significant resource degradation as well as negative social repercussions occurred. Now the groups have the authority to decide on user fees, to collect fees, and to impose penalties for community members who violate management practices. As of 1996, more than 2000 households had been given stewardship rights and had received the revenue generated from these resources. The majority of user groups have generated funds that are being invested back into the community.

Challenges remain, however, because active management of community forests has led in some cases to increased populations of predators, hiding places for Maoist guerrillas, conflicts among users, and even increased pressure on more distant government-owned forests that are not so well protected. There is also a risk that community control empowers elites, leading to further marginalization of the poorest. These problems may abate when community forests produce enough to contribute more to local livelihoods, and when villagers receive additional training and assistance in forest management, such as appropriate mapping; but countervailing populations' pressures may offset these gains.

Source: The Mountain Institute, 1997. Baral, "Unintended Outcomes of Community Forestry in Nepal", 2002, Bhandary, 2002, Stevens, 2002, Timsina, "Empowerment *vis a vis* Marginalization" 2002. Upadhaya, "Greening the Hills" n.d.)

62. Mountain goods and services often have significant 'public goods' aspects. By this, we mean those goods and services that do not satisfy the criteria of private goods in that it is virtually impossible to exclude others from the benefits of a public good, and use of the public good does not reduce its availability for use by others.²⁵ Most of the beneficial environmental services provided by mountains - water management, biodiversity, weather modulation, cultural, recreational, and amenity values have important public good aspects. These are often mixed with private good aspects, which makes it more difficult to determine how to assign ownership and prices, and how best to manage them.

²⁵ Technically the terms are 'excludability' and 'rivalry'. A lighthouse is a classic example of a pure public good – once in place, no-one can be prevented from benefiting from it, and anyone's benefiting from it does not prevent another from benefiting. In mountains, scenic views have similar characteristics. In practice, many goods have some public and some private good characteristics, and the challenge is to manage the balance. Keith Bazanson, , and Francisco Sagasti, 2001

63. When population pressures and economic pressures are low, the degree of use of public goods does not often pose a sustainability problem. As pressures have increased, overuse and abuse of public goods becomes more of a problem. Depending on the circumstances, threats can result from degradation due to open access exploitation,²⁶ from insufficient protection of valuable mountain assets, and/or from improper pricing of the goods provided. In such cases, attempts to appropriate mountain resources for private use can diminish their benefits to others (e.g., diversion or pollution of upstream water, or disruption of scenic views).

64. These characteristics make it more difficult to assign normal economic values to mountain goods and services, even those goods that appear conventional once extracted. Many valuable services that could be marketed are lost in the process of producing some commodities. Furthermore, there are many values in mountains that simply are not represented in markets. Spiritual, cultural, and natural beauty values have to be considered on their own terms and weighed by all interested stakeholders in order to make informed and equitable decisions about the sustainable use of mountain resources.

65. It is particularly important to obtain recognition for community property rights in mountain areas and vest control in local institutions through the application of principles of subsidiarity.²⁷ Means of identifying and quantifying the value of economically and socially beneficial services provided by mountains will permit creation of appropriate institutional structures, and proper remuneration of mountain people for services, thus improving the quality of life in both mountain and lowland areas. Market mechanisms can be used in many instances, once the proper institutional framework is in place. Means of improving communications and trust between upland and lowland groups will be essential to progress in these areas.

66. There are other cases where government has tried to apply private property rights to community assets in mountains. This involves government action assigning rights to individuals and setting limits on the extent of those rights. Trading in those rights can then take place in a well regulated and managed legal framework, which does establish market values for the resource. These systems also have some drawbacks, but can function well, as the case of Chile and water rights in Box 9 illustrates.

²⁶ Note that open access is not the only alternative to private property. There are a variety of viable common property control and management systems, both traditional and modern, that can be effectively used. Ostrom's 1999.

²⁷ Other rural areas could also benefit from greater recognition of community property as well, but it is particularly important in mountains.



Box 9: Chile: Tradable Water Use Rights, a Full-cost Pricing Policy

Chile considers water to be a national resource, but it has developed a system where individuals are granted perpetual irreversible and freely tradable water use rights independent of land ownership and use. Water use rights are defined for a fixed quantity per unit of time and are awarded following application by a potential user. The government grants the water right provided that (a) the new water right does not impair existing rights and (b) the ecological requirement of minimum flow has not yet been reached by previous right allocations. Water use rights are granted free of charge and recorded in a national register. The granting authority reserves the right to restrict water consumption in times of water shortage.

Downstream owners of water rights are entitled to a percentage share of the river flow but no protection against reduction of downstream flows due to increases in upstream use. While owners of consumptive rights (e.g. irrigation) have no specified obligation with regard to quality or quantity of return flows, owners of non-consumptive rights (e.g. hydropower and recreation) are required to return the same quantity and quality of water. The distribution of water, according to existing property rights, is organized by water users associations under the control of the general director. The water users associations are also responsible for maintaining the irrigation infrastructure.

By defining limits on the water rights, the government has established the rivalry and excludability needed for market transactions to work. Water rights are freely tradable and the market for water rights is quite active. Seasonal water rentals are particularly frequent within the agricultural sector. Farmers also sell or lease water rights to water supply utilities who often find such purchases a significantly less costly source than the development of new sources of supply for urban and industrial use. Individual negotiations determine the price of each transaction.

The benefit of having tradable water rights in Chile is that water scarcity and therefore water use is regulated through the market. Water users receive a price signal indicating the highest value of water on the market, thereby creating incentives to sell the water rights to the individual who places the highest value on it. On the other hand, these unregulated water markets may fail to include the costs to society for impacting on water quality changes, return flows, and watershed protection, and could potentially benefit from policies which reward watershed protection measures.

Source: TMI, "Investing in Mountains" 1997

67. It is clear that there is no one-size-fits-all approach. Different methods will have to be used in different areas and adapted to local circumstances. However, it is possible to identify a well defined range of possible situations and appropriate solutions as a starting point for local adaptation. This will be addressed in the next section

CHAPTER III:

A Framework for Managing Resources and Poverty Alleviation in Mountains

Thousands of tired, nerve shaken, over civilized people are beginning to find that going to the mountains is going home; that wilderness is a necessity; and that mountain parks and reservations are useful not only as fountains of timber and irrigating rivers, but as fountains of life.

John Muir, 1898

Variety of resources in mountains

68. Mountain environments and the well-being of mountain populations vary tremendously depending on natural and community resources, knowledge, access to lowland markets, the relative development of the national economy, voice in national decision-making, and valuation of mountain goods and services by the rest of the country and the world. The pictures in Figure 3 illustrate the extreme situations mountain people experience as a function of these factors – and the dramatic impact that linkages with markets can have.

69. In the first photo, well-fed cows are thriving in their European Alpine pastures. In the second, a gaunt Ethiopian farmer and his cattle are barely surviving. The stark difference between the life circumstances of farmers in these areas has been documented over the years by the work of Swiss scholars Bruno Messerli and Hans Hurni. It reflects differences between the respective natural resource endowments of rich and poor mountain regions, knowledge about how to develop it, access to markets, and general support from the rest of the nation. In the Alps, mountain areas have been maintained to assure their productivity; farmers have access to modern technology; and they have substantial political and financial support (subsidies) from the national government. There is strong popular support in France, Switzerland and other Alpine countries to maintain the rural mountain culture, which is seen as intrinsic to national identity. Such choices are not restricted to rich countries. Bhutan, a low income, landlocked mountain country in Asia has made similar choices to maintain its traditional mountain culture even when this involves sacrificing some short-term economic opportunities.²⁸

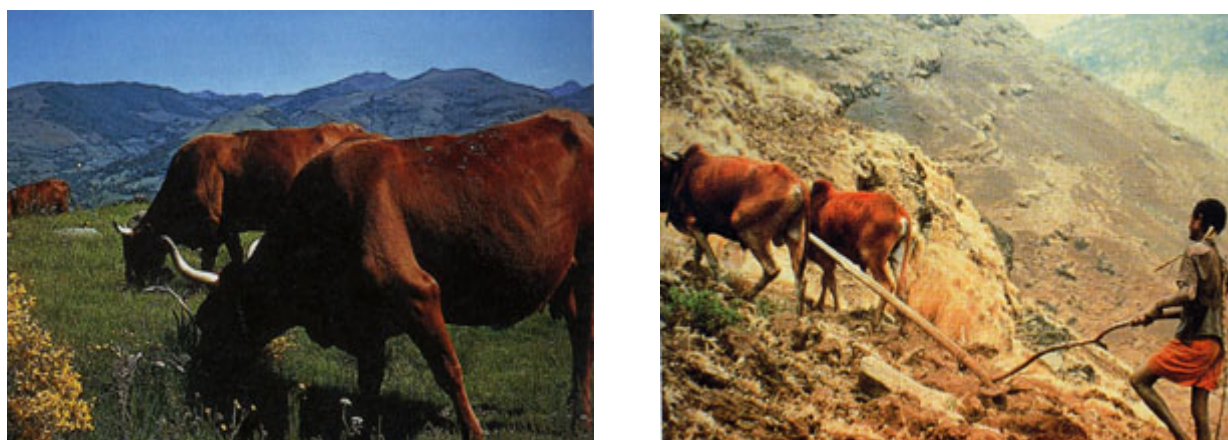
70. In the Ethiopian case, mountain resources have been depleted by overpopulation, little technical progress, and poor management. Incomes levels are lower than a generation ago, and there are few prospects for progress in the near future. Ethnic differences and general national poverty mean that there are no surplus national resources to support mountain cultures. Such relative poverty is not

²⁸ Despite advice from many development experts, including parts of the World Bank, it has decided to severely limit logging and forego the benefits for timber sales – preferring to establish a goal of keeping over 60% of the country in forest.

unique to developing countries. West Virginia, the Mountain State of the US ranks at the bottom of most income and human welfare indicators in the United States.

71. For rural populations everywhere, but particularly for mountain areas, natural resource endowment -- sometimes called natural capital-- provides the critical wherewithal for livelihoods. Complex social and environmental regimes support the maintenance of these mountain socio-economic systems, involving an intricate web of legal, economic, social, cultural, and often religious factors. In such systems, both incentives and sanctions ensure that the natural resource base is maintained for present and future generations.

Figure 3: Farming in the Ethiopian Highlands and the Alps



Photos by M. O. Ratouis and Hans Hurni.

72. Where highland producers have access to markets for high value added products, or where they receive transfer payments or premium prices from lowland markets in return for environmental services, such connections help mountain communities achieve a good quality of life. The absence of one or another of these factors creates special problems for conservation, and for poverty reduction and sustainable development in mountains. The pressures of expanding populations and demands for resources to fuel growth add tremendous stress to mountain ecosystems and threaten to make the Ethiopian example more common than the Swiss. Appropriate location-specific and issues-specific management of mountain assets and provision of adequate social welfare are needed to reverse this trend.

Characteristics of Mountain Resources

73. Approaches to sustainable development must be locally adapted. Nowhere is this truer than in mountains, where variations of altitude, rainfall, insolation, temperature, soil, vegetation and other factors create myriad micro-climates. Replication of "best practices" must take account of the exceptionally high variability of mountain ecosystems and cultures. Nevertheless, it is possible to construct a framework for assessing different mountain areas and circumstances in order to help

design the best approaches to contribute to sustainable development and poverty alleviation.

74. The analysis of a mountainous area can begin with determination of the resource base available. Mountain resources need to be looked at both for their ability to support human well-being and for their importance in providing environmental services. While the particular aspects of support in either case are highly site specific, we can identify two broad categories for our framework:

- ❖ Resources whose economic value depends on their being extracted and exported as commodities to the lowlands.
- ❖ Resources whose economic or aesthetic value to local and downstream beneficiaries results from the environmental services rendered by remaining as intact mountain ecosystems.

For analytic simplicity, we will consider the exportable and in-place resource values as separable attributes characterizing a given region.

75. Extractive Export Resources²⁹ consist of commercially traded resources that have economic value when they are removed from the mountains, converted to commodities, and sold. The vast majority of the demand and value of these products derives from usage outside of the mountain areas.³⁰ Hydropower, timber, mining (including minerals, gems, and building materials), and rare species are the best-known examples of such resources. These resources are typically exploited by representatives of the lowland or foreign beneficiaries who generally reap the bulk of the profits from the mountains' resources. Exploiters usually can gain property rights to the mountain resources from national governments who claim rights to all natural resources, and who benefit from rents from access to these resources. In most situations, mountain people do not benefit from their own natural resources, hence the high degree of poverty in many mountain regions. A special case of extractive export resources is the terrible trade in human beings, particularly women and girls, which is disproportionately prevalent in mountain regions throughout Asia. The isolation of such areas and the lack of access to normal social services contribute to misleading local people, who are too often convinced by false promises made by perpetrators of the illegal trade.

76. In-situ (or in-place) Resources refers to the value of a region's natural resource endowment that results from their existence and functioning *in situ*. Such natural resource values cover a broad range: biodiversity, maintenance of watersheds, traditional knowledge and production systems, environmental amenities such as clean air, pristine nature, and clean water, aesthetic and inspirational value, and the powerful appeal of all of these for tourism and construction of vacation homes. The service and amenity values of these resources largely depend on the recognized benefits conferred on downstream dwellers, who for most of history have taken these services for granted as a public good, who at most reside in the mountains only

²⁹ Export is used in the sense of exporting from mountain areas, even if the goods remain within the country, as is often the case.

