



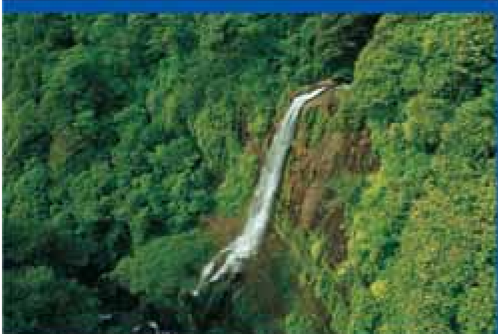
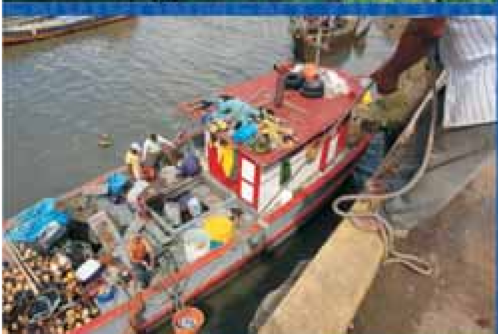

LATIN AMERICA AND THE CARIBBEAN: ENVIRONMENT OUTLOOK

GEO LAC 3

UNEP

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Foreword by the Executive Director of UNEP

One of the greatest challenges facing Latin America and the Caribbean is the sustainable management of its rich and economically-important natural resources. To a greater or lesser extent, all regions of the world but in particular developing economies are facing climate change, biodiversity loss, environmental degradation, emergencies caused by natural disasters, water scarcity and rapid urbanization.

There is an urgent need to bring sustainability into the debate as the world prepares for the Rio+20 meeting in Brazil in 2012 under the themes of the 'green economy' and the 'institutional framework for sustainable development'.

The historical development model in Latin America and the Caribbean has been largely based upon on the provision of food, raw materials and natural resources. This has generated economic growth but has undermined in many ways and in many places the social and environmental pillars of sustainable development.

At the national level, there has been progress in the development of environmental strategies, the creation of specialized agencies, the establishment of institutional and legal frameworks, and the ratification of international conventions. Progress is being made, for example on arresting deforestation of the Brazilian Amazon including monitoring alongside increasing coverage of protected areas. There are also encouraging national experiences in generating green jobs: recycling in Brazil; organic agricultural production and energy-efficiency lighting in Mexico; small scale agriculture in, for example Cuba; afforestation and reforestation in Mexico, Cuba and Brazil, and payments for environmental services in Bolivia, Colombia, Costa Rica and Nicaragua.

However the environment, and in particular those nature-based resources that cut across national boundaries, is yet to receive the priority it deserves as the world confronts multiple challenges from poverty and climate change to food and looming natural resource scarcities. This third report ***«Latin America and the Caribbean Environment Outlook – GEO LAC 3»****, presented by the UNEP, highlights the need to move away from sectoral, uncoordinated and short-term policies, and to work towards consolidating comprehensive and cross-sectoral environmental ones that put sustainability at the centre stage.*

Access to accurate and reliable information on the state of the environment, currently a challenge in the region, is a pre-requisite to achieve transformational change. Investment in the management and restoration of the region's ecosystems and their multi-trillion services also need to inform policy decisions.

Advancing toward a more prosperous and developed Latin American and Caribbean region is a task for all. National and local governments, civil society and NGOs at the national, local and international level need to agree on a way forward to solve the many environmental challenges highlighted in this report — but also the inordinate opportunities for this region and its people.

GEO LAC 3 is part of UNEP's contribution to catalyzing improvements to human well-being and framing a fresh debate around the concept of sustainability in the context of a world evolving from six billion, to nine billion people by 2050.

Achim Steiner

Achim Steiner,
UN Under-Secretary General and
United Nations Environment Programme Executive Director

READER'S GUIDE

Evaluating and informing on the state of the environment is one of the basic mandates of the United Nations Environment Programme. The process of Integrated Environmental Assessments, or GEO (Global Environment Outlook), emerged as a mandate of the Governing Council in 1995. Likewise, the Forum of Ministers of the Environment of Latin America and the Caribbean, through their decisions, ratified support for the preparation of GEO reports on a regional, subregional, national and urban scales.

For this reason, the UNEP has developed the methodology of **the Integrated Environmental Assessments** as a consultative, participatory, and structured process; the purpose is to produce up-to-date, exhaustive, scientifically credible, politically relevant and valid reports to support decision-making at all levels.

The GEO LAC 3 is the third comprehensive environmental assessment of the status and perspectives of the environment in the Latin American and Caribbean region. It is the result of a series of structured consultative process, with a solid scientific basis that analyze, in an impartial manner, the state of the environment, principal environmental impacts, and the motivating forces and pressures for environmental change. It presents action options for decision-makers and additional regional-level actors concerned about the state of the environment. The regional-level consultations and reviews were carried out in 2007-2008, using an interdisciplinary and trans-sectoral framework that strengthened the relevance and scientific, methodological, and technical rigor of the final report.

Through an analysis based on environmental and socioeconomic indicators, this integrated environmental assessment examines critical issues in the region, such as: the quantity and quality of fresh water; degradation of marine coastal areas; deforestation and habitat fragmentation; soil degradation; unplanned urban growth and solid waste management; fisheries; and the vulnerability of the region to climate change.

The GEO LAC 3 is divided into five chapters, and provides an overview of regional development trends, and of environmental changes and their impacts on human well-being in the region. The following summary highlights the focus of each chapter:

Chapter I. Predominant development models in Latin America and the Caribbean. Pressures for environmental change: Examines the currently prevalent model of development in the countries of Latin America and the Caribbean, and identifies the primary motivating forces and pressures that influence the environmental change affecting the region.

Chapter II. State of the Environment: Describes the status of the environment in the region, concentrating on the analysis of certain aspects: land; forests; biodiversity; water and hydrobiological resources; oceans and coastlines; air quality; and urban areas.

Chapter III. Relationships between Environmental Change and Human Well-Being in Latin America and the Caribbean: Using two iconic ecosystems of the region, this chapter presents an analysis of ecosystem vulnerability and the impact of environmental changes of the well-being of human beings.

Chapter IV. Scenarios: Develops different future scenarios for the region given specific policy developments.

Chapter V. Policies and Options for Action: Presents elements that allow broadening the discussion about development policy frameworks, and opens possibilities for a wider application of existing practical experiences to increase well-being and reduce the vulnerability of the region to environmental changes.

The result is a report on the environment of the region which, based on up-to-date, thorough, scientific information, is directed to the Ministers of Environment of Latin America and the Caribbean and their advisors, scientists, and civil society organizations, especially indigenous groups, youth, environmental NGOs, and the business sector. The report supports them in making decisions concerning the environment.

THE GEO CONCEPTUAL FRAMEWORK

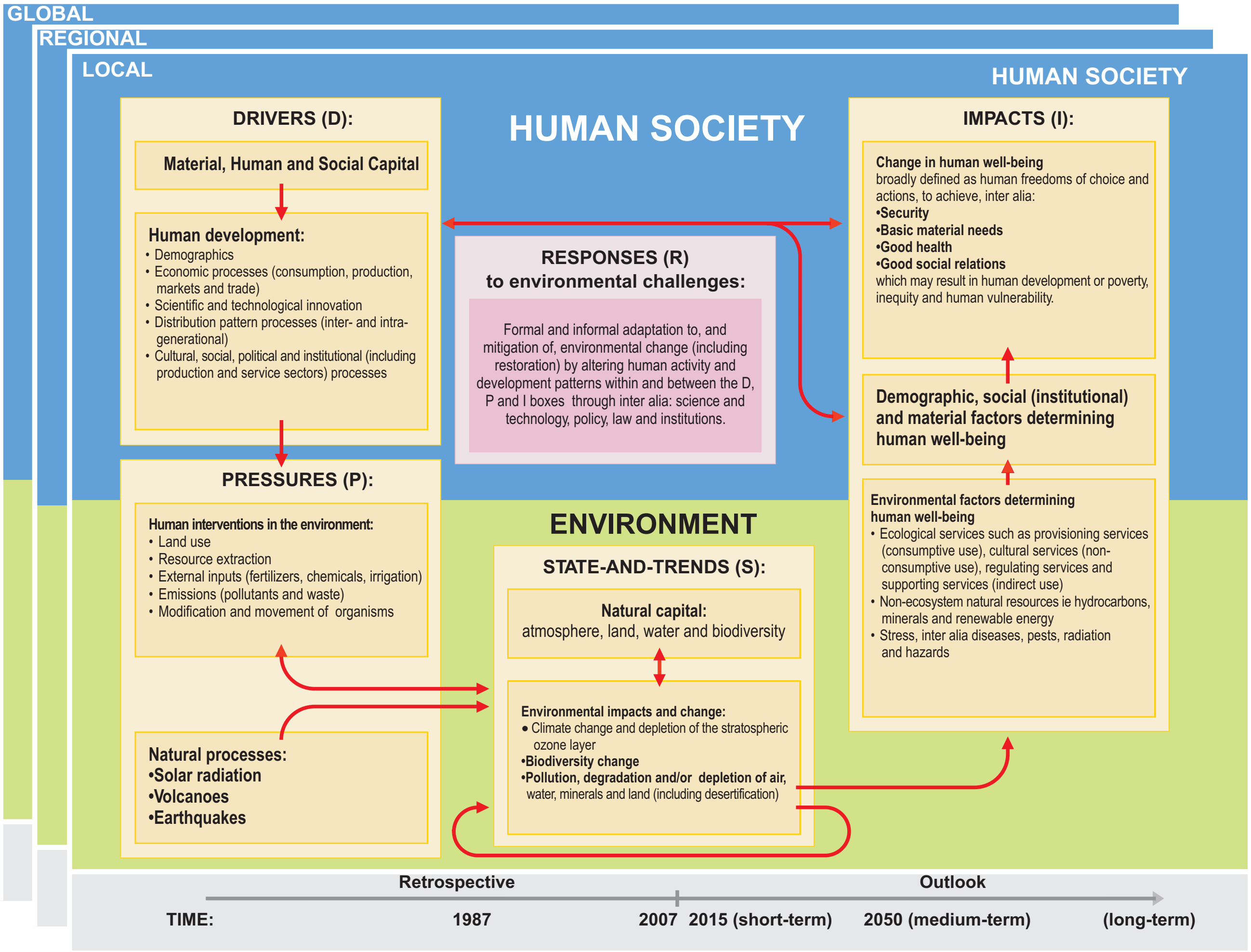
The GEO ALC 3 **uses the methodological framework** of Drivers – Pressure – State – Impact – Responses (DPSIR), which covers and analyzes the interrelationships between human society and the environment, placing emphasis on ecosystem services and their relationship with human well-being.

The Drivers, or indirect forces, are defined as fundamental processes in society (which include demographic changes and economic and social processes) that cause more concrete **Pressures** on the environemnt (such as changes in land use, resource extraction, pollution and waste production, and the modification and movement of organisms).

These pressures cause changes in the State of the environment that are equal in magnitude to those that result from natural processes. Environmental changes include climate change, the depletion of stratospheric ozone, changes in biodiversity, and the pollution or degradation of air, water, and soils. Said changes are made manifest in changes **in the services that the environment provides to humanity**, like the availability of clean air and water, food, and protection from ultraviolet radiation.

As a result of changes in ecosystem services and due to demographic, social and material factors, **impacts** are generated that **affect human well-being** (health, material assets, good social relations, and security). The **Responses** include formal and informal efforts to adapt to changes in ecosystem services or, instead, to reduce pressures on the environment.

The figure that follows shows the DPSIR framework used in the GEO 4 (Global Environment Outlook), and which has served as the basis for the analysis carried out in the GEO LAC 3.



Note to the reader: In this document the names Bolivia and Plurinational State of Bolivia, and Venezuela and Bolivarian Republic of Venezuela are used interchangeably, and do not reflect the political opinions of the UNEP or the authors of this report.

I. Predominant Development Models in Latin America and the Caribbean: Pressures for Environmental Change

Key Messages

- **Development model.** The absence of national environmental strategies that, first of all, assume and manage large environmental liabilities and, second, develop cross-sectorial and transversal policies to build a type of integrated development that improves the quality of life, corresponds to the increasing number of environmental problems not being addressed either because of gaps in legislation, or the lack of political will and continuity in implementing environmentally sound management and control systems. Even so, the growing interest in addressing the environmental issue and its inclusion on the agendas of different sectors –national and local governments, civil and business organizations, universities and research centres– in many cases based on consensus and cooperation, presents an opportunity to tackle environmental degradation and to provide a basis for moving towards a more sustainable development model that internalizes and considers the cost-benefit opportunities of protecting and preserving ecosystems and the environmental services they offer.

- **Demographic growth.** In 40 years the regional population grew by 51%, especially in urban areas. This growth, added to the lack of territorial planning and increasing poverty and inequality, determines the expansion of informal urban settlements. Basic infrastructure services coverage is not enough for the whole population and there are significant imbalances between and within countries. In 15 years, the demand for water grew by 76%. Pollution levels are increasing, and so are the impacts they have on health. Each year about 35 000 deaths are attributed to air pollution. New consumption patterns, together with economic growth, have increased per capita solid waste production in Latin America and the Caribbean. These aspects determine the challenges management must face if the Region's social and environmental vulnerability is to be reduced.

- **Poverty and inequality.** Poverty and inequality are the most serious challenges the Region faces. Where there is more inequality there is less capacity to reduce poverty. Thirty-five percent of the population (189 million people) are poor, while 14% are extremely poor. Their lack of access to essential services makes them vulnerable to environmental changes. It should be noted that in 2007-2008 a trend was observed towards better income distribution.

- **Trade.** Exporting natural resources and goods with little or no processing has enabled the Region to become a partner in international trade. Primary goods account for 73% of exports. In recent years increased trade between the Region and Asian countries, especially China and India, boosted agribusiness and the raw materials needed for biofuel production; this has had impacts on land use changes, pollution, and intensive use of water resources, among others. Foreign direct investment, that reached a record in 2008, plays an important role in exploiting natural resources for export, and in shaping production patterns.

- **Vulnerability to Climate Change.** While the Region's contribution to global emissions of greenhouse gases is only 11.8% (although rising), it is highly vulnerable to the effects of climate change such as rising sea levels, diseases and loss of species, among others. The Region's vulnerability is due not only to the increased frequency and magnitude of climatic events, but to the ever increasing exposure of the population, agriculture, fisheries, tourism, etc., to such threats. In this panorama, the Region's economies face the need for greater financial and technological resources to adapt to and mitigate the effects of climate change.

- **Energy:** In 35 years average electricity consumption quadrupled (from 427 to 1 688 kilowatt hours per inhabitant). In this context, energy production is facing serious problems that tend to escalate. There are countries with marked energy deficits that seek to increase their resources, often with a high degree of environmental unsustainability considering their great dependence on hydrocarbon-based energy production. The Region has significant potential to produce renewable energy and to promote energy efficiency. With more planning and more efficient energy consumption patterns, a platform for supporting economic growth could be formed without compromising sustainability.

- **Science, Technology and Innovation:** Research and development (R&D) investment has grown, although it is still insufficient in relation to what is needed. In the agricultural sector the structure of R&D expenditure, mostly with public sector finance, focuses on technology and less on how land is used and on controlling and protecting the environment.

  In recent years Latin American and Caribbean countries have also made progress in using Information and Communication Technologies (ICTs). The degree of advance varies depending on access to ICTs and shows that a digital gap exists between the more developed and less developed countries, as well as within countries.

- **Governance.** The management capacity of the Region's environmental institutions is limited not by the absence of laws - in recent years much legislation has been introduced ranging from environmental policy to sustainable management of ecosystems, wildlife diversity, forest resources or land and water - but by political weakness when it comes to enforcing them.

  In addition, and despite progress in establishing institutional and legal frameworks, the environment is still not receiving the policy and budgetary priority it deserves. Implicit short-term policies intensify environmental deterioration.

- **Civil Society:** Civil society organizations have a major role to play in denouncing environmental problems, as well as in correcting them. While persistent regional economic difficulties make it less likely that many people will participate in citizen organizations these, together with institutions of high education, play an important role in the environmental area. Today, their voice is an undeniable and indispensable part of the environmental debate.

1. Introduction

This chapter takes a retrospective look at the physical, socio-political and economic aspects that have driven the Region's development and at the consequences on human well-being.

This overview is divided into two sections. The first deals with the environmental complexity of Latin America and the Caribbean since the sixteenth century, defined by its development model based on a pattern of natural resources extraction; a model that has been sustained throughout the Region's history, with social and socio-environmental consequences. It also presents an analysis of the difficulties in developing an integrated series of strategies that allow structural changes to be made towards a more sustainable development model.

In the second section issues are dealt with such as demographic changes, demand for raw materials and trade, increasing globalization, climate change, technological development and socio-political and institutional aspects that are the driving forces conditioning pressures for environmental change. This section is intended to provide a starting point for analysing environmental impacts prevailing in the Region, as well as policy responses.

The entire chapter identifies substantive issues that show how Latin American and Caribbean society has developed; presenting also an overview that reflects both, significant challenges and opportunities for decision-makers.

2. Environmental Complexity of the Prevailing Development Model in Latin America and the Caribbean

The development model prevailing in Latin American and Caribbean countries at the beginning of the 21st century shows a complex situation as a result of the physical and social determinants that influenced the Region's historical development. The natural supply diversity of the Region is evident in its multiple ecosystems, biomes and components that have given it a predominant role as a supplier of natural resources. For that reason the heterogeneous nature of these territories is a premise that is difficult to avoid when analysing their environmental problems.

The Region's populations are also diverse with roots that long predate the European conquest and range from agricultural empires of different origins, forms and history – such as the Mayas, the Aztecs and the Incas – to small agricultural and harvesting societies inhabiting coastal, island, forest, mountain, and wetland regions. From these subjugated and mixed race societies, the present nations were formed in a long process from the sixteenth century onwards.

Many cultures, especially the imperial ones, survived, adapted and grew. Others disappeared for ever. All this became a mixture of peoples and environments, with their agreements and disagreements, whose complexity is reflected in the ecosystems that sustained them. Most of the world's existing life zones are found in Latin America and the Caribbean. This diversity ranges from the great Amazon Basin ecosystem, predominantly in the humid tropics, to the temperate-cold characteristics of Patagonia, passing from the Chaco, Páramo, Pre-puna, Puna, Cerrado, the high Andes, Paraense, Yungas, Pacific, Venezuelan, Atlantic, the Guyanas, Central Mexico, Pacific desert, Mexican desert, Central American highland, Central American Caribbean, the Espinal, South American mountains, the Pampas, the Central American tropics, Guajira, sub-Antarctic to the great Caribbean island ecosystem.

2.1 A historic look at the environmental complexity of Latin America and the Caribbean

American ecosystems have been exposed to human influence for at least some 14,000 years[1]. Even so, the contemporary Region's ecosystem, social and cultural extraordinary complexity dates from between 1500 and 1550 when Latin America and the Caribbean was included in the process of forming the modern world system as a supplier of food and raw materials, and as a resources reserve.

This model of inclusion in turn defines a long-lasting structure that operates at different times and with different models in at least four sub-regions, and with interactions between each of their social and natural systems. Thus, between the sixteenth and nineteenth centuries, and according to the fundamental way in which such interactions are organized, the following were created:

- *An Afro-American sub-region* built by slave labour, above all associated with –but not exclusive to– plantation activities.

- *An Indo-American sub-region* built by using different models of servile work –from land grants (encomienda) to peonage– especially for food production and mining.

- *A Euro-American sub-region* built by European immigrant populations in large areas of the Southern Cone, in which early industrialization processes often occurred from the first decades of the twentieth century.

- *A sub-region of vast marginal areas not directly included in the world market for quite a long period* –Araucanía, Patagonia, Amazonia, the Darien, the Mesoamerican Atlantic coast and Northeast Mexico– where a broad range of subsistence activities took place with relatively limited environmental impact.

Once national States were formed in the first half of the nineteenth century –in the Caribbean extending to the middle of the twentieth century– the transition to the twentieth century was made by forming labour and land markets by means of massive land expropriations and using non-capitalist production methods. This established the prerequisites for opening the Region to foreign direct investment and creating enclave economies in the framework of the so-called Liberal Oligarchic State. Subsequent cycles between 1930 and 1990 –conventionally described as populist, developmentalist, and neo-liberal– chart the course towards the twenty-first century.

In the process, new social groups emerged that were increasingly linked to the market economy; frontiers

1 *In this respect, see for example David Lentz, (2000).*

were expanded to exploit natural resources supported by greater technological complexity, and resulting in intensified environmental impacts; there was a notable de-ruralization and urbanization process, and all the societies in the Region experienced demographic transitions, while the environmental footprint of this combination of processes became increasingly extensive and more complex. In this context, our environmental history entered into a period in which conflicts about the environment –that is, those arising from the interest of different social groups to have exclusive use of shared ecosystems– play an ever more important role.

2.2 Development models or styles and dependence on natural patrimony

The development model –that mainly prioritizes economic policies over such classical macroeconomic variables as economic growth, monetary equilibrium, investment rates, inflation and exports– is the fundamental factor explaining the lack of success of environmental policies in the countries of the Region. These policies, by maintaining or intensifying social inequalities, seek to stimulate investment rates (national and foreign[2]) where there is limited demand.

The Region's economic history is, in effect, that of the use (and misuse in some instances) of its natural resources, from the mining exploitations and plantations of the seventeenth and eighteenth centuries to nineteenth century mono-export models, post-war industrialization processes, the period of privatization and structural reforms in the 1980's and 1990's. Furthermore, the current period is characterized by the rapid globalization of economies.

The results of this development model have been discontinuous and uneven. The Region has experienced periods of rapid economic growth accompanied by higher levels of well-being for the population, followed by others of limited and even negative growth with serious social and political consequences, and then by economic recovery processes with increased economic and social inequalities. All these combinations have shared a common factor: high levels of pressure, the progressive and sustained deterioration of the physical environment, and loss of ecosystems.

The structural heterogeneity that has been a feature of the Region's productive pattern during the past century and a half acquires special importance when analysing the environmental consequences of the development model[3] prevailing in Latin America and the Caribbean. Regional economies have tended to be organized around a sector directed at the foreign market and that receives national and foreign investment with the consequent, previously mentioned, environmental pressures. The rest of the economy, with low levels of investment and limited technology, demands a large amount of low productivity labour, and consequent low wages that reproduce and accentuate the unequal income distribution that is a feature of the Region.

2 *Even though it is known that most foreign direct investment (FDI), approximately 70%, is not meant to create new productive capacities but is used to merge and acquire companies. Of the little FDI directed at productive sectors, most os in sectors making intensive use of natural resources.*

3 *The concept of "structural heterogeneity", a term introduced four decades ago in the ECLAC study on underdevelopment, refers to the economic articulation of "advanced" or "modern" forms of production compared with "backward" forms of production. This is a division that ECLAC has recently reconceptualized with the idea of "three-speed economy": one of large national and international enterprises, public and private, with formal employment, more human capital and closer to the international technological frontier; intermediate-level enterprises with lower productivity; and a level of small and micro-enterprises with informal employment, a low level of capitalization and, nevertheless, that in the past decade has generated seven of every ten new jobs (ECLAC 2004).*

2.3 Environmental sustainability of the prevailing development model

Between 1950 and 1970 the economies of Latin America and the Caribbean showed sustained growth. However, environmental issues were almost absent from national strategies and policies, except for the traditional concerns about some renewable natural resources such as soils, native forests and certain fauna.

Signs that this situation was changing began to be seen at the beginning of the 1970's, following the United Nations Conference on the Human Environment, held in Stockholm in 1972. The theme of the environment began to appear with greater force and frequency on national agendas, although always subordinated to the priority of economic growth, and in response to our societies' demands coming "from outside and from above" rather than "from within and from below". Thus, at a time when the economic systems of the countries of the Region were affected by the change in the composition of international trade created by the emergence of novel technological paradigms and an almost unlimited credit supply, the need to find means to pay for the huge regional external debt led to unprecedented pressure on natural resources in order to increase exports and obtain needed foreign currencies.

In the light of a better environmental culture, it should be noted that the decade of the 1980's – the so-called "lost decade" – had two major negative effects on the environment: 1) creditor banks changed their policy because of the vulnerability of the economies of the Region's countries that caused an extraordinary readjustment effort to be made to be able to service the debt, resulting in a notable flow of economic resources abroad. This led to cuts in public spending which, added to the monetary expansion designed to finance it, stimulated inflation that exceeded 1 000 per cent by the end of the decade – and as a consequence increased unemployment, marginalization and poverty; 2) In this context, the environmental sector was affected by severe personnel and budget cuts at a time when, as never before, pressure mounted on natural resources, especially those that could be exported.

For their part citizen movements which, as in the previous decade, were confined to a small number of groups, began to gain public opinion legitimacy to the extent that their activities concerning the environmental consequences of the new economic policy tended to raise a more socially aware criticism about those issues.

At the same time, there was a more pronounced rejection in the Region of authoritarian regimes. Democratic regimes were gradually installed that kept their development models and encouraged the pursuit of macroeconomic balance, free markets, a reduced State role, deregulation, reduction of protectionist barriers, and the liberation of foreign investment regimes[4]. Thus, for the decade of the 1990's the expansion of the foreign market began to condition environmental control measures for trade, at the same time as global concerns about the environment were gaining strength in the Region.

However, this turnaround in the international system's environmental culture was not so much translated into broadening the social base of environmental organizations in the Region as in transnationalizing many of them through financial and programmatic dependency links with Non-Governmental Organizations (NGOs) in developed countries. For their part, all the States in the Region strengthened their environmental institutions with new laws and public bodies, from ministries of the environment to transversal commissions. This brought about a change from an essentially reactive policy to mixed policies of prevention and control; environmental impact assessment systems as well as regulatory bodies and control and superintendence institutions were established.[5]

Furthermore, to the pressures from old production processes and territorial occupation were added emerging environmental tensions that meant the process of environmental deterioration would remain on course, mainly due to: the inappropriate expansion of the agricultural frontier, especially towards the humid tropics; soil degradation caused by erosion, nutrient depletion and pollution; and the loss of biodiversity associated with habitat reduction. Continuing efforts to improve cities clashed with the pressures of their high growth rates, the rising demand for inputs and energy and increased waste generation.

4 *It is interesting to note that during the 1980's and the beginning of the 1990's, efforts to introduce better environmental regulations conflicted with a model where the State had lost its leading role, and even its ability to control had become weakened. Neoliberal orthodoxy imposed the idea that markets could regulate themselves. Whereas previously no environmental awareness had developed, during that period the greater awareness achieved clashed with an inability to make it a reality.*

5 *In spite of the above, in political terms it can be said that a significant part of what has been achieved in environmental institutional terms in the Region is due to the exporting sector's need to penetrate developed countries' markets. Because of the Region's political weakness, there is still very little capacity to influence its environmental movement.*

The neoliberal model resulted in a growing highly concentrated and denationalization process. The conflict between that development model and rising regional and global demands related to environmental sustainability and social equity became increasingly more evident following the World Summit on the Environment and Development held in Rio de Janeiro, Brazil, in 1992.

In this framework, preparing environmental strategies, creating specialized bodies, enacting laws, regulations and rules, and ratifying international agreements, have led to important advances being made concerning the environment. However, the lack of support in giving countries access to resources and technologies, and the difficulty of preparing transversal environmental policies, persist as significant challenges to effectively counteract the driving forces of the Region's economic model expressed in problems such as urban expansion and demographic pressures, as well as the generalization of production patterns that waste energy and materials, among others.

In the twenty-first century, the assumption in Latin America and the Caribbean is that the current economic model leads simultaneously to economic growth, social disintegration and environmental degradation, with a marked trend towards more income concentration and a less equitable share of the fruits of growth. In this context, social movements demanding more equity and greater citizen participation tend to become new types of political movements that voice majority demands for structural changes to allow societies to develop with more integration among themselves and in their natural environment.

Still, this has not yet been translated into a change in the dominant economic paradigms, although the widespread crisis that began in the United States in 2008 introduced a global debate that is questioning market self-regulation as a focal point around which to organize economies. In fact, it is since the crisis of 2008 and the publication of the Stern study that governments in the Region are taking stronger action on protecting and preserving the environment.

The lack of national environmental strategies to, first of all, assume and manage large environmental liabilities and, second, to develop sectorial and transversal policies to build a type of integrated development that improves the quality of life, corresponds to the growing number of environmental problems not being addressed either due to gaps in legislation, or to the lack of political will to implement satisfactory environmental management and control systems. Even so, the growing interest in addressing the environmental issue and its inclusion on the agendas of different sectors — national and local governments, civil and business organizations, universities and research centres – in many cases based on consensus and cooperation, presents an opportunity to address environmental deterioration and provide a basis for moving towards a more sustainable development model to internalize and consider the cost-benefit opportunities of protecting and preserving ecosystems, as well as the environmental services they offer.

3. Driving Forces and Pressures for Environmental Changes

Environmental changes and their effects on human well-being are caused by various driving forces and pressures. Specific driving forces such as demographic changes, the demand for raw materials and trade, increasing globalization, climate change, technological development and socio-political and institutional issues, result in pressures which, in turn, influence the state of the environment and have repercussions on the environment itself, on society and on the economy.

For example, most of the current pressures on Latin American and Caribbean ecosystems are the result of changes in emissions of greenhouse gases, land use conversions and patterns of resource exploitation (UNEP, 2007). The analyses made of the interrelationships shown by the driving forces-pressures-state-impacts-responses (DPSIR) model are the basis for making the GEOLAC assessment. Discussed below are the principal driving forces and pressures for environmental change in Latin America and the Caribbean.

3.1 Demography

The latest data show that in the period 1970 - 2009 the population of Latin America and the Caribbean grew by 295 million (51%), reaching a total of 581 million and, in turn, increasing the pressure for space for human settlements. By 2010, according to ECLAC (2008a) estimates, 79% of the population of Latin America and the Caribbean (about 470.5 million people) will be concentrated in urban areas and only 21% of the total population will live in rural areas (Figure1.1). These data show that the Region has tripled its urban population over a period of forty years which, according to the United Nations Population Fund (UNFPA) positions Latin America and the Caribbean as the region in the developing world with the largest proportion of this type of population.

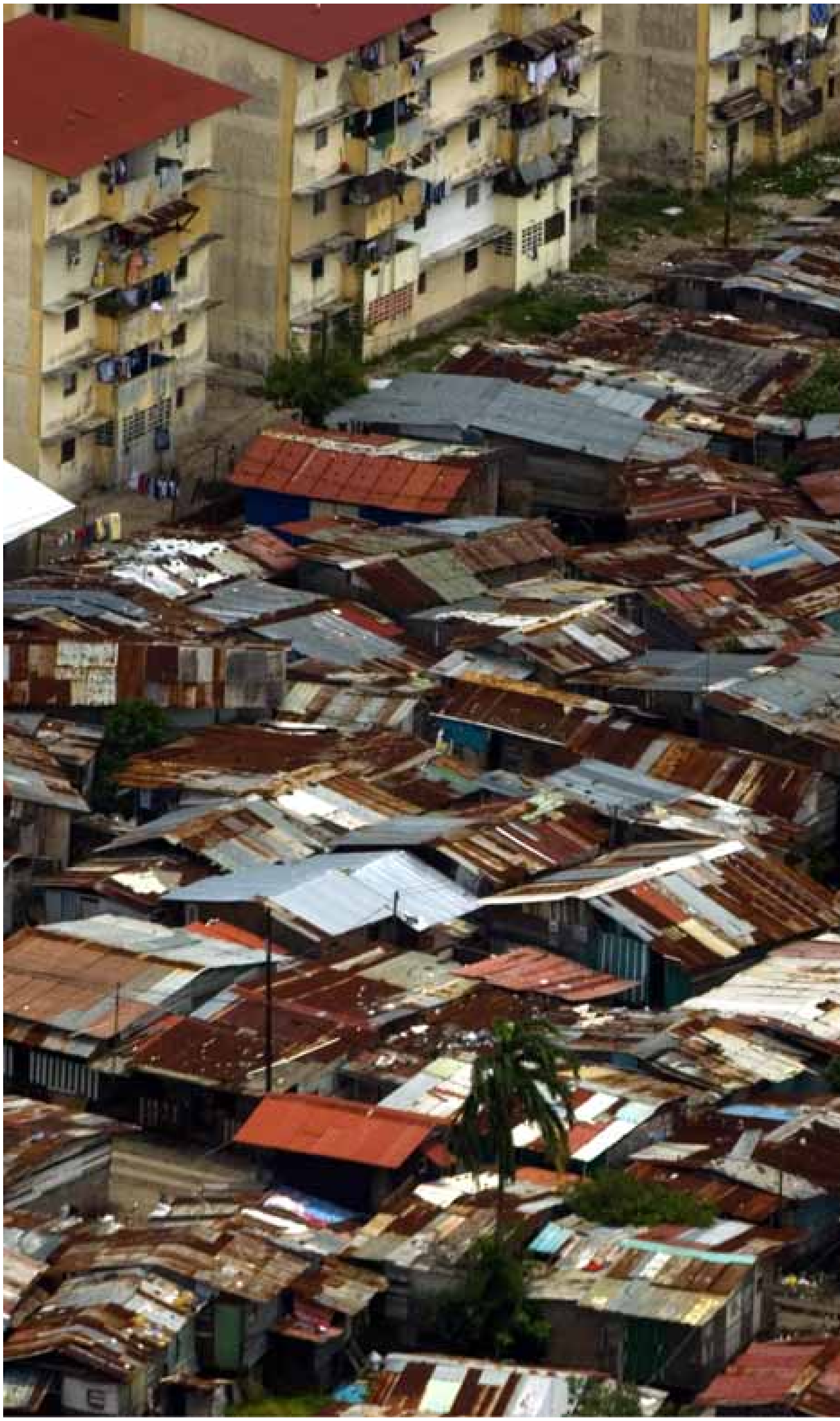
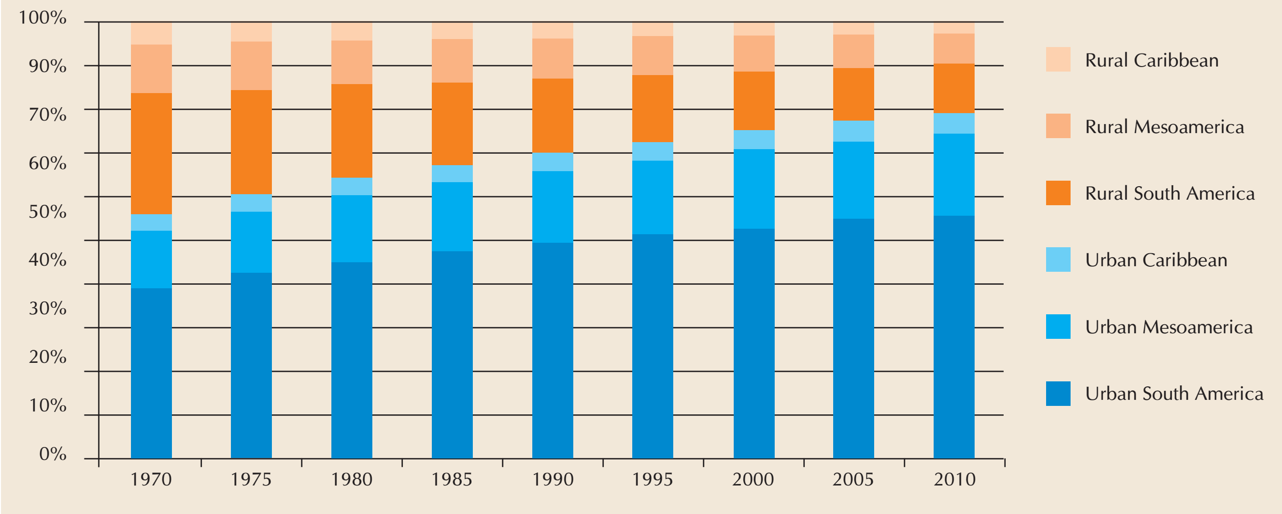


FIGURE 1.1

Latin America and the Caribbean: Urban and rural population distribution 1970-2010
(As a relative percentage from the total)



Source: Prepared by UNEP with statistics from the CEPALSTAT database. Consulted October 2009.

This continued growth of cities, especially of medium size (1 to 5 million inhabitants), aggravates the problems of urban demographic expansion while megacities (more than 10 million inhabitants) show serious conflicts and environmental risks. Some cities have increased levels of pollution and health impacts that demand greater management efforts be made on proper land use, water, solid waste, and transport (see section on urban areas in Chapter II).

Another problem intensified in cities is socio-spatial segregation, evidence of which is that 117 million (27%) people live in slums, although their overall growth rates have tended to decrease (UN-Habitat, 2008).

To the poverty and high-density characteristic of slums are added habitability and access problems, as well as a lack of infrastructure and public services such as potable water, sanitation, garbage collection and roads, thereby placing their populations in conditions of vulnerability and environmental risk

In 2006, access to potable water supply and improved sanitation basic services was, respectively, available to 92% and 78% of the population (United Nations, 2010). Worth noting are the significant imbalances both between and within countries. In most countries the percentage of electricity coverage is more than 90% in all cities (ECLAC, 2007a).

The demand for water in Latin America and the Caribbean increased by 76% (150 to 264.5 km^3/year between 1990 and 2004) as a result of population growth (especially urban), the expansion of industrial activity and the high demand for irrigation, factors that have affected both the declining quality of water resources due to pollution and the low percentage of sewage treatment (between 10 and 14%) (Biswas, 2006; UNEP, 2007).

Average daily water consumption per capita varies from 80 to 250 lit/inhab/day, giving an approximate figure for the whole of Latin America and the Caribbean of 150 lit/inhab/day (SUDAM/OAS, 1998; IDEAM n.d. The World's Water, 2001; WHO - UNICEF, 2007; INE, 2008). The demand for water for human or domestic use is 32.1 km^3/year, 12% of the total used by the Region (see section on water resources in Chapter II).

On the other hand, 35 000 annual deaths are attributed to air pollution in Latin America and the Caribbean, although the actual figure may be higher (CEPIS, 2005), making it a public health concern.

Results of a 2005 report by the Pan-American Centre for Sanitary Engineering and Environmental Sciences (CEPIS) take into account the association between morbidity and mortality and deteriorating air quality in major urban centres. In Rio de Janeiro (Brazil) it was observed that an increase of 10µg/m^3 in the concentration of PM_{10} results in a 1.84% increase in hospital admissions for respiratory causes. In Mexico City the same increase in particulate material corresponded to a 1.83% change in daily mortality. In

Santiago (Chile) the change is 0.75%, and in São Paulo (Brazil) 0.09% (see section on air quality in Chapter II).

New consumption patterns, coupled with economic growth, have led to an increase in per capita solid waste production in Latin American countries (UNEP and CLAES, 2008). For example, per capita solid waste production in the Region has doubled during the last 30 years, from 0.2-0.5 to 0.5-1.2 kg per day, with a regional average of 0. 92 Kg (ILAC, 2004).

3.2 Social situation: poverty and inequality

Poverty and inequality are the most serious challenges facing Latin America and the Caribbean (UNEP, 2007). When inequality increases it is less likely that poverty will be reduced. According to ECLAC estimates (2009c), 35.1% of the population, or 189 million people, live in poverty. It is also observed that 13.7% live in extreme poverty (Figure 1.2).

Similarly, countries in the Region show persistent inequality in income distribution, with an average Gini coefficient of 0.526[6] for Latin America and the Caribbean (ECLAC, 2009c). It should also be pointed out the clear trend towards better income distribution. In 2007-2008 the average reduction of the Gini index, compared with figures for 2002, was 5%. The indicator presented significant drops in several countries outstanding among

6 *Values close to zero indicate equality of income distribution. Typically, the index varies between 0.23 (countries like Sweden) and 0.707 (Namibia). For LAC, ECLAC prepares this coefficient for 18 countries based on special tabulations of household surveys in the respective countries.*

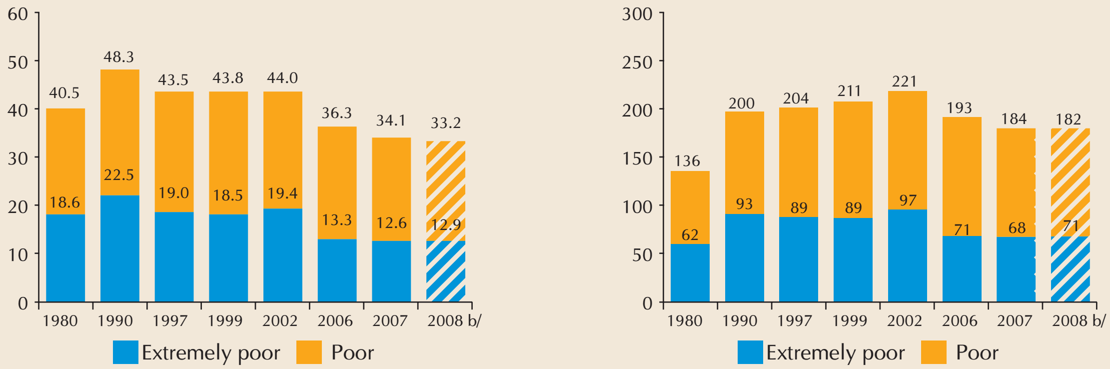
which are Venezuela (-18%), Argentina (-10%), Peru (-9%), Bolivia, Nicaragua, Panama and Paraguay (-8% in all of them). Only Colombia, Guatemala and the Dominican Republic showed increases in the concentration of income in this period (ECLAC, 2009b).

The economic growth in the Region from 2003 to 2007, with an average yearly per capita GDP growth of 3%, is the highest since the 1970's and has helped to reduce poverty. However, the onset of the international financial crisis marked the interruption of this phase of regional growth that began in 2003. The 2008 values take account of the slowdown in the process of poverty reduction and, in the case of extreme poverty, this translates into a reversal of what had been happening since 2002 (ECLAC, 2009b).

The decrease of 1.1 percentage points in the poverty rate in 2008 is significantly lower than the annual reduction of poverty that occurred between 2002 and 2007 and is the equivalent of 2 percentage points per year. As to extreme poverty, the rate rose by 0.3 percentage points, after having declined at a rate of 1.4 points per year. That poverty became worse was mainly due to the rise in food prices that resulted in an accelerated increase in the cost of the basic food basket (ECLAC, 2009b).

FIGURE 1.2

Latin America and the Caribbean: Evolution of poverty and extreme poverty, 1980-2009
(Percentage and millions of people)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on special tabulations from household surveys in the respective countries.
a/ Estimate for 18 countries in the Region plus Haiti. The figures on the upper sections of the bars represent the percentage and total number of poor people (extremely poor plus poor]

Notwithstanding the foregoing, the economic expansion experienced in recent years fundamentally responds to the increase in international prices of natural resources, also known as raw materials or commodities. Their intensified exploitation and export have produced rich dividends for many Latin American economies, net exporters of these commodities. This entails a challenge for the Region's economies: the need to change the production pattern for one that is more sustainable so that these social gains are consolidated as long-term permanent improvements.

The positive economic results achieved in recent years are highly vulnerable and affect the behaviour of the poverty and extreme poverty indicators. On the one hand there are cycles of sustained price increases of such foods as corn, wheat, rice and oilseeds, among others, because of a continued rise in world demand that influences consumer price indexes. These indexes accelerated in most economies of the Region during 2007, with cereals in different countries showing increases ranging between 6% and 20% annually. In 2007, cereals showed an increase of 41%; vegetable oils 60%; and dairy products 83%; and between March 2007 and March 2008 the selling price of wheat jumped by 130%.

As shown by the estimates in Table 1.1, increases of 15% in food prices could lead to 10 million people facing a growth in extreme poverty and poverty. This panorama is further complicated by the effects of fuel prices that have an impact on the cost of transport and various public services.

TABLE 1.1

Latin America and the Caribbean: Simulation of Food Price Increase on the Incidence of Poverty and Extreme Poverty, 2007 and 2008

	Percentages			Millions of people		
	Efective incidence	Simulted incidence[a]	Diference in percentage points	Efective incidence	Simulted incidence[a]	Diference in millions of people
2007						
Extreme poverty	12.6	11.9	0.7	67.8	64.2	3.6
Poverty	34.1	33.4	0.7	183.9	180.0	3.9
2008 (projection)						
Extreme poverty	12.9	10.9	2.0	70.8	59.6	11.2
Poverty	33.2	31.2	2.0	181.6	170.7	10.9

Source: *Economic Commission for Latin America and the Caribbean (ECLAC), based on special tabulations from household surveys in the respective countries.*
a-It is assumed that the rise in food prices was equal to the rise in CPI for the other goods and services from December 2006]

3.3 Growing globalization

Since the 1980's, the Region's economies are directed at external markets, especially those in developed countries and in the new economic powers in Asia such as China and India. In developing countries international trade has become an engine for growth. Technological improvements have reduced transport times between countries to unprecedented levels, while the opening up of financial markets has spread speculative activity in the capital markets, increasing their vulnerability as they expand, as well as economic insecurity.

The development model prevailing in the Region focuses on economic growth based on: natural resources and natural patrimony; increasing the product as a central objective; production directed at external markets; the demand for investments in production sectors with high demand of natural resources as the focus of macroeconomic policy. In this context, differences between countries in the Region are not caused by alternative development models, but by the role they play in the market and the State as economic regulators, re-distributors and/or producers, without any relevant questioning of the structural foundations or of the role of natural resources in the economic process.

Globalization is also seen in other dimensions such as integration of knowledge through the exchange of information, culture and technology. It is also recognized that environment and globalization are intrinsically linked. Resources are fuelling economic growth and trade. Solutions to environmental crises like climate change demand coordinated action and a greater globalization of governance (UNEP, 2007).

3.4 Economic Growth

Between 2005 and 2007 average annual growth was close to 5% (IMF, 2008). An important part of this was in the economies of China, India and Russia with growth rates of about 11%, 9% and 8% respectively in 2007. It is estimated that emerging economies now contribute with around 60% of annual global growth (ECLAC, 2007a).

Notwithstanding the above, in 2008 the favourable economic cycle trend was broken by serious economic and financial turbulences that had major impacts on developed countries' economies (see Box 1.1). Leading this deceleration were the developed economies which, for the first time since the post-war period, would contract by approximately -0.3%.

Latin America and the Caribbean continue to intensify the trade and economic opening that began in the late 1980's. Today, the Region's economies, especially the small and medium ones, are more open than in the

BOX 1.1

Origins of the World Economic Crisis

"…The origins of this crisis that affects the world's principal financial markets is explained by: i) the outbreak of the subprime mortgage crisis which started in the United States in 2007 and produced a recession of that country's and the world's economy; (ii) the weakening of the dollar during the first half of 2008 and the sustained demand by emerging economies that abruptly raised oil and food prices and accentuated speculative movements and volatility in those markets, thereby increasing concerns about inflation; (iii) the backlash of the subprime mortgage crisis that triggered a series of bankruptcies and shake-ups in the financial industry in the United States and Europe and in late September 2008 toppled the United States investment banking sector that had led the way to engineering the principal financial innovations of the global economy, and threatened an international financial crisis. Finally, fears of recession have led to a fall in raw material prices, especially of oil, copper and other commodities of regional interest.

In short, the subprime mortgage crisis is a case of a real estate bubble in the United States which, when it burst, sent ripples through financial institutions that had large amounts of assets locked into the payment of those mortgages. The resulting losses increased the institutions' debt and reduced their capital, limiting their capacity to meet the economy's credit needs. In view of this situation, they proceeded to sell off assets, thus accentuating their drop in price and consequently their own debt and capital difficulties. This downward spiral triggered a loss of confidence among the banks themselves, which sparked a credit crunch and set the stage for the failure of financial giants that had imprudently saddled themselves with excessively risky operations and short-term financing. At this point, it became absolutely indispensable for the State to step in to restore confidence and normalize financial flows."

Source: ECLAC (2007). "Panorama of the International Insertion of Latin America and the Caribbean. Trends 2008."

1990's. According to ECLAC estimates, the Region's GDP fell by 1.8% in 2009 after six years of growth, having registered a rate of 5.8% in 2007. This growth was underpinned by an expanding domestic demand that boosted imports while exports grew by 5%, a figure below the GDP growth in the Region, a situation seen for the first time in six years. Also to be noted is the 6% inflation in the Region in 2007, the lowest since 2002 (ECLAC, 2008b).

Unlike the 1990's, the increase in the Region's exports after 2001 responds to an effect of prices rather than of quantities. The effect of prices prevailed in countries exporting mining products and petroleum. Also worthy of note is more diversification of Latin American economies' exports although these are fundamentally founded on basic raw materials and manufactures based on natural resources. Two specialization patterns may be pointed out: In South America based on natural resources; and in Mexico, Central America and the Caribbean based on intensive labour sectors.

3.5 International trade

The commercial success of Latin America has become a determining factor in explaining current pressures on natural resources in areas ranging from mining and hydrocarbons to the expansion of the agricultural frontier and deforestation.

As Latin America has specialized in exporting natural resources concentrated on a few products, the result is heavy dependence on international markets. This is explained by the commodities super cycle given that increases in international prices of minerals such as copper, or grains such as soybeans, trigger an increase in production within the Region. These dynamics, therefore, are highly dependent on current globalization.

In turn, economic and technological development and population growth mean an ever closer relationship between trade and environment. The technological development of telecommunications and transportation has laid the groundwork for trade expansion which, because of its material base, demands more intensive use of natural resources, and places huge pressure on them. The lack of adequate policy and institutional frameworks results in predatory behaviour by operators seeking to maximize profits, with devastating consequences for ecosystems and, in general, for environmental sustainability.

A look at the present world economy highlights three challenges that are somehow closely linked and have an inseparable economic and environmental dimension: climate change; oil prices volatility and increased consumption; and the agrofood crisis. Technological and economic development based on oil has led to unsustainable levels of pollution that damage the population's health and have serious consequences on ecosystems (see section on atmosphere in Chapters II and III of this report).

3.5.1 The role of Latin America and the Caribbean in world trade

While the Region plays a modest role in world trade (the value of its exports has remained around 10–12% of the global total), in recent years a small rally has been reported, although this is due in particular to the increased value of commodities (Figure 1.3).

This role in world trade explains a related tension: on the one hand, international trade has key effects on land use and ownership of natural resources in Latin America and the Caribbean but, on the other, the Region lacks the instruments or does not have enough economic weight to decisively influence global trade. Indeed, the determination of the main products traded is made in places and by stakeholders from outside the Region (for example, the Chicago Mercantile Exchange).

3.5.2 Nature of exports: demand for raw materials

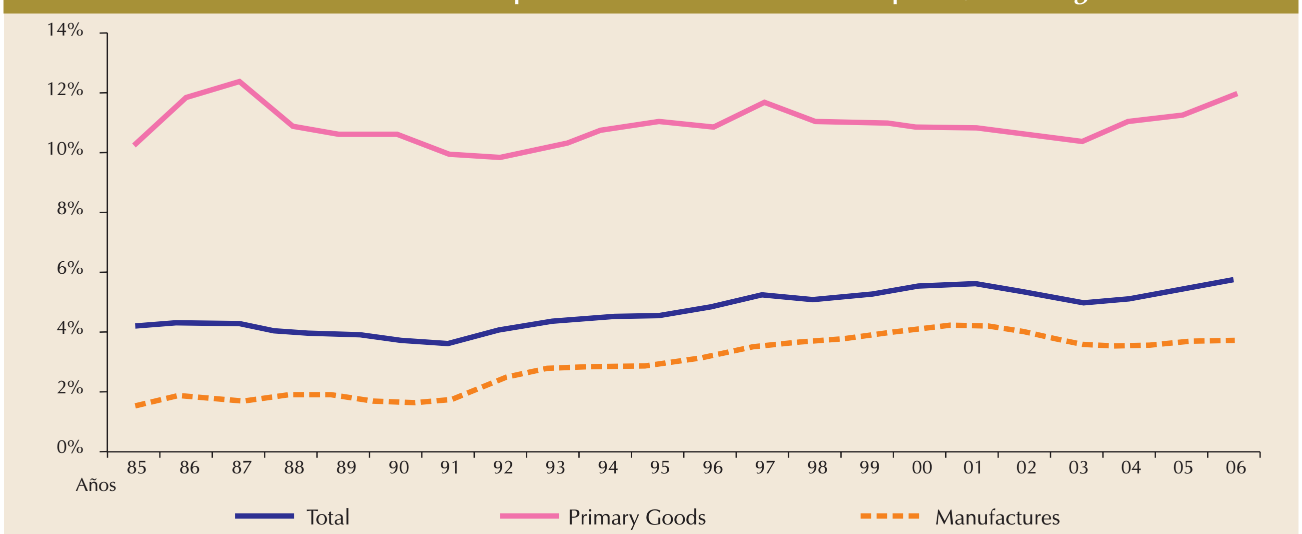
The confluence between the current dynamics of globalization and the development styles followed on the continent means that natural resources play a key role in supporting Latin American exports. Indeed, the international integration of the Region, especially in South America, is determined by a pattern where natural resources are seen to account for over half of total exports. These are mineral, hydrocarbon (notably natural gas and oil), agricultural and livestock, forestry and fishery products with little or no processing.

Approximately 54% of exports are raw materials. However, there are important sub-regional differences with Mexico showing a pattern of exports strongly linked to manufactures (about 74%). Therefore, excluding Mexico, it is seen that of the remaining Latin American exports, almost 73% are commodities based on natural resources. In some countries, exports of primary goods exceed 95% of total exports (Table 1.2).

Another aspect to consider is that raw materials exports have "embedded" components of energy and water appropriation. For example, there is growing concern that the water content in soybean plants is irreparably

FIGURE 1.3

Latin America and the Caribbean: Participation in the value of world exports *(Percentages)*



Source: Machinea, L. and Kacef, O. 2008. Latin America and the Caribbean and the new international economic scenario. ECLAC, Santiago.

TABLE 1.2

Latin America and the Caribbean: Exports Composition and Geographical Distribution in 2006 *(Percentage of total exports)*

	Total exports composition (% of total)	Geographical Distribution	
		Developed Countries	Emerging Economies
Latin America (19)			
Primary goods	54.2	57.9	42.1
Manufactures	44.6	71.5	28.5
Total	**98.9**	**63.6**	**36.4**
Latin America excluding Mexico (18)			
Primary goods	72.9	51.1	48.9
Manufactures	25.7	35.8	64.2
Total	**98.6**	**46.5**	**53.5**

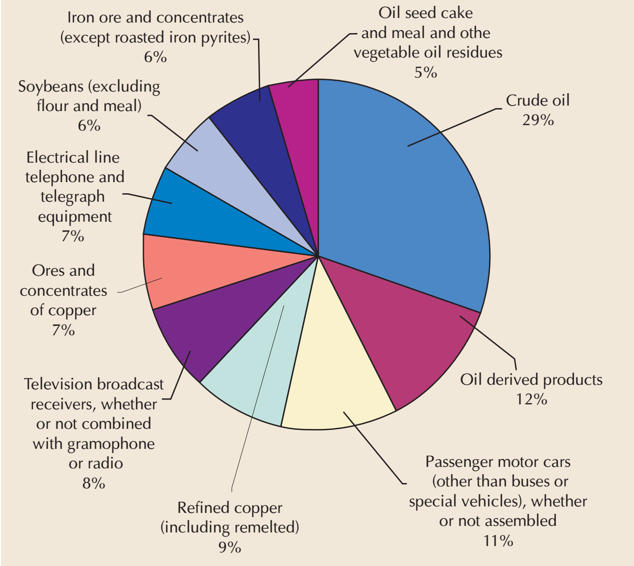
Source: ECLAC, 2007. "Panorama of the International Insertion of Latin America and the Caribbean. Trends 2008."

lost. In 2004 imports in China totalled 18 million tonnes that consumed 45 km^3 of water (a huge volume that represents two-thirds of global water consumption) (UNEP and CLAES, 2008).

A dependence on a few products is also observed. In effect, the 10 principal export products of most countries are primary mining and agricultural goods. At regional level, the main products exported are crude oil and its derivates (Figure 1.4). Brazil, El Salvador, Argentina and

FIGURE 1.4

Latin America and the Caribbean: Exports of the 10 principal products [(1)], according to Percentage Participation. 2008



(1) According to Standard International Trade Classification (SITC)
Source: Prepared by UNEP based on ECLAC Statistical Yearbook for Latin America and the Caribbean, 2009d.

México are the countries with higher diversification of their exports.

The Caribbean, meanwhile, is an "expensive" agricultural producer because of labour costs, the small size of the islands and the difficult terrain, making this sub-region uncompetitive in this area (Laurent, 2006). In one decade the countries of the eastern Caribbean stopped basing their economy on products and goods (about 66%, mainly bananas and sugar) to become a predominantly service-based economy (about 80%). In Cuba and the Dominican Republic tourism-related services make up the bulk of exports of services (Machinea, 2007).

The role of these commodities in the global economy has changed substantially in recent years. The increase was greater in sub-regions exporting minerals or agrofood; in South America the increase was about 52%.

In Mexico, which is essentially an exporter of manufactures, the increase was 21%, while in Central America it was only 14%. These changes are also being affected by growing South-South trade, as South American countries find new export destinations in Asia for their natural resources, while the Central American nations (and to some extent Mexico) have reduced their exports to the U.S. and other industrialized nations where they have been displaced by Asian products.

3.5.3 The role of Asia in Latin America and Caribbean trade

A key factor is the role of China and other countries in south-east Asia in buying Latin American raw materials such as copper or soya. The increasing demand for inputs from emerging economies like India and China has had a noticeable impact on the Region's exports. In 2000 trade between Latin America and China reached US$13 000 million; in 2007 it was US$103 000 million. In addition about 50% of China's foreign direct investment went to the Latin American and Caribbean Region. Latin American trade with India, though still modest (US$3 000 million in 2005), shows consistent growth and has enormous potential.

Consumption in Asia, and particularly in China, explains the continued commercial importance of extracting natural resources. In fact, since 2001 there has been a substantial increase in Chinese imports of all commodities. In 2007 goods imported from Latin America and the Caribbean were mainly soya (grain and oil), followed by copper ore (gross, concentrate), copper alloys, fish meal, leather and paper pulp (SELA, 2009).

This has significant environmental consequences since it tends to accentuate a development style that puts great pressure on natural resources. Actually, the increase in raw material prices and expectations of sustained or even increasing demands causes or aggravates pressure to extract more natural resources.

Moreover, demand from Asian countries reinforces exports of resources whose exploitation causes serious environmental impacts; they include coal, hydrocarbons, steel, copper, cement and other energy raw materials. This demand is generating significant changes in the energy and other markets such as agriculture, to produce biofuels.

3.5.4 Agricultural trade

Agroindustry has also had a strong rally in the Region due to increased global demand and international prices for both agrofoods and raw materials to produce biofuels.

It is currently estimated that the Region has some 720 million agricultural hectares (ECLAC, 2007b).

Production is being reshaped by an expansion of oilseeds, especially soya, while there is stagnation in some grains and a reduction in such traditional products as coffee and cocoa. There is also an increase in sales of meat –beef, pork, and poultry– that creates additional demand for grain for animal feed.

Given the changes in land use for agricultural production, the emphasis placed on agricultural exports involves a number of risks. Latin America and the Caribbean has one of the world's highest rates of deforestation and habitat loss; between 2000 and 2005 about 64% of global forest loss took place in the Region (FAO, 2007) (see section on forests in Chapter II), with South America suffering the largest net loss of almost 43 thousand km^2/year (FAO, 2007). This is also compounded by problems such as soil and water pollution resulting from using agrochemicals, the loss of soil quality, desertification, and intensive use of water resources for irrigation.

At least ten countries: Argentina, Bolivia, Brazil, Colombia, Ecuador, Guatemala, Honduras, Mexico, Paraguay and Peru, produce biofuels, and four countries export biofuels produced from their own crops with Brazil being the largest exporter. There are smaller sales from Bolivia and Guatemala and, recently, from Argentina. Because programmes are underway in almost all countries the list of producers is constantly increasing (CLAES, 2007).

The expansion of this sector involves a wide range of environmental and social impacts. The growing use of cereals, sugar, oilseeds and vegetable oils to produce fossil fuel substitutes such as ethanol and biodiesel, for example, leads to the agricultural frontier expanding onto wilderness areas. This affects biodiversity by reducing those areas and fragmenting the remaining ecosystems, whether by agricultural intensification on land occupied by large-scale monocultures that cause agrochemical pollution, water cycle changes, or by the loss of soil quality.

In addition, production meant for agrofuels would cause social impacts by directly increasing the price of basic foodstuffs - some with deep cultural roots such as maize in Mesoamerica - while the causes would be indirect in such cases as rising prices of livestock products, given grain prices increase.

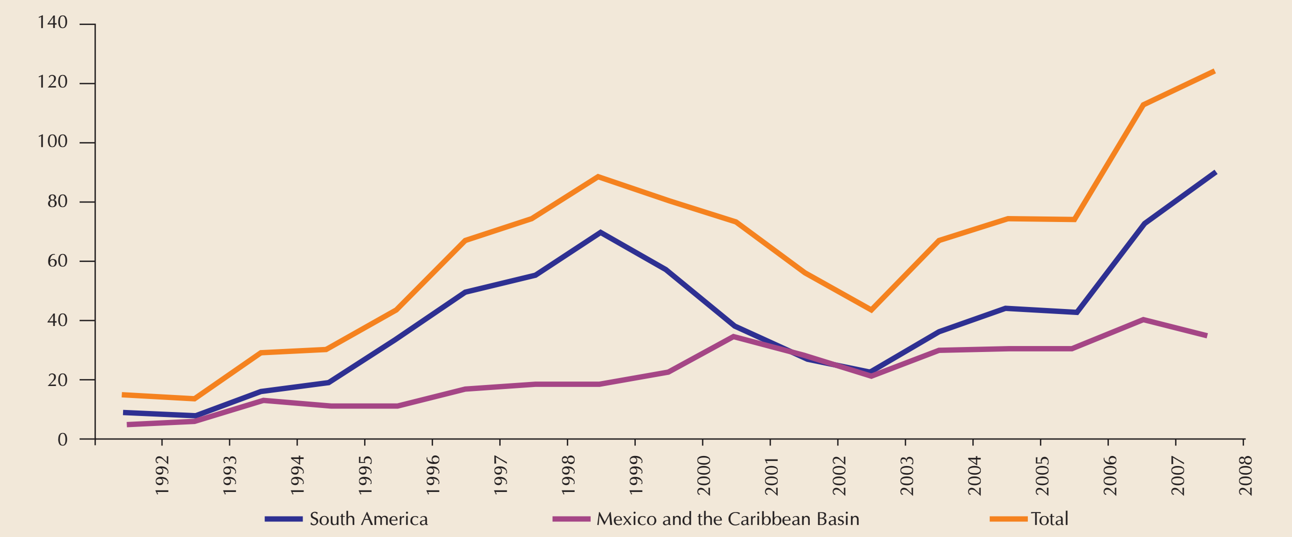
3.5.5 Foreign direct investments

As to foreign direct investment (FDI), this shows an upward trend that has been occurring since 2003 and reached a new historic record in 2008, in spite of the world financial and economic crisis when, excluding financial centres, the Region received US$128 301 million (Figure 1.5).

