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Environmental and Climate Change in Latin America and the Caribbean - Policy Brief[1]

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This Environment and Climate Change Policy Brief aims to summarise the key regional and sub-regional environmental and climate change problems and opportunities for Latin America and the Caribbean, related to poverty reduction, economic development and integration. The analysis focuses especially on the following sub-regions: the Amazon, Andean ridge, Central America, and the Caribbean, and attention is given to transboundary water resources management, climate change and land-use change. Regional and sub-regional actors are only briefly included in the analysis as the ongoing mapping exercise of regional stakeholders is not yet completed and could therefore not be used as a point of departure for this assignment.[2]

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[1] This Environmental and Climate Change Policy Brief was written, at the request of the Embassy of Sweden in Managua (Att: Karin Oskarsson) by *Gunilla Ölund Wingqvist* at the Environmental Economics Unit (EEU), Department of Economics, University of Gothenburg, as part of Sida-EEU's institutional collaboration on environmental economics and strategic environmental assessment, with contributions from SEI Oxford (Ben Smith and Tahia Devisscher). Comments can be sent to gunilla.wingqvist@economics.gu.se. The views expressed in this Environmental and Climate Change Policy Brief are those of the authors and do not necessarily represent the views of Sida.

[2] If nothing else is indicated, the UNEP GEO LAC (2003) is the main source of reference.

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Executive Summary

Historically, the Latin America and the Caribbean (LAC) region has depended on natural resource extraction as the basis of much of its economic development. Despite good economic performance during the last decade, the region still has significant levels of poverty, very high inequality, and a deteriorating environment, all which are intricately linked. Environmental and climate change issues are gaining weight at the regional level, but economic development is the highest priority – sometimes at the expense of the environment. The key regional environmental problems are loss of ecosystem services and biodiversity, and degradation of land, forests, water and coastal environments. These problems are linked to land-use change, caused by i.a. short-term economic gains, bad governance, weak institutions, and perverse economic incentives. The LAC is rich in natural resources, which provides tremendous opportunities to improve welfare for the people. The challenge is to balance the need for short-term gains with long-term sustainable development, and to use the resources without destroying them.

Vulnerability appears to be increasing, and poor people tend to be more vulnerable to environmental problems and anthropogenic climate change[3] than better-off people. Climate change is posing an unprecedented threat to the whole region and the Caribbean islands are especially vulnerable. Lack of security (such as land tenure or user rights, access to the natural commons or basic services) does not provide incentives for sustainable management of the resources or increased productivity, and therefore exacerbates poverty and environmental degradation.

Positive trends in recent years include a diversification of policies with improvements in the instruments, education efforts and increased participation. However, some challenges remain. The institutions related to environmental regulation and enforcement are generally weak and under-funded. There is a great need to foster coordinated and integrated management of natural resources, and to improve accountability, transparency and participation. A more systematic approach is needed to fiscal, economic, and sectoral policies that adequately incorporate environmental benefits and costs and the real economic value of resources. The environmental problems are closely linked to aspects of poverty and economic development, which is why sound environmental policies are likely to be powerfully redistributive and pro-poor. For example annual costs of environmental degradation has been estimated to be equivalent to roughly 3.8 % of GDP in Peru and Colombia, mainly due to increased mortality, morbidity and decreased productivity.

There are opportunities to support regional cooperation in different ways, for instance through strengthening existing institutions that cooperate around shared natural resources, or by supporting institutions that work with understanding the shared problems and finding solutions, such as NGOs or research institutes.

1. Introduction

Historically, the Latin America and the Caribbean (LAC) region has depended on natural resource extraction as the basis of much of its economic development. Despite good economic performance during the last decade, the region still has significant levels of poverty, very high inequality, and environmental deterioration has worsened in the last 30 years. The unemployment rate is around 8.3% and although poverty has been reduced, still 36.5% of the population lived in poverty in 2006.[4]

The LAC has had higher population growth than the world average the last decades, although the growth rate is currently decreasing. The urban population is 78% of the total and urban areas are expected to grow by 1.7% annually during the five-year period 2005-2010.[5] 60 of the 77 largest cities in LAC are situated on the coasts, and 60% of the population lives less than 100 km from the sea

[3] For the remainder of this brief the words 'climate change' are used to refer explicitly to anthropogenic climate change caused by increasing emissions of greenhouse gases.
[4] ILAC report, 2008.
[5] ILAC report, 2008.

(twice the world average).[6] A third of the total population is below 15 years of age and rural areas have the highest fertility and mortality levels. Environmental protection is becoming more important on the regional agenda. However, *economic development is the primary objective*, in many cases *at the expense of the environment*.

2. Key Regional Environmental Problems, their Causes and Opportunities

2.1 Key environmental problems and their causes

LAC is a diverse and heterogeneous continent ranging from the Andean mountains to the rainforests of Amazons and small island states. In areas as vast and diverse as LAC, the environmental problems are wide-ranging and vary between and within nations. Negative environmental trends are observed throughout the region, which are to a large extent the result of long historical patterns of growth obtained through non-sustainable consumption of natural resources.[7] The most important regional environmental problems are (not in order of priority and detailed below): loss of ecosystem services and biodiversity, degradation of land, forests, water and coastal environments. A significant feature of these environmental problems is that they are often shared between countries, and/or that regional cooperation could enhance the solution to the problems.

2.1.1 Loss of ecosystem services and biodiversity

LAC contains an exceptional variety of species and ecosystems. The biological wealth is undoubtedly one of the region's main assets, and its loss, one of its principal problems. The ecosystems provide fundamental services to human welfare, such as provisioning (of food, material, medicine, etc.), regulating (i.a. climate and water run-off) and cultural (such as aesthetic and spiritual) services (see Annex 7). These ecosystem services will become increasingly important to society in order to cope with expected effects of climate change. Physical changes and habitat pollution, as well as direct damage to organisms (introduction of exotic species and illegal wildlife trade), are among the main threats to biodiversity in the region. The main environmental problems in marine and coastal ecosystems are pollution and degradation. The causes of loss of ecosystem services and biodiversity are linked to human behaviour and national and global consumption patterns and are enhanced by globalisation.

Amazon sub-region[8]

The Amazon region, the planet's most extensive forest zone and one of the most divers ecosystems on earth (shared by Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Surinam, and Venezuela), is facing an accelerated ecosystem transformation and environmental degradation. Loss of biodiversity is one of the major effects of the ecosystem transformation, expressed in increased number of endangered species. Information related to biodiversity is available for the different countries, but there are no statistics available showing the updated information about this problem for the whole region. Plants are believed to be declining most rapidly in Brazil and Ecuador. Peru, together with Brazil, is among the countries with highest number of known threatened birds and mammals. One in every four mammals and one in every eight birds are facing a high risk of extinction. The ecosystem transformation is caused by i.a. economic activities, infrastructure construction and establishment of human settlements.

Andean sub-region[9]

The Andean sub-region consists of Bolivia, Chile, Colombia, Peru, and Venezuela, which all have the Andean Cordillera as a backbone. Furthermore, most are part of the Amazon basin. Due to the great difference in altitude and latitude, the Andean region has an enormous diversity in terms of climate and ecosystems. All the five countries are among the 10 countries in the world with the greatest biodiversity. There is a serious and extremely fast deterioration of forests and biodiversity, both in

[6] Knutsson, 2007.
[7] IDB, 2003.
[8] UNEP, GEO Amazonia, website; and ACTO strategic plan 2004-2012.
[9] EC, 2005b.

lowland and mountain areas, mainly due to agricultural expansion (including coca and opium poppy), inappropriate (legal and illegal) forest exploitation and inadequate management, and contamination by oil, mining, and other economic activities. Other causes are fishing, hunting and illegal commerce with all kinds of species. All but Bolivia have long stretches of coast. Coastal and marine ecosystems are threatened due to high concentration of population, overfishing and pollution by fishing industry, oil-palm plantations (Pacific coast), while sedimentation and pollution are the main problems on the Caribbean coast. The mangroves[10] of the Ecuadorean coast are seriously degraded, mainly due to construction of shrimp ponds.

Caribbean sub-region[11]

The Caribbean sub-region possesses many productive and biologically complex ecosystems including coral reefs (representing 11% of the world's total), sea grass beds, mangroves, coastal lagoons, beaches and mud bottom habitats. The health of these ecosystems has declined mainly because of pollution, overexploitation and habitat conversion. The sub-region has high biological diversity per unit of land area and high endemism. Biodiversity is lost due to natural resource exploitation, poorly managed tourism, mining, pollution, habitat destruction and conversion. Caribbean habitats are particularly fragile, and transformation of ecological and economically important habitats has led to a removal of the natural protective function provided by coastal ecosystems. The marine coastal environment is severely affected by habitat transformation (e.g. human settlements) and destruction, overfishing, tourism, reduction of mangroves, and pollution (industries, agriculture, urban waste and sewage, and solid wastes from shipping, off-shore petroleum industry, etc). Two thirds of the reefs are at risk and the number of large reef species is reduced or becoming scarce. Barely 20% of the reefs are under protection and only 4% thereof is deemed to have effective management systems.

Central American sub-region

With 2% of the world's territory, Central America has nearly 12% of the world's biological richness, the second most important coral reef barrier, 8% of the remaining world mangroves, as well as tropical forests and semiarid woody land. 33% of the seashore of Mesoamerica is seriously threatened by degradation and fish stocks are decreasing. The major cause for loss of biodiversity is habitat destruction through land-use changes and overexploitation. Mining and fossil fuel exploration are posing a serious threat to protected areas, biodiversity and human lives, especially in Guatemala and Honduras.[12]

2.1.2 Forest degradation

The forests in LAC, especially the Amazon rainforests, are of great national, regional as well as global importance. The forests store carbon, and thereby slow down climate change. Land-use change, especially tropical deforestation, on the other hand, enhances climate change by contributing to one-fifth of total annual carbon emissions.[13] The forests provide a number of ecosystem services including water- and climate regulation and water purification. Furthermore, they provide building material, energy, food and medicine for people living in or close to the forests. The average deforestation rate in LAC is high (0.50% per year, on par with the global average), however, with large variation between and within sub-regions. Between 1990 and 2000, the forests lost in LAC (470,000 km^2) constituted half of the world's total loss. The high deforestation rate in LAC is both a global and a local problem as it is linked to climate change, enhanced land degradation and food insecurity, loss of livelihood opportunities and reduced biodiversity. The recent loss of wooded surfaces is being mainly associated with conversion of forestland to other uses: agriculture, livestock, urbanisation, roads and other infrastructure, and mining. Other significant pressure comes from harvesting timber (fuel wood and to a lesser extent industrial production and sawmills), forest fires and climate phenomena, and biological

[10] Mangroves and coral reefs provide critical ecosystem services, including stabilising the coastline and stemming coastal erosion, providing shore protection both under normal sea conditions and during storms, buffer against tsunamis, and acting as nurseries for fish. UNEP-WCMC (2006).
[11] EC, 2009; EC, 2008; and the ILAC report, 2008
[12] EC, 2005
[13] SwedBio fact sheet; CIFOR, 2007

phenomena such as the proliferation of pests. Main causes of conversion of forestland are poorly directed subsidies or incentives, and export oriented policies to provide foreign currency. Furthermore, insufficient human and financial resources for operation and surveillance, lack of management plans or programs, the inadequate institutional arrangements and the low priorities sometimes granted to the subject, have been pointed out as big problems.

Amazon sub-region[14]

The proportion of forested areas is much greater in LAC than the global average and South America holds 92% of the regional forests, mainly in Brazil and Peru. Deforestation is another of the major environmental problems in the Amazon sub-region. By 2005, the accumulated deforestation in Amazonia was almost 859,000 km^2, reducing the region's forest cover with 17%. This is equal to two thirds of Peruvian, or 94% of Venezuelan territory. Global demand puts pressure on the sub-region to make intensive use of its natural resources without taking account of sustainable use criteria, which results in exploitation of timber and non-timber products, fossil fuels as well as expanding mining, agriculture and cattle raising to meet these demands. Deforestation in the Amazon sub-region may have an effect on the regional climate by a drop in rainfall. This will create a vicious circle that favours forest fires, reduces vapour, and increases smoke emissions, resulting in reduced precipitation and turning land into Savannah. Several studies indicate that increased temperatures and drought due to climate change will accelerate the process of Savannization and exacerbate the effects of deforestation. Deforestation also causes emissions of greenhouse gases, and reduces the uptake of carbon dioxide from the atmosphere, thus contributing to global warming.