³⁰ Mountain communities may use small quantities of these resources, but large-scale extraction with attendant impacts on the environment depends on export markets.

temporarily, and who do not make their living there.³¹ Only recently has the growing scarcity of some of these goods led people to place economic value on them. Even so, many believe they have “acquired rights” to such services, and are reluctant to pay for what was once free. The higher the appreciation of these services and the higher the income levels of downstream inhabitants, the greater economic value likely to be assigned to these services, and the greater the potential for viable economic transactions to help preserve these environmental services. For convenience, we group *in-situ* resources into four categories:

- ❖ *Environmental Services.* The range of environmental services provided by mountains is exceptional. Mountains are the source of fresh water for over half of the world’s population. Undisturbed, mountain streams provide clean water, reducing the need for expensive water treatment. Mountain ecosystems also provide carbon sequestration from intact and regenerating vegetative cover, risk abatement through mitigation of landslides and other hazards, and modulation of weather regimes on which current patterns of development are based.³²
- ❖ *Biodiversity:* Over half of the Earth’s biodiversity ‘hot spots’ are in mountains. The variety of mountain ecosystems creates rich but fragile biodiversity that is important for long-term sustainability, as well as providing a rich source of medicinal plants, important for both local communities and downstream populations.
- ❖ *Local Production Systems and Traditional Knowledge.* Mountain cultures have co-evolved over long periods with the ecosystems in which they exist, leading to development of detailed indigenous knowledge systems, local stewardship of timber and non-timber forest products, high altitude production systems, specialized food and craft products, and knowledge of medicinal and other properties of plants. Maintenance of such systems is critical to the sustainability of local mountain communities, who are the stewards of upland resources. It is also critical to continued availability of specialized products that are highly valued by lowland populations.³³ In addition, these traditional knowledge systems have developed valuable lessons and models of sustainability that can be shared with the international community.
- ❖ *Amenity Values.* Globally, Mountains are the second most popular destination for tourism, which generates income for mountain dwellers and provides incentives to preserve the features of mountains. Mass tourism, however, often increases environmental degradation more than it benefits local

³¹ Some, such as local flood control and the beauty of mountains also accrue to those living in mountains, and they are keen to protect these values. However, it is not often they have the resources to protect them without assistance from downstream beneficiaries as well, especially when threats come from outsiders.

³² Costanza, R. et.al. 1997, in *The Value of the World’s Ecosystem Services and Natural Capital*, have estimated that the total value of environmental goods and services exceeds total global GDP. While the actual value is hard to estimate, it is large.

³³ For example, it has been discovered recently that dairy products produced by cows grazing in high altitude pastures is significantly lower in cholesterol and higher in omega-3 fatty acids than dairy products from herds grazing at lower altitudes. Such products may be significant for the health and life of certain at-risk consumers.

economies.³⁴ Extensive visitation can reduce the amenity values that attract tourists in the first place. Recreational, aesthetic, sacred and inspirational values and the desire to experience nature in a pristine state are strong factors in the exceptionally high amenity value of mountain regions.

77. In reality, of course, these characteristics cannot be easily separated in any mountain area. There are often competitive demands on mountain resources – increased resource extraction reduces the extent and value of in-place services, or preserving in-place services may reduce what can be exported. Furthermore, the relative value placed on these resources depends on the tastes and technology of the rest of the world's economy. The values of export commodities are determined by world markets, and often by the tastes and income levels of the developed countries. The values of in-place services are usually determined by the tastes and income levels of the local downstream users.³⁵ In developing countries, this creates a bias for export that may or may not be justified, depending on the use of the proceeds of the exports and calculation of the in-place values.³⁶ However, even in developing countries, *in situ* values may exceed export values, as was demonstrated in the Indonesia case in Box 3.

Access to Mountain Resources

78. The economic value of mountain resources, whether export commodities or in-place services, is greatly affected by differences in market access. However, the correlations are not always clear or easy to predict. Easy access to markets makes exports easier, but it may also result in a higher value for in-place services. This happens, for example, when transportation provides better access for tourists to come to mountain resorts, increasing pressure for maintenance of amenity values. On the other hand, lack of access to markets may help preserve in-place services, but the resulting isolation may make it more difficult to provide basic services to mountain populations, and to alleviate poverty. This lack of systematic linkage between access and economic development make it difficult to generalize. It also suggests that this is an area where the choices of decision-makers can have significant impact. Access to markets consists of three complementary elements:

- ❖ transportation infrastructure linking mountain areas to markets;
- ❖ appropriate technology available to mountain people for communications (wireless telecom), energy (solar power, mini-hydro), and knowledge (distance learning, internet access); and

³⁴ Godde, Pamela, (ed.) 1998.

³⁵ For some services, such as high-end ecotourism, values in developing countries may be determined by adventurers in wealthy societies – e.g. trekking in Nepal and climbing Mt. Everest.

³⁶ To be correct, local values should be calculated on a purchasing power parity basis to begin to be comparable with export values. In practice, however, local markets would be based on actual price comparisons at current exchange rates, which would put a premium on exports, and which in turn raises equity issues.

- ❖ institutions to improve the sustainable management of mountain resources, including participatory governance, application of market mechanisms to a broader range of mountain goods and services, and appropriate regulatory and fiscal interventions.

79. Physical access to mountain areas is a function of proximity to lowland areas and the quality of transportation infrastructure in place. The more populated and the higher the income of the nearby lowland areas, and the greater the amenity values of the mountain range, the greater will be the access to markets and the potential for stronger interactions. These can either increase demand for exports of mountain goods, or the demand for in-place services, or some combination of both. On the other hand, greater distance, more rugged terrain, and lower amenity values are likely to further separate highlands from lowlands, reducing physical access and access to markets. Many of these factors change over time and are affected by the evolution of technology, policies, and institutional innovations. Lowland tastes and technology may change as well, which can increase or reduce the demand for mountain resources. Higher incomes are likely to increase the demands for and relative valuation put upon in-place services. Migration in and out of mountains is likely to increase access.³⁷ Conflicts and illicit activity reduce conventional interactions, such as happened with the Shining Path in Peru, the Maoists in Nepal, or the drug dealers in the Golden Triangle.

Matrix for mountain resources

80. To facilitate the analysis, we have constructed a simple matrix to illustrate different situations with respect to resource endowment of a given locale. Richness in extractive export resources are measured on the vertical axis, and richness in *in-situ* resources values are measured along the horizontal axis. This results in four quadrants, characterizing the most fundamental situations of mountains.³⁸ See Figure 4.

Figure 4: Mountain Resources

Export Resources	High Export, Low <i>In Situ</i> value	High Exports, High <i>In Situ</i> values

³⁷ However, too much migration of lowlanders into mountains (for recreation, resort, and retirement activities) may displace indigenous mountain dwellers. E.g. Aspen, Colorado and other resort developments.

³⁸ This could also be constructed in three dimensions where access to markets is measured on a third axis. However for ease of presentation, we will consider access as a separate mediating variable.

	Low Export, Low <i>In Situ</i> value	Low Export Value High <i>In Situ</i> Value,
<i>In Situ</i> Resources →		

81. Using this matrix, we can identify the key characteristics of each quadrant, present examples, and then suggest the kinds of policies that would be most appropriate to enhance sustainability and alleviate poverty in an equitable fashion. This will simplify and facilitate policy dialogue and implementation. Of course, individual mountain areas will fall at various places within a quadrant, depending on the relative value of different resources. But this framework will help identify the critical issues in each area; understand the most appropriate policies, management, and institutional approaches; and help in resolving outstanding problems.

82. It is relatively simple to see that the most intractable problems of sustainability are likely to arise in the “Low-Low” (low economic and low environmental value) and the “High-High” (high economic and high environmental value) quadrants. The Low-Low case represents the most extreme form of mountain marginality. There is little incentive for market interests to go to such areas, and the people are most likely to be poor due to lack of resources and contact with the rest of the world. The High-High case represents the archetypical case of conflict and competition for mountain resources. Without careful management of both types of resources and reasonable compromise, sustainability is truly at risk. The cases of High export resources and Low in-situ resources (High -Low) and Low export resources and High in-situ resources (Low-High) are likely to be more manageable with application of conventional approaches due to less conflict over sustainability objectives. Nevertheless, they require careful management to ensure both sustainability of the natural resource base and adequate livelihoods for mountain people.

Low value economic resources and low value *in situ* environmental resources requires welfare payments to reduce poverty: The ‘low-low’ case

Primary characteristics

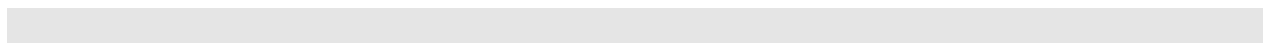
83. Poverty is pervasive in these areas. They are poor in resources that can directly sustain local populations or that can be marketed. And they are of low concern for environmental conservation issues. Mountain areas, such as in Central Asia, and Upland Plateau areas, such as the Puna region of the southern Andes and the western Tibetan highlands of the Himalayas, are characteristic of these Low-Low cases. While they may be the source of critical water supplies, they do not benefit

from economic connectedness to affected downstream communities. Mountain populations in these regions are likely to be ethnically and culturally isolated from nearby lowlands as well; and they often are nomadic due to the difficulty of sustaining a livelihood from sedentary agriculture, further adding to isolation. Institutions in these areas are typically weak, beyond local clans.

84. People in these areas are particularly vulnerable to the fact that caloric requirements of living at higher altitudes are greater, while agricultural production is decreased due to altitudinal conditions. These mountain areas are frequently characterized by environmental degradation. This may have been due to excessive population pressure, limited resources, or migration from nearby lowland areas that depleted or exhausted fragile resources.

85. The primary challenge in these areas is survival and basic poverty alleviation. The cost of providing public services and poverty alleviation is high. There is little immediate benefit from improving living standards in these areas beyond helping the local people and preserving precious traditional cultures and knowledge. Competition can be intense for the sparse resources that are available, and this may make developing a coherent program difficult, particularly if there are ethnic or cultural differences between or within communities in the isolated mountain areas, or between these communities and those in the lowland centers of wealth and power.

86. Improving communication systems for people in these areas can have a major positive impact it is allow them to gain access to information that can improve their livelihoods and to markets for their goods. Experience has shown that when isolated people can find out market prices for their products, they can avoid being cheated by middlemen and make a better living. They can also obtain important inputs for their production. Better communications can also help solve simple, but critical problems, as Box 10 demonstrates.



Box 10: Information Technology and Institutional Capacity Help Overcome Lack of Access

In 1997, a Peace Corps worker in a remote region of Nepal asked the then recently created Mountain Forum for help. He was training Peace Corps Volunteers working in natural resource positions, and they were confronting a serious problem. Red and white stem borers were attacking Arabica coffee crops; but since coffee was still new in Nepal, the country lacked the infrastructure of research and extension services available to other coffee growing countries. Since email access was not yet available, Chris Morrow faxed his request to the Global Node of the Mountain Forum, hosted by The Mountain Institute. TMI posted the query to the Mountain Forum, and the International Potato Center (CIP)'s Latin America/Caribbean node manager translated it into Spanish and posted it to the regional network. Responses came back immediately from CIP and FAO; and the much-needed information was faxed back to Nepal by TMI.

Source: TMI

87. It is interesting to note that a few areas in this quadrant are characterized by urban agglomerations, such as Mexico City, La Paz, or Lhasa. These were important historical centers when there were more advantages to living in mountains, and they have retained their importance over time. They are, however, highly or entirely dependent on their hinterlands for resources and incomes. They are important economic centers because of their concentration of political power, not due to any natural resources. And they typically have very good communications with their supporting lowlands.

88. Urban concentrations at high altitudes impose a heavy burden on their local environment, such as water depletion and air pollution, and they draw on resources of the rest of the country. In these areas, there is little left to preserve of the original environment, and decisions will be made primarily on the needs of the local populations. Moreover, improving general environmental conditions is important for improving living conditions for the urban poor. These areas are somewhat anomalous in that they are centers of prosperity in regions poor in natural resources. However, they also illustrate how access to markets, creation of productive activities, and net transfers of resources from other parts of the country can reduce poverty in low-low mountain areas. These areas still present challenges to environmental sustainability.

Policy Responses

89. Most low-low areas whether urbanized or not, do not have enough resources to sustain their populations and improve their living conditions. External support is needed. Explicit decisions need to be made to improve the conditions of people living in these areas. Providing health and education services are critical, as are supplying enough infrastructure to support better standards of living. Improving communications, using satellite linkages and solar power for connectivity, can be a cost-effective means of providing access to education and information, as we have seen in the example of the Mountain Forum cited above.

90. Initially, and perhaps over a longer term, this will involve net transfers from the rest of the country to the low-low mountain areas. Whether or not such transfers

are made usually depends on whether the mountain area can generate sufficient political access and voice. Even where political power is lacking, however, such support should be justified on equity grounds and may be required indefinitely. Where continuing welfare transfers is not sustainable, additional efforts should be undertaken to improve productivity in these mountain areas. Institutional reforms to improve governance, greater cooperation with other areas, and economic reform to increase access to markets are all important.

91. While these basic social services are noted here, for the low-low case, we want to emphasize that these minimum levels of services are essential in all mountain areas. They can be provided in innovative, and cost-effective ways, and their availability should be absolutely ensured by governments, supported by NGOs and bilateral and multilateral donors.

92. In areas where access to markets and technology can be enhanced, it may be possible to develop environmentally benign income generating activities in manufacturing and services. These programs would have to be carefully designed to protect what resources are there, and to prevent degradation. These programs should be aimed at developing better opportunities for the local poor. The Zuni native Americans live in a Low-Low region, but maintain a rich cultural tradition and make a reasonable living through sophisticated traditional knowledge of agricultural production, supplemented by selling their beautiful jewelry and other crafts in nearby affluent markets. Tibetans make equally impressive jewelry and crafts, but do not have an affluent market nearby. Establishing such relationships to generate income is likely to involve substantial institutional development, increased participation and voice of local communities, and more secure local control of natural resources.

93. Improving management of environmental services, such as water, can also be linked to developing market-based programs that pay local people for resource stewardship. Where mountain communities have access and control over the causes of the problems, this can help to prevent downstream damage. Payments based on stewardship services are not likely to be significant in these low-low areas, but they are areas with low, not zero, resources. Special efforts may be needed to determine what value exists in local natural assets and to help communities develop them in a sustainable manner.

94. If the main source of environmental degradation is exploitation of the meager remaining environmental resources, it will require stronger programs to involve local people in taking better care of their own environment, largely through enhanced training and mutually agreed guidelines. The potential for developing income generating activities and environmental services depends on developing strong institutions and appropriate relations with downstream markets and beneficiaries. Often, learning exchanges among people living in these regions is an effective means of support.