The current expansion of foreign direct investment not linked to privatization processes, unlike the 1990s. Also

FIGURE 1.5

Latin America and the Caribbean: Net foreign direct investment by sub-region, 1992-2008
(Thousands of millions of US$)



Source: ECLAC: Direct Foreign Investment in Latin America and the Caribbean, 2008b.
a- Principal financial centres not included

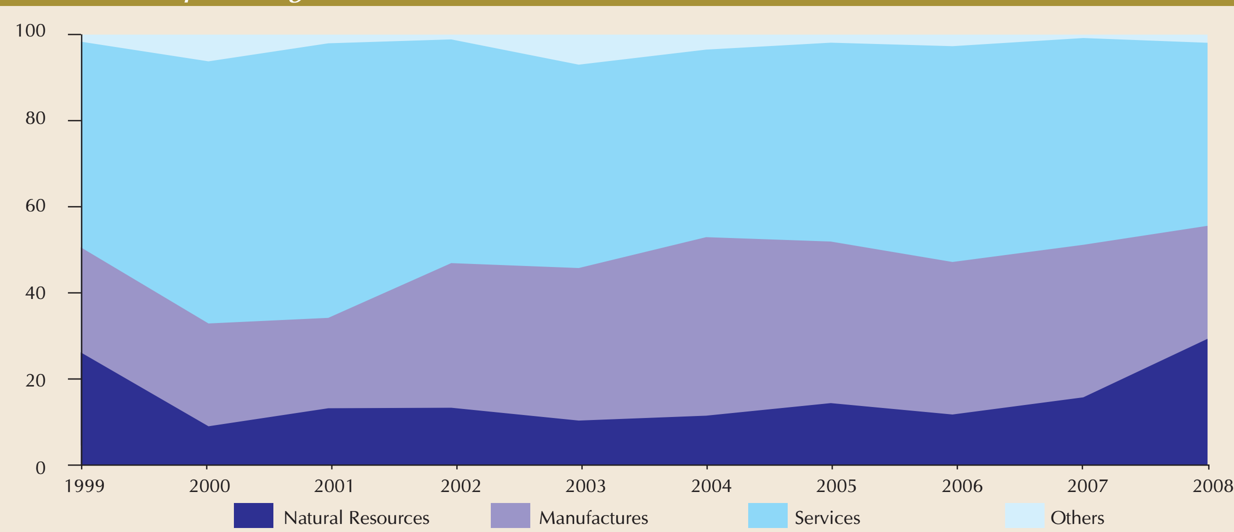
notable is the Region's greater participation in global FDI flows where it grew by 46% compared to the world growth of 36%. This is more significant considering the expansion took place when the Region's largest trade and investment partner, the United States, had suffered a slowdown of its economy since late 2006, with a strong effect on regional markets' dynamism and the diversification of exports, especially to the Asian market with its high natural resources demand (ECLAC, 2007a). The service sector is the largest recipient of FDI in the Region with increased investment in natural resources in 2007-2008 (Figure 1.6). Most natural resources investment is concentrated in South American countries; and FDI to improve export efficiency has helped to transform industry in some countries, primarily Mexico and in the Caribbean Basin, by making their manufactures more internationally competitive.

While FDI in Latin American and Caribbean countries has played an important role in implementing projects to exploit natural resources for export, with environmental consequences, it also helps to transfer knowledge and technology and to train human resources (ECLAC, 2009b). This is relevant in terms of sectorial allocation of FDI in assisting national efforts to introduce less polluting production systems.

A fundamental role has been played by foreign direct investment in shaping different export profiles. As Mexico attracts investment towards sectors with medium and high technological content this helps the country to set a cleaner export standard. In other cases, such as Chile, Peru or Venezuela, the impact of FDI has been a factor in reinforcing an even more polluting export pattern.

FIGURE 1.6

Latin America and the Caribbean: Evolution of the Sectorial Destination of Foreign Direct Investment 1999-2008[a] *(In percentages)*



Source: Economic Commission for Latin America and the Caribbean (ECLAC) based on official data of 15 May 2009
a Data from the Plurinational State of Bolivia represent net flows given that it is not known in which sectors disinvestments registered by the Central Bank took place.

3.5.6 Environmental trade and negotiations

With reference to environmental issues in trade negotiations, the United States and the European Union, the Region's main trading partners, include the theme in the agreements they sign, although in different ways. Two positions are seen among those opposed to including environmental issues in trade agreements: those who believe that the agreement is not strong or comprehensive enough concerning protection and want it to be a mechanism that meets national environmental standards; and those who see the issue as a non-tariff barrier and which, therefore, should not be part of the agreement. However, including the environmental theme in trade agreements is to recognize that both issues are closely related.

On the theme of market access and the environment, the current trend in developed countries is to establish stricter environmental and health regulations; particularly striking is that most of these requirements come from the countries' private sector. According to the rules of the World Trade Organization (WTO), provided they do not discriminate countries have a sovereign right to establish their own requirements concerning products entering their markets, and this is what is happening; if the countries of the Region want to export to such markets they must meet their requirements. An example of this is EurepGAP, a programme that establishes a set of social, labour and environmental conditions for products sold by the supermarket chains taking part in this programme. The consequence is that producers and exporters in the Region have had to invest and adapt their production and marketing processes to these new standards.

Environmental cooperation programmes that focus on strengthening developing countries' institutional environmental capacities are often included as complements to trade agreements. These programmes contemplate technical assistance, financial and business incentives for better environmental management.

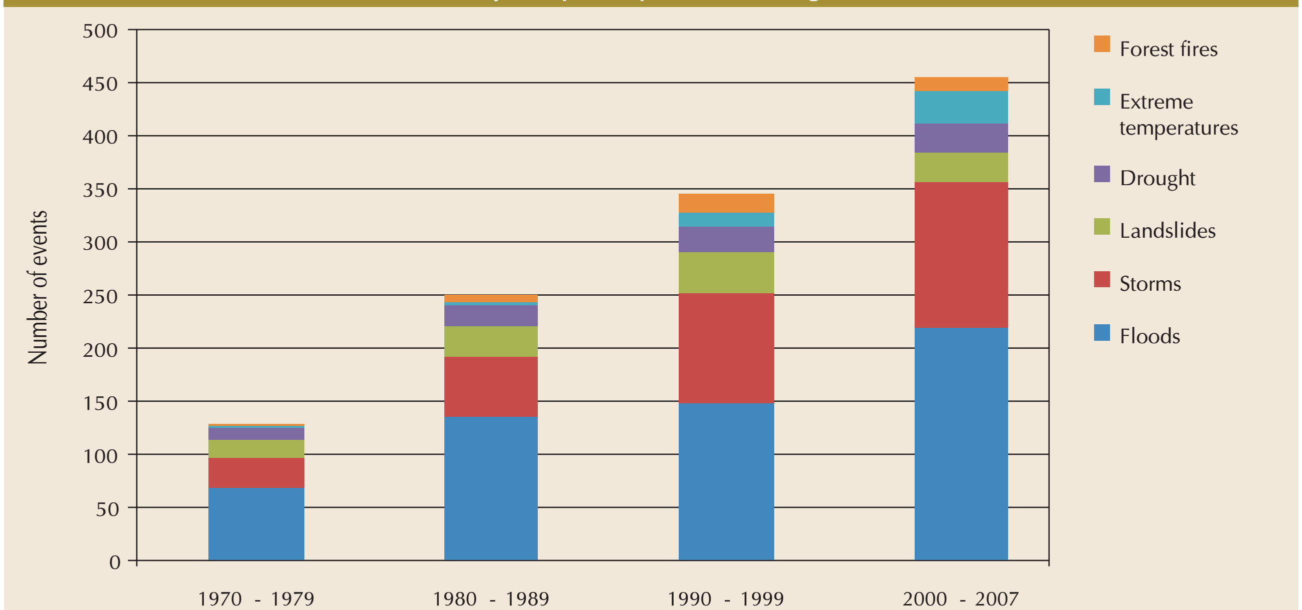
The WTO has taken some substantive steps among which mention should be made of: the search for a link between trade disciplines and the obligations imposed by multilateral environmental agreements; initiating a discussion on environmental goods and services; defining transparent procedures for invoking environmental measures such as restrictions on international trade so that they are not disguised barriers; and engaging in a robust debate on agricultural trade that has a significant impact in Latin America. Various aspects of this discussion are currently underway within the framework of the WTO Doha Round. Furthermore, within the WTO framework Latin America and Caribbean countries have developed and strengthened several complementary or trade liberalization agreements.

3.6 Climate change as a driving force for environmental changes in the Region

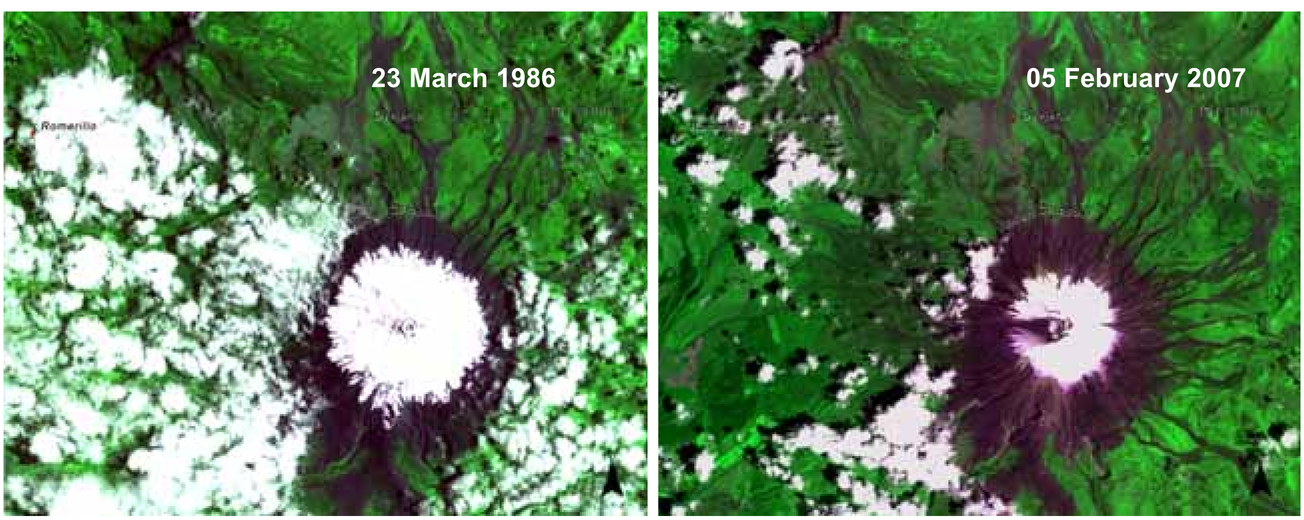
*It is now recognized that climate change i*s a major global challenge that will have significant and lasting impacts on human well-being and development (IPCC, 2007a; UNEP, 2007). There is conclusive evidence about climate change impacts, such as an increase in the Earth's average temperature by about 0.74°C over the past century. Various phenomena indicate the impact that global warming has had in the Region, including increased intensity and frequency of hurricanes in the Caribbean, changes in precipitation distribution patterns and intensity, changes in temperature levels, more droughts (Figure 1.7 and Map 1.1), increased sea level rise in coastal areas of South Atlantic countries, melting glaciers in Patagonia and the Andes, and ice sheet losses in West Antarctica (UNEP, 2009; Magrin and others, 2007; UNEP and SEMARNAT, 2006).

FIGURE 1.7

Latin America and the Caribbean: Frequency of Hydrometorological events, 1970-2007



Source: Prepared by UNEP with data from ECLAC, 2009a.



***Glacier Retreat:** Cotopaxi, Ecuador: Over the past 50 years, the glaciers of Cotopaxi and Antisana have shown a reduction of between 35 and 40 percent (equivalent to about 70 km²), partly because of climate change. Glacier melting and the decrease of water resources, the threat of mudslides and debris flows convert the Cotopaxi´s glacier retreat in an issue of importance to Ecuador. The Landsat satellite images show the reduction in the volume of the glacier (white layer) on the slopes of Cotopaxi volcano, over the period 1986-2007. Source: UNEP (2010). The LAC Atlas of Our Changing Environment.*

MAP 1.1

Latin America and the Caribbean: summary of projected climate change patterns to 2010

Source: Adapted by J.S. Contreras from ECLAC in Economics of Climate Change, 2009a

The Region's vulnerability is not only due to more frequent climatic events but also to the population's ever greater exposure to these threats of the population, agriculture, fisheries, tourism, etc. (Andean Community, 2008). In the Caribbean alone more than 26 million people were affected by natural disasters from 1950 to 2007 when nearly 22 000 deaths were recorded (UNEP, 2008). As to economics, ECLAC (2009a) indicates that in the period from 1970 to 2008 hydro-meteorological events in Latin America and the Caribbean were responsible for accumulated economic losses of US$81 000 million.

Paradoxically, the Region has minimum responsibility for one of the main causes of global warming because, in spite of its area and large population, it accounts for only 11.78%[7] of emissions of greenhouse gases (GHGs). However, the total volume of CO_2 emissions in Latin America and the Caribbean has increased steadily since 1990. Although they vary greatly between countries (Figure 1.8), CO_2 emissions per capita between 1990 and 2006 remained between 2.5 and 3.5 tonnes, well below levels in developed countries (ECLAC, 2009a) .

Data from the Intergovernmental Panel on Climate Change (IPCC) predict even more disturbing future situations. In 2007 it projected that sea levels could rise by between 18cm and 59cm in this century, and many researchers now believe that the sea level increase will be even greater –between 0.8 and 1.5 meters– in part as a result of new assessments of the physical fracture potential of the Greenland and Antarctica ice sheets (UNEP, 2009).

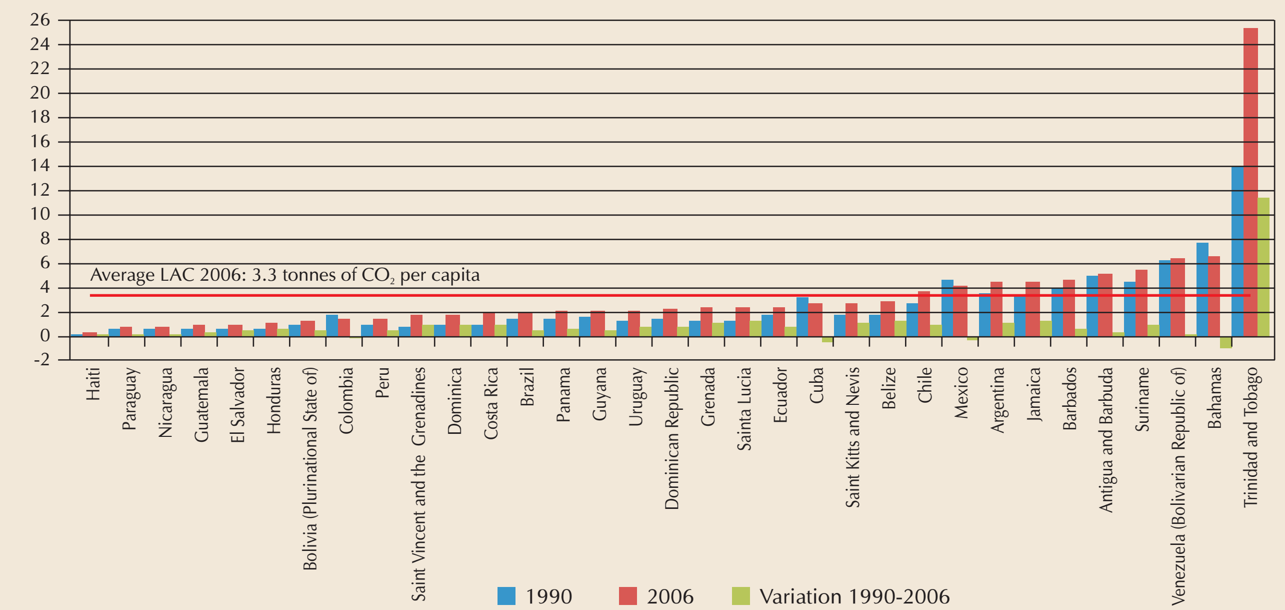
The recent report on advances on the environmental sustainability of development in Latin America and the Caribbean (United Nations 2010) highlights the findings of the Stern report on the need to halt the increase in concentrations of greenhouse gases (GHGs) to stabilize the range at between 450 to 550 parts per million (ppm) by the end of the century, resulting in a global increase in temperature of between 2 and 3°C. Beyond this threshold, the margins of change of all the planet's systems would offer little or no adaptation alternatives.

In this sense it could be argued that the current financial and economic crisis –although evidently transitory– has had a positive effect on reducing GHGs. Recent

7 *Emissions of GHGs in LAC were 11.8% of the world total in 2000, including those from land use changes (ECLAC, 2009a). The Region emitted relatively little, and emissions due to land use changes were a relatively high percentage of GHGs regional emissions (the share of LAC in annual global emissions of GHGs in 2000 was estimated at 5.4% excluding the land use source).*

FIGURE 1.8

Latin America and the Caribbean: Emissions of CO_2 per capita, 1990, 2006
(Metric tonnes of CO_2 per capita and variation percentage)



Source: United Nations, 2010 Prepared by ECLAC with statistics obtained from the UN MDG official site based on data compiled by Carbon Dioxide Information Analysis Centre (CDIAC), and includes emissions from burning fossil fuels and cement production. On line: http://mdgs.un.org/unsd/mdg/Default.aspx. Consulted September 2009.

statements by the International Energy Agency (IEA) (EFE, 2009) indicate a 3% reduction of such emissions in 2009, the most pronounced in the last 40 years, which would cause the volume of emissions in 2020 to be 5% lower than the 2008 IEA estimate.

Magrin and others (2007) note that, according to different IPCC climate models, the average temperature increase projected for Latin America by the end of the century varies from 1 to 4°C for scenarios that contemplate certain levels of emissions mitigation, and from 2 to 6°C for scenarios that do not make such predictions.

The IPCC report estimates, with a high degree of confidence, that under future climate change there is a risk that ecosystems will lose between 20% to 30% of the species at risk of extinction, and it is very likely that increases in mean sea level, climate variability and extremes will affect coastal areas, and cause adverse impacts on low-lying coastal areas, including destruction of mangroves, coral reefs (especially in Mesoamerica and the Caribbean). The availability of drinking water on the Pacific coast of Costa Rica, Ecuador and the Río de la Plata estuary, among others, would also be affected. These impacts are discussed in greater detail in Chapters II and III of this report. Small Island Developing States (SIDS) of the Caribbean are particularly vulnerable to climate change effects such as rising sea levels and extreme weather events (IPCC, 2007).

The reaction to the consequences of climate change can become a driving force that could underlie another driving force. The Region's traditional environmental problems are being distanced from the main focus of the strategies because of pressure from developed countries and by concentrating financial resources almost exclusively on climate issues. It is obvious that, because less attention is paid by the climate change hierarchy to issues such as deforestation, biodiversity loss, and soil degradation, this could have a negative effect on the environmental sustainability of the Latin American and Caribbean territory.

On the other hand, if used intelligently, the concern about climate change can become a positive driving force to help reduce the Region's present environmental unsustainability. This can, and would, happen if the resources meant to moderate the effects of climate change were systematically focussed on including the above-mentioned environmental issues within climate change mitigation and adaptation strategies.

Examples of the above are the projects registered with the Clean Development Mechanism in which the

countries with the greatest participation are Brazil, Mexico and Chile, and in which the Region as a whole has 838 projects, 17% of the world's total. These would account for 13.5% of the total emission reductions expected by 2012 (UNEP-Risoe, 2010).

While most projects are related to reductions in the agricultural sector (agro-industrial methane wastes), renewable energies (biomass) and landfills, it is expected that projects relevant to the Region addressing issues such as wind power sources, the efficient use of fossil fuels, forests and soil conservation, reforestation and urban public transport reorganization will be strengthened.

3.7 Energy

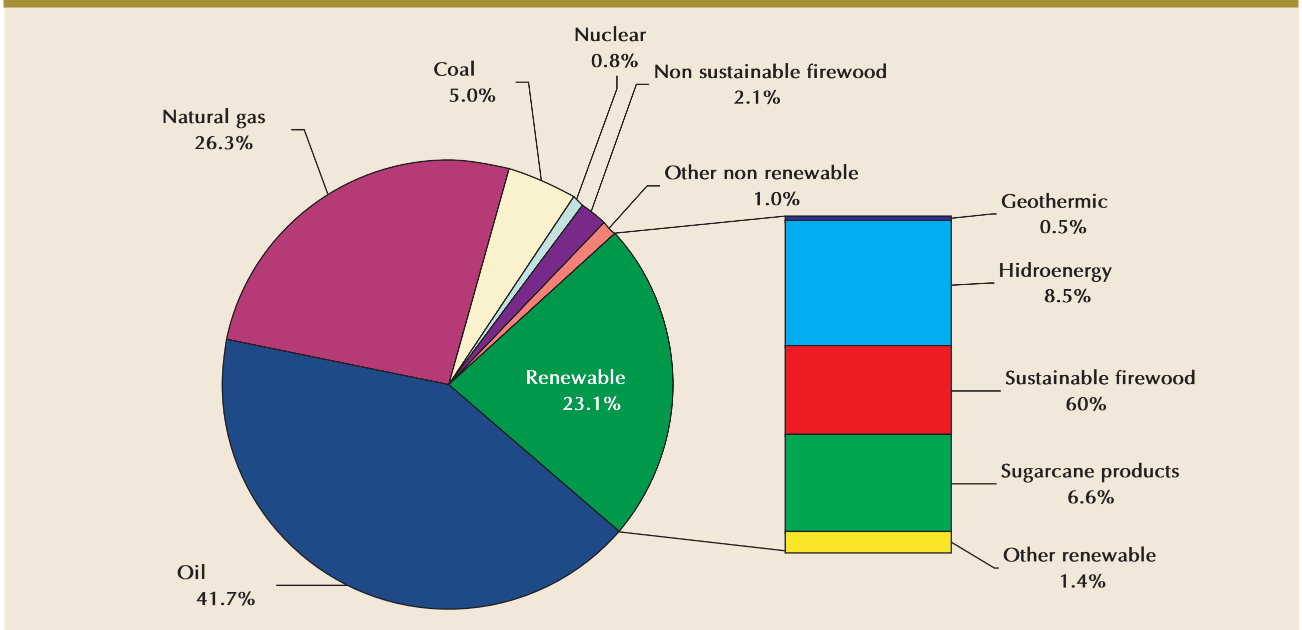
The region has significant potential for renewable energy generation. With some variations between countries, there is a relatively wide availability of hydroelectric, geothermal, wind, biomass and other (Figure 1.9) sources that could, with more planning and more efficient patterns of energy consumption, form an economic growth support platform without compromising sustainability (State of the Region, 2008).

Oil continues to be the Region's most important energy supply source (41.7%), followed by natural gas (26%) and energy from renewable sources (23%) (Figure 1.9). The exploitation of hydrocarbons is closely related to environmental deterioration, to the extent that even IEA members recognize that current trends in energy management are not sustainable and that, because the sector now makes a heavy contribution to climate change, a better balance must be found between energy production and the environment (IEA, 2008; Omar Farouk, 2007).

Recent data show that between 1970 and 2006 the Region doubled its population and quadrupled average electricity consumption (from 427 to 1,688 kilowatt hours per capita) (ECLAC, 2009c). In the past decade the largest increase in per capita energy use occurred in countries or sub-regions with greater economic dynamism such as Mexico, the Southern Cone and the English-speaking Caribbean. Figure 1.10 shows the evolution of total electricity consumption (ECLAC, 2007c) for the period 1980-2005 when the Caribbean, Mesoamerica and South America increased consumption by 165,236 and 194% respectively; during that period energy consumption tripled in the LAC Region as a whole.

FIGURE 1.9

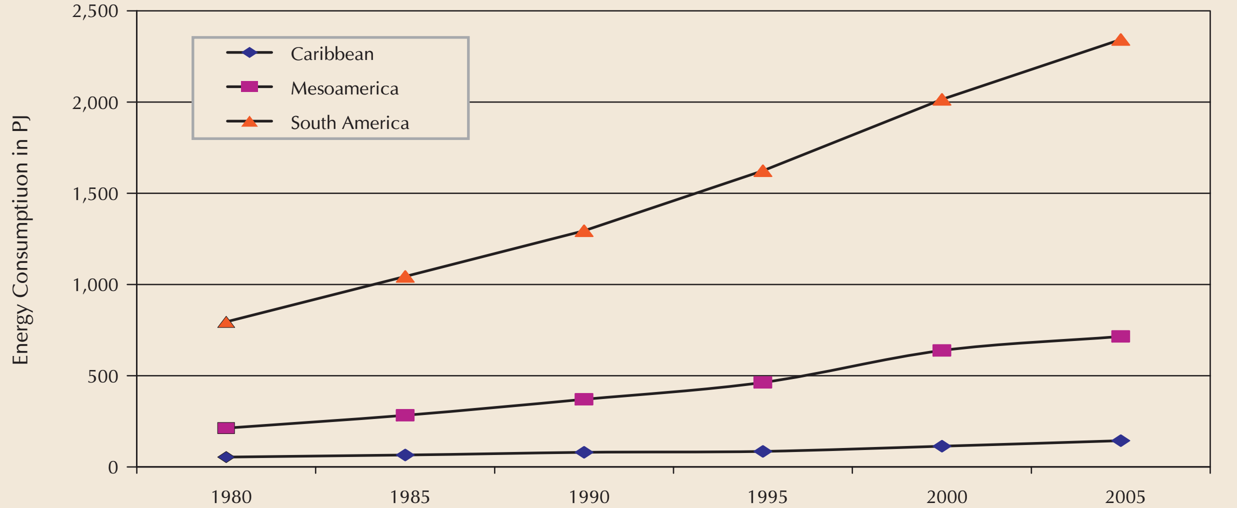
Latin America and the Caribbean: Total Energy Supply 2007



Source: United Nations, 2010 Prepared by ECLAC with statistics obtained from the Energy-Economic Information System (SIEE) of the Latin American Energy Organization (OLADE). On line: http://www.olade.org.ec/siee.html. Consulted October 2009.

FIGURE 1.10

Latin America and the Caribbean: Evolution of Electric Energy Consumption by Sub-regions 1980-2005 *(Energy consumption in PJ)*



Source: Prepared by L. Molina with data from ECLAC, 2007c.

In 2008, Latin America and Caribbean countries consumed 749.5 million tonnes of oil equivalent, or 6.6% of the world's total (BP, 2009). Global resources used in the Region are mainly hydroelectric power (22.5% of the world total), followed by oil (9.2%), natural gas, coal and nuclear energy (Table 1.3). Brazil, Mexico, Argentina and Venezuela had the highest electricity consumption (Figure 1.11).

TABLE 1.3

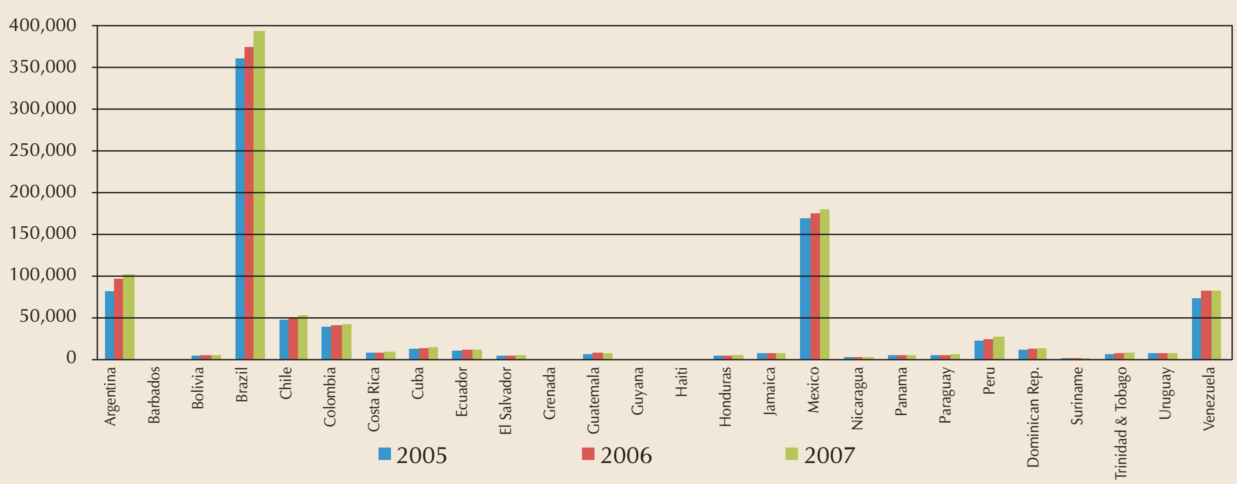
Latin America and the Caribbean: Energy consumption, 2008 *(Millions of tonnes of oil equivalent)*

	Oil	Natural Gas	Coal	Nuclear	Hydroelectric	Total
World	3,927.9	2,726.1	3,303.7	619.7	717.5	11,294.9
LAC	360.3	189.1	32.0	7.0	161.1	749.5
LAC/GLOBAL	**9.2%**	**6.9%**	**1.0%**	**1.1%**	**22.5%**	**6.6%**

Source: Prepared by UNEP with data from British Petroleum "Statistical Review of World Energy". www.bp.com/statisticalreview <http://www.bp.com/statisticalreview>. Consulted October 2009.

FIGURE 1.11

Latin America and the Caribbean: final electricity consumption, 2005-2007 *(GWh)*



Source: Prepared by UNEP with data from OLADE, Energy-Economic Information System – SIEE. Consulted October 2009.

Latin America and the Caribbean: final electricity consumption, 2005-2007

Fifty-three percent of the total electricity produced in the Region comes from hydroelectric plants with an installed capacity of 147.3 MW, followed by turbo steam (23%) and turbo gas (16%). Only 2% of capacity installed in the Region is nuclear power produced in Brazil, Mexico and Argentina (OLADE, 2008). Electricity generation installed capacity continues to grow, increasing by 7% from 2005 to 2008 (259.2 MW to 277.9 MW) mainly in hydroelectric energy (OLADE, 2008).

Energy production faces conflicts and problems that tend to escalate as demand increases. Some countries with marked deficits tend to intensify their resources and often jeopardize environmental sustainability. This situation's main determining factors include heavy dependence on imported oil, which in Central America accounts for 45% of total energy consumption, and low levels of energy consumption efficiency (Estado de la Región, 2008).

The application of national programmes and technologies to promote energy efficiency is an important tool to mitigate the negative effects of consumption and to manage increasing energy demands. While there is great potential for such initiatives, with significant achievements in Mexico and Brazil, the results usually obtained in the Region are hampered because of structural problems concerning the scope of the programmes, the application of new technologies and regulatory mechanisms.

In recent years, the Region has made advances in the renewable energy category, both in terms of legislation and of projects implemented. Only five countries - Argentina, Brazil, Ecuador, Nicaragua and Peru - provide direct renewable energy incentives such as awards, subsidies or promotional fixed prices (ECLAC, 2008b,c). Despite these incentives, the total energy supply trend remains almost flat.

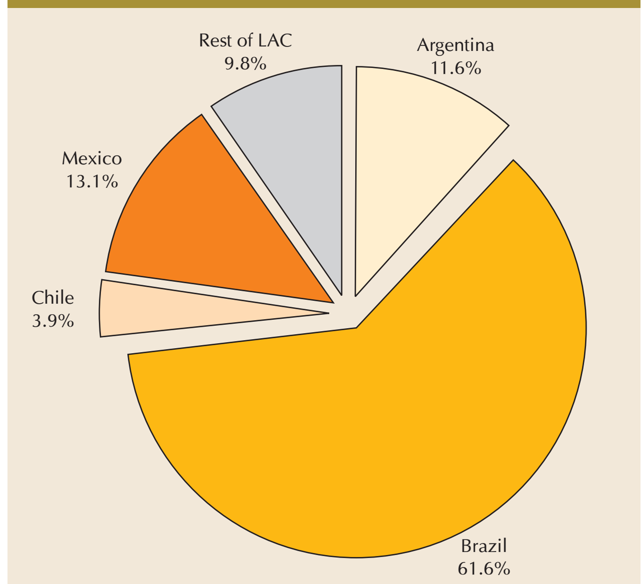
3.8 Science, technology and innovation

The development of science, technology and innovation capacity and infrastructure is essential for economic growth and for advances to be made on productivity, international competitiveness, and the countries' social and environmentally sustainable development. Latin America and the Caribbean face several challenges in this respect that must be addressed by reflecting on the historical role of science, technology and innovation concerning environmental sustainability, so that strategies can be developed that focus on more efficient and sustainable use of natural resources.

Investment by the Region in Research and Development (R&D) has increased, although it still falls short of what is needed. There are marked differences between countries in the Region, and the gap between it and other regions continues to grow. In 2006, investment was approximately US$18,000 million, 60% more than in 1997, or about 2% of total global R&D investment (Ricyt, 2008). Brazil, with more than half of Latin American and Caribbean investment in R&D, had the most significant growth (Figure 1.12).

FIGURE 1.12

Latin America and the Caribbean: Percentage of investment in research and development (R&D) 2006



Source: Network of Indicators of Science and Technology – Ibero-American and Inter-American. The State of Science. 2008.

According to 2006 data from the International Network of Science and Technology (Ricyt) the Region has 235,000 R&D researchers and technologists. In general, however, there is a lack of trained qualified personnel. Given that not enough resources are available in the research and development sector the demand for scientists and technicians is limited and this, in turn, prevents scientific work from being promoted.

The geographical distribution of human resources is evidence of the Region's heterogeneity and indicates they are concentrated in countries with the most resources. Of this highly qualified population 90% are in Chile, Brazil, Mexico and Argentina with 61%, 50.4%, 21%, and 14.9%, respectively. Some small countries like Cuba have a large number of researchers and technologists in relation to their populations (Ricyt, 2008).

Insufficient scientific development has historically marginalized the production of local knowledge, opening the way for indiscriminate entry of foreign technological knowledge. This has accentuated the structural heterogeneity of knowledge management by concentrating its development in universities and public institutions with few links to the productive sector, which is not what happens in the developed world.

Although companies in some countries (e.g. Brazil, Mexico and Uruguay), increased investment in R&D, "83.6% of knowledge management in the Region takes place in laboratories and universities dependent on government," while in OECD countries "universities and state agencies are responsible for only 31.7% of the activities, and the remaining 68.3% occurs within productive enterprises."[8]

The number of scientific publications produced in the Region doubled between 1997 and 2006. An analysis of knowledge distribution by areas reveals a relative specialization in agricultural sciences. The R&D sector contributes less to technological development and industrial application innovations, as is seen in the small number of patents granted compared to developed countries. This is due to a combination of factors, including less efficiency and the trend to adapt and import technology.

In particular, technological development strategies linked to environmental sustainability have encouraged the introduction of such new high-end technologies as biotechnology and nanotechnology. Besides these technological priorities, environmental bodies in most countries of the Region have also encouraged technologies linked to urban, industrial, and mining waste treatment, leaving aside technologies of other economic sectors.

The process of transnationalization that occurred in the 1980's and 1990's, and later the globalization process, meant few questions were asked about the technological generation, adoption and dissemination model, and very rarely was it suggested that environmental sustainability of development would only be achieved by technological transfer. These processes so penetrated the Latin American Region in those decades that there was practically no debate about the technological development model.[9]

The trend of developing sciences in the Region is seen in the demands made for scientific knowledge resulting from technological development. This has also raised the question of allocating resources for scientific development. In the great majority of countries scientific research is carried out whenever there is a need to adopt or adapt a technology and this inevitably leads to errors being made in the way financial resources are used, as well as in environmental management.

8 *Prioridades en ciencia y tecnología en América Latina y el Caribe (Science and Technology priorities in Latin America and the Caribbean). Lima, Peru, November 2004, p. 4-8. www.rau.edu.ay/universidad/consultiva/rectorado/prioridades.doc*

9 *In this general framework and seen in perspective, the initiative adopted by ECLAC in 2000, through its Sustainable Development and Human Settlements Division acquires special relevance in dealing with the theme of science and technology for environmental sustainability to promote and enrich the debate in the different countries in the Region. In 2006 ECLAC also published the document "Styles of development and environment in Latin America, a quarter of a century later" by Nicolo Gligo, which also highlights the theme when it comes to the process of "modernización del campo" (modernizing the countryside).*

There is still a long way to go before national scientific strategies are available to allow the problem of the environment to be tackled by using scientific knowledge about each country's territory, the behaviour of their ecosystems, and in particular of their biodiversity. Also, science and technology for Latin American development refers to knowledge that should be produced within the Region and, because it is closely connected with its specific ecological characteristics, cannot be replaced with knowledge obtained by the Region that has been produced in other countries (ECLAC, 2003).

Some countries' environmental strategies related to technological development are focused on introducing decontamination technologies, mainly in industry and mining. But little is discussed about technology packages that alter the Region's natural ecosystem structure to promote agricultural development and have had a high environmental cost.

The structure of the agricultural sector's R&D expenditure, mostly financed by the public sector, shows a concentration on technology and, to a lesser extent, on land use and on environmental protection and control. Concerning the last mentioned, R&D focuses on aspects such as identifying and analysing pollution sources, their dispersion in the environment, effects on human beings and species, and the development of pollution measuring facilities.

The importance of the costs associated with environmental control and protection is clearly seen in Ecuador, Cuba, Mexico, Panama and Guatemala. However, in Chile and Paraguay the costs related to land exploitation compete more directly with investments in agricultural technology (ECLAC, 2008).

In Latin American and Caribbean countries the major challenges for scientific strategies and policies on environmental sustainability are how to carry out new and more in-depth research about natural patrimony so as to gain full knowledge of the ecosystems' attributes and how they behave; there are large gaps in scientific knowledge are yet to be closed. Parallel research is needed on alternative development models that promote a new way to use natural resources and encourage a more harmonious relationship between society and the physical environment.

Mechanisms must also be developed to stimulate local research to allow each country's regions to advance by recognizing every locality's identity in accordance with its specific conditions. A long-term scientific strategy should be the basis for creating a model to produce, disseminate and adopt technology. That means stimulating research on local natural resources, including traditional knowledge about empirical sciences in the Region's own cultures.

In recent years countries in Latin America and the Caribbean have advanced in the use of information and communication technologies (ICTs) in different areas. The degree of progress varies throughout the Region depending on how much access there is to ICTs, and there is a digital divide between the more developed and less developed countries, as well as within them.

Having access to these tools facilitates environmental administration and management because it allows processes to be improved to produce, manage, integrate and share information as the basis to support decision making in different fields. In this sense, ICTs offer great potential to learn about ecosystems, natural resources, monitoring superficial changes, ecological land use planning, disaster risk prevention and management, and planning infrastructure for services.

Natural disasters in the Region in recent years resulted in agencies being established that, by using spatial data infrastructures (SDI) (see Chapter V, section 4), and remote sensing technology, distribute data at regional, national and local level with a clear focus on preventing or mitigating negative effects caused by nature, human beings and global changes. Worth special mention are the countries in Central America, with the Central American Geographic Information Project (PROCIG), the Programme on Reduction of Vulnerability and Environmental Degradation (PREVDA), and the project on Probabilistic Risk Assessment for Central America (CAPRA); and those of the Andean region with the Andean Community Disaster Prevention Project (PREDECAN), among others. Similar initiatives are required to improve access to ICT and to have specialized professionals and technical experts.

Also, to the extent that the public sector makes use of ICTs, there will be improved service and supply of information; in the case of the environment, this helps to increase production and provide better access to public environmental information, as well as to increase citizen participation in controlling how public policies are implemented.

3.9 Governance

3.9.1 The State's territorial trends capacity

Based on the current pattern of how natural resources are used, the nation-state "deterritorializes" when it comes to its limitations in regulating how its territory is used, with an impaired ability being observed to impose justice, control environmental impacts or manage productive extraction over vast zones[10].

On the other hand, the State is able to manage and apply regulations intended, in many cases, to permit natural resources to be extracted, especially for export. Examples of these regulations are those to protect capital inflows, intellectual property rights, and global procedures for settling disputes. Regulations on capital flows are part of the new globalization that is also characterized by the prominent part transnational corporations play in extracting natural resources, particularly minerals and hydrocarbons.

Deterritorialization ends by creating a set of niches closely connected to international production chains.

These are "nodes" connected by flows of people, materials, capital and information, supported by a network of natural resources and capital "flows" and in many cases are directly connected to globalization. The clearest cases are foreign investments in extractive sectors, the location of the projects, and channels to export the extracted products. Under current globalization conditions there are formal limitations to intensifying these structures' environmental management because such efforts may be resisted by invoking barriers to free trade or the free flow of capital. However, there is also informal resistance so long as countries (and even municipalities) can compete among themselves by reducing their social and environmental standards, thus causing unfair competition for fear of losing possible investments.

This global reflection on the State's presence in territorial trends in Latin America and the Caribbean is most clearly expressed in the various regional integration processes. While some have a long history, in recent years they have all been modified - and even relaunched. For some authors, this trend implies a "new regionalism".

10 Different studies have alerted about how present globalization is weakening the nation-state (for example, the classic by Ohmae, 1997; see also Strange, 1995; Weiss, 1997 and Beck, 1998). From the viewpoint of relations between the environment and development, the process is more complex because there is a simultaneous weakening and strengthening of a certain type of state intervention (Gudynas, 2005).

These processes are developing in a context of considerable trade opening and liberalization of trade rules, together with a series of market reforms taking place in various sectors (although with significant differences between countries). Similarly, all cases abide by the rules and disciplines of the World Trade Organization (WTO).

Territorial integration processes can be placed between two extremes: agreements restricted to free trade and, therefore, containing narrower components of joint production and political discussion, as is the case of the North American Free Trade Agreement (NAFTA); and wide spectrum integration processes which, besides trade agreements, also include accords on social, cultural and environmental themes, as is the case of MERCOSUR.

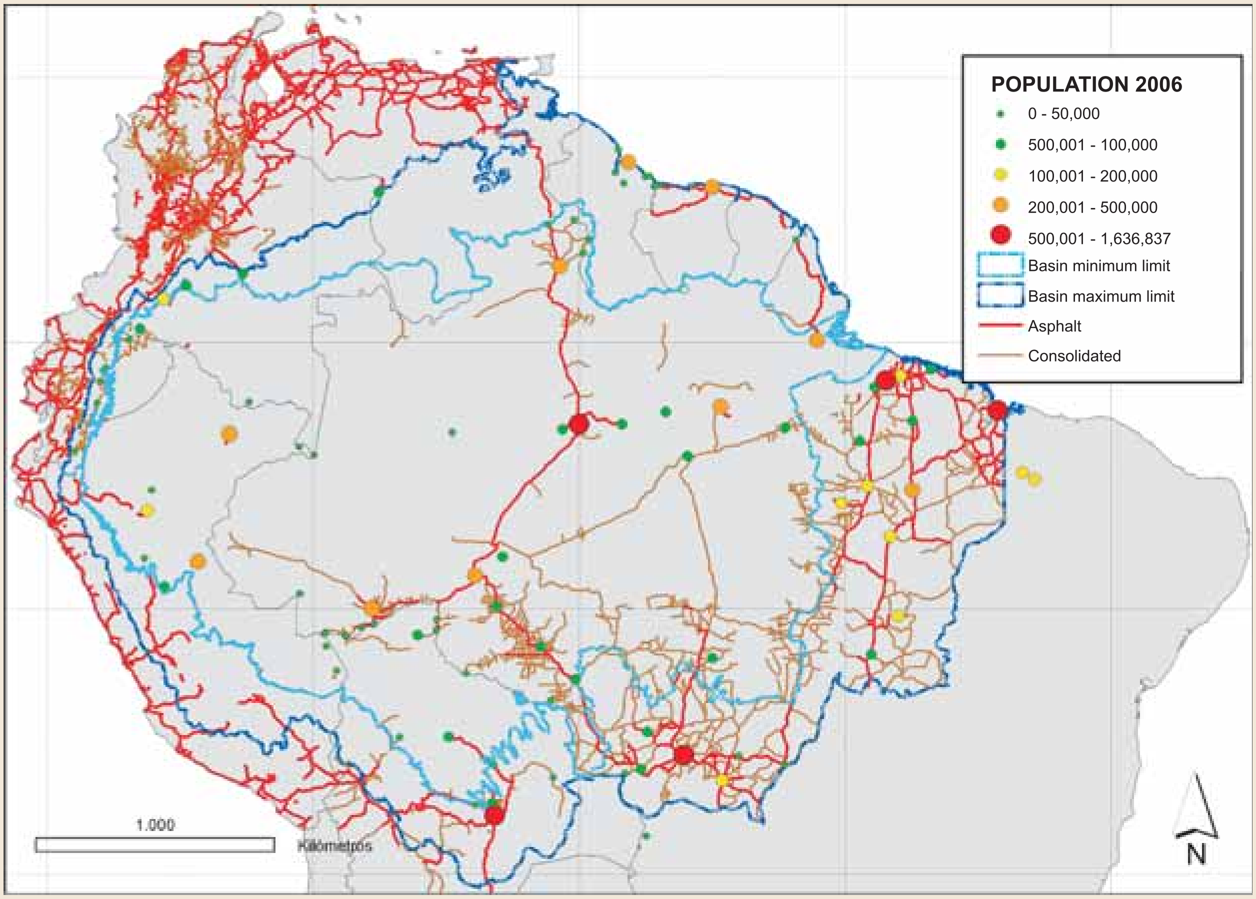
In one way or another, all of these processes address environmental issues. There are various institutional frameworks to manage these aspects, ranging from a NAFTA parallel specialized committee, to negotiating groups within the structure of the agreement itself, as in the case of MERCOSUR. Ministerial councils or commissions have been installed to analyse the environmental aspects of integration processes. For example, MERCOSUR has a Framework Agreement on the Environment (adopted in 2001), while the Andean Community (CAN) prepared a Regional Biodiversity Strategy for the Tropical Andean Countries adopted in 2002 (GTZ Fundeco IE, 2001). Similarly, the Free Trade Agreement between the Dominican Republic, Central America and the United States (DR-CAFTA) includes an Environmental Cooperation Agreement.

Also, major regional projects have been established to build an infrastructure to transport natural resources to ports so that they can be shipped to other continents. The clearest case is the Initiative for Regional Infrastructure of South America (IIRSA) that essentially establishes a series of transversal transport corridors ensuring connections between areas on the Atlantic Ocean and the Pacific Ocean, and opening up the continent's central areas.

In effect, some areas with limited connections, such as west-central Amazonia and the Amazonian plains of the Andean slopes in areas of Peru and Bolivia in particular, are beginning to have roads and bridges. While these works can solve local problems such as access to health facilities or education, or promote new economic options, it is also true that they "open up" new areas for intensive extraction of resources. For example, the IIRSA initiative can intensify factors that threaten Amazonia's survival, among them climate change, logging and forest clearance for farming. This becomes relevant when it is considered that, in nearly 30 years, the road network has increased more than nine times (UNEP-ACTO, 2009) (Map 1.2).

MAP 1.2

Main Highways in Amazonia



Source: original production of GEO Amazonia, with the technical collaboration of UNEP/GRID - Sioux Falls and Buenos Aires University, and with data from Bolivia: Conservation International and INE; Brazil: IBGE; Colombia: CIAT and DANE; Ecuador: INEC; Guyana: EPA; Peru: INEI; Suriname: General Statistics Office; and Venezuela: National Statistics Institute.

Therefore, there is an increase in the number of social stakeholders who arrive and engage in new productive activities, most of them associated with export sectors. They do not always have either the institutions or the resources for proper environmental management, or citizen participation mechanisms to properly manage risks and impacts.

3.9.2 Institutional political aspects

During the past three decades, many States in the Region (18 in Latin America and 14 in the Caribbean) have included provisions on environmental reforms or sanctions in their new constitutions to promote general "framework" laws that almost all the countries of the Region have used to establish more specific environmental standards. Ecuador, seeking to make structural changes that would provide a stronger institutional framework on environmental issues, promoted a constitutional reform which, for the first time in LAC, recognizes nature as being subject to law and the right of natural resources to be restored, thus placing them at the centre of policy decisions and providing environmental law guidelines (Gudynas, 2008).

Processes were also introduced to amend sectorial administrative legislation (e.g. regulations and technical standards), common law and penal law (especially to penalize crimes against the environment), civil law (environmental damage) and procedural law (concerning various adjectival aspects such as ownership in defence of widespread environmental interest, contracts to adapt environmental standards to lessen the burden of environmental testing, among others).

The Region in general has produced legislation to develop different topics that are essential when building the legal environmental network, such as: environmental policy and general application and implementation tools; environmental planning; land use planning; assessing the environmental impact; environmental management and its instruments; environmental emergency regimes; specific instruments for sustainable ecosystem management; biological diversity and security; wildlife; forest resources; soils; water and air; and marine ecosystems. Therefore, one limitation of the Region's environmental institutions' management capacity is not so much the lack of laws, but rather political weakness in enforcing them.

In practice, large sectors of society see the environment as a theme separate from that of survival and quality of life. This means that environmental concerns only become the subject of political debate in specific situations, such as where air or water pollution threatens human health and this, in turn, helps to maintain the gap between economic and environmental policy and to increase the weight of implicit environmental policies on sectorial policies.[11]

This is especially valid with regard to the agrosilvopastoral, mining, industrial, energy, fishing and urban sectors that outline their development policies – often environmentally negative – understood as those that subordinate the prevention or mitigation of impacts to maintaining high productivity and profits.

In this context, public environmental policy development has been weak when confronted with the economic, financial, trade and technology globalization agenda. The environment has not yet been given the priority it merits, as is reflected in budgets for environmental protection. In 2005 public spending on the environment represented 0.3% of GDP in Mexico and 0.06% of GDP in Brazil. In contrast, in Argentina, Belize, Chile, Colombia and Uruguay the share was substantially less at between 0.01% and 0.05% of GDP.

For reference, public spending on the environment in OECD countries represents between 1% and 2% of GDP (United Nations, 2010).

Environmental institutions thus tend to express a correlation of forces and influences between economic and environmental policies. An instance of this is seen in the trend towards sectorizing the theme of the environment by isolating it in institutions with very specific mandates to produce explicit environmental policies, to set standards, and to establish assessment systems. On the other hand, the territorial jurisdiction of environmental institutions depends on each country's type of political organization. For example, Federal States often establish regional bodies with some degree of autonomy, while unitary states centralize power at national level.

A positive note worth mentioning on environmental policy is the recent certification boom that has been increasing in the Region since 2001; in 2008 there were 5 470 companies certified with ISO 14001, mainly in industry and mining, that (ECLAC, 2009b). There has also been an increase in the number of initiatives and institutions in the Region promoting cleaner production and encouraging the inclusion of this type of technology. In this regard, 12 countries have national centres that address the issue. It is also relevant to highlight advances made in managing hazardous and industrial waste. Worth special mention are the efforts being made by 27 countries in the Region to eliminate hazardous chemicals and wastes by endorsing the Basel, Rotterdam and Stockholm Conventions, as well as the seven centres established to strengthen capacity-building and technology transfer on these themes.

11 The results of applying environmental policies have not always lived up to expectations. Even though most countries now have a series of environmental instruments and regulations, it has not been possible to halt and reverse the process of environmental deterioration. One of the causes of this trade-off is what Nicolo Gligo (1995) differentiated in Políticas ambientales explícitas e implícitas *(Explicit and implicit environmental policies). Explicit environmental policies refer to legal and institutional frameworks and existing instruments. It is the policy response to the problem of the environment. They usually have a minimum effect because they depend to a greater or less extent on the political will to apply them. On the other hand, implicit environmental policies are those that result in applying other policies, usually economic and that are the final reward (short-term profitability) and are also characterized by showing a negative result in terms of their environmental impact.*

3.9.3 Application and enforcement of environmental standards in Latin America and the Caribbean

The application and enforcement of environmental standards assumes an active attitude by the State in reaffirming its presence by: strict law enforcement; making the legal system effective based on legitimacy and efficiency; and applying approved standards.

The Region continues to present challenges in applying and enforcing environmental regulations. In turn, this offers opportunities to:

i. *Improve the distribution of powers at government level*. For example, before the creation of the Peruvian Ministry of the Environment, environmental functions were distributed among various public bodies (CONAM, DIGESA, INRENA, SENAMHI) and often resulted in functions being duplicated, in hindering one another and in failing to assume their responsibilities in the hope that others would do so; the result was that the Peruvian State played an inefficient role in this area. The creation of the Ministry of the Environment in Peru that concentrates all functions in one entity offers an opportunity to correct this situation.

ii. *Strengthen and consolidate citizen participation mechanisms.* Citizen participation is one of the crucial elements if the environmental system's mechanism is to function. However, it has been noted that in many cases citizen participation is nothing more than a mere requirement that the economic stakeholder (public or private) must meet before embarking on an activity that has environmental impacts, causing adverse reactions among the population that often lead to social conflicts and endanger society's foundations. These conditions present challenges to making participation a significant factor in achieving the efficient and effective environmental standards to be expected as a consequence of such participation.

iii. *Improve environmental transparency.* While many countries in the Region have enacted rules that give the public access to environmental information, there are still situations where it is difficult to obtain concrete data because of its "secret" character that often hinders the legitimate exercise of this right.

iv. *Make environmental and economic policies more consistent.* Included among the main functions of almost all environmental agencies in the Region is the control of different aspects related to preserving and promoting the environment. However, when these functions are subject to economic priorities or when the environmental cost-benefits are not embedded in economic decisions, many contradictions are evident and become worse because they are inconsistent with development policies. The most frequent case is the application of "environmental impact assessment" systems: technical studies, generated or requested by environmental agencies and not binding on decisions concerning development projects, where

politico-economic criteria often prevail over weak environmental control systems, thus limiting the effectiveness of many laws, regulations and standards. Another example is seen in the not fully considered "land use plans" –in countries that have them– in developing enterprises and investment projects and preventing proper environmental management, once again due to political and economic factors.

v. *Articulate and consolidate legal-environmental education.* The lack of efficient application/ enforcement of environmental regulations is the result, among other things, of neither the authorities nor society being fully aware of them; it thus happens that when there is little application, if a particular rule is applied to a specific situation it hardly has any effect on whoever is being punished, and has even less of an effect on society. Thus, because judicial and administrative sanctions often do not reflect the seriousness of the offence committed, a valuable opportunity is lost that would allow the authority to show the community how environmental policy operates.

vi. *Advance institutional credibility.* Society links the value of laws with that of the institutions called upon to enforce them. Environmental legislation in Latin America and the Caribbean has its origins in the legislative development of the last decades of the twentieth century; its legal structure, therefore, is quite new and the institutions that apply it are in a period of consolidation. If changes are to be made in the system, the State system and society itself need to be more effective in enforcing environmental standards,

vii. *Achieve advances in scientific knowledge and technological possibilities.* One important feature in formulating environmental regulations is to have solid and accurate scientific knowledge about what it is intended to regulate (diagnostic and monitoring studies of baseline environmental conditions, such as the characteristics of the air, water and soil components and how they affect human health and ecosystems), and this needs to be strengthened in the Region. Taking each country's particular situation into account (population, epidemiology, ecosystems, social development characteristics, etc.), work needs to be done on diagnostic, monitoring and risk studies.

Having access to technologies to comply with, and ensure compliance with, environmental standards remains as a regional challenge. It is difficult to enforce approved standards without taking this into account. Other challenges lie in continuously strengthening the institutions responsible for enforcing environmental laws and policies because they often lack the resources needed to carry out their work, and in any case they have much lower profiles than other similar ministries or institutions (UNEP, 2007).

Civil society organizations have a major role in denouncing and correcting environmental problems. For example, local participation in natural resources management has been associated with the establishment of systems of governance and institutional arrangements that promote sustainable use of resources while, at the same time, they ensure the livelihood of rural populations (Pacheco and others, 2009). For example, collective action and management studies on forest resources have focused on the role of community, peasant and indigenous organizations in social mobilization processes (Cronkleton and others, 2008) and provide evidence about how the involvement of these groups encourages the implementation of conservation mechanisms in forest ecosystems (Chhatre and Agrawal, 2008).

4. Final Reflections

The Region's environmental problems have been approached in different ways and, although there are many issues demanding urgent action, the advances made should not be overlooked. The countries of this Region have government structures specifically focused on attending to environmental problems. To protect their diversity, they have also developed systems of protected natural areas and in situ conservation mechanisms and economic instruments to protect their diversity. Extremely important is Latin American and Caribbean participation in international organizations and in international efforts such as the Convention on Biodiversity, the Ramsar Convention, the Montreal Protocol, the Kyoto Protocol and the Cartagena Protocol, among others.

Civil society organizations have a major role in denouncing environmental problems, as well as in correcting them. While continuing economic difficulties in the Region make it difficult for many people to participate, citizen organizations, together with higher education institutions, have played a preponderant role concerning the environment. Today, their opinions are undeniable and indispensable when it comes to environmental issues.

Latin America and the Caribbean face the challenge of achieving fairer and more equal economic development that requires making an effective shift towards sustainable development without decreasing the countries' natural capital. It is not enough that it is internationally recognized there is no contradiction between a healthy environment and the development of material goods. Natural and social capital must be preserved and this must be clearly expressed in public policies, both those explicitly and specifically directed at environmental problems and those that cover other areas. So long as environmental policies are not transversal, there will continue to be persistent contradictions between them and productive and trade policies, with the high social costs that have been evident over the years.

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II. The State of the Environment in Latin America and the Caribbean

KEY MESSAGES

- The inequalities present in Latin America and the Caribbean are reflected in, and are a cause of, the environmental degradation that is evident throughout the region.

- Of the world's 17 megadiverse countries, 6 are in Latin America and the Caribbean (LAC) and are home to a large number of endemic species. This impressive diversity is being extinguished by increasing deforestation and the destruction of habitats, in which many species are endangered to one degree or another.

- The region has a high degree of both genetic diversity and diversity in species and ecosystems. It contains a number of areas that are centres for the domestication and diversification of species (Mexico, Peru, Colombia, Brazil). These have contributed significantly to the agricultural biodiversity of the region and of the world. Unlike industrialized practices, the traditional agricultural techniques used, to this day, by peasants and indigenous groups have historically been conducive to genetic diversification. It should therefore be a priority to regulate the use of genetically modified organisms (GMOs), since their indiscriminate use creates a risk that this vast diversity –which constitutes a reservoir of germplasm of the species most important for human food and subsistence– will be lost in the quest for uniform agricultural genotypes. Many industrialised agricultural practices are based on narrow genetic diversity; GMOs, which can establish themselves in agricultural ecosystems and even in extant wild ancestors of agricultural plants, represent a new menace that should not be underestimated.

- Drastic changes are occurring in the use of the region's soils, and generally take place with little or no planning. The fragmentation, alteration and total destruction of ecosystems for agriculture, animal husbandry and human settlement have already caused a reduction in basic environmental services. This process is a continuing one, and is often dramatic, since it has high social costs, particularly for the most marginalised and defenceless sectors, whose access to basic resources (such as water) is being gradually eroded.

- Although there are important variations at the national level, LAC overall shows a pronounced trend toward urbanisation, with 79% of the population now living in cities. The region's urban development is highly heterogeneous. Most of its cities have no planning in place, and are expanding at the expense of natural ecosystems, some of which are disappearing entirely. Even relatively distant environments that supply urban centres with basics such as food, energy and water are being affected. Four of the six megacities in the Americas are in LAC (Mexico City, Buenos Aires, Rio de Janeiro and São Paulo), and they contain 13% of the region's population living in cities of more than one million inhabitants. However, the highest levels of urban growth are no longer limited to megacities: many cities of intermediate size are now growing faster than the large cities and still have a chance of achieving orderly and sustainable growth.

- The region's tropical forests (both moist and dry), as well as its temperate forests, have been used for thousands of years. However, the rate of deforestation in the region in the last 50 years is among the highest in the world. The transformation of forest soils into grazing land, farmland and, more recently, areas for biofuels production –as well as, to a lesser extent, for urban expansion– has compromised the ecological integrity of forest ecosystems, limited their ability to provide environmental services, fragmented them dramatically, and in many cases eliminated them entirely.
- The region's seas and coastal areas, which constitute great reserves of wealth, are under siege as a result of over-fishing (which has led to the disappearance of many populations), tourism (which, neglecting environmental considerations, has destroyed large portions of coastal ecosystems such as mangroves, dunes and coastal lagoons, in addition to causing sewage and solid wastes to be discharged directly into the sea) and oil drilling, which is profoundly disruptive and polluting.

1. Introduction

The Latin American and Caribbean region has a great diversity of environments, due to its wide variety of latitudes and altitudes. These range from the driest desert in the Americas (Chile's Atacama Desert) to the Amazonian jungle, one of the wettest areas in the world. The region also includes a major group of islands, in the Caribbean Sea. In short, the region is rich in diverse environments, ecosystems, species and cultures. In the past, it was the stage for the development of extraordinary cultures; today it is the scene of a complex environmental reality in which numerous socio-economic factors play a role. The social inequalities of the region are a reflection of, and part of, the environmental degradation taking place throughout the region.

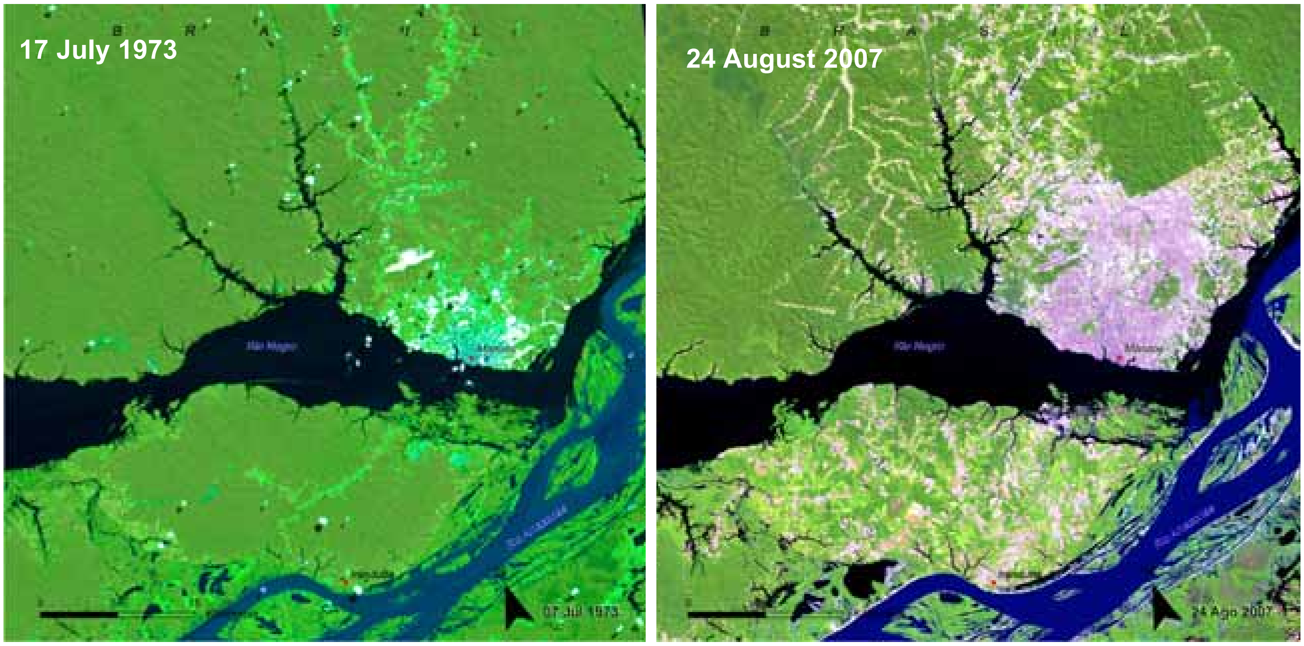
The present chapter offers an overview of the state of the region's environment, concentrating on an analysis of seven of its components: land, forests, biodiversity, water and hydrobiological resources, seas and coastal areas, air quality and urban areas.

