Regional Report

Sustainable Mountain Development in the Andes

From Rio 1992 to Rio 2012 and beyond

2012

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

CONDESAN
Consorcio para el Desarrollo Sostenible de la Ecorregión Andina

Mountain Partnership

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20 years of Sustainable Mountain Development in the Andes
- from Rio 1992 to 2012 and beyond -

Final version
May 2012

Editors:
Christian Devenish
Cecilia Gianella

Revision:
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Calle Mayorazgo 217 San Borja, Lima 41-Perú
Teléfono: +511 618-9400 · Fax: +511 618-9415
condesan@condesan.org · www.condesan.org

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Consorcio para el Desarrollo Sostenible de la Ecorregión Andina - CONDESAN
Calle Mayorazgo 217
San Borja
Lima, Peru
Tel. +51 1 6189400
Email: condesan@condesan.org

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Case study information contributed by:
Andrés Felipe Betancourth - CONDESAN, Tatiana Castillo - Grupo Randi Randi, Magda Choquevilca - Agrobiodiversidad - Jujuy, Ximena Contreras Fernández - Chile Sustentable, Alfredo Durán - Centro Agua / UMSS, Antenor Florindez - Instituto Cuencas, Carla Gavilanes - GIZ, Ana González - GIZ, Sara Larrain Ruiz Tagle - Chile Sustentable, Luís Daniel Llambí - Universidad de los Andes, Julio Martinez - UGICH-Jujuy, Susan V. Poats - Grupo Randi Randi, Felipe Rubio Torgler - Fundación Humedalas, Segundo Sánchez - RENAMA-Cajamarca, Marco Sotomayor - Proyecto Masal, Cristián Villarroel Novoa - Chile Sustentable

Additional information and contributions to the report:
Dora Arévalo - CONDESAN, Diana Arzuza, María Teresa Becerra - SG CAN, Francisco Cuesta - CONDESAN, Edith Fernandez-Baca - CONDESAN, Verónica Galmez - PACC - Helvetas, Andrew Jarvis - CIAT, Robert Hofstede, Pablo Lagos - MRI -Peru, Galo Medina - ECOBONA, Arturo Mora - UICN - Sur, Edwin Ortiz - CONDESAN, Manuel Peralvo - CONDESAN, Amiro Pérez-Leroux - BirdLife International, Teobaldo Pinzas - ETC Andes, Julián Ramírez - CIAT, Luzmila Rosales - CONDESAN , Miguel Saravia - CONDESAN, Johannes Signer - CIAT, Angélica Villalba Eljach - Parlamento Andino, Emmanuel Zapata-Caldas - CIAT

Additional information also provided by workshop participants (see 5.0 Appendix a, b, c)

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SUMMARY AND KEY POLICY ACTIONS

Why the Andes matter

The Andes, covering 33% of the area of the Andean countries, are vital for the livelihoods of the majority of the region's population and the countries' economies. However, increasing pressure, fuelled by growing population numbers, changes in land use, unsustainable exploitation of resources, and climate change, could have far-reaching negative impacts on ecosystem goods and services. To achieve sustainable development, policy action is required regarding the protection of water resources, responsible mining practices, adaptation to climate change and mechanisms to generate and use knowledge for sound decision making.

How the Andes contribute to sustainable development

The Andes, covering a contiguous mountain region within Argentina, Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela, occupy more than 2,500,000 km² and have a population of about 85 million (45% of total country populations), with the northern Andes as one of the most densely populated mountain regions in the world. At least a further 20 million people are also dependent on mountain resources and ecosystem services in the large cities along the Pacific coast of South America.

The Andes play a vital part in national economies, accounting for a significant proportion of the region's GDP, providing large agricultural areas, mineral resources, and water for agriculture, hydroelectricity, domestic use, and some of the largest business centres in South America. However, some of the region's poorest areas are also located in the mountains.

The region is highly diverse in terms of landscape, biodiversity including agro-biodiversity, languages, peoples and cultures. Such varied conditions have led to a vast pool of knowledge, often undervalued, but of great importance, for example in for climate change adaptation strategies and measures.

Mountain areas have provided fertile ground for innovation in local governance, for example, in making decentralization policies and citizen participation a reality. The Andes also provide a backdrop for the regional policies of the Andean Community, a political organization covering four Andean nations, which provides a regional framework for addressing issues related to sustainable mountain development.

Nevertheless, increasing pressure on mountains, fuelled by a growing population, changes in land use, unsustainable exploitation of resources, and climate change, are important challenges that must be tackled in the pursuit of sustainable development. Ensuring water supplies, maintaining a healthy environment, and addressing climate change are essential tasks for maintaining the livelihoods of the majority of the population of the Andean countries. Success in addressing them will depend on achieving sustainable development within and beyond mountain areas. Without significant policy adaptations, resource use and development in the region will become increasingly unsustainable, with serious consequences for the region's economies, societies and the environment.

Policy action – Andean mountains and the future we want

Policy action should cover the regional, national and local levels. Regional integration, stressing the importance of mountain issues, should be promoted within the Andean Community, and eventually, the Union of South American Nations. An especially important function of these organizations is to create a common regional platform for strengthening the position of mountains in international conventions (CBD, UNFCCC, and UNCCD). At the national and local levels, action should focus on drafting and implementing specific strategies (e.g. ecosystem protection, responsible mining, green economy) and on innovative institutional mechanisms that bring mountain issues on political agendas.

- **Protect mountain ecosystems to safeguard water supplies**
  Action includes strategies for conservation of mountain ecosystems (paramos, wetlands, puna); lobbying for legal protection (laws for no-go mining zones, protected areas); mobilise basin-wide responsibility through strengthening upstream-downstream partnerships.

- **Promote agricultural production in mountain areas by building on local knowledge and local native products, while improving food security and protecting biodiversity**
  Action includes the wider recognition of women's role in food security involving Andean products and incentives for combining environmental protection with increased agricultural production.

- **Implement climate change adaptation actions for mountain regions across regional, national and local policies**
  Action includes the promotion of research and monitoring for evaluating the current and future contributions of upland ecosystems (wetlands, glaciers) to overall water supply under different climate change scenarios.

- **Transform current mining methods with responsible mining codes**
  Action includes policy formulation for responsible mining, including recyclability at all stages of production chains, both within as well as beyond the mining region.

- **Use regional cooperation to share and replicate experience on where and how decentralization and increased citizens' participation has been beneficial for sustainable mountain development**
  Action includes innovative governance mechanisms that allow stronger representation of mountain communities in national and regional decision making.

- **Improve coordination between educational institutions (especially state universities in mountain areas, research NGOs), and governments to ensure that knowledge generated can be applied to sustainable mountain development**
  Action includes, for example, alignment of research agendas with the specific development needs in mountain areas.

- **Improve communication mechanisms within government**
  Action includes identifying overlapping jurisdictions between government departments, between government levels (local and national); implementing multi-level approaches.

- **Implement decision support systems at local and regional levels, covering issues such as water management and climate change adaptation**
  Action includes capacity development for using new technologies in mountain regions; provide incentives to generate and share mountain-specific information for sound decision-making.

PART 1: SETTING THE STAGE

1.1 Introduction

The Andes, the world's longest mountain chain, on the east side of the Pacific ring of Fire, form the backbone of South America and are a major global physiographic feature, influencing climate, seismic energy, biodiversity, human culture and history around the world. The Andes cover a length of approximately 8,000 km, from Venezuela to Chile, passing from tropical climates with rainforests on their lower slopes, topped by cold, highland grasslands and snow-capped peaks in the north of the continent, to temperate, seasonal forests and large extents of permanent glaciers in the south. They reach their maximum width of approximately 650 km between Peru and Bolivia at about 20°S, and maximum height at 6962 m in Argentina. Their varied topography, including rugged peaks, altiplanos, or highland plateaus, have played a major role in affecting the geography of human habitation and associated activities such as agriculture and industry, as well as the use of biodiversity in the region. The enormous variety of ecosystems makes the Andean region one of the most biodiverse on the planet. The Andes are a major influence on livelihoods in seven of South America's 14 countries, as a major source of cultivated crops, instrumental in providing water to more than 100 million people, account for a significant portion of the region's GDP, provide energy and have shaped the culture of a large part of a continent. However, many of the mountain region's inhabitants live below the poverty line and pressures such as unsustainable use of highland areas, increasing urbanization and climate change seriously threaten the sustainability of the region's development. This report reviews progress in major issues of sustainable development in the region over the last 20 years as well as providing recommendations for future directions in sustainable mountain development. An added complexity to such a report is the difficulty in attempting to draw regional conclusions from such a large, complex and varied region, where important variations exist between countries.

1.2 Characteristics of the Andean region

1.2.1 Defining the Andes

For the purposes of this report, the Andean region has been defined using a combination of ecosystem classifications (Olson et al., 2001), ruggedness measures (Riley et al., 1999) and altitudinal limits within the seven Andean countries of South America (Venezuela, Colombia, Ecuador, Peru, Bolivia, Chile and Argentina) (Figure 1a). All terrain above 1000 m was included in the contiguous region of the Andean cordillera, as well as very rugged land over 500 m, following categories defined by Meybeck et al., (2001)and using montane ecoregions as a guide in certain regions[1]. Different altitudinal limits have been employed to define the Andes, often varying over latitude, from 500 to 800 m (Anderson et al., 2011). In these terms, the geographical focus of this report is the contiguous mountainous region of west South America (Figure 1a), and will be different to many other ecological, geological or even cultural definitions of the Andes, for example, in the inclusion of some mountain ranges of very different geological origin, not always classified as Andean. As defined by this method, the Andes have an extension of more than 8,000 km, and occupy an area of 2,728,760 km^2, or 33.3% of the total area of the seven Andean countries, and 15% of all South America, however marked differences exist at country level (Figure 1b). The Andes reach their maximum altitude in Argentina, at 6962 m on Aconcagua.

[1] In Patagonia, the inferior altitudinal limit is lower, and a combination of the terrain ruggedness index and temperate forest ecosystems were used to delimit the mountainous region.

Table 1. Summary information for Andean countries

Country	Country terrestrial area (km^2)	Altitudinal range	Population[2]	GDP per capita 2010 (current USD)[3]	Andean area (km^2)	Population in Andes	Urban extent in Andes (% of total urban area)	Urban population as % of total (2010 /2020)[4]
Argentina	2,766,890	0–6962	40,117,096 (2010)	$9,067	699,890	3,464,585	7%	91.4 / 92.5%
Bolivia	1,098,581	80–6542	8,274,325 (2001)	$1,973	397,200	6,818,530	61%	71.0 / 74.8%
Chile	756,096	0–6893	15,116,435 (2002)	$11,873	533,210	7,100,061	22%	87.9 / 89.6%
Colombia	1,141,748	0–5794	41,468,384 (2005)	$6,224	274,510	33,404,255	55%	78.4 / 81.4%
Ecuador	256,370	0–6310	14,483,499 (2010)	$4,277	109,210	6,746,355	45%	68.5 / 72.5%
Peru	1,285,215.6	0–6768	27,412,157 (2007)	$5,216	636,810	15,411,380	50%	74.6 / 76.3%
Venezuela	916,445	0–5007	23,232,553 (2001)	$13,451	77,930	11,671,680	24%	89.9 / 91.5%
Total Andean Countries	**8,221,346**	**0 - 6962**	**170,104,449**		**2,728,760**	**44.5%**	**29%**	

1.2.2 Demography

Currently, the Andes hold a population of approximately 84,500,000 people, or 44.5% of the total population of the seven Andean countries, making them one of the most highly urbanized mountain region in the world. In fact, the region has a history of relatively high population numbers, with estimates putting the Western Hemisphere's population at more than that of Europe at the time of the Spanish conquest (Mann, 2006), with estimates of the indigenous populations in the Andes including between 6 to 37 million Incas (McEwan, 2008), or 15.7 million in the Andes (Denevan 1992), where control of vast herds and hundreds of varieties of high altitude tubers and grains helped to maintain the density of Andean populations (Kuiper 2011).

Current patterns of human inhabitancy of the mountains change considerably from north to south (Figure 1b). In the former, the area of the Andes with regard to the total country area is small, yet a disproportionately large proportion of the country's population inhabit the mountains, while towards the south of the continent the opposite is true, and in Chile, the mountains occupy a large proportion of the country, but are inhabited by a relatively small percentage of the country's population. However, more important than a head count within a geographic delimitation of the mountains, the Andes undoubtedly provide ecosystem services to an even larger proportion of the seven countries´ inhabitants, including, for example, all the major cities on the Pacific slope of the Andes, with an estimated further 20 million people also dependent on the Andes.

Over the last 20 years, Colombia has been the most populated country (45m in 2010; DANE 2010a), with Bolivia also maintaining the smallest population (projected 10m in 2010), however, population growth has changed between countries, for example, Argentina and Colombia began the 1990s with similar populations, but Colombia showed a higher growth rate towards the end of the 20 year period. In the northern Andes, population density has also increased more within the Andean region than outside (Figure 2b). In terms of percentage of countries' populations living in the Andes

[2] According to last official census results: AR: www.indec.gov.ar; BO: www.ine.gob.bo; CL: www.ine.cl; CO: www.dane.gov.co; EC: www.inec.gob.ec; PE: www.inei.gob.pe; VE: www.ine.gob.ve

[3] World Bank 2010

[4] CEPAL 2000.

between 1990 and 2010, this has decreased in Venezuela and Bolivia, increased slightly in Argentina, and remained approximately level in the remaining countries.

a.

b.

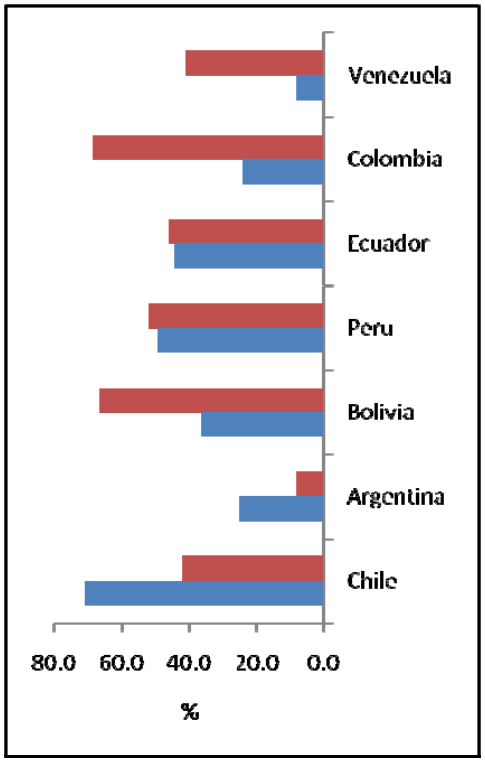

Figure 1. a) South America, showing the Andean region, as defined by this report; b) Proportion of total country area (blue) and population (red) represented by the Andean region.

The percentage of the population has increased in urban areas over the study period, with now between 69% and 91% of the Andean countries´ population living in urban areas, compared to 55% to 87% in 1990 (CEPAL 2000a). The highest rates of change correspond to Bolivia and Ecuador, with difference of 13 and 15 percentage points, respectively. The largest cities in the Andean countries (>1,000,000 inhabitants) are evenly distributed inside and outside the Andean region (Table 2), however, many of those outside, including Lima, the most populated city in the Andean countries, depend heavily on the Andes for resources, such as water and electricity. Although the number of regional capitals outside the Andes is considerably larger than within the Andean region, the total population of the cities between the two regions is almost the same (Table 2), and of the total area covered by cities in the Andean countries (calculated from CIESIN 2004), 29% lies within the Andes, implying that urban population density is considerably greater within the Andes than outside. By 2000, between 54% and 77% of total country populations were living in cities of over 20,000 inhabitants (CEPAL 2000b)

Table 2. Administrative region capitals and federal districts. Population data from most recent census[2]

	In Andes		Outside Andes	
Population group	**No. cities**	**Total population**	**No. cities**	**Total population**
≤ 50,000	8	224,987	17	430,621
>50,000	6	381,465	9	672,033
>100,000	28	6,480,750	52	11,948,493
>500,000	8	5,269,204	6	4,245,918
>1,000,000	6	13,586,660	8	14,633,970
>5,000,000	2	12,253,100	1	7,605,740
Total	**58**	**38,196,166**	**93**	**39,536,775**

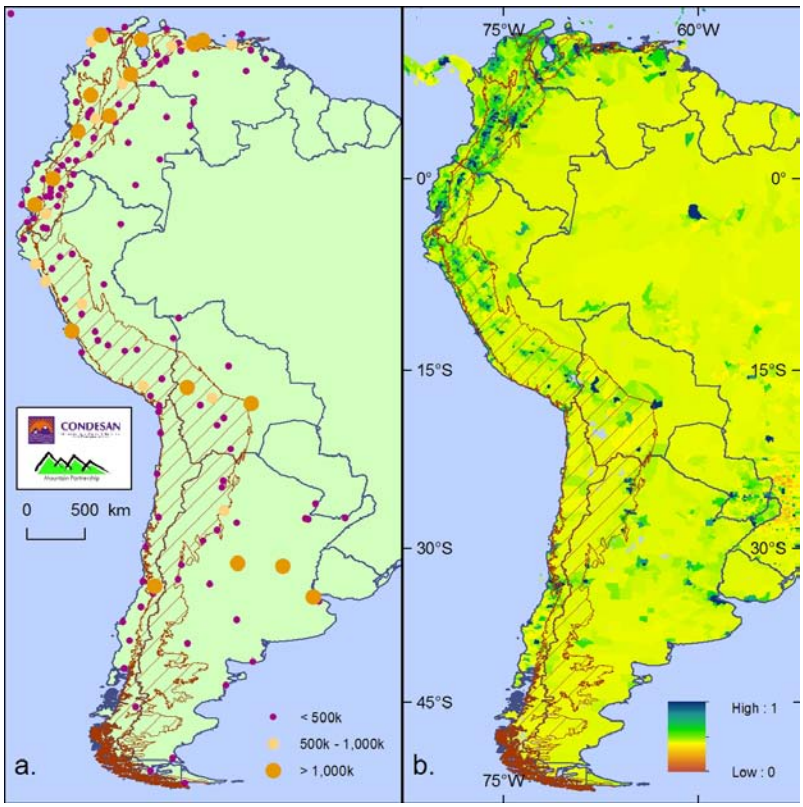

Figure 2. Andes area showing a) major cities by population size, b) normalised changes in population density (1990-2010) (CIESIN 2010).

1.2.3 Environmental characteristics

The Andes represent one of the most biodiverse regions of the world, especially in the north, where estimates of species richness in the Tropical Andes Hotspot are among the highest of any region on the planet (Mittermeier et al., 1999). Multiple climate types, ecosystems and habitats as well as high rates of speciation and presence of physical barriers are in part responsible for this diversity. Endemism is also pronounced, especially in the north, where an estimated half of the 30,000 plant species are endemic to the Tropical Andes biodiversity hotspot (Mittermeier et al., 1999). Further south, the Andean region also contains part of the Chilean Winter Rainfall-Valdivian Forests, where almost 2000 of the approximately 4000 plants are also endemic. The Andes are also important in providing habitat to many migratory species, for example, millions of Neotropical migrant birds spend several months of the year wintering in the Andes, or passing through to sites in the Amazon or Southern Cone grasslands.

According to the ecoregional classification (Olson et al., 2001), three major biomes account for more than 75% of the Andean region, 1) dry forests, scrub and deserts[5] (14%), including dry forests of the inter-Andean valleys and dry scrub at lower altitudes on the coastal side of the Andes in Venezuela, Colombia, Ecuador and Peru; 2) montane grasslands (31%), including paramo in the north from Venezuela to north Peru, and the puna of the Central Andes, as far as north Argentina, and 3) tropical broadleaf forests (29%), including cloud forest along the outer flanks of the Andes in the north to the yungas of Bolivia and north Argentina. Temperate grasslands and broadleaf forests (10% each) make up most of the remaining area, including the Valdivian and Magellanic forests and Patagonian steppe of Argentina and Chile.

The longest rivers originating in the Andes include the Pilcomayo (Bolivia, Argentina), Marañon, Ucayali (Peru), Putumayo (Colombia, Ecuador, Peru), Magdalena (Colombia) and Salado (Argentina), as tributaries of the Amazon in the first three cases, and the Paraná, in the latter. Rivers such as the Magdalena, the Amazon and Orinoco, whose tributaries originate in the Andes, are among some of the largest rivers in the world, and influenced by water levels in the above Andean rivers.

[5] Grouped from Deserts and Xeric Shrublands and Tropical and Subtropical Dry Broadleaf Forests.

In terms of climate, seasonal variation in temperature in the Andean mountains is much higher in the south of the continent than in the north, with little variation throughout the year in Colombia, Venezuela or Ecuador(Figure 3a). However, diurnal variation in temperature, generally increasing with higher altitude, is a strong influence on ecosystems and livelihoods throughout the Andes, although has its greatest expression in the Central Andes.

Although South America holds almost a third of the world's water resources and receives 26% of the world's precipitation (FAO 2003), these are unevenly distributed, especially in the Andes, where the effects of precipitation patterns, extreme temperature gradients, oceanic currents and humid air masses from the huge Amazon basin to the east and the relatively small Pacific basins to the west, create very different climate conditions. Patterns of rainfall resulting from humid air masses from the Amazon to the east, are generally less seasonal in the north, whereas further south in the Central Andes, rainfall peaks during the first months of the year. A similar pattern is shown on the Pacific side, but with more extreme variation in rainfall, from some of the highest rainfall in the world in the Colombia Chocó, but reaching very low levels all year round on the coasts of central Peru through to central Chile, due to effects of the cold Humboldt current. On average, precipitation in the mountainous region of the Andean countries is generally higher, and bimodal in the north, lower in the Central Andes and markedly less seasonal in the Southern Cone (Figure 3b). Local effects within inter-Andean valleys vary from little rainfall all year round to bimodal patterns or constant rainfall (De Bièvre et al., in press). Heterogeneity in these patterns have important implications in the availability of water for agriculture and large cities.

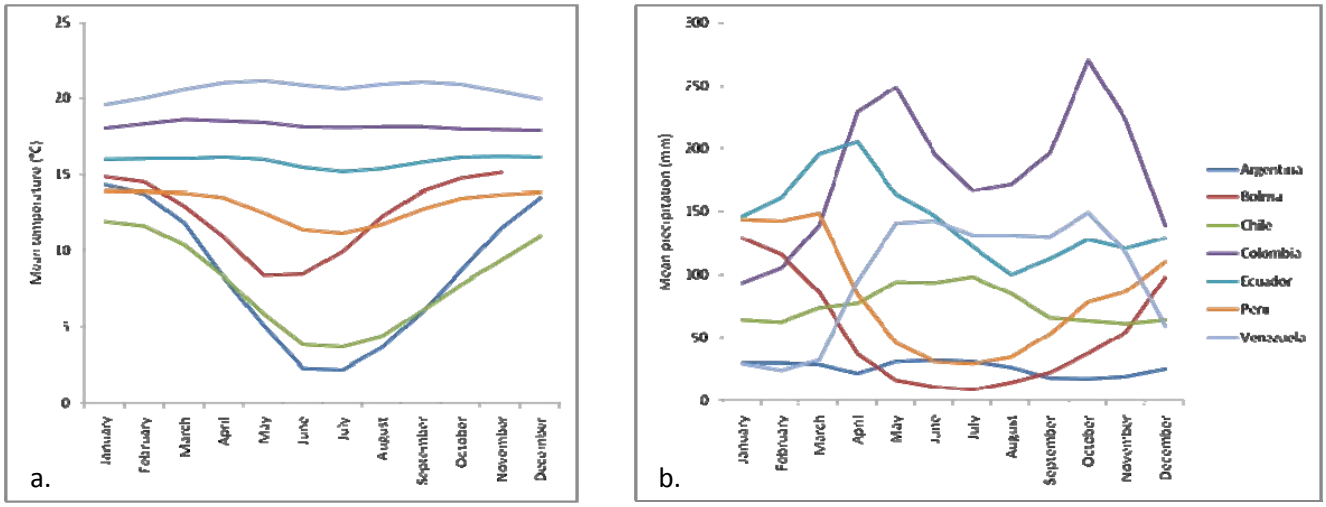

Figure 3. Mean monthly temperature (a) and (b) rainfall for the Andean mountain region (calculated from Hijmans et al., 2005).

The resulting provision of water, to maintain ecological processes as well as providing for human needs (i.e. agriculture, industry, and domestic consumption), is largely the sum of rainfall less effects of evaporation, which varies throughout the year, as described above. In this sense, mechanisms ensuring regulation of water supply, become especially important in maintaining water flows throughout drier periods of the year.

High mountain ecosystems, such as paramo and humid puna, are especially important in terms of water regulation, providing much of the water for large cities in the north of the region. Water retention in these ecosystems is influenced by a low level of evaporation due to the cold climate, high level of cloudiness and humus-rich soils. However, these systems are also fragile (leading to special protection in some cases - see 2.2), with water regulating properties affected by changes in vegetation coverage, for example, due to cattle and potato farming.

Additional regulation is provided by glaciers, although the extent of glaciers, and therefore the role they play in regulation, is limited in the Tropical Andes in the north. Total glacierized area in the Andes has been estimated at 25,000 km^2 (Dyurgerov & Meier 2005) and 36,700 km^2 (Radić & Hock 2010), representing 3.5% of the world´s glaciers (including Antarctica and Greenland) by volume and 5% by area (Radić & Hock 2010). Of these glaciers, about 80% are found in Chile (Bórquez et al., 2006).

Water resources per person in South America are approximately 35,000 m^3/year, well above the world's average, with higher values for northern Andean countries than southern Andean (FAO 2003). In terms of the total amount of fresh water that is used to produce the goods and services consumed by the inhabitants of a nation, known as the water footprint of national consumption (Mekonnen & Hoekstra, 2011), this also varies considerably among Andean countries, depending on factors such as water availability within the country (i.e. lower in countries with more extensive arid areas), dependence on agriculture and population (Table 3). Three countries are below the global average of 1385 m^3/yr per capita.