95. In some cases, it may be possible for an area to move from low to high natural resource value. The extreme harshness of the western portions of Tibet Autonomous Region of China, for example, makes its biodiversity value relatively low, and its isolation reduces the value of other environmental resources. However, the critical

role of this Himalayan area as the source of many of the world's great rivers, its mineral potential, and its cultural importance as the original home of Tibetan Buddhism are increasing recognized by key agents in these markets. With increasing access to markets and links to the rest of the world, it is shifting gradually from low to high natural resource value for both exports and *in-situ* benefits. This is a demonstration of how increased access and changing preferences of lowland markets can change the valuation of a mountain area.

96. Can other low-low areas, such as Mongolia or the Puna region of the Andes make a similar transition to improve local incomes by promoting changes in market perceptions for such things as high-end eco-tourism? That depends on local communities dissatisfaction with their current standards of living, their institutional capacity, the support they receive for their governments, their ability to gain access to new markets, and the extent to which they are willing to trade the integrity of their traditional culture for the mixed blessings of higher incomes. Downstream areas can significantly influence the outcomes too, as they may place a higher value on the resources from nearby mountains, or such areas may become valued due to their location, such as the potential value of the Pamirs or Caucuses as an export pathway for oil. Changing valuation is not an unmitigated blessing. As the region moves into another quadrant, it will face a different set of challenges and problems

97. Finally, in those areas where there are high population concentrations, particular attention must be directed toward protecting against severe environmental degradation, in addition to normal policies to address poverty issues. This involves control of pollution, ensuring adequate and safe water supply, and managing population expansion. Providing clean air and water will depend on applying best available technology wherever possible, imposing pollution control regulations, and undoubtedly passing on the costs to the bulk of the population through higher prices, taxes, or user fees. Care should be taken not to adversely impact the poor in these programs.

High economic export values, Low *in situ* environmental services value requires careful management of resource extraction: The 'high-low' case

Primary characteristics

98. These areas contain valuable exportable commodities, while their in-place environmental services are of relatively low value. Many of these areas are found in the Low Mountain areas and to a lesser extent in the middle levels of the High Mountain areas. The major exportable commodities are timber, minerals, and hydropower. With lower *in-situ* values, the potential for conflict among priorities for conservation and use is less severe; but resource extraction invariably entails serious challenges to protect the environment and local communities from pollution and degradation, and to assure that local people realize a fair income and long-term opportunities from the exploitation of mountain resources. Where these resources are accessible to markets or can be made so with appropriate infrastructure

investments, the value of resources can be realized. The challenge is to achieve the appropriate allocation of benefits and sustainable protection of the environment.

99. The issues relating to each type of product are different. For timber extraction, the operations often provide employment for a number of local inhabitants, though the sustainability of these livelihoods depends on the extent of the timber concessions and the country's reforestation policies. With proper reforestation and management, logging can be a sustainable enterprise, as demonstrated in Box 7 on India and Box 8 on Nepal. More frequently in developing countries, however, logging is carried out as a clear cutting operation. Employment is not long lasting in that case, and the clear cut land in mountain areas is particularly vulnerable to erosion and degradation. Unlike lowland forests, where land is often converted to agriculture, deforested mountain areas are difficult-to-impossible to convert for sustainable timber production or for other uses. Reforestation, if it occurs, usually takes a long time due to the more difficult growing conditions in mountains. These kinds of operations pose a real threat to both environmental and social sustainability.

100. Unlike timbering, mining activities are inherently unsustainable. Although modern extraction techniques allow obtaining minerals from lower quality ores -- a mixed blessing in terms of the additional slag and tailings created -- eventually the mineral resource will be exhausted. Mining permanently disrupts the environment and does not provide sustainable employment for local people, to the extent that they are hired at all.³⁹ Mine operations also typically produce tailings that may be toxic over a wide area. While attempts are made to control these pollutants, they pose a threat to the environment, both locally and downstream. These adverse impacts must be managed, even in areas where there are few valuable *in situ* environmental resources. Note the problems caused in the Grasberg Mine described in Box 5

101. Hydropower itself is a valuable renewable energy source. Its impact on mountain environments depends on how water flows are managed. Run-of-the-river hydroelectric plants usually cause few problems to the environment, requiring small dams or diversions and creating no, or only small, reservoirs. Large dam hydro-power plants pose many more problems - often inundating large areas, displacing local inhabitants, and changing downstream water flows. Even in areas of low *in-situ* values, these impacts can be disruptive. These operations provide few employment opportunities for local people, beyond temporary work on the dam. In all of these activities, efforts by the exploiting firm to minimize costs means that they typically plan to do only the minimum that is legally required to mitigate the impacts of their activities on local people or the environment. Many fall short of that in practice.

102. In developing countries, the bulk of extracted mountain resources are exported for consumption in developed countries. In most cases, the right to exploit the resource is determined by national governments, which normally claim ownership of such resources. The exploitation rights are typically given to large, well-funded firms

³⁹ As mining become more capital intensive, higher skills are required. Often most of the mine workers are brought in from elsewhere, creating social tensions as well.

- both foreign and domestic -- that exert influence over government regulations to their own benefit. Lowland or foreign elites and their intermediaries usually appropriate the revenues. Local mountain people are rarely compensated for the exploitation of their resource, or for the loss and degradation of other resources that result from the extraction activity.

Policy Responses

103. The primary concerns in these high-low areas are to assure that local inhabitants are compensated properly for the extraction of their resources and for the adverse impacts the process has on their lives, and to assure that the extraction process does not seriously damage or degrade the local or downstream environment. This involves assuring effective management of the rate and means of extraction of resources, minimizing the use of processes that degrade the environment during either production or transport, and protecting the integrity of indigenous cultures. It also means recognizing the traditional property rights of the people living in these areas. In areas where ownership rights can be secured by mountain people, living standards often can be improved. The forest management program in Costa Rica, small-scale tea plantations in Kenya, and some mining operations in Peru demonstrate possibilities for resolving some of these issues. Where such rights are not secured, the government should take responsibility to assure that an appropriate level of revenues are returned to mountain people, both through increased levels of social services and through direct income transfers.⁴⁰

⁴⁰ The transfers of income to Alaskan citizens from oil production is a model here.

Box 11 Antimina: Pulling a High-Low Case out of a High-High Risk

Antamina mine will be one of Peru's largest copper and other metal mines. It is located at an elevation between 4200 and 4700 meters (roughly 13,800 to 15,500 feet) on the eastern side of the Andes beyond the magnificent and ecologically significant Cordillera Blanca range, in a rocky, relatively barren, remote, and rugged area that is home to impoverished indigenous communities of Incan descent. Initial plans called for ore to be shipped to port by a road over the Andes -- going through the Huascarán National Park. Huascarán is of such biological and cultural importance that it enjoys three levels of protection: it is a National Park, a UNESCO International Biosphere Reserve and World Heritage site. The proposed road would have disrupted the habitat of several endangered species, including the extremely rare *puya raimondi*, the world's tallest flowering plant.

The mining company's environmental officials had received the indications from the highest levels of government that they could plan on shipping ore through the National Park, and claimed that their environmental assessment had been prepared according to World Bank standards.

The government supported the project because it had huge potential to generate badly-needed foreign exchange and jobs at a time of serious economic crisis. During the public comment period on the Environmental Impact Assessment, the Mountain Institute,⁴¹ other NGOs and community members tried to persuade the company to use alternatives to the road through the park. TMI suggested to Antimina that alternative options were in its own economic interest; but these were initially rejected as too costly or time consuming.

TMI then arranged a meeting with the financial group backing the mine. TMI pointed out that implementing the plan for a road through the park would result in the park's being placed on the "Endangered Parks" list. Other NGOs, once they learned of the threat to the protected areas, would protest strongly -- delaying but probably not stopping the project. Delays, however, would activate substantial penalty clauses in the mining company's contract. This new perspective led the consortium to rethink its plans. Fortunately, this coincided with a corporate merger that made available larger financial resources needed for up-front investments. The company opted for a slurry pipeline around the park. In the long term, this choice proved financially, as well as environmentally preferable. The company has since formed constructive partnerships with local communities, Park officials, and NGOs. While problems remain, there are now mechanisms available to address them. Antamina is a remarkable case because prior to the discovery of rich mineral deposits, it would have to be considered a low-low case. Once Antimina began operations, it was able to successfully move from having to manage expensive - and environmentally and socially costly - issues of High-High trade offs, to dealing with the more normal challenges of a High-Low context. The area thus moved from Low-Low to High-High, and finally to High-Low conditions, illustrating the point that movement across quadrants is possible depending on changes in the potential to supply resources, and the availability of linkages to markets.

Source: D. Jane Pratt, *Corporations, Communities, and Conservation*. California Management Review, Vol. 43, No. 3, Berkeley, Ca: Haas School of Business, U. of California Press, Spring 2001)

⁴¹ The Mountain Institute (TMI) supports projects in collaboration with Park authorities and local communities. TMI is an international NGO supporting range-based conservation and community development programs in the Himalayas, Appalachians, and Andes, as well as global networks. TMI works in partnership with other NGOs in the region, including CARE, and Pro Naturaleza, a Peruvian environmental organization.

104. Where mountain areas possess high value export products, but have low access to markets, it also becomes important to manage the construction of the necessary infrastructure to enable the evacuation of the product with minimal disruption to the environment. Mining is the most common example, as the resource is often discovered in remote mountain regions, and requires appropriate infrastructure to transport the product at commercially viable costs. See Box 11. Logging for timber and pulp and paper fall into this category as well. In these areas, it is important to prevent the extraction of resources from damaging other environmental goods and services, especially those that serve as sources of income for local populations.


105. An appropriate tool for ensuring proper treatment of the environment and protection of local people's interests is a well-designed Environmental Impact Assessment (EIA). Some type of EIA is required by most national governments; the challenge is to get good ones that cover all interests. Local populations should participate in the preparation and review of all such EIAs, and in implementing their recommendations. Depending on the situation, it may be desirable to limit physical access to the site in areas where the environment is fragile, and where allowing expanded settlement would have adverse impacts. A special case for actively limiting access exists where there is illegal trade, such as human beings, drugs⁴² and smuggling of rare and endangered species. Appropriate approaches are education, interdiction, provision of alternative livelihoods, managing access, and other actions designed to strengthen the rule of law.

106. Failure to follow such an approach can lead to serious consequences for the sustainability of local environments and alleviation of poverty among local peoples. One of the most egregious cases, that of the Grasberg Mine in Irian Jaya, Indonesia, is discussed in Box 5. The foreign mining company and the government accorded little *in-situ* value to the environment around the mine, but were anxious to extract massive profits. Local people placed high local income and cultural value on the area. Their interests were ignored. This has led to serious conflicts and eventually a major shift in allocation of resources to the area. In contrast, the Antimina copper mine in Peru managed to work more closely with government, NGOs and local people to avoid or address such conflicts, though it has been difficult to reach and maintain that level of cooperation. Compare the results in the Grasberg and Antimina mines described in Boxes 5 and 11.

107. As the example of Antimina illustrates, achieving good results in these areas requires a combination of institutional innovation and cooperation among interested parties in addition to government interventions to assure that the rights of inhabitants are protected. Because of the public good aspects of many of the environmental impacts and the conversion of natural resources into marketable commodities, a combination of market and regulatory regimes is needed to protect the environment and the access of local people to resources (or revenues from those resources). Once an overall framework is agreed upon, with adequate participation from the local

⁴² Colombia, Afghanistan, the Golden Triangle in Southeast Asia are the prime cases.

people, it is likely that many market-based mechanisms can be used to implement the policies. In Costa Rica, funds from the downstream purchase of hydropower are invested into upstream stewardship programs that prevent further environmental degradation and provide incentives for stewardship, as described in Box 12. Where reasonable institutions and social capital exist or can be developed, a range of effective policies can be supported.



Box 12: Costa Rica: Hydroelectric Investment in Upstream Stewardship Practices

In Costa Rica, private landowners are compensated by the National Government and Energia Global, a private hydroelectric company, when forest cover is maintained or increased in watershed areas. To pay for these services, the Government of Costa Rica established a fund, consisting largely of a 5% tax on fossil fuel, through the National Forest Office and National Fund for Forest Financing (FONAFIFO). The help of a local NGO, FUNDECOR (Fundacion para el Desarrollo de la Cordillera Volcanica Central), was enlisted to provide volunteer administrative expenses.

Due to low water storage capacity, Energia Global hopes both to increase the regularity of stream flow and to reduce reservoir sedimentation by paying for landowner services. The company believes that increased forest cover will help to achieve both of these objectives. Payments of \$48 per hectare are made directly to individual landowners through the local NGO. Payments are not based on the value of the hydro-electrical services, but on the approximate equivalent of the opportunity cost of foregone land development, which is primarily cattle ranching.

Source: Chomitz, Kenneth M., Brenes, and L. Constantino. 1998

Low Economic Export Value and High *in-situ* Environmental Services Value requires conservation and protection: The 'low-high' case

Primary characteristic

108. These areas provide important environmental services because they harbor a great deal of biodiversity, provide carbon sequestration (discussed in the next section), offer exceptional vistas and other amenity values, and/or supply water to their downstream areas. They are not known to have significant extractable resources.⁴³ Low-high areas tend to be found in Middle and High Mountains. The critical environmental issues in these areas are to preserve the *in-situ* resources and manage them in a sustainable manner. Most of these areas are now well known, and the local cultural and biodiversity resources identified. Conservation International has identified ten biodiversity hot spots in mountains. Other important areas have been proposed by governments, and designated by UNESCO as International Biosphere and International Heritage Reserves. IUCN, WWF, The Nature Conservancy, and other NGOs have supported governments in creating, demarcating, and managing national parks, protected areas, recreation areas, and other designated wilderness areas, as well as numerous sacred sites in mountain areas. Many countries have enacted legislation or promulgated decrees setting aside significant portions of national territory for conservation, or preserving portions of representative ecosystems. Areas of significant sacred and cultural heritage value are protected as well, such as Machu Pichu in Peru.

109. Many of these areas are managed for conservation purposes. In some cases, the policy has been to try to move indigenous people out of conservation areas in the belief that the best way to protect the environment was to keep all people out. Such actions often contributed to increasing poverty of the traditional inhabitants. It also

⁴³ Extractable resources may be found at a later date, which would shift these areas into the high-high quadrant.

wasted a valuable resource - the local knowledge of the traditional inhabitants whose survival has depended on managing those resources sustainably. More recently, programs have been developed to include traditional inhabitants of these areas in their long-term management. The case of Guinea in Box 13 is but one example of the value of including local people in resource management. Many other examples of best practice, such as the Annapurna Conservation Area and the Makalu Barun national park in Nepal.