Andean sub-region[15]

The Andean countries suffer from serious deforestation, with an average deforestation rate of 0.4%, ranging from near 2% in Ecuador to 0.3% in Bolivia. Most of the deforestation concerns tropical forests. The causes of deforestation are the same for all countries (e.g. advance of agriculture and cattle, legal and illegal logging, fuel-wood collection, and forest fires) in the sub-region, but in regard to legislation, protection, management, ownership and use of the forest resources, the situations are quite different between the countries.

Caribbean sub-region

Deforestation has been a big problem in the Caribbean. Currently, forest covers only 19% of the total land area in the Caribbean ranging from a low 3% in Haiti to 90% in Suriname. The most severe deforestation occurred when colonial settlers first arrived; Haiti lost 50% of its forests already in the 19th century. Deforestation the following century was due to the demand for wood as an energy source. More recently, deforestation in the region has been fuelled by the need for land for transportation infrastructure, agriculture, housing and industrial development.[16] The last years, however, (with the exception of Saint Lucia and Haiti) woods maintained, on the whole, a yearly *increase* of 0.9% in Caribbean.[17]

Central American sub-region

The deforestation rate in Mesoamerica is very high (1.2%), ranging from 4.6% annually in El Salvador to 0.8% in Costa Rica. 60,000 km^2 of forest cover were destroyed annually 1990-1995.[18] The degree of deforestation is decreasing (improving), mainly due to a reduced expansion of agriculture and cattle ranching and an increase of forest in protected areas and concessions in indigenous territories, especially in highly inaccessible zones.

[14] UNEP, GEO Amazonia, website: ; and ACTO strategic plan 2004-2012
[15] EC, 2005b.
[16] EC, 2008.
[17] ILAC report, 2008.
[18] EC, 2005

2.1.3 Land degradation

The LAC region has the world's largest reserves of arable land constituting almost 30% of the total territory. Land degradation is one of the most serious environmental problems in the region (more than 3 million square km of agricultural land - 16% of the world's total of degraded land - have suffered a significant loss of productivity), originating mainly from erosion but also from acidification, chemical pollution and salinisation. Land degradation is exacerbated by agricultural growth and intensified use of natural resources, and the past decade has seen an increase in arable land and grassland at the expense of forests and wetlands, as well as in increase in the irrigated area and the use of agrochemicals. Desertification, a constant threat to a large part of the region, is mainly caused by improper irrigation, deforestation, excessive grazing, poverty and political instability.

Amazon sub-region[19]

Current farming methods in the Amazonia cause serious problems of nutrient depletion and soil erosion. Furthermore, a growing population, increasing urbanisation, expanding economic activities and infrastructure construction has led to a significant change in the sub-region's land use, causing ecosystem fragmentation, deforestation and loss of biodiversity. One example is that the Brazilian Amazonian road network multiplied by 10 over a 30-year period (1975-2005), encouraging human settlements and facilitating access to natural resources. Increased bio-fuel production could accelerate this land use change.

Andean sub-region[20]

Soil erosion is one of the most serious environmental problems in all the Andean countries; Bolivia still has about half of its territory unaffected by land degradation, while Ecuador has almost no unaffected areas. The main causes of land degradation and erosion are deforestation and overgrazing, both linked to expanded agricultural and cattle-raising frontiers including expanding coca and poppy production (in Bolivia, Colombia and Peru). The cultivation of drugs is also linked with chemical pollution.

Caribbean sub-region

Almost all Caribbean states are islands, which presents land availability and degradation as major challenges. Most aspects of environmental management in the island Caribbean states are directly dependent on, and influenced by, the planning and utilization of land resources, which in turn is intimately linked coastal and marine management and protection. Land degradation often results in accelerated erosion and decline in soil fertility and productivity as well as the deterioration in water quality, particularly in coastal and marine areas. Land degradation stems from human action such as deforestation and unsustainable agricultural practices, natural phenomena such as severe weather conditions, and episodic events, such as fires and landslides.

Central American sub-region

The impact of land degradation is relatively greater in Central America than the LAC average, where 74% of the agricultural land was degraded in 1990. Particularly vulnerable is El Salvador followed by Nicaragua and Guatemala.

2.1.4 Freshwater availability and pollution

The LAC region contains a third of the world's freshwater resources and is thus generally rich in water resources, although with regional differences. The two most serious water problems are a reduction in available reserves and a drop in quality. Inundations, especially in flood deltas, are a growing concern. There is a steady increase in the water use in the LAC-region, but again with regional differences. The largest water-using sector is agriculture; LAC's 18.4 million hectares of irrigated land represent 14% of the world's total cultivated area. Water pollution in the periphery of urban areas is another concern. This situation is exacerbated as the numbers of landless or displaced people moving into the periphery of the main cities is increasing. Although there are still important unused amounts of water, good

[19] UNEP, GEO Amazonia, website; and ACTO strategic plan 2004-2012
[20] EC, 2005b.

governance will be crucial and water efficiency is becoming increasingly important, especially in the agricultural sector. A growing concern is the absence of integrated water management and laws to protect freshwater. Most water management is still sectoral and for a specific use, such as hydroelectricity.

Amazon sub-region

The Amazon region has important transboundary rivers such as the Amazon, which has unique hydrological characteristics and represents 20% of the world's total fresh water. The problems associated with surface water in the Amazonia are related to decreasing availability and quality, and the fact that it is a shared resource. Availability depends to a large extent on how each of the basin countries manages the water resources. Quality is affected by mine waste, hydrocarbon spills, use of agrochemicals, municipal solid wastes, and waste from processing of illicit crops e.g. coca. Other causes are linked to destruction of fragile ecosystems e.g. the Andean foothills, soil erosion and silting up (caused by deforestation mainly in the upper basin). In the middle and lower basin deforestation is the main problem, largely linked to excessive exploitation of high-value forest species, fires and mono-cultures.

Andean sub-region[21]

The Andean region is generally endowed with plenty of water resources, although it is unevenly distributed. The use of groundwater is significant in the Andean countries of Argentina, Bolivia, Chile and Peru. However, the knowledge about its relation to surface water, its quantity, its management, its economic and social value, is quite limited. The water quality is in some areas (e.g. Peru) an immediate concern, mainly due to lack of adequate municipal and industrial wastewater treatment and pollution from mining and agriculture. Melting glaciers will significantly change the hydrological regime in many Andean countries, and may threaten water supply to major cities such as La Paz.

Caribbean sub-region

Water availability is a problem in the Caribbean and some of the countries are classified as water scarce; water shortages increasingly affect a large number of islands and water demand is exceeding the natural supply capacity. Due to the limited amount of land on the islands, the challenge is to recognize and preserve watershed areas and not use them for agriculture or housing. The watersheds are still vulnerable to forest fires in the dry season and hurricanes and floods in the wet season. Pollution, either from agricultural, mining, industrial or domestic run-off, or from salt-water intrusion into aquifers, is yet another challenge to the availability of clean water for consumption, contemporary living and the sustaining of ecosystems. Access to technical information necessary for effective water resource management is difficult to obtain.

Central American sub-region

Central America is inhabited by approx 40 million people, of which a majority lives in the Pacific coast, where only the 30% of the water resources is available. The coverage of drinking water and sanitation is limited, and the amount of water resource per capita was reduced further between 2004 and 2006 (by 1.3%). Water is a major challenge for the whole society. There is a lack of knowledge about the exact water resources, although efforts are made to collect hydrological data. Central America is also affected by the degradation of water quality caused by untreated municipal wastewater, agro-chemicals, and solid waste, contributing to loss of biodiversity, eutrophication, and health problems. Sanitation and wastewater treatment is a major environmental concern in the region.

2.1.5 Natural disasters and climate change

The LAC region is constantly threatened by natural phenomena; between 1990 and 1998 the region experienced a total of 40 disasters per year.[22] The major damages were caused by tectonic activities (earthquakes, tidal waves, and volcanoes) and climatic events (hurricanes, floods, avalanches, landslides and fires), as well as epidemics. Related to climate there are two prime aggravating

[21] EC, 2005b
[22] IDB, 2003

circumstances: annual recurrence of hurricanes in Central America and the Caribbean, and the El Niño-Southern Oscillation (ENSO) that has impact on the whole region. Tectonic activities are most common on the Pacific coast. Climate change, which is expected to increase the above-mentioned stresses, is further described in section 4.

Amazon sub-region
Climate change and extreme events are putting pressure on the Amazonian ecosystems and making it more vulnerable. The eastern part in particular is at risk from climate change, deforestation and fires. The region has been affected by a rise in average temperature, although the extent differs depending on the zone. The level of precipitation has also changed although the trends are not very clear.

Andean sub-region
The Andean countries are not large producers of greenhouse gases, but the effect of climate change is visible particularly with regard to the reduction of glaciers and in changes of the traditional patterns of rainy and dry seasons. Desertification is an increasing threat (especially in Bolivia).

Caribbean sub-region
The Caribbean region is one of the most disaster-prone areas in the world, regularly hit by hurricanes, earthquakes, tsunamis, and volcanic eruptions, droughts and floods. Climate change is already having a significant impact on the Caribbean, and as well as rising sea-level a trend for increasing severity of disasters is likely.

Central American sub-region
Central America is constantly threatened by natural disasters, such as hurricanes, earthquakes, floods, fires, drought, and landslides. Effects of climate change are difficult to predict but changes are very likely in i.a. the frequency of extreme weather events, precipitation level and sea-level. Central America is likely to experience a decrease in precipitation, which will exacerbate problems of water availability.

2.2 Opportunities
Poverty reduction must be based on strengthening peoples' opportunities. Here, the quality of, and access to, environmental resources and ecosystem services play a key role. The LAC is rich in natural resources, which provides tremendous opportunities to improve welfare by investing natural resource rents into other productive capital for development. Failure to do so is often due to weak institutions and poor governance. The high biodiversity, fertile land and richness of natural resources could provide a solid basis for economic development and poverty reduction in LAC, provided there is good governance, effective regulatory frameworks, rigorous environmental and social safeguards, redistribution of wealth and the protection of rights. Some opportunities are present for the whole region: agriculture, if managed well, is an area that could create employment and income and increase food security. Thematic (eco, cultural, adventure) tourism, based on principles of sustainable development and community development, is another opportunity. Furthermore, there is scope to develop renewable energy sources (solar, wind and hydro power, geothermal energy, and biofuels) and even shift to low-carbon economies.

Amazon sub-region
The Amazon sub-region is very rich in natural resources, from the large forest and all that it provides, to minerals and fossil fuels. The challenge is to use these resources for the benefit of the people and the countries without destroying them. More specifically, Reduced Emissions from Deforestation and Land Degradation (REDD)[23] could provide an opportunity to preserve the forests while benefitting economically, and possibilities of having pro-poor benefits of REDD should be investigated. Trade in certified timber products, from planned, sustainably managed forests, is another opportunity. There is

[23] REDD is anticipated to become a part of the new (post Kyoto) climate regime and concerns payments for reduced deforestation and land degradation.

a huge market for non-timber forest products (e.g. bio-trade and biotechnology) that the countries in the sub-region are interested in exploiting.

Andean sub-region
Also endowed with forests and minerals, sustainable forest management is an opportunity and there are plenty of opportunities to explore REDD in the Andes. Bio-trade is included in the agenda. The mining sector is important, including artisanal mining. Environmental problems related to mining and oil extraction could be managed by good governance and sound policies, for instance by internalising environmental costs.

Caribbean sub-region
Fishery provides an opportunity for Caribbean, Central American and some Andean countries, and there is a potential to increase national consumption of fishery products, which would have positive health impacts. Integrated coastal and marine management would enhance natural protection against shocks and increase resilience of ecosystems. There are also opportunities to develop the use of solar energy for domestic water heating and for hotels, and for community-based projects. The use of wind-, hydropower-, and biomass sources is already successful in some small island states.

Central American sub-region
Central American countries are beginning to recognise the social value of biodiversity for local communities, and is re-evaluating its biodiversity and natural resources as the basis for the generation of new products (e.g. environmental services or clean technologies), which could offer opportunities for employment and business development.