Table 3. Water footprint for Andean nations (Mekonnen & Hoekstra, 2011)

Country	Total water footprint of national consumption per capita (m^3/yr/cap)
Argentina	1607
Bolivia	3468
Chile	1155
Colombia	1375
Ecuador	2007
Peru	1088
Venezuela	1710

1.2.4 Influence of the Andes on the regional economy

Mountains are hugely influential on the economies of the seven Andean countries, albeit with important differences between countries, in part, dependent on the proportion of national territory occupied by the Andes. The Andes contain important mineral resources for nearly all countries, large areas of agricultural land, provide water for agriculture, domestic use and hydroelectric energy production, and house some of the largest business capitals of South America.

GDP per capita in the seven countries has risen over the last 20 years (Figure 4), although effects of economic crises at national (2002, Argentina, Venezuela) or global level (1999, 2009) are evident, and order of magnitude differences between highest and lowest GDP among countries remain throughout the period (Table 1). Ecuador and Bolivia show the smallest increases, while Argentina has risen dramatically, despite the dip in 2002, in part reflecting slightly lower rates of population increase in this country. In terms of the specific contribution by the Andean region to GDP, data are generally unavailable, but mining, agriculture and services based in Andean cities represent important contributions from the mountain region.

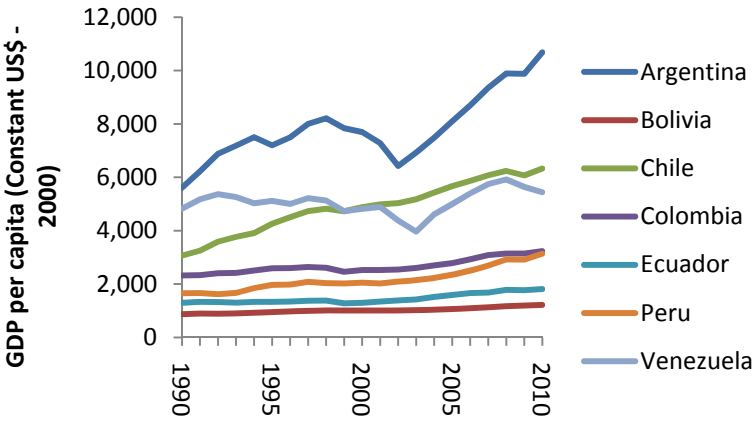

Figure 4. GDP per capita 1990-2010 for Andean countries (World Bank 2011)

Demographic trends in urban populations over the last 30 years also reflect economic transitions. A general approximation classifies countries according to degree of urban transition CEPAL (2000), with those in mid urban transition having large industrialized areas and characterised by development of tourist and industry sectors, corresponding to Colombia and Peru in the Andes. At the other ends of the extreme are those countries with an advanced urban transition (Argentina, Chile, Venezuela), representing post-industrial settlements with larger proportion of urban populations, and moving towards economies based on services; whereas those considered as having moderate urban transition (Ecuador, Bolivia) have important areas destined towards agriculture and rural activities. Although this may provide general indication of trends, precisions within countries, such as a strong agricultural sector in Argentina, or tourist development in Ecuador, should be taken into account.

Globally important reserves of metals and minerals are found in the Andes, with the mining sector representing a major part of the economies of all seven countries, gaining importance since 1990, with increasing trends in production of minerals (CEPAL Stat). However, its role in national economies is very different to that played by agriculture, for example, in that the activity generally employs less people, and represents a smaller contribution to GDP, but provides a large proportion of the total exports. For example, in Peru, mining contributed 4.1% of GDP in 2010, but accounted for 70% of exports, with metals, almost all originating from the Andes, representing 61%. Direct employment generated by mining activities was just under 1% of the economically active population, and including related service industries would have reached two or three times this figure, but remains small when compared to approximately 30% in agriculture. Growth of mining in Peru, between 1990 and 2010, as a percentage of total exports, has risen by almost 15 points, whereas the direct employment generated by the activity has remained relatively steady at 1% throughout the same period (ILO 2011). However, more integral economic indicators show different patterns, as in an example from Chile, often cited as the economic success of the Andean countries. While GDP grew by over 90% in a 30 year period, ending in 1995, an Index of Sustainable Economic Welfare, decreased by almost 5%, showing the gap between economic growth and environmental and social sustainability (Gudynas, 2004).

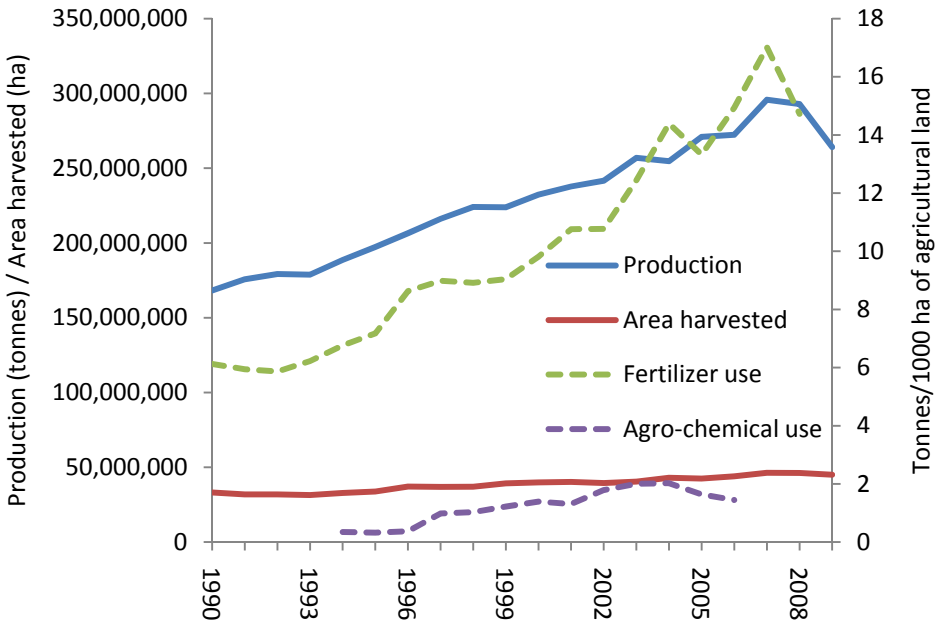

Figure 5. Agricultural production, harvested area (left axis) and chemical use (right axis) in Andean countries, 1990-2008 (CEPAL 2011, FAO Stats)[6].

Agricultural production in the seven Andean countries reached almost 300 million tonnes in 2009, representing a 75% increase in production since 1990, whereas the area harvested has remained relatively stable over the same time period

[6] Pesticide use only for Colombia, Ecuador and Peru.

(FAOSTAT 2010), implying an large increase in yield and agricultural intensity. Pesticide and fertilizer use during the same period showed parallel increases in all countries (Figure 5). The value of agricultural production has also increased in the last 20 years in all Andean countries, with annual growth rates of production value between 2 and 6% (calculated from FAO Stats), with the highest absolute difference between 1990 and 2009 registered in Argentina ($14,000 m USD), and the highest growth in Peru (6.6% annual growth). For the year 2009, agricultural crops in the Andean countries contributed to between 3 and 13% of GDP (World Bank 2011).

However, without detailed analysis of agricultural production at subnational level (although administrative boundaries are not aligned with the Andean region either), relative importance of the Andes for many products produced in mountain areas or outside is difficult to establish and the above trends may largely represent those in lowland areas. There have certainly been important increases in certain biofuel crops, for example, soybean or palm oil (e.g. in Argentina, Bolivia and Colombia), corresponding largely to areas outside the Andean region. An analysis of mainly Andean crops representing approximately 10% of the total agricultural production value for the seven countries, shows that although value has increased over the last 20 years, production has levelled off and area harvested has slightly decreased. However, important crops, such as rice and maize, cover both Andean areas and lowlands, and are difficult to break down into mountain and non-mountain components. Similarly in livestock, the Andes vary in importance for animals such as cattle, with the lowlands in Colombia, Venezuela and Argentina accounting for much of growth in this area, however, Andean camelids have shown increases in yield and value over the 20 year period in Peru and Bolivia. What is certain, is that water from the Andes, in two of the largest agricultural exporters, Peru and Chile, accounts for almost all water used in this activity.

The importance of the Andean region for agriculture was estimated using two models of cropland area for principal crops in South America (You et al., 2000, Ramankutty et al., 2008) intersected with the Andean region, as defined for this report. Overall, the Andes contributed to 15-17% of the total cropland area of the seven countries, with marked differences existing between countries, with the Andes being more important in the north, with large proportions of total crop area in Peru, Colombia and Ecuador

Dams and reservoir infrastructure in the Andes provide water for hydroelectric power and agriculture, with the mountain region holding 76% of the dams in the seven countries (data from Lehner et al., 2007[7]), however, most uses of reservoirs in this database are not specified. Hydroelectric energy represents an average of 63.6% of total energy supply across the Andean countries (CEPAL 2011), of which 52% is generated within the mountain region overall, but with large variation between countries[8]. Apart from Venezuela (dominated by the Guri plant, the third largest in the world) and Argentina, in the rest of the Andean countries, over 85% of hydroelectric energy generated in the mountain regions (Figure 6), representing a very significant contribution to the Andean countries' total energy supply. A large number of new hydroelectric plants are projected in several Andean countries.

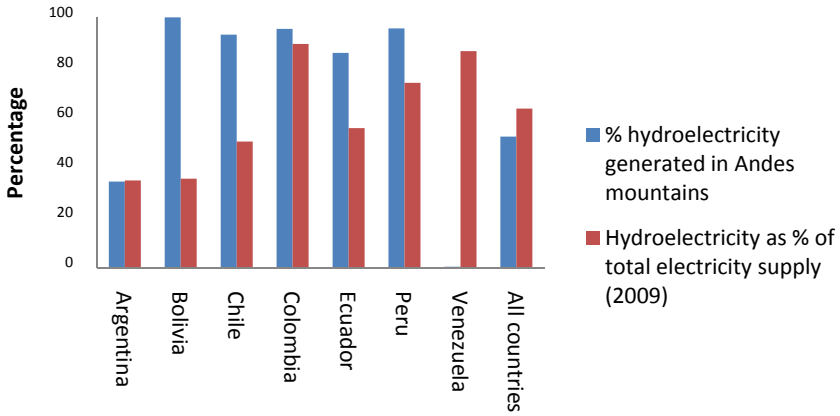

Figure 6. Hydroelectric energy generation in the Andes

[7] The database holds information on all reservoirs with a storage capacity of more than 0.1 km^3.

[8] Data from analysis for this report, based on national sources.

1.2.5 Social characteristics

The diversity of societies in the Andes, both at present, and during the long history of human habitation in the region, in many respects matches the degree of biological diversity discussed above. However, as opposed to biodiversity, unifying currencies, such as common systems of government and language, as well as a history of violent repression, may overshadow this diversity, at least, superficially.

Democracies have existed in all Andean countries for at least the last 20 years, with transitions from military dictatorships in five countries taking place in the decade before the period of this report. In other countries, histories of democracy date back much longer, although abrupt changes of government have taken place in Ecuador and Venezuela since 1990. However, even within democracies, tendencies for protagonism of strong political figures, above, or outside a traditional party political context, are still very evident. Furthermore, established democracies are still a long way from achieving fairer societies, as evidenced by civil society frustrations remaining focused on issues such as inequalities between wealth and power, weak participation in public issues, corruption and state weaknesses, among other issues[9] (PNUD & OEA 2010). In general, South America has shown increasing economic growth over the last 20 years, marked especially in the 1990s by a strong trend in Neoliberal economic policies, mainly based on extractive industries. However, although a certain economic and political stability has been achieved, the transformation of territories, and changes in access to resources such as land and water, have effected livelihoods in the Andes. In recent years, some Andean countries have placed a far greater emphasis on social inclusion within a wide spectrum of government initiatives, for example in Ecuador and Bolivia.

Spanish as a common language has undoubtedly benefitted social dialogue and integration across the Andes, as opposed to nearly all other mountain regions around the world, notwithstanding the large number of indigenous languages also spoken. Of these, Quechua is dominant in the region (in part, a legacy of the Inca empire), uniting some 10 million speakers from northern Ecuador to northern Argentina, and reflecting a certain degree of social unity, or Andean civilisation from earlier times, albeit without political integration (Kuiper, 2011). Indigenous languages are official languages in Andean countries (Peru and Bolivia), within country regions (Colombia, Ecuador) as well as being recognised in political constitutions (Venezuela, Ecuador).

A wide range of social groups exist across the Andean countries, including many distinct indigenous peoples, as well as other well-defined social groups, such as rural peasant farmers, and Afro-descendents, although the latter are generally settled in lowland, coastal areas, outside the mountainous region. However, indigenous communities represent the most organized and influential social movements in the Andes.

From the beginning of the 1990s, indigenous movements played important roles in fundamental aspects of national politics and legislation in Andean countries, such as the inclusion of indigenous issues in political constitutions. For instance, constitutions recognise the plurality of cultures and ethnicities of societies in Bolivia, Ecuador and Venezuela, and in Colombia, Ecuador and Venezuela, indigenous representatives participated within the constituent assemblies. In terms of autonomy over decisions affecting indigenous, or other native community territories, between 1991 and 2008, all Andean countries ratified the International Labour Organization (ILO) Convention 169 on rights of indigenous and tribal peoples to decide on their own development priorities (Table 8). Article 15 of this convention relates to obligatory consultation over resources within indigenous territories, as well as the participation of communities in the exploitation and management of these resources. Despite this article being employed repeatedly to defend indigenous rights, to date, only Peru has brought out legislation to implement this measure in law (see section 1.3.4) although regulations are yet to be issued for it.

[9] These themes are revisited within this report (see sections 2.2, 2.3) where both achievements and limitations in the context of sustainable mountain development are discussed.

Changes in land use and associated transformation of territories in the Andes, principally due to increasing urbanization and economies based on extractive industries, have effected indigenous movements, especially with regard to access and use of resources on which the livelihoods of rural populations are based. These changes have strengthened common objectives among organized groups, centred on issues of land and water, especially indigenous movements in Ecuador, Bolivia and Peru.

1.3 Drivers of change in the Andes

1.3.1 Population pressure and migration

The growing population in the Andes has increased demands on water and resources over the last 20 years. A 57% increase in energy consumption has been registered in all Andean countries between 1990 and 2009 (OLADE 2010), but the contribution of renewable sources of energy has decreased sharply in all countries except Venezuela and Argentina, dropping from 23% to 17% on average (CEPAL, calculated from OLADE 2010). Population pressures on ecosystems, measured in terms of population numbers and accessibility, show high degrees of threat in the Northern Andes at South American level, and in Patagonia where the road network is dense, despite low population levels (Jarvis et al., 2010). Migration processes have also played a role in changing regional dynamics, with moves towards cities, and migrations to other countries. Inadequate management of water resources (see section 2.5) has contributed to migrations away from rural areas towards cities, as a result of increasing poverty through worsening agricultural production, soil erosion and scarcity of water, among other issues (Acosta & Alvarez, in press). Hard hit areas include the River Santa basin in Ancash, Peru and River Checua, Cundinamarca, Colombia where in the latter, migration was actually promoted in the higher reaches of the river to detain further deterioration. In terms of international migration, receiving countries are principally the USA and Spain (Pizarro 2011) with Ecuador, Colombia and Bolivia representing the most numerous nationalities of immigrants to the latter country. Since the end of the 1990s, some 11% of Ecuador's population live outside the country, impacts on the economy can be appreciated in that remittances sent from abroad represent the greatest contribution to GPD after petroleum exports (Pizzaro 2011). If migrants generally send money back to their regions of origin, then more than 40% of those leaving are from the Andes, given that of five regions where more than 70% of remittances are concentrated, four are in the Andes, making up almost 40% of the total[10]. Effects on family life are also strong, with many children being left behind to be brought up by an older generation. In Colombia the situation is similar, with an important wave of migrations during the 1990s. Remittances in Colombia have increased almost threefold in the last 10 years, reaching 2.7 times the value of coffee exports in 2009. More than 50% of remittances are received in mainly Andean provinces of the country (DNP 2010), with a strong concentration in the Coffee-growing region.

1.3.2 Land use and agriculture

Parts of the Andes have been populated almost continuously for more than 20,000 years (Dollfus & Lavallee 1973), and this long period of human presence with associated changes in technology and land use systems has had a major impacts on natural landscapes (Denevan 1992). Areas within the Andes, especially the Tropical Andes, form part of at least 10 main centres of crop origin (Balter 2007), with the Southern Andes, also included in some classifications (Mannion 1999). The history of agriculture in the region dates back to at least 9,000 years ago (Dillehay et al., 2007; Piperno & Dillehay 2008), with indications of adoption of important crops such as potato, squash, cotton and possibly maize around this time. In fact, mayor land cover changes took place in the Andes several millennia ago (Young 2009). In order to support populations of at least 15 million people, mostly dependent on agriculture, land transformation, such as construction of terraces had already taken place over a large area of the Andean mountains by the time Columbus sighted land in 1492 in the New World (Butzer 1992; Denevan 1992).

Current changes in land use, strongly linked to agriculture, are responsible for growing pressures on natural systems in the Andes. At a regional level, South America suffered the largest net loss of forest between 1990 and 2010, at about 0.6

[10] http://www.remesasecuador.com/

hectares per year above Africa for the period 2000 - 2010 (FAO 2010). Between 1990 and 2010, forest extent for the whole of the seven Andean countries decreased by 239,110 km^2, as reported to the Forest and Agriculture Organization (FAO 2010), representing a decrease from 38% to 35% of total area covered in forest. During the same period, planted forest extent rose slightly, by almost 25,000 km^2. Forest cover of the seven countries varies considerably, from 10% in Argentina, to over 50% in Bolivia, Colombia, Peru and Venezuela, largely in proportion to their Amazon extents.

In a regional ecosystem map, covering the mountainous region of the northern Andes (without Chile and Argentina), transformed ecosystems were found to correspond to 22% of the area mapped for the period 2000-2003 (Josse et al., 2009). Differences between countries are marked, ranging from 3% of transformed areas in Bolivia to 58% in Colombia, with generally lower percentages of remaining natural ecosystems in the north of the continent, where the transformed area is actually larger than the area of natural vegetation, with the opposite occurring in the Central Andes (Josse et al., 2009).

A free trade agreement between Peru and the USA has increased production of certain products, for example asparagus, as almost exclusively for export. Even though these are grown outside the Andes, they have impacts on Andean regions, in terms of water availability. Water scarcity in the mountain region above Ica, in Peru, as a result of this particular case of agricultural expansion is already affecting the poorest communities (Hepworth et al., 2010). A free trade agreement between the USA and Colombia has recently been approved, after negotiations started in 2004.

Food supply from agriculture is subject to increasing uncertainty in areas where climate change could impact negatively in climate suitability for major crops, although changing climates are also predicted to increase agricultural production in some areas, and could increasingly drive agricultural expansion. Emerging issues, such as land grabbing, reducing civil society decision making capacity through reduced land ownership, could also effect the future distribution of agricultural production, however, available information emphasises investments in the lowlands of countries such as Brazil and Argentina. However, the location in the lowlands often provides little benefit to mountain populations, raising concerns for the fair and equitable sharing of benefits (Borras & Franco, 2010; Taylor & Bending 2009). In the Andes, increases in mining activity have been an important factor in land grabbing activities, for example in Chile and Peru, with serious implications for governance, access to water, and food security, among other issues.

1.3.3 Mining

A common denominator of the seven Andean countries is that their economies are heavily based on mineral extraction. Apart from petroleum and gas, mainly concentrated outside the Andes, the region is affected to different degrees in each country, but areas of high altitude, for example, paramos in the north and puna, further south, are increasingly affected by mining or are under concession. Mining is cited in Peru´s CBD national report as a threat for fragile mountain systems (Ministerio del Ambiente 2006). An analysis of mining concessions and exploitation in the northern Andes shows that mining exploitation is currently (2009) concentrated in Peru and Bolivia, while large areas have been granted concessions in Colombia and Ecuador, including in national parks in the latter. The study shows that large areas of montane forest in the four countries are under mining concessions, with up to 75% of humid forest in Ecuador (Cuesta et al., 2009; Figure 7, Table 4). Only a small area of each concession is actually used for exploitation, although the impacts of the activity, for example in pollution, opening access to undisturbed areas and changes in local social dynamics and economies, are often much further reaching. Conflicts for resources, especially water, are also increasingly common, and with a potential to become more serious as climate change affects water availability. In Argentina and Chile mining projects have caused controversy by destroying glaciers. Although mining has represented an important factor in the development of Andean countries over the last 20 years, social or economic investment in the actual areas of exploitation has not been proportional to the mining effort (e.g. Renaud, 2008). Mining activities have grown in all Andean countries as evidenced by growth in exports of mining products.

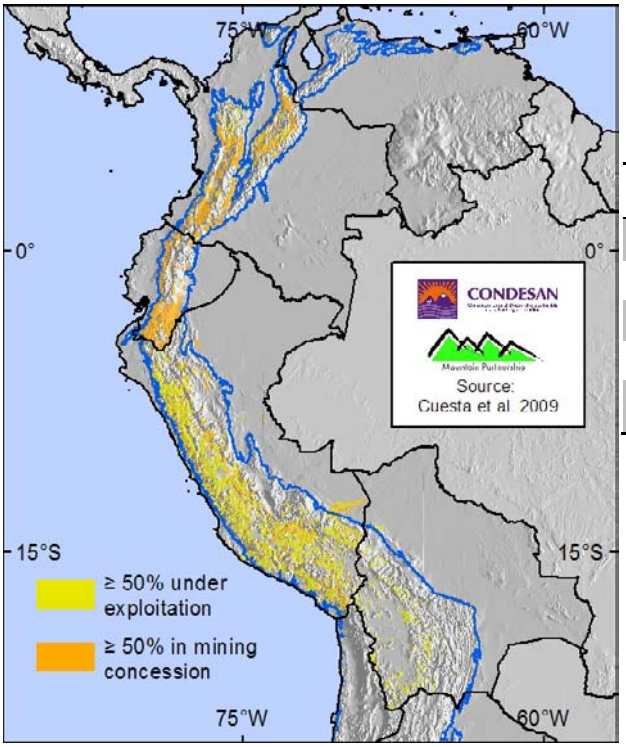

Figure 7. Mining concessions and exploitation in the northern Andes (Cuesta et al 2009)

Table 4. Area of forest types under mining exploitation or concession in the northern Andes (Cuesta el al 2009)

	Pluvial forest	Pluviseasonal forest	Xeric forest
Bolivia	233	262	940
Colombia	12,566	91	0
Ecuador	8,002	3,708	725
Peru	5,285	6,009	3,583
Total	**26,086 (12.9%)**	**10,070 (12.5%)**	**5,248 (6.9%)**

Investment in mining has been encouraged by most governments in the region, through legislation or hierarchies of applying legislation and norms. The Survey of Mining Companies, published by the Fraser Institute (McMahon & Cervantes 2011), provides trends on attractiveness of mining policies, based on opinions of mining company high executives. In the last five years, Colombia and Ecuador have both showed increases in potential, according to mining company bosses, Chile remains stable and Bolivia and Peru have shown decreases, possibly due to indigenous protests in Bolivia, and new legislation in Peru, although both countries, in practice, have increased mining activities over this period. In Argentina, the government introduced a packet of laws in the 1990s, paving the way for investment by multinational mining companies, at the same as creating a body for environmental control of mining, but under the control of the same body promoting mining investment, instead of the ministry of environment and sustainable development, or provincial environmental organizations.

Specific safeguards are also present in legislation on mining, for example, in Peru and Colombia. In Peru, a new law on "previous consultation" requires agreement with rural and indigenous communities to obtained prior to the implementation of projects effecting communities or their ancestral territories, with obvious implications for mining projects, although the right of veto is not included. In Colombia, a new law on mining excluded mining activities in paramo mountain ecosystems, however, its future is uncertain given that it has been declared unconstitutional (for other reasons) and a further limitation is that an exact definition and delimitation of paramos is yet to be produced.

1.3.4 Climate change

Climate change has already affected, and is set to increasingly affect biodiversity and livelihoods in the Andes, for example, in changes in climatic niches and habitats for biodiversity and changes in water availability and climate suitability for agriculture.

Mountain areas have experienced above average warming during the 20th century (Fischlin et al., 2007), in the Andes this is no exception. Key trends in climate change include increasing temperatures (driven by greenhouse gases), less precipitation, upward shifts in cloud bases, and affecting soil moisture content (CONDESAN-CIAT in press), Young 2009), but with different impacts locally (Table 5). Given the close relationship between climate and ecosystems (Rivas-Martínez

2008), ecosystems are expected to change, especially in areas, such as the Tropical Andes, where inter-annual variation in climate is less than predicted changes in climate (Anderson et al., 2011). Young et al., (2011) present a synthesis of the vulnerability of tropical Andean ecosystems to climate change, among those classified as most vulnerable are those with shortest history of human use, paramos (given their location on mountain tops, their area is likely to decline due to invasion of woody plants from lower altitudes and unsuitable soils for immediate colonisation higher up) and cloud forests (base levels of cloud will rise with warming temperatures, leading to less humidity, and also increasing vulnerability to conversion to agricultural uses). However, the high variation in relief may also buffer some impacts of climate change, with large climatic gradients over small areas providing potential sites for colonisation.