2. Land

Changes in land use constitute an important issue throughout the globe, and LAC is no exception. The main factors in this process, which unfolds at the expense of natural ecosystems, are: agricultural development; extractive activities such as mining; exploitation of fossil fuels; forestry; and urban development and increased tourism in coastal areas – all of which are examined here and in later sections of this chapter. Also relevant in this connection is the nature of land rights, which is to say the institutions and social relations that govern access to, and use of, natural resources and land. These institutions and social relations have an important influence on changing land use patterns. In LAC, according to Sunderlain and others (2008), land-holding rights are divided among the State (33%), collective indigenous and peasant groups (33%) and private owners (34%). The major forest ecosystems are concentrated in lands held by the State and by local peasant and indigenous groups. However, land is increasingly subject to pressure as a result of the high demand from both subsistence farming and agribusiness. This demand is one of the main factors associated with deforestation.

In Latin America, the socioeconomic aspects of globalisation lead to two opposing trends in land use. The increasing global demand for food accelerates deforestation, as land is converted to modern agricultural use. And while the abandonment of marginal agricultural land promotes the recovery of ecosystems in areas with poor soils, modern intensive agriculture is creating a new need for conservation, thus constituting a unique combination of threats and opportunities (Grau and Aide, 2008).

The loss of plant cover associated with changes in land use affects the exchange of energy between the earth's surface and the atmosphere. This produces microclimatic effects and influences carbon retention. Moreover, it erodes biodiversity at various scales, degrades soils, damages and even eliminates environmental services. In terms of societies, it leads to a loss of resilience and an increased vulnerability to natural disturbances and extreme climate events (Lambin and others, 2003).



Urban growth in Manaus (Brazil): *Manaus is the capital of the Amazonas state. The free zone created in 1967, has turned this city into an important industrial center, which caused abrupt and disorderly population growth and urban expansion. Currently, the city has an estimated population of 1.7 million. Urban development over the last 20 years has been the major challenge for environmental conservation in Manaus. The city unplanned development has caused environmental damage and impacts such as deforestation, damages to headwaters, erosion and threats of extinction of native species. The Landsat satellite images show the pattern of urban growth occurred between 1973 - 2007. Urban areas are shown in light blue (1973) and violet (2007). Other purple areas located north of the city correspond to deforested areas. Source: UNEP (2010). The LAC Atlas of Our Changing Environment.*

2.1 Agriculture and livestock raising

Nearly 30% of the land in Latin America and the Caribbean is suited to agriculture (UNEP, 2007). Because of the international demand for products such as cereals and soy, and increased demand for beef and poultry in both domestic and international markets, the amount of land area devoted to agriculture is increasing. In addition, sectoral policy can create incentives that lead to changes in land use. For example, the rising prices of raw materials such as soy have led to economic policies in Latin American countries such as Argentina, Brazil, Paraguay and the Plurinational State of Bolivia that encourage the expansion of large monocultures in order to meet foreign demand for soya products (Barbier, 2004).

Agricultural activities change over time, and some agricultural land is being converted to urban areas across the region, even in the Small Island States of the Caribbean. In addition, a concern about the sufficiency of the food supply has led some Caribbean countries to convert marginal-soil areas to farming, which requires the use of agrochemicals (FAO, 2008). Market changes can also have a strong effect on agricultural practices (as it has, for example, in the case of reduced banana growing in the Caribbean countries, which no longer receive preferential treatment from their traditional markets such as Great Britain).

However, agriculture as a proportion of the economy (the value of agricultural production as a percentage of GDP) stabilised at 6.3% in 2005 (ECLAC, 2007a). Notwithstanding certain trade problems, agricultural exports play an important role in the region's economy. Their largest foreign market at present is China (soy), followed by the United States (fruit, sugar and flowers) and the European Union (fruits and oilseeds) (ECLAC, 2007a). Table 2.1 groups the countries according to the economic importance of agriculture and the rural environment.

Between 2003 and 2005, there was an increase in the area used for agriculture in LAC,[1] with an additional 23,204 km^2 being added in the region during that period, representing an average annual increase of 0.13%. However, regional data do not show the wide variations from country to country. For example, the land converted to agriculture in the Plurinational State of Bolivia (the country that added the most agricultural land during those years) totalled 6,810 km^2 (FAO, 2008).

The countries in the region with the most land devoted to agriculture are Brazil and Argentina, with 26,360 km^2 and 12,935 km^2, respectively. Both make intense use of advanced technology, which has led to troubling levels of degradation (Seixas and Ardila 2002, ECLAC 2007a).

1 *Calculated using the FAO formula, 1996.*

TABLE 2.1

Latin America and the Caribbean: Relative Importance of Agriculture Economy

1. Decisive factor in the economy (between 34.1% and 17.2% of GDP)	2. Important, (between13.6% and 9.4% of GDP)	3. Somewhat important (between 7.9% and 6.9% of GDP)	4. Less important (between 6.4% and 0.7% of GDP)
Guyana	Honduras	Brazil	Cuba
Guatemala	Bolivia (Plurinational State of)	Costa Rica	Chile
Haiti	Colombia	Peru	Jamaica
Paraguay	Suriname	Uruguay	Argentina
Nicaragua	Ecuador	Panama	Barbados
Belize	El Salvador	Saint Vincent and the Grenadines	Mexico
Dominica			Venezuela (Bolivarian Rep. of)
			Saint Lucia
			Grenada
			Antigua and Barbuda
			Saint Kitts and Nevis
			Trinidad and Tobago

Source: ECLAC, 2007a.

TABLE 2.2

Latin America and the Caribbean: Land Area Devoted to Agriculture, by Country, 2007
(Thousands of hectares)

Country	Thousands Ha	Country	Thousands Ha
Argentina	133,350	Haiti	1,690
Bahamas	14	Honduras	3,128
Barbados	19	Jamaica	513
Belixe	152	Mexico	106,800
Bolivia (Plurinational State of)	36,828	Nicaragua	5,200
Brazil	263,500	Panama	2,230
Chile	15,762	Paraguay	20,400
Colombia	42,436	Peru	21,560
Costa Rica	2,750	Domincan Republic	2,517
Cuba	6,620	Saint Vincent and the Grenadines	14
Dominica	23	Saint Kitts and Nevis	5
Ecuador	7,412	Saint Lucia	11
El Salvador	1,556	Suriname	83
Grenada	13	Trinidad and Tobago	54
Guatemala	4,464	Uruguay	14,683
Guyana	1,680	Venezuela (Bolivarian Republic of)	21,350

Source: Prepared by UNEP, with data from FAOSTAT, 2007, available at: http://faostat.fao.org/default.aspx, consulted in October 2009.

According to the National Forest Inventory (Mas and others, 2004), only 19% of Mexico's continental territory is suited to agriculture, and less than 24% of this can be irrigated. As of 2005, however, nearly one million km^2 of land, or 55% of the entire national territory, was devoted to agriculture (FAO, 2008). Table 2.2 shows the land area used for agriculture in the region as of 2007, disaggregated by country. The region's agricultural land totals slightly over seven million km^2 overall, or 28% of the region's land area.

Worldwide, agricultural production for human food and animal feed has tripled since 1961. This represents average annual growth of 2.3%, much higher than the world population growth (1.7% per year) (FAO, 2007c). The expansion of agricultural production led to the conversion of land previously covered by different types of vegetation, predominantly forest, as well as to increased exploitation of natural resources such as soil and water, thus aggravating the existing process of soil degradation (UNEP, 2003a). The countries where agricultural growth exceeds the regional average are Belize, the Plurinational State of Bolivia, Brazil, Chile, Ecuador, Paraguay, Dominican Republic, Saint Kitts and Nevis and Uruguay (ECLAC, 2007a). Livestock grazing contributes to the degradation of areas where there continues to be vegetation. In Mexico, for example, it is estimated that only 27% of the area with natural vegetation is free of livestock (SEMARNAT, 2008).

Starting in the twentieth century, Latin America's humid tropical areas have been strongly affected by farming – the Amazon most of all, with the arc of deforestation extending beyond Brazil's borders, east of the Andes and into the Bolivarian Republic of Venezuela. More recently, the El Chaco region in Argentina and South America's Atlantic forests have been severely affected by the movement of the agricultural frontier (Lambin and others, 2003).

The increase in agricultural area is accompanied by a change in the type of products grown. Average per capita production of crops such as cassava, potatoes, wheat and rice is diminishing, while production of oils (soy, sunflower and African palm), corn (especially for industrial use), tropical fruits, vegetables and, to a lesser extent, sugar, is increasing (Seixas and Ardila 2002, ECLAC 2007a). The production of animal feed also has a significant effect on agricultural practices.

Thus, the region is transforming its agriculture to respond to a new economic model that seeks to increase trade. However, the capacity to produce basic foods has clearly been weakening, leading to a significant increase in agricultural imports (FAO, 2007e). Soy growing is emblematic of this process, as its economic importance increases at the expense of basic food crops and areas that are still covered by natural vegetation. Between 1990 and 2005, the land area devoted to soy increased by 22.3 million hectares, largely by taking over native forest lands.

Argentina's case is paradigmatic. Since 1995, the area dedicated to soy has tripled (Binimelis and others, 2009). The rise in the value of soy –from US$ 291.15 per ton in 1997 to US$ 418.17 in 2007[2]– consolidates Argentina's development model, as the country becomes a major world provider of soy derivatives (the third largest producer of flour and the largest producer of biodiesel). However, this economic development has been part of a process of «agriculturalization»: areas historically used for livestock are converted to agricultural use, while monocultures of soy are replacing other crops. Included in this process is the conversion of pampa land to soy-growing areas. One of the consequences of this trend is deforestation[3] (Navarrete and others, 2007).

Recently, more than in any past period, agricultural activity has been closely related to livestock raising. It is estimated that 40% of the grain produced in the world today is grown for animal feed (Bekoff, 2003). Between 1990 and 2007, the region saw an increase from 326 million head of livestock to 392.3 million head. Livestock increased by 66.3 million head in South and Central America, and declined by 800,000 head in the Caribbean (FAO, 2009c). Comparing deforestation rates with increases in livestock reveals that in many countries the two coincide (examples are the Plurinational State of Bolivia, Brazil, Colombia, Ecuador, Guatemala, Nicaragua, Paraguay, Peru and the Bolivarian Republic of Venezuela) (ECLAC, 2007a).

In countries such as Brazil, land use is changing substantially as a result of biofuels production, with areas of soy and sugarcane increasing in order to produce biodiesel and ethanol. This conversion of areas from food crops to biofuels is controversial, since it is linked to increases in the international market price of some of the crops used for biofuels production.

2 Data from: http://faostat.fao.org/site/570/DesktopDefault.aspx?PageID=570#ancor, consulted on 10 March 2010.

3 Data from FAO (2005), available at the GEO data site, indicate an average annual loss of 0.6% of the country's forest area in the 2000-2005 period.

2.2 Extractive activities

Extractive activities such as hydrocarbon extraction and mining lead, in many cases, to the settling and sinking of organic soils. This may be caused by (i) the oxidation of peat, as water levels subside; or (ii) the extraction of natural gas or water (Jiménez and others, 2006).

As forestry harvests wood, biodiversity suffers, as do the services provided by natural ecosystems, which include the maintenance of biogeochemical cycles, soil protection and conservation, and the supply of water in aquifers. Changes in forestry activity have also led to the phenomenon known as forest transition (see box 2.6).

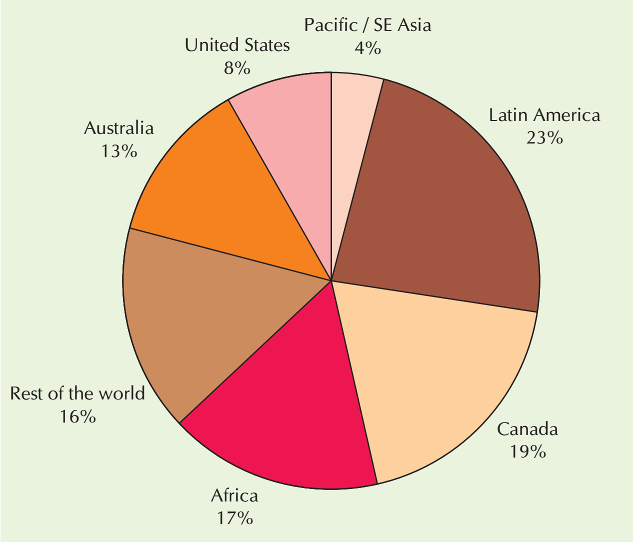
2.2.1 Mining

Since colonial times, mining has been one of the region's most polluting activities and one of those most severely harmful to human welfare. It not only affects mineral reserves, but also has a strong impact on other natural resources such as water, forests and soils, and generates vast quantities of polluting waste.

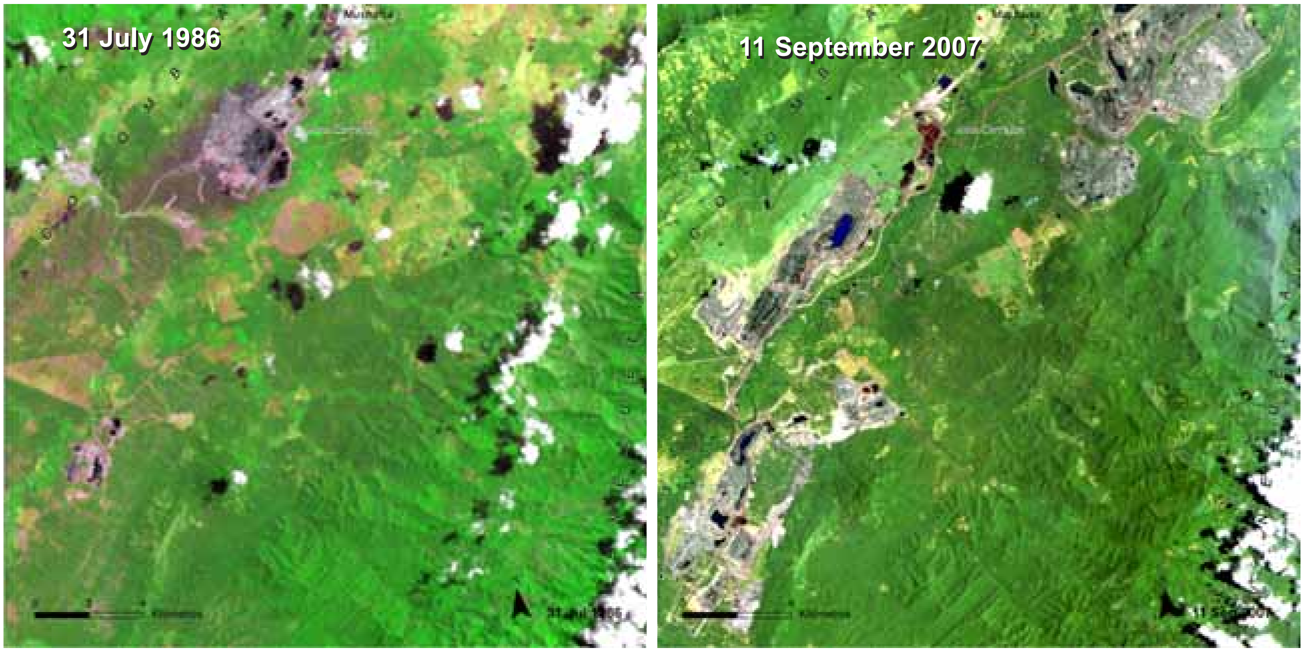
Mining continues to attract capital to the region. It is estimated that some US$ 10 thousand million is invested in the sector each year, making the region the largest magnet for capital in the world (figure 2.1). According to data from Bebbington (2009), foreign investment in the region's mining sector has increased 400% since 2000. Peru is a case in point: its foreign investment grew by more than 1,000% in the last 10 years (Bebbington and Bury, 2009).

FIGURE 2.1

Investment in Prospecting: Percentages by Region (2005)



Source: PricewaterhouseCoopers, 2006. Mine: let the good times roll. Review of global trends in the mining industry.



Mining: *The Cerrejón, Colombia, is one of the world's largest open pit coal mining operations, located on the peninsula and the department of La Guajira in northeastern Colombia. The Cerrejón project begun in the 1980s, has conducted a wide variety of environmental studies, monitored the air quality and recycled materials to reduce some of the negative effects of mining, including: the generation of particulate matter, gases and the conversion of about 7800 ha of land. The Landsat satellite images show changes in land cover in the area of Cerrejon, between 1986 and 2007. Source: UNEP (2010). The LAC Atlas of Our Changing Environment.*

In a number of Latin American and Caribbean countries, the factors that influence mining activity point to a trend towards specialisation in the extraction of non-renewable natural resources (Bebbington, 2009). As a result of international demand, mineral extraction has increased by nearly 56% in recent years, indicating that minerals continue to be important industrial and economic inputs. In view of its mining potential –assessed in terms of the best mining practices and without considering land use constraints– large investors consider Peru to be one of the most attractive countries, followed by Chile, Mexico, Brazil, Argentina, the Plurinational State of Bolivia, the Bolivarian Republic of Venezuela and Ecuador.

Mining in LAC has taken place in areas where mining has been a tradition, such as Chile, Peru, Mexico and Argentina. The main products extracted in these countries include copper, coal, nickel, gold and silver, along with construction materials such as sand. In the Caribbean sub-region, mining activity centres on bauxite (Jamaica) and, more generally, on sand and other construction materials from mountain areas and river banks.

Mining clearly has a major role in the region's economies, as evidenced by the share of the overall economy it represents in the different countries. According to Chaparro and Lardé, for example, mining in Chile accounts for between 6% and 8% of the country's economy, and the figures for Peru are similar (above the regional average of 4%). While the Central American mining sector as a whole represents no more than 3% of the economy, this figure is higher for Honduras and Guatemala, which conduct prospecting activities throughout the region. Jamaica is a special case: mining's share of GDP has been calculated to be between 10% and 25% of the country's economy (due to bauxite, in particular) (Chaparro and Lardé, 2005).

Colombia's mining projects for export are the largest open-pit operations in the world. In 2007, these were reported to cover more than 70,000 hectares, with annual export volumes of 29.8 million tons from a single coal-producing area, El Cerrejón. As the largest coal producer in Latin America, and the fourth largest in the world, Colombia has reserves of approximately 7,063 million tons, of which 84.5% are located in dry ecosystems in the Caribbean sub-region (Guajira, Cesar and Córdoba) (UPME 2005).

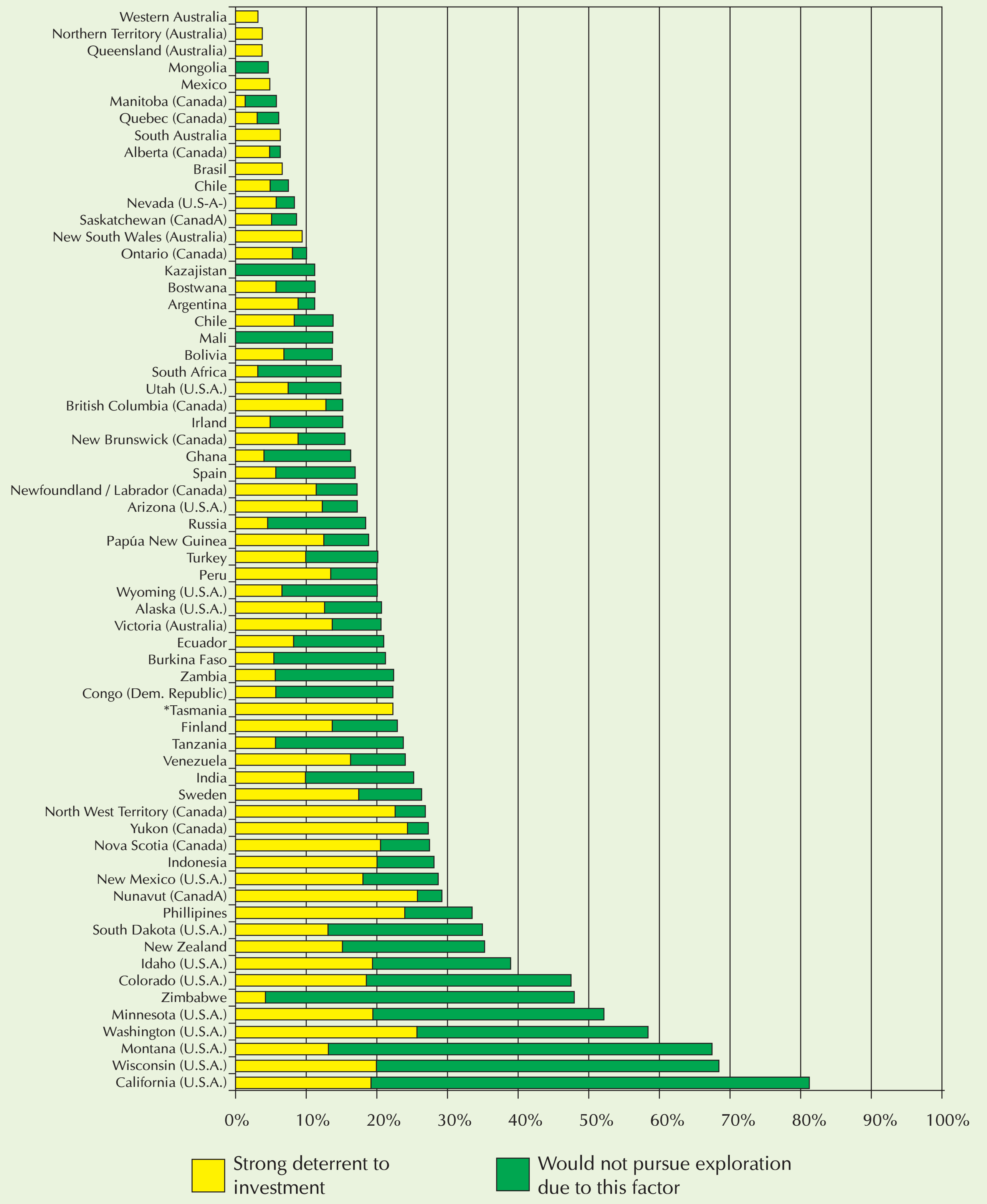
In various parts of LAC, small-scale mining is a major source of pollution. The use of mercury to extract minerals, along with erosion, is affecting water sources, to the detriment of aquatic organisms and populations– mainly in ranforest and mountain areas– that depend on this resource.

Recent studies estimate that, between 1975 and 2002, gold mining in the Brazilian Amazon produced approximately 2,000 tons of gold, leaving behind nearly 3,000 tons of mercury in the region's environment (Lacerda, 2003, quoted in UNEP, 2009). It is estimated that between 5% and 30% of the mercury used for small-scale gold mining in the Amazon basin is released into the water, while approximately 55% evaporates into the atmosphere (Singh and others, 2003, quoted in UNEP, 2009). The consequences of these practices, added to changing land use patterns and hydroelectric dams in the Amazon, in combination create mercury pollution in aquatic systems, in fish and in the human communities that depend on the fish (Kherig and others, 2008; Márques and others, 2005).

Environmental regulations on mining investment vary from country to country. In a number of the region's countries (figure 2.2) the industry does not regard regulation as a disincentive to investment.

FIGURE 2.2

Environmental Regulations on Mining



Source: Fraser Institute Annual Survey of Mining Companies, 2005/2006.
Available at: http://www.fraserinstitute.org/commerce.web/product_files/MiningSurvey2005.pdf.

Environmental regulations are necessary because of the range of serious environmental and social effects that mining can have. In some cases, there may be massive deforestation, with loss of plant cover, soil erosion and the formation of unstable soils. Sedimentation can also occur in streams and can alter the natural functioning of the basins. Such effects are multiplied in open-pit (as opposed to underground) mining, where the surface is stripped to extract the mineral (UNEP, 2003a; Jiménez and others, 2006).

Beyond the serious impact that mining has on ecosystems is the fact that the industry tends to consider land ownership and traditional systems of local governance as an «obstacle» (Camimex, 2008; Cortina and Zorrilla, 2009). This leads to inequities and can create social conflicts. According to a December 2008 report, Peru's Office of the People's Advocate registered 93 social-environmental conflicts, 46% of which were associated with mining.[4]

Rising mineral prices since 2007 have led to the opening of new mining sites. In Central America this has been accompanied by an increase in social-environmental conflicts. For example, among the 118 conflicts registered in the database of the Observatory of Mining Conflicts in Latin America,[4] linked to 140 mining or prospecting projects, at least 150 indigenous and peasant communities are known to have been affected. Of the total, the 21 events recorded in Central America and Mexico are recent episodes that began in the late 1990s and intensified during the first decade of the 2000s.

2.2.2 Hydrocarbon extraction

Oil drilling has high environmental costs, which range from the irreversible transformation of land-based and marine ecosystems, from which the «black gold» is extracted, to the severe effects of oil spills. These problems are aggravated when economic conditions in producing countries prevent the use of less risky, lower-impact, state-of-the-art technologies.

LAC has over 10% of the world's oil reserves, carries out approximately 14% of production and accounts for a relatively low 8.3% of world consumption. The economies of a number of the region's countries, such as Brazil, Mexico and the Bolivarian Republic of Venezuela, are highly dependent on the extraction and sale of fossil fuels. The Bolivarian Republic of Venezuela is one of the largest oil producers in the Western Hemisphere, and was the sixth largest net oil exporter in the world in 2006.

Mexico and the Bolivarian Republic of Venezuela are the region's principal oil exporters. Overall, 63% of the region's production comes from South America, 34% from Mesoamerica and a modest 13% from the

4 *Defensoría del Pueblo 2008. Online at: http://www.defensoria.gob.pe/conflictos-sociales-reportes.php.*

5 *Information available at: www.conflictosmineros.net.*

Caribbean (UNEP, 2010[6]). The region also contains over 4% of the world's natural gas reserves, is responsible for 6% of gas production and accounts for 6% of gas consumption. Argentina and the Plurinational State of Bolivia are the region's principal exporters of natural gas (IEA, 2008; Omar Farouk, 2007). Among the Small Island Developing States (SIDS) of the Caribbean, Trinidad and Tobago is the major oil producer. At present, it is also drawing on its natural gas reserves. Cuba is expanding its production outward, and parts of the Caribbean Sea are promising areas for oil.

In 2007, Nicaragua held a round of licensing for deep-water drilling sites in the Caribbean and Pacific basins. Similarly, current geological and seismic information in Jamaica's Exclusive Economic Zone[7] (EEZ) suggests that commercial quantities of oil and gas may be found in the Walton Basin and Pedro Bank areas in the Caribbean Sea. Exploration there began in early 2008, and various companies are now involved. Belize also began to investigate the possibility of deep-water oil wells in 2006. In Mexico, the State-owned oil company (PEMEX) decided to increase deep-water exploration in 2004, while the Bolivarian Republic of Venezuela invested US$ 8,261 millions in marine exploration in 2007.[8] Brazil is the only country in LAC with the technological capacity to carry out deep-water exploration[9] (Morales Gil, 2008).

Oil activity will very likely intensify, given the prospects of large unexplored fossil fuel fields. However, regulation of the oil and gas sector is principally handled by the individual jurisdictions, and although few impact studies have been conducted, it is clear, based on other parts of the world, that these activities can have environmental impacts if they are not effectively regulated. Currently, the region has no common policy.

6 *Información available at: www.geodatos.org.*

7 *http://www.un.org/Depts/los/convention_agreements/texts/unclos/convemar_es.pdf*

8 *Información available at: www.pdvsa.com.*

9 *Información available at: www.petrobras.com.*

10 *GLADA provides a new quantitative evaluation at the global level, identifying degraded areas by analysing net primary production (NPP) trends, or biomass production, over a 23-year period. NPP is deduced from satellite measurements (MODIS, GIMMS NDVI) of the Normalised Difference Vegetation Index (NDVI) or green index, and is combined with information on the efficiency with which rainwater is used. Areas that show trends of declining net primary production as well as a decline in the efficiency of rainwater use over the last 23 years are identified, controlling for the effects of drought.*

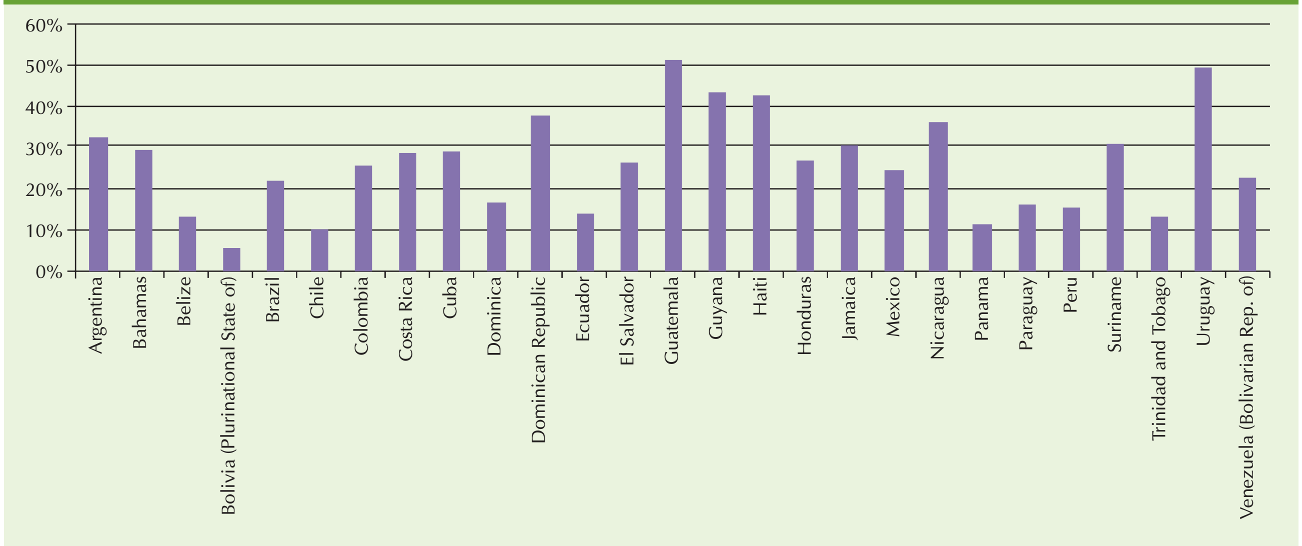
2.3 Land degradation

All of the countries in LAC are affected by one or more processes of soil degradation in at least part of their territory: salinization, compacting, water or wind erosion, exhaustion –or advanced loss– of nutrients, and accumulation of toxic substances. This scenario is aggravated by extreme climatic phenomena (ECLAC, 2007a). Degradation in arid, semi-arid and sub-humid zones is caused by the erosion that accompanies deforestation and excessive grazing, over-exploitation of the soil, failure to rotate crops or monoculture practices, and improper intensive irrigation.

According to data from the GEF-UNEP-FAO project GLADA (Global Assessment of Land Degradation and Improvement),[10] 14% of the world's land degradation occurs in Latin America and the Caribbean, and the process affects approximately 150 million of the region's inhabitants. The problem is most serious in Mesoamerica, where it affects 26% of the land, while in South America 14% of the land is affected (UNEP, 2007). Guatemala has the highest proportion of degraded land (51.3% of its national territory), followed by Uruguay (49.6%), Guyana (43.4%) and Haiti (42.6%) (see figure 2.3).

FIGURE 2.3

Latin America and the Caribbean: Degraded Area as a Percentage of National Territory, by Country



Source: Prepared by UNEP, with data from GLADA (Bai and others, 2008). Period: 1981-2003.

2.3.1 Soil erosion

Different degrees of degradation and vulnerability can be identified, ranging from desertification in low-lying tropical areas to severe degradation of arid soils in the *altiplano* above 4,000 metres in altitude. The Caribbean sub-region has marked seasonal variations in precipitation, and most of its territories suffer from prolonged droughts, followed by torrential rains that intensify soil erosion. In addition, the volcanic origin of some of the Caribbean Islands (Dominica, Saint Lucia, and Saint Vincent and the Grenadines) and the coral base of others (Antigua and Barbuda, Barbados, and parts of the Dominican Republic and Jamaica) make their soils highly vulnerable to degradation from erosion, especially in areas with scarce plant cover (ECLAC, 2007a).

Hispaniola represents an extreme case of degradation. With a population of 19.6 million as of 2008, this island, which is shared by the Dominican Republic and Haiti, is undergoing acute soil degradation and loss of biodiversity, especially in the area of greatest population pressure, which is Haiti (with 149 inhabitants per km^2 more than the Dominican Republic) (ECLAC, 2007a).

2.3.2 Pollution

Intensive use of fertilisers and pesticides contributes to the degradation and contamination of soils, air and water, and is associated with various environmental pollution problems (soil, water, ecosystems), as well as with human health problems. These issues are especially important in areas where there is intensive agriculture that uses these inputs (intensive vegetable growing) (United Nations, 2010).

Although regional statistics are not available on the use of pesticides, there is information on the use of fertilisers (figure 2.4). In Central America, for example, these chemicals are used most heavily in Costa Rica and Guatemala, with both countries having increased their consumption in 2003-2005. Although total consumption of such chemicals is considerably greater in other Latin American countries than in Central America, the per-hectare use of fertilisers in Costa Rica and Guatemala is higher than in countries such as Mexico or Colombia, though it is lower than in Brazil and Chile, which use

1.0 to 1.6 metric tons of fertiliser per hectare planted (State of the Region 2008).

Intensive agriculture is estimated to account for approximately 25% of the world's carbon dioxide emissions, 60% of its methane gas emissions and 80% of nitrous oxide emissions, all of which are potent greenhouse gases. Nitrous oxide is generated by denitrifying bacteria when the land is converted to agricultural use. When tropical forests are converted to grazing areas, releases of nitrous oxide triple. Nitrogenated fertilizers, such as those used in tree farming, are another major source of this chemical (ISIS, 2004).

In terms of the intensity of herbicide and insecticide use, among the countries for which statistics are available, Belize, Costa Rica and the Dominican Republic head the list (2001 figures) for both types of chemicals. Uruguay and Nicaragua are also heavy users of insecticides, while Ecuador and Paraguay have intense herbicide use (United Nations, 2010).

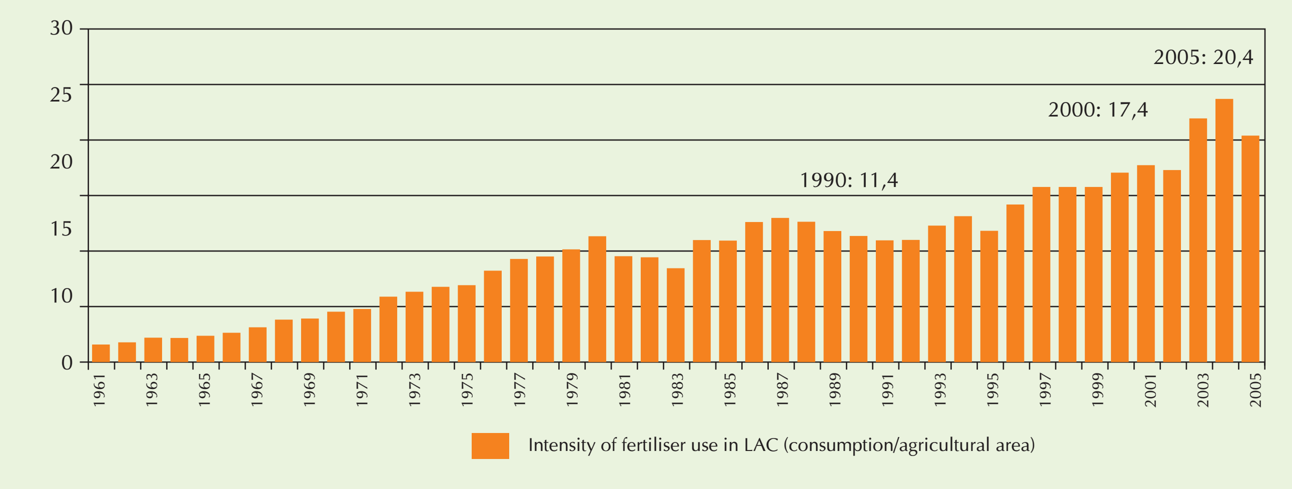
2.3.3 Desertification

Desertification is an extreme form of soil degradation, affecting over 6 million km² in Latin America – approximately 30% of the region's land, including arid, semi-arid and sub-humid areas (FAO, 2008) (see box 2.2).

Countries such as Brazil and Mexico have more and more areas at risk of desertification. Approximately 10%

FIGURE 2.4

Latin America and the Caribbean: Intensity of Fertiliser Consumption, 1961-2005
(Tons per thousand hectares)



Source: Prepared by ECLAC with statistics from CEPALSTAT-BADEIMA, based on data compiled by FAOSTAT, a database of the Food and Agriculture Organization of the United Nations. Online at: http://faostat.fao.org/default.aspx. Consulted in October 2009.

BOX 2.1

Desertification and its Consequences in Latin America and the Caribbean

(C) Alejandro Balaguer-Fundación Albatrosmedia-www.albatrosmedia.com

The United Nations defines desertification as the degradation of land in arid, semi-arid and dry sub-humid areas as a result of various factors, including climatic variations and human activities.

Such areas cover more than a third of the earth's surface. There are desert or arid lands in one fourth of the territory of Latin America and the Caribbean (some 5.3 million km^2) (UNEP, 2003a), and they are highly sensitive to inappropriate use of the soil –and particularly to over-exploitation–. Land can become less productive as a result of inadequate irrigation, deforestation, excessive grazing, poverty and political instability. Desertification is strongly linked to loss of biodiversity, and contributes to global climate change through the loss of potential carbon capture and the increased albedo of the earth's surface (Adeel and others, 2005).*

The Third Regional Report on the United Nations Convention to Combat Desertification (UNCCD) concludes that "LAC countries are affected by land degradation, desertification, coastal erosion, drought and natural disasters on a significant scale; they also have a backlog of environmental and social problems and overcoming them will require enormous financial, institutional and technical efforts. This situation shows that the LAC countries are neither a 'green region' nor a 'nature paradise', as is often claimed" (UNCDD, 2006).

Desertification and poverty form a vicious circle, since the soils that are most fragile and susceptible to desertification are occupied by marginalised groups, which have few economic options. This creates great pressure on the few resources that they do have—resources that, as a result, are rapidly and irreversibly being degraded. This process frequently causes migration to other equally poor and vulnerable areas.

Considerable efforts are being made to combat desertification, but in many cases they prove insufficient because of the complexity of the phenomenon (UNCCD, 2006).

Source: UNEP, 2003, Adeel and others, 2005 and UNCCD, 2006.
**Albedo is a body's ability to reflect the radiation that it receives. Albedo is 1 when all radiation is reflected, 0 when all is absorbed. From CAN, UNEP & AECID, 2007, Is it the end of snowy heights? Glaciers and climate change in the Andean Community. Lima, Peru.*

of Brazil's semi-arid areas (98,000 km^2) have been very seriously affected, 82,000 km^2 have been seriously affected, and 394,000 km^2 are moderately degraded (Brazil, 2000). Mexico reports that areas currently undergoing degradation total 560,000 km^2 (SEMARNAT, 2006). According to the Plurinational State of Bolivia, 41% of its territory is in danger of desertification, nearly double the area now covered by the country's arid zones (23%) (Bolivia, 2000). Problems of desertification are also being seen in Chile (24% of the national territory), Ecuador (21%), Puerto Rico (28%) and Venezuela (5%) (UNEP, 2007).

A 2004 UNDP study states that 16.9% of Colombia's territory shows signs of desertification, and that another 15% is vulnerable. A full 78.9% of the country's dry areas show some degree of desertification, principally from erosion and salinization, and nearly 74% of the country has problems of soil compaction. The Caribbean sub-region and the valleys of the Andes are also vulnerable. Forty-eight percent of soils are intensely degraded, with dry areas accounting for half of the more severe soil erosion processes (MAVDT, 2004).

Studies conducted during 2003 in 11 LAC countries (with calculations that included the effect on water resources and the impact from the physical loss of soil) estimated losses due to desertification at US$ 27,525 million (ECLAC, 2007a), with Argentina, Brazil and Mexico suffering the greatest losses.

3. Forests

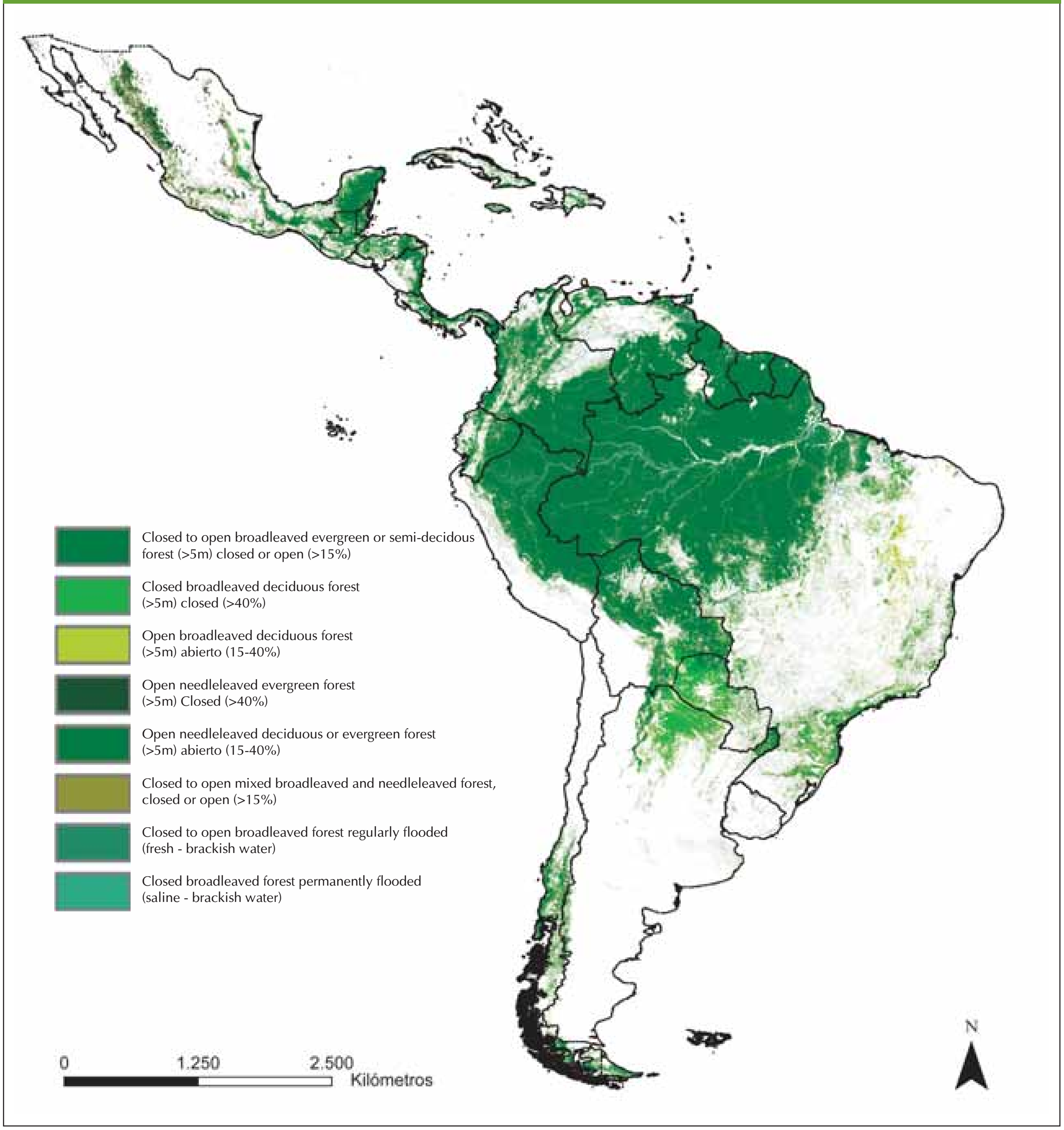
3.1 Area and percentage covered

The forest cover in Latin America and the Caribbean totals some 9 million km^2, representing nearly 45% of the region's land area (FAO, 2005). Between 1990 and 2005, the region's share of the world's forests fell from 24.1% to 23.2% (United Nations, 2010). Among all of the world's regions, LAC has the second-highest net loss of forests in the world (UN-DESA, 2009). Annual losses between 2000 and 2005 averaged 0.50%, nearly three times the global average of 0.18% (United Nations, 2010) (see table 2.3).

Map 2.1 shows the area and geographical distribution of the region's forests. The evergreen forests (high evergreen forest and tropical rain forest) represent 90% of the region's forest area, while deciduous forests account for 10%. The largest and most continuous fragments of rainforest are located in the Amazon Basin (6 million km^2), while the largest and most continuous fragments of deciduous forest are located in Santa Cruz, a region close to the border between Bolivia and Brazil (see Figure 1). Accurate measurements based on the different types of forests in LAC are still badly needed. Some of the difficulties for having them are described in box 2.3.

MAP 2.1

Extent and Distribution of Forests in Latin America and the Caribbean

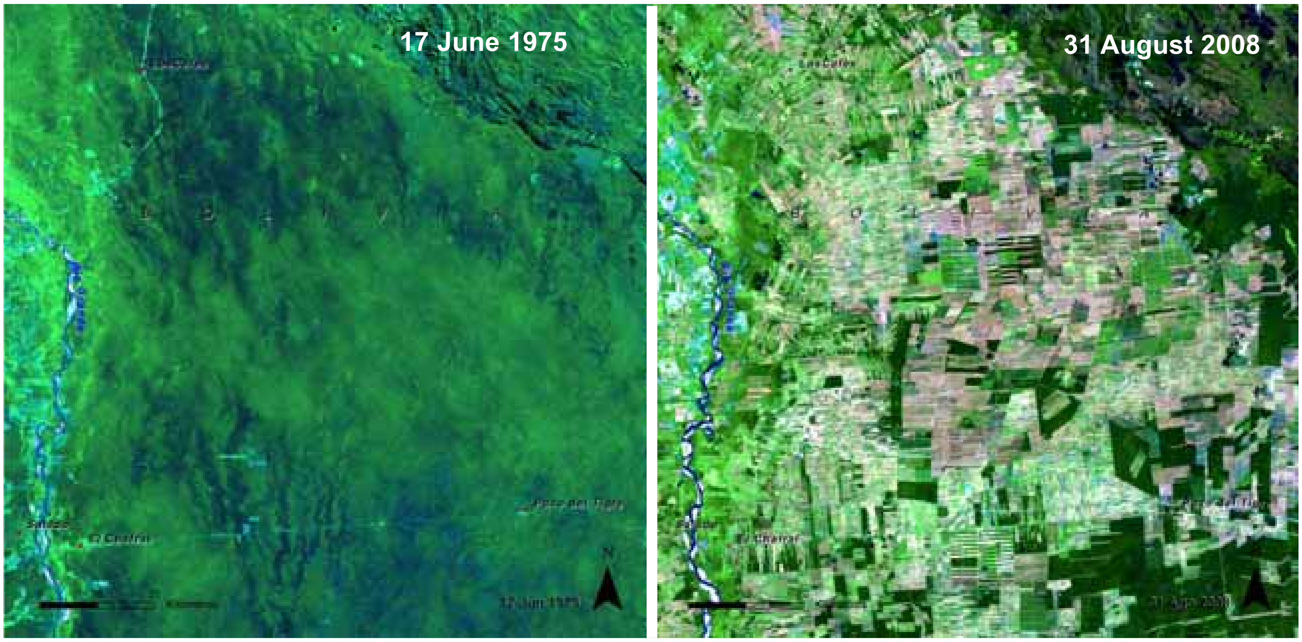


Source: Prepared by A. Kindgard with information from the GlobCover Project (v.2.2), 2008. GlobCover is based on ENVISAT-MERIS data with a spatial resolution of 300 m, and uses the United Nations Land Cover Classification System (LCCS), developed by the European Space Agency (ESA) in conjunction with JRC, EEA, FAO, UNEP, GOFC-GOLD, and IGBP. Available at: http://ionia1.esrin.esa.int/.

3.2 Changes in forest coverage

The Convention on Biological Diversity reports that conversion of forest to agricultural and grazing land, over-grazing, crop rotation without fallow periods, unsustainable forest management, invasive species, infrastructure development, mining and hydrocarbon production, fires and pollution are the main causes of the reduction in forest area (SCBD, 2001). In LAC, expansion of agricultural and livestock activities are, and have historically been, the main threats to forests in the tropical continental countries, while the expansion of infrastructure for urban development and tourism are major causes of deforestation in island regions.

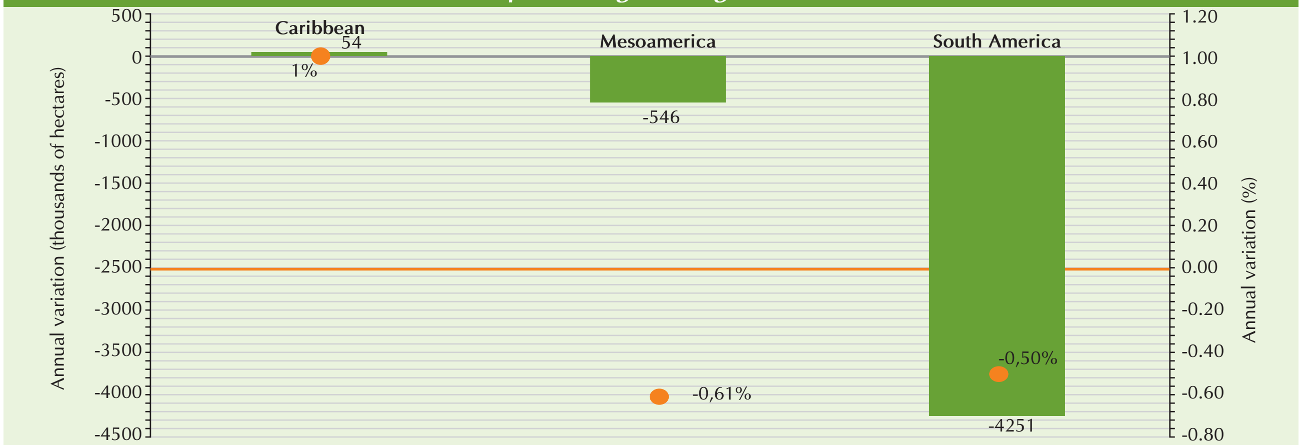
Figures on the cumulative change in forest coverage, by country, show a reduction in approximately 60% of the countries of LAC between 2000 and 2005. The cumulative regional loss of forest area in this period totalled approximately 24 million hectares, with the greatest average loss occurring in Mesoamerica (close to 0.6% of its forested area) (see figure 2.5). The total loss is equivalent to nearly 64% of the cumulative world loss during that period (table 2.3). In South America, whose tropical rainforest contains the world's greatest store of carbon, a net loss of forest of approximately 4.3 million hectares/year has been reported for 2000-2005, principally as a result of agricultural expansion (UNEP, 2007).



Land use changes: deforestation in Santa Cruz, Bolivia: *The department of Santa Cruz de la Sierra, Bolivia, is part of the Amazon Basin, and comprises a large area of the Bolivian lowland forests. Forest changes in this region began about 45 years ago, and even the 1980s, small-scale agriculture, unsustainable silvicultural practices, and cattle grazing were the main activities responsible for deforestation. The soybean crop production of Bolivia has been developed almost exclusively in this department and, after 1984, it became the main factor of deforestation, growing from an annual estimate of 34,000 ha in the period 1985-1990, to over 200,000 ha in the period 1993-2000. The Landsat satellite image of 1975 shows the department of Santa Cruz as an area of continuous forest, compared with the image of 2008, where the forest has been replaced by a patchwork of agricultural plots. Source: UNEP (2010). The LAC Atlas of Our Changing Environment.*

FIGURE 2.5

Latin America and the Caribbean: Changes in Forest Coverage by Sub-Region, 2000-2005
(Thousands of hectares and cumulative percentage change)



Source: Prepared by UNEP with data from United Nations (2010) and statistics from BADEIMA (CEPALSTAT) based on calculations of national forest areas (FRA 2005) and national land area (FAOSTAT). Consulted in May 2009.

TABLE 2.3

Latin America and the Caribbean: Extension and Variation in Forest Cover
(Thousands of hectares and cumulative percentage change)

Sub-Región	Forest Area (thousands hectares)			Variation				
				Anual Average (1000 ha)		Anual Average (%)		Cumulative
	1990	2000	2005	1990 -2000	2000 -2005	1990 -2000	2000 -2005	1990-2005 (%)
Caribbean	5,018	5,375	5,645	36	54	0.71	1.00	12.50
Mesoamerica	96,378	89,100	86,372	-728	-546	-0.76	-0.61	-10.38
South America	882,727	844,733	823,477	-3,799	-4,251	-0.43	-0.50	-6.71
LAC	984,123	939,208	915,494	-4,492	-4,743	-0.46	-0.50	-6.97
World	4,077,291	3.988,610	3,952,025	-8,868	-7,317	-0.22	-0.18	-3.07
% LAC/world	0.241	0.235	0.232					

Source: *UNITED NATIONS, 2010. Prepared by ECLAC with statistics from BADEIMA (CEPALSTAT) based on calculations of national forest areas (FRA 2005) and national land area (FAOSTAT). Consulted in May 2009.*
(a) These figures may not coincide with FAO figures, due to changes in the names of national territories or because of adjustments for the countries covered (ECLAC does not consider Anguilla, Aruba, the British Virgin Islands, the Cayman Islands, Guadeloupe, Martinique, Montserrat, the Netherlands Antilles, Puerto Rico, Turks and Caicos Islands, the United States Virgin Islands, the Falkland Islands (Malvinas), French Guyana or the South Georgia and the South Sandwich Islands to be part of LAC).

Most of the island nations have preserved or restored their forest areas, probably because they are economically dependent on ecotourism and have relatively low population pressure. In addition, the introduction of tree plantations, which some countries include in calculating the area covered by forests, could in part account for this increase in forest coverage. Differences in methods of measuring and monitoring should not be underestimated, since they can create discrepancies in regional information, and can lead to under- or over-estimating changes at the national level. In the tropical continental region, however, nearly all of the countries show losses. The less populated countries, such as Suriname, Guyana and Belize, are the exception in this respect.

Deforestation in the region is estimated to be responsible for 48.3% of global CO2 emissions associated with changing land use, with nearly half of such emissions originating in Brazil, mainly in the Amazon Basin (UNEP, 2007). Table 2.4 shows the deforested area in Brazil's «Legal Amazon». The Brazilian Amazon has been identified by Lambin and others (2003) as the largest tropical arc of deforestation in the world, with average deforestation of some 17,000 km^2/year in 1988-2000, over 22,000 km^2/year in 2001-2005 (27,400 km^2 in 2004 alone), declining to approximately 12,500 km^2/year in 2006-2008, and to an estimated 7,000 km^2/year in 2009 (Mahli and others, 2008; INPE, 2009).

Tree plantations have recently been replacing primary forests, and have also been used in restoration programmes and as carbon sinks in climate-change mitigation programmes (see chapter III). The coverage of these plantations has increased in recent years, as may be seen in figure 2.6. In 2005, 86% of the tree

TABLE 2.4

Brazil: Deforestation in the Legal Amazon 2000-2009 ***(km^2/year)***

Estado / Año	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009(d)
Acre	547	419	883	1,078	728	592	398	184	254	211
Amazonas	612	634	885	1,558	1,232	775	788	610	604	406
Amapá		7	0	25	46	33	30	39	100	0
Maranhão	1,065	958	1,014	993	755	922	651	613	1,272	980
Mato Grosso	6,369	7,703	7,892	10,405	11,814	7,145	4,333	2,678	3,258	1,047
Pará	6,671	5,237	7,324	6,996	8,521	5,731	5,505	5,425	5,606	3,687
Rondônia	2,465	2,673	3,099	3,597	3,858	3,244	2,049	1,611	1,136	505
Roraima	253	345	84	439	311	133	231	309	574	116
Tocantins	244	189	212	156	158	271	124	63	107	56
Total Legal Amazonía	**18,226**	**18,165**	**21,394**	**25,247**	**27,423**	**18,846**	**14,109**	**11,532**	**12,911**	**7,008**

(d) Estimated rate.
Source: Data reported by the Instituto Nacional de Pesquisas Espaciais (INPE), Brazil, 2008, available at: http://www.obt.inpe.br/prodes/prodes_1988_2009.htm.

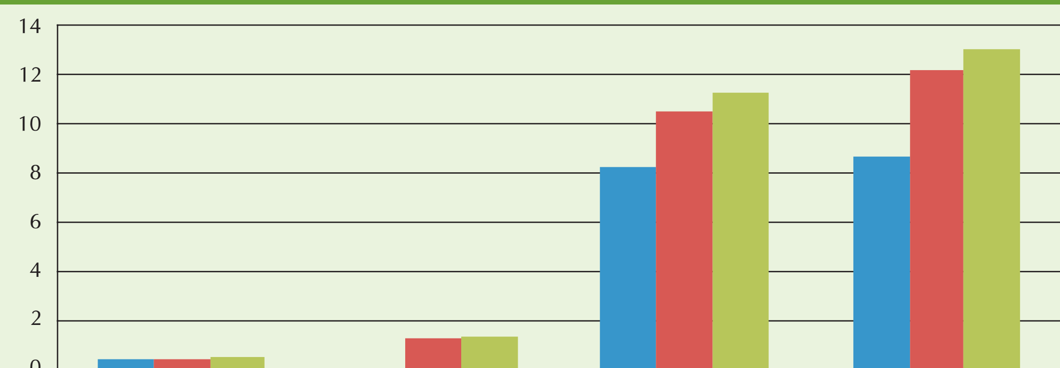
plantations in LAC were in South America, and 40% of the total planted area was in Brazil (5.38 million hectares), followed by Chile (2.66 million hectares). Argentina, Mexico, Uruguay, Peru and Cuba together accounted for 4.20 million hectares.

Eucalyptus (*Eucalyptus* sp.) and pine (*Pinus* sp.) are the two genera most extensively planted for wood and pulp in countries such as Argentina, Brazil, Colombia, Chile, Uruguay and the Bolivarian Republic of Venezuela (UAC and others, 1999). The introduction of exotic species such as eucalyptus entails risks to the environment, and can have undesirable effects such as the displacement of native species, toxic or semi-toxic effects on insects, increased water use, and the release of alelopathic substances.

Replacing primary forests with commercial plantations has major undesirable ecological effects (such as the loss of genetic diversity). Plantations do nothing to recover primary forests, and should not be used as a substitute for sound conservation programmes, although they can help reduce soil erosion and can lead to the recovery of certain environmental services, such as water capture. Although tree plantations have shown great potential for carbon storage (Olschewski and Benítez, 2005) and can be considered biomass reservoirs (Achard and others, 2004), a recent study reports that the carbon stock of monoculture plantations is 40 to 60 percent less on average than the carbon stock of natural, undisturbed forest (Mackey and others, 2008). Furthermore, the increasing creation and expansion of plantations (encouraged partly by carbon trading initiatives) can produce social conflicts due to the conversion of land devoted to subsistence farming (Gerber and others, 2009).

FIGURE 2.6

Latin America and the Caribbean: Forest Plantations 1990-2005
(Millions of hectares)



	Caribbean	Mesoamerica	South America	Total
1990	0.39	0.08	8.23	8.70
2000	0.39	1.27	10.57	12.23
2005	0.45	1.33	11.35	13.13

Source: Prepared by UNEP with data from FAO (Food and Agriculture Organisation of the United Nations), 2005: Global Forest Resources Assessment (RFA) 2005.

BOX 2.2

Problems on the Quantification of Forest Extent in the Americas

To accurately assess land cover changes in tropical environments at reasonable costs requires remote sensing technology. However, an initial problem in accurate estimation of forest cover is one of nomenclature (Jung and others, 2006). While there are numerous definitions of what is a forest, there is no consensus between the scientific community and the stakeholders (i.e. land owners, government panels, NGOs) on a definitive definition that can be used by remote sensing studies at the local, regional, national or continental level. In fact, many definitions are biased towards mature wet or rain forests, neglecting seasonally deciduous forests and stages of vegetation succession. This is compound by the difficulty of detecting tropical forest age, specially for forest over 15-year old in tropical rainforests.

Attempts have been made to consolidate definitions during the Marrakesh Accords(UNFCCC, 2001a). Based on those accords forest is defined as "a minimum area of land of 0.05-1.0ha with tree crown cover, or equivalent stocking level, of more than 10 to 30 percent and containing trees with the potential to reach a minimum height of 2 to 5 meters at maturity". This is also the definition adopted by the Eleventh Conference of the Parties when discussing the implementation of Certified Emission Reductions (Conference of the Parties 2005). In addition, stands temporarily below the thresholds but which are expected to grow or revert to forest are also included in the forest category (UNFCCC, 2001a). However, the definition of "forest" adopted by any one country is optional within the stated minimum levels defined by the Marrakesh Accords.

The effect of these discrepancies on definitions is even more evident when applied to the mapping of tropical dry forests. Although, methods for using remote sensing to monitor and detect tropical deforestation in the humid tropics have been successfully developed, tested, and implemented providing important information on the extent of tropical evergreen forests; tropical dry deciduous forests (T-df) in the other hand, have received less attention and thus the development of remote sensing methods for quantifying their extent has been neglected in comparison to wet/rain forests. Significant errors have resulted from mapping the extent of the tropical dry forest from satellite images because the cloud free images are most easily acquired during the dry season when an increased percentage of the canopy is leafless, lacking the spectral signature of green leaf biomass. This property of the canopy induces the misinterpretation of forested areas in the image for pastures or areas with dispersed trees.

To evaluate the effectiveness of climate change mitigation projects, biodiversity conservation or water resources management projects that involve the forestry sector, three fundamental questions must be addressed: what is the initial extent of the forests?, what type of forest is there (primary, secondary)? and what is the rate of change of the forest extent? Estimates of payments for environmental services, for example, are greatly dependent upon the differences between the baseline and mitigation scenarios and on deforestation rates before and after the implementation of a project; the greater the difference the greater the estimate of carbon sequestration/value of environmental services. Therefore, it is imperative that the initial state and extent of the forest (baseline determination) be characterized as accurately as possible, a problem that is not trivial due to the lack of standardized methods that can provide accurate information for different types of forest.

Until questions regarding nomenclature and types of forest classes are resolved, even for the simplest questions of "how much forest is there?" and "where is the forest?", discrepancies between various studies and problems with the estimations of payments of environmental services will persist. These discrepancies may end up costing hundreds of millions of dollars in erroneous payments, unsuccessful carbon mitigation projects or biodiversity conservation project located in the wrong place. The former also will have significant impacts on local and regional biodiversity with the results of irrevocable loss of biodiversity. In order to rectify the discrepancies, more rigorous methods including a greater emphasis on the collection of ground control data are required. In addition a standardized description of the "forest" class which takes into account the heterogeneity of the deciduous dry forests would reduce the uncertainty associated with the current land cover classifications. Some large scale global land cover maps are inherently unrealistic when examined closely at the ecosystem or country scales.

The LAC region would benefit of a joint monitoring effort, at the appropriate scale, that allows a better definition of forest ecosystems and an adequate monitoring program that allows better comparisons and more accurate information for decision making.

Source: Excerpted and adapted from Kalacska, M.; Sánchez-Azofeifa, G.A.; Rivard, B.; Calvo-Alvarado, J.C.; Quesada M. (2008). Baseline assessment for environmental services payments from satellite imagery: A case study from Costa Rica and Mexico. Journal of Environmental Management 88(2): 348-359.

3.3 Forest conservation and protection

The forests of LAC are valuable ecosystems, with a great biodiversity of species. Different strategies have been developed to conserve and protect the region's forest ecosystems. The many strategies include protected areas, forest certification, sustainable-use practices, and programmes that involve paying for environmental services (see the following sections and chapter V). Protected areas are established under national and local legislation and regulations, and face different threats at the local, national and regional levels.