Box 13: Guinea: Protecting Forests Through Co-Management

The National Directorate of Waters and Forests (Direction Nationale des Eaux et Forêts, DNEF) is legally responsible for management of Guinea's 113 national classified forests. Although most of these forests were classified by the French colonial regime in the 1940s and 1950s, due to limited government resources they have received little active management. Many have become degraded, due to years of wildlife, uncontrolled animal grazing, wildfire, clandestine timber cutting, and illegal encroachment. New management approaches are needed to stabilize and improve the condition of these forests to ensure that they meet objectives of protection of watersheds both for the nation and neighboring countries, biological diversity, and provision of needed forest resources.

Since 1992, USAID has been working with DNEF to improve natural resource management in the Fouta Djallon highlands of Guinea through co-management, aimed at sharing management responsibilities as well as benefits between the national government and the local population.

In 1999, DNEF signed the first five-year contract with an inter-village committee, to co-manage the Nialama Forest. The forest is located in the Linsan-Saran Sub-Prefecture of Lelouma Prefecture, on the border with Gaoual Prefecture. This forest is approximately 10,000 hectares in size, and is surrounded by approximately 30 villages and hamlets, home to more than 5,700 people.

Source: Laura Latigue, U.S. Agency for International Development, USAID.

110. Tourism is a major economic activity in many areas with high *in-situ* values. Mountains provide recreational opportunities and offer picture postcard images that reflect romantic, idealized mountain settings: Alpine and Rocky Mountain resorts, Himalayan hill stations, and pristine spas in Japan. In the latter half of the 20th Century, these services have been recognized as having marketable economic value. Up to a point, this can contribute important sources of income to local peoples through tourism. Eco-tourism has become a major growth industry in many countries, though there are differing experiences as to how much benefit is generated for the local people as opposed to foreign travel agents and tour operators. There are also serious risks to such tourism. It can lead to environmentally damaging construction and excessive pressure on the environment. Too many tourists can spoil the areas they visit by leaving too much human waste and litter, intruding too much on the delicate ecosystems, or converting wilderness to single purpose uses (e.g. ski areas, resort developments) that can themselves generate significant environmental degradation.

111. Watershed protection (water purification, siltation reduction, flow management) is perhaps the most important marketable service provided by these low-high areas. If undisturbed, good watersheds can protect downstream dams from siltation and maintain the quantity and quality of urban water supplies.⁴⁴ Heretofore, such services were simply taken for granted because they were provided “naturally” with no apparent efforts either by the recipients or those living upstream. With increased pressure on mountain areas and water resources, the value of watershed services is coming to be appreciated. This is especially true when comparing the costs of watershed protection with the much higher costs of paying for flood control and water purification, or when encroachment reduces areas available for recreation. Such trade-offs are directly related to the public good aspects of most of these services.⁴⁵ Both developed and developing countries have innovated schemes to recognize and pay for the value of preserving watershed management services.

Policy Responses

112. The challenge to managing these areas is to clearly identify the services that provide value and find ways for the providers (stewards) to be recompensed. These areas offer many opportunities to develop market-based mechanisms that both preserve the environment and reduce poverty where upland populations are disadvantaged. Success depends on creating market-based mechanisms that provide equitable payments in exchange for the maintenance of environmental services. Where both upstream and downstream populations recognize their individual and mutual benefit in doing so, incentives can be designed to maintain environmental services through imposition of taxes and fees on water users, with a share of the revenues reinvested in mountain communities. If the downstream benefits are clearly identifiable and quantifiable, beneficiaries may be willing to pay directly for improved environmental outcomes and markets can function directly as demonstrated in New York and Quito. See Boxes 1 and 2. If the benefits are more diffuse, or the beneficiaries constitute much of the population, tax systems may be used, as is the case in Costa Rica in Box 12.

113. For recreational values, protection and regulation of access through restricting and/or pricing access through user fees helps to maintain mountain ecosystems. Access regulation depends on a responsible authority that can effectively limit access, generate and allocate revenues to maintain mountain system integrity. In Bhutan, the government has fixed a minimum expenditure per tourist per day (over \$200) and requires use of licensed local tour agencies. The government collects a 30% tax from that minimum. This program serves to limit the number of tourists to a manageable number, generate business for local enterprises, and channel resources to the government for its programs to enhance the well-being of all its citizens.⁴⁶ However,

⁴⁴ The alternative would be for downstream populations to pay for water purification and treatment plants, build more flood control, and experience shorter useful lives for dams.

⁴⁵ The identification of these services also highlights the interconnectedness of mountain systems and raises the question of the responsibilities of owners of mountain property rights to leave intact certain of these interconnected services.

⁴⁶ Bhutan is blessed with a responsible and honest government committed to improving gross national happiness for all its people.

even without effective government, local inhabitants find it in their interest to protect local habitats with high tourist value. In Rwanda, people living in the park buffer zone and those employed by the forest service as guides have long benefited from tourists who come to see wild mountain gorillas in the National Park near Kigali. The relatively high fees charged tourists for observing the gorillas provided income for the guides, and the tourists' other expenditures helped the local economy. These local inhabitants protected the gorillas and their habitat from poaching during years of civil strife in order to preserve their valuable natural asset.

114. The challenge in national parks and other protected areas is to conserve these areas in an affordable manner and to keep physical access limited⁴⁷. With proper governance, these areas can be maintained through transfer payments, high-end eco-tourism, and "niche" economies that rely on production of highly specialized, high value-added products. Maintenance of both the conservation value of the natural resources and specialized niche economies depends on ensuring that access to markets is managed so as to prevent overexploitation of the services. This avoids degradation of the environment while maintaining the appeal of limited accessibility. To a large extent, benefits from improved environmental outcomes that result from such conservation efforts should be directed to the poor in these areas, who should be involved in enhanced stewardship. This should be a key part of any program - both through direct payments for stewardship activities and through programs to improve social services to poor and/or isolated populations.⁴⁸

115. For example, in the Annapurna Conservation Area in Nepal, visitors pay an entrance fee of \$12 which is channeled back to local people through the King Mahendra Trust for Nature Conservation, a local NGO. As of 1997, over \$400,000 had been collected -- enough to cover operating costs for the park as well as regional development programs. Of utmost importance when considering user or entrance fees for protected areas is the assurance that the funds are channeled back to local communities themselves. The reinvestment of these funds directly into local communities creates strong incentives for increased local stewardship activities.

116. In most of these cases, property rights and responsibilities must be clarified to manage the natural resources. Such property rights, which may be communal as well as individual, allow stewards to manage resources and maintain benefits in quantifiable, and monitorable ways. This in turn enables market transactions to be undertaken with downstream communities for preservation of natural resources and maintenance of environmental services. Alternatively, upstream dwellers can be taxed in ways that penalize activities that degrade the environment. Which approach is used will depend on the terms of property rights and governing regulations.⁴⁹

⁴⁷ Probably in both directions

⁴⁸ Such payments should not be considered subsidies. Rather, they are fair compensation for maintaining environmental services.

⁴⁹ Throughout, we have been using 'upstream-downstream' in a figurative sense. Those 'upstream' provide the environmental stewardship service, those 'downstream' consume it. They may not actually live in this relation along a specific waterway.

117. Such programs must be carefully designed to satisfy many competing interests and to permit a sustainable use of the valuable environmental resources in the area while providing adequate incomes to the local people who help in providing sustainable environmental services. This requires well-developed institutions to manage property rights issues and establish the necessary markets and transactions. Local communities must be able to survive on their own, with external revenues being used according to local priorities for 'lumpy' investments, public services, and buffering market fluctuations. The Makalu Barun park experience in Box 8 demonstrates the potential for communities to manage their own resources.

High Economic Export Value and High *in-situ* Environmental Services Value requires careful balancing of trade-offs: the 'high-high' case

Primary characteristics

118. These cases present the most difficult challenges. Their richness in both exportable and *in-situ* environmental resources creates conflict over the best use of the resources. These conflicts tend to occur more frequently in the Low and Middle level mountainous areas. All too often, the use of environmental resources for one goal impedes the realization of its value from another, or from maintenance of environmental services. The desire for economic profits from exportation of marketable commodities runs head-on into the desire to preserve in-place services and the integrity of the ecosystem. Frequently, the drive for economic profits prevails -- in part because the exploiters can gain rights to extraction -- with the promise of generating economic returns to authorities who control the resources -- and in part because of the difficulties of trying to realize equivalent returns through transactions for the use of environmental services.

119. Clearly, common pool asset and public good aspects play a key role in understanding this conflict. Different actors want to exploit or preserve different environmental resources or services for their own benefit. While markets provide ready cash for the exportable commodities, they do not recognize the full costs this may impose on others, nor all the benefits to society. Producers are rarely charged for the environmental damages done or costs imposed on others by the side effects of extraction.⁵⁰ Two elements of market failures -- difficulty in pricing the environmental services, and failure to price environmental costs -- create a bias in favor of exporting environmental commodities. This bias is exacerbated by the fact that export commodities are valued in global markets dominated by high-income countries with large ability to pay. The competing environmental services would be priced -- to the extent they are -- in local markets with lower income levels and ability to pay.⁵¹ When there are high values from both extraction and *in-situ* uses, these

⁵⁰ The logger does want to recognize and be charged for the downstream impacts of erosion and flooding that my result from his logging. The mine owner does not want to be responsible for preventing or cleaning up pollution due to mine operation, nor for restoring the land torn up. And typically they do not compensate local people for taking their natural resource.

⁵¹ The 'intrinsic' value of clean water would be the same to a rich New Yorker and a poor Javanese, but the former has the resources to pay upstream users not to pollute the water, whereas the latter does not.

trade-offs tend to favor extraction, to the systematic detriment of preserving *in situ* services.

120. The situation may be further compounded when major interests on both sides are not local inhabitants, and battles – more often legal but increasingly physical as well – are waged over the products of mountain areas. Too often, the interests of the local people are ignored. Not surprisingly, efforts to balance demands for environmental services and exports have made more progress in developed countries, but it is by no means all or nothing. Many of the protagonists who favor preserving the environment over exploitation in developing countries are from developed countries. They can afford to take such a stand. In the case of Antimina described in Box 11, many local people opposed the mine's proposed road through a national park, but were unable to make their views heard. Partnership with an international environmental group able to address financial backers from developed countries helped to make the case, and led to a broader coalition, including the mine, that now tries to resolve contentious issues peacefully through negotiation. There are growing numbers of cases in developing countries where the local people are making their voices heard in opposition to extractive industries. Box 14 highlights another current example from Peru.

121. The case makes very clear that in High-High cases such as Tampo Grande, conventional EIA will not suffice. Where there are major trade-offs, substantial added investments in time and money are needed to understand all perspectives, build trust, and seek ways to forge compromises, whereby extraction might still be possible and where local concerns are met. Because this was not done early on, the company and local citizens have already become antagonists. The only remaining possibility is for the government to take the lead in trying to bridge the divide while upholding its own environmental regulations in a way that reinforces its credibility as an honest broker.

Box 14: Tampo Grande, Mining versus Farming Leads to Conflict

In Tambo Grande, Peru, a classic case of High-High conflict is unfolding. Manhattan Minerals was granted a concession to mine rich gold, silver, copper and zinc deposits in the hills above the fertile San Lorenzo Valley. Manhattan Minerals' public estimate is that it will make over \$US 1 billion profit over the life of the project. The valley is highly productive agriculturally as a result of land reforms in the 1970s that gave peasants secure tenure and of irrigation projects sponsored in part by the World Bank. It is Peru's equivalent of the Golden Crescent with hundreds of small and medium-sized plots that produce over \$100 million annually in avocado, lime, and mangos, most of which are destined for export.

In early June, 2002, the 20,000 residents of Tambogrande held an unofficial referendum, which resulted in 90% of voters casting their votes in favor of maintaining their homes and agricultural lifestyles, even at the expense of foregoing development of the mine. A local resident, Hugo Abramonte Ato, was quoted as saying, "If they don't respect these results, we will have to rely on the power that comes from the whole world knowing that these are our wishes. We don't want to change our life in exchange for this supposed bonanza."

The referendum was unofficial; and its results are not binding. The newly-elected Peruvian government is committed to democracy and participation and thus faces a difficult dilemma:

- * respect the rule of law and the rights granted to the mining company by the previous (corrupt) administration. It would thereby gain substantial new employment, tax revenues, and foreign exchange from the mineral exports over the life of the mine, but lose the support of local people while destroying much of the productive potential of the farms; or,
- * respect the wishes of local communities and preserve a more sustainable production system and way of life, while foregoing the large export revenues.

Farmers most fear that a mining operation would consume farmland, contaminate their fruit and siphon off too much water, forcing them into mining jobs they know nothing about. Manhattan is one of 10 mining companies with concessions in and around Tambogrande, and residents fear it is the Trojan horse for an industry with designs on the whole valley. The mining company complains that the referendum, held three weeks before the release of the company's EIA, "should be seen for what it is, a public relations campaign."

Source: Scott Wilson, "A Life Worth More Than Gold." Washington Post, June 9, 2002.

122. Another example of conflict over extraction versus in-situ values concerns carbon sequestration. Carbon sequestration is not unique to mountain areas, but a function of growing and maintaining forests rather than cutting or burning them. This environmental benefit is in direct conflict with logging or other activities that cut down trees and do not regenerate them. There is a growing, but still speculative, market in preserving forest stands and compensating land owners for preserving the forests. The Kempff project in Bolivia illustrates how these programs can work, as described in Box 6.

Policy Responses

123. In the high-high areas, it is much harder to find satisfactory solutions. There are few win-win situations, and more inclination to view the options as zero-sum. As the Tambo Grande example shows, there may not be room for a mutually satisfactory solution that meets the needs and satisfies the desires of both parties. Where these areas have good access to markets, the competition is likely to be clear and out in the open. And there are likely to be strong advocates for both sides. This may increase the chance that a solution can be found.