However, uncertainty in predicting future changes in climate is high, especially given the complex nature of climate in the Andes, added to the lack of knowledge of their current situation (CONDESAN-CIAT, in press). Although temperature is predicted to increase, rainfall is more complex, and outside the southern Andes, where it is forecast to decrease, future patterns will depend heavily on changes in El Niño patterns (Kohler & Maselli, 2009)

Table 5. Expected climate change impacts in the Andean region of countries (National UNFCCC communications[11])

Country	Impacts
Argentina	Less snowfall in mountains (affecting hydroelectric production, and water availability for irrigation) Reduction in rainfall in mountains (trends recorded since last century) Warming of 1° C (greater demand for water in agriculture due to greater evapotranspiration
Bolivia	Greater concentration of rainfall with less days of rain and more intense flooding Greater frequency of frost Greater frequency of hail (destruction of crops) Longer periods without rain (greater need for irrigation, reduction in hydroelectric energy) Retreat of glaciers
Chile	Decrease in rainfall from north to centre of country (reduced agricultural yields), and increases on altiplano and further south (increase in suitable climate for grasslands and yields) Decrease in frosts, milder Spring temperatures (improve conditions for temperate fruit growing), but colder winter temperatures.
Colombia	Transition from semi-humid to semi-arid climate in mountain regions
Ecuador	Reduction in rainfall (affecting hydroelectric production), conversion to grasslands in some agriculture regions Reduction in glacier areas
Peru	Increase in rainfall north, central mountains, decrease in rainfall further south Increase in temperature in all mountain regions Drastic reduction in areas of glaciers, or disappearance (affecting tourism)
Venezuela	Increase in areas with less than four months of rain per year. Relocation of tourism to higher elevations

Nevertheless, this vulnerability of high Andean ecosystems, such as paramo and puna, to effects of climate change, in addition to more erratic precipitation patterns, increased evapotranspiration and alteration of soil properties, will have serious consequences for their function in surface water provision (CONDESAN-CIAT, in press, Buytaert et al., 2011). The role of Andean forests in water regulation is also important, although uncertainty exists as to how feedback from effects of changes in paramos ecosystems will affect cloud forests, with both higher or lower levels of cloudiness possible (Buytaert et al., 2011).

Retreating glaciers have been reported in all Andean countries over the last three decades due to atmospheric warming, with a mean decadal increase in temperature of 0.33°C reported for the Tropical Andes between Ecuador and Chile, from 1973 to 1998 (Vuille & Bradley, 2000). Numerous glaciers have been completely lost, for example, there are 145 cases in

[11] República de Argentina, 2007; Estado Plurinacional de Bolivia, 2009; República de Chile, 1999; República del Colombia, 2010; República del Ecuador, 2000; Ministerio de Medio Ambiente, Peru. 2010; República Bolivariana de Venezuela, 2005.

the Cordillera Blanca of Peru and rates of reduction of 26% between 1970 and 2003, 87% reduction in the Mérida Cordillera in Venezuela in the last 50 years, 27% in Ecuador from 1997 to 2006, and 2 to 5% annually in Colombia over the last 10 years. The annual rate of contribution to rising sea levels from the Patagonian ice fields has doubled in the period 2000-2005, compared to 1975-2000, with reductions of up to 50% in the area of small glaciers in the Argentinean Tierra del Fuego (López Arenas & Ramírez Cadena 2010).

In general, glaciers play a reduced role in the north of the continent in terms of water regulation, compared to that of high mountain ecosystems such as paramos, puna and Andean forests. However, melting glaciers, in regions where they become the most important source of runoff during dry seasons, will also affect water availability, as well as risk of flooding. There are already concerns for both drinking water and hydroelectric power in cities such as La Paz, Lima and Quito (Stern 2006), although the production of glacier runoff is minimal for Colombia and Ecuador (Buytaert et al., 2011), but more important for Peru and Bolivia. Effects will also be felt on Andean valley agriculture (Stern, 2006), including important contributions of meltwater supporting regional economies in the Cordillera Norte and Central in Argentina and Chile (López Arenas & Ramírez Cadena 2010). Decreases in water levels in rivers originating in mountains in the provinces of Río Negro and Neuquén, probably due to reductions in snowfall in the Andes, have already led to 40% reductions in hydroelectricity generation (República de Argentina 2007).

Frequency of extreme climate or weather events in Andean countries (not all necessarily associated with climate change), such as flooding, extreme temperatures, landslides, droughts and wildfires have increased by almost 40% in the period 2001-2010, when compared to 1991-2000, affecting 200% more people, but with a reduction in estimated cost of damage (EM-DAT, 2011). Extreme events are dominated by disasters due to excess water, with floods contributing 57% of disasters, with a peak between 2000 and 2004, followed by landslides at 15%. By contrast, droughts only represent 5% over the 20 year period.

Although these figures represent country level, mountains will be especially susceptible to extreme events such as landslide and events will especially affect areas with lower standard of urban living and greater dependence on agriculture (CEPAL 2011, Estado Plurinacional de Bolivia, 2009), for example in Andean regions of Bolivia, Ecuador and Peru, as well as densely populated mountain areas, for example in Colombia and Venezuela (República Bolivariana de Venezuela, 2005). In Bolivia, flooding caused over $450m US worth of damage in 2007 and 2008, representing 5% of GDP (Estado Plurinacional de Bolivia, 2009). The El Niño phenomenon of 1997-8 caused considerable losses in potato production in Peru, an important Andean crop, evidencing the need for proper risk management in agriculture, especially for crops such as potato, whose principal sources of risk are climatic (Proexpansión, 2011).

A study by the International Centre for Tropical Agriculture (CONDESAN-CIAT in press, Jarvis et al, 2010) modelled changes in climate suitability for principal crops in the northern Andes. Analysis of 25 crops showed reductions in suitable areas of crops for the following countries, in order of magnitude of effects (Venezuela, Colombia, Bolivia). In the case of Ecuador and Peru, some changes could be interpreted as positive, given that 17 out of 25 crops show increases in suitability under both emissions scenarios. In economic terms, Colombia and Venezuela are the most seriously affected countries, with regard to production of coffee and potato, followed by Bolivia. However, Ecuador and Peru, could gain on at least one of five principal crops analysed, with increases in production value of potato in Ecuador, and potato and beans in Peru (Zapata-Caldas et al, in press).

1.3.5 Other drivers

Armed conflict has affected three countries in the Andes over the last 20 years, with internal conflicts in Colombia and Peru, and a border conflict between Peru and Ecuador. Impacts have also been felt in neighbouring countries, especially Venezuela and Ecuador as a result of the Colombian conflict, however, armed conflict cannot be considered as a regional phenomenon during the period of this report[12]. The Colombian conflict began in the 1960s and continues to date, and has effected almost all areas of the Country, including the Andes. Conversely, the armed conflict in Peru, from the 1980s

[12] Additionally, it is beyond the scope of this report to provide a detailed analysis of this complex issue here, and its effects on sustainable development.

to the early 1990s, was concentrated in the mountainous regions of the centre south and Amazon foothills of the country. The Peruvian-Ecuadorian war of 1995 had its origins in border disputes dating back to the independence of both countries from the Spanish, although this outbreak, known as the Cenepa War, was localised in the Cordillera del Condor, a mountain range emerging from the Amazon region of both countries towards the Andean foothills.

The armed conflicts have undoubtedly effected sustainable mountain development, but a detailed analysis is beyond the scope of this report. In Colombia, the ongoing armed conflict has limited rural development in many places, especially in areas where a confluence of different armed actors exist. More positively, the peace accord between Peru and Ecuador in 1998, created an propitious environment for integration and development on the border area, including a binational development plan, leading to joint projects in development and conservation, but largely outside the Andes. However, a proposed joint conservation area in the Cordillera del Condor is being discussed and was set out in the peace agreement itself.

The illicit production and trade of drugs still has major impacts on the societies, economies and environment of Andean countries, with especial relevance for Colombia, Peru and Bolivia, although impacts are not limited to the mountains, and supply routes affect all countries. Although armed groups may have initiated without direct links to illicit trade in drugs, they are now increasingly linked to this trade. With regard to changes in land cover, illicit plantations have affected areas of the Andes over the last two decades, especially on the east Andean slopes of Bolivia in the Yungas region of La Paz, in Peru, in Huánuco, Cusco and Apurímac, and both slopes of the Andes in the South of Colombia, although much of the coca growing areas are outside the Andes (UNODC, 2008, UNODC 2011, UNODC 2010a). In terms of area, coca production decreased from the beginning of the 1990s in both Bolivia and Peru, until the early-mid 2000s, after which it has slightly increased again, in Colombia, after a peak in 2000, the area has decreased, although the country remains the highest producer in the region (UNODC 2010b). Illicit plantations, and associated impacts including from cocaine production and crop eradication, have been responsible for deforestation, contamination of ecosystems and water resources, conflicts in resource use among local communities, as well as severely disrupting livelihoods and community life.

The Initiative for the Integration of Regional Infrastructure in South America (IIRSA), aims to promote the development of transport, energy and communications infrastructure to facilitate physical integration of the 12 South American countries, with guiding principles including open regionalism and sustainable development, focusing on 10 development regions, all but two of which include the Andean mountains. Two regions, the Andean and Southern Andean, focus exclusively on the Andes. The initiative began in 2000, and boasts a portfolio of 524 projects, which will be funded by public and private sectors, as well as multilateral financial institutions, such as the Inter-American Development Bank (IDB) and the Corporación Andina de Fomento (CAF). Of the projects envisaged for the Andean region, 34 of 49 focus on improving the road network, with a view to improving transport of industrial products (IIRSA 2010). The initiative has raised concerns about its environmentally sustainability, especially in the Amazon (e.g. Fleck et al., 2007; Killeen 2007; Devenish et al., 2009), but less research has been implemented on its effects for the Andes.

PART 2: EVALUATING PROGRESS WITH SUSTAINABLE MOUNTAIN DEVELOPMENT: PROGRESS, CHANGES, AND LESSONS LEARNT IN THE REGION OVER THE LAST 20 YEARS

2.1 Introduction

The following section evaluates processes contributing to, and limiting, sustainable mountain development in the Andes over the last 20 years. The report focuses on drawing conclusions at regional level, but recognises that the size and heterogeneous nature of the region makes this difficult with regard to many issues. Some differences between countries are highlighted, but it is beyond the scope of this report to enter into a detailed discussion of national dynamics. Furthermore, the section attempts to highlight aspects of international, regional and national agreements, initiatives and legislation playing an important role in sustainable mountain development, but with the understanding that this often implies the specific application of more general policies rather than specific mechanisms themselves existing for mountain issues or regions. However, over the last 20 years, many events and declarations have been made with specific reference to sustainable development in the Andes (Table 6), derived from, and organized through both international and regional processes, providing important platforms for dialogue among different actors, and catalysing new Andean initiatives.

Table 6. Major events and agreements contributing to sustainable mountain development in the Andes

Year	Event/Agreement	Supporting institution	Significance for SMD in the Andes
1991	Mountain Geoecology of the Andes: Resource management and Sustainable development Santiago de Chile	Association of Andean Mountains	First in a series of specialised academic symposia on sustainable development in the Andes
1992	UN Conference on Development and Environment (Earth Summit)	UN	Chapter 13, Agenda 21
1995	Segunda consulta regional intergubernamental sobre el desarrollo sostenible de montanas	FAO, CIP, CONDESAN	Early event with 11 countries to exchange information and ideas on SMD in light of Chapter 13 (Mujica & Rueda 1996)
1995	II International Symposium on Sustainable Development in Mountain Ecosystems Huarina, Bolivia. Declaration	Association of Andean Mountains	Focused on management of fragile areas in the Andes
1996	The Summit of the Americas on Sustainable Development held in Santa Cruz de la Sierra, Bolivia, in 1996.	OAS	Erosion in mountains specifically mentioned in action plan
1997	I Congreso Latinoamericano de Parques Nacionales	IUCN	
1998	III International Symposium on Sustainable Mountain Development Quito, Ecuador. Declaration	Association of Andean Mountains	Focused on understanding the ecological interfaces in management of cultural landscapes in the Andes
2000	Millennium Summit	UN	
2001	Lima Meeting	Mountain Partnership	
2001	Quito Declaration by CAN group of Environmental Authorities		Approved Guidelines for Environmental management and sustainable development in Andean Community, with recognition of the importance of mountain systems. Commitment to draft sustainable development strategy for mountain ecosystems and populations.
2001	Taller Internacional sobre Ecosistemas de Montañas: Una visión del Futuro, Cusco, Peru	Grupo Nacional de Trabajo sobre	

	Cusco Declaration on Sustainable Mountain Development	Ecosistemas de Montaña, Peru	
2001	IV International Symposium on Sustainable Development in the Andes: Andean Strategy for 21 Century Mérida Declaration	Association of Andean Mountains	Analysis of challenges and opportunities facing the Andean region in 21st Century
2002	International Year of Mountains	United Nations	Many activities, especially, communicative, implemented to commemorate this year, boosting national mountain committee activity
2002	Rio + 10. World Summit on Sustainable Development (WSSD) Johannesburg, South Africa	United Nations	Paragraph 42 - Application plan, calls for specific protection measures for mountains
2002	II Encuentro Mundial de Poblaciones de Montaña, Quito, Ecuador	World Mountain People Association	
2002	Estrategia Regional de Biodiversidad - CAN	CAN	
2002	Reunión Mundial de Ecosistemas de Montañas, "Las Montañas al 2020: Agua, Vida y Producción", Huaraz Declaration on Sustainable Mountain Development	Grupo Nacional de Trabajo sobre Ecosistemas de Montaña, Peru	Declaration calls for conservation and rational use of natural resources, especially water resources in mountains; proposes the formation of Working Group on Mountain Ecosystems to implement chapter 13 (Agenda 21)
2002	Resolution VIII.39: High Andean wetlands as strategic ecosystems	Ramsar convention	Resolution giving rise to strategy on Andean wetlands
2002	I World Conference on Paramos, Paipa, Colombia Paipa Declaration	Conservation International, Ministry of the Environment (Colombia), Cundinamarca Regional Environmental Authority (CAR), Colombia, Colombia Meteorological Institute	Calls for a regional Andean Strategy on Management of Paramos
2002	The meeting of the Inter-American Committee on Sustainable Development (CIDS) in Washington DC, in 2002,	OAS	
2003	V World Parks Congress	IUCN	
2004	Seventh Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity, Kuala Lumpur, Malaysia	CBD - UN	Program of Work on Mountain Biodiversity established
2004	Cusco Conference and Declaration	Mountain Partnership	
2005	Agenda Ambiental Andina 2006-2010	CAN	
2005	High Andean Wetlands Strategy	Ramsar Convention	
2005	V simposio de desarrollo sustentable en los Andes - Jujuy, Argentina	Association of Andean Mountains	Last symposium to date on SMD in the Andes.
2005	Andean regional workshop "Indian Territories, Autonomies and States"	World Mountain People Association	
2006	Andean Regional Workshop-Encounter	World Mountain People Association	
2006	The First Inter-American Meeting and High Level Authorities on Sustainable Development (Santa Cruz + 10) in 2006,	OAS	
2007	II Congreso Latinoamericano de Parques Nacionales y otras Áreas Protegidas "Conservación, integración y bienestar para los pueblos de América Latina	IUCN	
2007	First Subregional Meeting of the Andes Initiative and Tucuman Declaration, Plan of Action for Sustainable	Mountain Partnership	

	Development of the Andes		
2009	II World Conference on Paramos, Loja, Ecuador Loja Declaration	CONDESAN, Ministry of the Environment (Ecuador)	Calls for intensified efforts to protect paramos, more regional collaboration, share experiences with other high mountain ecosystems
2010	The Second Inter-American Meeting of Ministers and High Level Authorities on Sustainable Development (Santo Dominguez) in 2010,	OAS	
2010	Side event COP 16 UNFCCC	Chile, Peru	Positive experiences and innovative examples of adaptation to climate change in mountain regions

Finally, this section draws heavily on nine case studies, summarised below (Table 7), and from which thematic components are compared across countries. The coincidence of several themes across the case studies and at two consultative workshops(Appendix 5.1), provides confidence that some general trends can be drawn from this relatively small sample size, and also provides the structure for this section. Furthermore, the case studies were chosen as representative sites across the Andes (Figure 8), both in terms of latitude and altitude, and document relatively long periods of interventions in sustainable mountain development, many of which span 20 years. A further important factor in choosing the case studies was the presence of existing documentation, given that field visits and evaluations were not contemplated as part of this report, although a workshop was held to support their preparation (Appendix 5.1).

Table 7. Overview of case studies

Country	**Focus**
Venezuela Gavidia and Mixteque (Mérida) **Luís Daniel Llambí** Universidad de los Andes	*Grass-roots organizations have led progress in land-use planning and environmental management, with support from pioneer research in paramos at regional universities.*
Colombia Coffee-growing region (Caldas, Quindío, Risaralda) **Andres Felipe Betancourth** Fundación FESCO	*Diverse sectors have come together in the Colombia Coffee-growing region to jointly plan for the sustainable development of an economically and environmentally important region*
Colombia Ubaté Valley wetlands (Cundinamarca, Boyacá) **Felipe Rubio Torgler** Fundación Humedales	*Twenty years of experiences in the Fúquene region provide a basis for implementing adaptive management in a social ecological system*
Ecuador El Ángel (Carchi) **Susan Poats** **Tatiana Castillo** Grupo Randi Randi	*An inter-institutional consortium, with strong community participation, has played a fundamental part in facilitating the joint management of the national park, El Angel, while documenting the 10 year history of its interventions, providing a solid basis for decision making.*
Peru Cajamarca **Marco Sotomayor** Proyecto Masal **Segundo Sánchez** RENAMA-Cajamarca	*A concerted process to create a regional biodiversity strategy, accompanied by land-use planning has created political momentum for its implementation, between regional and municipal government.*
Peru Mariño, Apurímac **Antenor Florindez** Instituto Cuencas	*A long history of initiatives in rural development, on the part of both public and private institutions, provided a strong basis in agriculture, and technological and institutional innovation, however, the recent increase in mining activity has transformed regional dynamics and requires new challenges to be addressed.*

Argentina Quebrada de Humahuaca (Jujuy) **Julio Martinez** UGICH-Jujuy **Magda Choquevilca** Agrobiodiversidad - Jujuy	*Through collaboration between academia and regional authorities, different types of information is made available, as a digital platform for technical data on water resources, as well as traditional knowledge on Andean crops*
Chile Santiago Andino **Ximena Contreras Fernández** **Cristián Villarroel Novoa** **Sara Larrain Ruiz Tagle** Chile Sustentable	*Management plans for land providing important sources of water for Chile's capital , aim to protect biodiversity and enable economic activities such as tourism and agriculture, by working with landowners in reaching agreements for their implementation.*

Figure 8. Case study locations

2.2 Policies and institutional frameworks

Sustainable development initiatives in the Andes have been greatly influenced by global and regional events and agreements, including some before the time period of this report. However, the Rio 1992 conference undoubtedly provided a major impetus in positioning sustainable development, and especially its environmental component, on national agendas. This section outlines some of the major global, regional and national mechanisms, while highlighting their significance for the Andean region.

One of the landmark agreements to come out of Rio 92 was the Convention on Biological Diversity (CBD), aimed at biodiversity conservation; sustainable use of biodiversity; and equitable sharing of the benefits deriving from genetic

resources. According to article 6, each party is required to develop national biodiversity strategies and action plans, as a means to implementing all three components of the convention, which all Andean countries had completed by 2003 (Table 8). Countries are currently updating their strategies, in line with the Aichi Biodiversity Targets, although Venezuela has already completed its second version for 2010-2020. In this context, Argentina has set itself the goal of integrating the principles of sustainable development in all policies and programmes of the country by 2015 (República de Argentina, 2010). Andean countries are also generally up to date with reporting obligations with both the Framework Convention on Climate Change (and Kyoto Protocol) and the Convention to Combat Desertification. Under the latter, national action programmes, as part of commitments acquired within the convention, were completed between 1997 and 2004 (Table 8). Several programmes of work within the CBD to further the convention´s implementation are relevant to conservation of mountain biodiversity, especially those on mountains, protected areas and forests. Implementation of the programme of work on mountains has been mixed within the region, with only three countries completing their thematic reports (Table 8). However, Ecuador has also implemented activities to further the program (F. Pin Hoppe pers comm). The country thematic reports for this program of work highlight concerns such as centralization of resources and lack of administrative inter-sectoral mechanisms to implement legislation and include national responses, such as management plans and zoning for high Andean ecosystems and protected areas, restoration of forests, priority setting and characterisation of Andean wetlands, decentralization for river basin management (Argentina) as well as several bilateral or regional initiatives.

Events leading up to Rio 1992 also promoted the participation of women in environmental conservation, as well as promoting the inclusion of a gender perspective. At the World Women's Congress for a Healthy Planet in 1991, Agenda 21 was reviewed, resulting in the inclusion of Chapter 24 on Action For Women Towards Sustainable And Equitable Development. Subsequent to this event, large scale meetings of this kind became more sustained. Furthermore, the inclusion of the gender perspective in rural development, including in the Andean region, was in part, promoted by international cooperation and international financial institutions, requiring an adoption of a gender perspective among implementing organizations. Similar conditions were often required for conservation funds, after Rio 1992.

Other international agreements with specific components on sustainable development in the Andes include the Ramsar Convention on Wetlands, Convention on Migratory species (including an MoU, signed in 2008 by Bolivia, Chile and Peru, to protect migratory flamingo populations and their habitats) and the exclusively Andean Convention for the Conservation and Management of Vicuña.

The High Andean Wetlands strategy is a regional initiative of the Ramsar Convention, resulting from a contact group of Andean countries, formed in 2002. The strategy aims to conserve and ensure the rational use of High Andean wetlands, which, although highly important in provision of ecosystem services for Andean communities and further downstream, are fragile and vulnerable ecosystems often lacking special attention from governments and other stakeholders (Ramsar 2005). The strategy provides a framework for regional cooperation between all seven Andean countries as well as Costa Rica, covering a projected 10 year period from 2005. Its implementation is supervised by a contact group, including the convention´s national focal points, NGO representatives who hold regular meetings. The strategy has successfully focused initiatives on national wetland policies, inventories (including threats), valuation of ecosystem services, management plans and specific site conservation actions, identification of new Ramsar sites, and provided important opportunities for cooperation between countries and organizations. Difficulties in implementing the strategy lie with coordination and communication between different jurisdictions, authorities and sectors related to high Andean wetlands, lack of funding and political support.

The Convention for the Conservation and Management of Vicuña, signed by Argentina, Chile, Bolivia, Peru and Ecuador in 1980, is aimed at their conservation and sustainable use. The agreement is supervised by a committee, meeting annually, and has been successful in protecting wild Vicuña populations, to the point that they were moved from CITES appendix I to II, allowing sustainable exploitation of their wool, providing important incomes for Andean populations and simultaneously providing incentives to prevent illegal hunting of the species. The agreement has also served to promote technological advances in Vicuña management through its cooperation mechanisms, as well as trade promotion, products by creating a brand and opening markets abroad for Vicuña products.

Table 8. Year of ratification of International and regional mechanisms supporting sustainable mountain development in the Andean region

Instrument	Reference year	Argentina	Bolivia	Chile	Colombia	Ecuador	Peru	Venezuela	Significance for SMD
International									
CBD	1992	1994	1994	1994	1994	1993	1993	1994	
NBSAP	1992	2003	2001	2003	1997	2001	2001	2001, 2010	
Regional biodiversity plans		Yes		Yes	Yes		Yes		
POW mountains	2003	2003	n/a	n/a	2002	n/a	2002	n/a	
POW protected areas		2003	2003		2003		2003		
UNFCCC	1992	1994	1994	1994	1995	1993	1993	1994	
Strategies and programmes			Adaptation strategy (2006), National Climate Change program, National adaptation mechanism		National Pilot Project for Adaptation, 2010 Awareness strategy (2010)	Adaptation, awareness (2009)	Mitigation, Adaptation (2010)	Incorporated into various conservation programmes	
UNCCD	1992	1997	1996	1997	1999	1995	1995	1998	
National Action Programme		1997	1997	1997	2004	2004	1996	2004	
World Heritage Convention	1975	1978	1976	1980	1983	1975	1982	1990	14 (48%) sites in Andes
Ramsar Convention	1971	1992	1990	1981	1998	1991	1992	1988	High Andean Wetland Strategy (2005); 31 (42%) sites in the Andes
Vicuña	1980	Yes	Yes	Yes	n/a	Yes	n/a	n/a	Sustainable use of Vicuña, providing important incomes for Andean communities
ILO Convention 169	1989	2000	1991	2008	1991	1998	1994	2002	Peru has legislation on prior consultation, which can be used to protect mountain territories
Regional									
CAN "Quito Declaration" Guidelines for Environmental management and sustainable development	2001	n/a	Yes	n/a	Yes	Yes	Yes	Yes	Specific on mountains Calls for sustainable development strategy mountain ecosystems
CAN Biodiversity strategy	2002	n/a	Yes	n/a	Yes	Yes	Yes	Yes	Support for protection of vulnerable mountain ecosystems
CAN Environmental Agenda 2006-2010	2005	n/a	Yes	n/a	Yes	Yes	Yes	n/a	Implementation of above strategy

Several supranational political agreements cover the Andean region, including the Andean Community (CAN), a regional integration organisation[13], Mercosur, primarily a trade and migrations agreement between Argentina, Uruguay, Paraguay and Brazil (and Venezuela awaiting ratification), the Latin American Integration Association (ALADI), also primarily

[13] Current members of the Andean Community are Colombia, Ecuador, Peru and Bolivia. Venezuela, was the original fifth member, but withdrew in 2006 (and formally so in 2011, five years after giving notice).

concerned with trade agreements, the Latin American Parliament, with commissions on regional development and the environment; the Organization of American States (OAS), and very recently, the Community of Latin American and Caribbean States, formed in Caracas in December 2011, and representing a further regional forum, with the participation of all states in the Americas except the USA and Canada.