3.3.1 Protected areas

The establishment of protected areas is one of the region's most important types of policy measures for conserving biodiversity. It is estimated that the total protected area in the region (in various categories) increased from 303.3 million hectares in 1995 to over 500 million hectares in 2007 (table 2.5). Currently, over 20% of the region's surface is protected (UNSTATS, 2009) (map 2.2), although this does not mean that all ecosystems are properly represented in the protected areas (Armenteras and others, 2003; Urquiza, forthcoming, 2009). Only 7.5% of the original Atlantic forests remains, and of this remaining portion, only 2.7% is protected (Hillstrom and Collier-Hillstrom, 2003).

TABLE 2.5

Latin America and the Caribbean: Protected Areas, Total Extension and Percentage of Global Total *(Millions of hectares)*

Year	Millions of Hectares	Percentage of global land area
1995	303.3	17.5
2000	394.4	20.4
2007	500.3	23.2

Source: UNEP- WCMC, 2008.

In a broad effort to protect areas in order to reduce the loss of species and natural ecosystems, and associated environmental services, the region has seen a general increase in protected forest area in recent times. The area specifically designated as protected forest rose from approximately 82.5 million hectares in 1990 to 133.2 million hectares in 2005, an increase of more than 60% (FAO, 2007c) (see map 2.2).

However, the pattern is heterogeneous: the rate of increase varies from country to country, and some sub-

MAP 2.2

Latin America and the Caribbean: Protected Areas

Source: Prepared by J.S. Contreras with data from WCMC, 2008, available at GEO Data Portal http://geodata.grid.unep.ch, consulted in February 2010.

regions even show negative growth of protected areas, as a result of illegal cutting, urban expansion, invasion by pests, and destruction by invasive species within the protected areas. The greatest amount of forest designated for conservation of biodiversity in the world is in South America, while Central America and Central Africa are the sub-regions where the greatest percentage of total global forest area is designated as such (table 2.6).

There is considerable debate regarding the effectiveness of protected areas in tropical forests. Specifically, there are concerns that many of the reserves do not adequately protect biodiversity, within their borders, from increasing human pressure, at times resulting in fires. Since the tropical moist forests are, in effect, immune to natural fires, the frequency of fires caused by human activity in these reserves is a good indicator of the performance

TABLE 2.6

Latin America and the Caribbean: Forest Area Allocated Mainly for Conservation

Sub-Región	Area (thousands of hectares)			Annual change (thousands of hectares)	
	1990	2000	2005	1990-2000	2000-2005
Caribbean	622	675	704	5	6
Mesoamerica	12,386	13,085	12,863	70	-45
South America	69,463	108,103	119,591	3,864	2,297
Latin America and the Caribbean Total	82,471	121,863	133,158	3,939	2,258
World Total	298,424	361,092	394,283	6,276	6,638

Source: FAO, 2007c.

and effectiveness of the reserves (see section on forest fires in this chapter).

Wright and others (2007) performed an analysis in which global fire detection records provided by the satellite-based Moderate Resolution Imaging Spectroradiometer (MODIS) were used to determine whether protected status influences fire occurrences for every tropical moist forest reserve. Results indicated that fire detection density was significantly lower inside reserves than in their surroundings, suggesting that tropical forest reserves do reduce the impact of human activities. However, this global effectiveness did not apply for all reserves in all countries. Tropical moist forest reserves vary wildly in their effectiveness to reduce fires.

Furthermore, there are pressures associated both with types of management and with policy frameworks (not only conservation policy, but also economic, agricultural and foreign trade policy), and these influence the effectiveness of protection schemes. Finally, co-management schemes, which represent a new feature in the region, pose additional challenges. (Examples of this are Colombia's indigenous reserves and Brazil's indigenous lands.) These approaches represent a quest for ways to respond to conflicts that arise from overlaps between indigenous areas and protected areas, and between conservation areas and mining or oil interests (box 2.3).

BOX 2.3

Protected Areas and Distributive Conflicts

One type of distributive conflict is the overlap between areas that are under some type of protection and regionally recognised indigenous land, since a number of LAC countries have specific legislation recognising the territorial rights of indigenous peoples (for example, Brazil, Ecuador, Colombia, Panama and Nicaragua). The case of the Amazon Basin (RAISG, 2009) illustrates how these overlaps can create conflict over what areas are to be conserved, the objectives of conservation activities, who is to be responsible for the conservation, and the distribution of the benefits of conservation. Although initial answers to these questions may seem simple, constructing a collective response is far more complex.

One specific case is that of Yasuní-ITT, in Ecuador, in which there was a complex interplay of interests in and demands on natural resources and conservation areas. This reserve is an example of overlap between a nature reserve, an indigenous territory and an oil drilling area. The initiative has been discussed at a State level in recent years (for more information, see the Yasuní-ITT project). The proposed solution involves keeping the crude oil in the ground to prevent CO_2 emissions, in exchange for which the international community is to compensate the Ecuadorian State for at least 50% of the income that the country would have obtained by extracting the crude oil. Although the initial objective would seem to benefit the Ecuadorian and world populations, the initiative has run into conflicting interests, and its implementation has therefore been stymied.

This is an example of how action to mitigate climate change can be linked with other conservation efforts in protected areas, such as those based on REDD initiatives (a program for reducing emissions from deforestation and forest degradation in developing countries) (see box 5.22 in Chapter V).

Source: Prepared by I. Monterroso with data from the Red Amazónica de Información Socioambiental Georreferenciada (RAISG) http://www.raisg.socioambiental.org (accessed in 2009) and Yasuní-ITT (http://www.yasunit-itt.senplades.gov.ec).

The LAC countries with the best-performing reserves include Costa Rica, Jamaica and Argentina, while those facing the greatest challenges are in Brazil, the Bolivarian Republic of Venezuela, Guatemala, Paraguay and Suriname. Success in managing and ensuring the effectiveness of protected natural areas depends to a great extent on the effectiveness of national and local institutions. As Wright and others (2007) have shown, it is also important to consider that the effectiveness of governance structures play a part in determining the design and implementation, as well as the success, of programmes to manage protected areas. The study by these authors emphasizes political instability, corruption and poverty as factors that compromise the effectiveness of reserves in Latin America and the Caribbean. Thus, the scientific community needs to improve its understanding of the reasons for variations in the effectiveness of reserve management, in order to work to improve the tropical forest reserves. Another study, which examines the establishment of two protected areas in Mexico and Guatemala (Manuel-Navarrete and others, 2006), recommends bringing together the different stakeholders involved in managing these areas at the different levels—local (communities, non-governmental organisations, State offices responsible for implementation) and national (central governments). The study underlines the importance of analysing the dynamics of local conflict, as well as the significance and beliefs that local populations attach to the environment as these relate to the existing discourse on conservation.

In addition, the ability of systems of protected areas to serve as mechanisms for conservation is being called into question as a result of new processes of global change. For example, changes in the spatial distribution of endangered species suggest the need to create new ways of managing protected areas to effectively deal with climate change (Hagerman and others, 2010). A recent effort to analyse the functioning and effectiveness of biosphere reserves, based on an approach developed by UNESCO, is the Biodiversity Governance Project,[11] which seeks to explore responses to tensions between conservation objectives and human development objectives, incorporating socio-ecological parameters in the analysis.

At the same time, socioeconomic pressures associated with the demand for resources reflect the differing interests (based on productive, subsistence or conservation objectives) with regard to soil use. Over the long term, it is important for countries to coordinate their conservation policy objectives with economic and agricultural policy goals. Otherwise, different natural resource demands and interests will create distributive conflicts regarding access to, use of, and control of resources (see box 2.3). Moreover, the fact that part of a particular protection scheme or management system is being used in one portion of a territory does not ensure that conservation schemes will be more efficient.

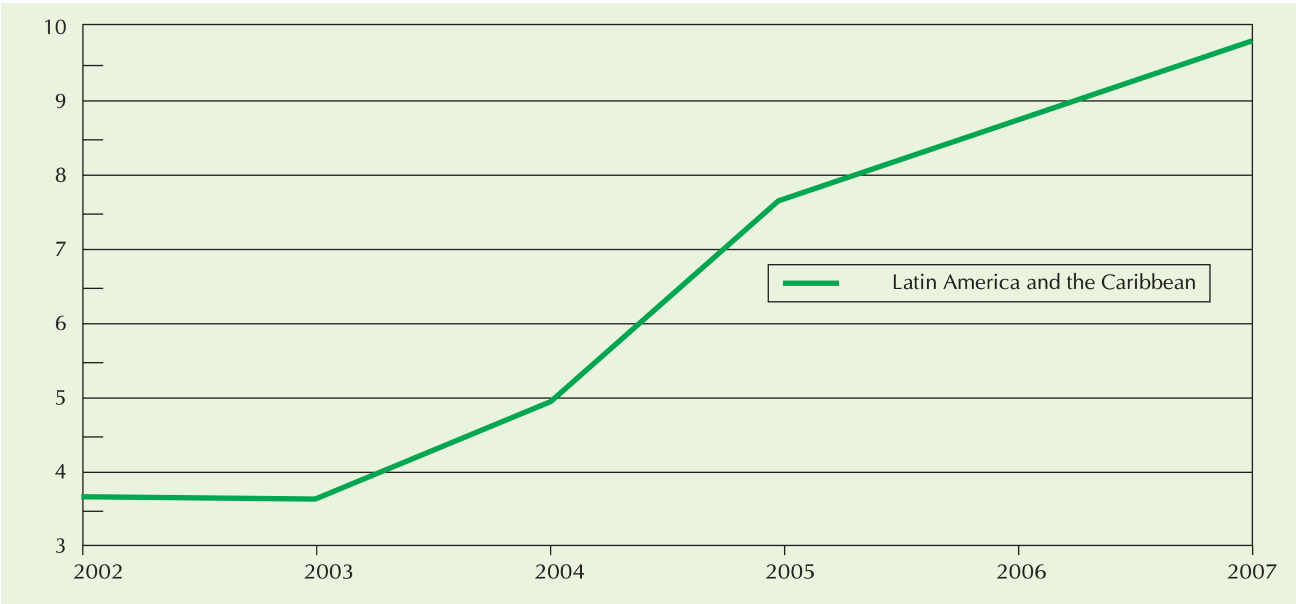
3.3.2. Certified forest production and community forest management

According to data from UNEP and the Forest Stewardship Council (FSC-UNEP, 2008), land devoted to certified forest production in LAC rose from slightly under 4 million hectares to nearly 10 million hectares between 2002 and 2007– constituting more than one million hectares annually on average (see figure 2.7).

11 http://www.biodiversitygovernance.de/publications.php?lang=en

FIGURE 2.7

Number of Hectares Devoted Annually to FSC-Certified Forest Production
(Million hectares)



Source: UNEP/DEWA/GRID-EUROPE, GEO Data portal: compiles from Forest Stewardship Council (FSC) data.

An important collateral benefit of this type of management is that it reduces the loss of local population due to migration to urban areas or to other countries. However, certification does not necessarily create an economic benefit that would compensate producers for the cost of certification, since markets do not recognise this as an important value added. Consequently, certified Latin American wood competes on an uneven playing field with the huge volume of uncertified wood (frequently foreign) that is sold on a massive scale at very low prices. The lack of economic incentives, and lack of response by consumers, could lead to both a loss of interest in certification and, in some cases, an incentive for unsustainable practices, as it could potentially promote illegal extractive activities (Urquiza, 2009).

Community forestry, as a development strategy based on community management of natural resources (forest resources, in particular), has been promoted as a viable strategy for reconciling conservation objectives with local practices and lifestyles. Such collective action has the potential to further long-term conservation goals, by establishing rules for managing and accessing forest resources, and by establishing control mechanisms and forms of organisation (see, for example, Ostrom, 1990 and Chhatre and Agrawal, 2008). Some of the region's best known experiments in community management of forest resources have occurred in Mexico, particularly in the *ejidos* (communal lands) and in Guatemala's community-owned forests and community forestry concessions in the Maya Biosphere Reserve (Larson and others, 2009). Regional experiments involving non-wood forest resources include extractive reserves in

Brazil and management of Brazil nuts in Bolivia (Cronkleton, 2008). These schemes depend on local initiatives for maximizing use of the resources.

Community management should become more important than it is today in the productive forestry sector (UNEP, 2003; Merino, 2006; Merino and Bray, 2005). Successes in forest management include dozens of cases of local community ventures that have become competitive in the wood market (Antinori and Bray, 2005). All of these cases highlight the importance of social organisation in communities and, more generally, of power relationships in the management of land.

3.3.3 Monitoring and impact of forest fires

Forest fires consume large areas. Preventing and managing them is a complex challenge, since fires of natural origin cannot be separated from those of human origin (such as fires caused by productive systems that incorporate burning as a way of eliminating plant cover or as a means of fertilisation). In addition, there is no consensus on monitoring and evaluation methods, nor is there currently any standardised terminology for reporting (FAO, 2007d).

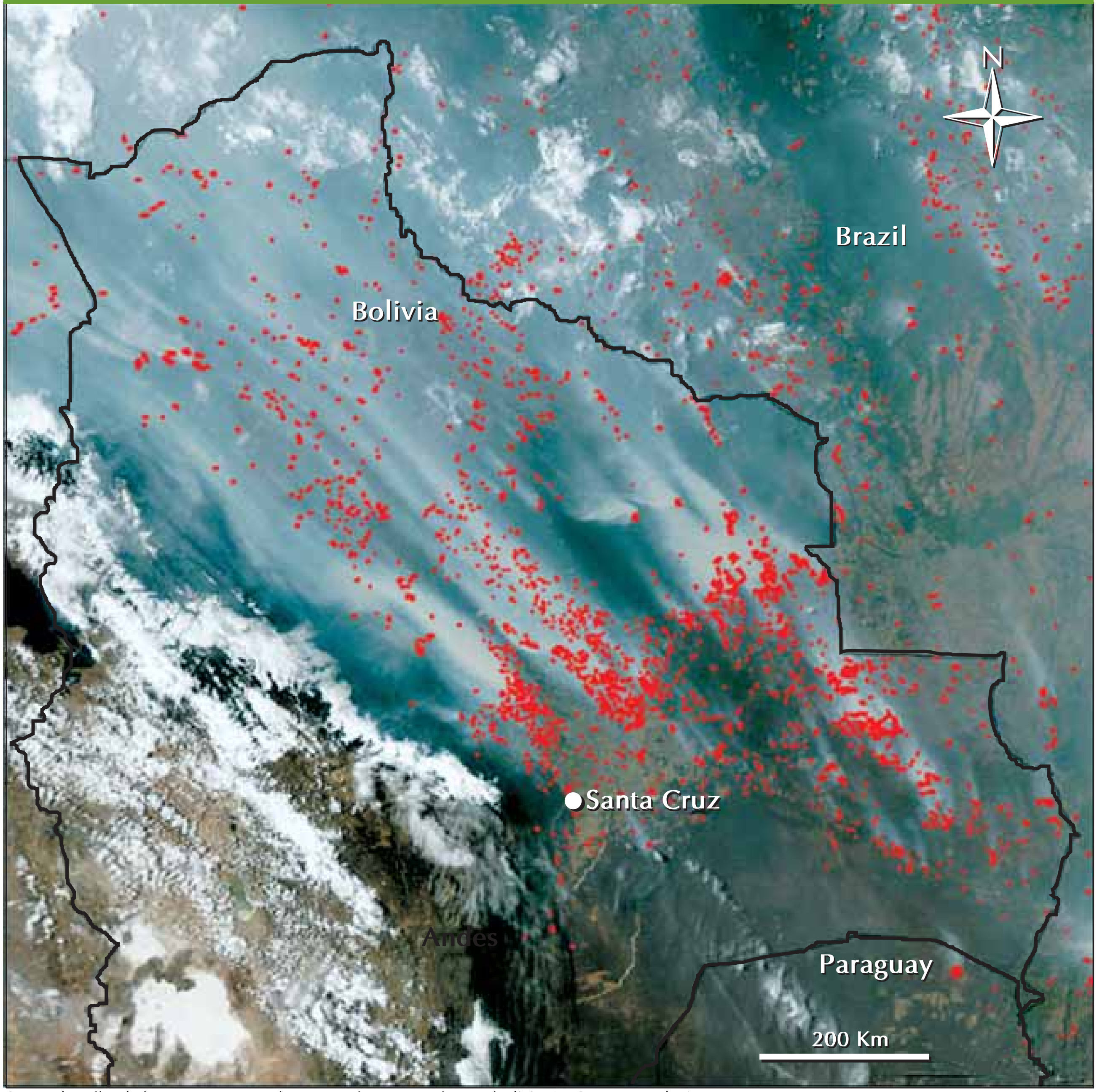
Forest fires have become increasingly important at the global level, as well as in LAC. In Central America alone, during 1998, there was a loss of more than 2.5 million hectares of forest as a result of fire (900,000 hectares in Nicaragua, 650,000 hectares in Guatemala and 575,000 hectares in Honduras), while Mexico lost 850,000 hectares. In the rest of Latin America, five million hectares were lost to fires (Cochrane, 2002). In 2004, multi-temporal images from the MODIS satellite showed 14,446 polygons corresponding to burnt areas in Latin America, covering slightly over 15,300 hectares (Chuvieco and others, 2008). The countries most affected were Argentina, Brazil, Colombia, the Plurinational State of Bolivia and the Bolivarian Republic of Venezuela. The savannah in Colombia and the Bolivarian Republic of Venezuela, the tropical forest boundary between Brazil and the Plurinational State of Bolivia, and Argentina's central and northern provinces suffered the largest burns. In LAC between 2000 and 2004, nearly 3.3 million hectares were lost to fire (FAO, 2007c). Mexico reports that 984,909 hectares were affected in areas with tree, shrub and grass cover in 2000-2004 (SEMARNAT, 2009). Given the scarcity of data, it is difficult to estimate the total regional impact. There are no recent figures, for example, for the Caribbean Island region. It is a notable fact, however, that fires are reported primarily in dry and semi-dry tropical forest ecosystems (Robbins, 2006).

In the last 31 years, the areas most severely affected have been protected areas in Argentina, the Plurinational State of Bolivia, Chile and Uruguay—particularly natural grasslands or secondary grasslands that emerged after the original vegetation was disturbed. The savannahs and dense scrublands of Brazil, the Plurinational State of Bolivia, Colombia and the Bolivarian Republic of Venezuela have been less affected, but 12% of the burnt areas are tropical rainforest in the Amazon Basin (Manta Nolasco, 2006), one of the planet's most productive ecosystems. Even in the absence of good monitoring and accurate figures, however, it is clear that human activity is the principal source of these fires, and is a direct determinant of the magnitude of the damage inflicted (Cochrane, 2002; FAO, 2007d; Manta Nolasco, 2006; Robbins, 2006).

Efforts to prevent and manage forest fires have led to a number of collaborative activities involving countries throughout the region. In Mexico, the detection of heat points is the responsibility of the National Commission for the Knowledge and Use of Biodiversity (CONABIO), with management and prevention being handled largely by the National Forest Commission. Guatemala, El Salvador, Costa Rica and Honduras operate within their Forest Fire Detection Programme. In South America, Argentina's National Meteorological Service provides daily updates to two fire indices; as a part of its Sustainable Forest Management Project, known as BOLFOR, the Plurinational State of Bolivia has a website that provides data from the Forest Fires Early Warning System (SATIF), which it updates on a daily basis; Brazil's National Meteorology Institute publishes early warnings as part of the PREVFOGO programme, while the National Space Research Institute monitors heat points in close to real time as part of the Pro Arc of Deforestation programme (Brazil, 2005a, b) (see map 2.3). Brazil also has Independent Forest Monitoring (IFM) projects (see box 2.4).

MAP 2.3

Heat Points Detected by the NASA Early Warning System, During the "Chaqueo" Season of 2007



Source: http://earthobservatory.nasa.gov/Newsroom/NewImages/Images/Bolivia_AMO_2007268_lrg.jpg

BOX 2.4

Independent Forest Monitoring (IFM)

The Independent Forest Monitoring (IFM) projects funded by Global Witness are based on cooperation by different actors —including governments, civil society and the private sector— in wood-producing countries. The programme's principal objective is to analyse violations of the law, treating the issue of fires as one of the main threats. The use of fire to convert forest lands to agricultural use or grazing has been widely studied as one of the major pressures associated with changes in land use, especially in sub-Saharan Africa and in Latin America (Lauk and Erb, 2009).

To address these pressures, IFM provides training in forest monitoring techniques, including fire monitoring and legal assistance in cases that are taken to court, in order to ensure that the benefits of forest management are not compromised by illegal activity or by transaction costs associated with the oversight that local groups must exercise to protect their right to exclude third parties. The programme is influential at the global level; in LAC it is being implemented in Honduras, Nicaragua and Peru.

Source: Prepared by I. Monterroso with data from Global Witness (http://www.globalwitness.org/pages/es/ifm.html) and Lauk and Erb, 2009.

3.4 Climate change and forest responses to climate change

In recent years, phenology, which is the study of recurrent biological events and their relation to climate change, has been recognised as a tool for detecting the effect of climate change on plants and animals (box 2.5). Despite the converging conclusions and the extensive evidence of both climate change and changes in biological systems documented in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report of Group I and Group II, evidence of these changes in tropical regions is still weak and has not been fully documented. In fact, more cases of climate change and ecological response have been documented in the United States than in all of Latin America, an area for which the IPCC (2007b) has only reported five studies involving some degree of forest response to climate change.

BOX 2.5

Phenological Patterns in the Amazon Forest

The phenological patterns (i.e. the pattern of periodical processes such as producing or loosing leaves, flowering and fruiting) of the Amazon forest trees are still to be revealed. The few data available up to now show the presence of seasonal patterns of flowering and fruiting, concentrated in the driest part of the year. If similar changes occur on plant reproductive phenology in the tropics, as described for temperate ecosystems, there may be stronger consequences of global climate change for this very diverse system.

More than 80% of tropical plants are dependent of animals for their pollination and seed dispersal, and many animals relay on plants as food supply. A break on the chain synchrony due to an early (or late) flowering or fruiting phenology may lead to the silent loss of many species through the loss of plant-animal interactions.

The leafing phenological patterns are even less understood, in spite of their importance for all other processes across the forest, from photosynthesis to reproduction. In the humid tropics, the pattern is supposed to be less seasonal than in dry or temperate ecosystems, occurring all over the seasons. The lack of historical data series is the main constraint to understand the Amazon forest dynamics and the influence of the changing climate.

The great extension and high diversity of the Amazonian forest prevents the development of extensive ground based studies. However, the creation of a network of phenological stations ideally associated to the established climatic stations and carbon monitoring systems would represent a great step forward to understand the effects of climatic changes on tropical forest reproductive and leafing patterns. A similar system has been used over all Europe for many years, and implemented over areas or countries without a similar system (COST action 725 'Establishing a European phenological data platform for climatological applications') (http://www.cost725.org), leading to an efficient way to monitoring climatic changes based on phenology.

Planning a phenology network for the tropics or even just for the Amazonian region is a huge task. However, such enterprise would provide much more than just the monitoring results expected. The phenology network data may turn more reliable the extractive activities due to the existence of a reproductive calendar for the key species on each ecosystem. The cross comparisons may improve our understanding of forest dynamics and the consequences of the loss of pollinators and seed dispersers.

Source: Prepared by P. Mollerato.

A limited number of regional studies have been conducted for Latin America and the Caribbean in efforts to better understand current climate trends. They show patterns of change in the occurrence of extreme events, suggesting that these are related to general warming; in addition, they signal an upward trend in the occurrence of intense rains followed by dry days (Magrin and others, 2007). However, the absence of long-term daily temperature and precipitation records in most of South America's tropical countries makes it impossible to assemble conclusive evidence of trends in patterns of extreme events.

Tropical plant and animal species can be highly sensitive to small climate variations, since biological systems respond slowly to changes that are, themselves, rather rapid (Magrin and others, 2007). Using climate models from the Hadley Centre at the British Meteorological Office, IPCC Group II cites the work of various researchers who point to the potential extinction of 24% of the 138 tree species in central Brazil by 2050, based on a projected temperature rise of 2°C (Magrin and others, 2007).

Studies of the Amazon's ecosystem, summarised in Betts and others (2008), establish that warming and increased dryness will lead to a rise in the altitude of certain temperature zones, and will bring changes in other key meteorological conditions, such as increased condensation, with the consequent migration of species (or of complete ecosystems) to higher altitudes more conductive to the conditions to which they are adapted. Similarly, Killeen and Solórzano (2008) stress that highly biodiverse mountain regions, such as the Andes and the Brazilian and Guyanese Shields, are highly vulnerable to climate change, and that they could become refuges for lowland species that cannot tolerate warming. Furthermore, Powel and others (2006) demonstrated for the first time that there is a significant connection between climate change, microclimate and the disappearance of biodiversity. Their study was based on long-term temperature series for various cloud forests in Latin America, and indicates that significant microclimatic changes are driving the extinction of up to 67% of the 110 species of harlequin frogs.

In many cases, these small changes in the forest microclimate, caused by climate change, may not be detectable, but they are an early warning sign of the vulnerability of Latin America's forests to climate change.

Although there is not yet a full understanding of the effects of growing CO_2 emissions, nitrogen fixing, air pollution (for example, from aerosols, deriving from the burning of biomass) and climate change, preliminary evidence suggests that these could cause significant changes in the structure of forest ecosystems and in their specific composition, especially in the Amazon (UNEP, 2009).

Recent studies have revealed that a process of migration is occurring, along with an expansion of certain types of ecosystems, in response to changes in climatic and biochemical conditions (Silva and others, 2008, quoted in UNEP, 2009). For instance, new evidence from central Brazil reveals a migration of gallery forests into surrounding savanna regions (UNEP, 2009). It appears that climate changes may be causing ecosystems to migrate, and that subsequent feedback mechanisms, including the accumulation of nutrients and the suppression of fires, can further drive the process of expansion (Silva and others, 2008, quoted in UNEP, 2009). Similarly, Phillips and others (2002) have found an increase in the density and predominance of large lianas during the last two decades of the twentieth century throughout the western Amazon, and a number of Atmosphere-Ocean General Circulation Models (AOGCM) indicate a trend to «savannization» in the eastern Amazon (Nobre and others, 2005) and in the tropical forests of central and southern Mexico (Arriaga and Gómez, 2004). What Phillips and others (2002) reported was later confirmed independently by Wright and Calderón (2005), who documented a similar increase in the predominance of lianas on Barro Colorado Island, in Panama. In a scenario of climate change trending towards warmer and drier climates in southern Mexico's Chiapas highlands, it was shown that narrowly endemic species could be in danger of extinction (Golicher and others, 2008). Other studies suggest that the semi-arid vegetation of northeastern Brazil could be replaced by arid vegetation (Nobre and others, 2005), as could also occur in most of central and northern Mexico (Conde Álvarez and Saldaña Zorrilla, 2007).

In the deciduous (low-lying) tropical forests of Mexico, Costa Rica, the Bolivarian Republic of Venezuela and Brazil, recent evidence points to changes in the ecosystems' productivity as a result of climate change (Sánchez Azofeifa and Quesada, 2009). It shows that deciduous tropical forests, specifically the forest situated along Mexico's Pacific coast (in the state of Jalisco) may be a unique indicator of response to climate change in tropical ecosystems, and could provide a phenological answer that is more precise and uniform, as well as easier to model and predict, than observations in tropical rainforests.

The framework of the new climate change negotiations has put forests at the centre of mitigation proposals, in initiatives such as REDD (see box 5.10, chapter V), which aims primarily to reduce greenhouse gas emissions, especially carbon dioxide, resulting from deforestation and forest degradation. The possibility of converting forests into carbon sinks that could be traded

on the market has irreversibly changed the social perception that forests are distant areas with little economic-development potential (RRI, 2010). These discussions have highlighted a series of risks and opportunities associated with forest ecosystems and the groups that inhabit them—for example, the possibility of strengthening the rights of local and indigenous populations that have historically lived in forested areas and the need to clarify who possesses the rights to the carbon, as well as the question of how decisions on this resource should be made. Finally, it is important to recognise that including forests in climate change negotiations creates an opportunity to advance forest resource governance at the global level.

3. 5 Forests and ecosystem services

Changes in soil use by human beings is one of the most important processes driving global environmental change. Approximately 50% of the earth's ice-free area has been profoundly altered by human activity (Turner and others, 2007). Over time, the cumulative effect of changes in how humans have used soil has put increasing pressure on ecosystem goods and services that sustain human life and maintain the integrity of ecosystems (Daily and others, 1997).

Understanding the causes of changes in land use and, no less importantly, how we can intervene to reduce their negative impact on ecosystems, is a significant, albeit difficult, challenge. Changes in land use are driven by a complex and dynamic interaction of structural (large-scale) and immediate (small-scale) factors (Lambin and others, 2003). To thoroughly understand the causes of global patterns of change in land use, we need to understand how large-scale influences lead to differing results in different places (Turner and others, 2007).

One important objective in researching changes in land use is to identify how governmental conservation programmes can act to lessen the negative impact on ecosystem services. The results of national conservation programmes can differ from place to place, just as large-scale changes in land use can have differing effects in different locations. Consequently, scientific investigation plays an important role by providing those responsible for managing conservation areas with information on how small-scale factors influence the potential effects of particular conservation programmes in specific places.

Costa Rica is an example of the connection between research and public policy. That country has implemented a large number of conservation programmes designed to change the way people use land, so as to reduce the negative impact on ecosystem services. The two most influential programmes are the National Protected Areas system and the Payment for Environmental (or ecosystem) Services (PES) programme.

The PES programme began in 1997 and is a complement to the protected areas system, providing economic compensation for land owners to protect forests or to reforest adjacent private land. The province of Guanacaste in northeastern Costa Rica is a good case study for investigating the structural and immediate causes of changes in land use, as well as the small-scale factors that affect the results of conservation programmes, especially those associated with payment for environmental services.

Traditionally a cattle-raising area, Guanacaste underwent significant social and economic change in the last 20 years: tourism expanded rapidly and trade grew, while agriculture and livestock became markedly less important in the region's economy. Starting in the 1930s, forest cover steadily decreased, as forest was converted into grazing land for cattle. This left the region with practically no forest cover by the early 1980s (Arroyo-Mora and others, 2005). Since then, however, forest cover has increased as grazing lands have been abandoned, permitting the forests to regenerate naturally. Today, young secondary forests cover nearly 47% of this area (Sánchez-Azofeifa and others, 2006), a pattern of loss and recovery that provides a good example of forest transition (Rudel and others, 2005) (see box 2.6).

However, this image of how land use has changed in Guanacaste Province is a simplistic one. At smaller scales, the area has experienced local patterns of forest loss due to residential and tourist development, expansion of large agribusiness and wood-cutting, and spontaneous forest fires. This pattern of small-scale deforestation contributed to the loss of over 8,000 hectares of forest between 2000 and 2005. Some interviews with landowners reveal that Guanacaste's young secondary forests are vulnerable to pressure from the emergence of new economic opportunities, as landowners seek new ways of supporting themselves in a rapidly changing economy or sell their property to foreign developers. This situation illustrates how specific local factors can impact the performance of conservation programmes.

Increasing land prices in Guanacaste have made land an important economic resource again, and in this context, payments under PES schemes are too low to effectively motivate people to protect their forests in the future. At the same time, the economic and cultural effects of modernisation and globalisation have increased living costs and changed the aspirations and lifestyles of traditional landowners. In recent years, this has led many families to sell property to foreign investors and to seek new job opportunities in tourism and commerce. It is unlikely that payments in the context of the PES will offer a substantial incentive to the new generation of foreign land owners, whose aspirations for land use are different from those of the original owners. Thus, rather than being «forests in transition», these should be considered «forests on hold», since their status can change rapidly as shifts in socioeconomic conditions begin to once again favour deforestation (Calvo Alvarado and others, 2009).

BOX 2.6

Forest Transition

Historically, the region has made intensive use of its forests, in addition to simply eliminating vegetation in order to convert land to urban development, agriculture, mining and other uses. In some places, however, the phenomenon of forest transition, or natural reforestation, has emerged where land that was originally forested and then converted to other uses is abandoned for one reason or another, allowing the forest to regenerate (Rudel and others, 2005):

- *The first form of transition occurs when workable land is abandoned, as the rural population seeks economically more profitable work, or what Rudel and others (2005) call the "path of economic development". This trend can be accentuated by policy decisions that designate certain areas as parks or reserves.*

- *The second form of transition occurs in cities whose ability to import forest products is minimal. Because of this, and the deforestation that has occurred previously, growers and peasants opt to develop forest plantations rather than engage in agriculture or cattle raising.*

In countries where soil exhaustion, poverty and the absence of economic opportunities, as well as emerging cultural patterns, are forcing rural populations to abandon their land and migrate to wealthier regions or countries, forest transition is slow. Such is the case, for example, in Michoacán, in Mexico (Klooster, 2000), and in Ecuador's Amazon and highlands (Preston, 1990, quoted in Rudel and others, 2002). No forest transition is expected in Brazil, because pressure from rural populations without land leads to rapid occupation of abandoned land, thus preventing reforestation (Rudel and others, 2002).

Source: Prepared based on Rudel and others, 2002, 2005. Klooster, 2000.

4. Biodiversity

According to the United Nations Convention on Biological Diversity (CBD), «Biological diversity» means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems» (CBD 2001). This definition highlights the multiple aspects of the concept and encompasses: the different levels at which it is expressed (ecosystems, species, populations and genotypes); geographical scale (local, regional, continental, global); and timeframes. All of these must be considered in examining biodiversity, along with the interaction between the different factors.

The distribution of biodiversity is neither random nor uniform throughout the planet; instead, biodiversity tends to be concentrated in specific locations (ecoregions). Moreover, most terrestrial species are distributed within relatively small areas, often coinciding geographically to produce areas with a wealth of species and/or of species unique to the region (endemic). The Latin American and Caribbean region is perhaps the most important repository of biodiversity on the planet, serving as home to an immense variety of ecosystems, species and genotypes (Dinerstein and others, 1995).

Ecoregions are large expanses of land or water that contain geographically distinct assemblages of natural communities that (a) have a majority of species and ecological dynamics in common; (b) share similar environmental conditions; and (c) interact ecologically in ways critical to their persistence over time. Although Latin America and the Caribbean (LAC) constitute only approximately 15% of the earth's surface, the region contains nearly 20% of all of the recognized ecoregions in the world (Table 2.7). The World Wildlife Fund (WWF) has identified what it terms the «Global 200», a group of 238 ecoregions (terrestrial, marine and freshwater) considered to be priority areas for global conservation and which, together, represent notable examples of the biodiversity of each continent and ocean basin (WWF, 2008). Fifty-three of these 238 ecoregions are located in Latin America and the Caribbean.

TABLE 2.7

Latin America and the Caribbean: Number of Ecoregions and Percentage as of Total Ecoregions

Ecoregions	World Total	LAC	% of world total
Terrestrial	867	184	21
Fresh Water	426	94	22
Marine	232	36	15.5

Source: Olson and others, 2001; Spalding and others, 2007; Abell and others, 2008.

It is no surprise that, as mentioned earlier, six of the region's countries (Brazil, Colombia, Ecuador, Mexico, Peru and the Bolivarian Republic of Venezuela) have been included among the 17 megadiverse countries in the world—a group of nations that comprises less than 10% of the earth's land surface but houses around 70% of its species of mammals, birds, reptiles, amphibians, plants and insects, and the majority of its moist tropical rain forests, coral reefs and other high-priority ecosystems (Mittermeier and others, 1997) (see Table 2.7). This is a region in which endemism is common: 50% of the plant life of the Caribbean sub-region exists nowhere else in the world (Mittermeier and others, 2004). LAC is the most ecologically diverse area on the planet. The richness of the eastern slope of the Andes is an example of this, and is due to a wide variety of factors, such as geographical position, altitudinal gradient, complex geological history and vast diversity of microhabitats (Van der Hammen, 2002; Young, 2007). The most important wildlands in the world, in terms of biodiversity, include vast expanses of this area. Examples include the *llanos* (flatlands) of Venezuela; the Pantanal (Mato Grosso, in Brazil, and parts of the Plurinational State of Bolivia and Paraguay), which is the largest wetlands area in the world; and Uruguay's Bañados del Este—all of which represent important habitats for terrestrial vertebrates endemic to these areas (Mittermeier and others, 1997; Hillstrom and Collier-Hillstrom, 2003).

4.1. Richness of species

It is difficult to arrive at a specific estimate of the number of species in the region; nor is there even, as yet, any reliable estimate of the total number of species in each of the world's various regions or on the planet as a whole (Dirzo and Raven, 2003). For some groups of organisms –typically the more conspicuous, widely appreciated, or economically important ones– there are reasonably complete catalogues of known species. This is not the case, however, for species with no recognized economic value, or for those that are small, difficult to collect, or that attract little popular interest. Table 2.8 shows the number of known species in LAC as a percentage of the total number of known species in the world.

TABLE 2.8

Latin America and the Caribbean: Total Number of Known Species in LAC as a Percentage of Total Known Species

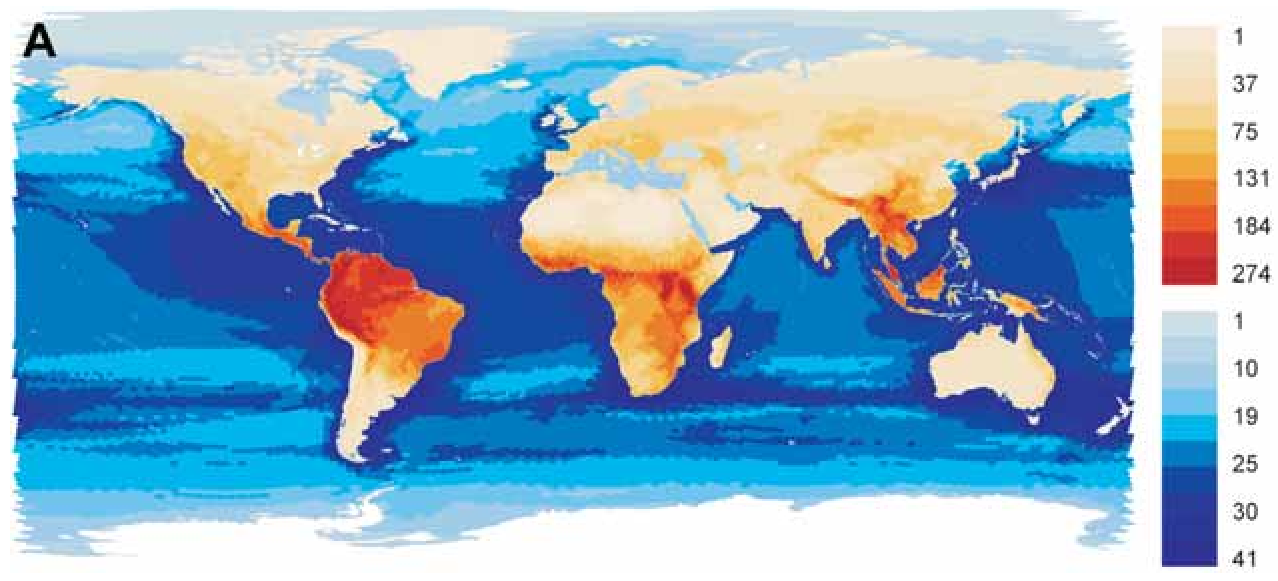
	Total known species[1]	Species in Latin America and the Caribbean	**% of World Total**
Birds	9,990	4,110 [2]	41%
Mammals	5,847	1,791 [1]	30%
Anmphibians	6,347	3,148 [3]	50%
Reptiles	8,734	3,060 [1]	35%
Fish	30,700	9,597 [5]	31%

Source: 1) IUCN, 2008b, 2) BirdLife International, 2003, 3) Frost, 2008, 4) Uetz, 2008, 5) Froese and Pauly, 2008.

The vast biological wealth of the region becomes clear when one examines geographical patterns of diversity. Map 2.4 shows the density of species of terrestrial and marine mammals, indicating the number of different species corresponding to contiguous hexagonal cells of 22,300 km² each (IUCN and others, 2008a). Some of world's highest-density concentrations of terrestrial mammals are in Central America and in tropical South America; a highly diverse range of marine mammals is concentrated in the Caribbean Sea and in the Central Pacific Ocean around Central America; and the Gulf of California is so rich in species that it has been called «the world's aquarium». A recent expedition, involving several small-submarine dives, identified between 15 and 20 new marine species (Aburto-Oropeza and others, 2010); in South America, Eschmeyer (2006), in a mere five years of research, found 465 new species of fish in bodies of freshwater. Brazil is home to the greatest number of native mammal species in the region (see Figure 2.7), with 648, followed by Mexico, with 523 (IUCN, 2008b).

MAP 2.4

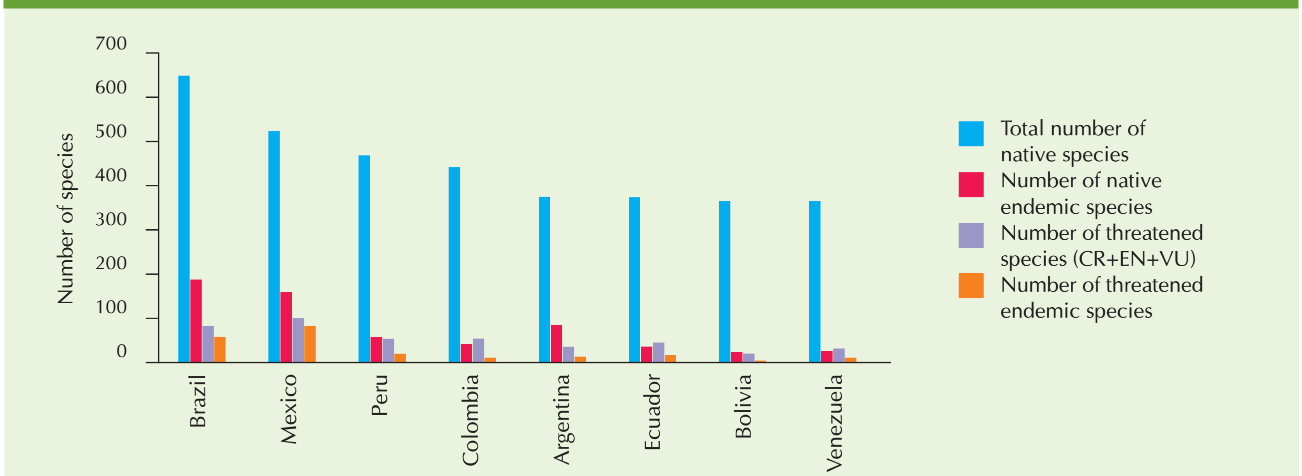
Density of Terrestrial and Freshwater (in brown) and Marine (in blue) Species in a Grid of Hexagonal Cells



Source: IUCN, 2008b.

FIGURE 2.8

The Eight Latin America and Caribbean Countries With the Greatest Diversity of Mammalian Species



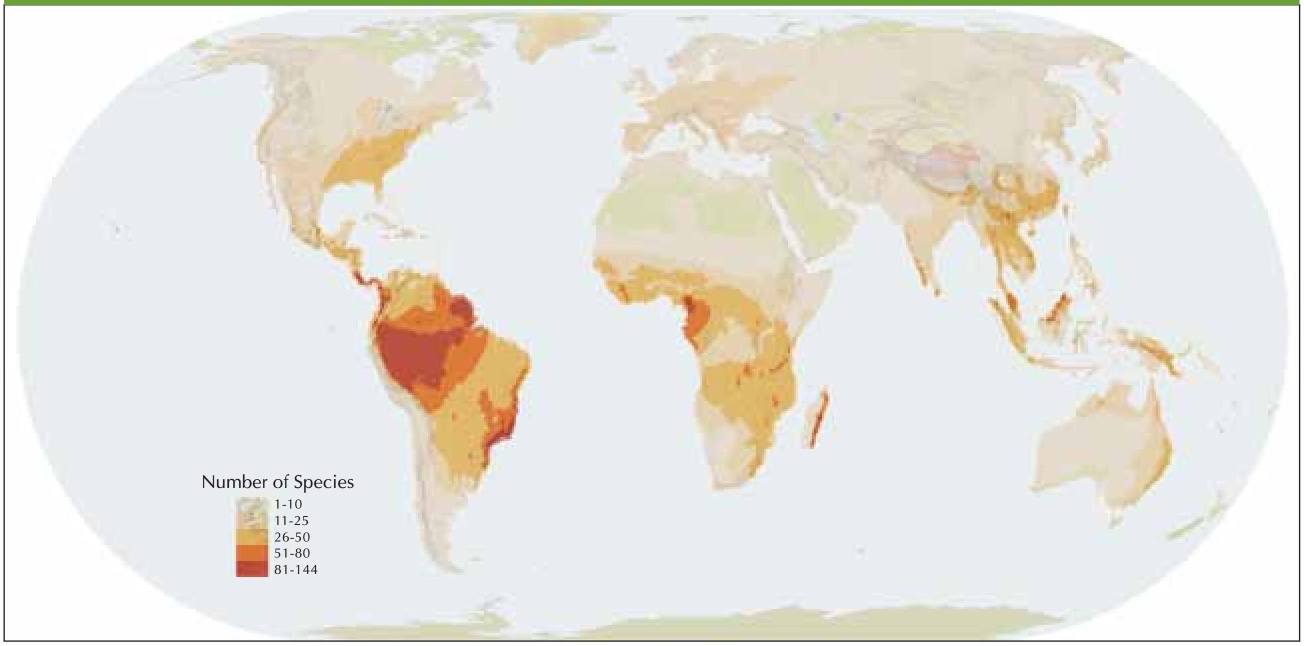
Source: IUCN, 2008b.
Note: Shown are the total number of native species, the number of endemic native species, endangered species and endemic endangered species. The total number of native species includes extinct species. EX= Extinct; CR = Critically threatened; EN = Endangered; VU = Vulnerable.

Map 2.5 shows the density of amphibian species at the world level (IUCN 2008c). The parts of the world with the greatest density of amphibian species are in southern Mesoamerica and in tropical South America. Brazil, with at least 798, is the country with the greatest number in the world, followed by Colombia. Figure 2.9 shows data for the nine LAC countries that are richest in amphibian species.

Map 2.6 shows the estimated richness of vascular plant species in the different ecoregions of LAC, which is the second most diverse region in the world for this group of organisms (Kier and others, 2005). Of the 51 ecoregions with over 5,000 higher plant species, 33 are in LAC, and 9 of the Mesoamerican and South American ecoregions have over 8,000 species each (table 2.7). While there is a vast number of known species, many

MAP 2.5

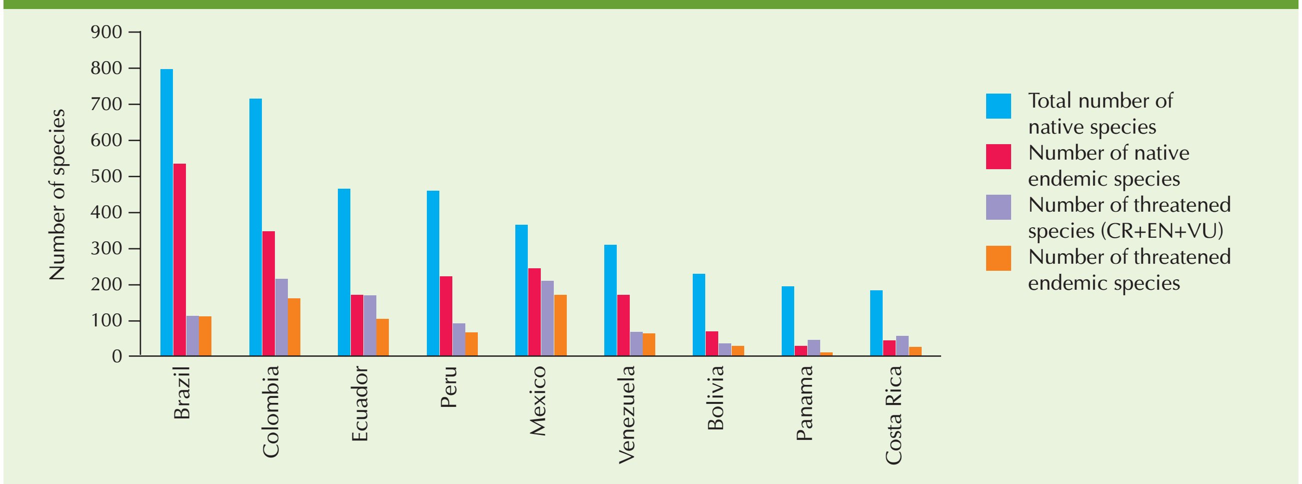
Density of Amphibian Species in a Grid of Hexagonal Cells



Source: IUCN, 2008c.

FIGURE 2.9

The Nine Latin American and Caribbean Countries with the Greatest Diversity of Amphibian Species



Source: IUCN, 2008c.
Note: Shown are the total number of native species, endemic native species, endangered species and endemic endangered species.
EX= Extinct; CR = Critically threatened; EN = Endangered; VU = Vulnerable.

remain to be discovered. In 2010, ten new species of frogs were found in the forests of Darién, in Colombia,[12] and 30 new species of frogs and salamanders were found in Ecuador.[13]

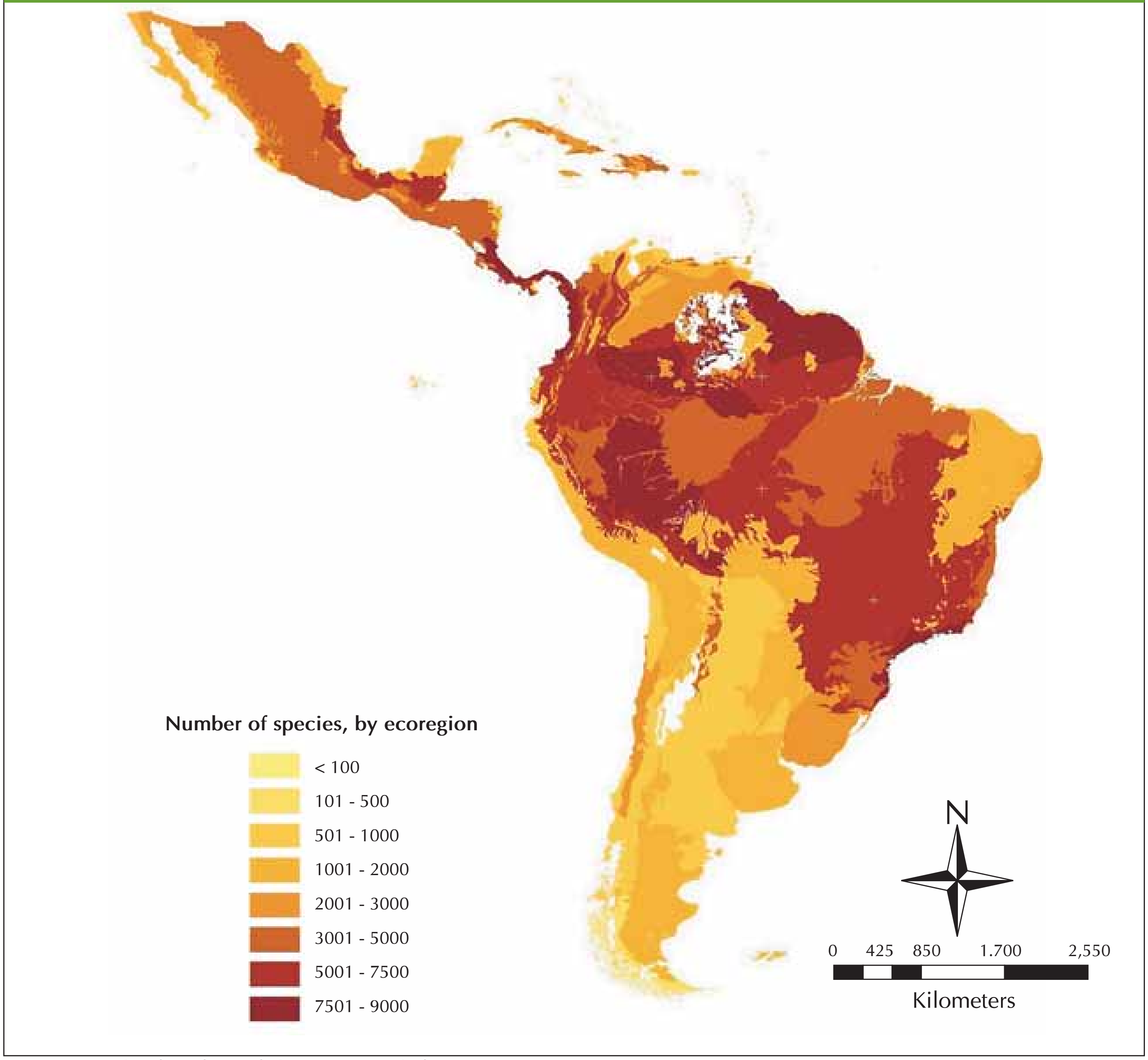
Table 2.9 shows the 33 LAC ecoregions with the greatest wealth of higher plant species. The name of each ecoregion is shown, along with its operative number of species and the estimated interval of the wealth of species. The interval is calculated based on both published and unpublished data, as well as on a variety

12 *http://www.eltiempo.com/verde/faunayflora/home/10-nuevas-especies-de-ranas-fueron-descubiertas-en-la-selva-colombiana-del-darien_4790946-1*

13 *http://www.bbc.co.uk/mundo/ciencia_tecnologia/2010/01/100119_1055_gale_lp.shtml*

MAP 2.6

Latin America and the Caribbean: Estimated Wealth of Vascular Plant Species in the Different LAC Ecoregions



Source: Prepared by the authors with data from Kier and others, 2005.

of additional data, using the most appropriate of four different estimation methods. The operative number of species is the particular estimate considered most suitable for each ecoregion and used by other studies. The relevant methodological details are described in Kier (2005).

TABLE 2.9

Latin America and the Caribbean: The 33 Ecoregions with the Greatest Wealth of Higher Plant Species

Ecoregion Name	Operative number of species	Estimated interval of wealth of species
Moist forests of Chocó-Darién	9,000	7,000-10,000
Coastal forests of Serra do Mar	9,000	6,000-11,000
Moist forests of Caqueta	9,000	7,000-11,000
Mountain forests of Talamanca	8,500	6,000-11,000
Moist forests of the Southeastern Amazon	8,500	6,000-9,000
Moist forests of Isthmus Atlantic Complex	8,000	5,000-11,000
Moist forests of Japura-Solimoes-Negro	8,000	5,000-10,000
Moist forests of the Guyana highlands	8,000	6,500-9,000
Moist forests of Guyana	8,000	7,500-9,000
Moist forests of Solimoes-Japura	7,000	5,500-11,000
Moist forests of Napo	7,000	6,000-10,000
Moist forests of Isthmus Pacific Complex	6,500	5,000-8,000
Mountain forests of the Northeastern Andes	6,500	5,500-7,000
Royal mountain forests of the Eastern Cordillera	6,500	5,500-8,000
Moist forests of Petén-Veracruz	6,500	5,000-8,000
The Peruvian Yungas	6,500	5,000-8,000
Moist forests of Negro-Branco	6,500	5,000-8,000
Moist forests of Uatuma-Trombetas	6,500	5,500-8,000
Interior forests of Paraná-Paraiba	6,500	4,500-8,000
The Cerrado	6,500	6,500-8,000
Moist forests of Veracruz	6,000	4,500-7,000
Bolivian Yungas	6,000	5,000-8,000
Interior forests of Bahia	6,000	5,000-7,500
Moist forests of Madeira-Tapajos	6,000	4,500-7,000
Mountain forests of the Eastern Cordillera	5,500	4,000-7,000
Mountain forests of the Magdalena Valley	5,500	4,000-7,000
Moist forests of Western Ecuador	5,300	4,500-7,000
Coastal forests of Bahia	5,000	4,000-6,000
Moist forests of Purus-Madeira	5,000	3,500-6,500
Varzea de Purus	5,000	3,500-6,000
Moist forests of Jurua-Purus	5,000	4,000-6,500
Moist forests of Xingu-Tocantins-Araguaia	5,000	4,000-6,000
Moist forests of Tapajos-Xingu	5,000	4,000-6,000

Source: Kier and others, 2005.

4.2 Habitat loss and fragmentation

Various social and environmental factors affect the loss and fragmentation of habitat in LAC. These include demographic pressures, globalisation of the market, pollution, climate change, over-exploitation, invasion of exotic species, changes in soil use, deforestation and forest fires, and weak and poorly implemented policy, as well as failure to effectively enforce laws (Laurance 1991; Lambin and others, 2003; Hillstrom and Collier-Hillstrom, 2003; UNEP 2007).

Habitat loss and fragmentation have a variety of negative effects on the ecological functioning of natural systems. For example, the plant structure of fragments of preserved forest are changed by, among other things, edge effects, which are changes in ecological conditions associated with boundaries where there are abrupt shifts in vegetation (Wiens and others, 1985; Harris, 1988; Murcia, 1995; Barillas-Gómez, 2007). Moreover, fragmentation of habitat leads to a significant loss of plants that depend on polinizing organisms to reproduce, as well as to a loss of animals that require large areas to survive (such as large predators and herbivores) (Laurance 2004; Laurance 2007). Phillips and others (2009) found that, under projected scenarios for the coming years, the Amazon forest could be a major source of carbon emissions into the atmosphere, as it loses biomass due to the death of various species as a result of changes in climate patterns.

Nine of the 34 places that Mittermeier and others (2004) identified as biodiversity «hotspots» (that is, areas with at least 1,500 endemic species and 70% loss of original habitat) are in Latin America and the Caribbean. These include part of the California Floristic Province, the Tropical Andes, Mesoamerica, the Caribbean Islands, the open pine-oak forests of the Sierra Madre, the Chilean Winter Rainfall-Valdivian Forests, Tumbes-Chocó-Magdalena, Cerrado, and the Atlantic Forest of Brazil (Map 2.7).

Group II of the Intergovernmental Panel on Climate Change (IPCC) states that deforestation and forest degradation resulting from fire, selective cutting, hunting, edge effects and fragmentation represent the

MAP 2.7

Latin America and the Caribben: Biodiversity *Hotspots*

Source: Prepared by the authors with data from Mittermeier and others, 2004.

greatest threat to biodiversity and source of change in South America (Magrin and others, 2007). However, the most important cause of habitat loss, overall, in the region during the last few years has been the notable expansion of large-scale commercial agriculture for export products such as soy, biofuels, beef cattle, fruits, vegetables and cut flowers (World Bank, 2007). Threats to biodiversity in marine and coastal ecosystems are discussed in the «Seas and coastal areas» section of this chapter.

4.3. Endangered/extinct species

Unfortunately, if many recent assessments and studies are correct, the enormous biodiversity of Latin America and the Caribbean is being lost or is seriously threatened by human activity, a phenomenon that is occurring at all levels and throughout nearly all of the region. In fact, according to the 2005 Millennium Ecosystem Assessment (MEA), global biodiversity is decreasing at rates unprecedented in human history, and LAC is no exception to this trend.

Five of the 20 countries with the greatest number of endangered species of fauna, and 7 of the 20 countries with the greatest number of endangered plant species, are in LAC (IUCN, 2008a) (see table 2.10). Unfortunately, there is increased risk of extinction for highly specialised organisms and for large organisms, such as many mammals, and this is particularly serious for species considered rare (Ceballos and others, 1998). This situation is aggravated by reductions and fragmentation of habitats. Moreover, the importance of other phenomena takes on even greater significance in light of the fact that rare species are more numerous than common species.

LAC is one of the richest regions in forest diversity. Ten of its countries each have over 1,000 species of trees (FAO, 2009a). However, the region is also among those

TABLE 2.10

Latin America and the Caribbean: Countries Among the Twenty with the Greatest Number of Endangered Plant and Animal Species

	Endangered Animal Species		Endangered Plant Species
Mexico	636	Brazil	382
Colombia	429	Peru	275
Ecuador	369	Mexico	231
Brazil	356	Colombia	223
Peru	261	Jamaica	209
		Panama	194
		Cuba	163

Source: IUCN, 2008a

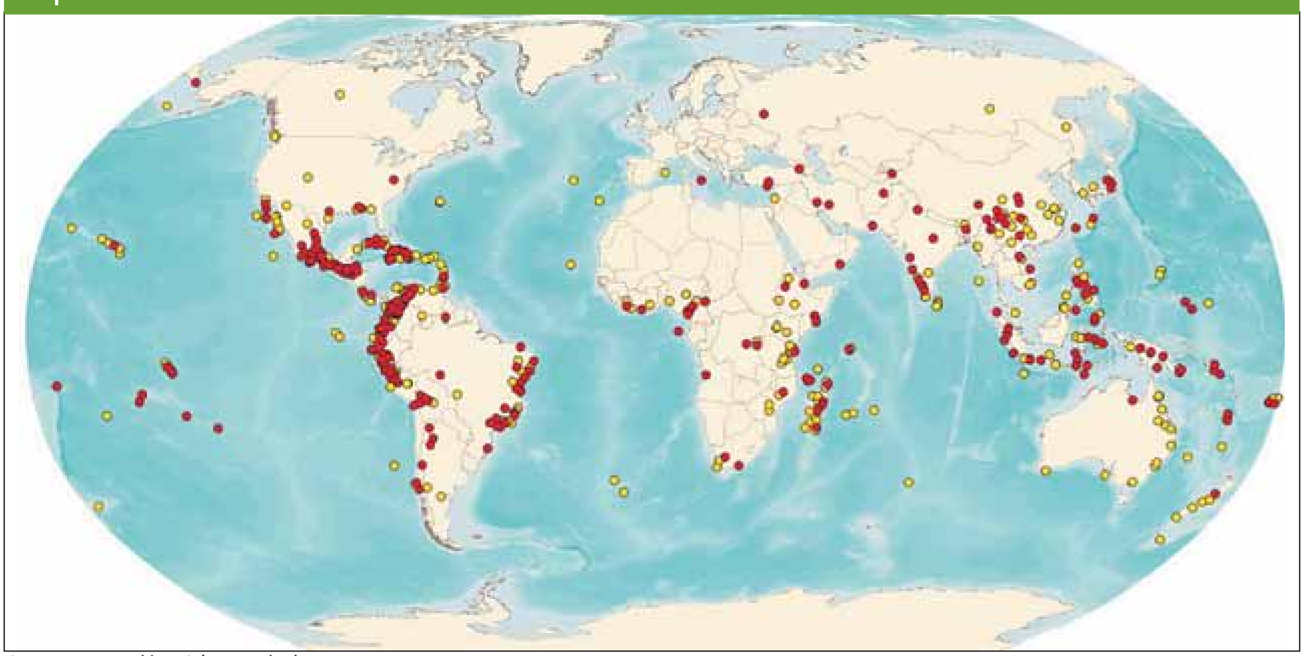
that have the greatest number of endangered, threatened or vulnerable tree species (FAO, 2005). For example, large-leaf mahogany, known also as Honduran mahogany (*Swietenia macrophylla*), is at the top of the list of CITES (Convention On International Trade In Endangered Species) Appendix II, and trade in the wood should be controlled (FAO, 2007c).