124. The key is the existence of adequate institutions that give voice to all sides in the dispute and recognize the rights of all. Where vested business interests wield the power and local interests cannot gain representation, economic exploitation is likely to prevail, whether in West Virginia or Irian Jaya. However, if mountain dwellers are able to make their concerns heard and can gain allies from among those who benefit from the environmental services downstream, there are good models to help manage the use of environmental resources and obtain payment so that stewards upstream will protect those services.

125. Depending on the circumstances, market instruments can play a large role, so long as there is an appropriate legal and regulatory framework allowing agreements to be made and enforced among the interested parties. This may require government or

other intervention to establish the basis of a market, such as required water quality levels or landscape preservation that will facilitate quantification of the environmental service provided. Various combinations of regulations and market instruments are possible.

126. In the end, the real challenge in the High-High case is how to take advantage of the exportable mountain resources without undue damage to *in-situ* mountain resources. This requires careful management and cooperation between public and private interests and a full understanding of all the costs and benefits of both kinds of resources. It also requires appreciation of the values and needs of the mountain people. Satisfactory solutions require balancing the need to generate income from both exportable and *in-situ* resources. To assure that local people receive income and social services, and to assure that environmental resources are managed sustainably will require applying the full range of institutional interventions discussed in more detail in Annex I.

127. Naturally, instruments like EIA will have to be used to assess potential consequences of proposed extractive activities. But they will have to get well beyond looking at mitigation measures to assessing the real costs of adverse impacts on environmental services, including aesthetic valuations. Interventions also will have to be much more attentive to giving voice to all stakeholders affected by the environmental choices made. The well-being of local people should be given priority, certainly, but other interests, local, national, and global need to be heard. Their objectives may carry weight, but they should also be expected to compensate local people for any losses or burdens imposed. Efforts to enhance global environmental sustainability, such as preserving forest cover and reducing carbon emissions should not impose burdens on poor, local people. Instead, those who benefit from clear cutting should have a burden of paying for the costs of their contribution to the deterioration of the public good.

Toward a comprehensive approach

128. There is a long way to go in reaching satisfactory agreements on sustainable use of environmental resources and poverty alleviation in mountains, particularly the high-high areas. Much work remains to be done. The discussion above illustrates the range of problems facing mountain areas and many of the approaches that can be used to address them. Not all solutions are appropriate for every area. And it is likely that some combination will be needed in each area. The choices will depend on the environmental and demographic circumstances, on the institutional capacities of the mountain groups and their downstream interlocutors, and on the market structures and location of demand relative to the mountain services. Based on the examples above, we can identify some of the most important factors for enhancing the sustainability of mountain areas and alleviating poverty. Indeed, in many cases, these can be complementary activities, often using market-oriented instrument.

129. In the Low-Low instances, the major concern will be to improve the welfare of the mountain people living in those areas. This will primarily involve government-

sponsored programs for subsidies and payments, but other instruments may be used as well. The emphasis should be on poverty alleviation. In the High export resource, Low in-situ resource instances, the primary concerns will be to mitigate potential damage to environmental sustainability while assuring that local people receive adequate compensation. This will involve management of social and environmental impacts using market mechanisms and traditional EIA methods - a combination of government and market interventions within the appropriate institutional framework. The emphasis would be on managing market-based mechanisms.

130. In the Low export resources High in-situ resource instances, the primary goal will be to protect the environmental services and assure incomes for the related stewardship services. This would involve government interventions establishing protected areas (parks), setting fees for resource use, making or arranging payments for local people to protect valuable services, and managing access to prevent overuse of the resources. The emphasis should be on developing market based approaches to complement regulatory interventions that protect in place services.

131. Finally, the High-High instances are intrinsically complex and involve difficult trade-offs. Some combination of the policies for the High-Low and Low-High cases would be required to protect the long-term viability of both the export and in-situ resources while assuring livelihoods for the local people. Cooperation of public and private institutions will be necessary, using market instruments to the extent possible, but recognizing the role of the public sector in assuring the public goods are adequately valued and managed. Here the emphasis should be on balancing competing demands and assuring adequate remuneration of mountain people for their resources.

CHAPTER IV: Mountain Program of Action

*Hope is like a path on the mountainside.
At first there is no path.
But then there are people passing that way,
And then there is a path.*

*Chinese writer Lu Xun:
(adapted by Catherine Nixon Cooke)*

Action Program

132. Priorities for action to conserve mountain ecosystems and to address the challenges of sustainable development in mountain regions have been developed over a period of years through highly participatory processes. The World Commission on Environment and Development in its 1987 Report: Our Common Future, identified the importance of sustainable development and outlined an action program. That program was picked up in the 1992 UNCED conference, where Chapter 13 of the Earth Summit's Agenda 21 focused on mountains.

133. Since then, the theme has been taken up by many others. The first NGO Consultation on the Mountain Agenda, organized by The Mountain Institute in 1994 and hosted by the International Potato Center (CIP) brought together some 120 mountain NGO leaders from nearly 40 countries with two specific objectives:

- ❖ Develop consensus on a prioritized action plan for conservation and sustainable development in mountain regions; and
- ❖ Create an ongoing forum of mountain NGOs, research organizations, governments, private sector individuals, and institutions concerned with mountains to share information and best practice.

134. The UN Food and Agriculture Organization (FAO), is the focal point for the Earth Summit's Agenda 21 Chapter 13, "Managing Fragile Ecosystems: Sustainable Mountain Development." It has convened a series of meetings, including NGOs and other UN agencies, to continue to address and report on progress during regular meetings of the UN Commission on Sustainable Development. As momentum has grown through these various forums, consensus has emerged regarding priorities, which were reaffirmed recently at meetings such as the Global Mountain Forum in Chambéry, France in 2000, the World Mountain Symposium in Interlaken, Switzerland in 2001, and the launch of the International Year of Mountains at the UN in December 2001. These priorities can be summarized as follows:

Programs that alleviate poverty and address social inequities facing mountain communities should be supported and implemented.

Globally significant biological diversity and watersheds should be conserved.

Mountain communities, especially women, should be involved in decisions affecting their lives and the resource base on which their livelihoods depend.

Mountain-specific policies and laws representing the needs and interests of mountain communities should be developed and implemented with full participation of stakeholders.

Innovative financing mechanisms should be implemented to ensure that an equitable share of benefits from resource outflows is allocated to mountain communities in ways that provide incentives for conservation.

Partnerships and collaboration should be promoted between government and local people, public and private sectors, upstream and downstream communities, and across boundaries.

Traditional mountain economies, sustainable livelihoods and small-scale production systems should be supported through improved access to markets.

Increased levels of eco- tourism should benefit from collaborative strategies of governments, local communities, and NGOs that minimize cultural and environmental impacts.

Indigenous knowledge systems and cultural heritage should be recognized and promoted as essential resources in achieving sustainable mountain development.

The sacred and spiritual values of mountain landscapes should be recognized as a valid basis for conservation of mountain environments.

Integrated and applied mountain research should receive more financial support and continue to expand in scope and impact.

135. These priorities accord well with the lessons that emerge from our analysis and case studies, and they lead to more focused policy recommendations. There is a risk that the mountain agenda, however significant for poverty alleviation and protection of globally critical resources, will be seen as just one more burden facing diminished capacity for burden sharing. Donor “aid weariness” is recognized and understandable. Our conclusions, however, recognize that the actions required are quite specific and limited - and most important, can be spatially defined. While everyone has a role to play, each actor has a well-defined part. No-one is expected to be responsible for everything. Indeed, no-one need be responsible for more than what they can and should do in their own interest. Let us therefore summarize the actions, and the actors, according to the matrix analysis:

136. *Low-Low case: the arid plateaus and poor mountain areas call for welfare payments and technology.* People living at altitude in arid regions face desperate poverty. They are often culturally rich, but economically poor, politically marginalized, and socially isolated. The need here is for interventions that provide appropriate technical packages to improve subsistence livelihoods, provide social services, and minimize environmental degradation. There is also a need for protection of fragile ecosystems, restoration of degraded areas, and in worst-case areas, for welfare payments and/or subsidies. Transfers may be limited to winter scarcity seasons, to a specific sector, such as livestock management, or to the most remote parts of the region. Governments must provide an appropriate policy framework,

based on existing models and best practice to help these regions in an effective manner.

137. Local institutions, communities and NGOs should be the primary actors in this arena. They are the best equipped to deal with the community-based approaches, technology, and small scale of activities needed. Such modest assistance can help communities in the low-low case areas to strengthen their cultural heritage and their sense of dignity, while achieving improved livelihoods and well being. What local communities and NGOs in turn require is modest funding support from donor governments, foundations, and private donors, who should make such marginal areas a special priority, following the examples of the Governments of Switzerland and the Netherlands. Large funding commitments are not needed, nor appropriate. Support to NGOs with proven track records, in the range of US\$100,000 to \$2 million would have very significant impacts in the low-low areas -- those suffering under the double burden of having low value exportable resources, and *in situ* natural resources that are not valued by larger populations living downstream.

138. *High-Low case: exportable wealth from desolate regions calls for rigorous application of conventional environmental safeguards.* In all cases where the economic value of resources justifies conversion for export to markets, there is a need to apply conventional approaches to mitigation of social and environmental impacts through environmental impact assessment with careful attention to quality analysis and full implementation and monitoring of recommendations. Where mining or hydropower projects are undertaken in remote areas with sparse population and low ecological priority, the rigorous application of environmental safeguards is essential. Remote communities lack political access and voice. They thus lack power to address injustices such as the take over of their traditional property, or to mitigate serious and lasting adverse social and environmental impacts. Moreover, even when the project site is in remote areas, changes in hydrology or downstream impacts of mining can cause great damage to lowland populations as well.

139. Application of environmental safeguards, best available practice, and technology therefore remain essential. This is primarily the job of large corporations engaged in mining and hydropower development, with governments responsible for establishing, monitoring, and enforcing environmental protection. For industry, costs of respecting environmental concerns are typically on the order of 2-4% of total investment or operating costs. However, companies with model environmental programs have found that these programs save them money overall and increase profitability in the long run.⁵² For governments, the costs involved are an integral part of their normal responsibilities.

140. The risk is that governments and industry collude, and that the market is distorted by corruption or by ineffective institutional capacity. The major challenge in this case is to provide sufficient incentives and penalties to ensure that existing safeguards are implemented. Establishing independent "watchdog" entities to ensure the integrity of the process has proven to be an effective tool in the case of the

⁵² Gordon, Pamela J., *Lean and Green: Profit for Your Workplace and the Environment*. (San Francisco: Berrett-Koehler, 2001).

independent panels of experts for dams. This model should be maintained and extended to mining. The incremental cost for this measure, in addition to providing grant funding for NGOs to continue their monitoring and surveillance activities, is likely to be very modest - on the order of a few million dollars US-equivalent annually. Investment by mining companies in such expert advisory panels will save them money. It is worth underlining that significant improvements in conservation of critical mountain resources, as well as great strides in alleviating poverty of mountain people, will also produce substantial social benefits in mountain areas and downstream.

141. *Low-High: Low export value areas with High Biodiversity require protection with community participation.* Where *in-situ* environmental services are valued, and/or where biodiversity "hot spots" exist, a wide range of policies and approaches can be drawn upon to ensure that ecosystems are preserved and their environmental services can be continued on a sustainable basis. Parks and protected areas can become sustainable through fees, debt-for-nature swaps, or mechanisms to effect appropriate transfer payments. Downstream water users can pay tariff supplements that are allocated to mountain communities for watershed protection investments. New models of community-based conservation can be expanded, involving local people in managing resources and receiving a share of tourist revenues. Such projects represent the best of "win-win" approaches: both upstream and downstream communities benefit, the richness of biodiversity is preserved, the system is self-sustaining, and everyone can appreciate the recreational, cultural and spiritual renewal opportunities offered by intact ecosystems.

142. Such environmental protection initiatives require first and foremost political will on the part of the government. Creation of parks and protected areas may seem a less urgent priority when debt service payments and employment are pressing needs. The costs are more time and staff intensive than monetarily high, making the investment easy to postpone. Establishing a park or protected area requires baseline studies, demarcation, and legislation to begin with. Then park guards, rangers, and foresters must be trained, positions filled, and salaries paid. Most operating costs can be offset by transfer payments or fees, as has been noted. The initial investment, however, is likely to require somewhere in the neighborhood of US\$100,000 to \$2 million per area. However, there are outstanding models of best practice from every region. Such investment pays off in increased employment in the tourism sector as well as substantial savings from watershed protection.

143. *High-High: The regions with high in-situ value and high export value face difficult trade-offs and require time and effort beyond conventional safeguards.* Most important, our analysis has shown that the greatest conflicts arise in cases where both environmental services and economic conversion values are high, and where there is a need for trade-offs. In the high-high case, there are no easy "win-win" solutions, only winners and losers. Even where the private sector has complied with regulations and has carried out required environmental assessments, compliance with this minimum standard is sufficient only for cases where *in-situ* environmental services and intact ecosystems are relatively low in value. Where environmental

service values are high, such conventional approaches are still necessary; but they are not sufficient to deal with cases where hard choices must be made.

144. In these instances, additional mechanisms must be brought to bear. These may take the form of additional legislative, regulatory, and enforcement frameworks; or they may involve special transfer payments or compensation for restoration, or for lost services. Where environmental priorities are very high, the result may well involve foregoing extraction of resources, either entirely or in part, with the loss of potential revenue. Increasingly, market based approaches are being conceived to help achieve such trade-offs efficiently. Supervision is still needed to ensure that equity needs are also respected.

145. Perhaps most important, these situations require a great deal more time to resolve, and require the involvement of many more stakeholders, who are likely to be mutually distrustful at best. Governments still have a lead role in most cases, as they are responsible for granting permits for extraction, and for ensuring that environmental regulations are respected. However, while governments must make the key decisions, and ensure that appropriate environmental safeguards are respected, they are seldom the best placed to mediate among parties, or to negotiate proposed solutions amongst stakeholders. They need to find ways to ensure that relationships of trust develop among stakeholders over time. If they attempt to impose a decision without creating a forum for understanding the differences in interests, they do so at their peril.