Perhaps the most influential in sustainable mountain development have been initiatives within the Andean Community, especially in terms of supranational environmental policy, and compared to the Alpine Convention, in the sense of an ecoregional approach (Church 2010). The Committee of Environmental Authorities was created in 1998, within the Andean Community, to advise and support the Secretariat in implementing community policy in the environment, with a strong emphasis on protecting genetic resources, reflecting concerns at the time. At the beginning of the 2000s, the country presidents of the Andean community agreed to establish joint policies in environmental management and sustainable development, also serving to strengthen the Andean Community's negotiating power at international level. In 2001, the document, "Guidelines for environmental management and sustainable development in the Andean Community", established sustainable development as a prerequisite for economic growth, social development and environmental management. These guidelines address specific threats to mountain communities, calling for **a** sustainable development strategy for mountain ecosystems, especially, for paramos, promoting integral management of soils, water and living resources, employing an ecosystem approach. The strategy has not been completed as such, but an alternative development strategy covering the whole of the CAN region was produced in 2005, with general focus on environment and illegal drug crop eradication, among other aspects.

In 2002, members of the CAN approved the Regional Biodiversity Strategy, launched at the Sustainable Development Summit in Johannesburg. The strategy, drafted while most countries were also working on their national biodiversity strategies for CBD, aims to set a basis for common policy in biodiversity, in view of challenges relating to free trade agreement negotiations and international environmental agreements. Importantly, the strategy, is an official instrument, representing supranational legislation, and is legally binding to all Andean Community countries. The strategy lacks a strong component on climate change, rather it focuses more on the three strategic areas of the Convention on Biological Diversity, and promotes the region's sustainable socioeconomic development, also a reflection of the priorities of the Andean Community at the time.

The Andean Community established a plan to monitor progress of the Johannesburg summit in the areas of biodiversity, climate change and water over the period 2003-2005. Subsequently, the Andean Environmental Agenda 2006-2010 was drawn up, based on three main areas, Biodiversity, Climate Change and Water, with three overarching themes covering sustainable development, education and strengthening trade. The Agenda is also articulated with the Andean Paramo Project (box 2.1.1). The Agenda is a more operational document, with a specific timeframe, and also introduces themes such as climate change and management of water resources, including specific actors to implement initiatives. Progress by countries in implementing the Agenda is currently being evaluated, and results will be published this year. The CAN Secretariat has also facilitated its implementation through the coordination of regional projects, including evaluating changes in land cover, measuring impact of, and developing capacity to adapt, to climate change. However, implementation of projects is sometimes delayed by the long process required to reach formal agreements between the four member countries. The themes of projects can also depend, to a certain extent, on trends within countries at specific times, in turn, dependent on the government in power. In this sense, national interests and priorities can play important roles in orienting activities within the Andean Community. However, in a move to overcome such difficulties, a recent Andean Presidential Declaration establishes the need for governments to work on defining a common position for the Rio+20 Summit, beyond the interests of each individual government.

A new Environmental Agenda is currently being drafted to cover the period 2011-2015, and as opposed to the first agenda (a guiding document), the second version aims to become a legal instrument, similar to the Biodiversity Strategy. Themes of the second agenda will cover biodiversity, climate change and water. However, although a working document is currently under construction, the final outcome is uncertain, given that the document is already a year overdue.

An important consideration for future integration in South America is that both Mercosur and CAN will eventually be superseded by the recently formed, Union of South American Nations (UNASUR), a position actively sought and welcomed by both entities. UNASUR seeks to achieve common policies in issues such as migration, economics, defence and environment, through greater integration of South America as a major bloc on the world stage. The constituent treaty, signed in Brazil in 2008, includes the formation of a supranational parliament, and includes the sustainable development of the region within its objectives. However, a ministerial council on environmental matters is yet to be established, although eight other councils have been formed, on issues ranging from defence, drugs, and infrastructure to health, education and science.

The Organization of American States has also provided impetus for sustainable development in the region over the last 20 years. In the 1990s, as a response to new global priorities, the OAS updated its program on Environmental Protection, to include sustainable development objectives, for example, in the modification of the OAS charter to update the mandate of the Inter-American Council for Integral Development in 1993 (OAS 1993), the inclusion of a special chapter on sustainable development and the natural environment in the Plan of Action of the First Summit of the Americas (OAS 1994), and a subsequent resolution on Sustainable Development, including the creation of an Inter-American Committee on Sustainable Development in 1996 (OAS 1996) as well as the Plan of Action resulting from the first summit of the Americas on Sustainable Development, in Santa Cruz, Bolivia. The Department of Sustainable Development, as an executing body, supports OAS members in the design and implementation of policies, programs and projects oriented to integrate environmental priorities with poverty alleviation and socio-economic development goals (OAS 2011). OAS technical cooperation programs address such areas as river basin management, the conservation of biodiversity, preservation of cultural diversity, planning for global climate change, sustainable tourism, and natural disaster mitigation.

The Mountain Partnership, a type 2 United Nations organization, was formed in 2002 as a result of commitments taken on at Rio+10, and represent an alliance between countries and civil society organizations. CONDESAN, the Consortium for the Sustainable Development of the Andean Ecoregion, hosts the secretariat hub for Latin America. CONDESAN has been specifically invited by the Convention on Biological Diversity to intensify its participation in formulating regional mountain strategies through this position (CBD 2010). To promote priority themes of the Alliance in Latin America, the Andes Initiative was formed in 2004, and consists of all Andean countries (led by Argentina, Bolivia, Colombia and Peru), a further four countries, and almost 50 other inter-governmental organizations and NGOs. The Andes Initiative (regional section of the Mountain Partnership) provided an important platform for dialogue, regional relations and different initiatives with regard to mountain issues.

The Tucumán declaration of 2007, established an Action Plan for the Andes Initiative, revolving around the following five central themes:

1. Sustainable livelihoods in mountain areas
2. Conservation of ecosystems and preservation of biodiversity and cultural and national heritage
3. Consolidation of institutional capacity in mountain issues
4. Climate change and its effect on mountain areas
5. Cross-cutting issues (education, awareness raising and capacity building, gender, youth and the aged, networks, local participation)

Although declarations and an action plan on sustainable mountain development have been produced for the Andes, follow-up to the declarations and implementation of the plan has not been systematically approached. Difficulties in organising activities within the Andes Initiative relate to the mixed nature and disperse membership of the Partnership, whereby countries and NGOs have equal voice and vote, although the Tucuman Plan of Action was only signed by countries, and a full assembly is yet to be held

The above international agreements have had important repercussions on regional and national initiatives and legislation in the region, with many derived policies and strategies on sustainable development, with some, but not many, specifically focused on mountain issues. In turn, national policies, have also derived subnational or local policies, often linked to decentralisation processes, for example, the national biodiversity strategies, leading to subnational strategies

over the last 10 years in countries including Colombia, Chile, Peru and Argentina, allowing integration with local agendas, across different institutions and with participation at community level (Box 2.1.2).

National legislation on the environment has also largely been created since 1992, as well as specific guarantees regarding the environment within political constitutions (Table 9). Moreover, the new Ecuadorian and Bolivian constitutions place emphasis on the rights of nature, as well as specific mention of fragile ecosystems in the case of Ecuador. Ministries of the Environment and/or Sustainable Development are present in all countries, the earliest in Venezuela, since 1976, and many have gone through processes of reform, fusion and/or separation. Environmental legislation in all countries is strong, and some have specific provisions for vulnerabilities which could be applied to mountains. An analysis of national instruments applicable to protection of high mountain ecosystems in the northern Andes (Corporación Ecoversa 2010) found 20 effective items of effective legislation in four countries, financial mechanisms such as payment for ecosystem services, tax exemptions for conservation, purchase of land for water production, and participation mechanisms (see below). In terms of water retribution schemes, an analysis of schemes in the Andes found that all had local legal instruments to formalise systems, including municipal bylaws and statutes (Quintero 2010).

National strategies and policies related to mountain ecosystems are also found in several countries, especially for paramos and wetlands, for example in Colombia, Ecuador and Peru. In Colombia, the six-year “Proyecto Andes” of the Instituto Humboldt, produced more than 50 publications, including strategies for the sustainable development of rural mountain landscapes, manuals on biocommerce, guides on Andean fauna and flora and management plans, based on pilot experiences implemented as part of the project. The former Ministry of Sustainable Development and Planning in Bolivia, published a strategy on “Political Priorities for the Development of Mountain Ecosystems”, destined at public and private sectors as well as civil society, as a result of activities during the International Year of Mountains (see below). Argentina has plans for a national policy on mountains, to be drawn up by the Mountain Committee, furthermore, the Strategic Tourism Plan (2005) supports protection of mountain ecosystems, especially with regard to awareness raising (Secretaría de Ambiente y Desarrollo Sustentable 2007). Chile has implemented an altitudinal limit of 1000 m on urban construction in an attempt to protect mountain ecosystems within local legislation of the Metropolitan Region, containing the city of Santiago de Chile (Comisión Nacional del Medio Ambiente 2005) .

Decentralisation of functions and autonomy in regional government differs among countries, with notable progress in Colombia, where regional environmental authorities have high degrees of autonomy, favouring participation at local level in environmental management. A further product of decentralisation in Colombia and Peru, results in land-use planning according to river basins, rather than administrative divisions (Box 2.1.1). The Argentinean constitution of 2004 seeks to ensure that decentralised environmental governance has a minimum protection standard, with sectoral laws being introduced from 2002 onwards, on issues such as water, PCBs and industrial residues (di Paola 2006).

Climate change has been incorporated into national policy through a variety of mechanisms, including the creation of government departments, committees, designation of responsibilities to existing institutions, and the production of national strategies and legislation (Maldonado et al., in press). Over the last 20 years, focus has shifted from mitigation, reducing greenhouse gas emissions and promotion of Clean Development Mechanisms, to adaptation and research on the effects climate change, in line with global trends (Maldonado et al., in press). Research has included monitoring stations, for example as part of the Global Observation and Research Initiative in Alpine Environments, with 15 permanent plots established across the High Andes, and a further eight plots planned. More recently, strategies for climate change adaptation have been produced in at least four countries, including at regional level in Peru. Specific focus on mountains includes a side event organized jointly by Chile and Peru at COP 16 in Cancún, Mexico in 2010 on adapting to the impacts of climate change in mountain areas.

The institutionalisation of policies and strategies within national scenarios has gained momentum in recent years, as focus and priorities for interventions have shifted, especially with regard to international cooperation. The importance of inter-institutional approaches, and working simultaneously at different levels (from national to local) has been increasingly recognised, and has facilitated the incorporation of learning from previous or pilot experiences into

government agendas at appropriate levels. Experiences in climate change adaptation and forest management from Andean areas show how knowledge is transferred.

Box 2.1.1 Changing perspectives of forest management Ecuador, Peru and Bolivia	
	Forestation with an economic and social perspective, was the starting point in the Andes for over 30 years of Swiss cooperation. Work was prioritised in the Andean region of three countries, Ecuador, Peru and Bolivia, using exotic species, mainly because forestry knowledge in these species was more advanced. At the end of the 1980s and beginning of the 1990s, Andean forest remnants became an important new focus of attention, with studies taking place in native species with forestry potential. Over the next 15 years, work focused on protection of forest remnants in protected areas, from a perspective of combating poverty and reducing pressures on natural ecosystems. At the beginning of the 1990s, the Swiss approach was novel in linking poverty reduction and forest conservation, given that for many organizations, themes such as these were still treated separately. During this time, a very local strategy was employed, very focused on communities as beneficiaries, with relatively little political involvement. However, this was later identified as a limitation, and deliberate steps were taken in subsequent program to position the issue of Andean forests in national and regional agendas, as well as incorporating lessons learnt from the earlier interventions. Thus, the ECOBONA programme was established in 2006 with a specific mandate to synthesise previous learning employing a systemic approach (as Andean forest ecosystems) and institutionalize knowledge as a specific five-year exit strategy. The programme, following the prior mandate to combat poverty, also became more focused outside protected areas, using a method of “ecological exchanges”. To transfer knowledge, the implementation of this programme was different in that it established a primary contact with intermediate level government from which both national government, and communities and municipal government levels were reached. In evaluating the relative success of this approach between countries, factors that influenced the programme´s outcomes included the size of the country, the level of decentralization, and dependence on the capital city, degree of citizen participation in policy development, and maturity of different levels of government. A further important conclusion, is that while frameworks and guidelines can be useful, the local situation is often very different and programmes must be adapted accordingly.

The International Year of Mountains (IYM) in 2002, provided impetus for a range of activities promoting sustainable development in mountains, foremost of which were the establishment of national mountain committees in nearly all Andean countries (Table 9), coordinated through the Mountain Partnership. Committees were mostly coordinated through Ministries of Foreign Affairs, with a strong inter-institutional make-up. In most cases, committees were set up at least two years before IYM, after the United Nations decision in 1998. National committees have implemented diverse activities nationally and jointly with other countries, such as research and evaluations of mountain areas, meetings and symposia, health issues in mountains, planning for mountain development, as well as many communications activities to promote awareness of mountains. Mountain committees remained active in most countries after IYM, with Argentina, Peru and Ecuador having particularly active committees, in the case of Colombia, mountain issues were treated by different research institutes, without the need for a specific committee. The Mountain Partnership recently began a 2.5 year project, funded by FAO, to strengthen regional institutional and technical capacity among members of the Andean Initiative, especially by involving mountain committees.

A frequently cited limitation to sustainable mountain development relates to a lack of coordination between or within government sectors, and across decision making levels, from national to local level, for example, between mining and environment sectors. Other examples include overlapping functions in legislation regarding the same issue, in Peru, a mandate for land-use planning was established in regional governments, but then also given to the newly created Ministry of the Environment (Box 2.1.2).

Table 9. Government structure and legislation for sustainable development, environmental management and indigenous issues in the Andean region

Instrument	Argentina	Bolivia	Chile	Colombia	Ecuador	Peru	Venezuela
Constitution	1994. Right to healthy environment and rational use of natural resources; Minimum protection standards (Art 41)	2009. Responsible and planned exploitation and industrialization of natural resources, as well environmental conservation (Art 9), section on environment, natural resources and territory (63 articles), including sustainable development of natural resources, and in protected areas	1980. Right to a healthy environment (Art 19)	1991.Right to a healthy environment (Art 79); sustainable development of natural resources (Art. 80)	2008.Right to healthy environment (Art 14) Guarantee rights of nature (Art 277) Protect fragile ecosystems (e.g. paramo, wetlands) (Art. 406 "Plan del buen vivir"	1993. Natural resource exploitation to be regulated by organic law (art. 66). Promotes sustainable exploitation of natural resources (Art 67), biodiversity conservation (Art 68)	1999. Obligation for environmental protection, right to healthy environment (Art 127). Environmental impact assessments for activities potential harming ecosystems (Art 129). State obligation to protect environment (Art 127), and ensure healthy environment
Legislation on environment and sustainable development	2002 General law on environment	1991. Environmental law "Rights of Nature" enshrined in law 071 of 2010	1994. General law on environment (Ley 19.300)	Law 99 (1993) (includes special protection for paramos) In 2010, law 1382 established areas of paramos and wetlands as mining excluded zones	Law on environmental management 1999 Proposed legislation will incorporate Ramsar sites as national parks	Codigo del Medio Ambiente 1990 Sustainable exploitation of natural resources. 1997, 1999. Ley general del ambiente. 2005.	Law on Environment 1976 Reformed; Law on Biodiversity 2000
Ministry of the Environment/Sustainable Development	1991. Ministry of Environment and Sustainable development	2009. Ministry of Environment and Water. Formerly Sustainable Development.	2010. Former CONAMA is fused into new Ministry Environment	1993 - Creation Ministry of the Environment, fused with Housing and Development Ministry in 2002, separated again in 2011, Ministry of Environment and Sustainable Development	1996. Ministry of the Environment	2008. Decreto Legislativo 1013 de 2008 (ministry of the environment created from CONAM	1976. Created as Ministry of the Environment and Natural Resources
Regional government	"Ley de presupuestos minimos" minimum standards for environmental protection		Regional governments 1992. Proposal for new functions for regional governments in 2011, based on constitutional reforms of 2009	Local environmental authorities		Regional biodiversity planning	Regional decision making opportunities
National policies		Strategy for Sustainable Development of	National Wetland Strategy, Threatened	National wetlands policy (2001),	Proposal for Program on Conservation and rational	Wetland conservation strategy 1996. Proposal	

		Mountain Ecosystems	Species, Protected Areas	strategies on specific taxonomic groups	use of wetlands Andean paramo ecosystems, wetlands, forests and agro-biodiversity	for Policy on Paramos and Jalcas including payment for ecosystem services,	
National Mountain Committees	"Committee for the Sustainable development of the Mountain Regions of Argentina" formed in 2005, as a result of work on International Year of the Mountain and activities over subsequent three years.	Mountain committee formed in 2002 for IYM, continued activities afterwards.		Committee formed for IYM celebrations, but not for long term activities. Mountain issues are dealt with by different quasi government institutes, such as Instituto Humboldt.	Formed in 2000, through Ministry of Foreign Affairs, Environment and the Ecuadorian Mountain Society.	National Working Group on Mountain Ecosystems formed in 2000, by Ministry of Foreign Affairs, as a coordination mechanism between state and civil society. After 2002, regional committees were formed in different mountains regions of the country	Formed in 2002 by Ministry of Environment,
Celebration "International Year of Mountains"	Committee formed to coordinate activities such as conferences, seminars, workshops and web page.	Committee formed to organize activities on social and environmental situation of mountains		Inter-institutional committee formed to organize celebration, led by environmental education NGO	Activities included preparation of information on water, climate change and health issues in mountains connected with malnutrition and poverty	Four strategic objectives established (ecosystems, international awareness, conservation, policies on sustainability), activities included workshops, meetings, courses, conferences held, and a commemorative stamp produced	Symposium on sustainable mountain development held as preparatory activity, meeting on desertification in 2002.
Indigenous issues							
Quota for indigenous representatives in government	no	yes	no	yes	yes	no	yes
Common Law Indigenous Rights	yes	yes	yes	yes	yes	yes	yes
Collective property	yes	yes	yes	yes	yes	yes	yes

Box 2.1.2 The role of local and regional policies in land-use planning		
	Processes and factors contributing to sustainable mountain development	**Processes and factors limiting sustainable mountain development**
Peru, Cajamarca	In Cajamarca, a political process has been constructed around the biodiversity strategy, involving coordination between different government levels and departments. A key piece of legislation to enable this, was the law creating regional governments in 2002, providing clear functions in land use planning and environmental management. In 2007, the regional government elect began processes on land-use planning and creation of a regional biodiversity strategy. Land use information, collected through an ecological and economic zoning, provided important baseline information for the biodiversity strategy. Through a joint process, consensus on the strategy was reached with many different stakeholders, including within the regional government, creating a willingness to implement and use the strategy. Implementation of the strategy falls under the responsibility of both the Regional and Municipal Environmental Committees. Coordination between these levels is achieved through the municipalities making up part of the regional committees. The fact that municipalities have created these committees, and that they are working together with the regional government, favours their annual budget allocation process with the central government, and thus, helps to ensure that the strategy will have sufficient funds to make it work.	Legislation creating regional governments gives these a mandate for land-use planning, but environmental legislation of 2005, also gives similar faculties to the Ministry of the Environment, creating a superimposition of jurisdictions and functions with regard to implementing land-use planning processes. A specific example of such superimposition comes from the municipal conservation area, Lagunas de Alto Peru, in Cajamarca. The area had been legally approved by the regional government, and recognised within the regional biodiversity strategy, but this decision has been challenged by a mining company with a concession in the area. However, the mining company has chosen to take up the case with the National Parks Authority in Lima, due to the fact that this body also has jurisdiction over the regional conservation area, and also in the city of Lima (permitted because its tax domicile is in this city), rather than with the regional authority, in Cajamarca.
Peru, Apurímac	The new law on water (2009) in Peru, and its subsequent regulation, is based on a more holistic vision of environmental management, such as an approach based on river basins or on principles of integrated river basin management. This approach provides for a more appropriate management of inter-sectoral resources. The law on water also clearly establishes that access to water for human consumption is unrestricted and a priority objective, irrespective of the state of the water, and whether it is above or below ground. The law also specifies the role of the National Water Authority on monitoring glaciers, especially with regard to the effects of climate change.	The new law created expectation in Apurímac given that it could be applied as a measure to prevent conflicts, and also, to integrate different functions and uses of water. However, the law has not been implemented yet, due to lack of funding. Further limitations come from an overlap of functions. Despite the new law on water having a more appropriate approach for water management, other legally binding mandates over this resource still apply within different sectors. Therefore, the rights on the use of water can still be awarded by both the Energy and Mining sector, as well as the Agricultural sector. Also, the National Water Authority in Peru is not decentralised and all decisions on the use of water resources can be imposed by central government from Lima. Furthermore, the role, authority and division of functions for regional governments is not clearly regulated. As a result, water basin committees, as established in the law, have not yet been set up in Apurímac, and agreement has not yet been reached on the management of river basins crossing administrative regions within the country.
Coffee-growing region, Colombia	Following the approval of the new constitution in 1991, environmental legislation in 1993 paved the way for the creation of a new Ministry of the Environment (headed by environmentalists at its beginning), as well as decentralized, autonomous environmental authorities, with a mandate to manage natural resources and the environment, and promote	Factors limiting sustainable development in the Coffee-growing region relate to the specific context of a change in national government in 2002, whereby changes in institutional structures were introduced, leading to a recentralisation of powers during the following eight years. The recently created Ministry of the Environment was fused into a Ministry of Environment, Housing and Development, leading to a demotion

	sustainable development. The same legislation also brought about the National Environmental System, an assemblage of legislation, activities, programmes and institutions to implement environmental legislation (SIAC 2011) with an emphasis on joint responsibility for natural resources management. Subsequently, legislation on land-use planning, established in 1997, anchored some of the above environmental processes in a territorial context, facilitating management of natural resources in the Colombia's Coffee-growing region. In 2002, further progress in national legislation came through land-use planning at river basin level, requiring that natural resources management and sustainable development should not be limited by administrative boundaries (e.g. municipal limits), but should rather respond to ecological units. Results of the above legislation, together with a strong participation from different sectors in the Coffee-growing region, have led to management plans, specific to high Andean habitats such as wetlands and paramos being created and implemented.	in importance in environmental matters, and subsequent weakening of environmental institutionality as well as creating greater distances between state and society. A further factor in the downturn of civil society participation came with defeat in a referendum on access to, and protection of water sources in 2009, however, strategic mistakes on the part of the social movement behind the referendum and a polarisation of society on the issue, led to a major defeat for the multitude of NGOs grouped within the initiative. Other limiting factors include a lack of stability in civil servants and emphasis on short-term planning (following administrative periods), as well as a lack of use and knowledge of legal instruments and legislation on the part of civil society.
Chile - Santiago Andino	Chile signed the CBD in 1994, the same year as creating a general law on the environment, facilitating environmental management in the country, including provisions for the national biodiversity strategy, and subsequent regional strategies. Within this context, a regional strategy for the Metropolitan Region of Santiago was approved in 2005, setting 23 sites as priorities for conservation. To implement the Santiago strategy, an action plan, Santiago Andino 2005-2012 was created jointly with the participation of state and civil society organisations. This initiative provides important management tools for an area still lacking in basic research, and insufficiently valued, but providing almost 75% of the water required by the Chile's capital city. A key player in the implementation of the action plan, and representing the state, is the National Agricultural and Cattle Service, belonging to the Ministry of Agriculture. They are participating in a project within a priority area, to create management plans for landowners in the mountain areas of the Metropolitan region, implemented by the University of Chile and the NGO Chile Sustentable. As part of their functions, the Agricultural Service are responsible for emitting technical opinions on land use as part of the plans.	A joint or coordinated process does not exist in land-use planning even though Chile has a series of legislative instruments for creating ordered and regulated use of its territory. In practice, these instruments are often dispersed across different state bodies, and those developed by more influential government departments, and resulting more legally binding, are imposed, causing controversy in their application. By using an approach based on land-use planning across individual plots of land to create management plans, a logical order declaration of conservation areas before implementing management has not been followed. However, whether or not the plans will lead to private conservation areas, and whether this is actually necessary, remains to be seen.
Ecuador El Angel	The Consorcio Carchi was formed in 1992-3, as an informal group of interested professionals, with backgrounds in agricultural research. The consortium has played a fundamental part in the governance of the national park, El Angel, and environmental management in the region, drawing support from municipal and regional policies, and creating management plans at different levels for El Angel watershed. It has also made evident that forms of local governance, with high levels of participation and transparency are possible. Community processes to draw up management plans	Overlapping policies within provincial and municipal government have caused difficulties, for example, in conflicts in land-use planning related to fragile zones such as forests or paramos and road building plans, originating from other government departments. Also, contradicting processes have been imposed through political decisions, creating confrontation between conservation and development sectors. In 2002, an attempt was made to use a further instrument for regional management, by creating an association of all municipalities benefitting from water produced in the national park, as well as landowners within the protected area. However, two reversals stalled this process, first, funding for

	for paramos areas, with support from the Proyecto Paramo Andino, have catalysed stronger relations with local authorities, such as funding agreements to implement the plans (including funding for park wardens and control activities) and importantly, the creation of new opportunities for participation in the management of the whole national protected area. In part due to difficulties creating a regional association of municipalities (contemplated in Ecuadorian law), an alternative body was created for regional environmental management. A technical assistance group was formed in 2006, making use of an instrument in secondary environmental legislation, consisting of several municipalities, NGOs and the Ministry of the Environment, leading to the updating of the reserve's management plan and the conformation of a permanent management committee. Legal participation in the technical group, on the part of NGOs has not been necessary, but their inclusion on the management committee will eventually be formalised. Both the consortium, the management plans and management committee have created a propitious environment for further collaboration and alliances with the Ministry of Environment and current activities include the inclusion of properties in the Sociobosque program (see section 2.5), water funds, agricultural projects, collaboration with the regional government on climate change adaptation plans.	the association was not forthcoming, and second, a legal analysis of the instrument ruled that it was not apt for NGO participation. Participation by community members in the Sociobosque (section 2.5) programme has been made more difficult due to land titling issues, especially in terms of historic documents. In order to accede to the program, modern land titles must be held. However, the programme itself provides little support for this process.