3. Effects of the environmental problems

3.1 Impact on poverty (vulnerability, security, opportunity)

3.1.1 Vulnerability
Vulnerability is a reflection of people's exposure to, and capacity to cope with, risks or shocks. Human vulnerability integrates many environmental concerns. Several natural phenomena pose threats, including extreme events such as floods, droughts, fire, storms, landslides, volcanic eruptions, earthquakes, heat waves, snow avalanches, severe erosion, but there are also human-induced (e.g. deteriorating resources) or technological threats (e.g. infrastructure destruction).

Environmental change and social vulnerability is nothing new. However, the degree and extent of vulnerability appears to be increasing because of a combination of such factors as the increasing impact of humans on the environment, reductions in the efficient functioning of ecosystems, the reduced ability of the environment to provide goods and services, growing and more spatially concentrated populations, and increasing human settlement in high risk areas. Climate change is expected to add to already existing stresses and increase both the frequency and magnitude of natural disasters, which – in turn – can cause life loss, undermine social structures and destroy livelihoods on a large-scale.

The definition of vulnerable groups varies between countries, but amongst the most important defining characteristics are age, sex, ethnicity and location. Furthermore, there are strong links between poverty and vulnerability to environmental or climate change. Location is important to the way people are vulnerable to natural hazards and environmental degradation or deteriorating resources. There is still no solid information on vulnerability or indicators thereof, to support a regional or even a sub-regional aggregation in the LAC. Nevertheless, indirectly there is a record of an increase in the population exposed to disasters of a meteorological nature, mostly the population residing in coastal zones. The

growth of the population that lives in risk zones was almost 20 million persons between 2000 and 2005.[24]

Poor countries and poor people are particularly vulnerable to natural disasters and changes in environmental conditions, just as they are more vulnerable to other stresses. Poverty increases vulnerability to natural disasters, and natural disasters can exacerbate poverty by destroying livelihoods or forcing the sale of assets to recover from the impact of a disaster. This in turn can leave the poor even more vulnerable to the next extreme event, creating a vicious cycle of poverty and vulnerability. Poor people tend to live in overcrowded, temporary settlements, which are erected on unsuitable land; they often lack access to power, capacities to claim their rights, and access to resources such as land. In LAC, poverty mainly affects rural areas but in absolute terms most of the poor live in urban areas. Poverty increases people's vulnerability; people in low-income countries are four times more likely to die in natural disasters than people in high income countries.[25] Between 1970 and 2001 natural disasters killed 246,569 people and affected another 144.9 million in LAC. Almost 28% of total mortality from disasters in LAC was caused by technological events or threats, including chemical spills, explosions, collapsed buildings and structures, poisoning and fires in residential areas.

Inequality is another major contributing factor to vulnerability and the LAC has the world's biggest income inequality. The number of households headed by women is growing. Female-headed households tend to be the poorest and are likely to be the group most challenged to cope with environmental and climate change. Ethnicity is another issue related to vulnerability. Indigenous people make up 10% of the total population in LAC and are often more dependent on natural resources for their livelihoods but often lack tenure or user rights, why they tend to be more vulnerable to environmental and climate change. Indigenous peoples are found to be largely *excluded* from the MDG process.[26] Other vulnerable groups include the very young, the old, disabled or chronically diseased[27] and displaced groups.

Poverty in LAC has been reduced from 44% of the population in 2002 to 36.5% in 2006; formal employment has been growing although unemployment is still high; income distribution has become a bit less unequal, and budgetary resources devoted to the social sectors (education, health, security, housing etc) have shown improvements in recent years. However, inequality, poverty, and vulnerability are still major issues in the LAC region. The poverty-environment links are evident, given that the poor are the most affected by pollution, deficient basic services, lack of land security, low levels of education, etc, and that the unsustainable use of natural resources is often the only option available with which to make a living.

Amazon sub-region

Expansion of livestock farming in many areas of the Amazon, to meet national and international market demands, has lessened the productive capacity of the land, which is increasing vulnerability and reducing livelihood opportunities. This expansion has been supported by governments through tax incentives, credit policies, construction of roads and the availability of a trained and cheap labour force.

Andean sub-region[28]

One of the main characteristics of the Andean countries is profound and widespread poverty around small enclaves of great affluence. The share of the population below national poverty lines varies from 30% (Venezuela 1989) to 64% (Colombia, 1999) of the total. The income inequality is extremely high

[24] The ILAC report, 2008..
[25] Oxfam, 2000.
[26] LAC Blog at ODI
[27] HIV and AIDS is an example of a chronic disease that increases vulnerability, especially to environmental health risks. The HIV prevalence seems to be stable but morbidity and mortality continue to increase in 2006, with 140 000 new infections for that same year in the whole region.
[28] EC, 2005b.

and corruption is rampant. Poverty is both a cause and consequence of environmental degradation. A large proportion of the population is totally dependent on short-sighted, inefficient and unsustainable use of natural resources, simply because they have no other options. Their economic base is reduced thereby conserving or increasing poverty – a classic vicious circle. Soil erosion and other deteriorating ecosystems increase vulnerability to natural disasters and reduce possibilities for agriculture or other livelihood opportunities. The poor are more vulnerable to natural disasters than more affluent population, mostly because they are forced to live in inappropriate areas and lack access to the resources which would allow them to cope with, and recover from, extreme events.

Caribbean sub-region

The poorest groups in society are directly facing the negative effects of poor environmental management. Contamination of surface water by industrial and municipal effluents, chemicals from agriculture, and mercury from mining have large impacts on their health. The high degree of deforestation in some countries decreases the possibilities of poor people to access natural resources, such as building material and fuel wood, and provision of other ecosystem services. Deforestation causes soil erosion (lowers agricultural productivity) and affects water run-off and siltation (affects water availability); in short, deforestation affects many of the MDGs negatively (especially poverty, maternal health and child mortality).

After poultry, fish is the largest source of protein in the Caribbean, and the poorest groups are most vulnerable to declining fish catches. Vulnerability is a very important aspect of poverty in fishing communities in Central America and the Caribbean, not only to natural disasters but also to fluctuating markets and lack of financial and social security, and variations in catches and international gasoline prices.[29] Erosion of the coast, flooding of low lands, damages to the infrastructure, and implications associated with climate change are increasing vulnerability, generating serious human and economic consequences.

Central American sub-region

The population in Central America has tripled between 1950s and 2000, now reaching nearly 40 million. Half of the population is women, one-fifth is indigenous, 40% are 14 years old or less, and half of the population is living in urban areas. The new urban dwellers are most likely to become the urban poor. Demographic impact on the environment is critical, through the exacerbating pressure on natural resources as a source of food, energy, and materials. Urban planning does not consider this situation and not all basic needs are met for the increasing number of poor people. Environmental effects of the large property/smallholding combination are particularly dramatic in Central America where smallholdings and crops lie on highly vulnerable hillsides, while extensive livestock farming and export crops are concentrated on lowlands. Most vulnerable people are found in zones of higher risks to natural disasters, which have increased in frequency and intensity in the past decade. Their association with poverty rank them high within the environmental problems of the region. Forest degradation is contributing to worsening poverty conditions and the vulnerability of the population, and periodic floods and droughts pose significant risks for the food security and economic development of countries in the region.

3.1.2 Security

Lack of security is a fundamental dimension of poverty. Environment-related security is manifested in resilient ecosystems, reliable access to food and water, adequate and sustained supply of essential natural resources, gradual accumulation of assets including natural capital, enhanced natural resource management, conflict prevention or freedom from conflicts, access to resource-based safety-nets such as goods and services from the natural commons (forests, grazing lands, marine resources etc), and private and/or communal insurances.

[29] Knutsson, 2007.

38% of LAC's rural population are smallholders and 31% are landless farm workers. Distribution of natural resources (especially agricultural land) has been influence by the interest of a minority that holds the economic and political power. Land tenure is a basic problem in the region, especially for indigenous groups, resulting in concentration of property and the lack of titles to the land. Inequitable land distribution and lack of clear legal definition of land rights is often associated with insecurity and low levels of investments and low agricultural productivity.

Amazon and Andean sub-regions
In all Amazonian countries the Constitution includes an article on the right to a healthy environment, a right that is not entirely fulfilled. Land tenure and institutional arrangements for forest management are important: when property rights over land are not clear, people tend to clear forests and build on those areas to establish a claim to them. People living in or close to the forests (often indigenous peoples) lose their traditional sources of food, medicine, material, and energy. Furthermore, land security for small-holders is challenged when firms claim/are given land for large-scale agricultural production e.g. for bio-fuel production. A primary pressure on forests is the predominance of a short-term and strictly financial view of the economic benefit of identifying development options. Cultural, environmental and socio-economic values are not taken into account.[30]

The political element of land distribution among the poor can also be relevant. In Colombia for instance, controversy surrounds the palm oil industry's alleged links with paramilitary forces as well as its practices, as cases of land seizures have been reported. Moreover, bio-fuel production has led to disputes between countries like Brazil (pro expansion) and Venezuela or Bolivia (against expansion), to the point that the debate becomes too politically charged to provide informed conclusions.[31]

Caribbean and Central American sub-regions
The Caribbean sub-region is twelve times as exposed to natural disasters as the world average, which affect human security negatively. Poor groups are most exposed to dangerous working conditions and toxic chemicals. Furthermore, when vast numbers of the population has no access to water, there will be an increased competition between water-using sectors (mainly agriculture, domestic water supply and industry); perhaps even a risk of conflict. This is particularly the case for El Salvador.

Fisheries pose different security issues, including extensive use of child labour (again especially in El Salvador), who are working under destructive and unsafe working conditions with negative impacts on psychological and physical health as well as education. Lack of education enhances the difficulties to claim their rights. Due to the lack of alternative income sources in fishing communities, the family is often dependent on a single income provider (most often the man). A death or divorce increases the insecurity of the women and children and can have serious poverty implications.

3.1.3 Opportunity[32]
There are plenty of opportunities for pro-poor economic growth in LAC, including the following:

- The region has the highest natural wealth per capita among developing regions, at US$17,000 per capita. Subsoil assets play a major role in the region's natural wealth, although caution should be shown at exploitation as it is linked with pollution. The agriculture and livestock sectors provide opportunities for innovation and application of new technologies. One example is agroforestry systems (integrating trees into pasture systems), which have the advantage of not only providing a better supply of ecosystem services but also reducing greenhouse gas emissions.

- Improving energy efficiency in LAC would postpone expensive investments in power-supply infrastructure, which could save the region an estimated US$ 36 billion over the next decade.

[30] IDB, 2003.
[31] LAC Blog at ODI, 28 May 2008.
[32] LAC Blog at ODI, 10 December 2008; EC, 2005b; Worldbank website www.worldbank.org

- REDD could offer large financial flows with some estimates reaching a total of US$53 billion per year for halving deforestation rates. Fears that REDD may further undermine indigenous peoples' rights and threaten their territories has led some indigenous groups to reject it. However, other groups view REDD not only as a potential threat, but also a considerable opportunity. REDD finance, for example, could help pay for the consolidation of indigenous reserves, which cover around 22% of Brazilian Amazonia highlighting the presence of indigenous groups in face of rampant deforestation. The justification for including indigenous peoples in REDD, as one of the most important conservation groups, is profound.

- There is a large potential for sustainable forest management. For instance the value of export of forest products for Bolivia was US$ 68 million (2001) and the export of non-timber forest products is increasing and potentially huge.

- There is enormous potential for wind power, geothermal and hydroelectric and solar power. Some countries, e.g. Brazil, have started its energy transition towards a renewable energy regime. If the Clean Development Mechanism (CDM) or similar will continue in the post-Kyoto period, that will be an opportunity for the renewable energy, mining and transport sectors if care can be taken to ensure poverty and sustainable development considerations. Also other flexible market mechanisms like carbon credits, may provide an opportunity for LAC as an important supplier (mainly from agriculture, livestock and energy sectors).