146. Innovative approaches - beyond safeguards - are needed. Again, an independent body is needed to facilitate resolution. In this case, however, the mandate of such a body must be to remain objective, and to serve as a facilitator only, rather than in an "expert" capacity. Large corporations interested in exploiting resources in mountain regions with high environmental value must be expected to pay substantially higher costs, including compensation for loss of public and private goods of people in the area and downstream.⁵³ Any entity created should provide for appropriate involvement of all parties. The costs of such efforts, of course, are not limited to negotiating compromises and illuminating the trade-offs involved. The costs of implementing any decision in a high-high area, including one not to proceed, will be much higher than in other cases because of the critical trade-offs involved. Exploiting the export good has a high cost in terms of the impacts on the *in situ* goods and services disrupted or destroyed. And preserving the *in situ* goods and services has a high cost in terms of the foregone exports. In the interests of equity, both incremental costs and benefits will have to be shared among all parties fairly. A recent paper prepared for the Bishkek Global Mountain Summit came to very similar conclusions, as adapted in Box 15.

Box 15: Sustaining Mountain Livelihoods and Poverty Alleviation

⁵³ To avoid bias, the corporation can be required to reimburse Government for the costs of creating an independent commission to study the issues and develop compromise proposals backed by stakeholders.

Experience in promoting sustainable livelihoods for poor people in mountain regions properly focuses on strategies for agricultural intensification while protecting the natural resource base; diversification of livelihood sources; improving physical access and infrastructure; developing mechanisms to compensate the highlands for the use of the mountain resource base by the lowlands; and the necessity to address the inequities that prevail in highland-lowland interactions. Analysis suggests that two broader dimensions should be added. The first is a “national dimension” that seeks to place mountain development in the national perspective. This dimension is traditionally understated because of the focus on the uniqueness of mountain environments and issues. The second is a “framework dimension” that uses a ‘people-centered’ framework, a sustainable livelihoods approach, for analysis and assessment of mountain livelihood issues and strategies.

The analysis also suggests that dependency between the highlands and the lowlands runs both ways. If the lowlands continue to depend heavily on natural resource extraction from the highlands, the highlands in return rely significantly on the growth trends in the lowlands for their own long-term growth and poverty reduction. This reverse dependency is most often described by its negative aspects. Mountain regions, however, benefit in at least four ways from a growing national economy. First, through state subsidy and resource flows; clearly a state with more fiscal space has more spending and resource allocation flexibility for mountain regions. Second, a growing national economy creates demand and market access for highland products. Third, steady economic growth conditions absorb surplus mountain labor, making possible migration to the lowlands for people who cannot find opportunities in limited mountain economies. Finally, links with the national economy promote livelihood diversification in the mountains and can help contain the pressure on natural resources exerted by growing populations.

Source: Stephen F. Rasmussen and Safdar Parvez: Aga Khan Rural Support Programme

Conclusion

147. For the development community and the environmental community, the cases of high economic potential with low environmental values, and of high environmental values with low economic potential require continuing vigilance to ensure that best practices are applied. In the case of environmental values, financial support for NGOs and local communities can go a long way to ensure that such vigilance is maintained. For economic potential, corporations need the assurance of a level playing field, and the ability to pass on higher costs to consumers. This is not a serious burden as such costs typically add no more than 2-5% to the costs of production; and often the investment is repaid through significant cost savings of added revenues.. Thus, while these cases require serious attention, it is clear that there is a great deal of best practice to draw upon in choosing how to manage them.

148. Where low environmental and economic values exist together, the situation is more challenging. These areas have tended to be neglected by development agencies, governments, and by many parts of the NGO community as well, and are in greatest need of special assistance for poverty alleviation and welfare efforts. For these areas, concerted action to alleviate poverty and protect what is important in the environment is essential.

149. The case of high economic and environmental values is most difficult and invariably requires trade-offs. To make informed trade-offs requires difficult and

complex calculations. These must begin with appropriate valuation of both economic and environmental values, considerations of political and economic equity (especially regarding property rights), bringing multiple stakeholders to the table (and keeping them there), and application of multiple management regimes. In the best cases, such trade-offs have worked because good-will and trust has been built up over time. Representatives of government, the private sector, and civil society have come to understand and respect each other's interests and obligations as legitimate.

150. In most cases, the actions needed and the costs involved are modest, and could achieve marked improvements in both environmental protection and poverty alleviation. Pinpointing the areas involved has been done in general terms, but support is urgently needed both for improving data and improving understanding of the spatial distribution of poverty and resources. An important contribution to this was ably stated by Rasmussen and Parvez. "In order to systematically apply mainstream methodologies to analyzing mountain development issues, there is an urgent need to reduce the current "statistical invisibility" of mountains through collection and dissemination of more organized data on social and economic issues to help make better quality comparative analysis possible and facilitate the creation and implementation of relevant development policies and strategies."

151. Most important, countries and other stakeholders must initiate the modest actions most needed. Where extractive and *in situ* values conflict, decisions must be made to start the facilitation process described above. This will have a rapid and large impact in achieving political and economic equity for mountain communities, creating the human and natural foundations for sustainability for all. In other words, we need to think like a mountain.

ANNEX I: Institutional Interventions to Promote Sustainable Development and Poverty Alleviation in Mountains

Government Interventions

Security

1. Security and enforcement are basic government activities and essential for sustainable development in any area and particularly so in mountains, which are disproportionately affected by warfare and armed conflict. Without basic security, protection of mountain resources cannot be assured. Indeed conflict is likely to contribute to degradation and inhibit efforts to alleviate poverty, as illustrated by the situations in Colombia and Afghanistan.⁵⁴ Security is critical in all quadrants of the text matrix, and enforcement of the rule of law is vital to establishing protected areas and to introducing market mechanisms.

Property Rights

2. Land rights are the basic, if not always the definitive factor in the use of mountain land. In most mountain areas, traditional use relies on open access, which functions so long as the usage does not exceed sustainable rates. Once the population and other pressures on the land become too large, there is a need for more control. Usually some form of community ownership has evolved, where the primary group using a mountain area allocates use of mountain resources to people in the community. This approach preserves the integrity of mountain assets, helps mitigate risks and variability of output, and manages the resources to meet community needs, while excluding outsiders. Combinations of more intense pressure on resources and the introduction of national government authority has led to state authority preempting property rights in many areas.

3. Different nation states have allocated use rights in different manners. Some land has been placed under conservation, some has been converted to private property, and some has been licensed for specific uses - all with varying degrees of enforcement. These changes have neither led to more sustainable use of the environmental resources nor to poverty alleviation in the mountains. Conservation uses may displace indigenous people who were managing the mountain assets sustainably. Conversion to private property has often been associated with conversion of land to specified commercial or agricultural uses, with mixed results for both the environment and poverty.⁵⁵

4. Licensing regimes have led to exploitation of exportable resources, often in unsustainable ways and rarely with due consideration of the rights and livelihood needs of mountain people.⁵⁶ Clear and proper definitions of land (or resource use)

⁵⁴ An interesting exception to this is the demilitarized zone separating North and South Korea, where a pristine environment has emerged because absolutely no activity is possible in that area.

⁵⁵ For example, in Central America, land titling schemes required potential land owners to convert mountain forest lands to commercial pasture or other agricultural use in order to secure title.

⁵⁶ Governments often grant rights to extract minerals and timber for very low fees to large firms. Adequate environmental protection is rarely required, and the bulk of the benefits accrue to the exploiting firm and the

rights are most important in the High Export value cases. That is where the terms of access to the exportable resources have to be defined, controls on over-exploitation imposed, and equitable distribution of revenues assured. In areas with low export values, governments have shown more flexibility in respect for customary rights; and in the low-low case, assertion of governmental rights to the resources is much less important than accepting responsibility for meeting at least minimum standards of living and human services.

5. Most important for governments is to define and properly enforce clear property rights regimes that respect the traditional rights of inhabitants of mountain areas. This may involve assigning individual or community property rights to traditional inhabitants as the regime is formalized, rather than appropriating those rights to the state and then reallocating to outside interests. Good property rights regimes incorporate the responsibilities of property owners to recognize the community benefits or costs of their actions and to compensate affected parties accordingly. This is especially important in mountain areas.

Regulatory Structures

6. The most common governmental interventions in mountains are in the area of command and control regulations, especially for land use. They involve direct regulation of uses of land, prohibition against certain activities, and limitations on pollution. While such policies have been criticized for being overly cumbersome and inefficient (especially when the regulations specify processes and not outcomes), there are cases where they are the only option.⁵⁷ Such interventions may be the only way to prevent degradation and protect mountain people's livelihoods. They may include prohibitions on release of toxic chemicals from mining, controls on road building activities in fragile areas, restriction on access, or other constraints.

7. It is important to design such regulations carefully and ensure that they are enforced. Such policies usually will have the greatest impact on high *in-situ* value cases to control and manage the public goods aspects. In some cases, adequate proxy markets can be established to improve the efficiency of the management of the goods, but not in all situations. In cases of high export value, it would be better to establish effective property rights systems, including the rights of the local inhabitants, and let market forces work. But in the absence of that, command and control policies may well be advisable if there is adequate enforcement, particularly on pollution and rates of extraction.

8. Creating markets for environmental services is more effective in many areas than command and control regulations. Governments should try to foster the establishment of markets for environmental services or for limiting degradation. The basic principle is simple: the public good nature of many environmental services can be converted into a marketable good by setting a cap on the amount of a pollutant

government (above or below the table). Little of the income finds its way back to the mountain people affected. This is as true in developed (Colorado, West Virginia) as developing countries.

⁵⁷ These policies can be easily abused as well, which is why they should be used as sparingly as possible and carefully monitored. Involvement of mountain people in their formulation and implementation is important in this regard.

emitted, or by rewarding stewards for assuring the quality of a service. Initial examples were the creation of sulfur dioxide emissions trading.⁵⁸ This has since been expanded to other emissions, carbon sequestration, and water quality, which are more directly relevant to mountains.

9. Depending on the circumstances, the degree of government intervention will vary. In some cases, such as the carbon sequestration project in Bolivia (See Box 6), little direct involvement is needed beyond supporting a framework that enables landowners to receive payments as an incentive for stewardship services. In other cases, such as the NYC water basin (See Box 1), government agencies were involved both in the demand for services and the payment mechanisms. These policies are important in high *in-situ* value areas because they introduce the efficiencies of the market to protection and management of what are largely public goods.

Fiscal Policy

10. Taxes and fees are traditional government mechanisms to raise money and influence behavior. These can be used to pay for stewardship services where the public good nature of the benefits does not permit more market-oriented approaches. Taxes can be imposed on extractive industries to control pollution emissions or to mitigate degradation; or they can be imposed on downstream users to pay for control and mitigation activities. In high *in-situ* resource situations, fees can sometimes be used to substitute for market pricing of a public good, e.g. taxes on the emission of a pollutant, or for entry into a national park. Such mechanisms offset the costs of remediation, and/or maintenance of protected areas. In high resource export areas, fees and royalties (e.g. on mining and timber extraction) can substitute for pricing of the natural resource. Taxes and fees should be designed in ways that minimize distortions.

11. All too often, such revenues are placed into general revenues and thus do not serve the purpose of protecting the common assets of the mountain areas. They do not contribute to payment for critical stewardship services provided by mountain people, nor do they pay mountain people for the use of their assets. These shortfalls diminish the extent of stewardship and of poverty alleviation. What is critical is that the revenues so generated are returned to mountain communities in the form of improved public services or transfer payments that enable communities to invest in their own priorities for development and to undertake stewardship and better management of the resource – staffing and managing national parks, controlling extraction, and promoting appropriate remediation, such as reforestation.

12. Provision of infrastructure is a critical function of governments in mountain areas, either directly or by means of supporting private investment. Transport infrastructure is especially important for improving access of mountains people to markets and other benefits of lowland areas. At the same time, the location and management of infrastructure can have critical impacts on the development of mountain resources. Roads can open up resources for export, but they are a major

⁵⁸ In effect this amounts to imposing rules that create rivalry or excludability or both on the public good. For example, issuing a limited number of permits for SO₂ emissions establishes rivalry in the emission of SO₂. If one firm uses a permit for x tons, no-one else can emit against that permit.

source of erosion and degradation. Roads built to extract resources also open up areas for settlement and conversion. The pattern of infrastructure development is a major tool governments have for managing mountain area development and should be planned carefully.

13. Private interests that want to exploit mountain resources may build their own roads, or try to get governments to do so for them. In some cases this can be quite damaging to the environment. In the case of Antimina in Peru, it turned out that an alternative method (a slurry pipeline) was more economic in the long run, and was considered only when necessity converged with opportunity. Pressure from national and international sources began to be felt at an opportune moment, when a corporate merger made it possible to make the much larger up-front expenditure needed for what was the more profitable long-term investment. Since the design and construction of the infrastructure can have either positive or negative impacts on the environment and the well-being of mountain people, it is important that the infrastructure be developed with sensitivity to these issues. In particular, governments should consult locally on infrastructure needs, and refrain from building roads simply to facilitate the export of mountain resources as a subsidy to the exporters.⁵⁹

Social Services

14. Provision of social services is another essential role of government in the alleviation of mountain poverty. Better education and health increases the capacity of mountain people to improve their standards of living and undertake new income-generating activities. In many cases, the combination of formal education with local traditional knowledge can greatly enhance the ability of mountain people to participate in stewardship transactions. Some of these are sophisticated and require different areas of understanding than may be found in traditional areas. But we should also learn as much as possible from the traditional knowledge of mountain people, which is often profound in areas of natural resource management and use.

15. Education can also enable mountain people to practice better environmental protection in their normal activities and identify and develop high-value niche markets (e.g. Switzerland). And it can equip them to gain livelihoods by migrating from mountain areas that are too poor or densely populated to support current populations at adequate levels. This is most important in the low-low areas, which need better social services and usually are the most deprived. Providing these services is justified on an equity basis, and as a means of improving the prospects of people in such areas to increase their standards of living or to migrate.