2.3 Participation, awareness and knowledge

There is no doubt that public awareness in Andean countries on the issues underpinning sustainable development has greatly increased in the 20 years following Rio 1992, particularly regarding the conservation of natural resources, such as water and forests, and its potential impacts on livelihoods. In a context of more opportunities for participation, resulting from both formal and informal mechanisms, as well as more educational opportunities, civil society has played an important role in bringing about changes in mountain areas (Box 2.3.1).

Decentralization of government structures, and transfer of powers, have provided greater opportunities for civil society participation in sustainable development in the last 10-15 years, depending on the country. Participation includes mechanisms for control, denouncement, exercise of rights, access to information and reaching consensuses with local government. For example, participative decision making processes in Colombia, include the participation of civil society organizations on the board of the regional environmental authorities, as established in environmental legislation (Box 2.1.2, 2.3.2). The decentralisation process in Ecuador has led to many policies, strategies and a plan for decentralised environmental management, with regional governments having mandates to support protected area management as strategy to guarantee the sustainability and supply of ecosystem services from these reserves (Poats and Suarez, 2007)(Box 2.1.2). In Peru, the participative municipal and regional budgets (2003) allow civil society organizations to propose local government projects and vote on setting priorities among them (Box 2.3.1), with similar mechanisms in Bolivia and Ecuador. In Argentina, the government structure is effectively decentralised, in that the country is a federation of autonomous provinces. The mountain province of Mendoza pioneered environmental legislation, with protection laws established in 1992, especially in establishing and regulating environmental impact assessments, with obvious relation to mining. In 1994, the same province, established a law requiring drivers of all-terrain vehicles to sit an exam on biodiversity conservation, recognising the fragile nature of the ecosystems in the province (Gobierno de Mendoza, 2009).

The indigenous movement in Andean countries, has also been an important factor in terms of participation in national and regional policy and decision making, especially in Ecuador, Bolivia and Peru. The Confederation of Indigenous Nationalities of Ecuador (CONAIE), created in 1986, is one of the most important indigenous organizations in Latin America. It has been instrumental in substantial achievements for indigenous communities in the country, as well as setting precedents at regional level. Achievements include land titling of collective territories, a new draft of the agrarian reform law between 1990 and 1994 and bilingual education for indigenous communities. CONAIE has also influenced the ousting of presidents in Ecuador as well as the conformation of a new Constituent Assembly in 2000.

In Bolivia, indigenous organizations have been especially active in issues such as obtaining protection for small scale farmers in the Andes, as well as access and control of resources such as water and gas. Political influence has also increased greatly, including achievements such as the election of indigenous leader, Evo Morales, as president of Bolivia.

In Peru, indigenous organizations have not had the same strength, due to various factors, but especially the political violence of the 1908s in which indigenous leader were targeted. The resulting widespread migration, impeded the political development of movements. Over the last 20 years, indigenous groups' demands have been channelled through more local groups, albeit with mixed results in terms of political influence. However, events surrounding protests against changes to Peruvian legislation connected to the free trade agreement with the United States, culminated in the worst political violence in recent years in the country, providing further impetus to indigenous groups' demands that the government comply with obligations of ILO Convention 169. These events were important precursors to the eventual enactment of the law on previous consultation, especially important for indigenous peoples, in September 2011 (see section 1.3.3).

Integration and exchange of experiences among different indigenous groups has also been facilitated by the World Mountain People Association, an NGO originating at the World Mountain Forum held at UNESCO, Paris, in 2000. The organization, with a regional body for the Andes, aims to promote understanding of mountains, share knowledge among mountain populations and support local partner initiatives. In this sense, the association has held several meetings and workshops in the Andes (Table 6), with a particular focus on territory and autonomy for indigenous mountain communities, as well as issues regarding their access to resources.

Box 2.3.1 Different approaches to participation in land-use planning

	Processes and factors contributing to sustainable mountain development	**Processes and factors limiting sustainable mountain development**
Peru	The law on participative budgets for local authorities was approved in 2003 within the decentralization process in Peru. This law, defines the participative budget as "a mechanism for fair, rational, efficient, effective and transparent allocation of public funds, strengthening relations between the state and civil society". The mechanism also provides opportunities for regional and municipal governments to promote participation, as well as social control of the management of public funds. *Apurimac* Participative budgets have been important in providing greater sustainability for efficient water management processes, and making them less dependent on cooperation for development. The active presence of local actors has resulted in a greater availability of specific funds for water management in some rural municipalities. In Apurímac, municipalities such as Andahuylas and Andarapa have destined up to 60% of their annual municipal budget on water, although it remains to be seen whether these high rates will remain in the future. However, results to date from these budget allocations have led to increases of up to	Participative budgets rely, by definition, on proper and timely flow of funds to local government. Thus, abrupt cutbacks to municipal budgets on the part of central government (for example, due to changes in market prices affecting national exports) have led to setbacks in participative processes in both regional and municipal governments. For instance, when metal prices fell in 2010, processes such as participative budgets were among the first cuts in Cajamarca, causing a cutback of 25% in municipal budget transfers from central government. Instability in participation processes as a result, led to a loss of confidence in local government among communities, and subsequently requiring new processes to revive participation after the reestablishment of funds. A different limitation to this participation mechanism revolves around the political willingness of both regional and municipal authorities to ensure its proper implementation. For example, changes in government due to elections, often cause existing participative processes to be truncated, subjecting them to timeframes which do not necessarily correspond to those of the processes.

	20%, in water availability for some rural communities, for example through protection mechanisms at riverheads. These increases have led to farmers being able to reap double harvests per year, with increases in incomes of up to 50%, implying less necessity for temporal migration in search of other employment during the dry seasons. This permanent presence of inhabitants also feeds back to improved social control and participation, in that participation in local government processes are more continuous.	
Colombia, *Coffee-growing region*	In the Coffee-growing region civil society participation is guaranteed through an important factor in the structure of the local environmental authorities. The maximum authority of the regional environmental, the board of directors, consists of both state and civil society members, including representatives of local government, private companies, indigenous organizations, Afro-Colombian communities and NGOs. Important achievements as a result of civil society lobbying from this position have included regional protected area declarations in three departments of the Coffee-growing region, consolidating research, education and management implemented by civil society groups, and thus, achieving the political backing of these authorities through the assignation of protected area categories. Protected areas such as Plan Alto in Caldas, or Ucumarí in Risaralda are just two examples of protected areas declared through civil society leadership. Indigenous groups have also achieved a wider awareness and incorporation of their values and world view into participative management plans, for example in the Totumal indigenous reserve where the plan's implementation has improved quality of life through projects on education, health, sanitation and nutrition. NGOs have also used this position to promote inter-institutional and inter-sectoral agreements for spending funds from environmental authorities, local governments, indigenous reserves and NGOs. One of the best examples of this type of agreement comes from a project for environmental sanitation in Caldas, constructing more than 3000 septic tanks, improving environmental conditions of the river basins and the living conditions of their inhabitants. On a similar theme, river basin management committees, set up for this precise purpose, provide further opportunities for civil society participation with local environmental authorities. In many cases in the Coffee-growing region, these committees have also taken on functions of, (and replaced) the sustainable development committees, contemplated in regional government legislation.	Although significant achievements through participation have been made, there is still a lack of use and knowledge of legal instruments and legislation on the part of civil society, implying that using the mechanisms described here, much more could be achieved from these sectors of society.
Venezuela *Gavidia - Misteque*	A grass-roots social movement in the communities of Gavidia and Misteque has achieved significant changes to the rural dynamics of the region, especially in the management of high Andean ecosystems. The social movements in Gavidia began in the 1990s, initially, as a group of NGOs working in rural tourism. The experience was successful in promoting sustainable tourism, and involved intense training with the local population, triggering a social process of re-evaluation of the local resources (paramos). At the same time,	Given that institutional arrangements and social innovations for paramo management has been spontaneous and originating from a grass-roots level, no formal regulation or municipal legislation has been achieved for ecosystem management, for example, in protecting water sources.

	other NGOs began working on issues such as agro-ecology and conservation. As a result, an initiative born from the local actors, led to a complete wetland conservation programme, with achievements such as fencing off some 190 streams and fragile areas of the paramo to protect them from cattle grazing. These factors have also facilitated successful processes of community participation with the scientific community within the Proyecto Paramo Andino, where prior experiences have been more formally organized into management plans for paramo regions.	
Chile	Very different territorial dynamics in the rural regions of Santiago, necessarily imply different types of participation. Large areas of rural land above the city of Santiago, and responsible for supplying water to the city, are owned by a small number of people, and have very low population densities, or are uninhabited. This means a rather more straightforward process of reaching a consensus with landowners, as oppose to the populated smallholdings of some countries in the northern Andes. However, the participation of landowners has been fundamental to the process of land-use planning and zoning (see Box 2.1.2) whereby owners are part of the planning process, led by the University of Chile, and agree to the zoning constraints set out within the resulting management plans.	Although consensus on plans is reached, a limiting factor for the success of their implementation is lack of funding on the part of municipalities for this stage of the process, for example in promoting sustainable tourism. This activity, already very popular in the area, could improve local incomes, as long as control mechanisms and delimited zones are adhered to (as set out within the plans), thus becoming an important part of the conservation mechanisms for Santiago's water supply.

Academic knowledge has also played an important part in sustainable mountain development initiatives in the Andes. There are now many postgraduate level courses offered at universities throughout the Andes on sustainable development, often in connection with subjects such as environmental management and local government, and generally aimed at graduates in a diverse range of subjects. University research is also in a position to make direct contributions to local processes, providing that the relevant dialogue with local authorities and decision makers is established (Box 2.3.2), however, there are still many gaps between research and its application, as well as setting research agendas which are more geared towards local needs (Box 2.3.2).

An important integration process among academics was played by the Association of Andean Mountains (AMA), an academic organization, specifically focused on the sustainable development of the Andean region. AMA's main achievement has been the organization of five international symposia, between 1991 and 2005, on sustainable mountain development in the Andes (Table 6), with the participation of academics, NGOs, community members and government authorities. The symposia provided valuable opportunities for dialogue and exchange of ideas between different actors, catalysing other initiatives, such as the Proyecto Paramo Andino. However, since the last meeting, AMA has been generally inactive, but possibilities exist that CONDESAN will organize the next symposia within the context of its annual meetings.

Further integration in the Andean region in with regard to education, culture, science and technology has been provided by the Andres Bello Convention, originally an Andean initiative, but now covering all 12 countries, including all Andean countries except Argentina. The convention promoted cultural exchange, for example, through a grant program for students, validation of primary and secondary education across member countries and facilitating travel for study purposes, among others. However, following financial difficulties, the convention is currently in a process of reorganization.

Bilingual intercultural education, understood as an education system taking its cultural reference from that of the students, i.e. indigenous culture, has become firmly established in the Andes since at least the 1980s. Many initiatives from within indigenous communities have been successful in promoting bilingual education, with a notable example from CONAIE in Ecuador, and NGOs, such as PROEIB (with activities in Bolivia, Colombia, Ecuador, Peru, Chile and Argentina), but also as a result of government initiatives (Lopez 2009), and with support from UNESCO, especially in the Andes

(Hornberger, 2000), with ensuing recognition in legislation or political constitutions, such as in Argentina, Bolivia, Colombia and Ecuador. Also, over the last 20 years, universities in Colombia, Ecuador, Bolivia, Chile and Peru have contributed with research programmes to support bilingual intercultural education. Important impacts of bilingual education in Andean countries have been documented, including improved performance at school (including in maths, and even in Spanish), increased proportion of children attending school, increased role and involvement of parents in school activities, and better social and political organization within communities (López & Küper, 1999). This latter point becomes important in the context of many of the processes highlighted in this report, as contributing or limiting sustainable mountain development.

The use and recuperation of tradition knowledge is also playing an increasingly important role in sustainable mountain development, but does not always occupy the position within academia that it merits, and is often not matched, or integrated against other types of knowledge. Traditional knowledge related to farming practices and water management will become increasing important in issues such as agricultural innovation and climate change adaptation. An important limiting factor to overcome is the relative value placed on traditional knowledge, which can be overcome to a certain extent by recovering pride in Andean cultures and practices (Box 2.3.2). A limiting factor in benefit sharing mechanisms for environmental services is the lack of exchange between academic and practical knowledge (CONDESAN 2011).

However well education programmes are aligned to support sustainable development, or regardless of the quality of knowledge generated, either traditional or academic, without proper information management, ensuring relevance, timeliness and availability, the utility of such information for decision making remains underexploited. Decision support systems, making the most of new technologies, often involving geographic information systems, real time information and online portals, are an emerging way of providing information to decision makers. In the Andes, examples exist for example, for local government, small scale famers, local hydrological information (see Box 2.3.2), and continent scale information, for example AquAndes[14]. The latter systems provides a testing environment, providing simulations of different impacts and policy options for water management decisions in the Andes, including areas such as water availability, impacts of payment for ecosystem services schemes, and projected land use change, among others (Mulligan et al., 2009). A recent GEF project on *in situ* conservation of crop wild relatives, including Bolivia, responded to a lack of information management for decision making on the conservation of crop wild relatives. A principal component of the project culminated in setting up an online database (www.cropwildrelatives.org) including data on occurrence and impacts of climate change on crop wild relatives (GEF, 2011, Meilleur & Hodgkin 2004). An information system planned by the national network of municipalities in Peru (REMURPE) aims to present data on areas such as demography, education, health, poverty, extractive industries and environmental data for decision making at municipal level.
However, limitations with such systems include lack of updating, lack of awareness of their existence, and capacity to use them, especially at local municipal level, where computer literacy often remains basic. However, given the speed of advance of incorporating new technology into government and civil society organizations (e.g. rise of computer use over the last 20 years), the implementation of such information systems could parallel this advance.

Box 2.3.2 Knowledge and information systems

	Processes and factors contributing to sustainable mountain development	**Processes and factors limiting sustainable mountain development**
Argentina, Jujuy	An agreement between the public University of Jujuy and the provincial government to manage the Humahuaca river basin shows how coordination and common agendas between academic institutions and regional government can ensure that information is used to its best potential in environmental management. The above agreement provided the basis to establish a river basin management body in 2002, responsible for	Although the agreement between the regional government and the university has worked well, there is no institutional framework or mandate between public institutions to share information. Lack of knowledge of agreements of this kind, on the part of institutions, also means that information is not used to its full extent, and is not provided in an opportune fashion.

[14] http://www.policysupport.org/cgi-bin/ecoengine/start.cgi?project=aguaandes

	generating hydrological information. Using an Integrated approach to river basin management, the joint project has produced baseline information as part of an online tool for planning and management. Information compiled for the project includes administrative boundaries, relief, hydrography, geology, land use, infrastructure, population, environmental information and satellite images, all of which has been updated throughout the project period. The project has also recovered historic climate data series and made them available online. Through the purchase of meteorological sensors, real time information is also provided. The online system has incorporated and adapted software to the local context, with the collaboration of the Politécnica de Madrid, to monitor and manage problems with erosion upstream during the concentrated period of rains. Water shortages in the Humahuaca river basin (in part due to the rapid expansion of hotels in the area following its declaration as a world heritage cultural landscape) are also being studied using information generated by the system. As part of the initiative, training in use of the information, for example in Geographic Information Systems is also provided.	
Venezuela, Gavidia - Misteque	Gavidia is one of the most studied paramos in South America, with a long history of research promoted by regional universities, dating back to 1989. Research has played a fundamental part in positioning the importance of paramos on national and international political agendas, creating benefits for their conservation and management. However, conservation activities in the area have also been based on informal knowledge, such as the early schemes to protect water sources. Management plans, created in recent years, have helped to bring together different types of knowledge from different sources, to the benefit of communities in the region.	
Chile, Santiago	The experience in Santiago Andino has brought together academic establishments and regional government in producing management plans to protect the capital's water supply. The University of Chile, together with the NGO Chile Sustentable, are providing the technical information for decision making within regional government as to the activities permitted on large estates bordering the city of Santiago. Using GIS, remote sensing, field surveys and with the participation of landowners, zoning establishes priority areas for conservation using a focal species approach, quotas for grazing livestock, based on the potential biomass of important grazing grasses and the type of livestock as well as areas for tourism or strict conservation.	Scientific research does not always relate its goals to the practical usage of results in the region, for example, in contributing to decision making processes or capacity builiding in communities.
Ecuador, El Ángel	The Carchi Consortium compiled research and learning on paramos systems, water, and irrigation over the length of its intervention in environmental management in Ecuador, resulting in a novel publication of information on the river basin as a CD "toolbook", containing maps, documents and	

	description of the methods the different processes. This compilation was a valuable source of information for many subsequent planning processes. Parallel to this process were educational activities linking the importance of the national park to the communities' water supply.	

2.4 Environmental management

The first national parks in the Andean countries were established at the beginning of the 20th Century in Chile and Argentina. National park coverage has grown at a steady rate since the 1970s, with a higher percentage of area covered within the Andean region, than outside (Figure 9), although in absolute terms, the area covered by national protected areas is less within the Andes, representing approximately 40% of the total 800,000 km^2. Overall, 12% of the Andean region lies within protected areas, compared to 9% outside the Andes within the seven countries, although percentages vary nationally, from 6% of the Argentinean Andean region, to 20% of the Ecuadorian Andes (Table 10). National protected area systems in the Andes. Growth patterns of protected areas show similar heterogeneity, with Chile, Venezuela and Ecuador having already established the majority of their existing protected areas by 1990s, whereas Peru, Bolivia and Colombia showed significant growth over the last 15 years.

The creation of protected area systems, allowing a coordinated approach to biodiversity protection and protecting viable populations of species and representative samples of ecosystems, is the fundamental aim of the CBD Programme of Work on Protected Areas (Dudley et al., 2005). The first protected area systems in the Andes were established in Venezuela and Chile, in 1983 and 1984, respectively, although Ecuador also identified strategies to plan for its protected areas jointly in 1989. The remaining countries implemented systems during the last 20 years, with Argentina completing its proposal in 2003. Nearly all systems allow for the inclusion of private and regional conservation areas, and Colombia has made provision for regional protected area systems at three different levels (see Box 2.4.1). In terms of biome representation by protected, temperate broadleaf forests, of the southern Andes have the highest representation at over 30% of the biome's area, followed by Tropical moist forest (15%) and montane grasslands(8%). As well as growth in national park areas, the effectiveness of their management must be measured in order to evaluate this component of sustainable development. Schemes have been implemented in some countries (e.g. WWF´s RAPPAM methodology in Chile and Colombia), but the recurring limitations of national parks, for example, lack of adequate staff, budgets and management are still present in mountain areas. Although management plans have undoubtedly increased on a par with the increase in protected areas, the way management is approached, or how plans are implemented, still requires profound debate for more effective management (e.g. Box 2.4.1).

Table 10. Proportion of the Andean region within protected areas

	% of land protected within Andes	% of land protected outside the Andes	Overall protection rate at country level
Argentina	6%	0.5%	2%
Bolivia	13%	17%	16%
Chile	19%	10%	17%
Colombia	11%	10%	10%
Ecuador	20%	14%	16%
Peru	11%	17%	14%
Venezuela	22%	15%	16%
All Countries	**12%**	**9%**	**10%**

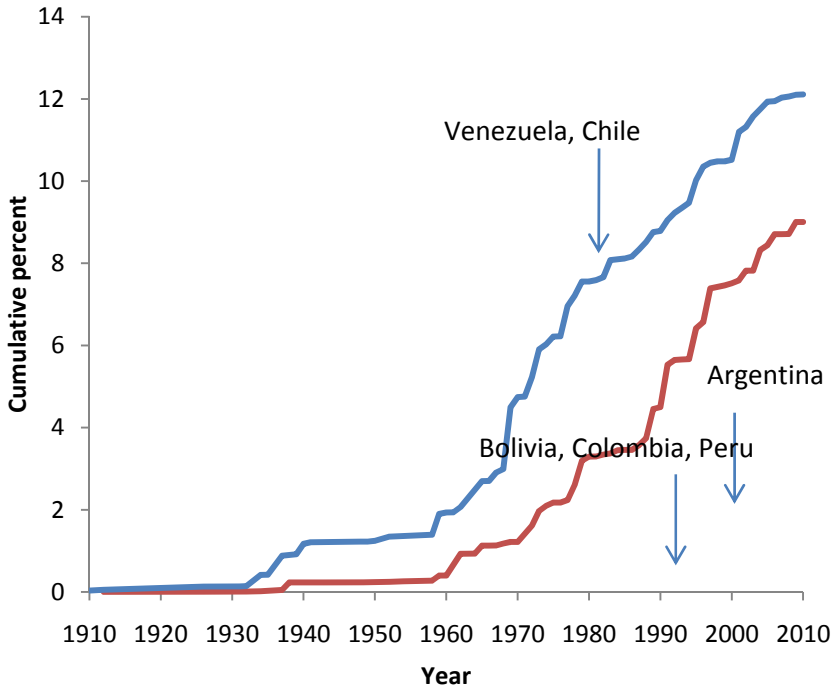

Figure 9. Growth of national protected areas within (blue) and outside (red) the Andes, showing dates of creation of protected area systems.

Box 2.4.1 Different aspects of environmental management in Colombia		
	Processes and factors contributing to sustainable mountain development	**Processes and factors limiting sustainable mountain development**
Regional system of protected areas in the Coffee-growing region of Colombia	Since the 1980s, strong relations have existed between local authorities with environmental protection mandates in the Coffee-growing region and the national parks authorities, in the former incarnations. With the environmental legislation in Colombia of the early 1990s, together with decentralization processes, a stronger regional approach to environmental management in the Coffee-growing region was enabled, bringing together different and diverse actors, with strong civil society participation. Other important factors in the build-up to the creation of the regional system included important conservation initiatives implemented by the environmental authorities, NGOs and landowners, and the regional water companies. Regional protected areas had also been created by local authorities prior to the establishment of the regional system (Nadachowski et al., 2009). An inter-institutional committee was formed in 2000 to create the Regional Protected Area System (SIRAP), including representatives of five Regional Environmental Authorities, regional office of the National Parks Authority, regional node of the Private Protected Areas Network, universities, local government and NGOs. After the formalisation of the regional protected area system (SIRAP) in 2001, through an inter-institutional agreement, the steering committee, through its executive and technical components, has now become the main consultative body on environmental management in the coffee-growing region. As of 2008, the SIRAP has 211 areas, totalling almost 4,500 km^2 (or 17% of the region) of which 73	Although significant increases in information have been achieved, there is still a lack of information for decision making on environmental management in the region. Furthermore, information produced is not always processed adequately for different audiences (e.g. decision makers), especially products from research. This is also linked to a lack of scientific and technological development, allowing suitable information to be collected and processed. Patterns of threats to the environment and the system of protected areas have changed over time. For example, the threat of deforestation for coffee growing has now been surpassed by other emerging threats such as mining activities, which threaten areas of higher altitude, especially the high Andean grasslands or paramos which are vital for providing water to the region. This change in environmental outlook has helped forge alliances, for example between hydroelectric sector and coffee-growers (protecting water sources) and bring diverse actors to joint committees.

	correspond to national categories, 47 to regional, and 92 to private reserves (Nadachowski et al., 2009). A novel feature of the system was the inclusion of private reserves since its beginnings, even before these were included in the National Protected Areas System. The declaration of the National Park, Selva de Florencia, after its identification as an Important Bird Area, also brought different actors together, given that communities living within the new park played an important role in its declaration.	
Twenty years of mixed experiences in the Fúquene region provide a basis for implementing adaptive management in a social ecological system *Fúquene - Rabanal* Colomb ia	At approximately 100 km north of the capital, Bogotá, the Ubaté Valley wetland complex lies on an Andean altiplano, and includes the lakes of Fúquene, Cucunubá and Palacio, Rabanal páramos. The wetlands are of very high, social, economic and environmental importance, providing drinking water to at least 150,000 people, and pasture for the region´s milk industry and small-scale landholdings, including potato farming on the paramos. Following the introduction of trout in the lake, local fishermen are also part of the local economy. However, the ecosystem has suffered multiple changes over the last 100 years, including the partial draining of the lake, but recent flooding events have increased the lake´s size again, making evident the precariousness of those who base their livelihoods and businesses within the lake´s floodplains or within its original extent. A large number of management proposals, interventions, and also some conservation areas, have been introduced or proposed over the last 20 years, but have led to, at most, mixed successes, reflecting a lack of consensus between different actors, with associated problems in governance and a lack of adaptive cycles to management plans, often related to fixed periods in office of local government and environmental authorities. For example, declaration of two small forest reserves in Rabanal were not effective due to a lack of implementation and in one case, 10 years passed before a management plan was even drafted for the area. In Fúquene, an official planning and investment document from 2006 involved agreements between different ministries, but led to few immediate results, given its rather antiquated land-management approach focused on the wetland´s irrigation system (including dredging and construction of a perimetric canal) in order to provide stable water supplies to the local population and industry. However, in reality, this approach represents just one aspect of the management of the wetland complex. A reflection on the last 20 years of environmental management in the Fuquene area, involving multiple organizations and actors, concludes that changes need to be introduced in the way that sustainability is addressed in environmental management, with a stronger role for adaptive management, where changes in the social and ecological systems can be readily accounted for, rather than following a fixed, predetermined plan. Mixed results have also been attributed to conflicts in resource use, lack of coordination between planning instruments and state sectors, lack of implementation of management plans, as well as more fundamental issues, such as not heeding social ecosystem thresholds or cultural barriers between actors, as well as the type of environmental management itself favoured by stakeholders. Although several achievements have been made in terms of the environmental management of the region, often in the context of Colombia´s innovative environmental and land-use planning legislation, the initiatives and strategies have lacked an integral approach, by not taking into account the dynamic nature of natural systems and focusing on all aspects of development equally. Only through this kind of systemic or “natural system” approach, focused on integral and participative management of basins, will lasting solutions, with widespread agreement be found for Fúquene´s environmental difficulties.	