- Taking advantage of biofuels' competitiveness on the energy market may result in higher employment and have positive effects on economic growth, domestic energy security and mitigate climate change. To exemplify, figures presented by FAO show that Brazil's biofuel sector accounted for 1 million jobs in 2001. However, the effects of increased biofuel production on food security, poverty and the local environment are uncertain and needs to be assessed in each case. Important criteria for promising or successful biofuel production include pro-poor and broad-based distribution of revenues, labour-intensive production, mitigation or prevention of pollution caused by the production process, clear land property rights, available land and alternative sources of domestic food production or affordable food imports (to compensate for the loss of food production), and high relative prices on other sources of energy such as coal and oil. Other issues to address include the institutional capacities to manage threats of deforestation, land degradation and biodiversity from the biofuel production. To summarise, expanded biofuel production may offer much needed positive effects on welfare as well as the environment nationally, regionally or globally (acknowledging the positive effects on the global climate), but each case or production scheme needs to acknowledge and address the risks pertaining to the local environment, food security, income distribution and poverty.

3.2 Impacts on Economic development

Economic development in LAC is closely linked to its environmental problems. With population growth, the aspiration for higher living standards and increasing demands both at national and global level, the pressure on LAC's environment will inevitably increase. The countries must balance the need of making productive use of their natural resources with maintaining its asset base through development investments.

Besides welfare losses, environmental change and natural disasters have important economic dimensions. For example annual costs of environmental degradation has been estimated to be equivalent to roughly 3.8 % of GDP in Peru and Colombia, mainly due to increased mortality, morbidity and decreased productivity.[33] Between 1990-1998 the LAC region experienced a total of 40 disasters/year, with total direct and indirect economic losses that amount to close to US$ 20 billion.[34] Land degradation and nutrient depletion are a major impediment to agricultural production growth. Furthermore, desertification causes annual losses of up to US$ 2,000 million; a figure that soars to

[33] World Bank (2006, 2007)
[34] IDB, 2003.

US$ 4,800 million if drought-related losses are included. The restoration cost has been estimated to US$ 13,000 million[35]; an investment that would only have a 7 year pay-back time. Sufficient aggregated information that link economy, social development and environment is missing.

Another key factor affecting long-term economic development in the region is the supply and consumption patterns of energy, which is closely linked to environment and climate change. The region has large reserves of petroleum, natural gas, coal and possesses 22% of the world's hydropower potential and 14% of installed geothermic capacity. The energy efficiency is low in the region compared to developed countries[36]and the future trend is that the difference will increase due to i.a. subsidised fuel prices, and failure to introduce better technology. It is projected that energy demand in LAC will increase by 75% over the next 20 years, requiring a 144 percent increase in the region's electricity capacity. [37]

The current global financial crisis and economic recession affects LAC and especially the poor groups mainly through weaker demand for commodity export, declining investments in productive sectors, lower remittances and limited fiscal space, affecting *i.a.* job opportunities, household income, and government spending in social sectors. Especially lower-income groups and women are effected by decreasing employment rates.[38]

Amazon sub-region
Profits from agricultural exports doubled in the 1990s, with growth more marked in large countries like in Colombia and Brazil. As detailed above, agricultural expansion is often associated with deforestation, and increasing yield does not always entail sustainable practices. Furthermore, the rapid expansion of petroleum extraction in Brazil, Ecuador, and Peru, offers new economic opportunities but involves large effects on the environment, both related to pollution, deforestation and loss of biodiversity.

Andean sub-region
Mineral rich countries such as Bolivia, Ecuador and Venezuela are not saving enough to offset resource depletion and environmental degradation, whereby their use of its natural capital is currently unsustainable. Glaciers in Peru are melting so quickly that by 2015 almost all of them may have disappeared, with large effects on e.g. hydroelectricity production for the whole sub-region. Ironically, this renewable energy source risks disappearing because of melting glaciers caused by climate change . Loss of this vital resource, combined with high prices and scant political enthusiasm for other renewable options (geothermal, wind and solar) may result in countries resorting to an increase in the use of fossil fuels.[39] Furthermore, the comparative advantage of countries with high dependency on seasonal crops and where specialty crops are only harvested once a year (especially valid for the Andean, but also other non-tropical, sub-regions.), will be affected by the gradual change of harvest periods. This will impact on investment flows from both public and private sectors.[40] In addition, inadequate water management causes considerable economic costs. The economic impacts associated with environmental degradation account for about 4 percent of GDP in Peru and over 1 percent of GDP in Colombia.[41]

Caribbean sub-region
The projected sea-level rise will affect coastal areas where most of the economic activities take place. A reduction in coastal arable land is also anticipated, and critical infrastructure (social services,

[35] GWP website.
[36] Examples of low energy efficiency and high carbon emissions are: Ecuador emits 1.16 kg CO_2-equivalents/$; Venezuela emits 1.11 kg CO_2-equivalents/$; while England emits 0.34 kg CO_2-equivalents/$. For other developed countries the figure is even smaller than for England. (Source: EfD-center in Central America, personal communication).
[37] LAC Blog at ODI, 10 December 2008.
[38] ECLAC notes December 2008.
[39] LAC Blog at ODI, 14 July 2008.
[40] EfD-centre in Costa Rica, personal communication.
[41] World Bank website: Water in Latin America and the Caribbean

airports, ports, telecommunication facilities, roads, coastal protection structures, tourism facilities and vital utilities) will be severely at risk. It has been suggested that land loss from sea-level rise, especially on the low limestone islands, is likely to be of a magnitude that would disrupt virtually all economic and social sectors. Natural disasters have an immediate impact both on the economy through contraction of economic output or worsening of balance of payments and on the budget (for instance, the impact of hurricane Ivan on Grenada was estimated at 200% of GDP, compared to 2% average of natural disasters elsewhere in the world[42]). Natural disasters also have severe consequences for tourism since its infrastructure tends to be located on beach fronts.[43]

Central American sub-region

Traditionally agricultural exports have been important to the Central American countries. However, productivity has declined substantially; almost 75% of the agricultural land is seriously degraded, which is a threat to food security. Fisheries contribute to economic growth through export earnings and employment. In Nicaragua, it is estimated that for each person employed in fisheries there are six persons economically dependent on the fishery resources. Currently, there is a problem with declining catch rates, especially for species with high commercial value. Reasons for the declining catch rates include: increased number of fishing boats and fishermen; climate change and variability; intrusion of foreign boats that exploit coastal resources; and destructive fishing methods. Furthermore, there is a risk that a large share of the incomes from export earnings is claimed by foreign interests, so industrial fishing may have a negative impact on livelihood security.[44] Tourism is another important economic sector, especially to Costa Rica, Belize and Panama. Other growth sectors include maquila industries.

3.3 Impacts on Public Health

Access to a safe environment, drinking water, sanitation, and good nutrition, is crucial for a healthy life, especially for vulnerable groups. Access to drinking water services has improved, mostly in rural areas. The region as a whole reached a coverage of 91% in 2004, although there are differences between the sub-regions and countries in LAC (see Table 1). The health of the population is affected by poverty related, water borne or vector borne diseases, and there are incidences of acute respiratory diseases and acute diarrhoeal diseases. Out of the total number of deaths in children of less than 5 years of age in LAC, 8.6% is attributed to acute respiratory diseases (20.7% in Central America and 10.7% in the Andes); while over 5% is attributed to acute diarrhoeal diseases in LAC (11.4% in Central America and 6.5 in Latin Caribbean). Population at risk of malaria and dengue is still very high, ranking from 10.3% in the Andean area to a 17.1% in the Latin Caribbean, and 13.1% in Central America, and climate change is expected to expand the range of these vector-borne diseases.[45]

Table 1: Percentage of the population with access to drinking water and sanitation

	Percentage of the population with access to drinking water		**Percentage of the population with access to sanitation**	
	2000	**2004**	**2000**	**2004**
LAC	89.20	91.00	75.09	77.16
Caribbean	82.80	84.40	72.25	74.15
Mesoamerica	91.40	94.90	73.45	77.32
South America	89.10	90.20	76.04	77.42
Source: WHO/UNICEF http://rbm.who.int/wmr2005/ Taken from the data base of ILAC				

[42] EC, 2009
[43] EC, 2008.
[44] Knutsson, 2007.
[45] The ILAC report, 2008.

Table 2 shows Disability Adjusted Life Year (DALY)[46] linked to environmental risk factors for selected countries in the LAC. From the table it can be seen that the diarrhoea DALY is high in e.g. Haiti and Bolivia, while the indoor air pollution (mainly caused by burning of wood fuel) is high in Haiti and Guatemala.

Table 2. Estimated deaths & DALYs attributable to selected environmental risk factors.

WHO estimates	**Water Sanitation & Hygiene**		**Indoor air pollution**		**Outdoor air pollution**	
Country	Diarrhoea deaths/year	Diarrhoea DALYs/1000 capita per year	Deaths/year	DALYs/1000 capita per year	Deaths/year	DALYs/1000 capita per year
Costa Rica	100	1	100	0,3	200	0,3
Guatemala	2 900	9	3 300	7,4	400	0,4
Bolivia	3 700	15	1 200	5,0	1 000	1,2
Brazil	15 000	3,6	4 100	0,6	12 900	0,6
Peru	3 900	6	1 500	1,8	3 100	0,8
Colombia	2 300	3	1 900	0,8	2 700	0,4
Haiti	5 000	20	2 900	13	500	0,7
Dominican Republic	1 100	5	<100	0,3	500	0,4

Source: WHO, 2007(data from 2002)

There are also other complicated links between environmental degradation and human health. For instance deforestation can result in less rainfall, higher air temperatures and more flooding, contributing to loss of food, medicines and fuel, reduction of crops and loss of vital nutrients, spread of tropical diseases and worsening climate change. Activities such as artisanal mining and the use of agrochemicals pollute soils, water and air with heavy metals, such as lead and mercury.

4. Climate Change

The approach taken in this section is not to provide a list of all the potential impacts of anthropogenic climate change on the region, but rather to focus on 4 major issues that will require regional cooperation to solve and where Sida could consider focussing its regional cooperation. We have chosen one issue for each of the sub-regions[47]. As there is a companion document that aims to map the institutional landscape for climate change there is little discussion of regional institutions working on climate change in this section.

4.1 Amazonian sub-region: Forest to Savannah?

The Amazonian sub-region is highly vulnerable to temperature rise and changes in precipitation pattern. Records of average monthly temperature in the north-eastern part of the Amazonian sub-region show a warming trend of 0.63°C over a period of 100 years[48]. Precipitation trends in Amazonia are not as clear. Variations in rainfall in different decades show opposite trends in the northern and southern parts of the Amazon basin. While the north of the Amazonia showed a rainy period from 1950 to 1976, the region has been rather dry since 1977[49], suggesting climate variability but not a defined rainfall trend[50]. There has been no overall trend in region-wide annual mean precipitation in recent decades, but evidence of increasing frequency of dry events in southern Amazonia over the period 1970–1999 has been found[51]. Moreover, water volume in Amazonian rivers has reduced

[46] The Disability Adjusted Life Year or DALY measures the overall disease burden, and is the sum of years of potential life lost due to premature mortality and the years of productive life lost due to disability.
[47] Annexes 1 and 4 provide additional information on El Niño and on Hurricanes and Storms.
[48] Victoria *et al* 1998
[49] IPCC 2001
[50] UNEP and ACTO 2009
[51] Li *et al* 2008

compared to average, showing trends in higher drought levels in the sub-region over the past decades[52].

Rising temperatures and transpiration rates, widespread deforestation, and climate-change induced forest retreat may further contribute to dry periods and the Amazonia and a degradation of the ecosystems. A study conducted by Malhi et al. (2009) exploring the likelihood of a climate-change-induced dieback of the Amazonia concluded that under mid-high GHG emissions scenarios, there is a high probability of intensified dry seasons in the Amazonia, and a medium probability that the rainfall regime will change sufficiently to a climate state where rainforest will shift to seasonal forest similar to tropical forest in South-east Asia. As a result, it is almost certain that the species composition will change to favour plants that can survive for months without water. Additionally, longer and more severe dry seasons create ideal conditions for starting and spreading of fires. If severe fires were to expand in eastern Amazon, huge amounts of carbon dioxide would be released into the atmosphere (the Amazon rainforest stores 90-140 billion metric tons of carbon), rainfall patterns would change worldwide, and local air pollution would be greatly affected. Forests may have some resilience to intensification of the dry season, however potential fires would increase their vulnerability, as seasonal tropical forest become flammable. In Brazil, 28% of the Amazonia is facing incipient fire risk with extensive fires leaking from agricultural areas into flammable forest during the droughts of 1997, 1998, 2005, and 2007.