Communications

16. Communication services are especially critical for mountain areas, to help communities gain access to knowledge and services that would otherwise be prohibitively expensive to provide. New technologies that allow satellite communications, linked to solar-powered computers can by-pass the need for

⁵⁹ Conventional transportation is not by any means the only or the most important intervention in mountain areas. Alternative and less costly technologies, such as tramways and rope bridges have proved invaluable in helping mountain communities gain access to social services.

expensive installation and repair of telephone and electricity transmission lines in remote areas. The value of such connectivity has been demonstrated by the Mountain Forum (www.mtnforum.org), a global network of individuals and organizations that work in and for conservation and sustainable development of mountain regions. Its six service nodes for Africa, Asia, Europe, Latin America and the Caribbean, North America, and Global members facilitate e-conferences and maintain an on-line library and calendar to promote sharing of information and best practice among its thousands of members. The Swiss Development Cooperation, UNEP and other donors support Mountain Forum as a cost-effective complement to development assistance. It works because it responds to priorities members themselves set; and it maintains an open, transparent, and highly participatory service that participants continue to value. Box 10 illustrates the value of such a network. Extension of access to this unique tool could be used by governments to extend real benefits to mountain communities at very low cost.

17. Transfer and welfare payments are also part of a government's toolbox. They are often abused, but are an essential last resort for areas where income opportunities are meager and migration not feasible. These payments could be associated with basic stewardship activities as well. Programs to improve sustainable economic activities may be used to create more viable jobs and income earning opportunities. These may also contain a subsidy element to offset some of the inherent disadvantages of working in mountain areas. Such transfers could also reduce the incentives for migration or resource exploitation, which would have identifiable public benefits. Unfortunately, most developing countries do not have resources for substantial transfers, and usually mountain people lack the political voice needed to obtain a fair share of benefits for themselves. This deprivation may lead to conflict and participation in illicit activities.

Institutional Interventions

18. The institutional framework includes the processes and procedures under which a society operates and its organizations exist and function. This encompasses what is often called social capital. Some institutional interventions have been addressed in the previous section, since the government is a major institution in most countries. Property rights regimes, fiscal structures, and regulatory organizations fall into this category. This section will address institutions in mountains covering local participation in community decision making, formalizing relations between upstream and downstream groups, specific agencies dealing with environmental issues, and methods for monitoring environmental impacts of mountain activities and stewardship.

Participation

19. Mechanisms that promote local participation are important for preserving mountain environments and improving the well-being of mountain communities. It enables them to express their preferences to political authorities, and to strengthen community management of their resources. In some areas, local communities have

come together to design and implement better community management with the acquiescence of the national government. In some cases such activities are actively encouraged by government action (Indonesian decentralization); but unfortunately in too many cases, governments discourage such local initiatives.

20. Where local participation is strong, there are generally positive impacts on both environmental sustainability and standards of living, as people take collective responsibility for their own long-term interests. The capacity to engage in local participation is critical for organizing market based stewardship activities and for assuring equitable distribution of returns. These institutional developments are most important in areas of high *in-situ* values. They provide a means of organizing local groups to recognize the value of the environmental services and to better realize their value through market or other interventions (Bhutan, Nepal, Sikkim, and India trekking associations). Participation is important in all areas as a way of getting people to work together to express and eventually achieve their goals. Local knowledge and local commitment have proven very important in motivating local success.

Coalitions

21. A framework for formalizing upstream-downstream relations can further strengthen benefits. This involves institutions that bring stakeholders to the table (and keep them there), building trust over time that is needed to agree on, implement, and monitor specific proposals. Some of these institutional arrangements can be informal and spontaneous. Others rely on a government structure, particularly for enforcing contracts. As the case studies demonstrate, a wide variety of arrangements have been created. What is important is that all parties have confidence that the other side will perform as agreed, and that the results can be monitored. These arrangements are easier to create where there is common culture and language. The role of the government in providing security and fair treatment of all parties is also a major factor, particularly for high *in-situ* value areas.

Environmental agencies

22. Agencies dealing with the environment play an essential role in promoting environmental sustainability. They represent the environmental concerns of the population at large and provide specialized programs and knowledge about environmental sustainability. These agencies can help design and implement stewardship programs, pay those who provide stewardship services, and monitor results. These agencies can also provide essential research about ways to improve sustainability and improve income opportunities in mountain areas. Such agencies are often under-funded in both developed and developing countries. Some of the environmental fees and taxes collected for mountain environmental services should help fund the mountain conservation activities of such agencies. This capacity is important in any area with high-value resources, and can help establish the actual value of the resources and the costs of using them. Such agencies have responsibility for establishing markets for many environmental services, and for assuring the appropriate EIA processes for resources extraction. It is difficult but essential to ensure their independence and objectivity, as corporations have greater political

access and voice with the agencies responsible for oversight than do the populations in the affected mountain areas.

23. Monitoring environmental impacts and results is critical to the success of any of the stewardship and most of the regulatory programs examined above. Often, it is the environmental agency that is responsible for monitoring, especially if the government has established a governing regulatory structure. However, for many of the other agreements, the monitoring is done by local agencies or by the interested parties themselves. In some cases the impacts are sufficiently obvious that failures of formal monitoring become obvious; but in most cases, the sources of damage and the benefits are diffused across a large number of locations and actors, necessitating formal monitoring and tighter accountability.

Market Interventions

24. One of the most important recent innovations in environmental management has been the introduction of explicit market mechanisms to promote environmentally sustainable activities. In addition, many of the causes of degradation have resulted from market failures and imperfections. Improving access to markets under the right circumstances is the most important engine for improving incomes and reducing poverty. In this section we will look at several key market institutions that are important for enhancing environmental sustainability and reducing poverty in mountain areas.

25. Much of this follows directly from the previous analysis, particularly with respect to governments creating the conditions of security, property rights, and rules of behavior and contracts that allow markets to function. In this section we will focus on identifying and quantifying environmental goods and services, valuing environmental services including full costing of both costs and benefits, and establishing markets for such goods. These are all critical for improving the efficiency of protection and use of high *in-situ* resources, and for assuring that resource extractions pay the full value of the costs they impose. In addition, improving market interventions will greatly enhance possibilities for increasing the incomes of the poor living in mountains as they are offered more opportunities to receive compensation for their stewardship services.

Identifying and quantifying environmental goods

26. Identifying environmental goods and services that do not have the private good characteristics of normally traded commodities is a crucial first step. A tree is readily identified as a commodity - timber. It is not nearly so readily identified as an economic good when it is part of an eco-system that regulates water flow, manages siltation, and provides recreational services. Because of the public good aspects of these services -- they cannot be segmented into individual chunks that can be traded in a conventional marketplace -- it is harder to conceive of them as equivalent to marketable goods that have an economic value. Recent advances in the understanding of the role and functioning of ecosystems in providing valuable services, and identifying clear benefits from environmental systems have helped to quantify these services in ways which allow the use of market-based systems.

27. For example, in the case of the New York City watershed (See Box 1), a group of upstream farmers (stewards) could be identified, and the potential for their collective action to improve their agricultural practices was recognized as a contribution to clean water flow.⁶⁰ The downstream users of the water also could be identified, and their collective benefit from not having to build an expensive water treatment plant quantified. The benefits vastly exceeded the costs. This in turn made it possible to structure a payment mechanism, so a quasi-market deal could be struck. In most such cases, careful monitoring of a range of stewardship activities and of the quality of the water flow is necessary for such a market to function properly. In this case, the beneficiaries had to act collectively to deal with the stewards, who acted individually, but within the context of an organization that assured a collective result. In other cases, environmental goods are 'created' by assigning limits to pollution and encouraging trading of permits. In this case, the good is the absence of a bad - avoiding loss of water quality and quantity, as well as higher costs.⁶¹ There are many other examples of creating environmental goods and services based on the benefits of maintaining normal ecosystem functions.⁶²

Valuing environmental goods and services

28. Valuing environmental goods and services follows from identifying and quantifying them; but it is necessary in addition to negotiate transactions. Since most of environmental public goods do not trade in a normal market, regular supply and demand forces are not available to establish a price. A variety of other mechanisms have been developed, such as establishing the costs of remediation without the service (building a water treatment plant in the case of the NYC water supply), opportunity costs of supplying the stewardship (the Bolivia sequestration case), imputed value from surveys, and other forms of estimation. In the end, the pricing is usually negotiated between the supplier and user groups, often with the intermediation of the government or environmental agencies. In some cases, full costs are borne directly by the beneficiaries. In other cases, where the benefits are much broader, intermediary groups intervene and provide some payments in the name of the public good. The valuation depends on a number of factors, including the income of the beneficiaries and their relative political and economic power. Where beneficiaries are poor, their direct ability to pay would be limited, and government supplements may be necessary. This is not really a case of welfare, but of transfer payments to provide necessary public services, such as clean water or air. Where the stewards are poor, the payments need to be adjusted to assure adequate livelihoods, and real incentives introduced for upstream communities to perform the stewardship services, and to discourage cheating.

Establishing markets

29. Establishing markets for environmental goods and services depends on the circumstances. Where reasonably well-functioning market structures exist and where

⁶⁰ These include both positive actions such as care of stream margins and negative actions such as not using certain fertilizers and pesticides.

⁶¹ A deeper question is whether the consumer has a right to clean air in the first place, in which case, the polluter should pay.

⁶² Perrot-Maitre, D. and P. Davis. 2001

the services can be formulated as an economic good, such as trading pollution rights, creating a market is relatively simple -- even though the details of the negotiations may be time-consuming as all parties strive to maximize their own advantage. Establishing market systems for many of the environmental stewardship systems prevalent in mountains is more difficult. Most of the services provided are the result of collective action to maintain the integrity of mountain ecosystems, preventing degradation, and restoring degraded areas. In these cases, it usually is necessary to work with communities in mountains to gain their support for the stewardship activities needed, and their knowledge of how to achieve it. That will involve assuring community control, providing adequate incentives in a combination of market and traditional forms, and managing access to resources.

30. Where there are competing demands for export of commodity goods, it is usually necessary either to forego development of the export resource in favor of maintaining long-term productivity, or to develop joint arrangements that allow for some reasonable amount of export while maintaining the integrity of the mountain ecosystems that provide alternative needed resources. One important factor would be to charge the extractors for the negative impacts they cause to the provision of other services, through various usage fees, etc. Some of this has been attempted in forest areas, but with mixed success.

31. In the end, it is clear that the whole range of interventions described above will be needed to improve environmental conservation and sustainability in mountain regions, and to reduce poverty by restraining the depredation of mountain assets. Destruction of the long-term income potential of mountain dwellers must be avoided and means found to increase their income potential by providing better management of mountain assets and more equitable distribution of their benefits, both from mountain commodities and from mountains services. The mix needed will depend on the circumstances, levels of wealth, and the institutional capacity of people involved - both upland and lowland.

ANNEX II: Maps of Mines by Mountain Location for Africa, Asia, and Latin America⁶³

African Mines and Mountains

QuickTime™ and a
GIF decompressor
are needed to see this picture.

⁶³ Source: US Bureau of Mines, World Bank, Note that the accuracy of data is much higher in the US than other continents, where only the larger mines are shown.

Asian Mines and
Mountains

QuickTime™ and a
GIF decompressor
are needed to see this picture.

Latin American Mines and Mountains

QuickTime™ and a
GIF decompressor
are needed to see this picture.

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BIBLIOGRAPHY

- Allen, Nigel J. R. ed. 1995, Mountains at Risk, Current Issues in Environmental Studies, Manohar, New Delhi
- Allen, Nigel J. R., Gregiry W. Knapp, Christoph Stadel eds. 1988, Human Impacts on Mountains, Rowman & Littlefield, Totowa, New Jersey
- Arnold, J.E.M. 1998, Managing Forests as Common Property. Food and Agriculture Organization of the United Nations, Rome.
- Banskota M., T.S. Papola, J. Richter (eds.) Growth, Poverty Alleviation and Sustainable Resource Management in the Mountain Areas of South Asia. Deutsche Stiftung fur internationale Entwicklung, Germany.
- Baral, Jagadish Chandra, "Context of Nepal's Terai Forests," "Who Should Control the Forests of Nepal?" Mountain Forum: Contribution to BGMS e-conference, March, 2002.
- Baral, Jagadish Chandra, "Unintended Outcomes of Community Forestry in Nepal" Mountain Forum: Contribution to BGMS e-conference, March, 2002.
- Barr, Christopher, and Jeffrey Sayer, 2001, *Losing Sight of the Forest for the Trees*, The Asian Wall Street Journal, September, 12
- Bayon, Ricardo, J.Steven Lovink, Wouter J. Veening, 2000, *Financing Biodiversity Conservation*, Inter American Development Bank, Washington, DC,
- Benavides, Hugo Rodriguez; Soria, Jaime Villena; Colque, Samuel Ordonez; and Valdivia, Marco Fernandez, "The *Waru Waru*: An Alternative Technology for the Sustainable Agriculture in Puno Peru." Peru: PIWANDES Institute of Technological Innovation and Promotion of Development: Contribution to BGMS e-conference, March, 2002.
- Bezanson, Keith, and Francisco Sagasti, 2001, Financing International Public Goods: Challenges, Problems, and a Way Forward, Final Draft Report, Institute for Development Studies, Sussex, England
- Bhandary, Uddhab K., "Rural Poverty Analysis and Mapping in Nepal," abstract of paper presented at International Seminar on Mountains, RONAST: Kathmandu, Nepal, March 2002.
- Castro, G. and I. Locker, 2000, Mapping Conservation Investments, Biodiversity Support Program, Washington, DC
- Castro, G., and I. Locker, with V. Russell, L. Cornwell and E. Fajor, *Mapping Conservation Investments: An Assessment of Biodiversity Funding in Latin America and the Caribbean*. Washington, D.C., Biodiversity Support Program.
- Centre for Development and Environment (CDE), Institute of Geography, University of Berne, *Mountain Forests and Sustainable Development*. CDE, Berne, 2000.
- Chambers, Nicky, Craig Simmons, Mathis Wackernagel, 2000, Sharing Nature's Interests: Ecological Footprints as an Indicator for Sustainability, Earthscan, London
- Chomitz, Kenneth M. 2000, *Evaluating Carbon Offsets for Forestry and Energy*

Projects: How Do They Compare?, Development Research Group, World Bank

Chomitz, Kenneth M. and Kanta Kumari, 1998, *The Domestic Benefits of Tropical Forests: A Critical Review*, The World Bank Research Observer, Vol. 13, No. 1, Washington DC

Chomitz, Kenneth M., Brenes, and L. Constantino. 1998. *Financing Environmental Services: The Costa Rica Experience and its Implications*. Paper prepared for Environmentally and Socially Sustainable Development, Latin America and Caribbean Region, World Bank. Washington: World Bank.