Other conservation areas have also increased greatly over the last 20 years, including international categories within environmental agreements, such as Biosphere reserves (MAB 2011), World Heritage Sites (UNESCO 2011) and Ramsar sites, as well as civil society initiatives such as Key Biodiversity Areas(Eken et al., 2004; Langhammer 2007), Important Bird Areas (Devenish et al., 2009) (Box 2), WHRSN, and Zero Extinction Alliance (Ricketts et al., 2005).

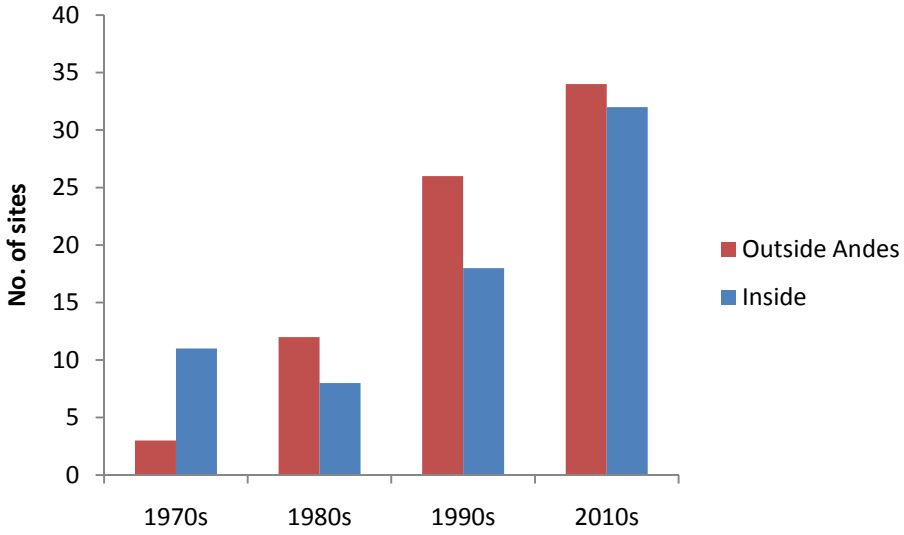

Figure 10. Growth of conservation areas within IEAs (Ramsar sites, World Heritage, Biosphere Reserves) inside and outside the Andes 1970 - 2010

Biosphere reserves, established under UNESCO's Man and the Biosphere (MAB) Programme, consist of protected core areas and buffer zones, aimed at promoting sustainable development. A total of 41 biosphere reserves have been declared in the seven Andean countries, totalling some 550,000 km^2, of which approximately half lies within the Andes (24 reserves). World Heritage Sites, established within the UNESCO convention of 1972 (UNESCO 1972), aim to protect cultural and natural heritage of outstanding value to humanity around the world. A total of 44 sites have been declared in the Andean countries, of which 23 are in the Andes, with a heavy bias towards cultural sites, with only six sites either natural or mixed. Ramsar sites, established between 1981 and 2009, of the total 74 sites in the Andean countries, totalling 212,651 km^2, 29% of their area are within the Andes, representing 42% of the number of sites. In all, 75% of sites of all three initiatives in the Andean countries were established between 1990 and 2010 (Figure 10). In terms of civil society initiatives, 689 and 566 sites were established over the last 10 years outside, and inside the Andes, respectively, including WHRSN, IBAs and AZE sites.

Strategies and planning for biodiversity conservation have increased greatly over the last 20 years, with all countries in the Andes completing their National Biodiversity Action Plans between 1997 and 2003 (Table 8), which have also led to planning documents at smaller geographical or taxonomical scales, for example, wetland or ecosystem conservation policies, conservation strategies for birds (Ecuador, Colombia, Chile) and regional conservation plans (Table 9). Species action plans for both threatened and non-threatened species have also been produced, with at least 30 species covered in the region.

Red Data books have been produced in all seven Andean countries over the last 20 years, covering species at national level, to date 50 publications have been produced, representing more than 15,000 evaluations. In at least three countries, red lists have been adopted into national legislation, providing different levels of protection to designated threatened species. An appropriate updating cycle, within appropriate biological and administrative timescales (e.g. for lists within national legislation), is important for continued functionality of red lists, and at least five countries have produced second or third editions of red lists over the last 20 years. Multiple editions of red lists also provide a means to measure changes in extinction risk over time, provided that compatible methods are used for each red list evaluation and that changes in category are ascribed to genuine changes in state, rather than resulting from new knowledge.

Civil society initiatives to monitor biodiversity have also increased in the last 20 years, for example, Christmas Bird Counts have accrued data from a large number of sites in the Andes, and the Neotropical Waterbird Censuses have been implemented at least once at more than 1600 sites across the seven Andean countries between 1990 and 2011, but continuity at sites is a limitation in both these initiatives.

A series of environmental indicators, within the framework of the 2010 Biodiversity Targets and Millennium Goals, was recently tested in a project coordinated by the Andean Community, with the participation of several environmental NGOs (Cuesta et al, 2010). Indicators, within a State, Pressure, Response framework, included area of biomes; change in climate niche of Andean species; change in climatic distribution of biomes; red list index for birds of the Tropical Andes; public governance and policy; civil society contributions towards 2010 targets and coverage of protected areas. Rather than focusing on the actual results of the indicators themselves, the study trialled their application with real data, in order to propose their periodic uptake to members of the Andean Community, in part, as a way of monitoring the Regional Biodiversity Strategy. Results showed promising feasibility, with sufficient information available to be able apply the indicators on a periodic basis, although, in many cases, this information was not in a readily available, compiled format, to allow for a practical application (Cuesta et al, 2010).

Box 2.4.2 Proyecto Paramo Andino	
	The Proyecto Paramo Andino, coordinated by CONDESAN, and implemented over the last six years by national partners in Venezuela, Colombia, Ecuador and Peru, aims to protect ecosystem services and improve the livelihoods of the inhabitants of the High Andean paramo. The initiative has its origins within the Working Group of Paramos, established in 1999, and project formulation began in 2003.After approval by GEF in 2005, the initiative established pilot projects at 14 sites across the four countries, including the three case study sites of Gavidia, El Angel and Rabanal, focusing on sustainable management, policy, training and education. The project has been successful in catalysing consensuses from within local communities in the management of paramo ecosystems, a process which has evolved from an era characterised by a dichotomy between conservation and use (effectively excluding people from conservation), evolving to an approach based on sustainable use, but actually reaching conclusions of strict conservation, in some areas, as initiatives arising from within communities. In this sense, and given the relatively long period of implementation, important results can be attributed to the education component which has been fundamental in bringing about these changes in awareness within local communities, as well as changes in attitude among conservation practitioners. To facilitate replication of successful projects, the initiative has worked to bring together different actors interested in the sustainable development of the High Andes, through events ranging from community meetings to international conferences, as well as setting up a clearing house mechanism where experiences, management plans, legislation and project documents can be accessed. Masters and doctoral students from the region have also been funded through the project.

The Andean region, as well as being one of the most biodiverse, is also one of the most threatened regions of the world, both in terms of ecosystems and species. A global classification of priority ecoregions, based on a representation approach of biological distinctiveness (Olson & Dinerstein 1998) included 24 of the “Global 200” ecoregions within the seven Andean countries. Of these, 11 have most of their area within the Andean region, and 10 are classified as Critically Endangered, or Vulnerable (Olson & Dinerstein 2002). In total, 46% of the area of threatened ecoregions of the seven Andean countries are within the Andean region (in 33% of total country area).

A study to quantify threats to ecosystems in South America modelled effects of fire, grazing, accessibility, infrastructure, oil and gas, and (recent) conversion to agriculture. High values of specific threats in the Andes mountains, correspond to fires and grazing in the high Andes of Peru, recent conversion to agriculture on the Pacific slope in Colombia, the Andes of Ecuador and Valdivian forests in Argentina and Chile. The highest values for combined threats are in Venezuelan Andes, the eastern cordillera of Colombia, the high Andes of Ecuador and Peru and the forests of Patagonia (Jarvis et al., 2010).

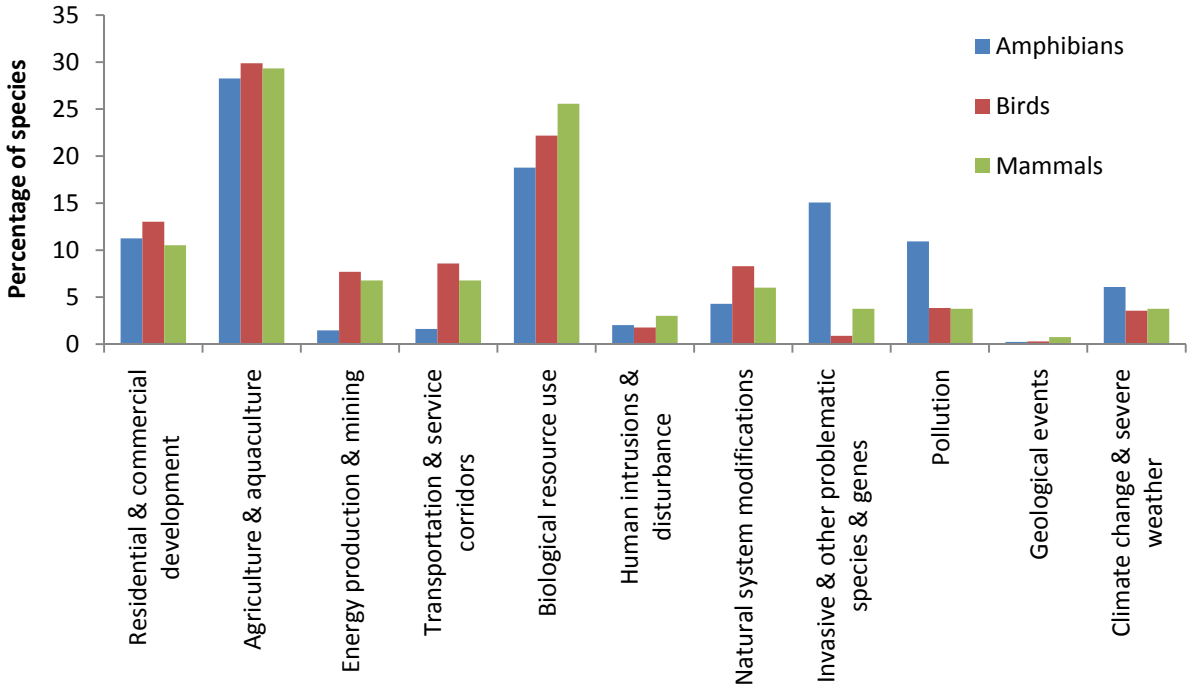

Figure 11. Principal threats to endemic species of the Andes

Using spatial information on threatened species distributions (BirdLife International 2010, IUCN 2010), the proportion of species threatened within the Andean region was calculated, giving 77% of threatened birds in the seven countries, 91% of threatened amphibians and 59% of threatened mammals occurring in the Andean region. Very high rates of endemism exist among threatened species, given that 57% of all threatened birds, 80% of amphibians, and 34% of mammals are endemic to mountain region. Principal threatening processes include agriculture, affecting the highest percentage of species in the Andes, followed by biological resource used, where mammals have a slightly higher percentage, reflecting greater hunting pressures (Figure 11). Threats to mountain systems mentioned in the thematic reports of Andean countries to the CBD program of work on mountain biodiversity include infrastructure development, mining, agriculture, climate change and invasive species. Trends in threat category, using the Red List Index, show increasing extinction risk between 1988 and 2008, in the case of genuine changes in threat category of bird species only occurring in the Andean region (Cuesta et al., 2010).

2.5 Exploitation and use of resources

This section examines progress and challenges resulting from the use of resources, with regard to ecosystem services, mining and land use. Central themes revolve around use of water, for example, in regard to retribution schemes for environmental services, and conflicts with regard to use, especially relating to mining. Conflicts could be further exacerbated by changes in water availability due to climate change, and also affect distribution patterns of agriculture.

The constitutions of all Andean countries include state obligations in environmental protection (Table 9), as well as including the provision of the private sector to receive economic contributions for contributing to the protection of natural resources. Only in the case of Ecuador, is it unclear in the new Constitution whether this type of alternative is viable (Quintero 2010). Payment for environmental services is not specifically mentioned in legislation in the Andean countries, but both Colombia and Peru are preparing a strategy and a law, respectively, treating the issue (Quintero 2010). Also, proposals going beyond the solely economic nature of retribution for environmental services propose benefit sharing mechanisms to ensure livelihoods within river basins, based on dialogue and social consensus (CONDESAN 2011). Research on, and implementation of water management and retribution schemes has grown over the last 20 years, and initiatives have been implemented at different scales. In rural mountain areas, lessons have been learnt in the appropriate scale of water management schemes, and advantages have been found favouring an approach based on very small scale basins. Recently, in a context of climate change, important progress has been made in the incorporation of a

systemic approach to watershed management, with communities playing leading roles in the management of natural resources through participatory drafting and implementation of local watershed management plans (Becerra et al., 2011).

Although the issue of climate change may have provided such a boost, integrated water resource management has steadily been gaining ground in the region. Until the 1970s, water management in the Andes, was compartmentalised according to sector (e.g. hydroelectric, agricultural or urban use), resulting in highly trained professionals in each area, but did not take into account the needs of other sectors, or the effects of each sector´s use on others. Early experiences in water resource management at river basin scale, taking a more integral approach, in the Andes come from Colombia, implementing research in Aguacatal basin in the 1970s, and in Rio Colorado in Argentina (Dourojeanni, 2011).
The river basin approach became more generalised in the 1990s, with the introduction of specific legal frameworks in countries such as Colombia, and Chile, albeit with very different approaches. Brazil´s laws on water became a reference for Andean countries, taking the lead from this approach based on integral management of river basins, rather than Chile´s more marketed oriented laws, allowing property rights for water. In 2000s, countries such as Peru, Bolivia and Ecuador began drafting laws on water, although only Peru has managed to approve a general law on water, with political processes in the latter two countries not favouring the law´s approval. Six pilot sites have been set up to test run Peru´s new law on water of 2010, where requirements, such as water basin committees (see Box 2.5.1) and river basin delimitation are beginning to be implemented. However, it is widely thought that it will take some 10-15 years for a generalised implementation at national level.

A recent study of experiences in Integrated Water Resources Management (Acosta & Alvarez, in press), found that most initiatives had not implemented activities across the whole river basin, from protecting higher areas, to improving efficiency of water use in lower regions. As a result of priority setting amongst activities, mainly due to budgetary constraints, most initiatives concentrated on protecting upstream regions. However, in other cases, separate initiatives, especially through development projects, had implemented projects on improving efficiency in agricultural use of water, but not as an integrated approach to river basin management. Important factors for successfully converting to integrated water resource management were found to be connected to generating knowledge of the particular river basin; improving educational processes whereby communities learn about the importance of the water cycle and where their water actually comes from (especially for downstream communities, within and outside the Andes); and involving a large number of stakeholders, including regional and local government, water users, water authorities, among others (Acosta & Alvarez, in press).

Two routes generally lead up to the conformation of specific platforms for water management (i.e. participation and shared management), first, as a result of specific problems associated with water (e.g. degradation of ecosystems, scarcity, conflicts of use, pollution), a political process aims to reach agreements on solutions and better management. However, disadvantages of this route mean that the implementation of concrete actions is often delayed, with the process becoming an end in itself. Second, specific actions, such as reforestation, or upstream protection, have triggered political processes leading to concerted water management, although in some cases by this route, these processes are not sufficiently strong to become sustainable. A further important contributing factor to improved water management has been the legal instrument to create associations between different regional or local governments (e.g. from the mid 2000s in Bolivia, Peru and Ecuador). Before this was possible, municipalities were not able to invest in upstream protection if these areas were physically outside their administrative region, with the ability to create associations, local governments can implement joint projects, with each municipality or regional government, contributing funds for its execution. Political willingness is an important factor in the success of such associations (Acosta & Alvarez, in press).

Many of the schemes to compensate environmental services revolve around water, with examples at different scales, although mainly still at the pilot stage. In some of the largest cities in the Andes, water funds have been set up, where users pay into funds for the water they receive, as part of the Latin American Water Funds Partnership, established by the Nature Conservancy. The initiative helps to protect Andean forests and grasslands in Quito and Cuenca in Ecuador, Bogotá and Valle de Cauca in Colombia and Lima, Peru (TNC 2011).

In an analysis of environmental services related to water in the Andes (Quintero 2010), participation in different components of retribution schemes was summarised. All schemes followed a cyclical system, broken down into components related to funding, regulation, administration of funds and investment in environmental protection and had legal instruments to formalise them. Actors providing funding included water users, local or regional governments and NGOs or international cooperation with funds administered by private or public banks or trust funds. Types of investment in environmental protection included payment, incentives or credits to landowners for protection; purchase of land, forest conservation or regeneration (mainly implemented by NGOs or local authorities); vigilance, as well as educational activities.

Other mechanisms providing economic retribution for protection of environmental services, appearing in public policies in the Andes, include incentives for reforestation or conservation of forests, tax exemptions, extra water tariffs and royalties from exploitation activities (Quintero 2010). One such program was recently started to protect high Andean ecosystems in Ecuador whose forests have one of the highest deforestation rates in South America (Clirsen 2000), threatening ecosystem services and livelihoods among local communities and causing CO^2 emissions of up to 55,000,000 tonnes per year. The "Socio Bosque" initiative, launched by the Ministry of the Environment, aims to provide economic incentives (up to $30 USD per hectare) to individual owners and rural communities (peasant farmers or indigenous groups) who voluntarily commit themselves to protecting their forests, paramos or other native vegetation for a period of 20 years. In 2009, at the World Conference on Paramos, the program launched a special goal of conserving 65% of the remaining high Andean paramo ecosystems. Inhabited areas of paramos in Ecuador make up 40% of their total area, with a population of some 500,000 people, the remaining area is divided between national parks (40%) and large estates (20%) (MAE 2009). By 2010, almost 540,000 ha had already been included in the scheme, with an investment of $2,668,025 USD and 631 agreements signed, of which 91% are with individuals (MAE 2011).

Box 2.5.1 Water management

	Processes and factors contributing to sustainable mountain development	**Processes and factors limiting sustainable mountain development**
Peru, Apurímac	A project on water management, within small-scale river basins, in Apurímac, Peru, has improved land use to suit environmental conditions and agro-ecological capacity, through collaboration with authorities and farmers. A particular feature of this project was that water management was approached from a perspective of demand at micro-basin scale, as oppose to previous projects which contemplated much larger scale interventions, with the result of raising water prices and creating unsustainable ventures which local communities were unable to manage. Also, accessible technological solutions were implemented, with little dependence on external supplies, resulting in an increase in water supplies of up to 20% within the project area.	
Peru, Cajamarca	Challenges to water management in Cajamarca include a largely rural population (67%), located on smallholdings where only 20% of lands are under irrigation schemes. Irrigation is generally deficient, due to inconsistent water flow, and infrequent supply. In total, 60% of land plots in the region are less than five hectares in size, and 84% are less than 10 ha. The project set out to introduce a different irrigation scheme, adapted to mountain regions, rather than that employed on the coastal plains. The approach used in the mountains took into account rainfall, and	

	was based on a network of dispersed, small reservoirs, instead of the large hydraulic infrastructure in the lowlands. These principles enabled water security in two provinces of Cajamarca, achieving improvements in quality of life for hundreds of smallholders. Once water security had been achieved, the project worked to coordinate production with local market dynamics. Finally, the project was supported through processes of land-use planning, including the definition of priority Andean ecosystems to be conserved in order to ensure water production, such as jalca.	
Venezuela	Water management challenges in the paramos of Gavidia stem from a large population in the highlands, with a long history of potato and garlic farming. Due to the economic success of the activity, especially during the 1908s, agricultural frontiers expanded and intensified over the years. At the beginning of the 1990s, a number of years of reduced water availability and subsequent conflicts over water, led to grass-roots organizations seeking strong local agreements on issues such as protection of water sources in the paramos. This was mainly a local process, with little government intervention, but was successful given the evident seriousness of the water shortage on economic activities. Currently, 45 associations of water users exist, with solid organizational history, who have managed to fence off and protect approximately 200 water sources.	
Bolivia, Cochabamba		*Protests over access to water* In September 1999, the private company, "Aguas del Tunari" won a tender, funded by foreign capital, to privatize the domestic water supply in the city of Cochabamba, Bolivia. Previously, a new law had been passed by the Bolivian government to ensure the legality of the privatization, interpreted by many as an instrument to allow a monopoly and commercialization of water resources. The law also included a requirement for the population to acquire a license for collecting rainwater. One of the first groups to protest against this was an irrigation association in Cochabamba, but soon other groups joined the protest, establishing a formal organization to oppose the new law. The above contract also included a clause cancelling the debt of the state company previously supplying the water, as well as the requirement to finishing the construction of a halted dam project (which the World Bank had declared unfeasible) and a water transfer scheme from another river basin. However, the water company decided to charge these activities to the inhabitants of Cochabamba, causing an increase in at least 35% in water bills. Added to the fact that the company was not able to provide a regular water service, further protests ensued. The protests were successful, in that the government backtracked on the policy, and set a precedent for a new vision of public policy on water, as well as establishing a debate on whether water should be considered as a marketable product, or whether it should be considered a common good. However, although the protests now have symbolic value across the Andes, unfortunately, they did not lead to a regulatory

		framework on water, and in Cochabamba, the organisations that fought the measure together, are now divided, and compete over an increasingly scarce resource (Antequera & Canedo, 2011, Ramírez et al, 2011).
Colombia, Coffee-growing region	Payment to regional environmental authorities in Colombia from hydroelectric companies was included in environmental legislation in 1993. Companies generating more than 10,000 kW are required to pay royalties of 6% of total sales, of which 3% goes to the local environmental authority with jurisdiction over the river basin to protect water sources and the environment and 3% to the municipalities within the basin, split equally between those containing the reservoir and those upstream. Royalties must be invested in environmental protection or sanitation, prior approval within municipal development plans (Quintero 2010). In the Coffee-growing region, these royalties have represented a major source of funding, for example, $14m US has been transferred to the Chinchiná river basin alone since 1994, with an area of 60,000 ha, of which 15,000 ha are within protected areas. This local source of funding has also had an important impact in the ability to implement initiatives in sustainable development without a reliance on international cooperation. A recent agreement with the hydroelectric company will allow five years' of royalties to be paid upfront, enabling land to be bought by the regional environmental authority upstream, to protect water sources.	Funding from royalties has also tended to produce initiatives based on short term aid in some cases, rather than fomenting participation in regional planning and state decision making processes.

Important progress was made in agricultural innovation at the end of the 1990s and beginning of 2000, with the objective of replacing traditional schemes of research and development, with more participative approaches for renewing agricultural initiatives. New approaches include the participation of social scientists, anthropologists and economists, as well as changing sources of knowledge to include local knowledge systems as well as the academic sector. For example, this changing focus is highlighted by the Papa Andina project, which documented the challenges associated with linking agricultural research to practical improvements in value chains for rural Andean farmers (Devaux et al., 2011). A recent study analysed 31 cases of agricultural innovation in the Andean countries (above 1000 m altitude), where innovation was directly related to economic growth and poverty reduction in rural areas (see Box 2.5.2), resulting in changes in social organizational systems and agricultural technologies. A lack of connection was found between those implementing innovation and public policies, especially in terms of upscaling initiatives to wider regional environments even though policies in countries such as Argentina, Chile, Colombia and Peru do focus on integrating research and development with the private sector (Montoya, M. P. & Fano, H. In press).

The variety and complexity of traditional farming systems in the Andes (e.g. planting multiple crops on different fields, at different altitudes and exposures), on the condition that they are preserved, and their knowledge passed on, could provide an important pool of farming practices for rapid adaptation to changing climates (Young 2009). In fact, research has showed that pre-Columbian agrarian societies implemented innovations in agricultural strategies and infrastructure in response to both temporary and long-term environmental change and uncertainty (e.g. Dillehay & Kolata 2004, Chepstow-Lusty et al. 2009), providing relevant examples for adapting to current changes. However, farming practices may also be forced to change as a result of climate-change induced reductions in water availability through less rainfall or melting glaciers, and in some areas farmers will need to move towards more elaborate irrigation schemes, or become more dependent on livestock, such as sheep or goats (Young 2009). The dynamics of puna systems, livestock and Andean communities are analysed in Box 2.5.2.

The role of women in agriculture has also changed over the last 20 years. According to a recent FAO report, Latin America has one of the highest regional proportions of female "agricultural holders"[15], reaching more than 25% in Chile and Ecuador (FAO 2011). The report also recognises the important position of women in small-scale livestock farming, for example, in High Andean areas, grazing and management of natural grassland is predominantly a female task. However, as is common across regions, women have less access to productive resources and opportunities, for example in access to technology. However, a certain success has been achieved in fruit production in Chile, where approximately 45% of the workforce is feminine, and in flower production for export in Colombia, with a 70% female workforce. Andean women have also played a key role in the conservation of genetic material of native Andean crops, especially seed material (Tapia & De La Torre, 1997, Conlago et al., 2011), as well as increasing family incomes through the use and promotion of Andean roots and tubers (Cadima et al., 2011). Local knowledge, such as the above, is only recently being fully valued and recognised, particularly as part of processes associated with the recognition of the importance of agro-biodiversity.