Among the region's endangered species, the amphibians are suffering the ravages of the chytrid fungus (*Batrachochytrium dendrobatydis*), which, as in other parts of the world, has killed off frogs and toads in massive numbers. Although there is a great deal of controversy on the topic, this fungus has been associated with the disappearance of nine species of frogs of the *Atelopus* genus, and has been detected in seven frog species in Ecuador, ten in Costa Rica, ten in Panama, three in Puerto Rico and at least three in Mexico (Lips, 1999; Ron and Merino-Viteri, 2000; Rollins-Smith and others, 2002; Lips and others, 2003; Puschendorf, 2003; Lips and others, 2004). Alarms have also been sounded in Cuba, Colombia and Ecuador. Panama has fared no better: the golden frog (*Atelopus zeteki*) is on the verge of extinction in its natural habitats, and only *ex situ* strategies are being implemented, as a last resort, to prevent its complete extinction (Mendelson and others, 2006). Apparently, the spread of this fungus, which has become a virtual pandemic among amphibians, is related to increased temperature associated with global warming (Punds and Coloma, 2008), and some authors cite macro- and micro-climate changes as factors in the high rates of extinctions in the region (Heyer and others, 1988; Stewart, 1995; Laurance and others, 1996; Pounds and others, 1999; Young and others, 2000). Meanwhile, Lips and others (2005) found that global climate change, which constitutes one of the three major factors contributing to the reduction of the world's amphibian populations, has had significant effects in Latin America and the Caribbean.

Unfortunately, such situations repeat themselves throughout the region for different groups of organisms. Ricketts and others (2005) show 595 locations, in different parts of the world, that have this type of problem. As they point out, LAC is deeply involved in the current episode of extinctions, which extend beyond the places where the threatened species are distributed and affect other sensitive species (map 2.8).

MAP 2.8

Map of the 595 Sites of Inminent Extinction



Source: Prepared by Ricketts and others, 2005.
Note: The yellow points are places that have at least partially protected areas, while the red points are places without protected areas and for which no information is available.

4.4 Genetic resources

Information on the region's genetic diversity is extremely limited. The most important information comes from various studies on the diversity of holoenzymes in different groups of organisms, and in particular from analysis of the genetic diversity of cultivated species (Dirzo and Raven, 2003). The great majority of cultivated plants used in the world today have their centres of genetic diversity in well defined areas: the Neotropics, the Middle East, the Mediterranean and North Africa, East Africa, South and Southeast Asia, and China. It has been estimated that over 118 economically important plant species were domesticated or manipulated by pre-Colombian farmers (Hernández, 1993), and 50% of the species eaten throughout the world come from Mesoamerica (see box 2.7), making the area a global focus of plant domestication.

A high proportion of the species living in LAC are endemic, that is, they can be found nowhere else in the world. Of the nearly 10,000 known species of birds in the world, over 2,500 are endemic to the region (in other words, they are distributed across an area of less than 50,000 km^2). BirdLife International (2003) has identified 218 regions of the world that have a considerable wealth of endemic bird species; these are designated as «endemic bird areas», or EBAs. One hundred and eleven EBAs, representing 51% of the total number, are in LAC. Some 694 (39%) of the 1,791 mammalian species and 70% of all amphibian species (3,148) are endemic to the region (IUCN, 2008b, 2008c). Although equally detailed and precise data are not available for other groups of organisms, it has been estimated that around 40% of higher plant species and 45% of reptilian species are also endemic to the region.

Genetic diversity has played an important role in the region's cultural and social development over time, as demonstrated by the great number of major food species and other economically important species that originated and diversified in the region. Moreover, this diversity has been the source of ambitious biotechnology programmes over the last few years.

BOX 2.7

Taking Advantage of Biological Diversity

It is estimated that human beings currently use approximately 50,000 different plant species (Bates, 1985; Vietmeyer, 1990; Heywood, 1993; Heywood and Dulloo, 2005). The exploitation of biological diversity is relatively recent in Latin America, dating back only some 14,000 years (MacNeish, 1992), but it represents a high percentage of the world's plant resources. Although there is no exact count of the number of useful plant species in the region, Mexico alone has on the order of 7,000 (Casas and Parra, 2007), while Peru has around 4,400 (Brack, 2003).

Despite the region's thousands of years of agricultural history, nearly 90% of the plant species used by rural communities in Latin America and the Caribbean are wild or field plants, and are collected in primary and secondary forests and in disturbed areas (Casas and others, 2008). For this reason, it is especially important that the region develop sustainable forest management strategies.

Vavilov (1926) and Harlan (1992) identified Mesoamerica and the Andean regions of Peru, the Plurinational State of Bolivia and Ecuador as the principal centres of plant domestication in Latin America. Today, throughout the world, approximately 7,000 different plant species are cultivated or managed in some fashion (Heywood and Dulloo, 2005), and of these, 2,000 to 3,000 show clear signs of domestication. In Mexico, some 700 native species are under silvicultural management, or are subject to low-intensity farming or other forms of management, while 200 are clearly domesticated (Caballero and others, 1998; Casas and others, 2007; Casas and Parra, 2007). In Peru, nearly 1,700 species are cultivated or are semi-cultivated, and 182 are clearly domesticated (Brack, 2003).

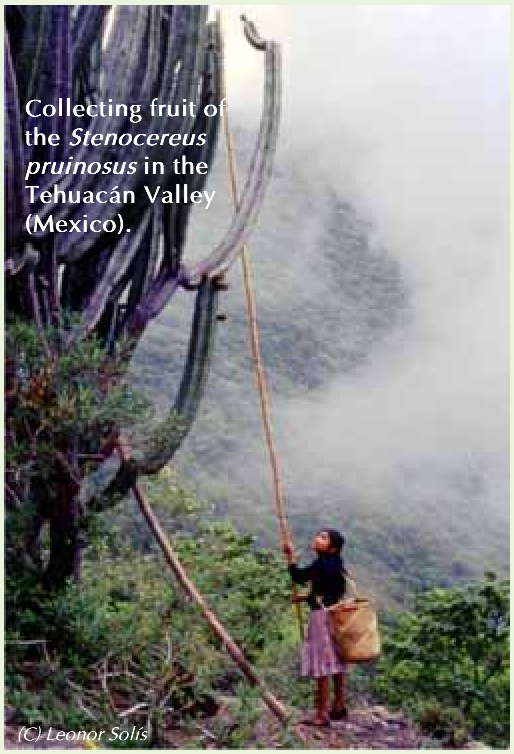
At the global level, only 100 species (including maize, wheat, barley, rice, beans, soy and cotton) are the main basis of agricultural production. Approximately 20 of these species come from Mesoamerica, 25 specifically from the Andean region of Peru. In addition, these few species include numerous variants resulting from the artificial selection that has historically been practised on them in various natural and agricultural environments. Moreover, the wild ancestors of these plants (different varieties, as well as other species of the same genus) are equally important, and genes can be interchanged between the two groups. For example, there are six different teocintles closely related to maize in Mesoamerica, and the Andean region has 230 wild species closely linked to the nine domesticated species of potato. Identifying the wild relatives of managed species and defining strategies to protect them are priority issues for the conservation of the region's genetic resources.

BOX 2.7

(Continued)

The main mechanism in the domestication process is artificial selection, which favours varieties that occur naturally among the populations of managed organisms, and discourages variants whose features are less useful to the human beings making the selection. The world's earliest centers of agriculture have a high degree of agricultural biodiversity as a result of long experimentation with selection by local cultures and the presence of wild ancestors that continually exchange genetic information with their domesticated relations.

Concern about loss of agricultural biodiversity has led to the creation of ex situ world conservation programmes (for example, in botanical gardens or in collections of germplasm, as well as in situ conservation initiatives by institutions and citizens designed to preserve diversity in the environments in which it evolved and occurs. In situ conservation of agricultural biodiversity involves maintaining, in an agricultural setting, the species and varieties that growers use, maintain and select, while also supporting the processes of genetic interaction with wild ancestors and the cultural processes that favour the diversified use of agricultural resources. For this reason, rural cultures that make use of agricultural biodiversity and work to create and maintain it are making a fundamental contribution to in situ conservation.



Collecting fruit of the *Stenocereus pruinosus* in the Tehuacán Valley (Mexico).

The management of environments and organisms generally entails a drastic reduction in biological diversity. However, important exceptions have been documented among indigenous peoples. For example, the traditional agroforestry systems of the Tehuacán Valley (Mexico) maintain 60% of the total plant species present in the forests that are harvested, as well as 93% of the genetic diversity of certain dominant tree species (Moreno-Calles and Casas, 2008). Human manipulation can also affect genetic diversity within a single species. For example, in different species of columnar cacti that are used in the Tehuacán Valley for their edible fruit, the populations cultivated in yards and in agroforestry systems show at least as much diversity as the wild populations (Casas and others, 2006, 2007; Blancas and others, 2006; Parra and others, 2008; Moreno-Calles and Casas, 2008). The wide variations in manipulated populations are the result of high levels of genetic flow between populations, and of growers' interest in maintaining a large range of variants, each with special attributes, that have particular advantages. They accomplish this by continually introducing and replacing plant material in the manipulated populations (Casas and others, 2006, 2007). Traditional agroforestry systems provide important reservoirs of biodiversity that merit special attention in conservation efforts.

Source: Prepared by A. Casas.

4. 5 Protecting biodiversity

One strategy for protecting biodiversity is to define protected areas (see «Forests» section of this chapter). The social processes involved in creating protected areas can be complex. Land holding arrangements, local institutions and communities, and power structures play an important role, and vary not only between countries but between regions within a given country. In Latin America and the Caribbean, land ownership in protected areas is frequently in the hands of indigenous communities, and decrees establishing natural areas must place priority on the rights, needs and interests of their inhabitants.

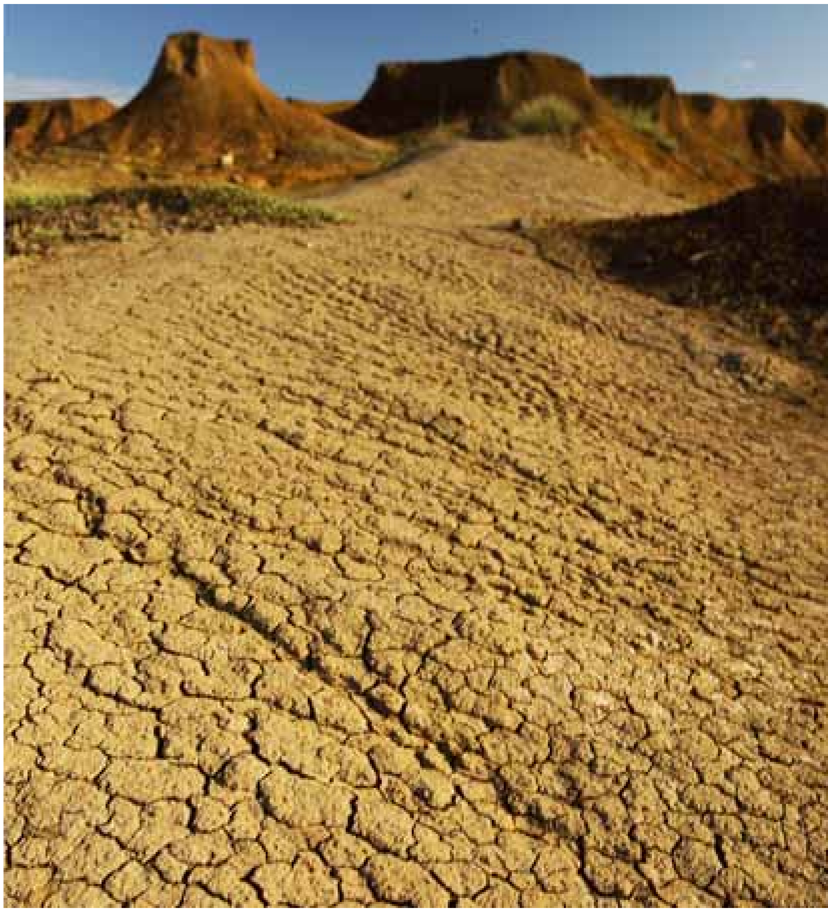
Yorio (2008) and Painter and others (2008) cite two case studies in Argentina (Patagonia) and the Plurinational State of Bolivia that highlight the importance of addressing biodiversity conservation and protection in terms of local ecosystem governance, taking account of the impact of human beings outside the conservation areas, and developing and implementing conservation strategies that are flexible enough to be applicable beyond the particular area involved. Protecting specific areas can have an effect on adjacent areas, and even on more distant ones. In Costa Rica, for example, herbaceous and shrub communities in the vicinity of the Las Cruces Biological Station and around the Puerto Jiménez and La Palma stations, are largely dependent on the adjacent vegetation systems (Mayfield and Daily, 2005). Although there is little information on this topic, it is important to call attention to the adverse effects of protecting natural areas and simultaneously neglecting others. The existence of protected areas should not become a license to indiscriminately destroy or disturb unprotected areas.

4.6 Climate change and biodiversity

The relation between loss of biodiversity and climate change can be assessed by examining the direct and indirect impacts that climate change has on biological diversity at different levels (Mooney and others, 2009). Direct impacts are those produced by changes in the composition of the atmosphere due to increased greenhouse gases, which raise the planet's temperature and alter precipitation patterns. An example of such impact is changes in the distribution of species due to the loss or fragmentation of ecological niches, leading, in extreme cases, to the extinction of species. Indirect impacts are those associated with changes in biological processes that alter the ecosystemic functions from which environmental goods and services flow. For example, the results of the 2005 MEA suggests that the disruptions created by human activity have reduced ecosystem services by as much as 60%. This analysis shows that the effects of human activity have intensified during the last 50 years.

Thus, the relation between climate change and loss of biodiversity is complex. It can be seen as the existence of a set of pressures (from human activity) that generate impacts (such as rising temperatures), reducing the capacity of systems to adapt—that is, their ability to adjust to, and/or resist the impact generated by, climate changes (Omann and others, 2009). Recent studies (Parmesan and Yohe, 2003; Root and others, 2003; Menzel and others, 2006; Nemani and others, 2003) point to some concrete impacts on biodiversity, including:

- Changes in species distribution and behaviour.
- Accelerated extinction of species due to vulnerability of habitat.
- Changes in species' migratory patterns due to the fragmentation of their ecosystems and/or loss of migratory corridors.



- Simplification of ecosystems when they are converted to agricultural use or livestock-raising.
- Reduction of ecosystems' net primary production.

Added to this, extreme events (such as drought and flood) reduce the resilience of ecosystems and thereby increase their vulnerability to these changes.

Predictions based on «ecological niche» models (Thomas and others, 2004*)* designed to analyse the process of species extinction show that if temperature trends continue (rising by 2-5 degrees centigrade), between 15% and 37% of existing species may be lost. Although it is true that the model's assumptions do not capture the complexity of the variables that play a role in biological processes, the numbers are an indication of the irreversible changes that could occur in the near future. Thus, one of the most important challenges for decision-makers is how to incorporate knowledge of these factors so as to formulate conservation policy that responds to these types of impacts. In this connection, a recent article (Hagerman and others, 2010) discusses how current conservation schemes in protected areas should be adapted to respond to new conditions.

5. Water and Hydrobiological Resources

The countries of Latin America and the Caribbean face the task of designing and implementing effective strategies for sustainable water use. The challenges involved in accomplishing this include: wide differences of climate within the region; different levels of economic development between and within countries; vast social inequalities; and deficiencies in public administration that make it difficult to implement policies and strategies that will resonate with the citizenry. Problems concerning the supply and quality of water are further aggravated by poor and inequitable service (see «Urban areas» section of this chapter). However, even in the driest areas, it is clear that appropriate management can prevent a water crisis (Biswas, 2007).

Despite the many difficulties involved in implementing a new approach to environmental sustainability on the planet (Brundtland, 1987), the countries have now committed themselves to sharing the responsibility for developing Integrated Water Resources Management (IWRM) (UNEP, 2005; IIDS, 2006; UNESCO, 2006; Tortajada, 2007a; 2007b), which is defined as «a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems» (GWP, 2000a).

Examples of such advances in the region (Guerrero and others, 2006) include:

- Environmental protection and sustainable development of the Guaraní Aquifer System (Brazil)
- Wetlands corridor initiative for fluvial and coastal areas (Argentina).
- Application of the ecosystemic approach in the Lake Titicaca basin (Plurinational State of Bolivia and Peru).
- Reducing poverty by improving natural resource management in the Pastaza River basin (Ecuador and Peru).
- Formulation of a wetlands management plan, with an ecosystem focus, for Lakes Fúquene, Cucunubá and El Palacio in the Ubaté River basin (Colombia).
- Integrated management of basins associated with the Barra de Santiago-El Imposible hydrographic watershed in Ahuachapán (El Salvador).

5.1. Availability of water resources and preservation of aquatic ecosystems

5.1.1. Changes in the water supply in LAC countries

LAC is estimated to have 31% of the earth's 35 million cubic kilometres of freshwater resources. These are essential to aquatic and terrestrial ecosystems, to a wide range of species and to the region's various types of human settlements (Bucher and others, 1997; Wambeke, 2007). In order to accurately assess how much water humanity has, FAO (2003) estimated total renewable water resources (TRWR) per inhabitant for the planet's different regions. The estimate considered the amount of water generated within a country as its internal renewable water resources (IRWR), and the water generated in neighbouring countries but usable, in part, by the country as its external renewable water resources (ERWR).

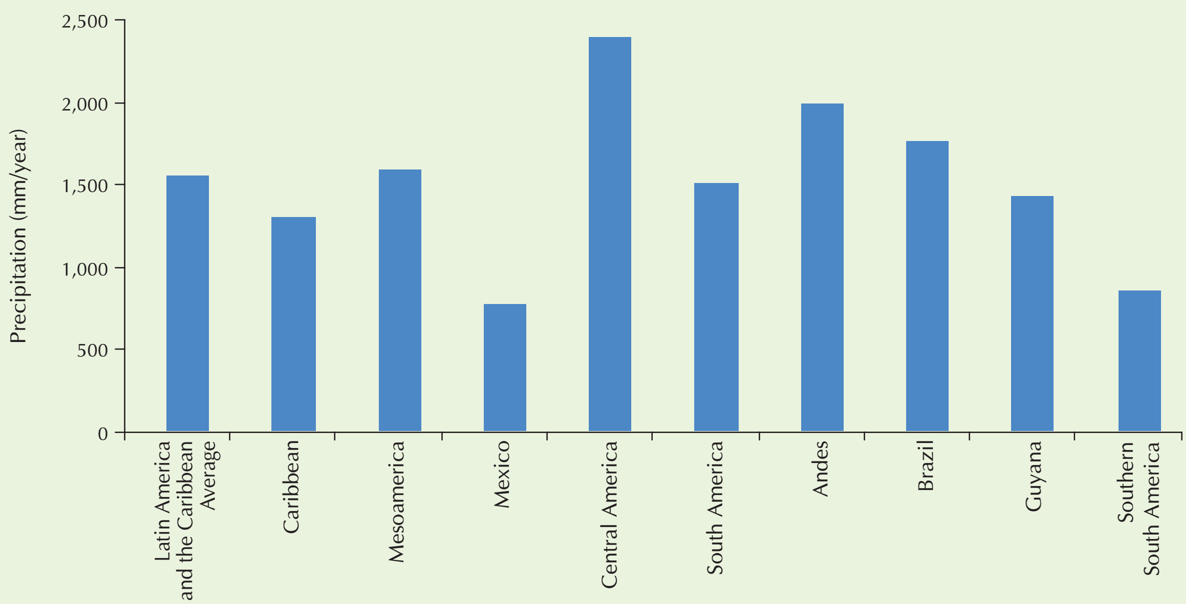
Since IRWR consists of the annual flow of surface and groundwater, which, in turn, comes largely from precipitation, it is important to know how rain is distributed (mm/year) in each sub-region. Average annual precipitation for LAC is close to 1,500 mm, with the Andean countries receiving the highest amounts (1,991 mm/year) and the southern part of the continent the least (770-850 mm/year). Excluding Mexico, which is a special case, the other 6 countries of Mesoamerica receive around 2,400 mm/year on average (figure 2.10) (FAO, 2002; UNEP and others, 2002; UNEP, 2003a).

As a result of the precipitation levels in LAC, the region's total renewable water resources, at 17,000 km^3/year, represent 39% of the planet's TRWR, which is 43,764 km^3/year. The former value is roughly half the figure reported by other studies, which make direct extrapolations without considering various details, including: volumes generated by surface runoff; recharging of aquifers through precipitation and filtering of river water; water volumes entering from neighbouring countries; river flows; water volumes of shared lakes; and evaporation (FAO, 2003; UNEP, 2003a; FAO, 2007a).

However, the pronounced differences in precipitation in the various geographical regions and differences between countries within LAC (figure 2.10) are reflected in the availability of freshwater: the Caribbean Islands

FIGURE 2.10

Latin America and the Caribbean: Average annual precipitations *(mm/year)*



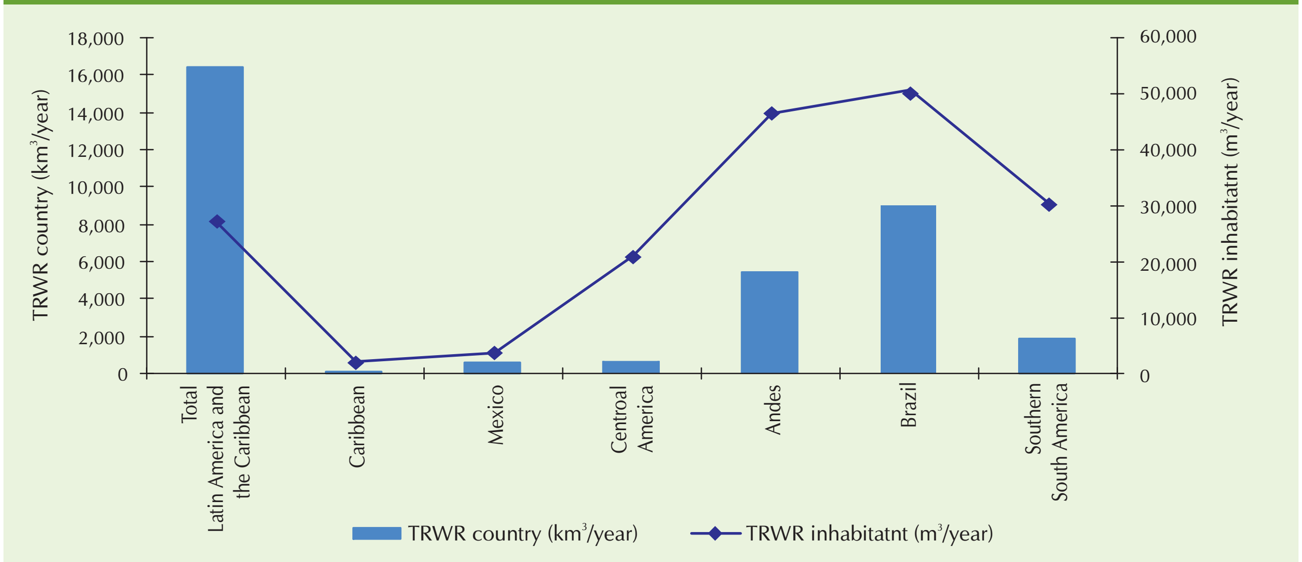
Source: Adapted from FAO, 2002; UNEP and others, 2002; UNEP, 2003a; FAO-AQUASTAT, 2004.

Note: Caribbean: Antigua and Barbuda, Barbados, Bahamas, Cuba, Dominica, Dominican Republic, Granada, Haiti, Jamaica, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago; Mesoamerica: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama; South America: Andes: Plurinational State of Bolivia, Colombia, Ecuador, Peru, Bolivarian Republic of Venezuela; Guyana: Guyana, Suriname; Brazil: Brazil; Southern South America: Argentina, Chile, Paraguay, Uruguay.

have the least (93 km^3/year), while the Andean countries (5,238 km^3/year) and Brazil (8,825 km^3/year) have the most (FAO, 2003). These latter two include the planet's largest watershed, with the Amazon discharging nearly 20% of the freshwater that the earth's rivers empty into the sea (12,000 km /year to 16,000 km /year) (Sioli, 1984; Goulding and others, 2003; UNEP, 2004a; Alonso and others, 2009). Lake Titicaca, the largest navigable lake in South America, is also a major contributor: situated in the high mountains shared by Peru and the Plurinational State of Bolivia, 3,810 metres above sea level, it covers an area of 8,448 km^2 and is estimated to

FIGURE 2.11

Latin America and the Caribbean: Total Renewable Water Resources (TRWR) Available Per Year (Km^3/year) and Per Person Per Year (m^3/year) for Selected Countries



Source: Adapted from UNEP and others, 2002; FAO, 2003; FAO-AQUASTAT, 2004.
Note: Caribbean: Antigua and Barbuda, Barbados, Cuba, Dominica, Dominican Republic, Granada, Haiti, Jamaica, Saint Kitts and Nevis, Santa Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago; Mesoamerica: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama; South America: Andes: Plurinational State of Bolivia, Colombia, Ecuador, Peru, Bolivarian Republic of Venezuela; Brazil: Brazil; Southern South America: Argentina, Chile, Paraguay, Uruguay.
Note: Guyana, French Guyana and Suriname are not taken into account, because their water per inhabitant is more than 300,000 m^3 /year.

have an average water volume of 932 km^3 (Kessler and Manheim, 1996; UNEP, 1996; UNESCO-WWAP, 2006; PELT, 2010).

On average, the annual per capita water use by LAC inhabitants could come to exceed that of the inhabitants of any other region in the world, as is clear from the fact that the average per capita TRWR for LAC is 7,231 m^3/inhabitant/year, with inhabitants of Brazil and the Mesoamerican, Andean and Southern South American countries having 2.6 to 6.7 times the mean global figure (figure 2.11) (FAO, 2003; FAO, 2007a).

A particular case of water oversupply occurs in Suriname, French Guiana and Guyana. These countries represent 2.1% of the territory of South America (468,240 km^2), and it is estimated they have 3.74% of the water available for this region. When matching the latter data with the number of inhabitants for these three countries (1,350,000 inhab.), it results that the TRWR reaches 344,750 m^3/inh/year (FAO, 2003), suggesting the governments of these three countries are likely to focus efforts on offering good services and quality of water supply, rather than worrying about water availability.

The most severe shortage of freshwater is in the Caribbean Islands, where the overall per capita average (TRWR=2,466 m^3/inhabitant/year) is less than one third of the TRWR world average (figure 2.11). The most acute problem is in the Lesser Antilles, which depend almost entirely on rainwater, owing to the lack of rivers and the fact that most of their aquifers are subject to saltwater infiltration when the sea level is high. The most extreme case is Barbados, with a mere 313 m^3/inhabitant/year, followed by Saint Kitts and Nevis (576 m^3/inhabitant/year) and Antigua and Barbuda (776 m^3/inhabitant/year) (UNEP, 1999; FAO-AQUASTAT, 2004; UNEP, 2004b).

Box 2.8 gives figures on water availability and use in the Panama Canal Basin.

There are also critical shortages in some areas that encompass territory of more than one country and within specific countries, primarily in the most densely populated areas, such as Chile's Central Valley, the Cuyo region in southern Argentina, the coastal areas of Peru and southern Ecuador, the Cauca and Magdalena Valleys in Colombia, the *altiplano* of the Plurinational State of Bolivia, the Gran Chaco, which is shared by Argentina, the Plurinational State of Bolivia and Paraguay, northeastern Brazil, the Pacific coast of Central America, and –a cause of major concern– a significant portion of Mexico (FAO-AQUASTAT, 2004; UNEP, 2004c; UNEP, 2006).

BOX 2.8

Availability and use of Water in the Panama Canal Basin

The Panama Canal Basin covers 5,527.6 km^2, or 6.5% of Panama's national territory, producing nearly 5 billion m^3 of water annually. The Canal's operations use 60% of this for the locks, 34% for hydroelectric power and the remaining 6% to supply drinking water to more than half of the country's population, as well as to two thirds of the industrial and service sectors.

Within the basin, erosion and sedimentation from deforestation have reduced water storage capacity in the Canal by nearly 17%, and water quality has been affected by agribusiness and urban development. Considering, in addition, the reduction in supply that can accompany the periodic El Niño phenomenon, along with increasing demand for Canal operations and growing water demand by the population, prospects for the basin are less than encouraging. For this reason, the Government and the Panama Canal Authority have been working, since 1997, on a new legal framework. As of 2000, this process sought the involvement of rural and local-community stakeholders in creating the current IWRM scheme for the country's most important water basin.

Source: GWP-CA, 2006.

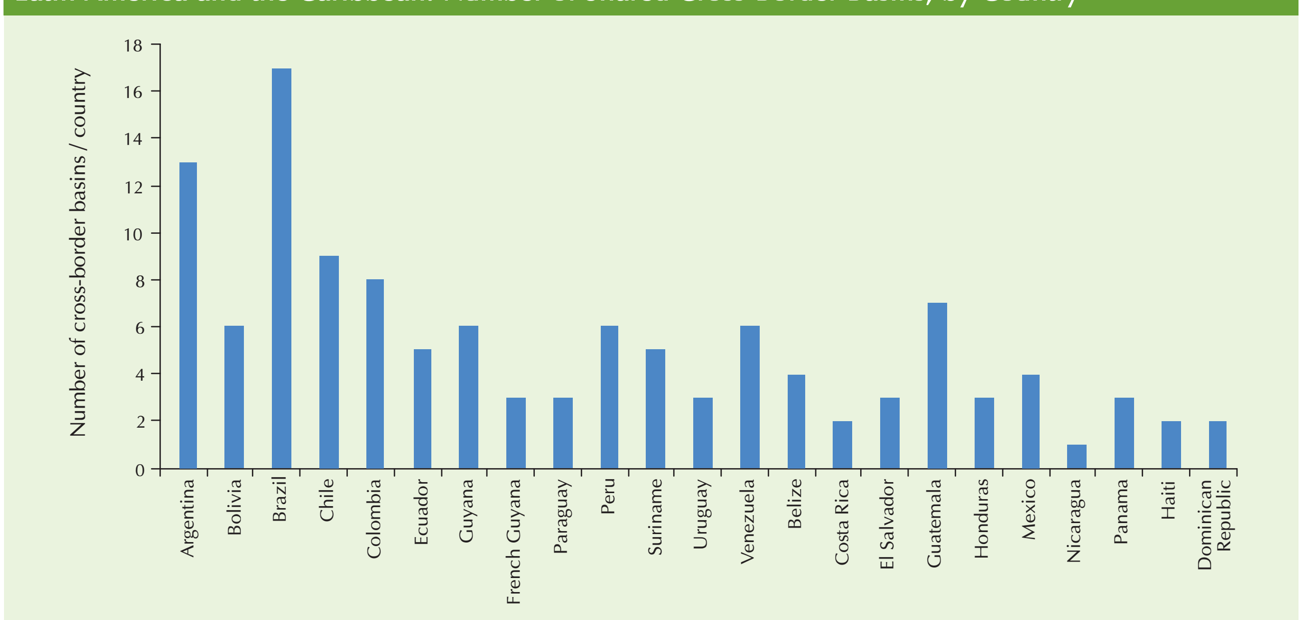
5.1.2 Surface water and cross-border aquifers that provide water for LAC

At the global level, there are approximately 263 basins with rivers that cross national borders. Europe has the greatest number of these (73), followed by Latin America and the Caribbean (61). These transnational systems provide the continent's greatest volume of freshwater: the La Plata River Basin channels water from five countries, the Amazon from eight. Within South America, Brazil contains the most massive cross-border bodies of surface water (17), followed by Argentina (13), Chile (9) and Colombia (8) (figure 2.12) (Wolf and others, 1999; Pochat, 2007). In Mesoamerica, there is the exceptional case of Guatemala, which shares 8 basins with its neighbours, while in the Caribbean sub-region, Haiti and the Dominican Republic share the waters of the Ariboneti and Pedernales Rivers (figure 2.12) (Wolf and others, 1999; Pochat, 2007).

The other vitally important sources of hydrological balance in LAC are those derived from ground water. This includes 64 aquifers (including those shared by Mexico and the United States). Brazil shares 26 aquifers with its neighbours, Argentina and Paraguay each share 15, though Paraguay is 6.8 times smaller in area than Argentina (see figure 2.13 and box 2.9) (UNESCO/IHP-OAS ISARM project, 2005).

FIGURE 2.12

Latin America and the Caribbean: Number of Shared Cross-Border Basins, by Country

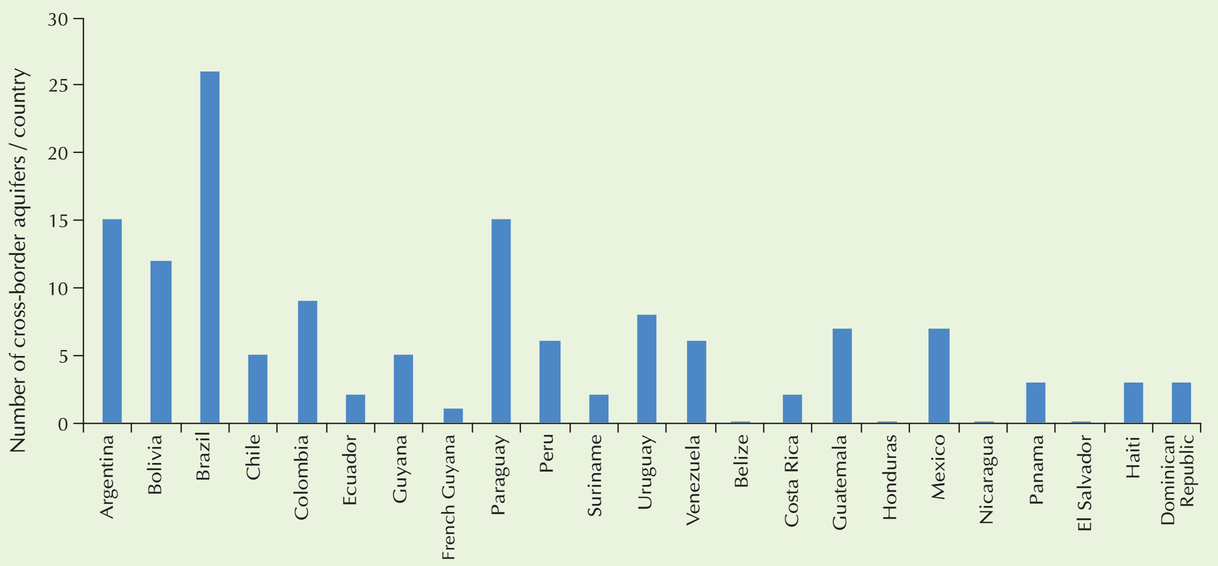


Source: Adapted from Wolf and others, 1999; Pochat, 2007.

This scenario of shared water resources underlines the importance of joint management of cross-border basins and aquifers in LAC. Commissions and organisations have been created and are working on various fronts, including negotiation, cooperation, management, technical assistance and economic development (Jouravlev, 2001; Bakker, 2006). However, there have been major political obstacles between countries that share basins. These conflicts, along with a strong trend towards privatisation of water resources, is standing in the way of establishing an appropriate oversight and management system. Such a system would establish ongoing joint action to protect the welfare of the aquatic ecosystems, at the same time ensuring sustained benefits to the populations that depend on them (Yoffe and Ward, 1999; Wolf, 1998; Wolf and others, 1999; Frers, 2003; Querol, 2003; Claude, 2005).

FIGURE 2.13

Latin America And The Caribbean: Number olf Shared Cross-Border Aquifers, by Country



Source: Adapted from UNESCO/IHP-OAS ISARM project, 2005.

BOX 2.9

Cross Border Aquifers

In recent years, the issue of aquifers has assumed international importance (World Summit on Sustainable Development, Johannesburg, 2002; Third World Water Forum, Kyoto, 2003). Organisations such as the United Nations International Law Commission (UNILC), UNESCO and OAS are reviewing existing legislation affecting cross-border natural resources.

Reflecting these initiatives is the framework project, Sustainable Management of the Water Resources of the La Plata River Basin, which involves the Governments of Argentina, the Plurinational State of Bolivia, Brazil, Paraguay and Uruguay. It seeks to establish a framework for adapting to the effects of El Niño and preventing the growing contamination produced by excessive sediment loads in the La Plata estuary. In addition, a UNESCO/OAS ISARM Americas Programme case study is in progress to examine the Yrendá-Toba-Tarijeño (SAYTT) Aquifer System. The main purpose of this undertaking is to ensure the sustainable management of this system, with participation by both users and beneficiaries (OAS, 2004). Another example of regional collaboration is the Guaraní Aquifer System (SAG) Project, which is the first project in the Americas to address cross-border aquifers, and one of the first such initiatives in the world involving a number of countries (Miletto and Kirchheim, 2004).

UNEP is helping to create capacities for the design and implementation of legal and institutional frameworks for cross-border aquifers, as part of the Regional Training Programme on Environmental Management of Coastal and Marine Areas for Latin American countries.

Source: OAS, 2004; Miletto and Kirchheim, 2004. UNEP, 2009. http://www.UNEP.org/deramb/actividades/gobernanza/cd/index.html

5.2 Demand for water resources

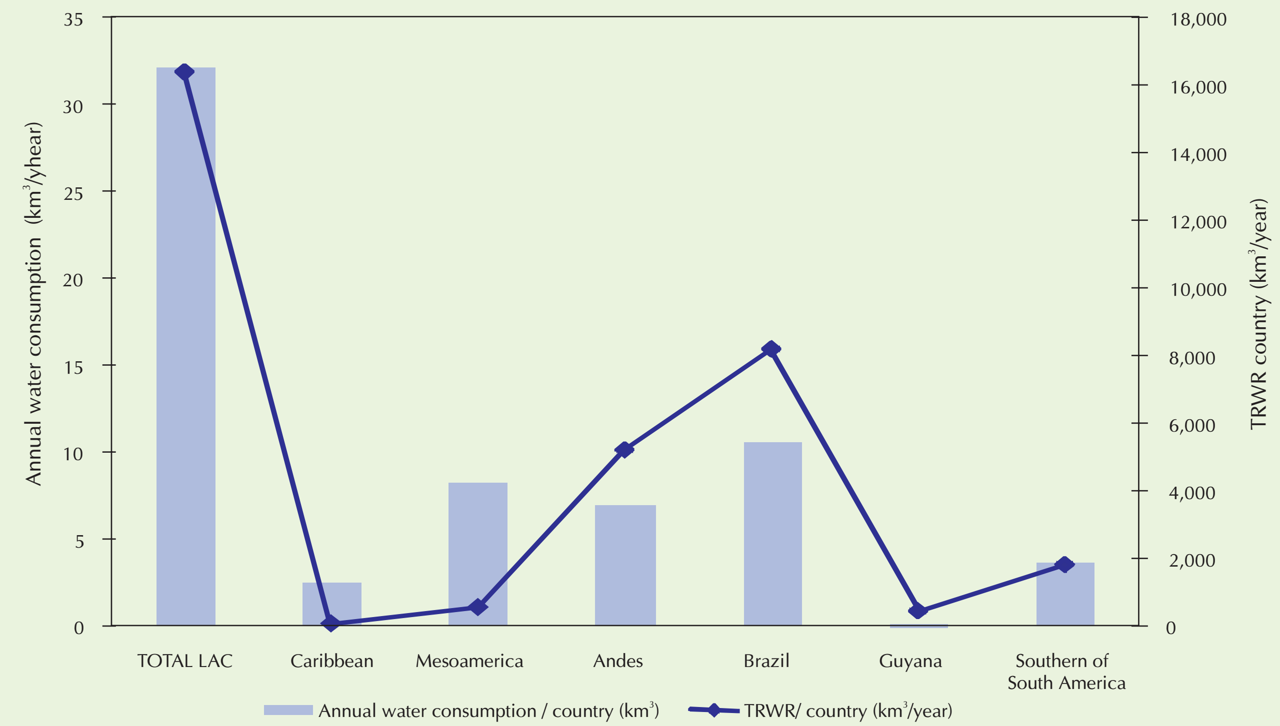
As mentioned in chapter I, the demand for water in LAC has increased. Data vary depending on the source, but average daily per capita water consumption is estimated to be approximately 150 litres/inhabitant/day (SUDAM/OAS, 1998; IDEAM, undated; The World's Water, 2001; WHO–UNICEF, 2007; INE, 2008). A direct calculation of demand indicates that 32.1 km^3/year goes for general household use and human consumption, representing 12% of the total used by the region (figure 2.14). If this volume is compared with the region's total renewable water resources (TRWR), it becomes clear that the Caribbean Islands and Mesoamerica are most vulnerable, while the Andean countries and Brazil have sufficient reserves (SUDAM/OAS, 1998; IDEAM, undated; WHO–UNICEF, 2007; UNEP and others, 2002; FAO, 2003; UNEP, 2003a; FAO-AQUASTAT, 2004; UNEP, 2007).

5.2.1. Water uses and hydrobiological resources

The above figures show that, in general, water for domestic use should not be a problem in LAC. However, the large-scale figures fail to show critical conditions in certain areas, and it will be difficult to meet the Millennium Development Goals on sustainable access to drinking-water and sanitation. The water supplied to inhabitants of marginal sections of the large cities, and to an even greater extent, inhabitants of rural areas far from urban centres, is not suitable for drinking (Van Damme, 2002; PAHO/WHO, 2003; Gutiérrez and others, 2004; Orozco, 2004; Nippon Koei Lac Co, 2005; USAID, 2005; Ortiz, 2006; WHO/UNICEF, 2007; UNEP, ANA and MMA, 2007; SISS, 2007; UNDP Paraguay, 2007). An example of the various consequences of this situation is that current per capita consumption of

FIGURE 2.14

Latin America and the Caribbean: Annual Water Consumption for all Inhabitants *(Km^3/Year)*



Source: Adapted from: SUDAM/OAS,1998; IDEAM, undated; The World's Water, 2001; UNEP and others, 2002; FAO, 2003; FAO-AQUASTAT, 2004; WHO-UNICEF, 2007; INE, 2008.
Note: Calculation is based on multiplying the average of 150 litres/person/day by the number of persons per country and the 365 days of the year, and on this figure as a proportion of total renewable water resources (TRWR) available (km3/year) for the countries of Latin America and the Caribbean (LAC) as a whole:: Caribbean: Antigua and Barbuda, Barbados, Cuba, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Saint Kitts and Nevis, Santa Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago; Mesoamerica: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama; South America: Andes: Plurinational State of Bolivia, Colombia, Ecuador, Peru, Bolivarian Republic of Venezuela; Guyana: Guyana, French Guyana, Suriname; Brazil: Brazil; Southern South America: Argentina, Chile, Paraguay, Uruguay.

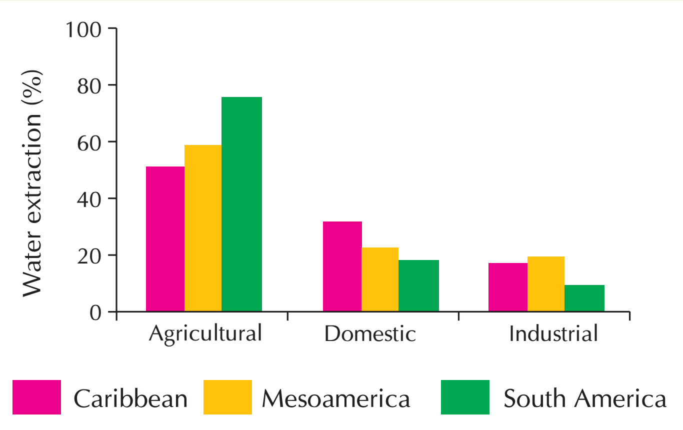
bottled water in Mexico is twice what it is in the United States (Biswas, 2007), despite the sharp economic contrast between the two countries. Similar situations occur in relation to other services affecting household water, such as basic sanitation (wastewater and waste disposal) – issues closely linked with urban and rural settlements. The section of this chapter that deals with urban areas covers this subject in greater detail. Box 2.10 examines the consumption of freshwater by different sectors in LAC.

BOX 2.10

Freshwater Consumption by Sector in Latin America and the Caribbean

In addition to general household use and human consumption, the greatest volumes of water (70%-75%) in LAC are used for agricultural (agriculture and/or livestock) purposes, while the rest is distributed in industry (8%-12%) and other processes such as electrical generation and mining (FAO, 2003; ECLAC, 2005; UNESCO-WWAP, 2006; GWP-CA, 2006; ECLAC, 2007a).

Water use varies from sector to sector, and in differing proportions from one sub-region to another within LAC. In the Caribbean sub-region, more water is put to household use (31%) than in the other two sub-regions (figure a), with household and industrial sectors in Mesoamerica ranging between 20% and 22% (figure b) (WRI, 2009).



In South America, farming accounts for 75% of water use, while industry uses a smaller proportion (8%) than is the case anywhere else in the region (figure c) (WRI, 2009).

Note: a. Caribbean: Antigua and Barbuda, Barbados, Cuba, Dominica, Dominican Republic, Granada, Haiti, Jamaica, Saint Kitts and Nevis, Santa Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago; b. Mesoamerica: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama; c. South America: Plurinational State of Bolivia, Colombia, Ecuador, Peru, Bolivarian Republic of Venezuela, Guyana, French Guyana, Suriname, Brazil, Argentina, Chile, Paraguay, Uruguay.

Source: Adapted from WRI, 2009.

5.2.2. Water for productive processes

a) Agriculture

In recent years, the region's amount of irrigated area has grown substantially (table 2.11, figures 2.15 and 2.16). Among the Mesoamerican countries, Mexico uses the highest levels of water for this purpose (13,500 m³/hectare/year) (FAO, 2002; ECLAC, 2007). It would be helpful if the countries of LAC consolidated their statistics on water needs for agriculture, and even for cattle-raising, so that the region could standardise its calculation of water-use efficiency, thus making it possible to draw a relation between the productivity of cultivation (kg/ha) and the amount of water used (m³) (López-Urrea, 2003; De Souza, and others, undated).

In simpler terms, a comparison between Brazil and Chile shows that although Brazil has the second-highest amount of irrigated area in the region, this represents only 6.2% of its agricultural land. Thus, the country is using more water than necessary for current levels of production (Vieira and Van Wambeke, 2002; GEO Brazil: Water Resources, 2007). Chile, on the other hand, is among the countries in which there has been considerable private investment in irrigation, which now covers 82.7% of all of its agricultural land (GWP, 2000b; Vieira and Van Wambeke, 2002; ECLAC, 2005; UNESCO-WWAP, 2006).

TABLE 2.11

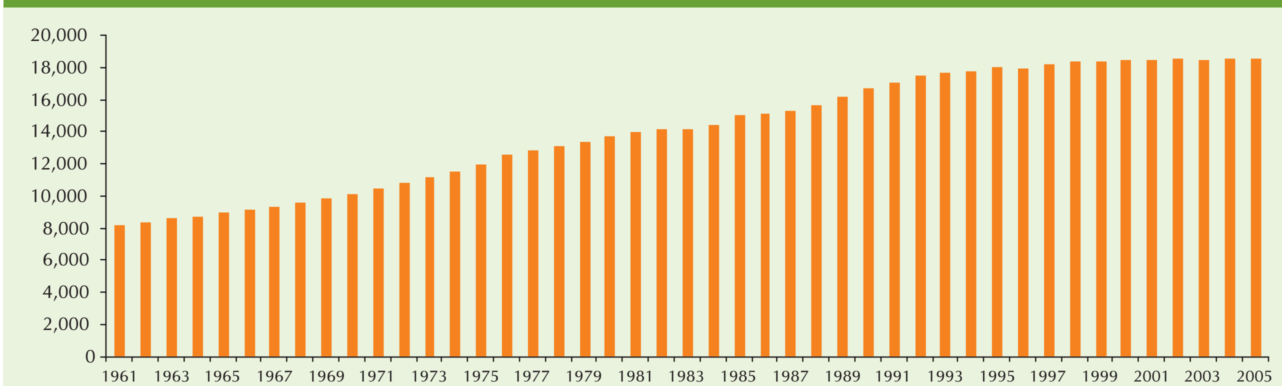
Latin America and the Caribbean: Percentage Increase of Irrigated Area, 1961-2005 *(Thousands of hectares)*

	Irrigated Area *(thousand of ha.)*		Increase percentage
	1961	2005	
LAC	8,219	18,563	55
Mexico	3,000	6,300	52
Brazil	490	3,663	86
Chile	1,075	1,900	43
Argentina	980	1,550	3

Source: ECLAC, 2007a. GEO Brazil: Water Resources, 2007.
Note: The countries listed are those with the highest rates of increase.

FIGURE 2.15

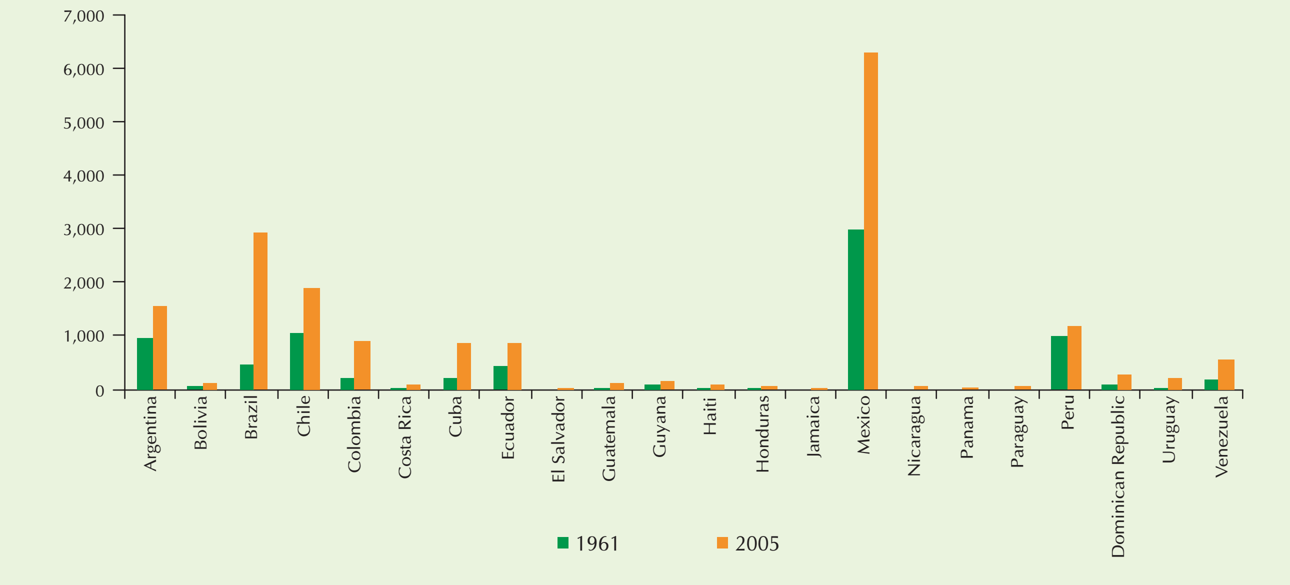
Latin America and the Caribbean: History of Area Irrigated that uses the Region's Water Resources for Agricultural Development *(Thousands of hectares)*



Source: Adapted from FAO, 2003; ECLAC, 2007a.

FIGURE 2.16

Latin America and the Caribbean: Change in the Irrigated Area, 1961 – 2005
(In thousands of hectares)



Source. Adapted from FAO, 2003; ECLAC, 2007.

The pollution of ground and surface water is the main impact in LAC resulting from the expansion of agricultural land and the associated extraction of water. This can be seen, for example, in cases of contamination with mercury and organophosphates in Guatemala. In El Salvador, rivers and streams near agricultural areas have registered traces of pesticides (DDT), with reported concentrations of 3.15 mg/litre in systems such as the Río Grande de San Miguel—an amount that is three times the lethal limit for fish (ECLAC, 2005). In Chile's Mediterranean-type drylands, 100% of samples of wells for human consumption show contamination with nitrates, along with high levels of fecal coliform bacteria (78.3%) and total coliforms (88%) (Claret and others, 2003).

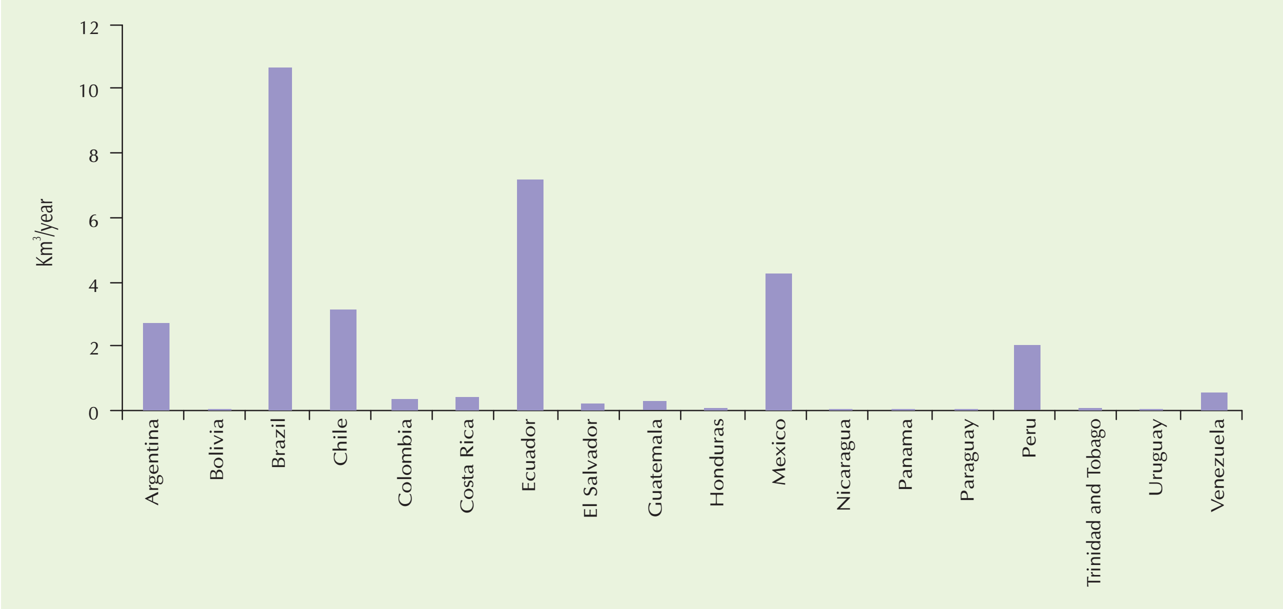
b) Industry

Although the impact of the industrial sector on the future availability of water in LAC is not as representative as that of the agricultural sector, the discharge of its untreated wastewater is much more damaging. In Ecuador, open-pit mining affects various lotic systems (the Chico, Siete, Tenguel and Gala rivers), which are contaminated with mercury (49 times above the threshold), arsenic (19 times above the threshold), chrome, vanadium, nickel and cadmium – all at higher than permitted levels. This creates serious problems for the village households that use the water.[14] In Colombia, the Bogotá River contains significant concentrations of metals such as cadmium and arsenic, as a result of cement production and leather processing. One of the most urgent problems is the fact that this water is used to irrigate crops, and in doing so it contaminates not only the soil, but also the crops, which accumulate these substances in their tissues (González and Mejía, 1995). The countries that extract the greatest amount of water for industry are Brazil (10.65 km^3/year), Ecuador (7.18 km^3/year), Mexico (4.29 km^3/year), Chile (3.16 km^3/year), Argentina (2.76 km^3/year) and Peru (2.03 km^3/year) (figure 2.17) (UNESCO-WWAP, 2006).

14 www.ecoportal.net/content/view/full/77902

FIGURE 2.17

Latin America and the Caribbean: Highest Water Extracting Countries for Industrial Processes



Source: Adapted from UNESCO-WWAP, 2006.

c) Hydroelectric power

Another important use of water is for generating energy. LAC possesses 22% of the world's hydroelectric potential (see Chapter I), or 582,033 MW/year, of which only 139,688 MW (approximately 24%) is being used (OLADE, 2005). By way of example, Central America (excluding Belize) has installed capacity of 8,348 MW and total net production of 31,369 GWh. Of the energy produced, 45.5% is thermal, while production of hydroelectric energy is estimated to represent 45.9% of the total. Costa Rica is the main Central American energy producer, generating 41.8% of the total (ECLAC, 2004; GWP-CA, 2006).

Brazil's energy plan, in which hydroelectric power is a significant component, stands out among the plans of LAC countries. Hydroelectric generation currently produces 65,859 MW, and it is estimated that this figure will reach 113,828 MW by 2020, under an optimistic scenario of rational water and energy use (PNUMA, ANA y MMA, 2007).

A collaborative region-wide effort to assess the magnitude of this potential would be in line with the proposed UNESCO-WWAP (2006) approach, which suggests that a simultaneous analysis of energy and water use at the regional scale could lead to substantial energy savings and rationalisation of demand for water. In light of the information in this chapter, it is reasonable to believe that including energy efficiency considerations in water policy decisions at the national and regional levels could contribute substantially to preserving and improving management of the aquatic ecosystems involved in these hydroelectric projects, whose greatest impact is on the biodiversity of flora and fauna (see box 2.11).

BOX 2.11

Potential Impact on the Continuum of a Basin and its Hydrobiological Resources: The Madeira River Hydroelectric Project

This hydroelectric complex, planned by Brazil and the Plurinational State of Bolivia for the Madeira River –the largest of the Amazon tributaries– includes four dams: Cachuela Esperanza, Guarajá Mirim, Jiraú and Santo Antonio. As might be expected with a project of this magnitude, it has both strong allies and vigorous detractors, one group motivated by political and economic forces, the other by environmental and social/cultural concerns. The main conflict centres on the possible effects of the high sediment load carried by the Madeira and its tributaries, accounting for nearly 40% of the sediment that enters the enormous Amazon Basin (600-900 million tons) (Goulding and others, 2003; Filizola, 2003; Molina, 2006).

A study using a hydrosedimentological model estimated more extensive and pronounced erosion and sedimentation than had been forecast by previous feasibility/viability studies. This would mean a greater rise in the bed of the river and its tributaries, with a consequent rise in the water level of these systems (Molina, 2006). Thus, despite the recognition that constructing these four plants is important for both countries, it is also clear that previous studies, in failing to take account of the continuity and connectivity of the ecosystem (the entire Madeira watershed), do not provide an accurate projection of the impact on the entire ecosystem and its natural resources.

An example of this is the gilded catfish (Brachyplatystoma rousseauxii), which is the second most important commercially fished species in the Amazon Basin, with an annual catch of between 15 and 18 thousand tons. Studies of genetics and population dynamics indicate that this species has the longest migration path of any freshwater fish in the world, travelling more than 3,500 km during its lifecycle (Alonso and Pirker, 2005; Batista and others, 2005; Barthem and Goulding, 2007). It migrates through the Madeira River to areas above San Antonio, in search of suitable spawning grounds. The proposed complex would substantially change these migratory routes, affecting not only commercial fishing in this border area, and creating socioeconomic problems for local inhabitants, but also altering the abundance and natural supply of this fish in the Amazon Basin (Barthem and Goulding, 1997; 2007; Alonso and Pirker, 2005; Fabré and others, 2005; Carvalho and Fabré, 2006).

Source: Goulding, and others, 2003; Filizola, 2003; Molina, 2006; Barthem and Goulding, 1997; 2007; Alonso and Pirker, 2005; Fabré and others, 2005; Carvalho and Fabré, 2006.

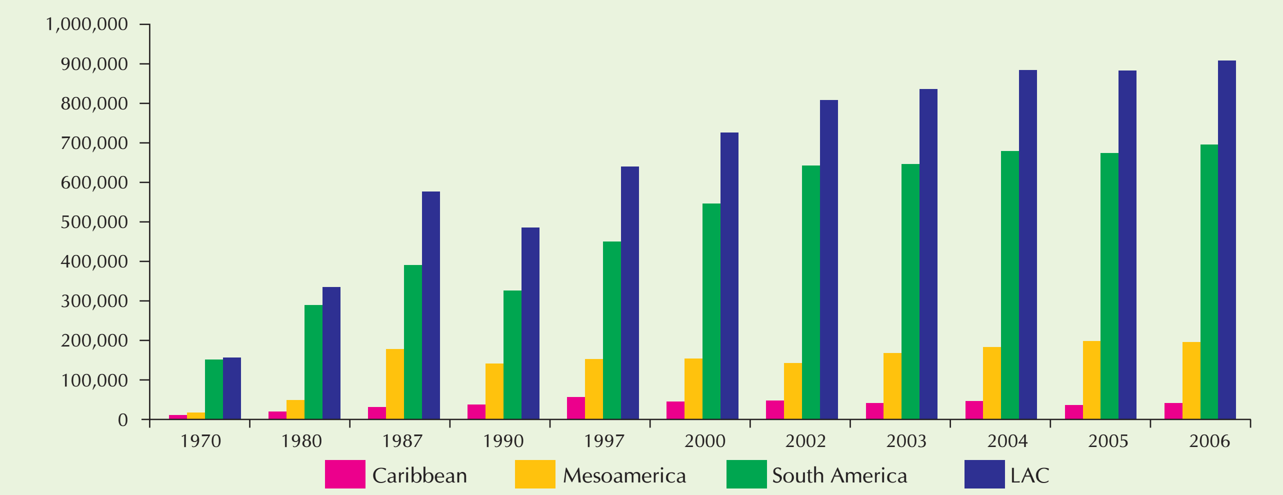
5.3 Use of hydrobiological resources

In addition to supplying water, the aquatic ecosystems of LAC provide equally important environmental services, such as fishing opportunities (see «Seas and coastal areas» section of this chapter). Continental fishing plays an important socioeconomic role in LAC, producing 800 to 900 thousand tons of fish annually (figure 2.18 and box 2.12) (COPESCAL, 2003; FAO, 2007a; Valbo-Jorgensen, 2008), representing approximately 6% of the world's continental catch. Brazil accounts for 45% of the total, Mexico 18%, the Bolivarian Republic of Venezuela 9%, Peru 7%, Argentina 6% and Colombia 5% (figure 2.20) (WRI, 2009; Valbo-Jorgensen and others, 2008). Although the Caribbean Islands, based on the quantities they report, are not among the region's largest marketers of fish, the sum of their catch from continental waters averages 34 thousand tons per year.

Official figures show little growth in the region's continental fishing, compared with the growing demand for freshwater fish. FAO (2009), reporting this, estimated that in low-income countries with food deficits, fish accounts for close to 18.5% of animal protein in the diet. This figure may be even higher than shown by official statistics, given the possible underestimation of the catch due to incomplete and unreliable data on small-scale fishing and fishing for personal consumption. Such fishing is often the only low-cost source of protein among the poorest rural populations in riverine areas (COPESCAL, 2003; FAO, 2007a; FAO, 2009; Valbo-Jorgensen, 2008). The economic and social role of the aquatic ecosystems of LAC is not fully accounted for in the development of the region's natural resource and land use management plans. This lack of recognition, and the scarce institutional and political backing, make it difficult to gain basic support for the sustainable development of the aquatic ecosystems. Added to the degradation of aquatic ecosystems and growing global competitiveness, this situation points to the need for regional and international cooperation.