Conservation International (Indonesia), 1999, *Valuation of Mt. Gede-Pangrango National Park*, Natural Resource Management Program,.

Costanza, R. et.al. 1997, *The Value of the World's Ecosystem Services and Natural Capital*, Nature, Vol. 387, pp. 253-260

Crawford, David. "The Salience of Local Labor Organization in Morocco's High Atlas," Contribution to BGMS e-conference, March, 2002.

Davis, P., and D. Perrot-Maitre. 2001. *Case Studies of Markets and Innovative Financial Mechanisms for Water Services from Forests*. Case 2- Costa Rica: Hydroelectric Utilities' Financing of Upstream Reforestation. Forest Trends, Washington, DC

Dax, Thomas, "Endogenous Development in Austria's Mountain Regions: From a Source of Irritation to a Mainstream Movement" Mountain Forum: Contribution to BGMS e-conference, March, 2002, based on case study published in MR&D, Vol 21, No. 2, August, 2001.

De Soto, Hernando, 2000, The Mystery of Capitalism: Why Capitalism Triumphs in the West and Fails Everywhere Else, Basic Books

Denniston, D., *High Priorities: Conserving Mountain Ecosystems*, Worldwatch Paper 123, February 1995

Desmond, Helen, and Digby Race, 2000, Global Survey and Analytical Framework for Forestry Out-grower Arrangements, Final Report for FAO

Dunaway, Wilma A. 1996, *The Incorporation of Mountain Ecosystems into the Capitalist World-System*, Review, Bernand Braudel Center, Vol. XIX Number 4, Binghamton University, Binghamton, NY

Duzgun, "Forestry Based Contributions to the Sustainable Livelihoods of Forest-Dependent Mountain Communities in Turkey," Ministry of Forestry, Turkey: Contribution to BGMS e-conference, March, 2002.

Ellerman, David, 2001, *Introduction to Property Theory: The Fundamental Theorems*, World Bank Research Paper, draft

Enote, Jim, in *Sacred Mountains and Environmental Conservation: A Practitioner's Worldshop*. The Mountain Institute, April, 1998.

EPA: New York Watershed Agreement

<http://www.epa.gov/OWOW/watershed/wpnyc.html>-

Ferraro, P.J. *Global Habitat Protection: limitations of development interventions and a role for conservation performance payments*. Department of Applied Economics and Management Working Paper no. 2000-03 (Revised). Cornell University, Ithaca, NY.

Ferraro, Paul J., and R. David Simpson, 2001, *The Cost Effectiveness of Conservation Payments*, Resources for the Future Discussion Paper, forthcoming in *Land Economics*, Vol. 78, No. 3

Godde, Pamela, (ed.), *Community-Based Mountain Tourism: Practices for Linking Conservation with Enterprise*. Mountain Forum and The Mountain Institute, 1998.

Gordon, Pamela J., Lean and Green: Profit for Your Workplace and the Environment. San Francisco: Berrett-Koehler, 2001.

Guoxia, Su and McKinley, Terry, *Et al*, UNDP and World Bank Leading Group for Poverty Reduction, *China: Overcoming Rural Poverty*. Washington, D.C.: World Bank, October 18, 2000.

Hardin, G. 1968. *The Tragedy of the Commons*, *Science*, Vol. 162 No. 1, pp 243-48.

Hernandez, Arrufo Alcantara, "Tradition and Conflict in the Organization of Rural Space in the Andes," Contribution to BGMS e-conference, March, 2002.

IUCN, 2000, Linking People with Nature, Proceedings of the Consultative Workshop, Rajendrapur, Bangladesh,

Ives, J.D. (1997), Comparative Inequalities - *Mountain communities and mountain Families* in B. Messerli and J. D. Ives (eds) Mountains of the World - A Global Priority. Parthenon, New York: 61-84

Ives, J.D., Messerli, B., Spiess, E. (1997) *Mountains of the World - A Global Priority* in B. Messerli and J. D. Ives (eds) Mountains of the World - A Global Priority. Parthenon, New York: 1-15.

Ives, J.D. (1997), Comparative Inequalities - *Mountain communities and mountain Families* in B. Messerli and J. D. Ives (eds) Mountains of the World - A Global Priority. Parthenon, New York: 61-84

Kapos et al., *Mountains and People: An account of Mountain Development Programmes*, supported by the Swiss Agency for Development and Cooperation (SDC). Berne, 2001.

Kapos, V., et al (2000) *Developing a map of the world's mountain forests* in M.F. Price and N. Butt (eds.) Forests in sustainable mountain development: A state-of-knowledge report for 2000. CAB International, Wallingford: 4-9.

Kapos, V., et al (2000) *Developing a map of the world's mountain forests* in M.F. Price and N. Butt (eds.) Forests in sustainable mountain development: A state-of-knowledge report for 2000. CAB International, Wallingford: 4-9.

Kenny-Jordan, Charles B., Carlos Herz, Mario Anazco and Miguel Andrade, *Pioneering*

Change: Community Forestry in the Andean Highlands. Quito, Ecuador: FAO, 1999.

Koch-Weser, Maritta & Walter Kahlenborn, *Legal, economic, and compensation mechanisms in support of sustainable mountain development*. Bishkek Global Mountain Summit 2002 background paper.

Kreutzmann, Hermann (2001) *Development Indicators for Mountains*, Mountain Research and Development, 21(2): 132-139.

Latigue, Laura, "Protecting Forests through Co-Management". USAID: Contribution to BGMS e-conference, March, 2002.

Lewis, Ronald L. 1998. Transforming the Appalachian Countryside. Railroads, Deforestation, and Social Change in West Virginia, 1880-1920. Chapel Hill, U. of North Carolina Press.

Libiszewski, S. and Bachler, G.(1997), *Conflicts in mountain areas - a predicament for sustainable development* in B. Messerli and J. D. Ives (eds) Mountains of the World - A Global Priority Parthenon, New York: 103-130.

Lopez, Andres Felipe Betancourth, "The Phenomena of Peasant Mobility as a Search for Territories of Peace in the Central Mountains of Columbia." Universidad de Caldas, Columbia: Contribution to BGMS e-conference, March, 2002.

Lutz, Ernst, Stefano Pagiola, Carlos Reiche, 1994, *The Costs and Benefits of Soil Conservation: The Farmers Viewpoint*, The World Bank Research Observer, Vol. 9, No. 2, Washington DC

Messerli, B. and J. D. Ives (eds) (1997) Mountains of the World - A Global Priority. Parthenon, New York.

Meybeck, Michel, Pamela Green, and Charles Vorosmarty, *A New Typology for Mountains and Other Relief Classes*, Mountain Research and Development, February, 2001

Mphale, "Energy Demand, Access, Supply and Implications for Lesotho's Mountain Areas," National University of Lesotho: Contribution to BGMS e-conference, March, 2002.

New York State Environmental Facilities Corporation: New York City (NYC) Watershed Programs <http://www.nysefc.org/tas/NYCwatershed.htm>

Olsen, David M., et al, 2001, *Terrestrial Ecoregions of the World: A New Map of Life on Earth*, Bioscience Vol. 51, No. 11

Ostrom, Elinor, 1999, *Reformulating the Commons*, Center for Study of Institutions, Population, and the Environmental Change, Indiana University,

Pagiola, Stephen, 1998, *Economic Analysis of Incentives for Soil Conservation*, Environment Department, World Bank, forthcoming in Using Incentives for Soil Conservation, D. W. Sanders et al, eds, Science Publishers, Inc.

Perrot-Maitre, D. and P. Davis. 2001. *Case studies of Markets and Innovative Financial Mechanisms for Water Services from Forests*. Forest Trends, Washington DC.

Pinedo-Vassquez, Miguel, Daniel J. Zarin, Kevin Coffey, Christine Padoch, and Fernando Rabelo, 2001, *Post-Boom Logging in Amazonia*, Center for Environmental Research and Conservation, Columbia University, NYC, NY

Prahalad, C. K., and Stuart L. Hart, 2001, *The Fortune as the Bottom of the Pyramid*, Strategy and Security, Reprint No. 02106

Pratt, D. Jane, *Corporations, Communities, and Conservation*, California Management Review, University of California, Berkeley, 2001

----- *Corporations, Communities, and Conservation*. California Management Review, Vol. 43, No. 3, Berkeley, Ca: Haas School of Business, U. of California Press, Spring 2001

Rasmussen, Stephen F. and Safdar Parvez, *Sustaining Mountain Economies: Sustainable Livelihoods and Poverty Alleviation*, paper prepared by the Aga Khan Rural Support Programme for Bishkek Global Mountain Summit, Bishkek, October, 2002

Read, Tory, and Lafacadio Cortesi, Stories at the Forest Edge, The KEMALA approach to Crafting Good Governance and Sustainable Futures, Biodiversity Support Program, Washington, DC, 2001

Reetz, Geene, "Water Quality: A Case Study in the San Juan Mountains" US EPA: Contribution to BGMS e-conference, March, 2002, based on case study presented at the National Mountain Conference: Stewardship and Human Powered Recreation for the New Century, Golden Colorado, September, 2000.

Rerkasem, Kanok, and Benjavan Rerkasem, 1995, *Montane Mainland South-East Asia: Agroecosystems in Transition*, Global Environmental Change, Vol. 5, pp. 313-322, Elsevier Science Ltd. Great Britain

Rhodes, Robert E. (ed.), *Bridging Human and Ecological Landscapes: Participatory Research and Sustainable Development in an Andean Agricultural Frontier*. Dubuque, Iowa: Kendall/Hunt Publishing Co., 2001.

Rich, Bruce, 2000, *Trading in Global Negligence: The Need for Reform of Export Credit Agencies*, Workshop on global Dimensions of Global Financial Assistance, New America Foundation

Schlager, E., and E. Ostrom, 1992, *Property Rights Regimes and Natural Resources: A Conceptual Analysis*, Land Economics, Vol. 68, No. 3, pp 249-62

Shari, M and, and S. Prass. 2000. *Freeport-McMoRan: A Pit of Trouble (int'l edition)*. http://www.businessweek.com/2000/00_31/b3692148.htm. West Papua, Indonesia.

Shilling, John D. and Jennifer Osha, *Making Markets Pay for Stewardship: Opportunities to Reduce Rural Poverty and Enhance Conservation through Innovative Property Right Regimes and Markets for Environmental Services*, WWF-MPO, to be published, 2000

Smith, Anthony. 2000. Rural Mountain Community Asset-Building Program (RUMCAB). Lightstone Community Development Corporation and the Mountain Institute, Moyers,

West Virginia

Starr, S. Frederick, *Conflict and Peace in Mountain Societies*, paper prepared for Bishkek Global Mountain Summit, Bishkek, October, 2002

Stevens, Mervin. Comment on BMS-C1, Mountain Forum, March, 2002.

Swiss Agency for Development and Cooperation (2001) Mountains and People: An Account of Mountain Development Programmes by the SDC, Berne, Switzerland.

The Mountain Agenda, 1999, Mountains of the World, Tourism and Sustainable Mountain Development, Prepared for The Commission on sustainable Development, Center for Development and Environment, University of Berne, Berne Switzerland

----- 2000, Mountains of the World, Mountain Forests and Sustainable Development, Prepared for The Commission on sustainable Development, Center for Development and Environment, University of Berne, Berne Switzerland

----- 2001, Mountains of the World, Mountains, Energy, and Transport, Prepared for The Commission on sustainable Development, Center for Development and Environment, University of Berne, Berne Switzerland

The Mountain Institute, Investing in Mountains, 1997.

----- 1997. Investing in Mountains: Innovative Mechanisms and Promising Examples for Financing Conservation and Sustainable Development. Synthesis of a Mountain Forum Electronic Conference in Support of the Mountain Agenda.

----- 1998, Community Based Mountain Tourism, Practices for Linking Conservation with Enterprise, Synthesis of a Mountain Forum Electronic Conference in Support of the Mountain Agenda.

----- 1998, Sacred Mountains and Environmental Conservation, A Practitioner's Workshop, Synthesis of a Mountain Forum Electronic Conference in Support of the Mountain Agenda.

The Nature Conservancy, 2000, *Climate Action: Noel Kempff Mercado National Park, Bolivia*, Project Description and Operating Protocols (1999)

The Royal Swedish Academy of Sciences, The Abisko Agenda: Research for Mountain Area Development, 2002

Timsina, Netra Prasad, "Empowerment *vis a vis* marginalization: a mixed response from the decentralized institutions for sustainable resource management." Mountain Forum: Contribution to BGMS e-conference, March, 2002.

Tognetti, S.S. 2001. *Creating Incentives for River Basin Management as a Conservation Strategy- A survey of the Literature and Existing Initiatives*. US World Wildlife Fund.

Tupayachi, Epifanio Baca. "Experiences of Local Management, Ayacucho, Peru," Contribution to BGMS e-conference, March, 2002.

United Nations, The Declaration of IYM Objectives. NYC, December 2001

Upadhaya, Madhukar. *Greening Hills: Seeing the forest and the trees in Tough*

Terrain: Media Reports on Mountain Issues. Asia Pacific Mountain Network and Panos Institute South Asia.

Wackernagel, Mathis and William E. Rees, 1996, Our Ecological Footprint: Reducing Human Impact on the Earth, New Society Publishers, Gabriola Island, BC

Wilson, Scott, "A Life Worth More Than Gold." Washington Post, June 9, 2002

Wily, Liz Alden, and Sue Mbaya, 2001, *Land, People, and Forests, in eastern and southern Africa at the beginning of the 21st Century*, IUCN Eastern Africa Regional Office, Nairobi, Kenya

World Bank, World Development Report 2000/2001, Attacking Poverty, Washington DC, 2000

-----, World Development Report 2002/2003, Dynamic Development in a Sustainable World, Washington DC, 2002

Wunder, Sven, 2001, *Poverty Alleviation and Tropical Forests - What scope for Synergies?*, World Development, Vol 29, No. 11

WWF 2000 Living Planet Report, 2000, Gland, Switzerland

Notes to readers

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