In this sense, native Andean crops have played an important role in promoting sustainable development, with many initiatives being implemented, including ex situ conservation of genetic resources, and a "potato park" in Peru, where 600 varieties of potato are conserved in over 12,000 ha (CIP 2011). Recently, Andean potato varieties have become widely available in different products, including potato crisps, as part of the "Papa Andina" brand, both within the Andean region and internationally, as a result of the Papa Andina project implemented by International Potato Centre based in Lima (Devaux et al., 2011). The project focused on promoting agricultural innovation based on native crops, as a strategy for reducing poverty, with a central theme to recognise the value of local knowledge and biodiversity. However, mobilising these resources requires the development of participatory technology and improving linkages to agricultural food chains (Thiele & Devaux, 2011). The demand for native crops is reported have increased 50-fold in the last five years,[16] which is strongly related to a recent surge in Peruvian cuisine, both nationally and internationally. In Argentina, native Andean crops have been subject of research and community-based initiatives to promote development (Box 2.5.2). Marketing of products is also a key consideration in making these projects sustainable, as consumer preferences change and are increasingly influenced by imported products.

Andean crops are also the target of conservation initiatives in their own right, for example as crop wild relatives. A review of *in situ* conservation initiatives on crop wild relatives (Meilleur & Hodgkin 2004) lists Bolivia and Ecuador as implementing activities in this respect, activities included an inventory of potential sites for *in situ* conservation, including national parks, setting up an information system on crop wild relatives (see section 2.3) in Bolivia, and protection of relict forest containing a species of *Persea* genus in Ecuador. The USDA Agricultural Research Service is also involved in listing protected areas Bolivia with potential for conserving crop wild relatives (Meilleur & Hodgkin 2004).

Box 2.5.2 Native Andean agriculture benefits communities

	Processes and factors contributing to sustainable mountain development	Processes and factors limiting sustainable mountain development
Jujuy, Argentina	The Conference on Andean Crops in 2001 in Jujuy, Argentina was instrumental in both initiating an awareness raising process on the importance and value Andean crops in the region, but also for reasserting a sense of belonging to the Andean region for Jujuy. In the years following the conference, projects were initiated to raise awareness among local actors of the importance and value of agrobiodiversity. Innovations in processing local produce led to new products for local consumption, accompanied by training in best industry practices. In 2003, the declaration of the Quebrada de	The boom in tourism, brought about by the declaration of the World Heritage Site, was new to the area, resulting in unplanned development, as well as the arrival of investors from outside the region. As a result, water shortages and conflicts for use of resources resulted, as well as creating tension among inhabitants. For example, due to the requirements by new hotels to only use formally qualified staff for jobs such as chef, community members were often overlooked even though they may have received training through the Andean crops projects. This situation led to the formation of a Gastronomy School in the region, providing free training, the only one of its kind in the country.

[15] Defined as the person or group of persons who exercise management control over an agricultural holding (FAO 2011).

[16] http://www.theworld.org/2011/11/researchers-restaurateurs-work-to-save-peru-food-diversity

	Humahuaca, Jujuy as a World Heritage Cultural Landscape, meant that a management plan for the region had to be presented as part of the application requirements. This management plan included an agro-biodiversity component, which was created as a programme within the Ministry of Production and Environment of Jujuy province, and later became the current programme on Andean crops, under the responsibility of the Agricultural Development Department. This interest also led to the creation of a Centre of Andean Crops within the Faculty of Agricultural Sciences at University of Jujuy. The Centre has based its work around the conservation of agro-biodiversity, rural agricultural innovation based on Andean crops and the recuperation of knowledge and the way that Andean crops are valued within the local community and the scientific community at national level. Activities have included recuperating ancestral irrigation systems, creating living seed banks, creating local certification schemes for seeds, diversifying products from Andean crops (including training in production techniques) including liqueurs, jams, dehydrated fruit and speciality flours, participation in organic food fairs. As well as regained pride in local, traditional produce, an important achievement has also been the learning experience of the process to recognise Andean crops within the national alimentary code (a necessary requirement for their subsequent sale). A cooperative within the local community has now been set up, with infrastructure and equipment for food processing as a result of key inter-institutional alliances, especially with the public sector which have extended beyond electoral periods. For example, the municipality has provided infrastructure, the regional government has provided equipment, and NGOs provided training. An important achievement is the recuperation of the state's role in promoting development, by providing infrastructure and opportunities for Andean crops to provide important incomes to local communities. Experiences in the region have also managed to use tourism to promote local agro-biodiversity, generating new economic dynamics which not only help to commercialise local products, but also raise awareness as to its cultural and ecological value.	National policies aimed at biodiversity conservation do not contemplate the commercial value of biodiversity. For example, the majority of native Andean crops in Argentina are not included within the Alimentary Code, an obligatory requirement for their commercialisation, and therefore, cannot be sold as foodstuff until they have been registered.

As discussed above, mining has increased in the Andean region, and is a vital part of economies. The theme is present in almost all the case studies, and in many, has changed local dynamics, but rather than opposing mining categorically, the case studies present responsible mining as a challenge (see Part 3). Nevertheless, in terms of sustainable mountain development, mining, as currently addressed by the case studies, is seen as a direct threat to biodiversity conservation, a source of conflicts in resource use between mining operations and communities, and as creating divisions within communities (e.g. Bebbington et al., 2008) as regards their best choices for development (see Box 2.5.3).

The majority of mining-related conflicts revolve around water and land. In areas where water resources are more plentiful, such as paramos ecosystems, pollution problems are potentially more serious, whereas, in areas of water

shortage, such as the mountains of south Peru and north Chile, use of water by mining companies competes with undervalued or unvalued ecosystem services or directly with the water needs of communities.

Legislation within the majority of Andean countries generally treats surface land and subsoil independently, and are even administered by different sectors within the state, often lacking the necessary coordination between them for correct land-use planning. This can lead to complaints on environmental issues caused by mining being treated by sectors outside environmental jurisdictions. For example, in Peru or Chile, complaints made about mining are not treated by agricultural or environmental sectors of government.

An information system to document social and environmental conflicts in Latin America (OLCA) (http://www.olca.cl/oca/index.htm) presents a diverse array of mining conflicts in the region, including at least 145 communities, most of which were from the mountain regions (Table 11). However, what is reported often depends on the degree of institutionality and legislation in each country. For example, differences in the constitutional structure of Colombia, compared with Chile or Argentina, favour the former in providing opportunities for social control and making formal complaints or information requests. In Peru, conflicts related to mining, reported to the Ombudsman's Office, rose from 33 to 89 between 2007 and 2009 (Bebbington 2009).

Table 11. Mining conflicts reported by county (OLCA 2011)

Country	No. of projects	Mining companies involved	Communities involved
Argentina	30	43	37
Bolivia	6	7	21
Chile	28	42	34
Colombia	32	21	20
Ecuador	5	4	5
Peru	26	42	28
Total	**127**		**145**

Initiatives aimed at establishing a more "responsible" mining development also exist in the region. For example, in Argentina, the organization, Fundación Cambio Democratico has set up a platform to involve diverse social and government actors, academia and the private sector linked to mining to generate joint diagnosis of mining conflicts and establish strategies for responsible mining. Codes of conduct, both social and environmental, have also been established at different scales, for example, minimum conditions for mining in Ecuador (CEDENMA, 2011), as well as by mining companies, and international NGOs, and industry organizations, although these should be adapted to specific sites, especially in sensitive areas, such as high Andean paramo (Guerrero, 2008).

Over the last 20 years, mining companies have developed biodiversity and social strategies. However, the effect of these on mining operations and their impact on livelihoods is not clear, given that many appear to be offset strategies, rather than addressing direct operational issues, for example, one strategy aims to have a "net positive impact" on biodiversity. In this sense, biodiversity conservation projects in adjacent areas to mining operations, or infrastructure construction in municipalities where mining takes place have their benefits, but their focus on changing operational procedures or resolving conflicts related to resource use is more limited.

Box 2.5.3 Balancing economic alternatives with use of resources

	Processes and factors contributing to sustainable mountain development	Processes and factors limiting sustainable mountain development
Peru, *Apurímac*	*Competing interests in water management* The Mariño river basin in Apurímac has a long history of projects in the management of water resources. Experiences have demonstrated that it is possible to improve efficiency of irrigation, as well as build local	Over the last nine years, new factors have appeared, which have totally modified the economic panorama of the region. First, the arrival of drug trafficking in the region has meant that incomes can be supplemented from this source. Second,

	capacities among the different actors involved. With improved water supplies, local agriculture is more competitive in markets and becomes a mainstay for livelihoods. Another factor in regional water management, is the town of Abancay, the capital of Apurímac. Located at almost 2500 m in the southern Andes of Peru, it has a population of over 55,000 inhabitants. The upper reaches of the Mariño basin supplies part of the water for this city, where institutional retribution schemes with the inhabitants upstream are a possibility in the future. Such schemes would focus on maintaining activities compatible with the conservation of ecosystems to ensure water production.	mining has grown by almost 70% in the region, with 40 mining projects now under way. This growing activity, provides challenges, given that it competes with agriculture for land and water resources. According to official data, mining concessions have already been adjudicated in 40% of the province of Abancay. Therefore, projects also focusing on capacity building have provided inhabitants with better capacity to take decisions on how to balance sustainable development with the regions challenging economic activities.
Peru, Cajamaca	*High Andean ecosystems and mining - Alto Peru* The Alto Peru lakes are located in San Pablo, Cajamarca, near the border with Ecuador. This area consists of 284 wetlands and lakes at the headwaters of the Jequetepeque River Basin (at 4732 km2, one of the most important in Peru), representing one of the most important sources area of water and pastureland for farmers and ranchers, as well as being an area of cultural heritage.	On February 28, 2007, the provincial municipality of San Pablo declared the area as a conservation area, for the protection of native species and water resources, among others. Subsequently, the Yanacocha Mining company filed a lawsuit against the ordinance, citing that the declaration violated their property rights. Yanacocha owns mining concessions in the area. The suit was first declared inadmissible by the Superior Court of Lima, but later the Constitutional Court revoked the decision in December 2010. The lack of dialogue between sectors becomes especially evident during these conflicts. The implications of mining activities on water resources, and access to them, has provoked serious conflicts in Peru in recent years, and continues to do so. Furthermore, given that Peru is widely considered to be one of the most vulnerable countries to severe water shortages in South America, there is a real and increasing threat of conflict over the distribution of water in the country. A recent conflict over the proposed plans of a different mining company to “transfer” four high Andean lakes, has caused further protest. However, an encouraging sign has been the suspension of activities until a proper dialogue can be re-established between communities, local government, national government and the mining company.

The role of mountain ecosystems in fomenting tourism has resulted in an increased value being given to both altered and undisturbed landscapes, according to different focuses of tourism. Nature and adventure tourism tend to favour undisturbed landscapes, whereas agro-tourism, or that based on rural communities, focuses on cultural or agricultural landscapes. For instance, in Argentina, the declaration of the Quebrada de Humahuaca, Jujuy, in 2003, as a World Heritage Cultural Landscape attracted a greater number of tourists to the area, especially because national tourism had increased greatly given the economic crisis of 2003 in Argentina reducing many trips abroad.

Although tourism can be a sustainable activity in the mountains, and considered an ecosystem service, the majority of tourist activity does not comply with criteria of sustainability. Furthermore, apart from isolated examples, such as Machu Picchu and in some national parks in the south, tourism itself is not a well-developed mass activity, as in some other mountain areas of the world. However, many initiatives do exist to present sustainable models, particularly rural ones, as alternatives for development in mountain regions. The Mountain Partnership, for example, is supporting sustainable tourism projects in frontier regions of Argentina, Bolivia and Chile.

Tourism has grown at an annual rate of almost 3% in the Andean community since the 1990s (IICA 2008), and an influx of tourists in rural areas has meant changes to working routines among rural communities, with many projects implemented in capacity building, training and preparation of tourist products over recent years. Tourism is presented as a

complementary, rather than alternative strategy for development, alongside more traditional rural activities or other alternatives for development, an important consideration given the seasonality of the activity. Different types of rural tourism have been identified, ranging from community tourism, where community projects provide a joint service with sharing of benefits, to those based more on individual landowners providing accommodation on rural estates, or in family homes. Many national strategies and plans on sustainable tourism have been released over the last 20 years in the Andes, as well as the conformation of national and regional networks of service provides, academics and government bodies, with regular conferences and meetings on the subject. More specialized types of tourism have also increased across the whole region, such as birdwatching, but especially focused on regions with high rates of endemism, such as the Tropical Andes, with national strategies and guidelines produced, for example in Ecuador.

2.6 Funding and international cooperation for development

International cooperation (ODA)[17], has channelled substantial funds for reaching development objectives in the Andean countries significantly over the last 20 years. As a proportion of GDP, development assistance reached maximums of almost 20% in Bolivia, and 3% in the other countries, but is decreasing in the Andean region (Figure 12a), as GDP increases and cooperation remains stable. However, as cooperation agencies realign their priorities (e.g. to other regions such as Africa), it is expected that this source will cease to be a major funder of sustainable development initiatives in the next 10 years, with possibly the exception of Bolivia, with some agencies recently defining exit strategies in some Andean countries (e.g. CSD will shift priority to Bolivia while closing existing operation in Ecuador and Peru). The implications for the region are that more regional sources, for both funding and technical support will need to be found (see Part 3).

With regard to the implementation of Rio 92 objectives in sustainable development, analysis of ODA shows that funding has increased slightly in absolute terms and as percentage of total development assistance in projects with principal or significant objectives related to biodiversity, climate change or desertification[18] (Figure 12b), reaching over 10% of all assistance by 2009. However, the slight increase observed at the end of the 2008 period may be an artefact of obligatory reporting being implemented from this time, as well as reporting cycles and changes in thematic focus, therefore a trend is difficult to diagnose. Individual components of aid to Rio objectives show an increasing trend in funding for both biodiversity and climate change components, and decreasing in desertification-related aid, with climate change overtaking biodiversity only in the last two year period (Figure 13). However, in terms of numbers of projects, more have been implemented in biodiversity related themes consistently over the last 20 years.

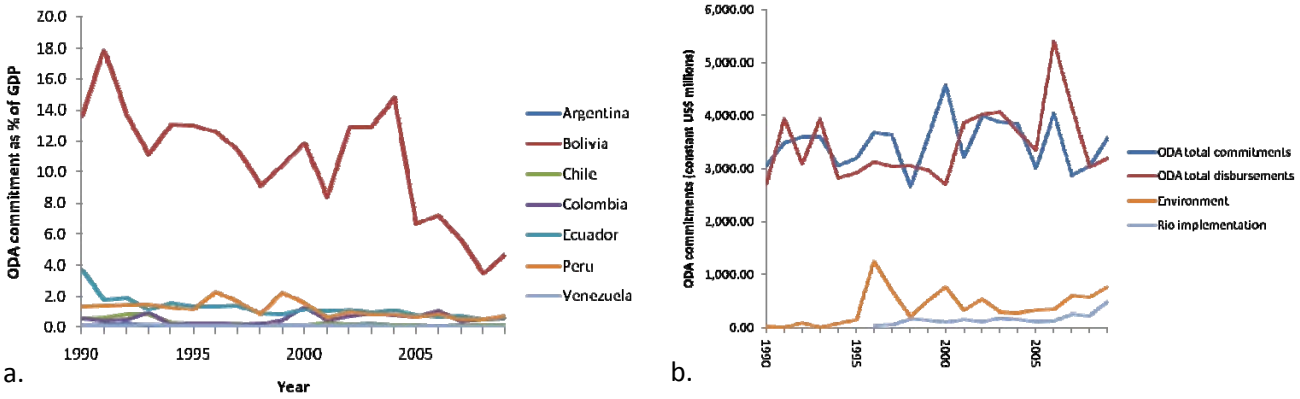

Figure 12. a) Development aid as percentage of GDP (OECD, IADB); b) Total ODA funding, and broken down for environment sectors and Rio 92 markers.

[17] Defined as Official Development Assistance (ODA) (OECD 2011): Grants or loans to countries and territories on the OECD Development Assistance Committee List of ODA Recipients (developing countries) and to multilateral agencies which are: (a) undertaken by the official sector; (b) with promotion of economic development and welfare as the main objective; (c) at concessional financial terms (if a loan, having a grant element of at least 25 per cent).

[18] See OECD 2009 for definitions of these types of aid.

Figures on development assistance for environmental sustainability not only includes specific environmental projects, but also other development projects with environmental components (OECD 2009). Aid for environmental sustainability peaked in 1996 in Andean countries, but has shown an increasing trend since 2005, reflecting aid to Rio objectives over the same period, and reaching over 20% of all development assistance to Andean nations in 2009 (Figure 12b).

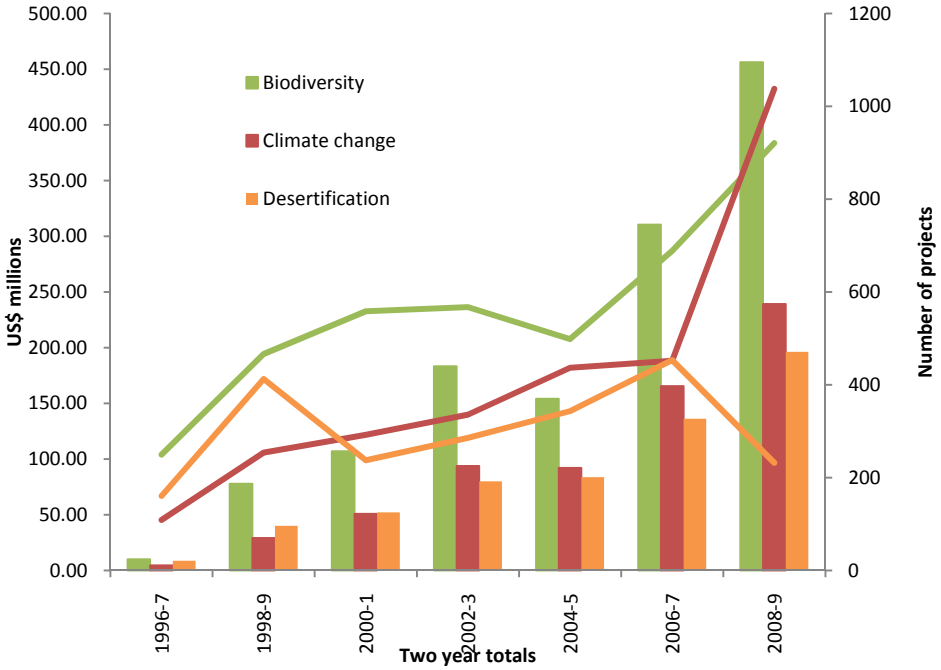

Figure 13. Numbers of projects (bars, right axis) and total funding (lines, left axis) for implementation of Rio objectives in development assistance 1996-2009.

Although climate change is now firmly on the agenda of governments, NGOs and funding agencies, compared to 20 years ago, initiatives formerly focused on desertification may be classified more generally related to water issues and overlap with climate change, perhaps related to a semantic understanding of reporting markers. Development assistance to implement Rio objectives falls into five principal sectors (agriculture, energy, forestry, environmental protection, water), with proportionally more being spent on energy related initiatives (due to climate change related initiatives), and less on forestry related initiatives in the last five year period.

Projects addressing climate change funded by Official Development Assistance (see note 4) in the Andean countries have increased steadily over the last 15 years, to almost 600 projects implemented over the period 2008-2009, with funding increasing from $45.3 million USD in 1996-7, to $432.4 million USD in 2008-9, for a total of $1,215 million USD over the whole period[19], with over 75% of this funding provided by Germany, Netherlands and Japan, and over 65% corresponding to GTZ, KFW (Germany), MFA (Netherlands) and JICA (Japan).

[19] Country reporting including Rio Markers only became obligatory in 2008.

2.7 Conclusions on processes promoting or limiting sustainable mountain development in the Andes

In 1995, a meeting was convened by FAO held in Lima, Peru, to evaluate progress on sustainable development in mountains in the Latin America, identify challenges and establish strategies to implement chapter 13 of Agenda 21 (Mujica & Rueda, 1996). The conclusions of the meeting began by recommending the following:

- Land use planning based on river basins
- Organization among small scale farmers to integrated management of river basins
- Creation of specific strategies for protection and conservation, at international, national and local level (e.g. protected areas)
- Identification and monitoring of environmental indicators
- Conditions for integrated land use planning
- Establishment of regulatory frameworks for sustainable use of mountain ecosystems
- Establish national and local strategies for sustainable mountain development

Subsequently, a further series of recommendations were drafted, under the following themes: socio-political; economic and financial, technical-scientific, organizational and institutional; education. Although many of the conclusions reached below, almost 20 years later, recur to the same themes (e.g. valuation of mountain resources, education on sustainable mountain development, regional integration, more autonomy for regional government, etc.), as shown in this report, substantial progress has been made in all of the above, highlighted, recommendations. However, maybe the area where the greatest challenges still lie, is what the above document labels as a the conciliation of two different styles of development, which leads governments to look at mountain regions with two different perspectives; on the one hand, as a region of great cultural and natural wealth, but with a poor, underdeveloped population, and on the other, solely as a source of wealth for large scale production or extraction. Although this dichotomy may not be as strong today as 20 years ago, current models of developments within the region, implemented by national governments, within a global economy and global political arena, still present the same challenges with regard to achieving sustainable development.

A wide variety of institutional processes have promoted sustainable mountain development strategies in the Andes over the last 20 years, in a progression which can often be tracked from commitments acquired as part of international agreements, leading to incorporation into political constitutions, resulting in national policies or legislation, and implementation at regional or local level. Increasing protagonism at local level has been supported by decentralisations processes. This vertical movement through government levels has been repeatedly singled out as a vital component for effective implementation, especially since this process is a necessary precursor for community participation. It is when this process is interrupted, that limitations are identified to sustainable development, for example, in overlapping authorities, lack of coordination or integration between levels, or separate treatment of such interdependent quantities as water and land.

Participation at regional and local levels has also been a major promoter of sustainable development, enabled through policies which have largely been created over the last 20 years. Limitations are again identified when participation processes are interrupted, for example, through deficiencies in knowledge, budget restraints, corruption and conflict of interests, institutional instability in NGOs and dependence on electoral periods. Experiences from Peru and Ecuador clearly show the positive value of local participation in alliances towards sustainability, but also make evident its incipient fragile nature. As a result, it is important that these processes are firmly institutionalised, but also embedded culturally, in an attempt to prevent loss of confidence in them and ensure effective social control. In Colombia, participation has a longer history, and in some regions this cultural component is already evident, with limitations revolving more around information gaps. Decisions as to when or when not to participate become more important at this stage.

In general, these limiting or promoting institutional factors, are not intrinsic to mountain areas, and would surely be identified in a wider survey of sustainable development at national levels. What is important, though, is to take into account the specific mountain context in their analysis, in that greater levels of poverty may exist, greater vulnerability of biodiversity, greater risk from climate change impacts and water shortage, and greater potential for conflicts regarding resource use. Of course, these statements do not hold across the whole Andean region, and as has been made clear throughout this report, the size and diversity of the Andes make a synoptic regional analysis difficult, but at local level, they certainly compound the limiting factors identified in this report.

A recurring theme revolves around water management and availability, with effects of changing climates contributing to serious challenges ahead for the livelihoods of mountain communities. Examples abound from cases in Bolivia, Peru, Chile and Argentina, where water shortages will require sustainable solutions, above all, within institutional frameworks. Retribution schemes for ecosystem services, such as water provision, from micro-basin level to the scale of cities, have shown great promise, with emerging approaches in benefit sharing, rather than straight economic payment for services.

A second recurring theme is related to resource exploitation, and burgeoning economies of some countries, based on extractive systems. Often related to these cases, is that land-use planning instruments, combined with decentralisation and other favourable institutional frameworks have failed to reach consensus as to the use of mountain resources, whereas they have been very successful in other cases. It is these economic systems that demand a larger quantity of resources of mountains than is sustainable, creating conflicts of interest, which will be exacerbated with reductions in water availability and its consequences. Furthermore, market forces, such as the price of commodities, exert influences which are often uncontrollable at national level, but have wide-ranging effects.

The sustainable exploitation of mountain resources, including for tourism, agriculture and biocommerce (especially with regard to native species), has great potential among the diverse visual scenery and wealth of cultures and species in the Andes. Experiences at local levels, have the potential to provide incomes and improve livelihoods, and could consider high quality, but low volume products. In this respect, certification, denomination of origin schemes and other market instruments, will favour sustainability and alternative exploitation of natural resources. Furthermore, the recuperation of traditional Andean knowledge will also play a key part in alternative income generation from these sources. It should be noted, however, that these experiences are also valuable as local strategies, where export markets are not the prime target.

Environmental management has become stronger in the region since 1992, with many specific instruments for better identification of priorities, better management of ecosystems and better incorporation of livelihoods into conservation schemes, as shown by examples from Colombia and Venezuela. Greater awareness of environmental issues on the part of civil society, has also been a goal of many of these measures, and in turn, has facilitated others.

Many projects have been implemented at national, bilateral and regional level with objectives in-line with sustainable mountain development, including biodiversity conservation, protected area creation, land-use planning, and poverty eradication, among others. On balance, many international agreements have a high rate of uptake among Andean countries, with high compliance in terms of reporting commitments, and important progress in the creation and implementation of derived national policies, action plans on climate change, reports on specific programmes of work. Implementation has also become incorporated into national legislation, in action plans and threatened species protection, for example, as well as national policies. However, indicators for the achievement of environmental Millennium Development Goals in Latin America show mainly negative trends (CEPAL 2010), including the 2010 CBD biodiversity targets (Butchart et al., 2010).

The relative importance of mountains within the different Andean countries somewhat reflects the degree of implementation of sustainable mountain development initiatives. For countries with small mountains areas, such as Venezuela and Argentina, priority is perceived as low, although in the case of Venezuela, the country is much more dependent on mountain systems (e.g. in terms of population and ecosystem services). In the case of countries with a much larger proportion of the Andes making up their territory, such as Ecuador, Peru, Bolivia and Chile differences also

exist. For example, in Peru and Chile, the relative priority given to mountains is lower, in Peru, in part due to a large degree of centralization in Lima on the coast, although the city is very dependent on mountain systems. In Ecuador and Bolivia, the situation seems to be more balanced, and in Colombia, where almost the opposite occurs, in that priority is given to mountain systems where the population is concentrated, even though they make up a relatively small part of the national territory. These observation highlight the importance of raising awareness of the importance of mountain systems at national level. For example, the International Year of Mountains played an important part in the formation of national mountain working groups, and creating awareness of mountain issues nationally through diverse activities in all countries.