FIGURE 2.18

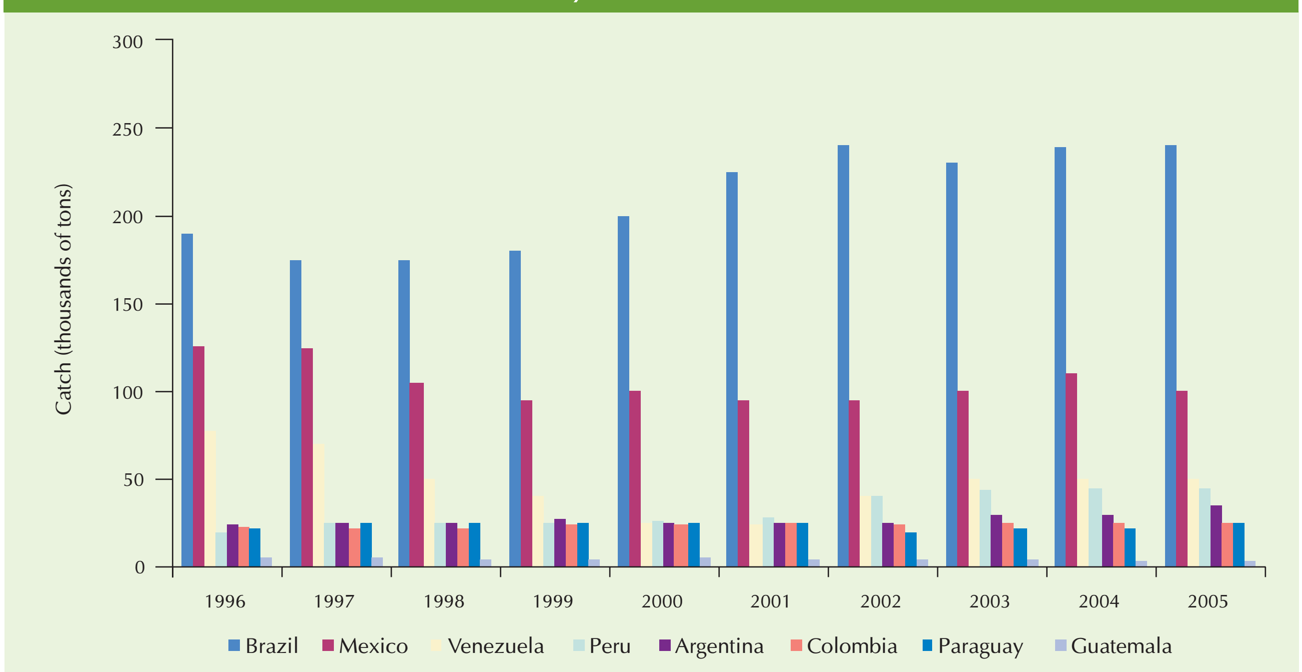
Latin America and the Caribbean: Official Figures on Changes in Fisheries Production in Continental Waters *(In metric tons)*



Source: Adapted from COPESCAL, 2003; Valbo-Jorgensen and others, 2008; WRI, 2009.

FIGURE 2.19

Latin America and the Caribbean: Official Catch Figures for Continental Waters of the Countries with the Greatest Fisheries Production *(Tons/year)*



Source: Adapted from COPESCAL 2003, WRI, 20009; Valbo-Jorgensen and others, 2008.

BOX 2.12

Ornamental Fish and Invasive Species in Latin America and the Caribbean

Another intensively used natural resource in some LAC countries is ornamental fish from marine and continental ecosystems. It is now recognised that this has a major social and economic impact at the local and regional levels (INCODER; TRAFFIC and WWF, 2006). This can be seen in countries like Peru, where approximately 100,000 people fish for these species and an average of 9 million live fish per year are exported, and Brazil, which markets nearly twice the number of such fish, primarily from the Amazon area.

Although ornamental species are generally small, it is now profitable to trade in young and juvenile fish of species normally used for human consumption, such as freshwater stingrays, catfish (Siluriformes), arawana (Osteoglosum bicirrhosum) and paiche, also known as pirarucu (Arapaima gigas). This has led to conflicts between fishermen and merchants working in these two areas: food fish and ornamental fish.

Meanwhile, environmental problems are being created by moving or accidentally introducing certain foreign species (some, even, from other continents) into ecosystems, since these new arrivals become aggressive and harmful invaders. Although a study in the Bolivarian Republic of Venezuela indicated that more than 60 exotic fish species have been introduced without any evidence of negative effects, certain species for human consumption, such as trout, tilapia and some mojarras, are predators and compete strongly with native species. Mexico is currently suffering from a serious invasion of Hypostomus plecostomus, a loricariid originating in the Amazon and normally used in aquariums as "window-washers". This species is compromising continental fisheries and changing aquatic ecosystems throughout the country.

Source: Chao and others, 2001; Alonso and others, 2009; Tello and Cánepa, 1991; FAO, 2000; Araújo and others, 2004; Environmental News Service, 2005; Ortega and others, 2006; Ojasti, 2001; Mendoza and others, 2007.

5.4 Climate change and the function of water potential in LAC

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change states that by 2020, as a result of climate change, the number of persons in LAC affected by water shortages will be between 12 million and 81 million, with the estimate rising to between 79 million and 178 million for 2050 (Arnell, 2004). These figures, however, do not take account of populations that may leave areas where water shortage is a problem (Magrin and others, 2007).

A report by the World Bank examines the possibility that climate change has already affected the circulation patterns that bring water vapour to the paramos, as well as the possibility of the savannization of the Amazon Basin as the result of an extreme reduction in precipitation accompanied by rising temperatures. The increase in temperature has also produced a rise in water levels, which could lead to coastal flooding and saturation of sanitation systems, and could cause people to migrate to other areas, where the infrastructure necessary for adequate clean water and sanitation is not in place (Fricas and Martz, 2007).

Severe water shortages can be expected in various parts of Latin America: eastern Central America; the plains; the Montagua Valley and the Pacific slopes of Guatemala; eastern and western El Salvador; the Central Valley and Pacific portion of Costa Rica; the northern, central and western inter-mountain areas of Honduras; and the Panama's Azuero Peninsula. These changes would affect water supplies and hydroelectric generation (Ramírez and Brenes, 2001; ECLAC, 2002a).

For Mexico, some models project slight increases in precipitation, while others project drastic declines. However, the majority agree in forecasting declines in winter precipitation of up to 15% in parts of central Mexico and 5% in the Gulf of Mexico area. Projections also suggest that rains will begin later and last longer into the fall in much of the country (Semarnat, INE, 2006c).

The loss of glaciers in Latin America is a particularly dramatic sign of climate change. Glaciers in the Andes and in Argentine Patagonia show evidence of shrinkage, along with a reduction in areas of snow cover (UNEP, 2007). The shrinkage of the glaciers and the reduced availability of water is currently one of the major concerns for the Andean countries. The Andes contain 90% of the world's tropical glaciers, and 10% of the world's water comes from high Andean ecosystems and glaciers, which drain primarily into the Amazon region (CAN, 2008).

Changing flows will clearly have a dramatic effect on the region, in terms of access to water, hydropower and agriculture, as well as with regard to the conservation of natural ecosystems, particularly in the Amazon. According to the Ministry of Agriculture of Peru (a country in which 70% of the world's tropical mountain glaciers are located), the area covered by Andean glaciers diminished by 22% between 1970 and 1997, and smaller glaciated areas have declined by as much as 80%, causing a 12% reduction in the freshwater available to coastal areas that are home to 60% of the population. One example of this process is Mount Huascarán, which has lost 12.8 km^2 of ice. The size of the glaciers of Yanamarey, Uruashraju and Broggi, in the Andes, is also shrinking. In Ecuador, the ice cover of the Cotopaxi volcano declined by 31% between 1976 and 1997, and the Antisan glacier receded eight times faster in the 1990s than it had in other decades. In Colombia, the Cocuy (the country's largest glacial mass) has been receding at an average of 15 metres per year—at which rate it would, according to estimates, disappear entirely by 2030 (Simas, 2006). The Chacaltaya glacier in the Plurinational State of Bolivia, at an altitude of 5,300 metres above sea level, finished melting in 2009, six years before experts had projected.

The loss of glaciers in the Andes, and saltwater infiltration as sea levels rise, will affect the availability of drinking water, and could also impact agricultural production and tourism. Thus, despite the fact that LAC itself has little or no effect on climate change (BMI, 2007), 70% of the region's population may be living in water-stressed areas by 2025, due to the impact of climate change on freshwater sources (Simas, 2006). Vulnerability studies predict that glaciers will continue to recede. The possible water «bonanza» that some glacier basins will experience as a result of deglaciation in the coming years, as well as imminent water shortages in dry or water-depleted areas that have passed the point of no return, makes planning an urgent necessity (CAN, 2008).

6. Seas and coastal areas

Since pre-Colombian times, the coastal areas of Latin America and the Caribbean have been inhabited principally by indigenous hunters and gatherers who had at their disposal the region's abundant resources. According to Jackson and others (2008), overfishing is not a recent phenomenon: it has been occurring since pre-historic times and is responsible for major ecological extinctions more extensive, presumably, than those caused by pollution, habitat degradation and global phenomena associated with natural variations in temperature. Roberts (2007) presents evidence that overfishing has occurred in certain areas, particularly the North Atlantic, for centuries. Except for some coral reefs in the Caribbean, there has been little documentation of overfishing in LAC coastal areas. The low levels of this resource are a common feature of all of these areas.

LAC has one of the highest rates of population growth in the world. Much of the region's population is migrating to the large cities (see «Urban areas» section of this chapter) and to coastal areas in search of economic opportunities and means of subsistence. Under a scenario of growing shortages of water for irrigation, increasing privatisation of land, and changes in soil use, coastal areas become more attractive to population groups displaced from the interior, who can turn to fishing as an economically profitable activity. Lack of knowledge about sustainable fishing, added to increasing demand in international markets, has led to excessive fishing and over-exploitation of resources, destruction of critical habitat and even the extinction of some species. The destruction of mangroves to build tourist facilities and fish farms also has a profound effect on the entire region (Halpern and others, 2008).

6.1 Marine protected areas in LAC

Marine Protected Areas (MPAs) are emerging as a way of conserving and protecting habitats and their resources. An MPA is defined as *«Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment»* (IUCN, 1999). In LAC, MPAs are a relatively recent phenomenon, having first been used as a major management tool in the 1990s (WDPA, 2008).

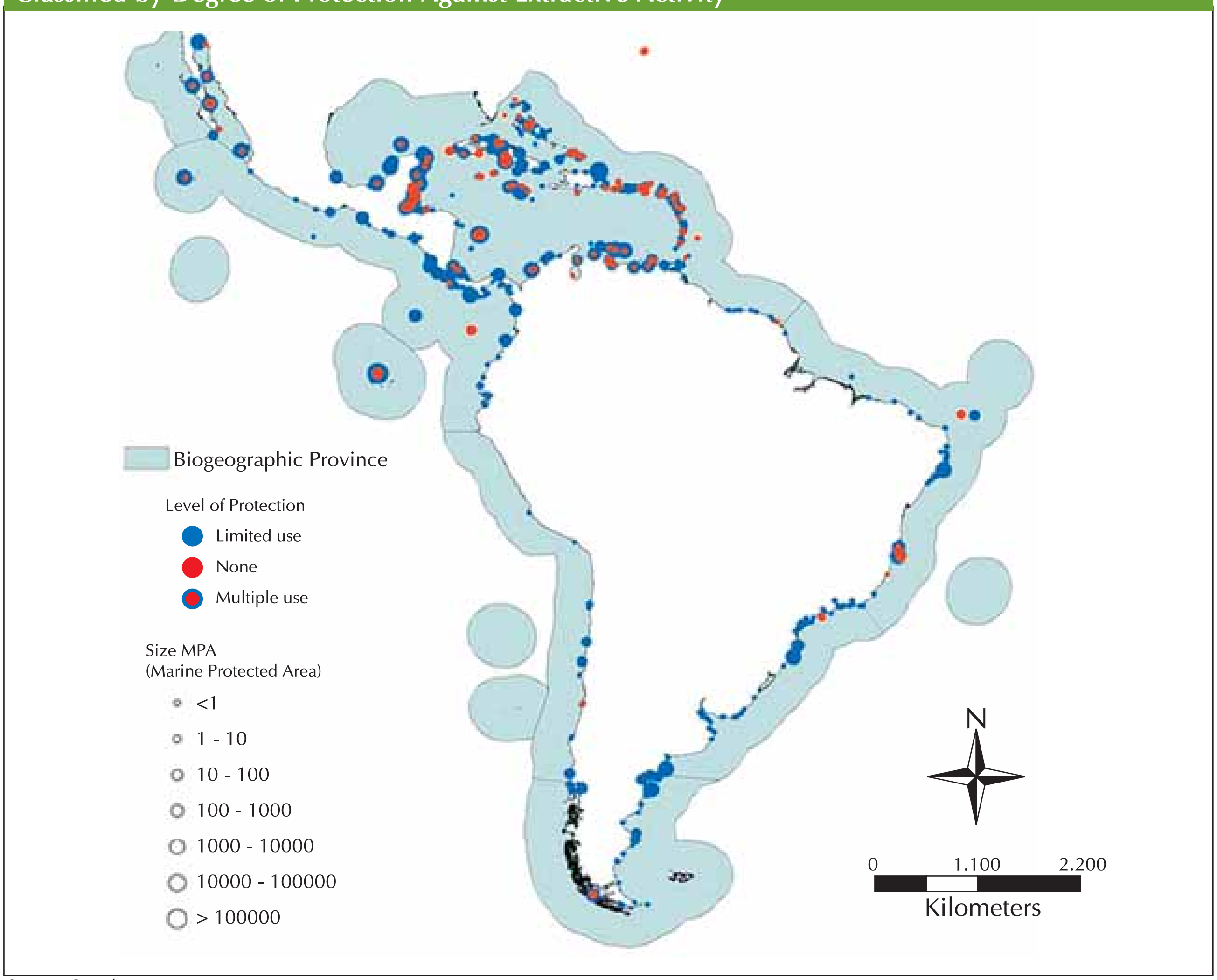
15 *http://www.un.org/Depts/los/convention_agreements/texts/unclos/convemar_es.pdf*

Marine reserves are estimated to represent less than 0.1% of the exclusive economic zone (EEZ[15]) in LAC (PISCO, 2008). Most of the region's reserves are small, comprising less than 7 km^2 (map 2.9). Many of these, however, are not managed effectively, and a recent evaluation of 255 reserves showed that only 12 are periodically monitored to prevent illegal fishing (PISCO, 2008). In the Small Island Developing States (SIDS) of the Caribbean, only a small fraction of the MPAs have any management plan (Singh and others, 2008).

Guarderas (2007) described the state of the MPAs and of non-extractive reserves, examining changes in their number, level of protection, size and connectivity, degree to which they conform to the IUCN (1994) management categories, and size and level of protection in relation to the particular countries and biogeographical regions in which they were located. Guarderas also evaluated the importance of MPAs in LAC in relation to regional and global conservation initiatives. She found that their distribution varied widely: they were concentrated in certain biogeographical regions and absent from others. (An example of this can be found by examining the case of the southern coasts of the Pacific and Atlantic Oceans). Another problem is that in the Caribbean sub-region, MPAs are predominantly established around coral reefs, while other important habitats are afforded no protection. Moreover, fundamental issues such as connectivity, size and distance between reserves—factors that are essential to their effectiveness—have not been adequately considered in designing the areas. Map 2.9 shows the MPAs of LAC, along with their size and the type of agreement that they have with the IUCN.

MAP 2.9

Latin America and the Caribbean: Distribution of Marine Protected Areas (MPAS), Classified by Degree of Protection Against Extractive Activity



Source: Guarderas, 2007.

6.2 Wetlands

There are 227 designated Ramsar sites[16] in LAC, covering a total area of approximately 35.9 million hectares. Mexico has the highest proportion, with 89 sites.[17] However, Peru has the most area (approximately 6.8 million hectares), followed by Mexico, the Plurinational State of Bolivia and Brazil (figure 2.20). There are 14 Ramsar sites of different sizes in the Caribbean.

The world's wetlands include mangroves, which have been under such severe threats that roughly 20% have disappeared since 1980 (Valiela and others, 2001; FAO, 2006), including significant areas in LAC (table 2.12). The region's wetlands are among the most under-valued of coastal ecosystems. One example of this is Belize City, where a system of pools, surrounded by mangroves and the associated drainage areas, have been used as a natural sewage treatment facility for most of the city's wastewater. Furthermore, dredging that is occurring there in connection with a major port expansion has destroyed additional mangroves, along with the free environmental services that they provided (WWF, 2004).

Elsewhere, it has been estimated that over 50% of Saint Lucia's mangroves have been lost to hotel development (Singh, 2005; Bushnell and others, 2001). The conversion of mangroves for tourism and other types of land use has resulted in the destruction of these ecosystems, with direct effects on fishing and on the ability of the systems to provide needed environmental services.

16 *Sites designated by the Convention on Wetlands of International Importance, known as the Ramsar Convention.*

17 *http://Ramsar.wetlands.org/; revised 10 June 2008.*

FIGURE 2.20

Latin America and the Caribbean: Wetlands Area Under the RAMSAR Convention
(Millions of hectares)

Source: Prepared by UNEP with data from http://www.ramsar.org/cda/ramsar/display/main/main.jsp?zn=ramsar&cp=1_4000_2. Accessed September 2008.

TABLE 2.12

Latin America and the Caribbean: Changes in Wetlands Area

Country/Area	Most recent reliable estimate		1980	1990	Annual Change 1980-1990		2000	Annual Change 1990-2000		2005	Annual Change 2000 - 2005	
	Ha	Ref. year	Ha	Ha	Ha	%	Ha	Ha	%	Ha	Ha	%
Brazil	1,012,376	1991	1,050,000	1,015,000	-3,500	-0.3	1,000,000	-1,500	-0.1	1,000,000	0	0
Colombia	371,250	1997	440,000	393,000	-4,700	-1.1	360,300	-3,270	-0.9	350,000	-2,060	-0.6
Ecuador	149,556	1999	203,000	163,000	-4,000	-2.2	150,200	-1,280	-0.8	150,500	60	n.s.
Peru	4,550	1995	8,300	5,800	-250	-3.5	4,500	-130	-2.5	4,500	0	0
Suriname	114,600	1998	115,000	114,800	-20	n.s.	114,600	-20	n.s.	114,400	-40	n.s.
Venezuela (Bol. Rep. of)	250,000	1986	260,000	244,500	-1,550	-0.6	231,000	-1,350	-0.6	223,500	-1,500	-0.7
Costa Rica	41,840	2000	63,400	53,400	-1,000	-1.7	41,800	-1,160	-2.4	41,000	-160	-0.4
El Salvador	28,000	2004	46,700	35,300	-1,140	-2.8	28,500	-680	-2.1	28,000	-100	-0.3
Guatemala	17,727	1999	18,600	17,400	-120	-0.7	17,500	10	0.1	17,500	0	0
Honduras	78,668	2000	152,500	118,400	-3,410	-2.5	78,700	-3,970	-4	67,200	-2,300	-3.1
Mexico	882,032	2002	1,124,000	985,600	-13,480	-1.3	885,000	-10,060	-1.1	820,000	-13,000	-1.5
Nicaragua	69,050	1998	103,400	79,300	-2,410	-2.6	65,000	-1,430	-2	65,000	0	0
Panama	174,435	2000	250,000	190,000	-6,000	-2.7	174,400	-1,560	-0.8	170,000	-880	-0.5
Antigua and Barbuda	1,175	1991	1,570	1,200	-37	-2.6	850	-35	-3.4	700	-30	-3.8
Bahamas	141,957	1991	180,000	145,000	-3,500	-2.1	140,000	-500	-0.3	140,000	0	0
Barbados	4	2004	30	16	-1	-1.6	7	-1	-7.9	4	-1	-10.6
Belize	78,511	1990	78,500	78,500	0	0	76,500	-200	-0.3	76,000	-100	-0.1
Cuba	5,485	2003	537,400	541,400	400	0.1	445,500	410	0.1	547,500	400	0.1
Dominica	10	1991	12	10	n.s.	-1.8	10	0	0	9	n.s.	-2.1
Grenada	225	1992	295	260	-4	-1.2	230	-3	-1.2	215	-3	-1.3
Guyana	80,432	1992	91,000	82,200	-880	-1	80,000	-220	-0.3	80,000	0	0
Dominican Republic	21,215	1998	34,400	25,800	-860	-2.8	19,400	-640	-2.8	16,800	-520	-2.8
Haití	15,000	1988	17,800	15,000	-280	-1.7	14,300	-70	-0.5	13,700	-120	-0.8
Jamaica	9,731	1997	12,000	10,700	-130	-1.1	9,700	-100	-1	9,600	-20	-0.2
Saint Kitts and Nevis	79	1991	85	80	-1	-0.6	75	-1	-0.6	70	-1	-1.4
Saint Lucia	200	2002	200	200	0	0	200	0	0	200	0	0
Saint Vincent and the Grenadines	51	1991	55	51	n.s.	-0.7	50	n.s.	-0.2	50	0	0
Trinidad and Tobago	7,150	1991	7,500	7,170	-33	-0.4	7,000	-17	-0.2	7,000	0	0

Source: FAO, 2007f. The World's Mangroves 1980 – 2005. A Thematic Study Prepared in the Framework of the Global Forest Resources Assessment, Rome.
.n.s.: not significant

In the Caribbean sub-region, it has been shown that, despite the Ramsar sites and the coastal management programmes to protect mangroves, there is an ongoing net loss of mangroves and saltwater coastal lagoons. Effects of various types have been identified, including the following major ones (Singh, 2005):

- Increase in landfills and solid waste disposal sites.
- Loss of vegetation, particularly unregulated tree cutting for charcoal production.
- Conversion of land to agriculture and aquaculture.
- Hydrological effects, especially as a result of highway construction and schemes, to rechannel flows when water levels surge.
- Pollution from factory and household effluents.
- Excessive sedimentation due to poor soil use practices in adjacent areas.

6.3 Pressures on marine and coastal areas

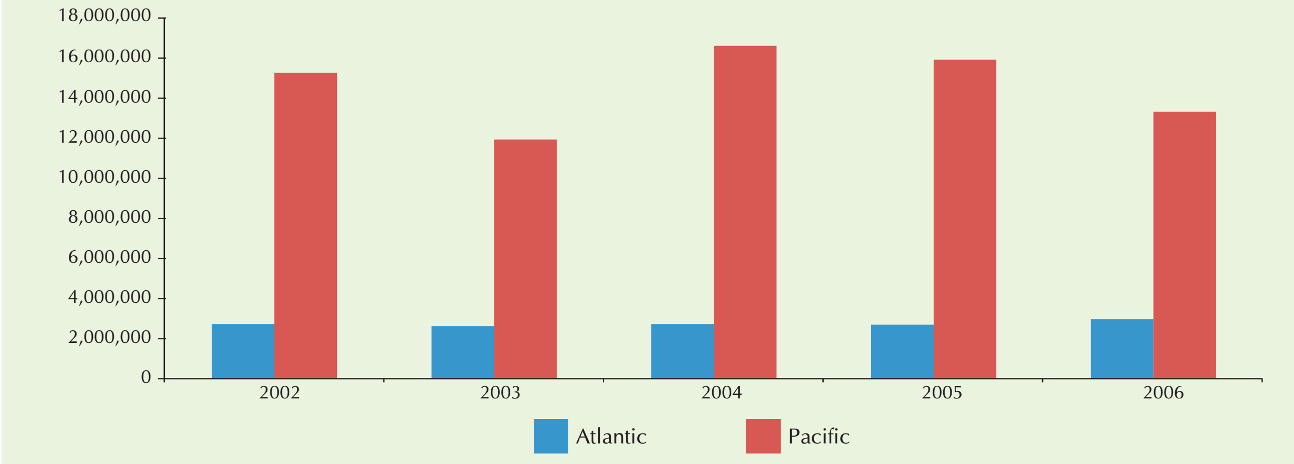
6.3.1 Fishing

The marine fisheries of Chile, Ecuador and Peru are recognised worldwide. Thanks to the effects of the Humboldt Current, they account for nearly 20% of the world catch (Agüero, 2007). Fishing represents a significant proportion of the region's income and provides added dietary protein (see «Water and hydrobiological resources» section of this chapter). The sector's importance is clear from the documented catch figures (figures 2.21, 2.22 and 2.23). Over a four-year period, Argentina accounted for the highest volume of fish caught in the Atlantic, while Peru had the highest catch for the Pacific.

Many species are overfished, and many of the region's single- and multiple-species fisheries are collapsing or are under immense pressure (see chapter III for more information on this topic). Among the reason for these collapses are overfishing, destructive fishing methods and pressures from anthropogenic pollution.

FIGURE 2.21

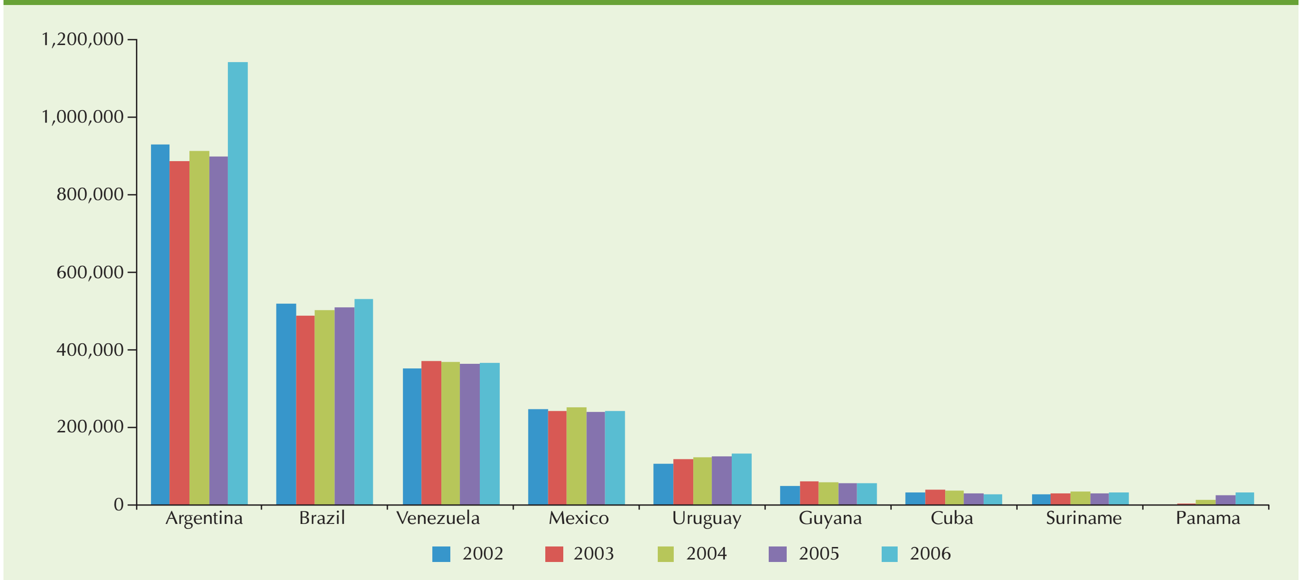
Latin America and the Caribbean: Catches on the Atlantic and Pacific Coasts, 2002-2006 *(Tons)*



Source: Prepared by UNEP with data from the GEOLAC regional website (www.geodatos.org). Accessed October 2009.

FIGURE 2.22

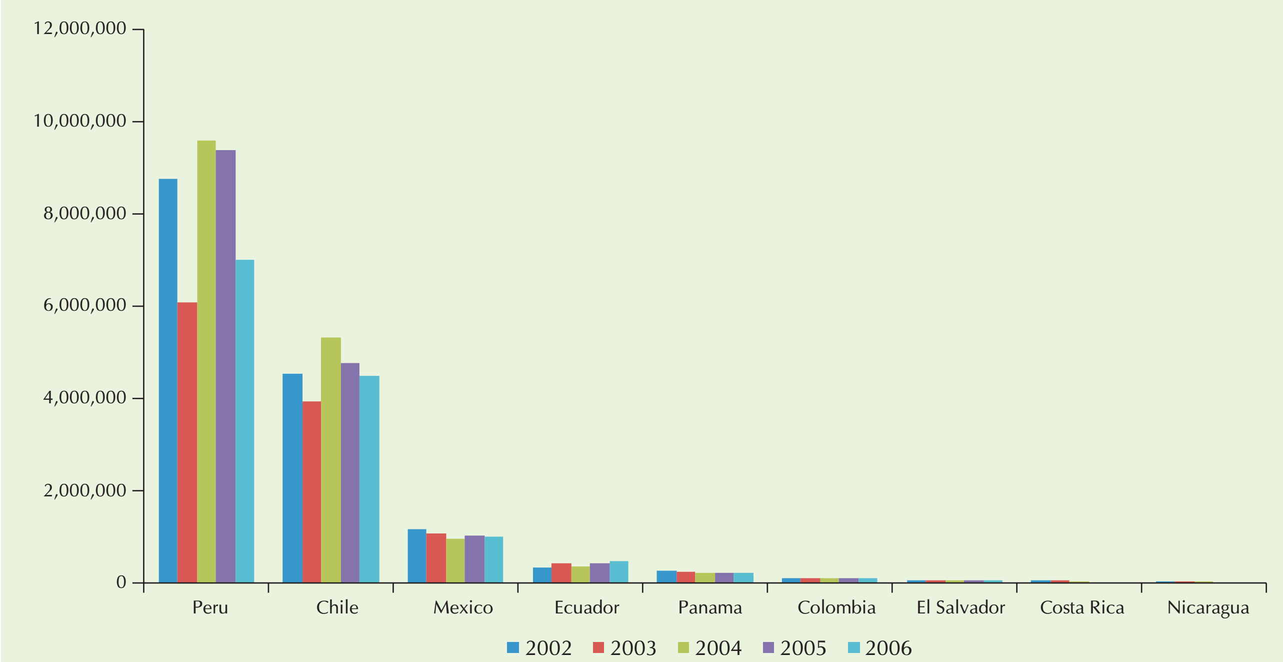
Latin America and the Caribbean: Catch in the Atlantic for the Nine Major Fishing Countries *(Tons)*



Source: Prepared by UNEP with data from the GEOLAC regional website (www.geodatos.org). Accessed October 2009.

FIGURE 2.23

Latin America and the Caribbean: Catch in the Pacific for the Nine Major Fishing Countries *(Tons)*



Source: Prepared by UNEP with data from the GEOLAC regional website (www.geodatos.org). Accessed October 2009.

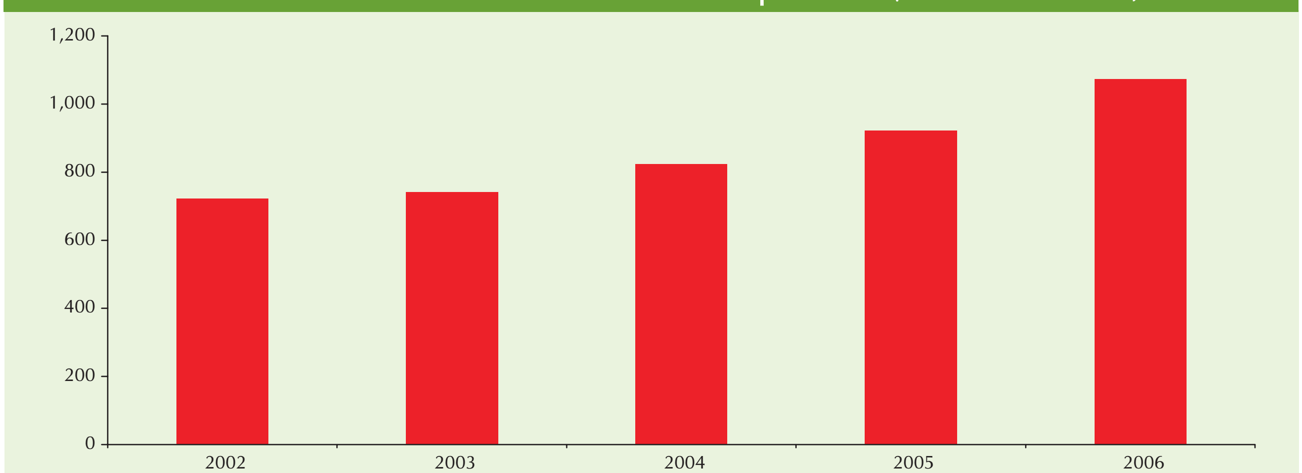
6.3.2 Aquaculture

Aquaculture is on the rise, having increased from approximately 722,000 tons in 2002 to 1.072 million tons in 2006 (figure 2.24) (FAO, 2008). Given the growing demand for fisheries products, and the downward trend in the natural fish populations suggested by inventories, aquaculture is likely to continue increasing in the region over the next decade.

For 2002-2006, FAO reported aquaculture operations in 31 of the region's countries. Chile and Brazil together account for 90% of the region's production. Chile produces 80% of these products, followed by Brazil (10%), Mexico (5%) and Colombia (2%) (figure 2.25). In terms of production by the different sub-regions, South America produces 85% of the region's aquaculture by

FIGURE 2.24

Latin America and the Caribbean: Total Production From Aquaculture *(Thousands of Tons)*



Source: FAO 2008. Available at www.fao.org/fishery/statistics/software/fishstat. Accessed 25 September 2008.

volume, and 84% by value; Central America accounts for 10.1% of volume and 14.3% of value; and the Caribbean sub-region accounts for 5.6% of volume and 2% of value (Rojas and Wadsworths, 2007).

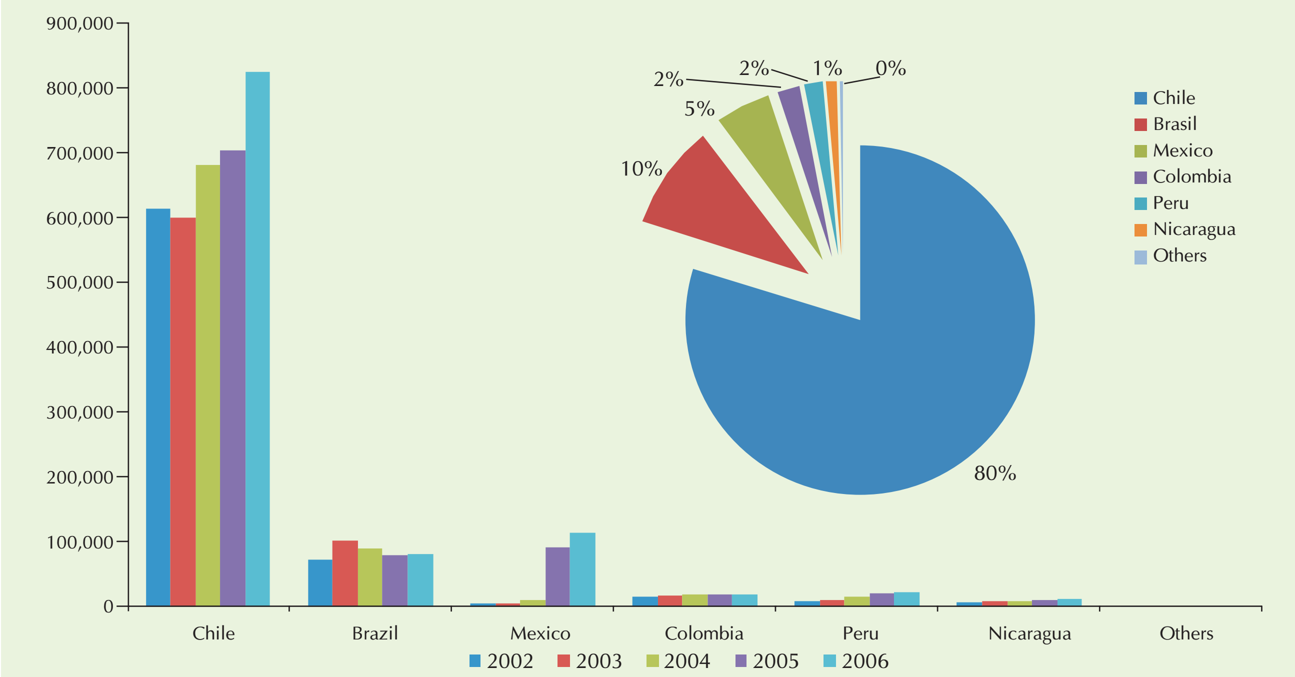
However, the increase in both marine and land-based aquaculture areas, the intensive production technologies used, the introduction of non-native species, the growing use of formulated foods, and the administration of prophylactics to control and manage disease and pathogens, are an inherent part of this increased aquaculture production. According to FAO (2007a), these practices will inevitably produce:

- Increased nutrients and organic enrichment of the waters involved, with a consequent increase of anoxic sediments
- Changes in benthic communities and eutrophication of coastal lakes and areas
- Fragmentation, and sometimes permanent restructuring, of biological and/or social environments
- Competition for resources (such as water) and, in some cases, reduction in these resources
- Negative effects from cultivated organisms that escape from operating areas
- Growing demand for fish meal and oil, which are the principal constituents of the foods consumed by carnivorous and omnivorous species

A full 90% of the LAC countries need to create or strengthen plans to develop and manage aquaculture, whose growth has been shaped essentially by the private sector and by international market demand (Veiulka and others, 2006). The countries of the region need to implement policies and plans for sustainable development of this economic sector and for the protection of the environment.

FIGURE 2.25

Latin America and the Caribbean: Annual Aquaculture Production by Country *(Tons)*



Source: Prepared by UNEP with data from FAO, 2008.
Note: The insert shows the percentage of production by country.

6.4 Threats to coastal/marine ecosystems

6.4.1 Beach erosion

As a result of their need for foreign currency, many Latin American countries are promoting nautical tourism. This involves building marinas, dykes and other port structures, often without the oceanographic studies needed to prevent beach erosion, which, not infrequently, is one effect of such activities (see box 2.13). Beach profile and sediment transport are important factors in designing coastal structures, since they are affected by wave height and period, and by the slope and material composition of the beaches.

6.4.2 Urban development in coastal areas

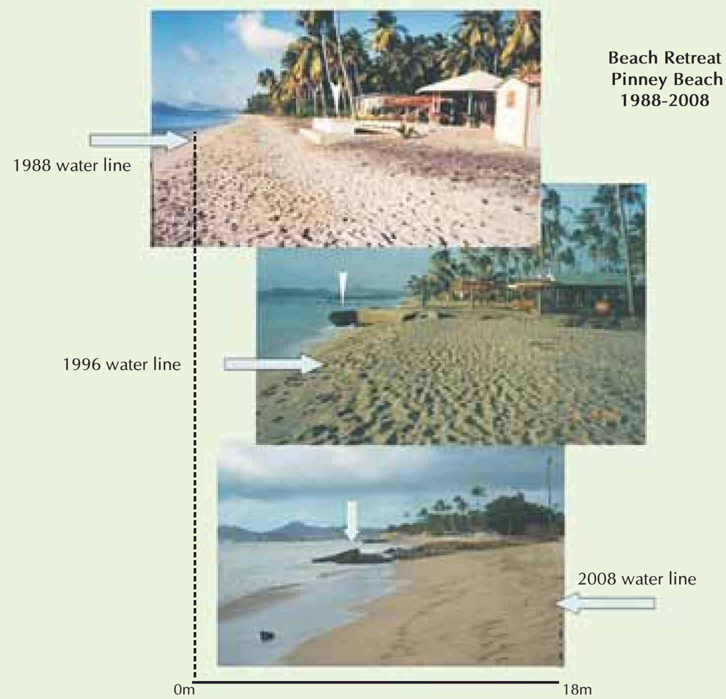
Urban development in coastal areas (see «Urban areas» section of this chapter), mostly in the form of tourism complexes, is a constant in all LAC countries that have beaches attractive to tourists. Many of these changes have negative ecological and social consequences.

BOX 2.13

Effects of Coastal Erosion

Beach erosion is not a regular phenomenon. Years may pass with only seasonal changes; then, a particular storm may cause erosion. Erosion in the Caribbean Islands occurs as a result of human factors such as extraction of sand, coastal developments and poorly planned marine defences, as well as winter surf and hurricanes. Sea level also plays a role.

Tropical storms and hurricanes seem to be dominant factors, producing erosion that cannot be entirely reversed once the particular event ends. Loss of physical habitat has serious implications for flora and fauna, especially given the number and intensity of events related to climate change caused by human factors.



The removal and disappearance of dunes is another phenomenon that has been extensively documented in the Caribbean islands. When the great black sand dunes on Saint Vincent and the Grenadines, 6 metres in height, were exploited in Diamond Bay in the 1980s, the result was a coastal terrain that lacked vegetation and was vulnerable to high seas. Recession of cliffs and changes in rocky coasts are less documented, although the increased exposure of cliffs is associated with beach erosion, which is extensive. In countries such as Guyana and Suriname, beaches suffer, however, from cyclical erosion due to the discharges from the Orinoco River in South America.

Between 1988 and 2008, the high tide line has moved inland by an average 18 metres (59 feet) at Pinney Beach, on Nevis. This erosion is due to a combination of factors:

- *(a) Higher sea level*
- *(b) A series of hurricanes (Hugo in 1989, Luis in 1995, Lenny in 1999)*
- *(c) Human factors, including construction close to the beach, poorly planned sea barriers, extraction of sand, offshore dredging and removal of coastal vegetation.*

The retreating coastline has severe effects on the existing coastal infrastructure, especially on tourist properties in coastal areas of LAC.

Source: Bruun, 1962; Cambers, 1998, 2005.

Alcalá (2008), for example, showed how coastal development has excluded fishermen from developed areas and has caused the disappearance of the communal system of land ownership known as the *ejido*. Traditional users of coastal areas found their beach access restricted, leading to new conflicts similar to those already present in the tourist-oriented Caribbean SIDS. The increasing trend of creating «all-included» recreation sites has exacerbated this problem. On many islands, such as the Grenadines, the best beach land is sold to foreigners. As a result, beach access is limited, and the local population's recreational and cultural possibilities shrink accordingly. The loss of such services through privatisation of property can have serious socioeconomic consequences and can create conflicts between users.

The severe impact that urbanisation was having in the coastal areas of South America led to the Declaration of Santa Clara (2005) (signed at Santa Clara del Mar, Argentina), through which small-scale fishermen, non-governmental organisations, scientists and indigenous groups expressed their concern about the effects of the global neoliberal policies that are dominant in the region. They attributed these effects to unregulated development and to expanding economic activity in coastal areas, including intensive aquaculture, industrial fishing and luxury tourism. These practices, the Declaration states, lead to the degradation of coastal ecosystems, while small-scale fishermen, coastal communities and indigenous groups are displaced from their homes. In addition, privatisation has resulted in a large proportion of properties being concentrated in the hands of a small percentage of the population, exacerbating social inequalities. These issues demand policy responses across the region.

6.4.3 Pollution

In Latin America, 86% of wastewater is discharged, untreated, into rivers and oceans. In the Caribbean, this figure is between 80% and 90% (UNEP, 2007). Not only is such water urban in origin, it is also industrial. Many industrial plants in upper basins discharge their wastewater into rivers, which end up carrying a wide range of pollutants, ranging from heavy metals to excess organic matter. This is a clear case of externalisation, since the polluter does not pay for the treatment of the wastewater, but rather leaves the cost to be borne by down-river users of water—those in the fishing and tourism sectors.

Despite its ecological, economic and cultural importance, the Wider Caribbean Region is exposed to environmental pollution from various sources: human activity in coastal and continental areas, and in the Sea. Gold Bouchot (2003), Beltrán and others (2005) and Toledo (2005) have identified some of the sources and forms of pollution for this area:

Activities related to hydrocarbon exploitation

- Maritime transport that entails systematic losses such as operational discharges to wash tanks, as well as critical events such as accidental oil spills.
- Broken piping, conduits and valves through which oil and gas escape.
- Activities connected to offshore oil platforms.
- Discharges from inland industrial activities, with wastes being transported to the sea by river; thermoelectric emissions and emissions from petrochemical and industrial complexes.

Heavy metals (such as mercury, chrome, lead and nickel):

- Oil-related activities.
- Metallurgy.
- Fluvial transport of agrochemicals such as pesticides and herbicides that directly impact certain marine biota.
- Waste from inland industrial activities discharged into rivers, which then carry it to the sea.
- Industrial activity in coastal areas.
- Waste from hydroelectric plants.
- Untreated urban and industrial wastewater.

Eutrophication: nutrients and sediments:

- Nitrogen- and phosphorus-based nutrients from household waste in urban centres and from agricultural areas.
- Industrial discharges (refineries, pulp and paper factories, food and chemical industry plants).
- Mining wastes.
- Soil (and nutrients) removed as a result of deforestation.

Pathogens:

- Wastewater discharged directly into bodies of water, both continental and marine.
- Persistent toxic substances.
- Residues of household insecticides in coastal areas.
- Residues of pesticides used in agricultural areas.

Waste from boats:

- Ballast and bilge water.
- Wastewater.

Other:

- Antibiotics used in cattle-raising
- Antibiotics used in aquaculture

6.4.4 Invasive species

The intense maritime traffic resulting from globalisation inevitably involves the movement of species from one place to another, across thousands of kilometres. In recent years, regulatory efforts have concentrated on ballast water and their sediments (see box 2.14). It is estimated that up to 14 billion tons of ballast water is transferred from one location to another across the globe, and that at any given time, between 7,000 and 10,000 marine species may be present. The introduction of species such as bivalves (for example, the notorious zebra mussel, or *Dreissena polymorpha*, one of the principal exotic species causing problems in large lakes around the world, according to Hall and Mill, 2000), as well as other invasive processes in aquatic and terrestrial ecosystems, can have adverse ecological effects on ecosystems. This, in turn, affects both human well-being and economic activities such as fishing, while also taking a toll on businesses such as sight-seeing and other culturally valuable services (Pejchar and Mooney, 2009).

As a response to the need for information on invasive species, Mexico's National Commission for the Knowledge and Use of Biodiversity (CONABIO, 2008), with help from experts, implemented the Invasive Species in Mexico System. The Commission has reported three invasive fish species in the marine environment,

BOX 2.14

Risks from invasive species in the Galápagos Islands Marine Reserve

In the Galápagos Islands Marine Reserve, the Committee on Agricultural Health and the Galápagos Inspection and Quarantine System (SICGAL)[1] developed a plan to manage invasive species in the reserve. The plan places priority on developing protocols for the three principal vectors:

- *Bilge water. This is probably a minimal risk, since most boats operate exclusively inside the reserve, and few traverse it.*
- *Ballast water. This is probably a minimal risk, since the four freighters that enter and leave the reserve enter with cargo and return to the continent empty. Consequently, they are loading ballast rather than releasing ballast when in the Galápagos.*
- *Cyst infestations. This is probably the greatest risk, since boats (tourist and freight vessels) normally travel between the continent and the archipelago—the small yachts making regular annual trips, the freight vessels doing so monthly. Including the Galápagos on international cruise itineraries could increase this risk.*

Source: Charles Darwin Foundation and Galápagos National Park. Available at: http://www.hear.org/galapagos/invasoras/temas/manejo/marina/index.html. Accessed October 2008.

as well as 17 crustaceans, 12 molluscs, 24 other invertebrates and 49 algae. This contrasts with only 22 species reported for Mexico in the Global Invasive Species Database,[18] a discrepancy that underlines the need for continual monitoring and for better-organised scientific information at the regional level.

6.4.5 Threats to coral reefs

It is estimated that 7% of the world's coral reefs are in the Wider Caribbean Region (CARSEA, 2007). There are over 1,000 species of coral in the Caribbean (Gjerde and Davidson, 1988; Edmunds and others, 1990, Singh, 2005), including many species of both hard and soft coral (CARICOM, 2002). The inventory of soft gorgonian coral is greater in the Caribbean than in other parts of the world, and the most common are the shoreline corals (UNEP/CEP, 2003). The Caribbean has the greatest number of regionally endemic genera in the world (ICRAN, 2001), and according to Groombridge and Jenkins (1996), there are nine endemic genera of corals in the Caribbean. The region's coral reefs often form just offshore, parallel to the coastline, although some recent studies have also revealed deepwater coral reefs in the LAC region.

Humans use the reefs and their products widely as sources of food, construction materials, pharmaceutical drugs and material for aquarium hobbyists, and for other purposes (see chapter III). In addition, their beauty and uniqueness makes them an important attraction for the region's tourist industry and an element of its economic underpinnings.

Unfortunately, these valuable ecosystems are being rapidly degraded by human activities such as coastal development, sedimentation, overfishing and marine pollution. Approximately 36% of the Caribbean's coral reefs are within 2 km of the coast, leaving them highly vulnerable to pressures from coastal activities (Burke and Maidens, 2004).

18 Information available at: http://www.issg.org/database/. Accessed October 2008.

Cambers and others (2008) mention some of the pressures affecting coral reef systems:

- Coral reefs develop in waters with low levels of nutrients. It is estimated that, in the Caribbean, less than 20% of wastewater is treated before entering the ocean (Burke and Maidens, 2004). Untreated wastewater is a major source of nutrients in coastal waters that would not normally contain them; these nutrients foster the growth of algae at the expense of coral (Souter and Linden, 2000), since coral reefs develop in waters with low concentrations of nutrients.
- The tourist industry, which plays an important role in the region's economy, also poses a variety of threats to coral. Dive boats can damage reef structure with their anchors, divers cause physical damage, and the development and operation of large tourist complexes worsen pollution by increasing the quantity of wastewater emptied into coastal waters. Construction of tourist infrastructure (highways, marines, airports) has a similar effect.
- Converting land to agricultural use increases soil erosion and the transport of sediment (accompanied by pesticides and nutrients) to coastal waters. Nearly one fourth of the soil that drains into the Caribbean Sea is agricultural (Burke and Maidens, 2004). The increase in sediment puts pressure on coastal ecosystems in various ways, such as filtering out light needed for photosynthesis, reducing the substrates necessary to juvenile coral and, in extreme cases, asphyxiating the coral. Previously, sediment and nutrients from the continent were filtered by mangroves and seagrass before emptying into the sea. However, loss of these important ecosystems, and their services, has become widespread in the Caribbean (Jameson and others, 1995).
- Sources of pollution from the sea, including oil discharges and spills, wastewater, ballast and bilge water, disposal of human waste and waste from boats are a serious cause of concern in the Caribbean sub-region (Burke and Maidens, 2004).
- Fishing also impacts coral reefs. Fishermen typically seek the reefs' largest fish, which have the highest market value. The consequent reduction in the population of these fish leads to a decrease in the average size of the species fished, and can cause fishermen to fish for less-valuable species, eliminating still more links in the food chain of the coral reefs (McManus and others, 2000). The disappearance of some species can significantly alter a reef's structure. For example, herbivorous species control algae growth; if they are removed from the system, algae can develop, with a consequent reduction in the coral area (Bohnsack, 1993).
- As mentioned, hurricanes (for example, Hurricane Mitch in Central America) cause extensive damage to coral reefs (Bahena and others, 2000). They reduce the physical complexity of the reefs and the abundance of live coral (Steneck, 1994). These effects are greatest in shallow waters, where wave action is greater.

Coral reefs are considered to be in crisis. The underlying facts are well documented and have stimulated numerous publications on the future of the reefs (Hoegh-Guldberg, 1999) and their vulnerability to environmental changes. Contributing to this crisis, in addition to the pressures cited above, is a complex mix of human and climatic pressures, including factors such as disease outbreaks that are suspected (though this has not been proven) to be connected with both of these types of pressures. Nearly two thirds of the Caribbean Basin's coral reefs are threatened by some type of human activity (coastal development, sediment and pollution from river basins, marine pollution and overfishing) (Burke and Maidens, 2004). The coverage of coral has declined by as much as 10% in the last three decades (Gardner and others, 2003).

The deepest and most widespread changes in the Caribbean coral reefs during this time have been attributed to disease. However, the reasons for this sudden emergence and rapid spread of disease are not entirely clear (Buddemeire and Kleypas, 2004). Twenty-three diseases and syndromes affecting coral in the Caribbean have been identified, and in most cases the pathogen responsible is not known (UNEP-WCMC, 2001). Two specific outbreaks have radically altered the ecology of the Caribbean's coral reefs. One disease killed over 97% of the sea urchin (*Diadema antillarum)* (Lessios, 1988), some populations of which subsequently began to recover (Miller and others, 2003), while white band disease has killed many of the elkhorn coral (*Acropora palmata*) and staghorn coral (*Acropora cervicornis*) throughout the Caribbean. These were the dominant coral species in the formation of the Caribbean's reefs during tens or hundreds of millennia, but since 1972, white band disease has played a role in reducing these species, to the point that they are now candidates for the endangered species list (Aronson and Precht, 2001). The spread of white band disease among the coral is principally a result of increased water temperature (see chapter III) and a reduction in growth rate due to the acidification of the sea water – which in turn is a consequence of increased concentrations of carbon dioxide (CO_2) in the atmosphere (Doney and others, 2009).

The emergence of these coral diseases also seems to coincide with releases of dust in Africa[19], possibly associated with increasing desertification in the northern part of the continent. In Barbados, the years of heaviest dust accumulation were 1983, 1985 and 1987—peaks that coincide with disturbances in coral reefs throughout the Caribbean (UNEP/GPA, 2006).

Mangrove ecosystems are undergoing major degradation as a consequence of tourism development in coastal areas, over-fishing, tree cutting, shrimp farming, transport of nutrients from upper basins released by deforestation, contamination from agricultural products, and industrial and urban pollution (see Chapter III).

19 Dust or sand can travel from the Sahara across the Atlantic to the Americas, falling to the sea throughout its voyage. It can affect coral by directly fertilising benthic algae with iron and other nutrients that interact with ammonia and nitrites, and this can affect nitrate-rich water at the sea floor and spread bacterial spores, viruses and fungi.

7. Air quality

Air pollution problems overlap with other complex urban and environmental issues that are of growing importance in many areas in LAC region, such as traffic congestion and mobility, land use changes, regional climate, ecosystem degradation, as well as regional haze and noise pollution that affect the quality of life and the well-being of the population.

Air pollution is a persistent and pervasive environmental problem that imposes significant health and economic costs on society. Addressing the problem of rapidly growing cities with severe air pollution has become one of the most important environmental challenges in the LAC region. Atmospheric emissions from urban areas affect air quality and climate as well, with impacts at local, regional, continental and global scales.

Air pollution problems in urban areas differ greatly and are influenced by a number of factors, including

- Topography and meteorology of the urban area,
- Demographic characteristics,
- mobility and transportation patterns,
- fuel quality and usage,
- level and rate of industrialization, and
- socio-economic development.

Large cities such as Sao Paulo, Santiago, Mexico City, and Buenos Aires all experience similar and serious air pollution problems brought about by rapid population growth, uncontrolled urban expansion, unsustained economic growth, increased energy consumption and increased motorization (Molina and Molina, 2004; Molina and others, 2004).

Exposure to air pollutants has been linked to an increased risk of mortality and morbidity, including respiratory and cardiovascular diseases, especially the children and the elderly (Evans and others, 2002). For example, the Project «Missions, Megacities and Climate in South America (SAEMC),»[20] sponsored by the Inter-American Institute for Research on Climate Change (IAI), has found that:

- Inhabitants of Mexico City, Santiago, Buenos Aires and Bogotá have a higher health risk due to the high pollution levels they are exposed to. Ambient particulate matter exceeds WHO guidelines by 90%, while nitrogen oxides exceed those standards by 73%,
- The influence of air pollution and climate on health differs by city and season. Inhabitants of Buenos Aires and Mexico City have a higher risk of mortality from respiratory causes during the warm season, while the children in Bogotá are more affected during the cold season. Cardiovascular mortality is higher in the elderly during the warm season in Bogotá,
- Age, sex and income level influence the population susceptibility to respiratory and cardiovascular diseases; the low income population of Bogotá is more vulnerable, and the differences become more evident during the cold season.

7.1 Urban air quality

In LAC, approximately 79% of the population lives in densely populated urban areas[2]. In Mexico alone, approximately 25 million people are affected by air pollution (INE, 2004). Another 85 million live in other urban areas of LAC that do not meet WHO guidelines or their countries' standards for ambient air quality, such as Arequipa, Bogota, Fortaleza, Lima, Medellin, Santiago, and San Salvador (PAHO, 2005).

Air quality problems differ from one city to another, influenced by several factors listed above; for example, vehicle combustion processes are less efficient at high altitudes. This is a significant factor in the air pollution problems of many LAC cities including Arequipa, Bogota, Mexico City, and Quito (see Figure 2.26). In Mexico City and Santiago thermal inversions cause frequent episodes of poor ventilation, trapping pollutants, deteriorating air quality and increasing population exposure (Molina and Molina, 2002; Molina and Molina 2004). Dispersion conditions can also be poor at times in Bogota, Quito, and Sao Paulo. Large quantities of fine particles ($PM_{2.5}$ or particles with aerodynamic diameter of 2.5 µm or less) from North African dust storms are transported into the Caribbean (Prospero, 2003), thus affecting coral reef ecosystems (see «Ocean and Coasts» section).

20 http://saemc.cmm.uchile.cl//index.php?option=com_docman&task=cat_view&gid=60&Itemid=46

BOX 2.15

Air Quality in the Mexico City Metropolitan Area

Mexico City Metropolitan Area (MCMA) lies in an elevated basin 2240 m above sea level and surrounded on three sides by mountain ridges. During the twentieth century the MCMA experienced huge increases in population and urbanized area as it attracted migrants from other parts of the country and industrialization stimulated economic growth. Today, the metropolitan area's nearly 20 million inhabitants, over 40,000 industries and 4 million vehicles consume more than 40 million liters of fuel per day and produce thousands of tons of pollutants. The high altitude and mild climate facilitates ozone production all year and contributes to the formation of secondary particulate matter.

During the past decade, the Mexican government has made significant progress in improving air quality. Substantial reductions in the concentrations of some criteria pollutants (such as lead, carbon monoxide and sulfur dioxide) were achieved by implementing comprehensive air quality management programs and improving air quality monitoring and evaluation programs (Molina and others, 2002). Figure 2 shows the air quality trends for Mexico City (together with other selected cities in the LAC region) for ozone and PM_{10}, the two pollutants that are most harmful to human health. Despite these important gains, the MCMA residents remain exposed to unhealthy concentrations of air-borne pollutants, especially particulate matter (PM) and ozone (Molina and Molina, 2002). Currently an air quality forecast is being developed to anticipate episodes and enforce short-term measures to reduce population exposure to pollutants (Garcia-Reynoso and others, 2006). The results indicate that the air qualtiy problem is regional, i.e., emissions from nearby cities also contribute to the MCMA's air quality (Garcia-Reynoso, and others, 2009).

Recent MCMA-2003 Campaign (Molina and others, 2007) to characterize the pollutants emitted to the MCMA atmosphere, and the 2006 MILAGRO Campaign (Molina and others, 2010) to study the outflow of air pollutants from Mexico City have provided very comprehensive data sets for updating and improving the emissions inventory, the chemistry, dispersion and transport processes of the pollutants emitted to the MCMA atmosphere and their regional and global impacts.

Like many large urban areas, the MCMA's air often contains very high levels of fine (submicron) aerosol particles as well as a wide range of toxic gaseous air pollutants (Molina and others, 2007; Molina and others, 2010). Mexico City's fine PM is usually dominated by organic species (Salcedo and others, 2006; Aiken and others, 2009) and it has been observed to grow very rapidly during sunlight hours, far faster than current atmospheric models or laboratory simulation experiments with suspected precursor gases can explain (Volkamer and others, 2006). Air quality analyses have also been carried out at other cities such as Mexicali (Osornio and others, 2007), Querétaro (Coronel, 2005), Chihuahua (Cortés, 2005) and Acapulco (Ortínez and others, 2007).

Sources: Molina and others, 2002; Molina and Molina, 2002; García-Reynoso and others, 2006; García-Reynoso, and others, 2009; Molina and others, 2007; Molina and others, 2010; Volkamer and others, 2006. Osornio and others, 2007; Coronel, 2005; Cortés, 2005; Ortínez and others, 2007.

Table 2.13 shows annual average ambient concentrations of PM_{10} (particles with aerodynamic diameter of 10 µm or less) measured in several cities. Some cities such as Mexico City, Sao Paulo and Santiago have a long history of monitoring air quality; whereas in other cities, there are only a few annual average concentration data points. In some cities, such as Lima ambient concentrations are very high[21]. In other cities of the Region ambient PM_{10} concentrations are lower but many still do not meet national standards[22] and WHO guidelines (WHO, 2007).

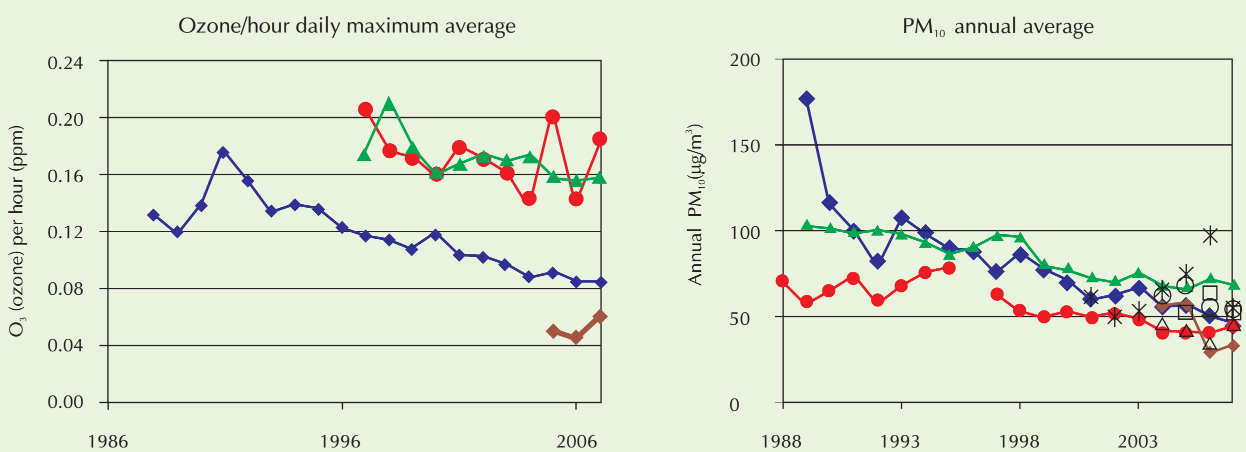
In countries that currently do not have ambient monitoring network in place, an initial step towards

21 *The monitoring sites may have been placed near the roadside, though. Lima has a higher share of buses and trucks than other large LAC cities (IVE, 2008).*

22 *Most of the countries have enacted a national annual ambient air quality Standard of 50 µg/m³; the exception is Colombia, that has a level set at 70 µg/m³ in 2006 to be reduced to 60 µg/m³ in 2009 and to 50 µg/m³ in 2011.*

FIGURE 2.26

Latin America and the Caribbean: Urban Air Quality Trends In Selected Cities, Ozone and PM_{10}



*PM_{10} = Suspended particulate matter with an aerodynamic diameter of 10 μg or less.

Cities selected are: Mexico City (blue diamond), Sao Paulo (red circle), Santiago (green triangle), Quito (brown diamond), Bogota (gray dashed line). In the PM plot the following cities are also displayed: Lima (''), San Jose (triangles), San Salvador (squares), and La Paz (circles). For Lima $PM_{2.5}$ annual average is plotted instead of PM_{10}, and the ozone data for Quito are 8-h average values. In the case of Mexico City, the values plotted for gases are city wide average values. Sources of information are listed in the following Table 2.13.*

TABLE 2.13

Latin America and the Caribbean: Annual Ambient PM_{10} Concentrations for Selected Cities

Ciudad	Ambient average annual concentration of PM_{10} (µg/m^3)							
	2000	2001	2002	2003	2004	2005	2006	2007
La Paz[1]					62	67	55	54
North Lima ($PM_{2,5}$)[2]		61	49	53	65	75	97	55
Mexico City[3]	71	60	62	66	56	56	50	46
Quito ($PM_{2,5}$)[4]					56	57	29	33
San Jose[5]					46	42	35	46
San Salvador[6]					52	63	52	52
Santiago[7]	77	72	71	74	68	66	71	69
Sao Paulo[8]	52	49	51	48	41	40	40	44

Sources: 1-Red MoniCA Bolivia, http://redmonica.com/contaminantes.php; 2-Dirección General de Salud Ambiental, www.digesa.sld.pe/; 3-Mexico City, Federal District Government 2006; www.sma.df.gob.mx/simat; 4-CORPAIRE, www.corpaire.org; 5-Estado de la Calidad del Aire en Costa Rica, 2007; 6-FUSADES, Informes de Monitoreo de la Calidad del Aire del Area Metropolitana de San Salvador 2004-2006; 7-Comisión Nacional del Medio Ambiente, www.conama.cl/rm ; 8-CETESB, Relatorio do Qualidade do Ar 2006, http://www.cetesb.sp.gov.br/Ar/publicacoes.asp.