Moreover, the rainforest's future is dependent on climate and soil nutrient feedbacks associated with land use trends in the sub-region. Recent studies show how the interaction between the different factors affecting forests may lead in some instances to tipping-points. Senna et al. (2009) conducted a study using a coupled climate-biosphere model to investigate a threshold of deforestation that could cause a tipping-point in certain parts of the Amazon forest. Results show that the reduction in rainfall is proportional to the amount of deforestation and is more drastic when the deforested area is higher than 40% of the original forest extent. This simulated precipitation reduction alone is not sufficient to prevent the rainforest recover. When integrating soil nutrient stress into their models, the change was much more profound, showing that a tipping-point may be reached and a savannization process may start over southern Amazonia (northern Mato Grosso state), no matter how much is deforested. At present, already 17% of the Mato Grosso region has been cleared. Senna found that with 20% deforestation the northern Mato Grosso would not be able to recover its forested state even after 50 years, and instead it would became a bare savannah. According to Nobre and Oyama (2003), the trend of increasing drought and heat in Amazonia could eventually convert 60% of the territory into a savannah in this century.

Recognizing that Amazonian countries share a variety of ecosystems, it is important to have a common and closely coordinated strategy for the integrated management of these ecosystems. UNEP and ACTO (2009) suggest concentrating efforts along three lines of action: forest conservation and climate change; integrated water resources management; and sustainable management of biodiversity and environmental services. Moreover, an important consideration to reduce the growing vulnerability of forests to climate change is to incorporate adaptation and risk management measures into the Amazonian development strategies (UNEP and ACTO 2009). Just as land use and human activity may be critical in triggering a degradation of forest, direct intervention to maintain forest area and limit the spread of agriculture and fire offers the potential to maintain forest resilience and avoid any tipping points. To pursue this end, different processed have been initiated in the sub-region. Some of these initiatives are described in Annex 3.

4.2 Andean sub-region: Glacial Withdrawal

Despite contributing little to the global production of GHG, the Andean sub-region is at high risk from climate change, given the fragility and high vulnerability of its population and ecosystems[53]. Average temperature rise in the Andean region is 0,34ºC/decade, about 70% more than the global average.

[52] UNEP and ACTO 2009
[53] AEA 2008

Climate-related disasters in Bolivia, Ecuador, Colombia and Peru cost over 10% of GDP, while the rest of the region presents ratios from 0.1 to 6%. The high vulnerability of these countries is related to the fragile ecosystems, but also to the high poverty (above 50%), and extreme poverty (between 15 and 30%) incidence levels. The Andean Community estimates that additional economic damage caused by climate change will reach US$ 30 millions by 2025, equivalent to 4.5% of the sub-region's GDP and similar to the investment currently allocated to the health sector. Such an impact can jeopardize the potential development of all Andean countries[54].

Besides exacerbating the occurrence and intensity of natural disasters (see Annex 1), climate change is accelerating the withdrawal of glaciers in the sub-region. In the past 25 years, all glaciers in the Andean region have reduced in mass. Almost 95% of the tropical glaciers are found in this sub-region, and some of them have already lost 80% of their glacier areas. The Peruvian White Mountain Range, for instance, has already lost 26% of glacier mass and this loss is accelerating[55]. It is estimated that by 2050 glaciers in the sub-region will only exist above 6,000 meters of altitude, and it is probable that small glaciers would have completely disappeared by 2025[56].

The withdrawal of glaciers in the sub-region has an enormous impact on water availability and electricity generation. More than 70% of electricity in the Andean countries is generated by hydropower plants, some of which depend upon the glacial basins for water supply. It is estimated that by 2025 climate change could contribute to a 70% increase in the number of people with difficulties to access drinking water in the Andes. The populations in the cities of La Paz, Quito, and Lima are expected to be the most affected. By 2020 around 40 million people could be affected by water deficit for hydro energy, water consumption and water use in agriculture due to glacier withdrawal [57].

The commonalities in terms of vulnerability, potential risks and impacts, as well as institutional frameworks in the area of climate change, set up the need to draw up an Andean Strategy on Climate Change that would make it possible to agree upon a common aim for the sub-region to cope with and mitigate climate change related effects. The Presidents of the Andean Countries recognized this need at the Andean Presidential Council in 2004[58]. The Andean Environmental Agenda for 2006-2010 provides for the formulation and organization of the Andean Strategy on Climate Change (EACC) and its corresponding Action Plan, as a basis for coordination on priority issues for the sub-region. Several strategies and programs to build capacity to adapt to glacial ablation have already been initiated in the sub-region. Annex 2 provides a brief description of these initiatives.

4.3 The Caribbean: Sea-Level Rise

The Caribbean is particularly vulnerable to sea-level rise due to the island nature of the sub-region, the concentration of important infrastructure and population centres in coastal zones and its reliance on sectors such as tourism that will be adversely affected by sea-level rise[59]. Estimates for global sea-level rise from the IPCC are of 26-59cm for the end of the 21st century (2090-2099), however recent studies including the contribution from ice-sheet melt indicate that sea-level rise of 50-140 cm for 2100 under the A2 emissions scenario is possible[60]. Observed sea-level rise in the Caribbean is close to the global observed figure, suggesting that global projections of sea-level rise should be a good indication of rise in the Caribbean, however there will be local differences due to tectonic activity; for example sea-level is rising four times as fast in the south of Trinidad than in the north[61]. Temperature and precipitation projections for the Caribbean are provided in Annex 5.

[54] CAN 2008
[55] Alvarado 2006
[56] IPCC 2007
[57] CAN 2008
[58] AEA 2008
[59] Mimura *et al* 2007
[60] Rahmstorf 2007
[61] Mimura *et al* 2007

Sea-level rise will threaten key coastal infrastructure and cities, increase damage caused by hurricanes and storm surges, could exacerbate water shortages through salinization and will put pressure on coastal ecosystems[62]. Erosion of beaches, damage to natural resources on which tourism is based, such as coral reefs, and flooding of tourist sites and infrastructure could have a large negative effect on this important sector which was worth $28bn in 2004 and employs 15.5 % of the population, with concurrent effects on the wider economy.

A recent study on the cost of anthropogenic climate change to the Caribbean without any adaptation measures concluded that the cost to the region could be $5.7-27.6bn/year by 2050 (2.7-13% of current GDP) and reach $55.8bn/year by 2100 (26.3% of GDP). It is important to note that this study was aimed at showing the damages in the Caribbean that could be avoided through strong global mitigation measures, and does not include any costs (or avoided costs) from adaptation. A summary of the results of this study is provided in Annex 6. The cost of climate change could reach over 100% of current GDP in particularly vulnerable countries. Sea-level rise is responsible for the majority of this cost, which is consistent with a 2002 study indicating that it could account for 75% of the total cost of climate change for the Caribbean[63].

Adaptation is thus vital in order to reduce the negative impacts of sea-level rise. Many argue that adaptation in the Caribbean must take the approach of building the resilience of the wider island ecosystem, taking an integrated approach. Improved planning and building regulations to stop the construction/reconstruction of buildings and infrastructure in areas vulnerable to flooding is an important first step in adapting to sea-level rise. An Integrated Coastal Zone Management (ICZM) approach is a key part of any adaptation strategy and is already being implemented in several areas, however will need to take an explicitly long-term view in order to successfully adapt to future sea-level rise[64]

4.4 Central America: Water Availability[65]

The sub-region is expected to warm on average by 1.8-5.0°C for the period 2081-2100 and there is significant model agreement that there will be a decrease in precipitation and an increase in the frequency of extremely dry seasons, which is consistent with observed drying trends for most of Central America since 1950. The models produce a large range for the severity of decrease, and given the geography of the region there are likely to be significant local to national variations. El Niño causes drought in Central America, and any increase in the frequency and intensity of these events could have severe effects on the sub-region.[66]

As a result both surface and groundwater availability in Central America are expected to decrease significantly, through a combination of decreased precipitation and run-off, increased evapo-transpiration due to higher temperatures, decreased soil moisture and an increase in the intensity of rainfall meaning that rainfall is less evenly distributed. Other issues such as deforestation, soil erosion, population growth and increased demand will compound the effects of climate change on water availability and water quality.[67]

Water is a vital cross-cutting sector with linkages to almost all aspects of environment, economy and society, so the effects of reduced water availability go far beyond a reduction in availability for human consumption; some (but by no means all) of these are shown below.[68] Increased water stress and its effects across different sectors is likely to hamper poverty reduction and development efforts.

[62] Magrin *et al* 2007, Mimura *et al* 2007, UNEP 2008
[63] Bueno *et al* 2008, Haites *et al* 2002
[64] Mimura *et al* 2007, UNEP 2008
[65] Hurricanes are a major issue for both Central America and the Caribbean but are not adressed in the main body of text. Please see Annex 4 for a discussion on climate change and hurricanes.
[66] Paragraph based on Christensen *et al* 2007, Aguilar 2007, Bates *et al 2008*
[67] Tearfund 2005, Up in Smoke 2006, Aguilar 2007, Bates *et al* 2008
[68] Bates *et al* 2008

Table 3: Some effects of reduced water availability on other sectors[69]

Agriculture	Probable decrease in productivity, increased risk of crop failure and livestock mortality from droughts, knock-on effects on food security.
Health	Decrease in water availability and quality leads to increase in gastro-intestinal and respiratory disease, amongst others.
Energy	Decreased run-off, increased drought will reduce hydro-electric generation
Ecosystems	Risk of desertification, fire, loss of biodiversity and ecosystem resilience.
Livelihoods	Decreased food security, drought increases rural-urban migration.

Adaptation to decreased water availability will require an integrated cross-sectoral approach and will require both demand and supply-side solutions. There is no shortage of regional activity and planning to manage water resources, for example the Central American Plan for Water Resources (PACADIRH) was established in 1999 and a new regional strategy for water management is currently being elaborated, however the challenge is the capacity and institutional framework to implement these plans.[70] There is a need for much greater investment and capacity to manage water resources in order to ensure adequate supply as availability decreases. The protection and restoration where possible of natural ecosystems will help regulate water supply and protect biodiversity. Effective early-warning systems for drought and economic diversification will reduce the exposure of small-holder agriculture to climatic risks.[71]

5. Regional response to environment and climate change challenges

Most environmental problems in LAC are rooted in human activities and behaviour that respond to distorted sets of incentives and signals, and are exacerbated by climate change. The environmental problems are more related to *how* production is done, than *what* is being produced, which is why public policies play a large role. The responsibilities to develop and implement policies related to sustainable development rest at the country level (or local levels), but some regional coordination efforts are initiated.

5.1 Key actors and their priorities

The ***Economic Commission for Latin America and the Caribbean,*** *ECLAC* (or CEPAL[72]), headquartered in Santiago, Chile, is one of the five regional commissions of the United Nations. It was founded with the purpose of contributing to the economic development and promoting social development of Latin America, coordinating actions directed towards this end, and reinforcing economic ties among countries and with other nations of the world.

The ***Forum of Ministers of the Environment of Latin America and the Caribbean*** (the Forum) "constitutes the main body for regional inter-governmental political consensus building on environmental issues".[73] The Forum has approved the *Latin American and Caribbean Initiative for Sustainable Development* (ILAC), which establishes a common regional agenda geared towards achieving sustainable development and its main implementation tool is the *Regional Action Plan* (RAP). ILAC's goals, purposes and indicators are structured around the following six subjects: biodiversity; water resources management; vulnerability, human settlements and sustainable cities; social issues including health, inequity, and poverty; economic aspects including competitiveness, trade and the patterns of production and consumption (energy); and institutional aspects. These six subjects are reflected in the eight priority areas of the RAP: (i) access to genetic resources and fair distribution of the benefits; (ii) water resources; (iii) human settlements vulnerability and land use; (iv) renewable energy sources; (v) trade and environment; (vi) economic instruments and fiscal policy;

[69] Compiled from: Aguilar 2007, Bates *et al* 2008, Magrin *et al* 2007, Ammour and Elizondo 2008
[70] For full discussion of initiatives on water and climate change please refer to Ammour and Elizondo 2008
[71] Magrin *et al* 2007, Ammour and Elizondo 2008
[72] Comision Economica Para America Latina, CEPAL
[73] UNEP, Declaration of Santo Domingo, February 2008.