In addition to awareness, information created on mountains, has been identified as both limiting and promoting mountain development, as a function of its utility in decision making. This depends greatly on its degree of processing and format, as well as the level of communication with the appropriate authorities, at all stages of academic activities, that is, before, during and after research activities.

Experiences have shown when local knowledge is included in initiatives, there is a higher uptake by stakeholders, there is no shortage of local knowledge in the Andes, and combined with an incredibly diverse territory of cultures, species and ecosystems, spanning a mountain range of more than 6000 km in length, a complexity results in multiple dimensions. Tapping this complexity itself, ranging from gene pools and seed banks, to traditional farming practices and indigenous languages, is surely one of the key factors to attain sustainable mountain development with approaches originating in the region.

PART 3: EMERGING CHALLENGES AND OPPORTUNITIES

3.1 Future challenges for sustainable mountain development in the Andean region

Following consultation (see Appendix 2b), and from the conclusions of the above report, the following challenges have been prioritised in terms of sustainable mountain development in the Andean region. Challenges fall into two broad areas (see 3.2), and many imply changes to institutional frameworks or are related to implementing green economies.

- **Regional differences and integration**
  As this report has highlighted throughout, many differences exist between the North and South Andes, and the same is true of the challenges. For example, in the south, mountain issues do not have the same exposure on national political agendas, even in Chile, which has one of the highest proportional areas of mountain region per country in South America. In the north, mountains are more important to livelihoods (not just economies) and increased social participation in the last 20 years has ensured a wider exposure of mountain issues. A further consideration, in terms of regional integration, is the purpose and scope of such integration, given the wide differences between countries. Although exchange of information and experiences in sustainable mountain development among countries of the continent has undoubted benefits, it is rather idealistic to envision a complete integration across a wide spectrum of issues. Rather, integration must serve specific purposes, in areas where such integration is both feasible and useful, especially given the difficulties and timeframes of reaching agreements between just four countries in the Andean Community (CAN). Nevertheless, the CAN has played an important role in integration in the north of the continent, especially with supranational legislation, for example, in the Biodiversity Strategy. However, this type of political proximity between countries, for the purposes of joint construction and implementation of policies on sustainable mountain development, will only be possible with an underlying political pact. In this case, the Union of South American Nations (UNASUR), may eventually provide this opportunity, if it takes on and supersedes the role of the CAN (and Mercosur to a lesser extent) across the continent. UNASUR has only just been created as a political entity, and although the potential for such integration is clearly set out in its statutes and proposed commissions, it is still too early to comment on its effectiveness. What is important, however, at this crucial initial stage, is that issues relative to mountains are clearly set out on UNASUR's agenda by the member countries.

- **Economic systems**
  Given the importance of extractive industries in the economies of the Andean countries, and the perceived incompatibility of many of these with sustainable development, a major challenge relates to how resources are valued, and how benefits are distributed. Economic systems need to incorporate the real value of resources, including the full process used to obtain benefit (e.g. extractive industries, water provision) and include retribution systems taking this value into account. Retribution systems and benefit sharing, understood as mechanisms based on dialogue and social consensus, not just economic schemes, must ensure that inhabitants benefit fairly and that ecosystems are adequately protected. For example, in the case of water provision from northern Andean paramos, a sustainable use must ensure protection and/or restoration upstream, often in areas which are far from the largest concentrations of users. In the case of mining, a responsible use must ensure adequate protection measures for ecosystems and inhabitants during exploitation and restoration at the close of activities. Also, the way in which economic systems are measured, needs to incorporate further concepts of sustainability, for example, in proposals based on sustainable economic welfare to replace gross domestic product.

  Bringing about changes in economic models is perhaps the hardest, but most important challenge for sustainable mountain development. The challenge of determining the capacity of Andean systems to support these economic models must be addressed under criteria of sustainability. However, given the important mineral reserves still within the Andean mountain region, it seems very unlikely that economic models will change in the short to medium term unless governments radically change their policies.

- **Intra- and inter-institutional dialogue**
  A further major challenge identifies strengthening inter-institutional dialogues at a variety of scales and levels, both within and between public and civil society sectors. With regard to the changes in economic models mentioned above, a lack of dialogue between government sectors has been repeatedly recognised as a major limitation to sustainable mountain development. It is often the case in Andean countries that conflicts of interest and jurisdiction, sometimes resulting from hierarchies of authority, exist between and within the different government departments responsible for the environment, sustainable development , agriculture , mining and petroleum extraction. Improving joint agendas for responsible development is necessary between government sectors, and with the participation of the private sector, which often include multinational companies. Private companies also have an important role to play, and although practices and policies must be regulated by the state, existing private company strategies on biodiversity and social development, for example, could be further aligned with national policy.
  Specific examples highlighting this issue, with great relevance for the Andean region, include the construction of new hydroelectric plants or placement of mining operations. A balance must be struck between the environmental impacts, social acceptance and energy needs or economic development of the country. This is where the role of the state, with a sound, and working coordination between government sectors, and between central and regional government is vital. It is evident that the lack of this dialogue often lies at the root of many conflicts in the region today.

- **Decentralization**
  Trends in decentralization have been very positive for sustainable mountain development in many countries, with important benefits to environmental management and civil society participation at different levels. Implementation of strategies derived from international agreements at regional and local level has become a reality over 20 years, with strong local participation. It is often at this level where results are most tangible, for example, in improving livelihoods or in biodiversity conservation, underlining the importance of regional contexts to many development processes. However, maintaining these trends in decentralization and the opportunities for dialogue between national and regional level remains a challenge, given a certain dependence on changes within national politics or on periods of office of regional and national governments (e.g. changes in governors, political parties), rather than a reliance on institutionalised state policies.

- **Research agendas, education and traditional knowledge**
  Universities have an important contribution to make to achieving sustainable mountain development. Areas where challenges exist include further alignment of research agendas with policy gaps and priorities; more emphasis on including traditional Andean knowledge; and better dialogue with government and NGO sectors. Research is necessary in all areas of sustainable mountain development in order to ensure that decisions are based on sound knowledge, whether its source is scientific or traditional. However, research agendas at universities are not always in line with the priority needs of policy makers. In the case that universities want to contribute to decision-making processes through research results, dialogue is needed on the part of both those who set and communicate the priorities and those who ensure that ensuing results are fed back to decision makers in an suitable format. A further issue is providing content at universities, with more specific focus and relevance to Andean dynamics, especially at a regional level, where universities are more geared towards an almost exclusively Andean market and provide an opportunity to integrate issues of sustainability across many different programmes, with the aim of achieving greater practical implementation of sustainable mountain development.

  Traditional knowledge, for example, social dynamics of Andean families, farming techniques and irrigation systems, are increasingly valued in processes related to sustainable development. The variety of farming techniques, for example, is an important source for adaptation measures related to changes in climate. Recuperating traditional crops also has untold potential in terms of feeding populations, including up to global scales, given the importance of the Andes as centres of crop origin. Already, small scale-projects have been successful in regaining esteem among communities as to the value of traditional crops, in economic and nutritional terms. Making sure these pilot

schemes are communicated and fed back into policy is an important, and sometimes neglected part of a project cycle or loop.

- **Specific mountain initiatives**
  Significant progress has been made in specific sustainable mountain development initiatives in the Andes, both within civil society and the state sector, albeit relatively few exist. A lack of continuity in others, is also, to some degree, an indicator of the relative importance placed on the subject on the part of both public and civil society sectors. Furthermore, there has been little interaction between different initiatives in the region, even though in many, the same actors or focal points are involved. Before creating more specific initiatives in sustainable mountain development in the region, two points should be addressed, the inclusion of specific mountain themes in existing initiatives (and national policies) as a way to increase awareness of the importance of mountains, and to ensure that mountains are treated on a par with other thematic issues, and that greater interaction between existing initiatives makes their implementation more efficient. Nevertheless, there is still scope for more regional initiatives, such as monitoring and information systems, but ensuring that existing institutional frameworks, such as CONDESAN, the Andean Community, the Mountain Partnership, or the Strategy on High Andean Wetlands are used.

  Interactions could also span continents, across northern South America and southern Central America, where obvious cultural similarities exist, for example, between Panama and Colombia, and biogeographic affinities, for example, in paramo ecosystems in Costa Rica and northern South America.

- **Information management and regional information sources**
  Although much information has been produced of great utility to promoting sustainable development in the Andean region, there is still a major lack in making this information available to decision makers and public and private bodies. Decision support systems, especially with geographic, real time information, helping to bridge the gap between science and policy, represent ways of making information available and should be implemented, with regular updating cycles as essential parts of project cycles.

- A specific case is provided by the general lack of compiled regional information relating to the Andean countries, and to an even greater extent on the mountain region of these countries. Although much information exists at country level, without time- and resource-intensive processes to consolidate this at regional level (e.g. ensuring compatible scales, methods etc.) comparisons are difficult to draw. This applies to many different topics, from landscape changes to legal frameworks. A regional information system, incorporating monitoring results of environmental, social and economic indicators and compiled, standardized information at regional level would improve decision making processes within existing initiatives.

- **Water and climate change**
  Other challenges cover cross-cutting issues, such as climate change, water and rural livelihoods. Without a doubt, water availability is a critical issue in most of the Andean region, increasingly affected by, and highly vulnerable to, changes in climate. Ensuring adequate water availability throughout the year is already becoming noticeably difficult in some regions. Pilot processes have been successful in increasing water availability through integral river basin and water management, such as alternative irrigation systems. As mentioned above, it is important that these type of projects are adequately communicated and fed back into policy and decision making arenas. At a larger scale, research is still needed to evaluate the full effect of changing climate on glaciers, paramo, puna and montane forests with regard to water availability throughout the region, furthermore, much of the uncertainty is a result of information gaps on present situation, rather than future models. However, it will be almost a race between obtaining the information and implementing suitable adaptation mechanisms, where possible, undoubtedly with elements of risk involved. An important factor here is to use existing experiences where changes in climate have already led to adaptation measures. In general, research on climate change is still troubled by uncertainly, especially regarding future climate models for the Andes, requiring more emphasis on the development of regional models.

  The effects of climate change also need to be considered across policies and initiatives, for example, with regard to

large scale infrastructure development related to agriculture (e.g. some projects within the Regional South American Integration Initiative) where changes in climate must be related to crop suitability in the future. As adaptation measures are implemented, a major challenge relates to upscaling or rolling out initiatives after pilots have been implemented without adequate timescales to allow for monitoring to provide sufficient data to assess their effectiveness. However, given the estimated timescales for changes in climate taking place in the Andes, a balance must be reached between waiting for monitoring results and having enough time for implementation. Care must also be taken that other issues are not marginalised by an increasing focus on climate change, for example, with regard to habitat loss, which remains the most important cause of threat to species and hydrology in the region.

- **Native crops and agro-biodiversity**
  With the increasing importance of conservation beyond formal protected areas, issues such as conservation of agro-biodiversity will play an increasingly important role in engaging local communities in more sustainable use of landscapes, especially where natural resources are major components to sustain livelihoods. Added to the importance of conservation of wild crop relatives, and the increasing interest in the issue, opportunities arise for incorporating more integral approaches to natural resource management and farming. Countries need to continue to improve the recognition of the role played by small scale farmers, create incentives for sustainable use at this level, and increase their participation in the economy, as part of strategies to maintain livelihoods and for environmental protection in the rural Andes. Marketing of native Andean products must also be carefully studied and incorporated into projects to help ensure their sustainability.

- **Funding and international cooperation**
  In terms of funding, international cooperation in the region has remained stable, but decreased as a percentage of GDP in all countries, and is not expected to increase. Some cooperation programmes are also in their final stages as global priorities shift. Moreover, economic crises, for example of 2008-2009, have recently hit North America and Europe harder than South America, and caused instability in funding sources and international cooperation from the north. A new, more strategic model of cooperation, going beyond the traditional approach, needs to be implemented, where cooperation catalyses processes rather than funds projects.

  Achieving financial stability, and fairer distribution of wealth is a fundamental factor in achieving sustainable development. In this sense, given the enormous wealth of the region, the challenge is also very related to developing alternative economic models (for example, considering stability rather than growth, as important indicators or that outlined in green economy model) which include both the provision of funding within countries and technical cooperation from within the region as well as South-South cooperation (e.g. with Africa, Himalaya). Models also need to include greater capacity to respond to changing environments (e.g. climate change, financial instability), and systems such as adaptive management could become increasingly important in many different scenarios.

3.2 Summary of key challenges and recommendations for sustainable mountain development in the Andes

The key challenges and recommendations are summarised below, grouped into the two broad themes of strengthening institutional frameworks and improving knowledge and information systems, as well as cross-cutting themes.

3.2.1 Strengthening institutional frameworks

- Institutionalised and regulated framework for incorporating real values of renewable and non-renewable resource exploitation into economic models, especially those based on mining and petroleum extraction.
  - Design, implement and/or consolidate retribution systems to protect (restore, if necessary) and transfer benefits to mountain areas and inhabitants from resources generated within them, e.g. regulatory function in water cycle of high Andean ecosystems, royalties from mining in the Andes

- Achieve socially and environmentally responsible mining (combat illegal mining, consolidate regulations, change attitudes), with special focus on ensuring proper conciliation and dialogue between sectors (e.g. mining, local communities, conservation).

- Inter-institutional and inter-sectoral dialogue within and between governments (national and regional level), especially important where conflicts of interests, jurisdictions and authorities exist, e.g. between Agriculture, Environment and Mining authorities within government.
    - Improve mechanisms for evaluating issues of sustainability (especially social and environmental) between government sectors (inter-ministerial) and government levels (central / regional) in infrastructure development (energy - hydroelectricity, wind; mining operations, etc, transport - road building, waterways).
    - Strengthen or create mechanisms for inter-institutional dialogue within countries, e.g. between universities and local government, between local and national government

- Increase presence of mountains on political agendas
    - Emphasis on regional participation from mountain areas in the national political agenda
    - Achieve policies on mountains which are integrated with national policies (not separate)
    - Consolidate an ecosystem approach to sustainable development in mountain areas, determining compatible and incompatible land uses with sustainable mountain development

- Ensure strong institutional frameworks and state policies for
    - Maintaining and increasing decentralization
    - Maintaining and increasing participation on part of civil society
    - Land ownership, especially to ensure that inhabitants are included in decision making processes affecting where their livelihoods are based.

- Consolidate or create specific national or regional mountain initiatives, derived from national policies or regional agreements, in areas such as vulnerability to climate change, biodiversity conservation, monitoring systems, combating poverty, avoiding emigration from mountain areas, etc, using existing frameworks, e.g. Mountain Partnership, High Andean Wetland Strategy, etc.
    - Build on and consolidate CBD Program of Work on Mountains, ensuring full coverage of this program across Andean countries.
    - Use regional platforms, such as CONDESAN, to facilitate formulation and implementation of sustainable development strategies

- Improved institutional frameworks for risk management (economic, natural disasters, extreme climate events, etc)

3.2.2 Improving knowledge and information systems

- Integrate local and traditional knowledge into existing mechanisms for knowledge management, e.g. routes for incorporating research results into policy.
    - Ensure traditional knowledge is adequately covered by university research agendas
    - Recuperate and create awareness of the real value of knowledge on Andean family dynamics, social structure and farming methods, especially as input for climate change adaptation measures, alternative incomes, improving rural livelihoods, etc.

- Enable research priorities and research results to be communicated between decision makers and research institutes/universities

- Implement a monitoring and information system at Andean level geared to support decision making, incorporating environmental, social and economic indicators (including climate change and adaptation), with participation from universities and governments
    - Include a special emphasis on planning for extreme climate events in mountain areas

- Implement decision support systems at local and regional levels, aimed at ensuring maximum benefits from information produced in the Andes.

- Increase risk management for climate related effects on livelihoods (e.g. agriculture, housing, health, etc). Could be part of systems in the previous recommendation.

- Achieve further integration of, and dialogue between specific mountain initiatives in the Andes
    - Revitalise national mountain committees where necessary
    - Further relations between north South America and Mesoamerica (especially south) building on cultural and biogeographic similarities
- Continue to cover gaps in knowledge of current situations, given that the most important source of uncertainty on future scenarios is due to this lack of information.

3.2.3 Cross-cutting challenges

- In the context of climate change, certain issues of special importance to the Andean region include:
    - Ensuring year-round water availability
    - Implementing adaptation measures, with emphasis on the most vulnerable mountain regions
    - Food security - priorities for rural Andean inhabitants

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5.0 Appendix

5.1 Workshop participants

a. Case studies Workshop (Lima, Peru: 14-15 July 2011; Quito, Ecuador: 11 August 2011)

Country	Name	Organization	Email
Peru	Luis Acosta Sullcahua	CONDESAN - Lima	luis.acosta@condesan.org
Colombia	Andrés Felipe Betancourth	CONDESAN	andresbet@gmail.com
Ecuador	Tatiana Castillo	Grupo Randi Randi	tatycastillov63@yahoo.com
Argentina	Magda Choquevilca	Agrobiodiversidad - Jujuy	maguijuy@gmail.com
Ecuador	Christian Devenish	CONDESAN - Quito	christian.devenish@condesan.org
Peru	Antenor Florindez	Instituto Cuencas	antenorflorindez@yahoo.com
Peru	Mirella Gallardo	Consultora	mirella.gallardo@gmail.com
Ecuador	Carla Gavilanes	GIZ	carla.gavilanes@giz.de
Peru	Cecilia Gianella	Consultora	cgianella@etcandes.com.pe
Ecuador	Ana González	GIZ	agonzalez@gizecuador.org.ec
Argentina	Julio Martinez	UGICH-Jujuy	jcmartinez033@yahoo.com.ar
Ecuador	Susan V. Poats	Grupo Randi Randi	spoats@interactive.net.ec
Peru	Luzmila Rosales	CONDESAN - Lima	luzmila.rosales@condesan.org
Peru	Segundo Sánchez	RENAMA-Cajamarca	sanchiz2@gmail.com
Peru	Miguel Saravia	CONDESAN - Lima	miguel.saravia@condesan.org
Peru	Marco Sotomayor	Proyecto Masal	marco@masal.org.pe, apu-rimac1020@hotmail.com
Ecuador	Federico Starnfeld	GIZ	fstarnfeld@gizecuador.org.ec
Colombia	Felipe Rubio Torgler	Fundación Humedales	felipe.rubio.torgler@gmail.com

b. Future challenges Workshop (Santiago de Chile, Chile: 12 September 2011)

Country	Name	Organization	Email
Chile	Antonio Aguilar	Ministerio de Defensa	aaguilar@emco.mil.cl
Perú	Dora Arévalo	CONDESAN	dora.arevalo@condesan.org
Perú	Augusto Arzubiaga Schuch	Ministerio de Relaciones Exteriores Perú-Director de Medio Ambiente	aarzubiaga@rree.gob.pe donarzu@hotmail.com
Colombia	Andrés Felipe Betancourth	CONDESAN	andresbet@gmail.com
Argentina	Alejandro D. Brown	Fundación ProYungas	abrown@proyungas.org.ar

Chile	Bernardo Castro	Ministerio de Defensa	bcastro@emco.mil.cl
Costa Rica	Olivier Chassot	Centro Científico Tropical	ochassot@cct.or.cr
Chile	Gilles Cliche	RIMISP	gcliche@rimisp.org
Perú	Christian Devenish	CONDESAN	christian.devenish@condesan.org
Bolivia	Alfredo Durán	Centro Agua / UMSS	alfduran@centro-agua.org Alfredo.duran.nunez@gmail.com
Colombia	Patricia Escobar	Fundación Fesco	patricia. escobar@fundacionfesco.org.co
Chile	Alejandra Figueroa	Ministerio Medio Ambiente	afigueroa@mma.gob.cl
Perú	Cecilia Gianella	CONDESAN	cgianella@etcandes.com.pe
Chile	José Javier Gómez	CEPAL: Oficial de Asuntos Ambientales	Jose.GOMEZ@cepal.org
Peru	Pablo Lagos	MRI -Perú	plagose@gmail.com
Chile	Arlette Levy	Subdirección estudios Sernatur	arlevy@senatur.cl
Venezuela	Luís Daniel Llambí	Universidad de los Andes	llambi@ula.ve
Chile	Maria Llia Cárdenas	Ciren Chile	mcardenas@ciren.cl
Chile	Francisco Mendoza	FAO/ Oficina Regional Santiago	francisco.mendoza@fao.org
Chile	Mercedes Meneses	Ministerio de Relaciones Exteriores de Chile	mimeneses@minrel.gov.cl
Chile	Ivy Ortiz	FAO, Oficial Forestal de la Oficina Regional de la FAO	Hivy.OrtizChour@fao.org
Chile	Heather Page	CEPAL: Oficial de Asuntos Ambientales	Heather.PAGE@cepal.org
Chile	Maria Loreto Pérez	Sernatur	mperezr@sernatur.cl
Peru	Daniel Rodriguez	Soluciones Prácticas	drodriguez@itdg.org.pe drodriguez@solucionespracticas.org.pe
Italia	Rosalaura Romeo	MPS -FAO	rosalaura.romeo@fao.org
Chile	Joseluis Samaniego	CEPAL: Director de la División de Desarrollo Sostenible y Asentamientos Humanos	Joseluis.SAMANIEGO@cepal.org
Chile	Francisco Sotomayor	Proandes Chile	francisco.sotomayor@proandes.net
Chile	Luis Villena Silva	Servicio Nal. De Geología y Minería	lvillena@sernageomin.cl

c. Americas Regional Discussion, World Mountain Conference (Lucerne, Switzerland: 11 October 2011)

Country	Name	Organization	Email
Peru	Marco Antonio Arenas Aspilcueta	Ministerio del Ambiente - SERNANP	marenas@sernanp.gob.pe
Chile	Jose Luís Balmaceda	Ministry of Foreign Affairs	jbalmaceda@minrel.gov.cl
France	Jean Bourliaud	World Mountain People Association	bourliaud@free.fr
Costa Rica	Olivier Chassot	Tropical Science Center	ochassot@cct.oLcr
Ecuador	Bert De Bievre	CONDESAN	bert.debievre@condesan.org
Peru	Christian Devenish	CONDESAN	christian.devenish@condesan.org
Costa Rica	Javier Díaz Carmona	Ministry of Foreign Affairs	jjdccr@gmail.com
USA	Liz Lord	United States Mission of USA to the UN in Geneva	lorde@state.gov
Italy	Sara Maulo	FAO / MP Secretariat	sara.maulo@fao.org
Chile	Mercedes Meneses	Ministry of Foreign Affairs	mimeneses@minrel.gov.cl
Guatemala	Rita Mishaan	Ministry of Environment and Natural Resources	ritamishaan@gmail.com
France	Anil Mishra	UNESCO International Hydrological Programme	a.mishra@unesco.org
Switzerland	Valerie Pellé	Zoi Environment Network	valerie.pelle@zoinet.org
Canada	Saran Pepper	Bernstein Intern. Environ. Law Consulting	saranlpepper@gmail.com
Italy	Rosalaura Romeo	FAO / MP Secretariat	rosalaura.romeo@fao.org
Peru	Miguel Saravia	CONDESAN	miguel.saravia@condesan.org

Colombia Pamela Zamira Terán Novoa Ministry of Environment pamelat17@gmail.com

In 1992, at the United Nations Conference on Environment and Development – commonly referred to as 'Rio 1992' or 'the Rio Earth Summit' – mountains received unexpected high political attention. They were granted a chapter in the 'Agenda 21' as fragile ecosystems that matter for humankind.

Since then, efforts by different actors have been undertaken to promote Sustainable Mountain Development. Some of them relate to the above event, others just emerged on their own. However, in view of the UN Conference Rio+20 – United Nations Conference on Sustainable Development in 2012 it seemed relevant to assess and understand what has been achieved by whom and how. It appears equally important to learn what has worked and what has not worked, and why, in order to draw lessons for more effective interventions in future. The anticipation of possible future challenges or opportunities may further help to be better prepared for their management. This will certainly encompass the adaptation to and mitigation of global change as the mainstream concern of the last decade as well as the new, albeit disputed paradigm of a Green Economy. As in the past, major unexpected and unpredictable political, social, economic or technological innovations may overshadow such mainstreams.

The Swiss Agency for Development and Cooperation, committed to sustainable mountain development since many decades, has commissioned a number of regional reports to assess achievements and progress in major mountain regions such as in particular Central Asia, Hindu Kush-Himalaya and the South East Pacific, South and Meso America or the Middle East and North Africa. The Swiss Federal Office for Spatial Development has commissioned - in the context of the Swiss Presidency of the Alpine Convention 2011/12 – a report on the European Alps. In addition, UNEP has facilitated the production of the report on Africa's mountains and mountains in Central, Eastern and South Eastern Europe; and the Aspen International Mountain Foundation together with the Telluride Institute has prepared a report on the mountains of North America.

The insights gained through these reports, which were presented at the Lucerne World Mountain Conference in 2011, and in which key local, regional and global actors have been actively involved provided the inputs for a mountain section in the outcome document of Rio+20. They are also meant to feed into future global and regional processes, institutional mechanisms, and initiatives that emerge as a result of Rio+20 in support of Sustainable Mountain Development.

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

FAO FIAT PANIS

UNEP

UNESCO MaB

ZOI environment

u b
b UNIVERSITÄT BERN
CDE CENTRE FOR DEVELOPMENT AND ENVIRONMENT

mri mountain research initiative

IMS International Mountain Society

ICIMOD

CONDESAN
Consorcio para el Desarrollo Sostenible de la Ecorregión Andina

UCA UNIVERSITY OF CENTRAL ASIA
Mountain Societies Research Centre

ASPEN INTERNATIONAL MOUNTAIN FOUNDATION

Mountain Partnership