BOX 2.16

Emissions Inventories and Air Quality Modeling

Numerical simulation of air quality at urban zones is a complex task that requires detailed emission inventories accounting for the spatial and temporal variation of emission sources. In addition, reliable meteorological fields of wind, temperature, etc., are required to properly simulate photochemical processes leading to formation of ozone, seconday aerosols and other oxidants in the atmosphere. However, emissions inventory in many LAC cities are lacking. For those that have developed an inventory, there is significant uncertainty in the estimates of emissions e, particularly for mobile sources. This is most likely due lack of institutional, financial and technical resources in collecting, evaluating and validating the data. Clearly, this is a major hurdle for reliable air quality modeling in the region.

These models can be used to explain past episodes, to evaluate the potential effects of different emission reduction strategies, or to make air quality forecasts. Because of strong concern for high levels of ozone and particulate matter, measurements and modeling activities have focused on speciated volatile organic compounds (VOC) and nitrogen oxides (NO_x) emissions, as well PM_{10} or $PM_{2.5}$ mass concentration and bulk composition.

In the metropolitan area of Mexico City, while some measurements of pollutants from stationary sources (e.g., Mejia and others, 2007), and area sources (Velasco and others, 2005a; 2005b; 2009) have been reported recently, much of the effort has been concerned with motor vehicle emissions. Investigations have ranged from vehicle dynamometer studies (e.g., Jazcilevich and others, 2007) to remote sensing (Schifter and others, 2003) and mobile laboratory sampling (Zavala and others, 2006; 2009). The consistency of the emission inventory calculations for Mexico City has been evaluated through different techniques, including inverse air quality modeling and source apportionment approaches (e.g., Vega and others, 2000, and Vega and others, 1997).

In Sao Paulo, Martins and others (2006) and Sanchez-Ccoyllo and others (2007) have used tunnel measurements to estimate average emission factors for light and heavy-duty vehicles. In general, the particle emissions in São Paulo tunnels are higher than those found in other cities of the world. The use of this kind of technique combined with ambient measurements leads to improvements in emission inventories. Applications of this concept have been reported for Bogotá (Zarate et al, 2007), Mexico City (Arriaga Colina and others, 2004), Sao Paulo (Andrade and others, 2004; Freitas and others, 2005; Sanchez-Ccoyllo and others, 2006a, 2006b, 2007), and Santiago, Chile (Schmitz, 2005), among others.

Air pollution science has progressed steadily due to improvements in the ability to measure pollutants, precursors, and reactive intermediates. This information has facilitated the development of improved computer models of the complex photochemistry that cause the formation of O_3, other oxidants and secondary PM. For example, in Mexico City, both measurements and chemical transport model simulations suggest that O_3 production in the source region is VOC limited in the photochemically active periods (Lei and others, 2007; 2008). The ozone formation sensitivity has important policy implication.

In Santiago air quality forecasting is used as a tool to implement real-time mitigation strategies. A statistical model developed by Joe Cassmassi is used, which takes previous day observations and large scale synoptic features to predict next day PM_{10} concentrations (Schmitz, 2007). The governor of Santiago has the authority to decree restrictions to vehicular transport (up to 60% of non-catalytic and 40% of catalytic park) and industrial sources if air quality is predicted to reach unhealthy levels. CONAMA, the local environmental agency, has developed emissions inventories combining on site measurements with activity based emission factors. This inventory has been used for multiple hindcast numerical air quality modeling of PM_{10}, $PM_{2.5}$ (Jorquera and others, 2002a,b; Karamchandani and others, 1991) and ozone (Schmitz, 2005). Only the latter has been implemented for operational air quality forecasting. Recent failures in statistical air quality forecasting (less than 50% success in predicting episodes) have led the government to look into numerical air quality forecasting (which links emissions restrictions to the modeling) for the future, and have fostered the development of alternative models such as a neural network forecasting system (Perez and Reyes, 2006).

Sources: Lei and others, 2007, 2008; Mejía and others, 2007, Velasco and others, 2005a; 2005b; Jazcilevich and others, 2007; Schifter and others, 2003; Zavala and others, 2006, 2009; Martins and others, 2006; Sánchez Ccoyllo and others, 2006a, 2006b 2007; Zarate and others, 2007; Arriaga Colina and others, 2004; Andrade and others, 2004; Freitas and others, 2005; Schmitz, 2005, 2007; Jorquera and others, 2002a, 2002b; Karamchandani and others, 1991,

quantifying the magnitude of the impacts is to collect GIS-based data on industrial emission sources and anthropogenic activity and construct a map, ranking the potential cities at higher risk, as has been done for Cuba (Wallo and Cuesta, 2006). This would then suggest where to begin ambient monitoring.

7.1.1. Transport

Emission inventory estimates indicate that mobile sources are responsible for most of the air pollution in the Region's urban areas (CAM, 2008; CETESB, 2007; IVE, 2008; CONAMA 2008). Old gasoline vehicles and diesel buses and trucks using outdated technologies and low-quality fuels comprise a large part of vehicle fleets in many LAC countries. In addition to partiulate matter, motor vehicles are also important sources of CO, NO_X and VOCs.

Transport has grown rapidly throughout LAC. As presented in Table 2.14, between 1990 and 2005, the total vehicle fleets in Mexico, Brazil, and Chile increased by 211, 230 and 219%, respectively (ECLAC, 2007). In 1994, the Metropolitan Area of Santiago contained 58% of all of the motor vehicles in Chile while in Argentina, 51% of the national fleet was in Greater Buenos Aires. In Brazil, the three largest metropolitan areas– Sao Paulo, Rio de Janeiro, and Belo Horizonte – collectively accounted for 45% of the national vehicle fleet. In El Salvador and Costa Rica, 43 and 75% of the vehicles, respectively, are in the capital cities of San Salvador and San José (Eurolatina, 2006).

TABLE 2.14

Latin America and the Caribbean: Total Number of Registered Vehicles, per Country, 1990-2006 *(thousands)*

Country	1990	1995	2000	2001	2002	2003	2004	2005	2006
Belize	20	25	35	40	40	45	50	50	55
Bolivia	0	0	390	410	420	440	490	540	600
Brazil	18,300	26,600	29,500	31,900	34,300	36,700	39,200	42,000	
Chile	1,120	1,630	2,080	2,120	2,170	2,200	2,300	2,450	2,600
Colombia	1,480	2,250	3,060	3,140	3,240	3,450			
El Salvador				540	570	610			
Guatemala	470	660	820	850	880	920	980	1,050	1,080
Honduras				480	520	540	580	610	670
Mexico	10,200	12,000	17,200	18,300	20,000	21,000	20,900	21,500	21,800
Panama	190	260	320	310	320	340	350	350	370
Paraguay	190	340	490	0	0	450	470	510	550
Peru	610	860	1,160	1,210	1,340	1,460	1,510	1,610	1,680
Dominincan Republic		300	1,990	2,120	2,320	2,330	2,120	2,240	
Venezuela	2,340	2,320	2,490	2,710	2,920	3,030	3,230	3,530	

Source: ECLAC Environmental database, http://www.cepal.org/deype/statambiental (accessed July 2008). Numbers have been rounded off because of uncertainties in accounting for total registered vehicles.

Other factors that influence vehicle emissions in LAC are age of the fleet, poor maintenance, lack of emission control technology and fuel quality. In some countries, the practice of importing inefficient used vehicles influences the fleet age. For instance, in a study conducted in 2003 in Lima, the passenger cars' mean age was 11 years, compared with 6.5 and 7.4 years for Santiago (2002) and Sao Paulo (2004) for the same vehicle class (IVE, 2008). In the metropolitan area of San Salvador, buses and trucks constitute only 10% of the fleet but contribute 75% of PM_{10} emissions from transport (Eurolatina, 2006).

Diesel is used widely in LAC in the transport sector. The sulfur content in diesel is critical in determining the level of particles in its emissions: the higher the sulfur content, the higher are the emissions of particles (Clark and others, 2002; COPERT III, 2005). Sulfur content of diesel in LAC varies from country to country: El Salvador 0.50% (NSO 75.04.05:97), Panama 0.50-1.50%, Venezuela 0.50%, Bolivia 0.35%, Uruguay 0.25%, Brazil 0.20%, Argentina 0.15%, Colombia 0.10-0.40%, Chile 0.005-0.03 %, Peru 0.035-0.50% and Mexico, 0.03 -0.5%. It is estimated that cutting the sulfur content from 0.5% to 0.035% would reduce diesel vehicle PM_{10} emissions by 75% (COPERT III, 2005). Hence, significant reductions in PM_{10} emissions from the introduction of cleaner fuels are possible and would be beneficial to public health. At current sulfur levels in diesel across LAC it is expected that transport sources will continue to be a major contributor to ambient particles and gaseous pollutants throughout the region.

The Metropolitan Area of São Paulo (MASP) with nearly 19 million inhabitants in 2006, about 2000 major industrial facilities, and more than 7 million vehicles powered by diesel, gasoline, and ethanol, accounted for 17% of the Brazilian economy in 2000. Between 1980 and 2006 the population increased 65% while the number of vehicles increased sevenfold. The PROCONVE program (*Programa de Controle das Emissões Veiculares*), was implemented in 1986, establishing emission standards for new vehicles. Since then the emission of pollutants has been reduced significantly, and air quality has improved (see box 2.17). Nonetheless, rapid land use change has promoted local and regional climate modification, like a shift of rainfall patterns, increasing heavy rain events. Phase VI of PROCONVE (expected to be implemented in January, 2009) established more restrictive standards for all heavy-duty emission of particles less than 10 µm (PM_{10}). Since fine particles are the most important pollutant relative to impacts on health, radiative process and cloud formation, that Program phase is expected to yield more benefits.

BOX 2.17

Sao Paulo's Experience with Alternative Fuels

In the MASP, currently there are approximately 7.2 million passenger and commercial vehicles, of which 93.5% are light-duty and 6.5% heavy-duty diesel vehicles. Of the light-duty vehicles, approximately 76.3% burn a mixture of 78-80% (v/v) gasoline and 22% ethanol (referred to as gasohol), and 17.2% use hydrated ethanol (95% ethanol + 5% water), (Cetesb, 2007). The addition of ethanol to motor vehicle fuels reduces carbon monoxide but increases in aldehyde emissions have induced a unique photochemical smog problem. Since 2003 the number of flex fuels vehicles –motors that can run with different ratios of gasoline and alcohol– has increased substantially. In spring time, ozone levels routinely exceed the 160 µg/m³ hourly Brazilian National Ambient Air Quality Standard. Approximately 90% of the ozone precursors in the MASP atmosphere are emitted by the vehicular fleet (CETESB, 2007). According to the official state inventory of hydrocarbon emissions from mobile sources, 22% are from gasohol-powered vehicles, 15% from diesel-powered vehicles, 6% from ethanol-powered vehicles, and 5% from motorcycles. In addition, a significant contribution to hydrocarbon emissions comes from evaporative emissions, which constitute 48% of total hydrocarbon emissions to the atmosphere. Hydrocarbons contribute to the formation of the photochemical smog, and are generally attributed to mobile sources. In the specific case of nitrogen oxides, 78% comes from diesel-powered vehicles, 13% from gasohol-powered vehicles, and 4% from ethanol-powered vehicles.

Source: CETESB, 2007; compiled by M. F. Andrade.

In the Mexico City Metropolitan Area (MCMA), about 54% of the gasoline fleet (total 4.03 million) and 43% of the diesel fleet (total 165,000) in 2006 were less than 8 years old (CAM, 2008). In 2007, the authorities introduced a scheme of incentives to promote cleaner and more efficient cars. New vehicles are given a 2, 4 or up to 6 year waiver of the inspection and maintenance test (which is mandatory twice per year in the city) depending on the levels of emissions and the mileage of the unit. This program (called *verificación vehicular*) aims at the quick introduction of TIER 2 and low emission vehicles.

As mentioned above, transportation emissions are the major cause of air quality problems in many large urban centers, and the trend in LAC region is for these emissions to become the dominant source of air pollutants. However, without any traffic control or infrastructure improvement the increasing number of vehicles will cause congestion resulting in both poor air quality and hindered economic growth. The challenge is thus to improve air quality while ensuring personal and freight mobility. The city of Bogota operates the successful TransMilenio Program (box 2.18). The bus rapid transit (BRT) system deployed in this program has resulted in travel time and operational cost reductions, as well as in a decline in traffic accidents. Furthermore, air pollutant emission reductions have been achieved as a consequence of replacing an obsolete transit fleet, running more efficient bus transit operations, and shifting to more efficient transportation.

Other Latin American cities have introduced similar BRT system or are planning to expand existing infrastructure. In the case of Mexico City, a recent study conducted by researchers at INE/SEMARNAT showed that commuter's exposure to carbon monoxide, hydrocarbons and PM was reduced by about 50% when the 22-seater gasoline minibuses were replaced by modern diesel buses (Metrobus) running in a confined or dedicated lane (Wöhrnschimmel and others, 2008). This study corroborated Bogotá's findings that BRT can simultaneously reduce criteria pollutant and greenhouse gas emissions, commuters'exposure levels and travel time.

BOX 2.18

TransMilenio: The Bus Rapid Transit System of Bogotá, Colombia

Launched in December 2000, the Transmilenio BRT is currently providing fast, reliable transit to 1.4 million passengers/day at an average speed of 29 km/hour. Travel times have been reduced by 32% for system users and traffic fatalities in the corridor by 88%. Greenhouse gases have been estimated to decrease by about 134,000 Tons/year (J. Grütter, 2007). This initiative has improved air quality near the BRT corridors. For example, measurements at a site in Av. Caracas in 2000 and 2001 (before and after launching the BRT) showed reductions in SO_2, NO_x and PM10 of 43%, 18% and 12%, respectively.

View of Transmilenio System in Bogota, Colombia. Source: D. Hidalgo, 2007.

The system's infrastructure includes 84 km of exclusive bus lanes in major roads, roads for feeder buses, terminals, intermediate integration points, and 100 enclosed stations with pre-payment and level boarding to the buses. Trunk lines are served by 1,070 articulated buses, while integrated feeder lines are served by 410 conventional buses (www.transmilenio.gov.co). Bus and Fare Collection services are operated by private operators, including traditional transport providers, procured under competitively tendered concession contracts. Overall system planning, management and oversight is performed by a new public agency (TRANSMILENIO S.A.).

The implementation of TransMilenio, along with other sustainable transport initiatives, have resulted in a reduction of private automobile use (below 15% of trips), an increase in non-motorized transport and stable public transit share of trips (traditional plus TransMilenio).

Sources: Compiled by D. Hidalgo with data from J. Grütter, 2007; www.transmilenio.gov.co.

7.1.2. Industry

Many non-transport related activities contribute to air pollution in the LAC region. Among the most important are the generation of electric power, the production of goods and services in industry and commercial establishments, food preparation, water treatment, the use of a variety of consumer products in homes, and the management and distribution of fuels.

Coal and fuel oil fired power generation plants are important point sources of particles and sulfur dioxide into the atmosphere. A study conducted in Mexico estimated that health and monetary impacts caused by large power plants could be substantial, affecting populations within a radius of several hundred kilometers from the point source (Lopez and others, 2005).

According to the data from OLADE (Latin American Energy Organization)[23], 19% of CO_2 emissions were released by the industrial sector, of which 15% of the total emissions came from power generation, therefore that sector is the third important source after emissions from land use change and transport.

7.2. Rural air quality

As urbanization spreads it has been recognized that photochemical oxidant production is increasingly a regional problem (NRC, 1991). Photo-chemically produced oxidants and their precursors flowing out of major cities frequently produce high levels of ozone and other oxidants all the way to the next major city, subjecting the intervening suburbs, forests, and agricultural areas to high oxidant exposures. Air Quality monitoring in LAC has been focused on urban areas. For instance, to date, there is no air quality monitoring station in Mexico that could be clasified as rural.

Burning of wood refuse and crop wastes, such as sugar cane, is widespread in Mesoamerican countries where the extent of urbanization is lower and poverty is higher. In countries with high biomass consumption this is a common source of fuel in urban areas as well as in rural areas (ECLAC, 2003).

Residential sustainability index (RSI[24]) estimates reveal large differences in the way populations meet their domestic energy needs (ECLAC, 2003). Households in Haiti, Paraguay, Honduras, Guatemala, Nicaragua, El Salvador, Peru, and Brazil rely heavily on wood for cooking and heating, and the RSI for these countries range from 75 to 100. In contrast, wood use for domestic energy purposes is lower in Mexico, Costa Rica, Argentina, and Venezuela where the RSI was under 25%.

7.2.1. Mining

Intensive mining activities, including oil extraction, are major sources of PM, SO_2 and VOC emissions. Oil extraction is relevant in Mexico, Venezuela, Ecuador, Cuba, Brazil and Trinidad and Tobago. Mining activities are relevant in Chile (world's leading copper producer), Peru, Brazil and Mexico. The consequent impacts on air quality may range from local to regional, and deposition of heavy metals leads to ecosystem degradation (Carrizales and others, 2006; De Gregori and others, 2003; Gidgahen and others, 2002; Ginocchio, 2000; Klumpp and others, 2003; Moraes and others, 2002; Richter and others, 2004).

Mining is an important sector in Mexico; it is the 3rd producer of silver, 5th in lead and 6th in molydenum and

23 OLADE 2007, Data available at: http://www.olade.org.ec/

24 The index represents the ratio of wood use to consumption of petroleum derivates or secondary hydrocarbons (kerosene, diesel, liquefied petroleum gas) in residential settings.

zinc[25]. In 2005 the annual production was $4,900 million dollars (1.6% of the GDP). The social impact of mining extends to 24 of the 32 states with a direct or indirect impact in 83 million Mexicans[26]. Emission from mining and steel in 2004 was 6,317,000 Mg/yr of CO_2, 13,952 Mg/yr NO_2 and 212 Mg/yr of air toxics (benzene, heavy metals and others).

7.2.2. Agriculture

Air quality monitoring in LAC has been focused on urban areas and research on impacts has addressed public health issues. There are very few studies done on impacts of air pollution on crops and forests. Exposure to ozone and related photochemical oxidants is known to damage both native and agricultural vegetation. A review by Fenn and others (2002) documents the significant damage to forests surrounding the Mexico City air basin caused by exposure to high levels of photochemical oxidants, mainly ozone. There are also studies in Mexico that demonstrate harmful effects of air pollutants on agricultural crops. For example, susceptibility of mango plantations located downwind from a thermoelectric power plant has been shown to increase from exposure to acid rain and Ni- and V-rich ash (CFE Report, 2003; Siebe and others 2003).

The emission from agriculture support equipment is a relevant source. Such machinery usually burns diesel or fuel oil, tends to be fairly old and many have faulty or poorly maintained engines. Consequently, emission figures are more than likely to be underestimated in current emission inventories (Clark and others, 2002).

25 http://cuentame.inegi.gob.mx/impresion/economia/mineria.asp

26 http://www.sonami.cl/exposiciones/expomin2006/sergio_almazan.pdf

The increase in agricultural exports from Mesoamerica, Colombia, Chile and other countries in the region has caused an increase in the use of pesticides, particularly on Mesoamerica, with a per capita consumption of 1,3 kg, one of the highest worldwide (Chelala, 2004) (See «Land» section in this chapter). This poses the risk of acute and chronic poisoning for the population potentially exposed, particularly children. In the RESSCAD XVI conference in 2000 the Health Ministries of Mesoamerica agreed upon restricting the use of pesticides, particulary the 'dirty dozen' (PAHO, 2004). However, only Costa Rica has banned those chemicals from imports since 2004; in El Salvador tighter controls on the sales of pesticides have been enacted since 2004, but there is no follow up how effective that legislation is (PLAGSALUD, 2008).

7.2.3. Fires

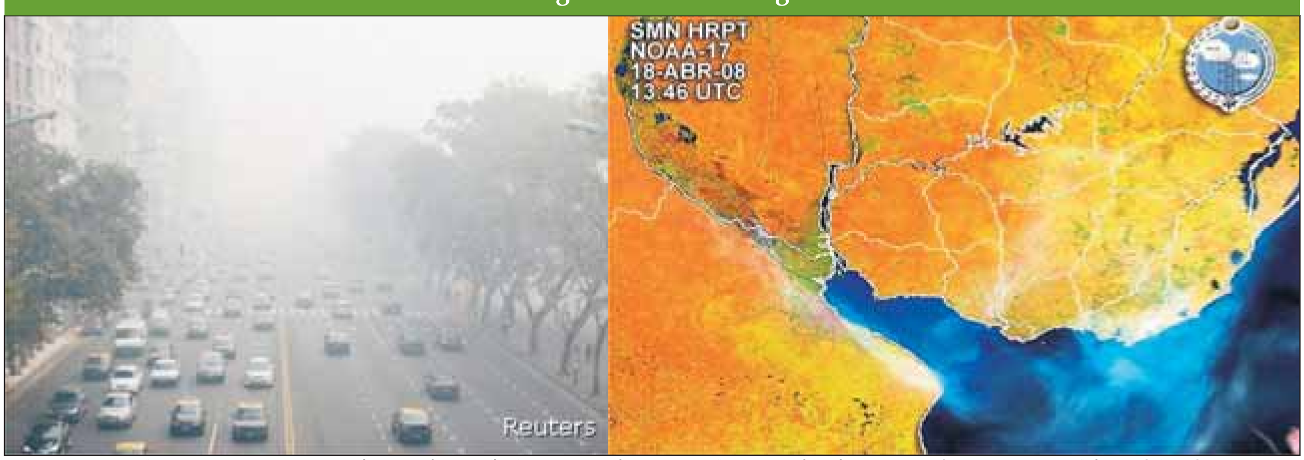
Forest clearing and stubble burning is common practice for converting rain forest into agricultural land and for further maintenance. During fires, ambient particles and carbon monoxide concentrations are high and invariably exceed air quality standards (Reinhardt, 2001; Arbex, 2004). The fires represent a significant source of air pollution, although they mostly occur in rural areas, where air quality problems arising from traffic or industry are less likely and population density is much lower. Burning episodes tend to be fairly short, compare to emissions from other sources, however human populations living in the proximity are exposed to high concentrations of air pollutants. Such episodes are likely to become important regional sources of air pollution (see map 2.10).

Burning of agricultural wastes in the field, such as sugar cane and stalks from grain crops, is another common practice. Up to 20 tons sugar cane/ha are burned every year to facilitate harvesting; the fires also have significant effects on the composition and acidity of rainwater over large areas of southeastern Brazil (Cançado and others, 2006, Lara and others, 2005).

An especially critical area in the country is the Amazon region (see Forest section in this chapter), where every year approximately more than 10,000 km^2 of tropical forests are cut down and most of them burned. Figure 6 shows the amount of burned forest in the Amazon Area. From the total Amazon area (5.5 million km^2), 14% has been deforested (INPE 2008). Biomass burning in Brazil is responsible for 75% of greenhouse gases national emissions (Ministerio de Ciencia e Tecnologia, 2009), being the main source the tropical forest burning. In Mexico, field studies in 2006 indicate that biomass burning - agricultural, forest, and trash fires - contributes to urban and regional pollution in the MCMA (Yokelson and others, 2007; Moffet and others, 2007; Stone and others, 2008; Querol and others, 2008). In El Salvador, biomass burning accounts for approximately 3,300 tons of PM_{10} and approximately 925,000 tons of CO_2 (Eurolatina, 2006).

MAP 2.10

A view of downtown Buenos Aires due to agricultural burning in the Paraná River delta.



Note: A view of downtown Buenos Aires in late April 2008 (left). Poor visibility is caused by agricultural burning in the Paraná River delta (right). (white areas in satellite image NOAA-17)

7.3. Impact on human well-being

Epidemiological and toxicological studies have shown an association between increases in air pollution and excess daily mortality at the levels of air pollution observed in LAC. An estimated 31,000 annual deaths from cardiovascular disease occur in the Region from air pollution exposures (Cohen and others, 2004). Although many pollutants were not measured in epidemiological studies, PM has received the most recent attention in observational and experimental studies, which provided the most compelling evidence that exposure to PM itself causes adverse effects (Pope and Dockery, 2006). A meta-analysis of the time-series studies conducted in LAC between 1994 and 2004 focused on particulate matter has been performed (PAHO, 2005). Quantitative summary estimates were calculated to assess the percent increase in daily mortality associated to a 10 µg/m^3 increase in PM_{10} for some mortality causes. Figure 2.27 shows the results for all-cause, all-age mortality. The value of the above effect is similar to meta-analyses conducted worldwide (Stieb, 2002) and in Europe as well (Katsouyanni, 2002).

Other effects of air pollution include exacerbated bouts of asthma and an increased occurrence of respiratory illnesses and symptoms. Asthmatics are more susceptible to the development of respiratory symptoms, including asthma attacks, and require medical attention during episodes of increased air pollution levels. Respiratory infections and symptoms, such as chest tightness, coughing, and wheezing, also occur in relation to increased air pollution levels (American Lung Association, 2001; Mallol, 2004; Schei and others, 2004).

BOX 2.19

Source Apportionment of Ambient Particulate Matter

Ambient concentrations of particulate matter (PM_{10} and $PM_{2.5}$) are the result of dispersion of local emissions, transport of regional contributions and generation of secondary aerosols, combined with removal processes and turbulent transport in the lower atmosphere. Because of this complexity, specific tools have been developed to manage the diagnostic and identification of relevant sources in a given area, to help targeting emission reductions. Receptor models are mathematical procedures for identifying and quantifying the sources of ambient air pollution and their effects at a site (receptor), primarily on the basis of concentration measurements at the receptor site and generally, without need of emission inventories and meteorological data (Willis, 2000).

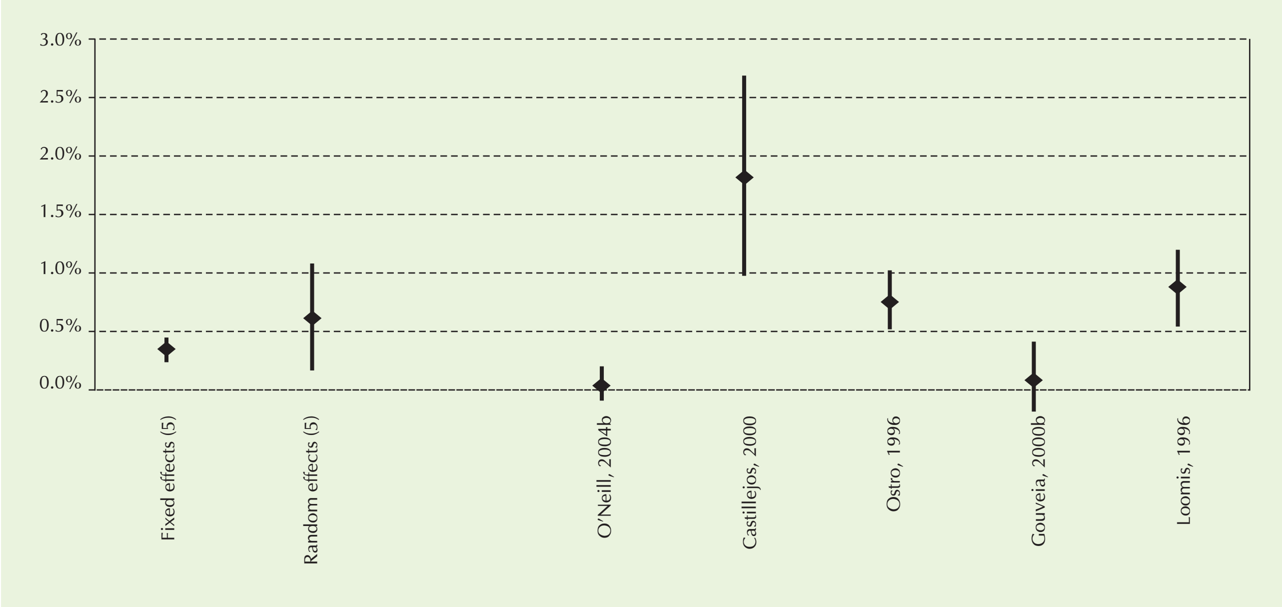
In the LAC region several studies have characterized urban aerosols. In Sao Paulo, CETESB published a Chemical Mass Balance analysis for a central area of the city and found that 67% of fine particles are related to the vehicular emission (CETESB, 2002). Other studies have been performed using multivariate statistics– Factor Analysis, Cluster Analysis and Principal Component Analysis (Andrade and others, 1994; Castanho and Artaxo, 2001), which corroborated these findings from CETESB. The results showed a significant participation of vehicular emission in the mass of fine particles, mainly related to the concentration of Black Carbon. With those methodologies it was possible to determine with better resolution the elemental structure and the size distribution of particulate matter, as presented in the work of Castanho and Artaxo (2001), Miranda and others, (2002), Sanchez-Ccoyllo and Andrade (2002), and Miranda and Andrade (2005).

In Mexico City, Vega and others (1997) applied the chemical mass balance approach to ambient $PM_{2.5}$ and found that the main sources were older vehicles without catalytic converters and heavy-duty diesel vehicles; the former contributed 50% of $PM_{2.5}$ during the day and 38% at night. In Chile, Kavouras and others (2001) applied factor analysis in five mid-size cities, finding a variety of sources of PM_{10} and $PM_{2.5}$ such as copper smelters, motor vehicles, street dust, wood burning, secondary sulfates, windborne dust and sea salt. Hedberg and others (2005) applied receptor modeling to estimate impacts of copper smelters to ambient arsenic concentrations in Central Chile, to distinguish natural and anthropogenic contributions to PM_{10}. Both studies have found ambient levels of ~ 30-70 ng/m^3 in populated areas near copper smelters, well above the global background of 1-10 ng/m^3 (WHO, 2000).

Source: Willis, 2000; CETESB, 2002; Castanho and Artaxo, 2001; Miranda and others, 2002; Sánchez-Ccoyllo and Andrade, 2002; Miranda and Andrade, 2005; Vega and others, 1997; Kavouras and others, 2001; Hedberg and others, 2005; WHO, 2000.

FIGURE 2.27

Estimates of Increases in Mortality (all causes, all ages) for a 10 (μg/m³) Increment in Ambient PM_{10}



Source: PAHO, 2005.

Many studies have been carried out in São Paulo regarding the effects of air pollution on the population health. Higher levels of air pollution in São Paulo have been associated with several health outcomes, including low birth weight (Gouveia and others, 2004), hospital admissions (Braga and others, 1999, 2001; Saldiva and others, 1994; Gouveia and Fletcher, 2000), ischemic cardiovascular emergency room visits (Lin and others, 2003), and mortality (Saldiva and others, 1995; Botter and others, 2002; Martins and others, 2004).

Air pollution is generally composed of the same pollutants across LAC. Vehicle emissions are a pervasive source of exposure to PM, NOx, CO and VOCs; ozone generated from NOx and VOC precursors is an important health concern in the region. Commuting has been consistently found to be the activity with the largest contribution to air pollution exposure for most people living in large cities. This has been documented by a number of personal exposure studies conducted in Mexico City (Fernández and Ashmore 1995; Gomez-Perales and others, 2004; Shiohara and others, 2005).

Differences among the countries in combustion sources and fuels may also lead to differences in exposure and health risks. Households may use a combination of fuels such as electricity for lighting and wood for cooking and heating in urban and suburban areas. But poorly functioning stoves with inadequate venting are common. Studies conducted in Metropolitan Santiago to assess indoor particle concentrations reported 24-hour average exposure levels of 103-173 μg/m³ (Rojas and others, 2001; Cáceres and others, 2001). Biomass fuels are cheaper than other types of fuels, and so continued use is favored amongst the poor. Besides economic motives certain cultural reasons also exist for favoring the use of biomass.

The health effects of air pollution can be influenced by several demographic, socioeconomic and health factors. Both the very young and elderly populations have been shown to be sensitive to air pollution exposure. A time series mortality study (Castillejos, 2005; Loomis and others, 1999) suggested that particles were more toxic per unit of mass for infants and old people in Mexico City. Another study from Mexico City pointed toward genetic susceptibility to ozone exposure in asthmatic children (Romieu and others 2004; 2006).

Cakmak and others (2007) studied the estimated mortality rate associated with ambient air pollution in seven Chilean urban centers during 1997-2003 and found that the very elderly are particularly susceptible to dying from air pollution. Concentrations deemed acceptable for the general population may not adequately protect the very elderly. Sanhueza and others (1998) studied the impact of air pollution by fine particulate matter on daily mortality in Temuco, a city in Southern Chile that has high levels of air pollution from fine PM. They found that there was a significant and positive association between PM_{10} concentration and daily mortality caused by respiratory and cardiovascular diseases in people aged 65 years and more.

People with less education in Europe, Asia, and the United States are at higher risk of mortality associated with daily and longer-term air pollution exposure. However, a new study examining whether educational level modified the risk of mortality associated with exposure to ambient particulate pollution (PM_{10}) in three Latin American cities (Mexico City, Santiago, and São Paulo) during 1998 – 2002; the results indicates that PM_{10} had important short- and intermediate-term effects on mortality in these Latin American cities, but the effects did not differ consistently by educational level.

Evidence linking air pollution exposure with adverse health consequences continues to accumulate. However, very few pollutants, other than the criteria pollutants, have been studied or regulated. Mexico is in the early stages of addressing the air toxics issue. An air toxics emissions inventory was prepared for the MCMA in 2004 and 2006 (SMA/GDF). Field measurement studies in 2003 and 2006 conducted in Mexico City have begun to provide valuable information about non-criteria pollutants (Molina and others, 2007; 2008).

TABLE 2.15

Epidemiological studies of health effects of $PM_{2.5}$ in Sao Paulo (1996 to 2005)

Cause of mortality	Mortality increase (%) per de 10 [µg/m³] of increase in $PM_{2,5}$ (95% of IC)
Cardiovascular	1.12 (0.9-1.17)
Chronic Obstructive Pulmonary Disease	1.15 (0.8-1.24)
Lung Cancer (age 55 to 64)	1.19 (0.9-1.35)

Sources: Saldiva and others, (1994, 1995); Gouveia and others, 2004; Gouveia and Fletcher, 2000; Martins and others, 2004. The WHO has estimated that indoor smoke from solid fuel causes about one-third of lower respiratory infections, about one-fifth of chronic obstructive pulmonary disease, and approximately 1 per cent of cancers of the trachea, bronchus and lung (WHO, 2002).

7.4 Air quality and climate change

As mentioned in Chapter I, the LAC region, especially the small Caribbean island states, are particularly vulnerable to climate change impacts such as sea level rise and extreme events (IPCC, 2007). Air quality is highly sensitive to weather; it follows that climate change may have important air quality implications. In Mexico, there are particular concerns about the effects of drought-related forest fires on air quality and whether or not the frequency of severe droughts might be enhanced by climate change. The effect of forest fires on urban air quality in Mexico can be substantial. For example, in the spring of 2005 metropolitan Guadalajara experienced one of the most severe air quality episodes in its history due to a fire in the La Primavera forest (INE-SEMARNAT, 2006b).

Integrated assessments evaluating co-benefits of coordinated air pollution and climate mitigation efforts have been conducted for different parts of the world. For example, an examination of four megacities (Mexico City, New York City, Santiago, and Sao Paulo) indicated that greenhouse gas mitigation would lead to large reductions in ozone and particulate matter concentrations with substantial resulting improvements in public health (Cifuentes and others, 2001). McKinley and others (2005) found that five proposed control measures in Mexico City that were estimated to reduce annual particle exposure by 1 per cent and maximum daily ozone by 3 per cent, would also reduce greenhouse gas emissions by 2 per cent for both periods 2003-2010 and 2003-2020. Furthermore, about 4,400 Quality Adjusted Life Years (QALYs) would be saved for both time horizons. Another study showed that if the current air quality management plan (PROAIRE 2002-2010) for Mexico City were implemented as planned, they will result in a reduction of 3.1% of projected CO_2 emissions in 2010, in addition to substantial local air pollutant reductions (West and others, 2004).

In summary, climate change can have important impacts on air quality; air pollutants, in turn, are major climate forcing agents. Therefore it is important to integrate air quality and climate stabilization goals in the design of environmental policy to realize potential synergistic benefits and to ensure that actions undertaken to reduce greenhouse gas emissions do not result in unintended consequence with regards to air quality or vice versa.

8. Urban areas

LAC has a long urban tradition, and its cities have a complex history, often marked by their pre-Colombian past – a history that reflects the changing relationship that has evolved between societies and the environment since colonial times. The region's cities of today are in part a product of historical events, which have played a role in shaping their effect on the environment.

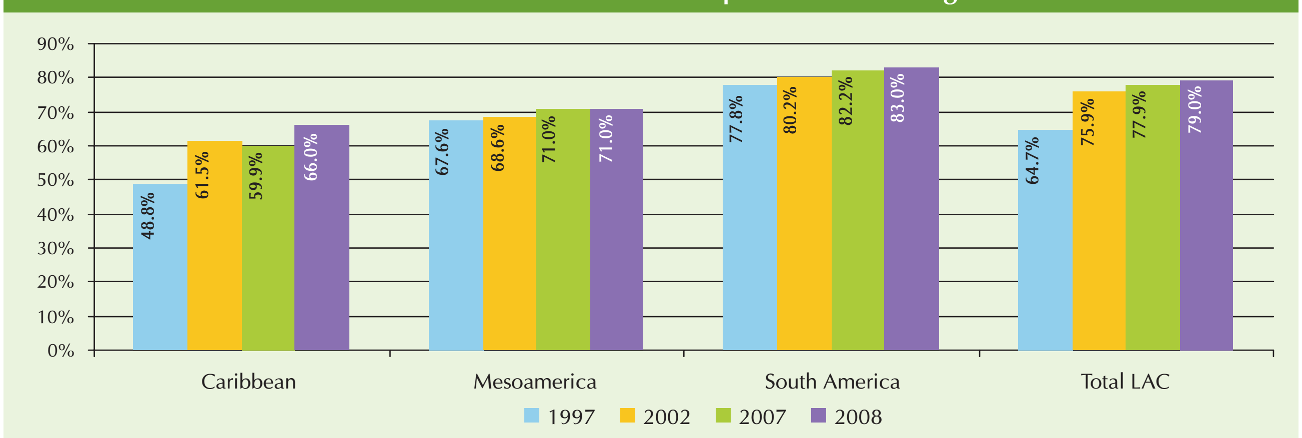
8.1 Urbanisation in LAC

The trend towards increasing urbanisation is a worldwide phenomenon with major environmental, social, economic and political consequences. It is estimated that within two decades 60% of the world's population will live in urban areas. Currently, 79% of the Latin American and Caribbean population is in cities. Among developing regions, LAC has the highest proportion of urban population; Africa and Asia have urban populations of only 39% and 41%, respectively (UNFPA, 2008). The urban population in Latin America and the Caribbean is expected to grow by an average of 1.46% annually, rising from 394 million in 2000 to 609 million by 2030 (UN-Habitat, 2007). Within LAC, South America has the region's highest proportion of urban dwellers (83%), followed by Mesoamerica (71%) and the Caribbean (66%) (UNFPA, 2008) (figure 2.28).

Urban development within the region varies –both in scale and form– from one country to another, based on the particular political-institutional, socio-demographic, economic and environmental characteristics of each. Although the predominant population pattern is urban, this pattern varies depending on the particular country. Notably, the Caribbean sub-region differs from other insular areas by virtue of its high level of urbanisation. Nevertheless, there are important differences within this sub-region: countries such as Antigua, Barbuda, Haiti and Montserrat have urban populations that are below 40% of the total population, while for the Bahamas, Guadalupe and Martinique the figures are above 80%

FIGURE 2.28

Latin America and the Caribbean: Evolution in Urban Population Percentage



Source: United Nations Population Fund (UNPFA), 2008.

(UNDP, 2007). In countries with developed economies, it is common for the urbanisation process to extend across many medium-sized cities, while the most common pattern in developing countries is a phenomenon unknown until the twentieth century: megacities (or «megalopolises»). These are cities with over 10 million inhabitants in which there is a concentration of financial resources, industrial and commercial structures, political and administrative activities, educational facilities and scientific personnel (Fuchs, 1999). Four percent of the world's population and 9% of the world's urban population is concentrated in megacities (UNFPA, 2008). Nineteen of the 21 megacities are concentrated in developing countries, with 4 in LAC: Mexico City (the largest in the region and one of the four largest in the world), São Paulo, Rio de Janeiro and Buenos Aires. In addition to the megacities, there are cities of various other sizes; these are categorised as large, intermediate and small (table 2.16).

The growth of intermediate cities is often due to a concentration of new, economically important activities, such as those in the maquila and tourism sectors, or to the influence of nearby larger cities (UN-Habitat, 2008). Currently, over 60% of the population of LAC lives in cities of under one million inhabitants, and some of these are important for the articulating role they play in the relationships between these cities and other urban centers outside the area (Ballet and Llop, 2004).

Today, it is often the intermediate –and, to an even greater degree, the small– cities, rather than (as in the past) the megacities, that are growing fastest. One can observe a transition from single-centre systems, in which one large city is the most important, towards polycentric systems in which a number of smaller cities serve as the stage for equally important social, economic and political activities. Indeed, in LAC, cities with populations of between 100,000 and 500,000 contain a greater proportion of the urban population (39%) than is the case for any other developing region (18% in Asia, 16% in Africa), and nearly half of the new urban dwellers live in these cities (UN-Habitat, 2008). This can be seen, for example, in Brazil, Mexico and the Bolivarian Republic of Venezuela (Bazant, 2001; Garza and Ruiz Chiapetto, 2000; Garza, 2002; UN-Habitat, 2008).

TABLE 2.16

Latin America and the Caribbean: Population in the Largest Major Cities, 2006
(Millions of inhabitants)

Size Range	Number of cities	Population
Megacities: 10 million or more inhabitants	(4) Sao Paulo (Br), Mexico City (Mx), Buenos Aires (Ar), Río de Janeiro (Br)	62.42
Large cities: Between 5.000.000 and 9.999.999 inhabitants	(4) Bogotá (Co), Lima (Pe), Santiago de Chile (Chi), Belo Horizonte (Br),	27.08
Intermediate cities: Between 1.000.000 and 4.999.999 inhabitants	(48) Argentina 3, Bolivia 1, Brasil 19, Chile 1, Colombia 5, Costa Rica 1, Cuba 1, Dominican Republic 1, Ecuador 1, El Salvador 1, Guatemala 1, Haiti 1, Mexico 9, Panama 1, Paraguay 1, Peru 1, Uruguay 1, Venezuela 5.	96.69
Small cities: Between 500,000 and 999,000 inhabitants		*

Source: Prepared by the authors based on data from the United Nations Population Fund (UNFPA 2007), State of the World Population, 2007*.*
** Data not available in this category, because UNFPA, 2008 only reports data for cities of over one million inhabitants.*

Although the trend is for the primary cities to become less dominant, this process is not uniform across the region. In some places, primary cities still represent the major focus of growth (examples are Port au Prince, in Haiti, Panama City, in Panama and San José, in Costa Rica, each of which contains 50% of its country's population) (UN-Habitat, 2008).

One reason for the growth of smaller cities is the accelerated job growth produced by market demand. The maquila industry, which drove the growth of border cities such as Reynosa, Matamoros, Nuevo Laredo and Ciudad Juárez in Mexico, is an example of this phenomenon. Small cities also grow by offering services to nearby large cities. The airport in Alajuela, which serves the residents of San José (Costa Rica), and the industrial growth of São Jose dos Pinhas, near Curitiba (Brazil) illustrate this. Similarly, San Bernardo (Chile) has grown because of its proximity to Santiago, while Cabinas (Bolivarian Republic of Venezuela), has grown as a result of its close links with Maracaibo.

Immigration from rural areas, which is a decisive engine of growth for the cities of the region, is the result of various factors, including: extreme impoverishment caused by erosion of the means of subsistence; increased lack of security; and efforts to find jobs or services (such as health care or education) (Mendoza, 2003). In addition, there is a high percentage of inter-urban migration, and close to 50% of emigration begins and ends in urban areas (UN-Habitat, 2008).

In LAC, as in other world regions, poverty is being urbanised (UNEP, 2005; UNFPA, 2008), since most rural-urban immigrants live in poverty in the cities before moving in search of better living conditions. Thus, for example, 40% of urban Mexico City residents –and 30% of São Paulo residents– who have migrated from rural areas live in poverty (CONAPO, 2004; UN-Habitat, 2008[27]). This pattern is can be seen in all of the region's large cities (UNFPA, 2007), many of which have some of the highest indices of socioeconomic inequality in the world (UN-Habitat, 2008).

Although there has been a decline in informal settlements, they housed more than 117 million people in LAC as of 2005, or nearly 27% of the region's population (UN-Habitat, 2008). LAC is the only developing region in which social inequalities are comparable in urban and rural areas. In Chile and Mexico, they are, in fact, nearly identical. The cities with the most severe socioeconomic inequality are

Goiânia, Brasilia, Belo Horizonte, Fortaleza and São Paulo (Brazil) and Bogotá (Colombia). Caracas (Venezuela), Montevideo (Uruguay) and Guadalajara (Mexico) have lower levels of inequality (UN-Habitat 2008). Inequality is both a cause and a reflection of the cities' environmental problems, and is undoubtedly one of the priority issues for all of the region's population centres.

The urban population in coastal areas also represents a challenge for urban development and an obstacle to reducing the effects of climate change. According to UN-Habitat (2008), 33.5 million people live in low-lying coastal areas, with three quarters of them living in urban areas. Of the world's cities that are most vulnerable to the rising sea levels that accompany climate change, 27% (904) are in LAC (see «Seas and coastal areas» section of this chapter and the subsections «Urban vulnerability, extreme events and climate change» in the present section). Close to 50% of the region's population lives within 100 km of the coast (GEO Data), thus leaving nearly 290 million people vulnerable to this threat.

27 *Information available at: www.unhabitat.org/mdg/lac.summary.asp*

8.2 Urban environmental conditions

There is reason to be concerned about the general environmental situation in the cities of LAC. One manifestation of the imbalances in the functioning of the urban system is the persistence of environmental problems. These include: absence of territorial planning; unplanned land use, with the consequent loss of plant cover and biodiversity, as well as the loss environmental services in general; and air, water and soil pollution.

Providing services to the inhabitants of a city is always a challenge for government, but it is also an opportunity to develop sustainable modalities, taking account of the fact that demand—that is, the people who require services—tends to be concentrated in specific areas. However, when cities grow in a haphazard fashion, as have most of the cities in LAC, problems intensify and aggravate each other. Sometimes existing services are even lost, or their quality is eroded.

One of the undesirable effects of unplanned growth is the spread of a city's environmental impact beyond the actual boundaries of the city. A large city's need for water, food, construction materials and energy are generally met at the expense of areas that are outside the city and often quite distant from it (100 km or more in the case of São Paulo). Moreover, urban waste in many cases has direct or indirect effects on neighbouring regions. Thus, drainage systems are polluting bodies of water that extend into non-urban areas, atmospheric pollutants spread to peri-urban and nearby rural areas, and solid wastes invade areas that, by themselves, do not produce quantities comparable to those generated by the city. In addition, leaching brings substances to the aquifers, resulting in contaminated groundwater. Thus, the cities' ecological footprints are much larger than they appear to be, even in terms of the land area they affect (see box 2.20). Furthermore, as mentioned earlier, the very presence of a large city triggers the growth of other cities which then function as subsidiaries, due to their close proximity to the large city. This phenomenon occurs in the case of airports and real estate developments that offer affordable prices.

Some of the most notable aspects of urban development include: the link between health and solid wastes; availability and quality of water; air quality; the connection between transportation and health; green areas and urban biodiversity; and urban vulnerability due to climate change and extreme events. Except for air quality and its relationship to transportation and health, a topic examined in the foregoing section of this chapter, these issues are analysed below. The GEO Cities reports on selected cities[1] served as a basis for the following analysis.

28 Cities that have been analysed with the UNEP methodology, and for which there is a specific GEO Report (PNUMA 2002a; 2002b, 2003b; 2003c; 2003d; 2003e; 2003f; 2004b; 2006; 2005a; 2005b; 2005c; 2004a; 2007a; 2007b; 2007c; 2008a; 2008b, 2008c; 2008d).

BOX 2.20

Ecological Footprint

Ecological footprint is an indicator used to measure human pressure on the planet's resources. It indicates the demand that a person, country or region makes on global resources. For example, according to proponents of this indicator, it shows the number of hectares of land (out of the total available globally) required to satisfy the needs of one person (a figure that varies based on socio-cultural and economic context). According to data from Global Footprint Network, figures for some LAC countries (Colombia and Nicaragua) are between 2 and 3 global hectares per capita, respectively, while a resident of Haiti requires slightly less than 0.6 global hectares (calculations pre-date the 2010 earthquake). This suggests that a person living in Colombia or Nicaragua needs more hectares than one living in Haiti. By way of further contrast, demands on natural resources from a person living in the United States will be far greater than the demands of all of those other countries combined: per capita demand in the United States represents more than 10 global hectares (with the world average being 3 global hectares).

Surce: Prepared by I. Monterroso using data from Wackernagel and Rees, 1996, and Wackernagel and others, 2002, http://www.footprintnetwork.org.

8.2.1 Water availability and quality

Cities with high growth rates face constraints in supplying potable water for their growing populations, regardless of whether they draw on surface water (rivers and lakes) or groundwater (aquifers).

Cities in LAC have often over-exploited their water resources, to the point of creating an imbalance between the availability of the resource and the population's growing needs for drinking water. This pattern can make water—on a large (regional) scale—into a non-renewable resource (Carabias and Landa, 2005). In addition, different countries have faced repeated economic crises and extreme natural events such as earthquakes and floods, which affect installed infrastructure, and this has limited the maintenance of supply services and water quality (examples of this include Managua and Havana) (Pérez Rodríguez, 2008).

Access to potable water and sanitation

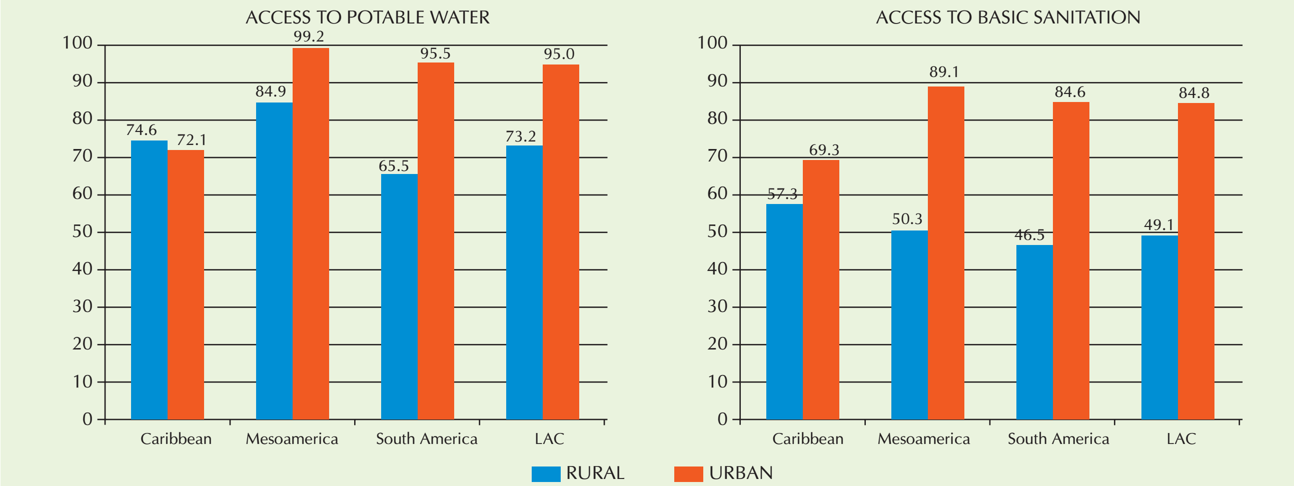
In LAC, potable water through household connections is available for 80% of the population, but there are still approximately 50 million people who lack even minimal access to this vital resource. Most of the region's countries have nearly universal access to potable water and sanitation (UN-Habitat, 2008). The lowest averages (under 50%) are in Guatemala, Haiti, Nicaragua and the Plurinational State of Bolivia (CEPALSTAT 2010[29]). Despite the high percentage of people covered, there is a vast difference between urban and rural areas. Figure 2.29 illustrates access to potable water in urban as compared with rural areas (WSP, 2007) by sub-region, while figure 2.30 shows coverage of potable water and sanitation by country in the different sub-regions, and in rural and urban areas.

If the current trend of growing access to potable water continues, it is estimated that, by 2015, the number of persons without access to improved drinking water sources will have dropped to 25 million (WHO/UNICEF, 2007).

29 http://websie.eclac.cl/sisgen/ConsultaIntegrada.asp

FIGURE 2.29

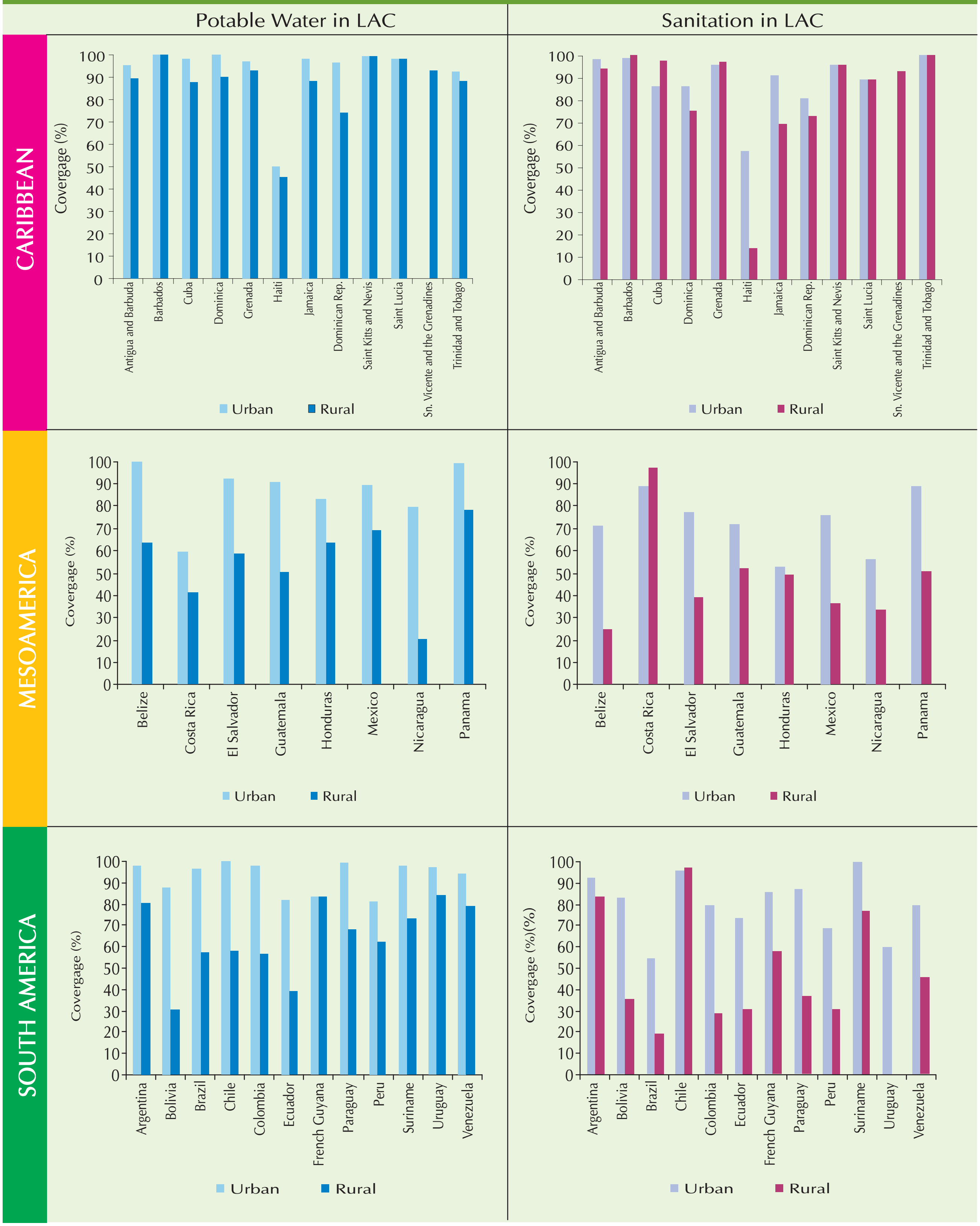
Latin America and the Caribbean: Proportion of Population with Access to Potable Water and Basic Sanitation in Rural and Urban Areas, by Sub-Region, 2004 *(Percentage)*



Source: Prepared by UNEP with data from GEO Data Portal http://geodata.grid.unep.ch. Accessed February 2010. Data from WHO (2006).
Note: Percentages calculated for 46 economies.

FIGURE 2.30

Latin America and the Caribbean: Access to Potable Water and Basic Sanitation, Countries by Sub-Region



Sources: GWP, 2008; INRH, 2005; IRC, 2008; JMP, 2006; Martínez-Frías and others, 2003; Marín and Ramírez, 2005; PAHO/WHO, 2003; WHO/UNICEF, 2007; Orozco, 2004; Ortiz, 2006; UNEP/ANA/MMA, 2007; RAS-ES, 2001; Recalde, 2003; SISS, 2007; UNDP Paraguay, 2007; UNICEF-Guatemala, undated; UNICEF-Jamaica, 2004; Uribe, 2007; USAID, 2005; Van Damme, 2002; Vega and others, 2006; Velásquez and Serrano, 2004.

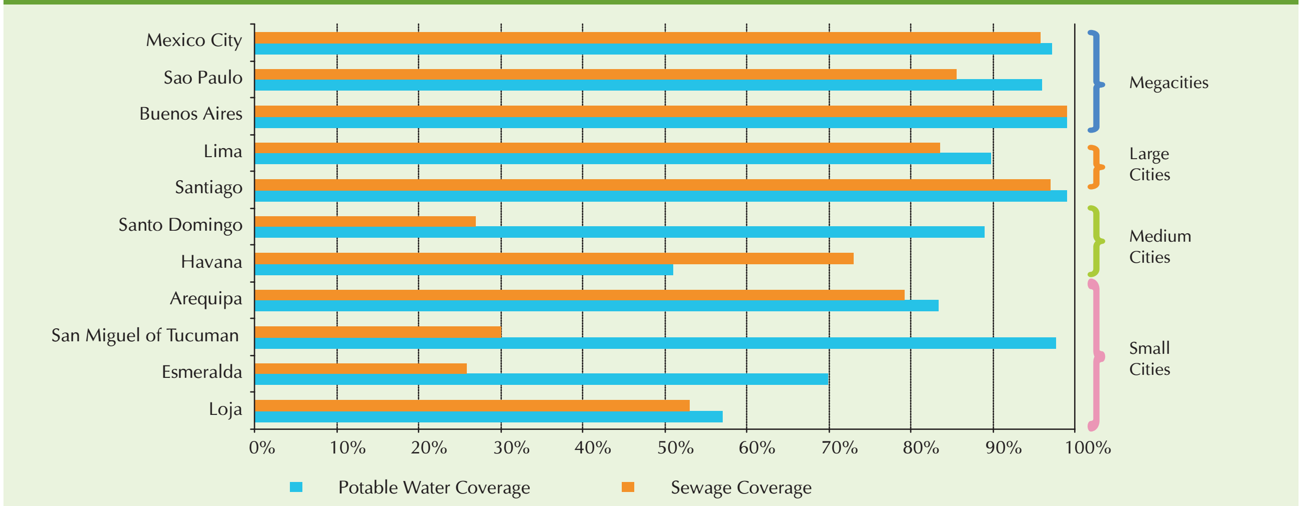
The lack of access to potable water has very differing effects –including effects on the health and economy of families– in different areas. Since the low-income population has limited access to potable water, it depends on purchasing water from tank trucks at prices above the regular rates. Thus, paradoxically, those with the least money are forced to spend most for water. Moreover, this water is generally of dubious quality and poses a risk to the population's health (WHO, 2000a).

The development of infrastructure to provide drinking water and sanitation is directly related to the investment capacity of local, regional and national governments, as well as to rate policy and the ability to actually collect these charges from the population. In some cases, subsidised rates favour wasteful behaviour and limit the availability of financial resources to invest in infrastructure and expand coverage. On the other hand, the population's income and capacity to pay limit the possibilities of maintaining and supervising the system. This contradiction is one factor that hinders access to clean water, as well as to the sanitation and recycling services that should accompany it. In many cases, the problem is aggravated by an insufficient legal or regulatory framework and by poor enforcement capacity.

Infrastructure for supplying water and sewerage has improved in a number of the region's cities. Thus, in 9 of the 17 regional urban environmental profiles (GEO Cities), which were used for the present analysis, over 90% of the population has access to potable water (see figure 2.31). However, access and quality vary within each city. In the region as a whole, marginal areas face recurrent and critical problems of basic sanitation, lack of potable water and lack of garbage-collection services, among other problems.

FIGURE 2.31

Latin America and the Caribbean: Coverage of Potable Water and Sewerage in Selected Cities



Source: GEO Cities reports on Mexico City, São Paulo, Buenos Aires, Lima, Bogotá, Santiago, Río de Janeiro, Montevideo, Santo Domingo, Panama City, Havana, San José (Costa Rica), Rosario, Arequipa, Chiclayo, Tucumán, Esmeralda and Loja.

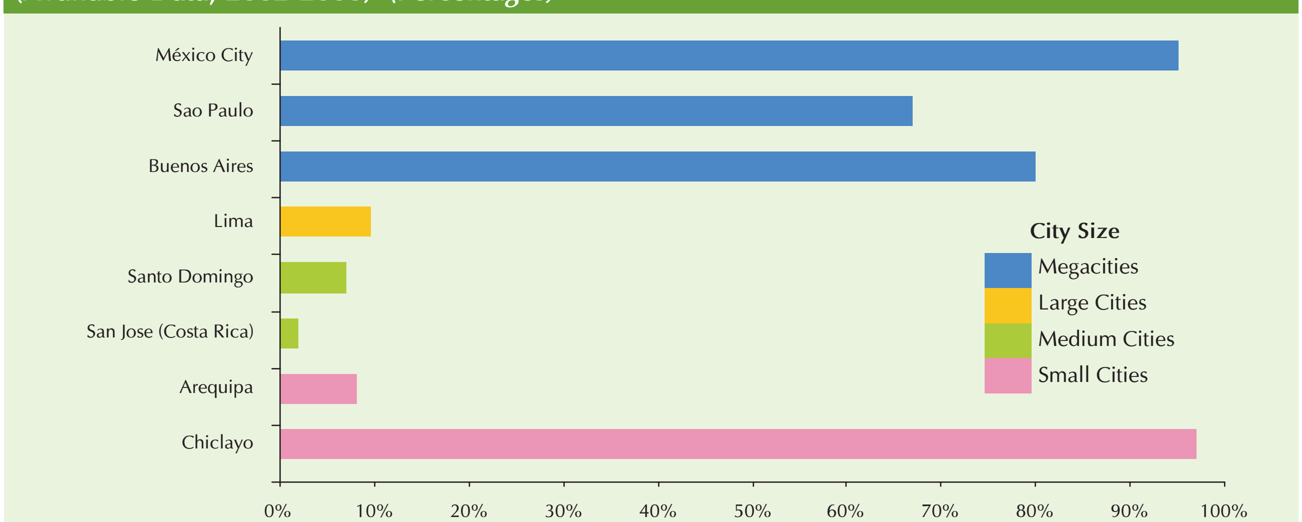
According to WHO/UNICEF (2007), in order for LAC to reach the Millennium Development Goals (MDGs), 10 million people will have to obtain access to sanitation each year, and if current trends continue until 2015, the number of persons who lack improved sanitation will decline by 24 million. Similarly, some countries, such as Argentina, Chile, Ecuador, Guatemala, Mexico, Paraguay, Dominican Republic and Uruguay, could meet the MDGs on schedule (JMP, 2006).