(vii) climate change; and (viii) environmental indicators. Common studies and recommendations are performed by expert groups and institutions that make up the Inter-Agency Technical Committee (ITC). Indicators are being developed to monitor the progress towards the goals for the ILAC through coordination with the UNEP (PNUMA) and the University of the Costa Rica Development Watcher. Countries are expected to publish reports periodically; to date, three countries have published national ILAC reports and another two are in the process of developing them. In addition, 19 countries have prepared national GEO reports. The region is showing an observable strive towards the systematization of information and making it publicly available.[74]

The ***Inter-American Water Resources Network*** (IWRN) was established of more than 130 institutions, with a technical secretariat at the headquarters of the *Organisation of American States* (OAS). The purpose of IWRN is to build and strengthen water resources partnerships among nations, organizations, and individuals; to promote education and the open exchange of information and technical expertise; and to enhance communication, cooperation, collaboration and financial commitment to integrated water and land resources management within the context of environmental and economic sustainability in the Americas. At present, IWRN's main agenda items are: Transboundary water basin management; Metropolitan zones water management; The effects of climate on water resources; and The management of water resources in arid and semi-arid zones.

Other important regional actors include the World Conservation Union (***IUCN***), working i.a. with conservation, water and climate change, and the Tropical Agricultural Research and higher Education Center (***CATIE***), a major player in the field of Natural Resources research, education and project development focused on sustainable human development and natural resources conservation. The Global Water Partnership (***GWP***) is assisting governments to create platforms for dialogue in order to develop e.g. plans for integrated water resources management (IWRM) and water efficiency.

Amazon sub-region

The ***Amazon Cooperation Treaty Organisation (ACTO***) is a regional political forum for integration and sustainable development of the respective Amazon territories of the eight country members (Bolivia, Brazil, Colombia, Ecuador, Guyana, Surinam, Peru, and Venezuela). The mission of ACTO is to achieve a balanced distribution of generated benefits to the country members and improve living conditions particularly for the local Amazon populations. Their mandate includes strengthening or building technical and financial mechanisms and tools, and shared or complementary policies, for regional integration and sustainable development. Their purpose is to develop the resources of the Amazon basin in a sustainable way. The Permanent Secretariat was established in Brasilia in 2003. The strategic plan (approved in 2004) gives priority to i.a. water, forest, biodiversity, and social and communication infrastructure. ACTO is financed by member countries and external sources.

Mercosur is a regional trade agreement among Argentina, Brazil, Paraguay, and Uruguay. Venezuela has applied for membership and the Andean Community member states are associate members. Mercosur is striving towards abolition of trade obstacles and free movement of people and capital. In 1995 an environmental working group was established (SGT6). A number of ad-hoc groups have been set up under SGT6, including a group on biodiversity and one, started recently, on environmental goods and services. In the Framework Agreement on the Environment (ratified in 2004), Mercosur reaffirms its commitment to the principles of the Rio Declaration of 1992 and also commits to cooperating on environmental protection and on actions to ensure the sustainable use of natural resources.[75]

Andean sub-region[76]

[74] The ILAC report, 2008.
[75] EC, 2007b.
[76] EC, 2005b; and CAN website http://www.comunidadandina.org/

The ***Andean Community of Nations (CAN)*** has four member states (Bolivia, Colombia, Ecuador, and Peru) and is striving towards increased integration and sustainable development. After entering into a cooperation agreement with Mercosur another four countries are associate members. CAN has also signed a memorandum of understanding with ACTO, which is important considering the environmental interdependence between the Andean countries and the Amazon area. CAN is active in environmental matters and has developed guidelines for environmental management and sustainable development, a state of the environment report, and approved a Regional Strategy on Biodiversity for Tropical Andean Countries. Currently, the Andean Committee of Environmental Authorities (CAAM) is preparing an action plan and project portfolio for the strategy. Besides biodiversity, CAN's focus is on water resources, climate change and disaster prevention and relief.

Caribbean sub-region[77]

The regional institution with the broadest membership is the Association of Caribbean States (ACS), which focuses on four areas: trade, transportation, tourism and natural resources. Their main environmental focus is sustainable tourism. The other major intergovernmental institution is the ***Caribbean Community (CARICOM***), an organization of 15 Caribbean nations and dependencies, with the purpose to promote economic integration and cooperation among its members, to ensure that the benefits of integration are equitably shared, and to coordinate foreign policy. The *Sustainable Development Programme*, which falls within the Human and Social Development Directorate, is comprised of three sub-programmes: sustainable development; environment; and human development. The Caribbean sub-region puts specific attention on water resources, disaster management, and climate change adaptation. Emphasis is also put on renewable bio- and agro-energy programmes, the management of marine resources and a framework for managing the Caribbean Sea. Other important regional environmental programmes include the Caribbean Environment Programme; marine issues are addressed through the Integrating Watershed and Coastal Area Management (IWCAM) in small island developing states of the Caribbean; and climate change adaptation is addressed through the Caribbean Planning for Adaptation to Climate Change (CPACC). The Caribbean Disaster Emergency Response Agency (CDERA) has developed a Comprehensive Disaster Management Strategy and Framework to have a more coordinated regional approach to disaster preparedness.[78]

Central American sub-region[79]

The Central American Integration System (SICA) promotes integration, aiming towards a sustainable development in the sub-region. Central America has a large number of regional agreements related to environmental issues through three main institutions of the SICA system related to environment: the ***Central America Commission on Environment (CCAD***), the ***Regional Water Resources Committee (CRRH***), and ***Central American Coordinating Centre for Natural Disaster Prevention (CEPREDENAC***). There are three master strategies and plans to guide the agenda of disaster prevention, water resources and climate. The Environmental Plan for the Central American Region (PARCA) is the principal instrument to direct the work. PARCA has two objectives (strengthening of the CCAD and the national institutions in charge of the environment; and the harmonisation of the environmental management instruments in the region) and four thematic areas (forests and biodiversity; water; clean production; and institutional strengthening for environmental management). The Environmental Regional Programme, funded by Danida and implemented by CCAD, started in 2005-2006. Furthermore, CCAD and CRRH have prepared a Plan of Action for the Integrated Development of Water Resources in Central America. Sida has supported "Proyecto EIA – Una Herramienta para el Desarroloo Sostenible" 2006-2009, through the CCAD, with the aim to strengthen and harmonise systems for Environmental Impact Assessment in the region.

Donors and other actors

The EU is the main donor in LAC, and its development cooperation (2007-2013) is governed by the Development Cooperation Instrument. For Latin America the total amount for 2007–13 is EUR 2.6

[77] EC, 2008; and CARICOM website www.caricom.org
[78] EC, 2009.
[79] EC, 2005.

billion. Furthermore, EU is the second largest trading partner of LAC (after the USA).). The EU is currently negotiating Association Agreements with Mercosur and with Central America. The Agreement with Central America will, *inter alia*, create a free trade area between the EU and Central America. In addition, the Commission is announcing a €15 million aid package to support the strengthening of regional institutions in Central America and the participation of civil society in the process. [80] The ***Inter-American Institute for Cooperation on Agriculture*** (IICA) has signed an agreement with the World Food Program, which will assist rural communities to develop projects to tackle food insecurity and climate change.

UN, GEF and the World Bank are other large donors in LAC, for instance supporting the establishment of water laws and institutional frameworks to implement IWRM. WB is also developing strategies for REDD. The ***Caribbean Development Bank***, the OAS and CIDA, have launched an initiative to integrate natural hazard and climate change impact assessment in the project preparation in the Caribbean and appraisal process of the Bank and participating countries. Moreover, LAC has over 30% of the CDM-registered projects worldwide (compared to 64% in Asia and very few in Africa).

Sida has been cooperation with LAC mainly on bilateral basis, but also on a regional level in Central America (see above). Sida is currently supporting the ***Environment for Development Initiative*** (EfD), which is a network of think tanks working with research, education and policy advice to promote poverty alleviation and sustainable development through increased use of environmental economics. The EfD-centre for Central America is hosted by CATIE, and has a good track record in policy advice, for instance related to payments for ecosystem services; climate change adaptation, water resource management and environmental regulation, among others.[81] Sida-financed support to International Training Programmes (ITP) has also included participants from LAC. One concrete result is that participants from an ITP on Environmental Assessment (implemented by Ramboll) have formed a network for environmental-assessment professionals in the region: ***Asociación Latinoamericana de Evaluación Ambiental*** (ALEA).

5.2 Implementation and integration

The regional political institutions are commonly forums for sharing and promoting ideas and reaching consensus, while most development and implementation of environmental policies and strategies are done at national levels. Despite the importance of natural resources to economic development in the region, the environment and natural resources have been considered open access resources with no economic value assigned to their quality or scarcity. Investments are often led by short-term financial and rent-seeking considerations, leading to a process of continuous environmental degradation, with little provision for conservation. Coupled with these market failures is the low capacity of governments to develop and sustain credible environmental institutions, and pass and enforce effective laws and regulations. Corruption is a problem in many countries in LAC, and there is no doubt that corruption plays a considerable role with regard to the non-compliance with environmental laws and regulations. Market failures and government structures need to be corrected within a framework of transparent and participatory governance. There is also a need for progressive elimination of environmentally destructive subsidies or inadequate pricing of environmental services.

The LAC countries have drawn up policies that are reasonably comprehensive in response to the main environmental pressures on coastal and marine areas. Related to fresh water resources, institutions (e.g. water basin committees) are being created with the objectives of formulating water policies, agree on water allocation and coordinate the multiple use of water, and supervise pollution control and flood protection. The linkages between environment and health are given priority. However, implementation is in many instances still quite weak, and the political will for reforms seems limited. Policies are often sectoral and lack the integrated approach sustainable management requires. According to the IBD (2003), investments in natural resource management often fail to attain

[80] http://europa.eu/rapid/pressReleasesAction.do?reference=IP/09/119&format=HTML&aged=0&language=EN&guiLanguage=en
[81] For further details see http://www.efdinitiative.org/centers/central-america

sustainable goals, since the countries do not advance sufficiently in correcting key policy problems in areas such as land markets, credit markets, and agricultural subsidies, etc.

Amazon sub-region

An important achievement of ***ACTO*** has been the development of regional criteria and indicators for the sustainability of the Amazonian forest (see Annex 8). This is the result of five years of consultation at all levels (including civil society as well as government) within and among the eight member countries. At the time of establishment, the permanent secretariat identified as its main task to develop a strategic plan to guide the formulation, implementation and monitoring of regional programmes and projects. This has been done. During its short institutional life, the permanent secretariat has negotiated and signed a number of cooperation agreements with organizations and specialized agencies of the United Nations to execute tasks towards sustainable development in the Amazon region. Its efforts may reflect the political will of the member governments in taking action to reinvigorate the Amazon Cooperation Treaty.[82] The *institutional capacity and possible capacity needs of ACTO is difficult to assess* through this desk study. Concrete results for the peoples of the basin remains to be seen.

In collaboration with UNEP and Centro Latinoamericano de Ecolgía Social (CLAES) the "GEO MERCOSUR: Integration, Trade and Environment" report was developed and presented in November 2008. GEO MERCOSUR offers an analysis on relationships between trade and the regional integration process and their environmental dimension, and highlights the importance of incorporating the environmental dimension into regional integration. Regional collaboration around shared natural resources, especially water resources, is also emphasised.[83] Additional efforts are required to move environmental issues further up ***Mercosur***'s agenda. Moreover, the organisation still has significant gaps related to democracy and transparency. One of the three priority areas within the Association agreement with EC, is promotion of environmentally sustainable trade and economic growth for instance by boosting trade in environmental technologies and environmentally friendly goods and by identifying needs related to technical assistance and capacity building. Implementation of the strategy will be the responsibility of a single Mercosur institution still to be identified.[84]

Andean sub-region

Andean parliaments are productive regarding approving laws. In most cases, however, there is a serious absence of consultation and insufficient public information. The budget allocations to environmental issues are insufficient, but what is most lacking is political will to enforce environmental legislation. Environmental management is still concentrated to central ministries, although decentralisation is ongoing and public participation is increasing. Sometimes, too many institutions are involved which can create duplication of work, voids, and inter-institutional conflicts. A large proportion of the protected areas are protected only in theory but not in reality. The CAN is described as a weak organisation, but "could in the best of cases be used for regional studies and proposals for new laws".[85]

Caribbean sub-region

Most Caribbean states have specialised institutions for environmental management and biodiversity conservations. The public policy framework is largely command-and-control with few economic instruments. Civil society participation has not been adequately institutionalised. There are ongoing efforts to mainstream climate change in development planning in the Caribbean countries. The challenges of sustainable resource management go far beyond formal legislation and directives. For instance, fishermen and women in Central America and Caribbean complained – not about the efforts to regulate and restrict access to fishery resources – but about the inability of the governments to enforce regulations. There are insufficient resources for control and supervision.

[82] FAO website: http://www.fao.org/docrep/007/y5841e/y5841e12.htm
[83] UNEP Press Bulletin 19th November 2008.
[84] EC, 2007b.
[85] EC, 2005b.

Central American sub-region[86]
In Central America, all regional work is done through national ministries, which in general have low budget allocations, limited capacity, uneven application of the rule of law, and lack of accountability. Policy and regulatory instruments are commonly in place (it is interesting to note that countries that have developed favourable environmental policies are those with legislation on land tenure and long-term use mechanisms), but implementation and enforcement is lagging. Regional projects have not been fully efficient (due to i.a. a sectoral approach, they are initiated but not continued, high transaction costs, etc.). The response has been to launch more strategic programmes that are tied to key regional policies and strategies. A regional IWRM-strategy was recently developed aimed at guiding development of national institutions and integration structures. In addition, environment-related activities are often project-driven as implementing organisations look for externally funded projects. Indirectly, weak institutional structure has left a door open for unsustainable practices. There is a need for a sound legal framework for integrated land and water resources management, and to decentralise governance.

5.3 Challenges and Capacity needs

Some positive trends in recent years in LAC include a diversification of policies with improvements in the instruments, including economic instruments, evaluation systems and environmental indicators, efforts of education for sustainability, and increased public participation. However, some challenges remain. The institutions related to environmental regulation and enforcement are generally weak and under-funded. Especially in small countries, such as the small Caribbean island states, there is a lack of skilled labour, which in combination with small national budgets and job markets, results in small institutional capacities. There is a great need to foster inter-sectoral coordination and increase awareness at the highest political level, and to strengthen local environmental management as part of viable decentralisation processes. A more systematic approach is needed to fiscal, economic, and sectoral policies that adequately incorporate environmental benefits and costs and the real economic value of resources. Incentive-based instruments should be elaborated as economic policies and incentives fundamentally shape the behaviour of individuals, firms and institutions.

A limited number of priorities would give greater emphasis to crucial topics including: the implications of the production and the growing use of biofuels; the strengthening of the action strategies in the face of the growing threats of climatic change; as well as the integrated management of natural resources.

One of the key challenges is the need to increase statistical information and analysis on environmental conditions and sustainability indicators at the country-specific and regional levels. In the area of trade and integration, the trade agenda should provide an opportunity to advance environmental standards, institutions, civil society networks and the private sector in assessing the social and environmental impacts of economic liberalisation.

6. What are the implications for Swedish Development Cooperation?

6.1 Conclusions

When a river crosses national boundaries, the riparian countries are placed into a state of interdependence. Activities in the upstream country will inevitably affect the quantity and quality of the water available for the downstream country, possibly with environmental, health and economic impacts. The same is valid for other transboundary natural resources such as forests, oceans and other ecosystems. This is why shared natural resources or common environmental problems, calls for regional cooperation even when action is taken on national or local level. However, when an issue crosses a national border, technical as it might be, it becomes political. Therefore, regional cooperation requires both technical and political cooperation and political will at the highest level to be effective,

[86] EC, 2005; CABAL, 2008.

especially if it is linked to reforms and changes in policies. Even when there is political will, regional cooperation is often a very slow and time-consuming process, because of its complexity. Despite this, it is sometimes necessary and when successful often very rewarding in terms of results. Trends towards economic integration among countries show that regional environmental mechanisms and institutions need to be developed and strengthened. And vice-versa, regional cooperation around a shared resource or problem builds trust in general and often has spill-over effects on other areas and is positive for regional integration.

The main regional environmental problems are associated with environmental and climate change caused by economic short-term gains and international demand, and fuelled by aspects such as corruption, weak environmental institutions, inefficient policies, lack of coordination and weak enforcement and control, combined with high incidences of poverty, inequality and vulnerability. However, local knowledge constitutes at the same time an enormous resource for sustainable development. Regional institutions, such as civil society organisation and research institutes, possess vast knowledge and present a great potential for sustainable development.

The great challenge is to find the balance between increased production and increased protection of the resource. Economic development through utilisation of natural capital is nothing wrong per se, but requires investments in development and good governance in order to be sustainable. The environmental problems are closely linked to aspects of poverty and economic development, so sound environmental policies are likely to be powerfully redistributive and pro-poor.

Supporting regional cooperation can be done either though strengthening existing (political or technical) institutions that cooperate around shared natural resources or with a thematic area relevant to Sida, or by supporting institutions that work with understanding the shared problems and finding solutions to them, such as civil society organisations or research institutes.

7.2 Issues for Sida to consider

Against this background the following issues could be relevant for Sida, in a dialogue with other donors and regional/sub-regional institutions, to consider in the development of a new cooperation strategy with Latin America and the Caribbean:

Regional/sub-regional cooperation around shared natural resources

- Provide support to basin-wide integrated land and water resources management (IWRM) through
  - Supporting networks or organisations that promote IWRM or assist governments to improve cross-sectoral and vertical stakeholder participation, transparency and accountability around IWRM-related policies (water, land, agriculture, energy, etc.).
  - Support the establishment of water basin committees that will work with joint IWRM strategies, agree on mechanisms for water allocation and principles for instance related to equitability, efficiency, sustainability and benefit-sharing.

- Support existing regional initiatives to manage the impacts of climate change, such as the Andean initiative on adapting to glacier melt, in Annex 2. Exploring avenues for the effective implementation of regional plans is particularly important.

- Promote the dissemination and use of climate change information for adaptation decision-making and development planning. This would involve training organisations to 'translate' the complexity and uncertainty in climate projections into policy-relevant outputs and language, and dialogue between the users and providers of this information.

- Support existing regional or sub-regional initiatives (such as the CCAD) to improve capacity for environmental assessment (EIA and SEA), through strengthening of legal systems and improving competence and capacity in terms of resources within responsible ministries and authorities to implement legislation, provide guidance and follow-up on environmental assessments.

- Given the central role natural resources play in the region, a good understanding of the issues at stake is necessary for sound planning of Swedish development cooperation with Latin America and the Caribbean. Further studies, seminars and stakeholder dialogues around environment, natural resources, ecosystem services, and related issues should be considered as part of the process of developing a new cooperation strategy with LAC. A focus on specific environmental issues and their implications for poverty reduction and economic development is suggested, in order to get away from a single and general "environment is important discussion".

Regional/sub-regional cooperation around solutions to shared problems

- Reduced Emissions from Deforestation and Land Degradation (REDD) is anticipated to become a part of the new climate regime. If LAC wants to benefit from REDD, preparations ought to start immediately.
  - Support could be given to research institutions or CSOs, to enhance the understanding of risks and benefits with REDD, and investigate the possibilities and requirements of making it pro-poor;
  - Support could also be given to implementing institutions, to develop capacity to formulate, implement, and monitor REDD projects.

- Support research and policy outreach related to:
  - research into, and pilots of, payment for ecosystem services schemes (for example REDD, water services) to conserve biodiversity and ecosystem integrity;
  - the implications on production and the growing use of bio-fuels;
  - a systematic approach (e.g. Life Cycle Assessment) of agriculture and animal husbandry on topics related to climate, water, etc., to clarify the links between climate change mitigation, adaptation, and welfare effects.

- Economic and market based policy instruments, (fees, taxes, tax incentives, tradable permits, etc) might be developed regionally. This is also critical in order to address issues of financial sustainability, which is a major bottleneck in environmental institutional development.

- Support the development of a region-wide programme on the downscaling of climate models (both through regional climate modelling and statistical downscaling) to provide climate projections at a more policy-relevant scale. Such a programme could be housed by regional centres such as the Caribbean Community Climate Change Centre (CCCCC) or CATHLAC, and supported by existing centres of excellence in downscaling, such as the University of Cape Town.

- Support to develop statistical information and analysis on environmental conditions and sustainability indicators at the country-specific and regional levels, as well as improving monitoring and evaluation capacity.

Finally, this policy brief touches upon a range of highly complex issues. Needless to say, there are many aspects that deserve a much more detailed level of analysis. We hope, however, that this Environmental and Climate Change Policy Brief fulfils its aim of being a point of departure for a discussion on how environmental and natural resources aspects can be integrated into Swedish development cooperation with Latin America and the Caribbean.

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Annex 1: Intensification of El Niño-Southern Oscillation (ENSO)

One of the climatic events that may become more frequent and intense due to climate change is El Nino. Over the last 3 decades the Andean sub-region has experimented an increase in the El Nino[87] events, with two extremely intense events in 82/83 and 97/98 (CAN 2008). The Corporacion Andina de Fomento (CAF) estimated that El Nino event in 97/98 produced losses of US$ 7,545 million, equivalent to 2.6% of the sub-region's GDP. Three of the most affected countries were Ecuador (14% of GDP), Bolivia (7% of GDP), and Peru (4.5% of GDP) (AEA 2008). It is recognized that more than half of all emergencies in the Andean region have hydrometeorological origin. Between 1970-1999 and 2000-2005, the number of annual hydrometeorological events has increased 2.4 times (Stern 2006). Natural disasters in the region have been estimated to cause the death of around 3,500 lives and affecting more than 1 million of people (CAN 2008). El Nino event is also associated with droughts in north-eastern Brazil, and natural disasters on the Pacific coast of Central America.

Annex 2: Building Capacity to Adapt to Glacial Melt

The Andean Community is financing, in collaboration with the World Bank and supported by the GEF (through the Special Climate Change Fund), a US$ 32 million project to study the glacial retreat and create an adaptation plan for the Andean sub-region affected by this phenomenon (World Bank 2008). The project will carry out pilot activities to evaluate the costs and benefits of adaptation measures in the affected countries and contribute to build adaptive capacity in vulnerable ecosystems and local economies. For instance, it aims to develop alternative sources of water supply, diversify energy sources away from reliance on hydropower and provide advanced irrigation systems to minimise the impact of glacier melt on Andean communities (Vergara et al. 2007). In parallel to this project, the GTZ is leading a regional programme on Climate Change to be implemented in Bolivia, Peru and Ecuador. The focus of this programme is centred on local capacities in two priority areas: watershed management and forest management (Considering the REDD scheme). Furthermore, the Institute of Research for Development (IRD 2007) is implementing a regional research programme to investigate the evolution of glaciers in the Andes and evaluate future behaviour of water resources that depend on glaciers and their relation to climatic variability. This programme is carried out in collaboration with universities in Bolivia, Peru and Ecuador.

[87] (ENSO).

Annex 3: Initiatives to conserve the Amazonia and build mechanisms to cope with climate change

With the collaboration of UNEP, GEF and OAS, the Amazon Cooperation Treaty Organization (ACTO) has initiated a process of dialogue and design of a regional programme for integrated management of water resources. Also, different initiatives (at the national level and through schemes such as the Forest Carbon Partnership Facility) have recently started to support the design of strategies to implement Reduced Emissions from Deforestation and Degradation (REDD) as a mechanism for mitigating climate change and conserving forested areas in Brazil, Peru, Bolivia, Guyana and other countries that share the Amazon basin. Conservation efforts through payment for ecosystem services such as REDD are not only a strategy for climate-change mitigation, regional development, and biodiversity conservation but also a potential strategy for adaptation as the climate of Amazonia, particularly eastern, tends toward one of intensified seasonality (Malhi et al. 2009). REDD could also provide a strong market-based incentive for complying with environmental laws and using best land management practices, while encouraging protection of large areas of forest sitting on soils that are not suitable for cattle ranching and soybean production.

Nepstad (2007) estimated that 94% of the Amazonia could be compensated at less than $10 per ton of carbon, which means that is really only 10% of forests sitting in soils very suitable for soybeans (biodiesel) and with good road connection that drive the price, currently estimated at a REDD opportunity cost of around $100 per ton.

Annex 4: Hurricanes and Storms

Hurricanes and storms are a major hazard in both Central America and the Caribbean and will continue to be so in the future. The effects of anthropogenic climate change on hurricane frequency and intensity is debated, as although there has been a trend for increasing numbers of storms reaching categories 4 and 5 since 1970[88] this may merely be part of a natural cycle. There are indications that hurricane intensity will increase in the Caribbean basin, but these projections should still be treated with caution.[89] It is clear, however, that the economic damage and number of people affected by hurricanes and tropical storms has increased. For example the number of people affected by hurricanes and storms in the Caribbean and Central America for the period 1991-2008 is more than four times that for the period 1970-1990, and economic damages for the 1991-2008 are 7.5 and 10.5 times as great as 1970-1990 in the Caribbean and Central America respectively.[90] This trend is likely to continue even if overall numbers of storms stay the same due to a combination of population growth, economic development and rising sea-levels exacerbating the effects of storm surges.

A stark example of the devastating effects of hurricanes comes from the case of Grenada, which was hit by Hurricanes Ivan and Emily in 2004 and 2005. Overall losses were estimated at more than double total GDP, 90% of housing stock was affected and 90% of tourist beds damaged or destroyed. Grenada has recovered to some extent from hurricanes Ivan and Emily, but growth in 2008 was only 3.7% compared to pre-hurricane estimates for 5.6%, and the cost of reconstruction has left the island with a debt-to-GDP ratio of 110%.[91]

Changes to storms and hurricanes may be uncertain, but focusing on disaster preparedness and risk reduction will not only have immediate development benefits but will also act to prepare the sub-region for any increase in frequency and intensity that does occur. A synergistic approach between climate change adaptation and disaster risk reduction should be pursued, in particular given the circumstances of the Caribbean and Central America, for example by implementing the Hyogo Framework for Disaster Risk Reduction[92].

[88] Mimura *et al* 2007
[89] Magrin *et al* 2007
[90] CRED 2009
[91] CIA Factbook 2009
[92] Magrin 2007, UNEP 2008,

Annex 5: Climate Projections for the Caribbean

Warming is likely to be less than the global average in the Caribbean at +1.4-3.2°C by 2081-2100 (with a median response of +2°C), and there is a robust signal for a reduction in precipitation, although projections range from a small increase to a large decrease (Christensen *et al.* 2007). The island nature of the region means that local changes may be significantly different to the regional picture, in particular given that islands are below the resolution of most climate models. There is a need to further explore the use of downscaled climate scenarios for the Caribbean, including both regional climate modelling (some of which the CCCCC is already carrying out) and statistical downscaling approaches.

		Temperature Response (°C)						Precipitation Response (%)						Extreme Seasons (%)		
Region[a]	Season	Min	25	50	75	Max	T yrs	Min	25	50	75	Max	T yrs	Warm	Wet	Dry
CAR	DJF	1.4	1.8	2.1	2.4	3.2	10	-21	-11	-6	0	10		100	2	
	MAM	1.3	1.8	2.2	2.4	3.2	10	-28	-20	-13	-6	6	>100	100	3	18
10N,85W	JJA	1.3	1.8	2.0	2.4	3.2	10	-57	-35	-20	-6	8	60	100	2	40
to	SON	1.6	1.9	2.0	2.5	3.4	10	-38	-18	-6	1	19		100		22
25N,60W	Annual	1.4	1.8	2.0	2.4	3.2	10	-39	-19	-12	-3	11	60	100	3	39

IPCC data on climate projections for the Caribbean based on projections from 21 global climate models. The shaded areas indicate that the middle half (25-75%) of the model distribution all indicate a decrease in precipitation. Source: Christensen et al 2007.

Annex 6: The Cost of Inaction in the Caribbean

Table 2. Caribbean Region—Low- and High-Impact Scenarios

Total Caribbean	Climate Change Scenarios: $US Billions			
LOW-IMPACT	**2025**	**2050**	**2075**	**2100**
Storms	1.9	2.0	2.0	2.1
Tourism	0.4	0.8	1.2	1.6
Infrastructure	1.5	2.9	4.4	5.9
Total	**$3.8**	**$5.7**	**$7.7**	**$9.6**
% Current GDP	**1.8%**	**2.7%**	**3.6%**	**4.5%**
HIGH-IMPACT	**2025**	**2050**	**2075**	**2100**
Storms	3.1	4.7	7.0	10.0
Tourism	2.0	4.0	6.0	8.0
Infrastructure	9.4	18.9	28.3	37.8
Total	**$14.5**	**$27.6**	**$41.3**	**$55.8**
% Current GDP	**6.8%**	**13.0%**	**19.5%**	**26.3%**

Sources: Authors' calculations. Amounts in 2007 dollars; percentages based on 2004 GDP.

Economic impacts of climate change in the Caribbean for high temperatures rise and low temperature rise scenarios. Source Bueno et al 2008.

Table ES-1. Caribbean Region—Cost of Inaction

(High-Impact minus Low-Impact Scenarios)

Total Caribbean	Cost of Inaction ($US Billions)			
	2025	**2050**	**2075**	**2100**
Storms	$ 1.1	$ 2.8	$ 4.9	$ 7.9
Tourism	1.6	3.2	4.8	6.4
Infrastructure	8.0	15.9	23.9	31.9
Total	$10.7	$21.9	$33.7	$46.2
% Current GDP	**5.0%**	**10.3%**	**15.9%**	**21.7%**

Sources: Authors' calculations. Amounts in 2007 dollars; percentages based on 2004 GDP.

The cost of inaction on climate change in the Caribbean (high impact scenario minus low impact scenario). Note these figures do not include adaptation. Source Bueno et al. 2008

Annex 7: The Millennium Ecosystem Assessment

The Millennium Ecosystem Assessment in brief

The Millennium Ecosystem Assessment (MA) was called for by the United Nations Secretary-General Kofi Annan in 2000. Initiated in 2001, the objective of the MA was to assess the consequences of ecosystem change for human well-being and the scientific basis for action needed to enhance the conservation and sustainable use of those systems and their contribution to human well-being. The MA has involved the work of more than 1,360 experts worldwide. Their findings, contained in five technical volumes and six synthesis reports, provide a state-of-the-art scientific appraisal of the condition and trends in the world's ecosystems and the services they provide (such as clean water, food, forest products, flood control, and natural resources) and the options to restore, conserve or enhance the sustainable use of ecosystems.

There is a growing understanding of the fundamental role ecosystems and the services they provide play for human welfare, see Fig 1. describing the linkages between biodiversity, ecosystem services and human well-being.

Key findings of the Millennium Ecosystem Assessment[93], finalised in 2005 and the so far most comprehensive survey of the ecological state of the planet, include:

- 60% of world ecosystem services have been degraded
- Of 24 evaluated ecosystems, 15 are being damaged, see Table 1.
- About a quarter of the Earth's land surface is now cultivated.
- People now use between 40 percent and 50 percent of all available freshwater running off the land. Water withdrawals have doubled over the past 40 years.
- Over a quarter of all fish stocks are overharvested.
- Since 1980, about 35 percent of mangroves have been lost
- Nutrient pollution has led to eutrophication of waters and coastal dead zones
- Species extinction rates are now 100-1,000 times above the background rate

The degradation of ecosystem services is hence already a significant barrier to achieving the Millennium Development Goals, contributes to growing inequities and disparities across groups of people, and is sometimes the principal factor causing poverty and social conflicts.

Ecosystem Services in Latin America and the Caribbean

As yet there has been no comprehensive assessment made of status and trends of ecosystem services in Latin America and the Caribbean. Based on the findings in this Environmental Policy Brief we estimate that at least the following ecosystem services are either seriously degraded, or under risk of possibly being so:

Seriously degraded:	***Under risk or possibly degraded:***
Fresh water	Wild foods and Genetic resources
Air quality regulation	Carbon sequestration
Erosion regulation	Water regulation and purification
Natural hazard regulation	Disease and Pest regulation
Spiritual and religious values	Regional and local climate regulation

Figure 1. Links between biodiversity, ecosystem services and human well-being

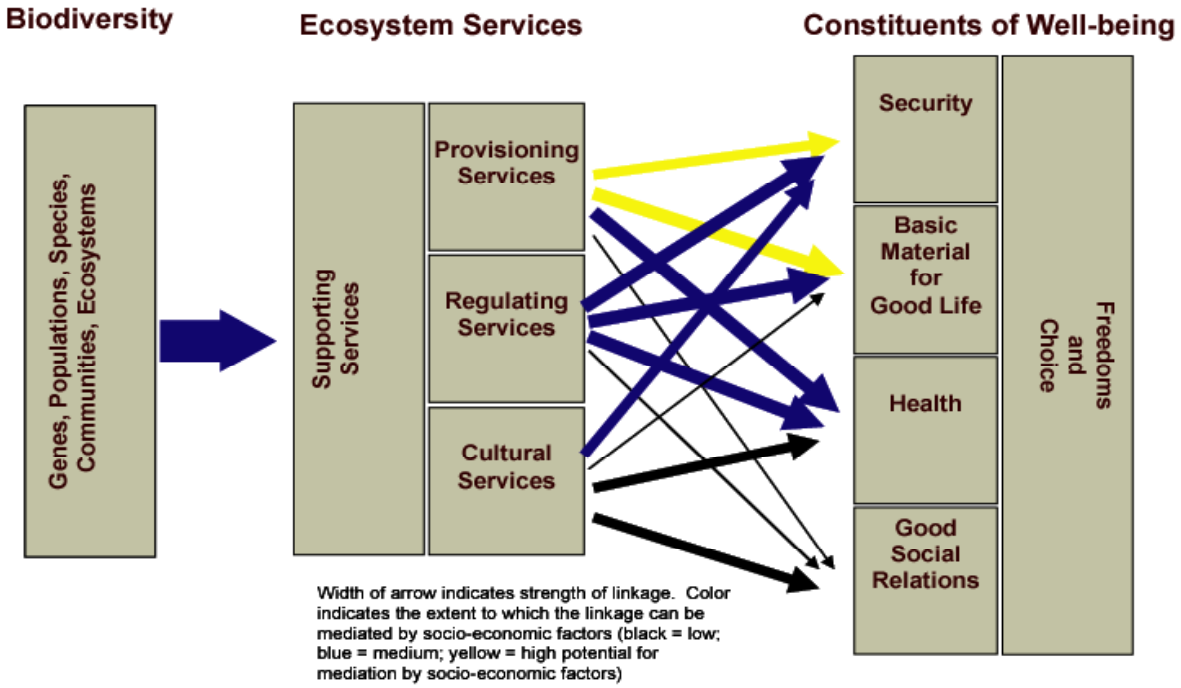

Table 1: Global condition of Ecosystem Services Examined by the Millennium Ecosystem Assessment

Ecosystem Services	Enhanced	Mixed	Degraded
Provisioning	Crops Livestock Aquaculture Carbon	Timber Fiber	Capture fisheries Wild foods Wood fuel Genetic resources Biochemicals Fresh Water
Regulating	Carbon sequestration	Water regulation Disease regulation	Air quality regulation Regional & local climate regulation Erosion regulation Water purification Pest regulation Pollination Natural Hazard regulation
Cultural		Recreation & ecotourism	Spiritual & religious Aesthetic values

For additional information on the MA including presentation materials etc, see http://www.maweb.org

Annex 8. Fifteen priority indicators of sustainable Amazon forest management

NATIONAL LEVEL

1. Existence of policies and a legal framework for land-use planning through ecological and economic zoning
2. Area, by forest type, categorized as conservation areas, in relation to total forest area
3. Rate of conversion of forest cover to other uses
4. Quantity and quality of appropriate techniques for forest management and sustainable production
5. Investment in research, education and technology transfer
6. Quantity and quality of research and sustainable development projects in course of implementation

MANAGEMENT UNIT LEVEL

7. Forest management plan and other plans concerning the use of forest resources, approved by the authorities responsible
8. Frequency of the evaluation of management plan implementation and the average percentage of implementation
9. Degree of utilization of environmentally sound, appropriate and compatible technologies
10. Proportion of environmental protection areas as against permanent production areas
11. Existence of prevention measures to protect water courses from the impact of forest extraction activities
12. Number of direct and indirect jobs, and income levels

GLOBAL LEVEL

13. Contribution to the conservation of biological diversity
14. Contribution to the maintenance, restoration and protection of the cultural values and diversity of the indigenous and local population
15. Contribution to the economy, health, culture, science and recreation