Over 125 million of the region's inhabitants lack access to proper sanitation facilities (WSP, 2007). While urban conglomerates have better sanitation than do rural areas, there is increasing pressure on bodies of water within cities, since these are the receptacles for household and industrial effluents. Wastewater treatment is not widespread in the region, with only 14% of wastewater being treated – an indicator far below other world regions such as Asia (35%) or Europe (66%) (WHO, 2000a).

In LAC, urban wastewater is discharged into bodies of water without receiving any major treatment. For example, the city of Guayaquil, in Ecuador, is situated at the estuary of two rivers, which are used to discharge urban and industrial wastes, while in Argentina, the La Plata River receives waste from Montevideo and Buenos Aires. Mexico City uses a deep drain system to discharge its sewage into bodies of water outside the city, creating major environmental and health problems in the process. The low volume of wastewater being treated contrasts with the high volumes being generated. Approximately 30 million m^3 of household wastewater is discharged daily into bodies of surface water (Biswas, 2006). The percentage of wastewater treated varies significantly between countries: some countries, such as El Salvador (3%), Haiti (5%), Colombia (8%), Guatemala (9%) and Honduras (11%) (WSP, 2007), have alarmingly low figures, while figures for other countries are much higher. For instance, Santiago, Chile, treats over 80% of its wastewater (Chile: Superintendency of Sanitation Services, 2007). Figure 2.32 shows related information from the GEO Cities reports. At the regional level, the data are heterogeneous, making it difficult to arrive at a precise estimate of the volumes treated and the quality of treatment.

FIGURE 2.32

Latin America and the Caribbean: Wastewater Treatment in Selected Cities (Available Data, 2002-2008) *(Percentages)*



Source: GEO Cities reports Mexico City, São Paulo, Buenos Aires, Lima, Bogotá, Santiago, Rio de Janeiro, Montevideo, Santo Domingo, Panama, Havana, San José (Costa Rica), Rosario, Arequipa, Chiclayo, Tucumán, Esmeralda and Loja.

Wastewater management is an issue on the agenda of a number of the region's cities. Santiago, Chile, has created a plan known as «Clean Urban Mapocho,» whose goal is to clean up the water of the Mapocho River and, by 2012, make Santiago the first Latin American capital that recycles all of its wastewater. This involves closing 21 subsystems that discharge wastewater into the river, along with constructing a 28-kilometre underground collector parallel to the river to feed two treatment plants. This will have the additional advantage of restoring the river banks as places for public recreation (Chile: Superintendency of Sanitation Services, 2008).

8.2.2 Green areas and urban biodiversity

Conserving biodiversity in urban, semi-urban and peri-urban areas is one of the major challenges facing the region's cities. When these cities lose biodiversity, they not only experience a loss of some of their natural capital, but also lose part of their cultural wealth, while environmental services also disappear (Pisanty and others, 2009).

Green areas can consist of urban recreational areas or undeveloped areas with primary or secondary vegetation. As a result of a failure to appreciate the services that they provide, and the cost required to maintain them, efforts to conserve the region's urban green areas have varied.

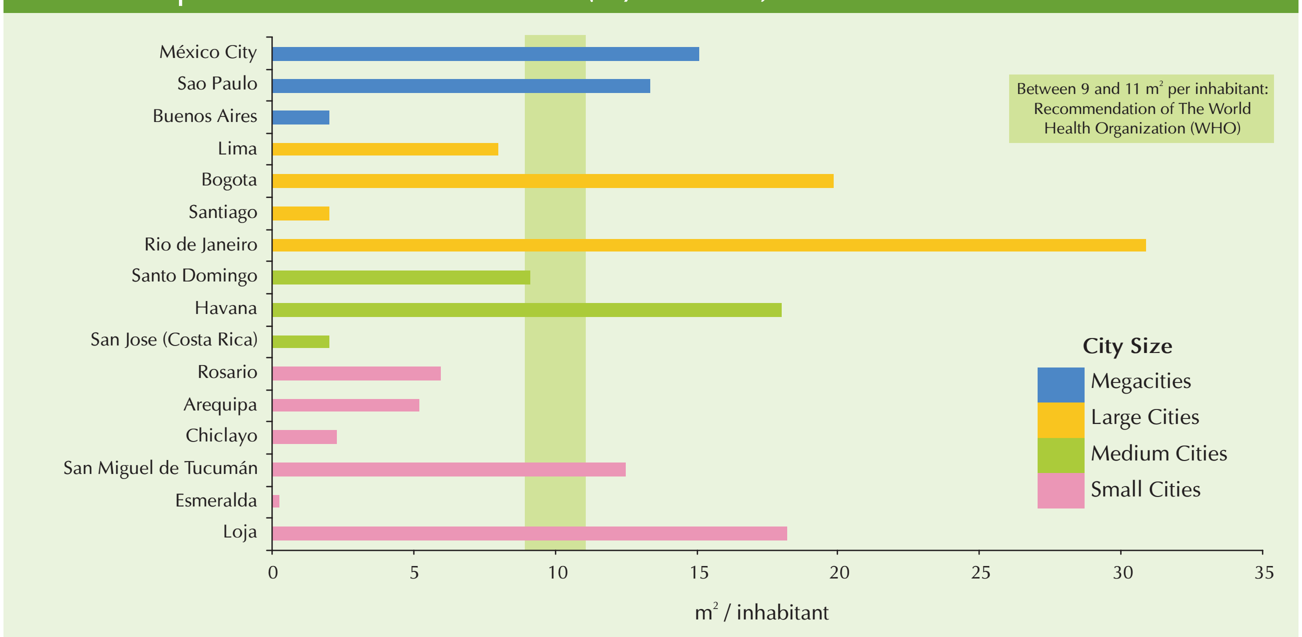
The World Health Organisation calls for between 9 m^2 and 11 m^2 of green area per inhabitant. However, determining the actual average in a given city is a complicated task, because the criteria for defining green areas vary enormously, and because the areas are typically distributed unevenly, given that most cities have grown in a haphazard way and without regard to environmental criteria.

According to UNEP (PNUMA 2008a, PNUMA 2004, PNUMA 2003c, 2003e), Rio de Janeiro, Bogotá, Havana, Loja and Mexico City are above the WHO standard for green areas (figure 2.33). In light of the uneven distribution of green areas within these cities, however, the assessment may be an overestimate. For example, there are vast sections of Mexico City with no green areas at all, while such areas are abundant in other parts of the city that are undeveloped, where there are areas covered by primary or secondary vegetation that are considered to be conservation land, with certain regulatory provisions in place to prevent their development. In Havana and São Paulo, the green belts at the periphery of the cities could be considered urban, but they are not part of daily life for people living in the central parts of the city, who lack easily accessible green areas.

Some cities exceed the ranges defined by WHO. For example, Curitiba, in Brazil, has an average of 52 m^2 of green area per inhabitant. These areas consist of parks

FIGURE 2.33

Green Areas per Inhabitant in Selected Cites *(m^2/inhabitant)*



Source: GEO Cities reports on Mexico City, São Paulo, Buenos Aires, Lima, Bogotá, Santiago, Rio de Janeiro, Montevideo, Santo Domingo, Panama City, Havana, San José (Costa Rica), Rosario, Arequipa, Chiclayo, Tucumán, Esmeralda and Loja.

and urban woods (including the so-called major native woodlands). This makes Curitiba among the greenest cities in the world. The city also maintains a list of 22 tree species whose cutting is prohibited (Pereira and others, 2006, ECODICAS[30]). The population's participation has been one of the keys to this successful green area programme. The intensive environmental education campaigns undertaken before the green policies were implemented are a central part of this process, which has moved the city from 1 m² of green area per inhabitant in 1970, when it had one million inhabitants, to its current level, with a population of two million.

Some cities have special programmes for conserving green areas, which draw on participation by neighbourhood residents, social organisations and NGOs. Examples of such initiatives are Panama's programme of Environmental Education for Parks and Green Areas, the recovery of degraded areas in São Paulo, and the PRU-GAM programme in San José, Costa Rica. In addition, some municipalities have carried out their own programmes. These include the urban tree planting programme in Santo Domingo and the Urban Parks Programme in Santiago, Chile, as well as the soil conservation programme, mentioned earlier, in the southern part of the Mexico City Basin. Individual groups have also been organized to address the issue in specific areas.

The lands, near cities, that are still rural or semi-rural, and that may even include areas covered with original vegetation, provide an opportunity for biodiversity conservation, restoration of environmental services, environmental education and sustainable recreation. Such efforts must go hand in hand with ecological land use programmes, and there must be political will, as well as a desire, on the part of citizens, to protect these areas.

8.2.3 Solid waste

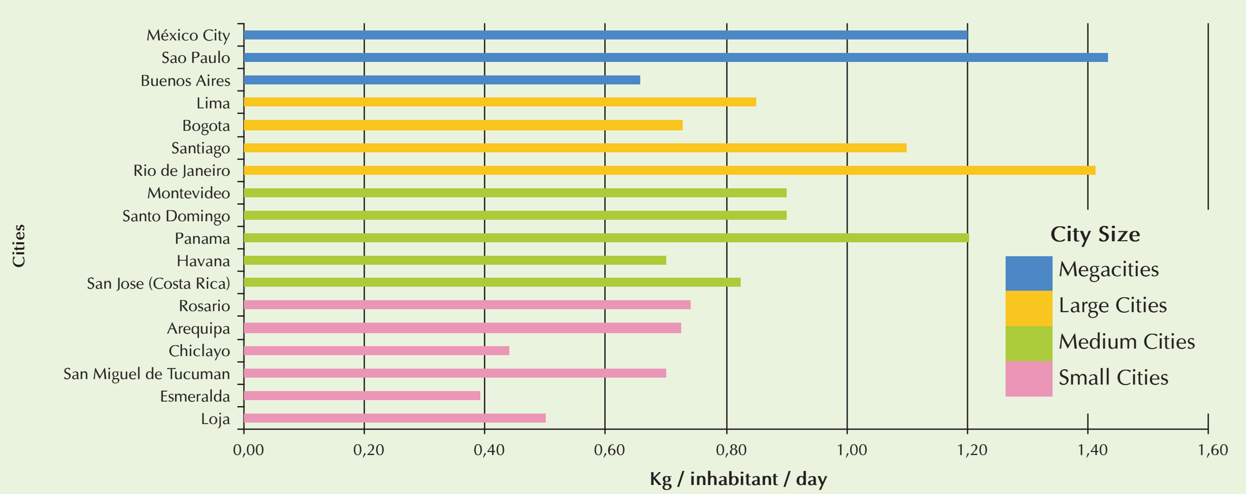
The generation of solid waste has increased in most of the cities, in tandem with population growth and industrial and commercial expansion (see chapter I). Per capita generation of solid waste varies according to the size of the city and the dominant patterns of consumption (see figure 2.34). In general, sources of hazardous wastes –which can include explosive, corrosive, infectious, toxic and oxidising substances– are concentrated in cities, frequently in industrial areas and areas with medical facilities.

Final disposal of solid waste and the effectiveness of collection systems vary considerably from one city to another (box 2.21). In 2000, Asunción (Paraguay) and Quito (Ecuador) were the only capital cities without sanitary landfills. Today, all Latin American capitals have such facilities,[31] although this does not necessarily mean

30 *ECODICAS, blogspot.com/2004/07/curitiba_exemplo_de_gerencia miento_de-html.*

FIGURE 2.34

Urban Generation of Solid Waste, in Selected Cities *(kg/inhabitant/day)*



Source: GEO Cities reports for Mexico City, São Paulo, Buenos Aires, Lima, Bogotá, Santiago, Rio de Janeiro, Montevideo, Santo Domingo, Panama, Havana, San José (Costa Rica), Rosario, Arequipa, Chiclayo, Tucumán, Esmeralda and Loja.

that all solid waste is disposed of there, since improvised dumps in natural ecosystems or on unused land are also used for final disposal. This creates problems of gas emissions, leaching of lixiviates, and ground where vectors of various diseases can develop. Although recycling is still inadequate in the region, important programmes advanced by local governments, sometimes in partnership with civil and private organisations, have been implemented (see box 2.21).

In terms of household sorting of waste, there are noteworthy non-governmental initiatives. In Peru, for example, the National Environmental Council (now the Ministry of Environment) initiated a recycling programme («Programa Recicla») as part of the SENREM/USAID project, and successfully worked with over 800 schools to promote management of sorted solid waste from schools. In 2006, the programme became known as the School Environmental Management System (SIGAE). A number of private initiatives, with support from private capital, have also contributed to the recycling effort. A programme in Peru, led collaboratively by the non-governmental organisation FUNDADES and the Owens-Illinois company, has successfully promoted glass recycling as a means of obtaining resources to finance skills-development among disabled children.[32]

Despite progress in organised recycling, informal recycling still takes place in LAC. This brings with it risks to the health of those involved, and is often associated with serious corruption.

31 (http://www.vidaparaquito.com/index.php?option=com_contentytask=viewyid=59yItemid=50).

32 http://www.fundades.org/doc/pardo.doc.

BOX 2.21

Solid Waste Management

In Curitiba (Brazil), a wide-ranging media campaign encouraged the population to segregate household waste. Families began to separate organic from other wastes. In informal neighbourhoods, communities were hired to collect wastes, trading them, by weight, for quantities of food or milk, or for public transportation vouchers (Pereira and others, 2006). Curitiba thus became the first city in the region to have household sorting of wastes (UN-Habitat, 2005).

Quito has no waste sorting programme. However, in 1998 the Ecuadorian city of Loja, with support from the German Development Service (DED), began to implement a comprehensive solid waste management programme, an initiative in which 80% of the population now participates. Biodegradable garbage, after being processed in an earthworm composting plant, is sold as agricultural fertiliser to farmers and citizens, or is used for the city's parks and gardens. To improve the working conditions of the local recyclers, a recycling plant with modern equipment was built at the landfill, making it possible to sort and clean waste, and to sell it for reuse or recycling. Based on this experience, the city of Loja, in collaboration with the Association of Municipalities of Ecuador (AME) created a technical training centre to provide advice on solid waste management to other municipalities in Ecuador and throughout the region. In addition, the city collects garbage from 91.9% of its households. Despite these major achievements, only 15% of non-biodegradable waste and 13% of biodegradable waste is recycled (UNEP, 2008a; UN-Habitat, 2005).*

In Haiti, the region's poorest country with 80% of the population living below the poverty line, only one third of household waste is collected. The rest is thrown into ravines, drainage canals, unused lots, or on the streets and squares, causing extremely undesirable environmental and public health conditions.

Throughout the region, many organisational efforts regarding adequate comprehensive waste management have fallen short of their goals as a result of financial problems.

*Source: UN-Habitat , 2005. *www.loja.gov.ec/loja/index.php?option=com_contentytask=viewyid=58yItemid=119ylimit=1ylimitstart=8*

Most of the region's countries have made progress in solid waste management, at least in the last decade, both in terms of regulations and with respect to designing and implementing programmes and projects, though these remain limited and isolated, even with individual countries. Solid waste management continues to be a critical issue in the region—above all in Central America, where, as highlighted in the GEO Cities report cited here, financial constraints, along with an insufficiently comprehensive view of the problem, play a major role. There has been a gradual recognition that efficient management of solid wastes requires that there be long-term programmes and effective socioeconomic processes at the local level that take account of the population's economic and health conditions, as well as of its educational level and degree of community participation (Zepeda, 2000).

8.2.4 Urban vulnerability, extreme events and climate change

LAC is increasingly vulnerable to extreme climatic and other natural events (earthquakes, tropical storms, hurricanes, floods, and so on) as a result of various factors, including: its pattern of economic growth, extensive poverty, un-planned urban development, the emergence of precarious human settlements, insufficient infrastructure, and human occupation of high-risk areas (Winchester, 2006).

Hurricanes severely affect the Caribbean Islands, and the scenario created by climate change is a cause of concern. In 2008, Cuba, Haiti and other islands were devastated by these hydrometeorological phenomena. In 2005, Hurricane Vilma, the most severe Atlantic coast hurricane ever recorded, inflicted damage to 98% of the coastal infrastructure on the Yucatán Peninsula, with losses of US$ 1.5 billion. The rising sea level that is expected as a result of climate change will place the region's coastal cities at serious risk (De la Torre and others, 2009) (see «Seas and coastal areas» section of this chapter).

Although there has been investment in prevention programmes, as well as in programmes to develop early warning systems, the results have so far been subject to political, cultural, financial and technological constraints. Strategic urban planning and the development of land use instruments must take account of urban vulnerability in its various dimensions, while at the same time incorporating mitigation and adaptation measures (see box 2.22).

BOX 2.22

Climate Change Reduces the Availability of Water in Urban Areas of Latin America and the Caribbean

Urban areas in LAC are more vulnerable to future reductions in the availability of water than are urban areas in other parts of the world, for both endogenous and exogenous reasons. The endogenous factors include the deforestation of basins and undesirable incentives to over-use water for various economic activities (agriculture, mining, manufacturing and power generation, among others), while climate change is a major exogenous factor.

Climate change has significant impacts on rain patterns and on the region's glaciers, which are melting. These glaciers are an important source of water supply for some cities. The city of Quito (Ecuador) obtains 60% of its water from the glaciers, while the figure for La Paz (Plurinational State of Bolivia) is 30%. The glacier area lost in Peru, to date, represents 7 billion cubic metres of water, a quantity that could supply Lima for 10 years. According to World Bank estimates, the loss of glaciers jeopardises the water supply of 30 million of the region's inhabitants.

Source: Vergara, 2007; De la Torre and others, 2009.

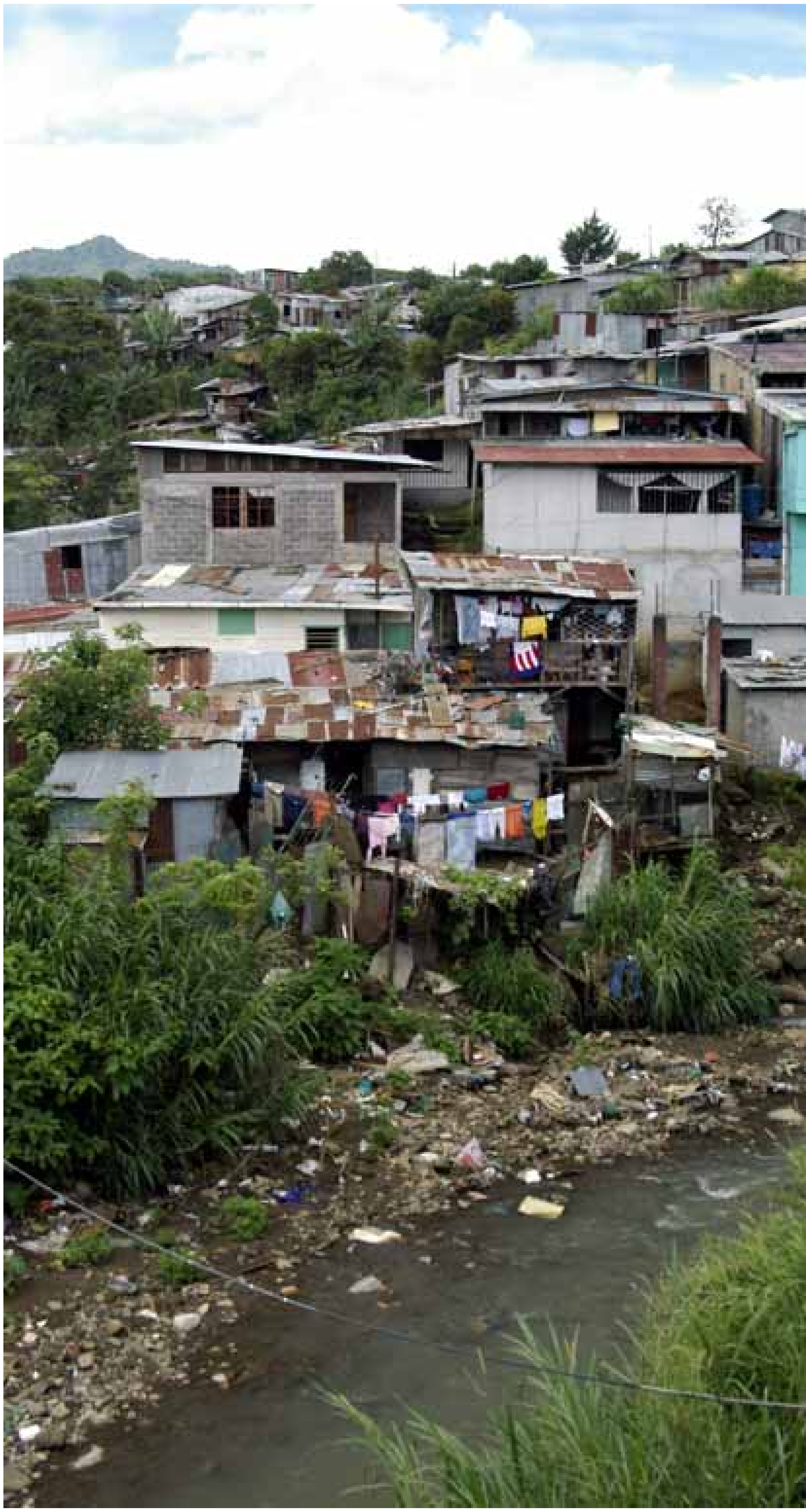
8.2.5 Climate change and rural-urban migration

Migration has historically been an element in human survival strategies during periods of shortages or change. Although climate change in itself does not directly provoke migration, the climatic vulnerability that it causes exacerbates impacts on groups in areas affected by drought, flooding and storms. In 2008, for example, 20 million people were displaced due to extreme climate events, and it is estimated that the effects of climate change associated with rising temperatures will produce 200 million environmental migrants (IOM, 2009a).

According to a recent report published by the International Organization for Migration (IOM) (2009a), the relation between migration and climate change can be a function of:

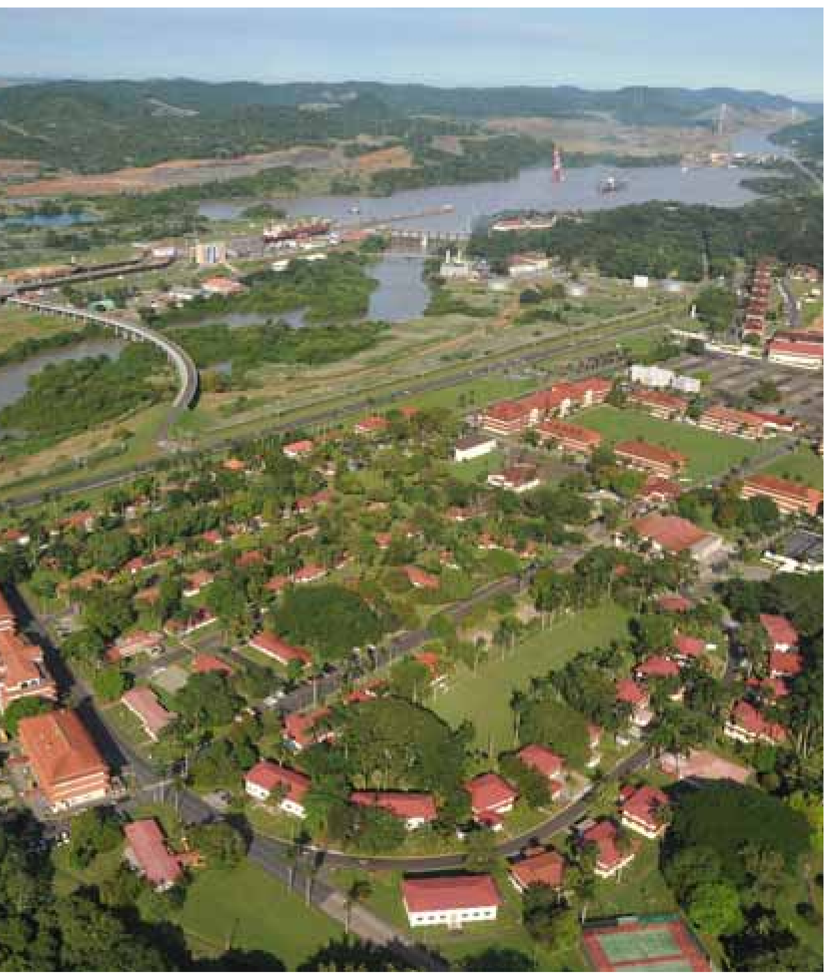
- Intensification of natural disasters.
- Intensification of periods of drought, affecting agricultural production and water access.
- Higher sea levels that will make coastal areas uninhabitable, and that could even mean the disappearance of some island States. According to the OIM report, over 40% of the world's population lives within 150 kilometres of coastal areas.
- Increased conflict generated by competition for resources.

Field research carried out by the IOM since 1990 suggests that changes in climate patterns, or climatic vulnerability, may affect internal migrations (IOM, 2009b). Within Latin America, case studies in Mexico show a direct relation between migratory flows (rural-rural and rural-urban) on one hand, and periods of extreme drought and areas of desertification on the other. According to Leighton (2006), such areas represent two thirds of Mexico's national territory. Recurrent drought, combined with poor soil management, contributes to erosion. This, in turn, reduces households' ability to generate income. Thus, internal migration (rural-urban or rural-rural) becomes a strategy for obtaining additional income. It has been determined that Oaxaca and Tamaulipas, two states suffering from rapidly advancing desertification, are also areas with intense migratory flows (Leighton, 1997). A similar study in Ecuador (Bilsborrow, 2004) ascertained that climatic vulnerability in that country has influenced internal rural-urban migration, especially from parts of the *altiplano*. This study shows that migration towards border areas has intensified during periods of drought. According to the International Organization for Migration (2009b), it will be difficult for urban centres to adequately prepare to receive these massive unplanned population flows, since the majority of migrations provoked by climatic vulnerability will be of the rural-urban type. Resources will have to be allocated for infrastructure, jobs and basic services to accommodate these populations.



8.3 Outlook and institutional responses

The cities in many ways contain and mirror the contradictions in each country's and each region's development process, clearly reflecting the type of development, population dynamics and social contradictions present. Many of the urban agglomerations in Latin America and the Caribbean have well developed institutions, regulatory frameworks and urban-environmental management instruments. Most of the cities have also been involved in a process of decentralisation through which local authorities have gained authority to regulate and manage cities' functioning. However, the role of cities in designing mechanisms to monitor and evaluate policies, programmes and projects has yet to be consolidated. Such a role would help to give environmental policies long-term continuity, while at the same time making it possible to more effectively use information garnered from successful experiments.



In the last several years, many cities have strengthened or developed their information systems and their legal/regulatory, economic and technological instruments. However, monitoring and evaluation continue to be largely absent from urban-environmental management. The region is making efforts to improve urban environmental quality. For example, resources are being invested in improving environmental information and developing technical capacities. The formulation of strategies based on participation by local stakeholders has improved, and mechanisms are being developed to institutionalise urban-environmental planning and management (UN-Habitat, 2006).

Many national officials have expressed their concern about the need to improve urban-environmental planning and management. Brazil, for example, in order to enhance inter-institutional coordination, created its Ministry of Cities, while Peru, to promote urban-environmental management, designed and implemented a local environmental certification process (Sustainable Environmental Management) within the Certification of Sustainable Municipalities framework (CONAM and UNEP, 2006). Mexico, after a number of years of increases in the release of pollutants, began to use economic instruments such as tax incentives to drive the effort to modernize the country's automobile fleet. Accompanying such initiatives are efforts that have been undertaken by the Metropolitan Environmental Commission, a body with representatives from Governments of states that border Mexico City.

A number of environmental reports emphasize that the deterioration of the urban environment is one of the major challenges that the region faces (UNEP, 2007). This situation must be mitigated through efforts to address housing and services for the most disadvantaged, drawing on new urban development patterns that prevent illegal settlements and their accompanying problems. In addition, comprehensive and multi-sectoral land use instruments must be used, in order to avoid fragmentation in the design of policies and measures. These efforts, as well as success stories in planning and management, should be a basis for regulating growth and stimulating a different form of urban development in intermediate cities, where urban growth is currently concentrated. The enormous environmental costs of the current trend—urbanization, which implies increasingly concentrated populations in cities—could still become opportunities for reducing the ecological footprint of urban development, and for increasing human welfare, if the lessons learned from the predominant schemes of uncontrolled growth at the local and national levels are heeded.

9. Final Reflections

The environmental diversity characteristic of Latin America and the Caribbean –one of its fundamental features– represents a great source of wealth for the region. LAC has a vast diversity in both ecosystems and species. The region includes 6 of the world's 17 megadiverse countries (Brazil, Colombia, Ecuador, Mexico, Peru and the Bolivarian Republic of Venezuela), each with a high degree of genetic diversity, while the region also houses various centres of domestication and diversification (Mexico, Peru, Colombia, Brazil). The region's genetic wealth has generated extensive interest in bioprospecting – a development that highlights the need for strict biosafety measures.

This wealth is threatened by a variety of factors, including changes in land use, which has often taken place without regulation or regard for environmental criteria. Today, many of the changes are driven by demand for agricultural products (recently including biofuels), as well as by the exploitation of hydrocarbons and the process of constant urban growth. Great areas of temperate and tropical forest (both dry and moist) have been, and continue to be, transformed to meet domestic and international demand. As part of this process, 64% of global deforestation between 2000 and 2005 occurred in LAC.

The high rates of deforestation in the region, and the consequent reduction, fragmentation, and even disappearance of habitat, represent a threat to the region's biodiversity. Five of the twenty countries with the greatest number of endangered animal species, and seven of the twenty with the highest number of endangered plant species, are in Latin America and the Caribbean. A great number of species are at varying levels of risk, both regionally and nationally.

As one strategy for protecting biodiversity, natural protected areas have been established. Currently, over 20% of the region's territory is under protection; marine reserves are estimated to represent less than 0.1% of the Exclusive Economic Zone in the region's countries. Progress is still needed, at both the regional and national levels, in consolidating such areas, as well as in implementing sustainable natural resource use by employing versatile and innovative instruments that make it possible to safeguard the region's great natural capital.

The seas and coastal areas of Latin America and the Caribbean encompass marine and coastal ecosystems that are the source of many riches, including foods. However, these are under siege from fishing activities: overfishing has brought the populations of many species to the limit of their economic yield, and even, in some cases, to extinction. As often happens in this region, ecological damage directly affects small-scale fishermen, while they rarely share in the vast wealth generated by their activities.

Many of the region's coastal areas, thanks to their beauty and warm climates, are frequent sites of tourist activity. Although tourism has been touted as an «industry without smokestacks», it exacts an extremely high environmental cost in many coastal areas, since it has traditionally ignored environmental considerations. Vast areas of mangroves, dunes and coastal lagoons have been destroyed as a result of tourist activities and by the discharge of hotel sewage and solid waste directly into the sea.

Unfortunately, there are powerful economic interests at play in these areas, and due to the lack of horizontal environmental criteria, so common in the region, there is little to constrain this power. The consequences of high-impact tourism are aggravated by deficiencies in the legal frameworks and, above all, by the difficulties that many countries in the region face in attempting to enforce their laws.

The phenomenon of urban development takes different forms from one country to another in the region. What remains true throughout Latin America and the Caribbean, however, is the fact that, of all developing regions on the globe, LAC has the highest proportion of urban population in the world, and is the only one in which social inequalities in urban and rural areas are comparable. In addition to having four of the megacities on the American continent –one in Mesoamerica (Mexico City) and three in South America (Rio de Janeiro and São Paulo in Brazil, Buenos Aires in Argentina)– LAC has a huge number of large and intermediate cities. Today, it is the intermediate cities that are growing fastest, not the megacities, which experienced massive growth during the second half of the twentieth century. Urban development provides a concentration of services that most smaller cities (and rural areas) in the region lacked: potable water, sanitation, electrification, education and health care, in addition to jobs. The increased growth of intermediate cities has been stimulated by the unequal distribution of services and opportunities, and simultaneously by the difficulties inherent in large cities. This situation represents a great opportunity to direct urban growth towards sustainability and greater equity, above all by heeding the lessons learned from the development pattern that has characterized the large cities of Latin America.

Contamination of soil, air, and continental and sea water, is a growing problem throughout the region. The large cities and, in some cases, even intermediate cities, have severe air pollution, which affects their inhabitants and the surrounding ecosystems in various ways. The same is true of bodies of water, which spread contaminants over large distances. Thus, agriculture and animal husbandry can have an impact on distant marine and coastal areas. Growing pollution further increases the health vulnerability of both ecosystems and people. Strategies for managing solid waste, discharges into bodies of water, and particles emitted into the atmosphere are issues that Latin America and the Caribbean have yet to fully address.

The lack of homogeneous, up-to-date and comparable data that would allow for an objective analysis of the environment, and for decision-making based on the best available scientific and technical information, is a problem at all scales in LAC. The generation of information and knowledge faces many difficulties throughout the region, including, not insignificantly, problems of funding. Evaluating the state of the environment at the regional, sub-regional, national and local scale is limited by these problems, and impacts decision-making. The situation also encourages the implementation of unsustainable development strategies that seriously affect the region's natural capital and the welfare of its inhabitants.

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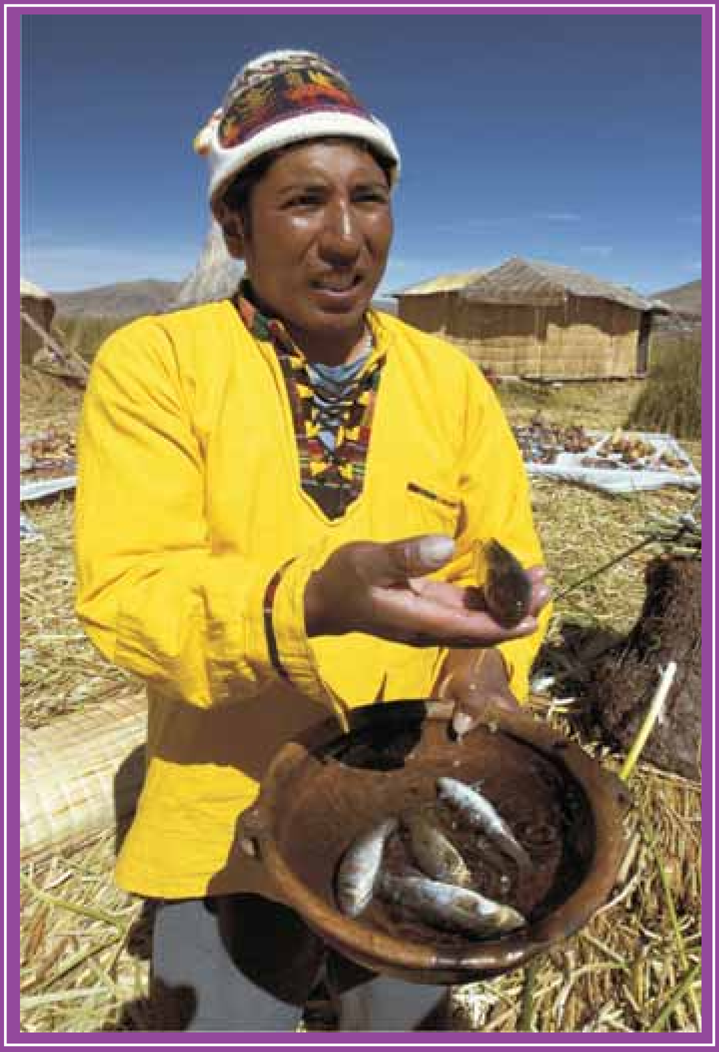
III. Relations between Environmental Changes and Human Well-Being in Latin America and the Caribbean

Key messages

- Ecosystems provide critical and valuable services to populations at the community, local, national, regional and global levels and are among the most important contributors to human well-being. Ecosystems are being modified because of human activities and this, in turn, has direct, indirect, positive and negative consequences for human well-being on, for example, access to housing, drinking water, optimum health conditions, infrastructure, or on mitigating the effects of natural disasters.

- Because their complex links are little understood, it may not always be possible to establish the causal relationship between environmental changes and the concomitant consequences. However, the international community is increasingly aware of the importance of learning more about the human-environment relationship and, in particular, about the importance of environmental goods and services (EGS), defined as the benefits people obtain from the environment. The EGS can only be preserved from generation to generation if the "natural" ecosystem function is safeguarded. To do so it is essential that an assessment be made of environmental goods and services; it should be pointed out that, compared to the world's other developing regions, there are more examples of payment for environmental goods and services schemes in Latin America and the Caribbean, although such schemes still need to be expanded in the Region.

- While all sectors of society depend on environmental goods and services, these become particularly important for lower income populations and those directly dependent on ecosystems for economic and other forms of sustenance. It is vital that these groups have access to forest, marine and coastal resources on which their survival may even depend. Ironically, the wide range of goods and services produced by these ecosystems also expose them to overexploitation due to anthropic activities and this, in turn, increases the vulnerability of populations who depend on such goods and services (Windevoxhel, 1994; Creel, 2003; UNEP-WCMC, 2006). The Region must develop systems which, on one hand, preserve sustainable activities while, on the other, create more mechanisms to regulate industrial and large-scale exploitation of these ecosystem services.



1. Introduction

1.1 Ecosystem approach

Human beings and their actions are intrinsically associated to the natural environment and should be viewed as a unit. However, in the past they were often considered as separate entities, although this is now changing. Over the past decade the notion of a single unit has become more accepted and increasingly appreciated by those concerned. In 2000, therefore, the Convention on Biological Diversity took this idea to the global political level by suggesting that the "ecosystem approach" be employed as a strategy for integrated land, water and natural resources management, and that human beings be included as an integral component of all the world's ecosystems. This ecosystem-based approach, still being perfected, is today used more widely to illustrate the interrelation between people and the environment, either to obtain profits from it (e.g. food, shelter, fuel, water), or to show the relationship between human actions and their impacts and consequences (managing waste and nutrients in water).

In this chapter, the principles of the ecosystem-based approach will be used to assess relationships and linkages between environmental changes and human well-being in the LAC Region, using forest, marine and coastal ecosystems as examples. While there are other equally important ecosystems in the Region (drylands, savannahs, deserts, grasslands, moorlands), these two were selected because of their geographical scale and distribution, and the very large number of people who depend on them for survival. This chapter introduces a general view of the impacts in LAC of these ecosystems' degradation, a product both of human activities and of natural phenomena, as well as the effects of climate change. It also describes how human well-being and access to goods and services provided by ecosystems are being compromised and affected.

1.2 Ecosystems: Goods and services

Ecosystem goods and services are the benefits people derive from their direct or indirect use. Most ecosystem services result from long-term natural, ecological and physical processes. Since the term "ecosystem services" was emphasized by Costanza and others (1997) it has become a widely debated concept.

According to the Millennium Ecosystem Assessment (2005a), environmental goods and services include:

a) Provision: products obtained from ecosystems, such as water, timber and non- timber forest products, or genetic resources;
b) Regulation: benefits from the ecological processes of regulation, such as climate, food or disease control;
c) Cultural: nonmaterial benefits, such as cultural, recreational or spiritual values;
d) Support: services needed to produce the other three categories, such as primary production or nutrient recycling.

The later application by other authors of Costanza´s work on ecosystem services led to an additional category being proposed, called "option value use". This refers to unknown or speculative future benefits (Beaumont and others, 2006; Martinez and others, 2007).

Table 3.1 shows general definitions and examples of some environmental goods and services provided by forest and coastal and marine ecosystems.

TABLE 3.1

Definitions of Types of Goods and Services Related to Forest and Coastal / Marine Ecosystems

Type	Good/Service	Definition	Examples
Provision	Food	Animals or plants for human consumption obtained from ecosystems.	Food (fish or meat)Salt, minerals and oil resources.
	Materials	Animal or plant by-products extracted from ecosystems for multiple purposes, but not intended for human consumption.	Construction materials (sand, rock, lime, wood, timber)Biofuels, fuel wood. Non timber forest products such as raw materials (colorants, dyes), crafts or utensils.
Regulation	Gas and Climatic	The balance and maintenance of the chemical composition of the atmosphere and oceans provided by forest or marine living organisms.	Regulation of climateLocal microclimate (shade, surface cooling, etc) Photosynthesis.
	Disturbance Prevention	The dampening of environmental disturbances by biogenic structures.	Regulation of floods and diseases.
	Bio-recovery of waste	Removal of pollutants by way of storage, burying and recycling.	Regulation and recycling of wastes and improvement of water quality through filtering and water recycling (through evapo-transpiration, etc).
Cultural	Recreation	Stimulation of human body and mind through the interaction with living organisms in their natural environment.	Vacation destinations, cruises and stay-over visitors. Ecotourism, bird watching, whale watching, hiking Hunting
	Cultural heritage and identity	Benefit of biodiversity that is of utmost significance or bears witness to multiple cultural identities from a community.	Cultural heritage, sacred sites.
	Cognitive benefits	Cognitive development, including education and research, resulting from organisms.	Genetic resources. Medicinal plants. Pharmaceuticals.
Support	Resilience and resistance	The extent to which ecosystems can absorb recurrent natural and human disruptions and continue to regenerate without slowly degrading or unexpectedly flipping to alternate states.	
	Biologically mediated habitat	Habitat which is provided by living organisms.	Pollinators.
	Nutrient cycling	Storage, cycling and maintenance of nutrients by living organisms.	C cycle, N cycle, etc.
Options and Use	Option, use values	Unknown future use of ecosystems.	Biodiversity genetic stock that has potential application for biotechnology and medicine.

Source: Modified from Beaumont and others (2006)

1.3 Ecosystems and human well-being in Latin America and the Caribbean

To define human well-being this report takes a multidimensional approach, similar to that developed in GEO-4 (UNEP, 2007a). The GEO-4 report defined it as the potential of individuals, communities and nations to make their own decisions and maximize opportunities to achieve security and good health, to attain the materials needed for a good life and form good social relationships. People and their well-being depend on planet Earth's environment. Well-being, as such, is measured by the ability of ecosystems to provide human beings with services ranging from basic needs such as food, energy, water and shelter, to equally important requirements such as safety and health.

However, over the past 100 years human beings have dramatically altered the planet's ecosystems, primarily to meet growing demands resulting from an increasing population and changes in lifestyles. These considerable demands, which include access to food, fresh water, timber, fibres and fuel, have intensified the impacts on the resilience of ecosystems and, therefore, have caused degradation. The Millennium Ecosystem Assessment (2005a) estimated that close to 60 percent of the world's ecosystems are either degraded or are used unsustainably. The Latin America and Caribbean Region is no exception to this global trend. Nevertheless, there are successful examples of sustainable management of natural resources initiatives by civil society, indigenous and local communities, by the private sector and by governments that indicate a degree of institutional response in the Region.

The forest and marine and coastal ecosystems of LAC provide a wide range of environmental goods and services, including food, shelter, water and air purification, coastal defense, genetic diversity, spiritual and cultural, among others. Progressively, and over considerable periods of time, many communities and states in the Region have depended for their survival and economic support on these goods and services, however, only recently have they begun to recognize and appreciate their importance. In this regard, it may be said that human well-being is to a great extent conditioned by these ecosystems and, therefore, it is vital that they maintain their capacity to withstand anthropic and natural interventions; however, this depends to some extent on levels of exposure, how sensitive they are to impacts, and whether or not they are able to accept or adapt to changes. The effects of climate change, deforestation, and biodiversity loss, worsening air quality, water and soil pollution, inappropriate land use, desertification, and overfishing are among the main drivers of changes in forest, coastal and marine ecosystems.

There are variations in the level of importance and the quality of different goods and services provided by these ecosystems, partly influenced by spatial considerations. For example, dry forests in the LAC region primarily play a protective role in flood prevention and in mitigating dryland soil erosion. Riverine mangroves along the Orinoco in Venezuela, Brazil's Amazon and the Essequibo in Guyana also play a role in protecting against floods and erosion, a well as trapping sediments. Similarly, watersheds with forest cover provide services that include nutrient recycling and improving water quality among others (Ruitenbeek, 1992). Coral reefs and seagrasses distributed throughout Latin America and the Caribbean perform functions similar to those classified as cultural or provision (Singh, 2005). Hereafter follows a general description of the goods and services provided by forest and coastal marine ecosystems in Latin America and the Caribbean.

2. Identification of Forest and Marine-Coastal Ecosystems Goods and Services in Latin America and the Caribbean

According to FAO (2006), the Latin America and Caribbean Region has 23 percent of the planet's total forest area with close to 916 million hectares of global reserves. Most of these forests are in South America (823 million hectares). In spite of this substantial proportion, the 2005 forest area in LAC reported by FAO shows an accumulated loss of approximately 24 million hectares of forest surface in the period 2000-2005 (see also the section on forests in Chapter II of this report). Considering the high biodiversity levels in forests it is no surprise that they are regarded as being among the greatest suppliers of environmental goods and services, not only for the LAC Region but also for the rest of the world (Nasi and others, 2002).

Forests in Latin America and the Caribbean have a variety of compositions and types, and while the Region is often recognized for its large proportion of tropical rainforest, there are also vast extensions of other types of forests. For example, a quarter of the Region's land area consists of dry ecosystems, including remnants of dry tropical forests, and a considerable amount of temperate forests and forest plantations, mainly distributed throughout Mexico, Chile and Argentina (UNEP, 2003; see also the forest section in Chapter II of this report).

With regard to marine and coastal ecosystems, in Latin America and the Caribbean there are three large bodies of water that are vitally important for the Region's human well-being: the Atlantic Ocean; the Pacific Ocean; and the Caribbean Sea. Of these areas, the semi-enclosed Caribbean Sea is characterized as an ecosystem whose services depend to a great extent on how four interdependent and interrelated coastal formations function: seagrasses, mangroves, coral reefs and beaches (UNEP, 2006; Singh, 2005). The relative abundance of these ecosystems, the degree to which they are interconnected and their level of vulnerability are greater in the Caribbean Sea than in the two oceans. These ecosystems are occupying a growing niche in the Region's ecotourism market which, although still developing in Latin America and the Caribbean, has huge potential.

The following section gives a general description of the goods and services of forest, marine and coastal ecosystems of Latin America and the Caribbean for which it uses the classification adopted by the Millennium Ecosystem Assessment (2005a) and Ranganathan and others (2008).

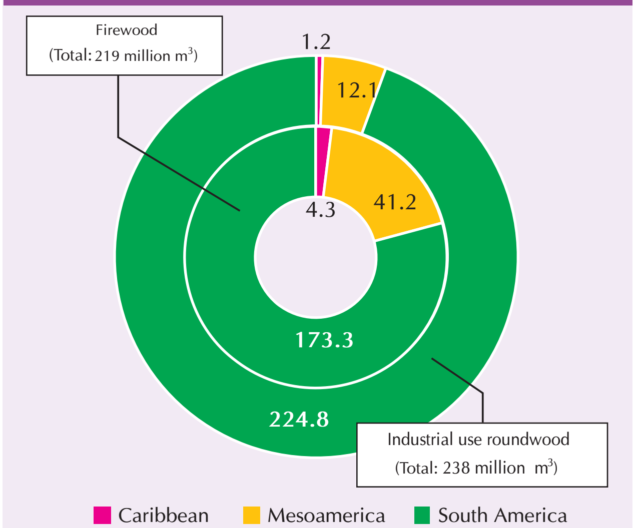
2.1 For goods and services of forests

The population in LAC obtains a series of goods and services from forests that range from goods such as timber, fuel wood, and/or medicinal plants, to services (some of international importance) such as erosion control, flood and climate regulation, nutrient recycling, or cultural services such as areas for recreation, heritage sites or locations with special cultural values.

Timber, used for commercial and other purposes, is one of the principal goods extracted from forests. According to FAO (2006), from 2000 to 2005 approximately 450 million m^3 per year of forest products were removed in LAC (Figure 3.1). In 2005, forest production of roundwood for industrial use was similar to that of fuel wood, with a difference of only 20 million m^3 (Figure 3.2). For one sub-region, data for that same period on income derived from forests showed that South American forests are now the Region's main providers of forest products. In addition, FAO (2006) estimates that timber extractions in 2005, of which the largest proportion (74%) was industrial use roundwood, brought more than US$7 000 million to the South American sub-region. Highlighted also are non-timber forest products (NTFP) that account for 3.3 percent of total extraction with profits estimated at US$234 million per year. In the Caribbean region, Haiti had the highest removal rate of forest products in the sub-region, about 2.5 million m^3, most of it (89.2%) for use as fuel wood. In the Mesoamerican region, Guatemala produced close to 19 million m^3, with a high proportion (93%) to be used as fuel wood. As to how much is extracted per country, Brazil is in first place with 290 million m^3 of forest products extracted in 2005 of which 58 percent was industrial use roundwood, with the remainder for use as fuel wood. The high rate of forest products removal in Brazil is due mainly to the country's high proportion of forest cover. In general, although the data show timber to be the most important forest product in the Region, fuel wood and the NTFP are the most important for local consumption and economic support.

FIGURE 3.2

Latin America and the Caribbean: Extraction of Fuel Wood and Industrial use Roundwood in 2005
(Millions of cubic meters)



Source: United Nations Food and Agriculture Organization (FAO), 2006.

FIGURE 3.1

Latin America and the Caribbean: Forest Products Extraction ***(Millions of cubic meters)***

	Caribbean	Mesoamerica	South America	Total
2000	5.7	50.5	390.8	447
2005	5.5	53.3	398.2	457

Source: United Nations Food and Agriculture Organization (FAO), 2006.

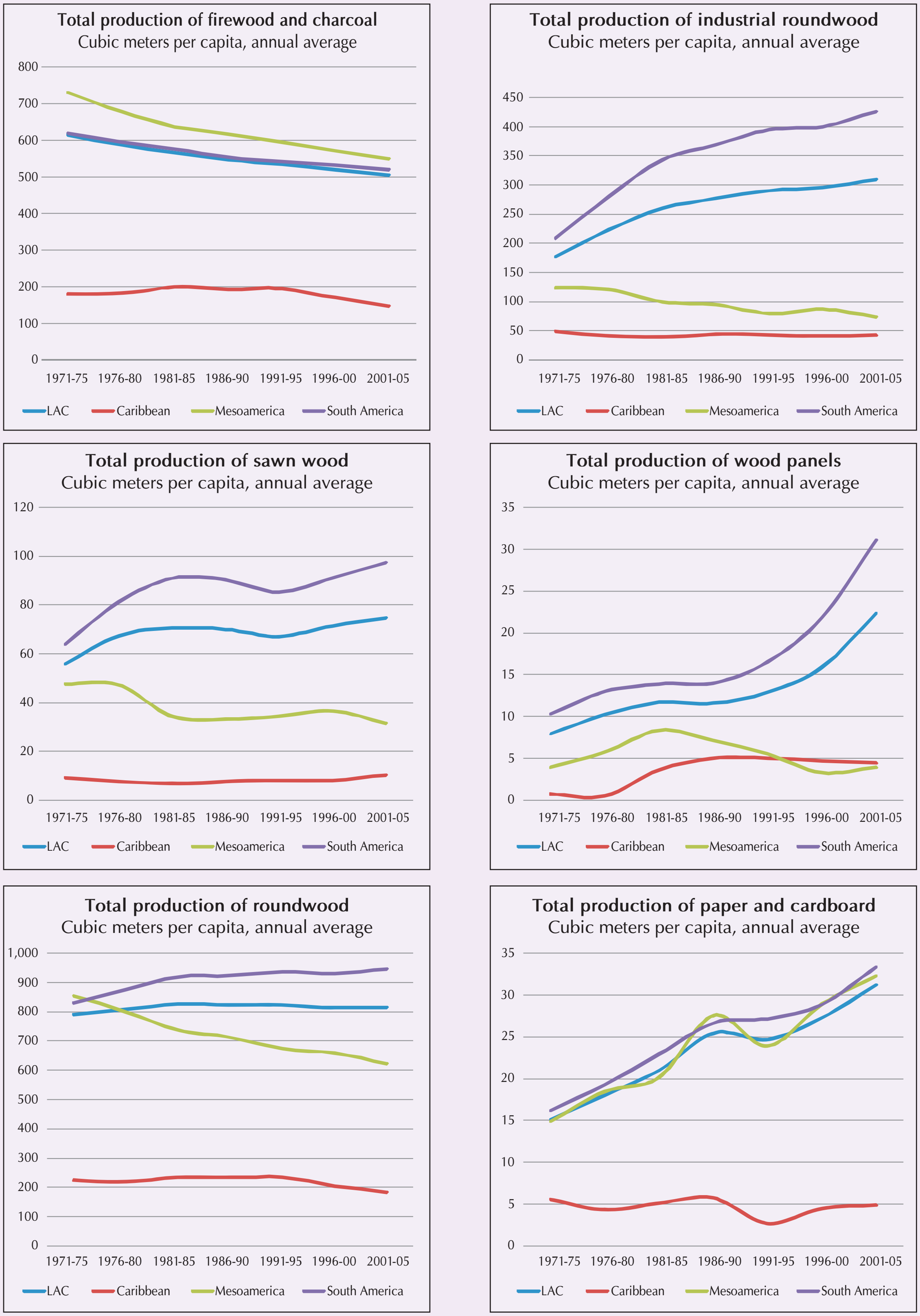
The production of most forest goods in the Region has increased since the 1970's, with the exception of fuel wood and charcoal that showed a declining trend (Figure 3.3). Although South America has the greatest total forest production per capita, Mesoamerica has the highest level of fuel wood and charcoal production with 551 m^3, followed by South America with 521 m^3, and the Caribbean with 145 m^3. Within the sub-regions, the largest annual producers per capita are Honduras in Mesoamerica (1,315 m^3), Guyana in South America (1,179 m^3) and Jamaica in the Caribbean (218 m^3).

The largest increase in production of wood panels, paper and cardboard in LAC from 2000 to 2005 was in the Caribbean, with an average of 31m^3 per capita. In terms of country output, Chile produced 67 m^3 per capita in South America, followed by Mexico in Mesoamerica with 42 m^3, and the Dominican Republic in the Caribbean with 14 m^3. On average, per capita annual production of wood panels in LAC is 22 m^3, with Chile producing almost five times more than the total average (108 m^3), followed by Guyana (78 m^3) and Brazil (41m^3). Paraguay and Argentina had the lowest production with an average of 28 m^3 in each country.

These figures show that forests are essential for the Region's population, especially local communities. In particular, the use of non-timber forest products (NTFPs) has social, cultural, economic and environmental implications for numerous rural communities in the Region (Delang, 2006; Ticktin and others, 2007; Box 3.1). These forests should be considered as part of a conservation strategy that goes hand in hand with designing and assessing management practices that are already being applied in some communities (Tickin, 2004, and forest section of Chapter II of this report).

FIGURE 3.3

Latin America and the Caribbean: Good Provided by Forests, Total and by Sub-Regions



Source: Statistics database (FAOSTAT), from United Nations Food and Agriculture Organizacion (FAO), 2008.

BOX 3.1

Promoting Sound NTFP Forest Management In LAC: Case Study in Boyacá, Colombia

The Ráquira municipality in Boyacá is considered to be Colombia's craftwork capital with crafts made from clay, as well as various fabrics for bags, baskets, and hammocks, and pottery in general. It has 13 300 inhabitants, of whom approximately 1,250 are artisans, and 75 percent of its economy is based in this activities. Of all the tree species recorded in the municipality of Ráquira (287) it was found that 46 percent are of current or potential use; pottery activity uses 42 species as fuel wood and 19 species are used for craftwork, where the lianas Smilax floribunda and Smilax and aff. tomentosa stand out, as do other species such as Indigofera suffruticosa (indigo), used as a dye and Juncus effusus (esparto) used in basketry. These species are a priority input for management plans relating to the use of models and market studies to ensure economic benefit to the Region's farmers and artisans (Lee, 2006).

Equally successful cases of local communities that have greatly benefited (both socially and economically) from the use of forests to extract non-timber products may be found in other areas of Latin America and the Caribbean (the Maya Reserve in Guatemala, as reported by Millinedo and others, 2001).

Source: Prepared by R. López from López, 2006; Millinedo and others, 2001.

For centuries, the local population of the Region, especially rural and indigenous communities living close to forests, has used goods from the forest as part of their traditional medicines; although a large amount of forest products are used for this purpose, there is a lack of information on the extent of their use or on levels of dependence for economic profit, nor is there any regional information on pharmaceutical use of the genetic material forests provide. However, there are some examples of the use of ingredients provided by forest plants like quinine that are extracted from the bark of some species of the genus *Cinchona* (e.g. *C. officinalis*) to synthesize medicines to control malaria (Chivian, 2003). Indigenous communities in Amazonia have long used a preparation made from this same group of species to treat fevers.

Dry tropical forests also provide important goods and services (Box 3.2) and are a genetic resources reserve. They are also important areas in which to develop sustainable productive activities. For example, dry forests harbour genetic resources of wild relatives of domestic plants such as *Cucurbita* spp., *Annona cherimolia*, *Carica microcarpa* subsp. *baccata* and *Grias peruviana*, among others. Some species such as *Hylocereus polyrhizus*, *Bromelia pinguin*, *Malpighia punicifolia* and *Opuntia dillenii* are of potential commercial value. Ornamental plants such as *Bougainvillea peruviana* and some species of orchids also have economic value. In addition, the presence of numerous species of hard woods such as the genera *Tabebuia*, *Hura*, *Heliotropium*, *Capparis*, *Cordia*, *Phyllanthus* or *Prosopis* used in the timber industry, has been recorded in the Region. Other species serve as food, for example *Malpighia emarginata*, *Maclura tinctoria* and *Geoffroa spinosa* (Aguirre and others, 2001; World Wildlife Fund 2001a and 2001b; Neill, 2000; Dry Forest Project, 1999; INEFAN, 1998; Josse, 1996). These forest ecosystems also have species with an aquaculture potential such as *Dormitador latifrons* and *Macrobrachium* spp. (Neill, 2000).

BOX 3.2

Dry Forests and Ecosystems in Colombia: Caribbean and Andes

Dry forests have historically experienced high levels of conversion to agricultural and livestock grazing lands; they are considered to be among the most threatened and worst conserved ecosystems in the tropics (Grau and others, 2008; Sanchez-Azofeifa and others, 2005; Vieira and Scariot, 2005). Colombia is no exception to this process; it is estimated that originally there were about 80 000 km², reduced by the 1950s to more than half (Diaz, 2006), and with a present surface area between 1.5 and 2 percent of the original area. Although dry ecosystems have less diversity of species than other ecosystems, they are dry Pleistoceno period refuges and, therefore, have played an important role in the evolution of South American biota (Ojeda and others, 1998).

Pennington and others (2000) differentiated between two dry regions in Colombia: the Caribbean lowlands, shared with Venezuela, and the inter-Andean valleys extending from Venezuela to Peru; in the first region there are national conservation areas. In addition, there are some azonal enclaves located in the Andean region at altitudes above 1,000 meters that are important because they are in situ gene banks and a source of fodder leguminous plants (Rodriguez and others, 2006).

Ecosystem goods and services

Dry ecosystems have a value beyond the direct goods they provide: climate regulation; flood control; maintenance of soil fertility; control of pollinization by native bees; and bioregulation are now recognized as benefiting human beings (Maass and others, 2005). They are classified as having endemism levels (Hernández and others, 1992) that in some biological groups, such as plants, may be more than 20 percent (Josse, 1996). The scenic beauty of these landscapes has become a valuable resource for developing ecological tourism; in addition, some areas, including existing National Parks, are of paleontological, archaeological and cultural importance.

BOX 3.2

(Continued)

As suppliers of timber and non-timber products (fuel wood, fruits, medicinal and ornamental plants, resins, alkaloids, fibres) are species with forest potential including Pachira quinata, Jacaranda copaia, Maclura tinctoria, Anacardium excelsum, Ceiba pentandra, Bursera simarouba, and several species of the genus Acacia and Tabebuia that have been used in forestation processes and that have a high potential to be used in carbon restoration and sequestration. As to non-timber products, 98 species of native origin have been identified in the remnants of the inter-Andean dry valleys, and 76 species in dry azonal ecosystems (Lopez and Cavelier, 2007) many of them with cultural and ancestral traditions.

Many basic crops are food staples – wheat, barley, cotton, tobacco, tomato, beans, and squash – that originated in dry zones and are a source for genetic improvement and resistance to pests and diseases (MADVT, 2004).

Pressures

Extensive cattle grazing has been identified as one of the main factors leading to worldwide desertification (Bisigato and others, 2005). In Colombia most forest lands in these ecosystems are overused for this purpose: while 2.3 million hectares are suitable for livestock, 5.9 million hectares are used activity to graze 7 750 339 head of cattle, or 30 percent of the country's total (Gamarra, 2007). Dry zones in Colombia have been underutilized for agriculture with the exception of the Cauca river valley where, because of climate limitations, large sugar refineries have been installed. In these ecosystems only oil palm and traditional maize give higher yields. Locally, the indigenous (Wayuu) communities inhabiting these ecosystems engage in pre-Columbian subsistence farming, and graze goats in the Andean zones; they also set fires that cause land degradation.

Economic and social pressures have strong impacts on the ecosystem. Despite the technology applied, mining activities have a considerable impact on the environment and surrounding populations because they pollute the air and water resources, with negative human health effects. Present land use and tenure (latifundia), water scarcity and soil degradation, increasing erosive processes have consequences on global warming, desertification and the loss of environmental services. From the environmental perspective, the way local communities have used flora and fauna since pre-historic times has caused the deterioration of populations of natural species and led to the selective reduction of populations and, in some cases, the local disappearance of the species (Ulloa, 2007).

Impacts and effects on the provision of environmental goods and services

The loss of biodiversity due, among other reasons, to fragmentation processes, together with the small size of remnants, alters the interactions between flora and fauna and results in biological extinction because of the cascade effect. This has a negative impact on the activity of pollinators, the successful reproduction of some species, and on maintaining populations that require more extensive distribution areas (Diaz, 2007; Quesada and others, 2001; IAvH, 1997). Associated with habitat destruction are grassland expansion processes with antropozoogenic grasses to raise cows and goats, causing serious implications for regional biodiversity conservation and accelerating desertification (Ulloa, 2007). Finally, hunting activities and illegal removal of timber and non-timber species have reduced their populations, and expose them to different types of threats.

Desertification causes loss of biodiversity, and has negative repercussions on local communities' quality of life (epidemics) and economic development, increasing poverty levels and water shortages and causing productivity loss due to soil degradation. In addition, drought in dry zones has historically been related to the El Niño warming phenomenon in the Pacific, and has had impacts on agricultural production (food security) and livestock, as well as on water supply to cities and rural communities where the "indices of scarcity and vulnerability of water resources are now showing worrying and unsustainable municipal water supply trends" (IDEAM, 2004). Different human activities causing deforestation in the Region, such as land conversion and mining, among others, have increased sediment flows and erosion rates in water basins with hydrological anomalies that have consequences for the population (Restrepo and others, 2005).

Source: Prepared by N. Rodríguez Eraso from Grau and others, 2008; Sánchez-Azofeifa and others, 2005; Vieira and Scarios, 2005; Ojeda and others, 1998; Rodríguez and others, 2006; Vitoria de la Hoz, 1998; Gamarra, 2007; Maass, and others, 2005; Hernández and others, 1992; Josse, 1996; López and Cavelier, 1997; MADVT, 2004; Bisigato and others, 2005; Gamarra, 2007; UPME, 2005; Ulloa, 2007; Diaz, 2007; Quesada and others, 2001; IAvH, 1997; IDEAM, 2004; Restrepo and others, 2005.

Forests provide vital regulation services for human well-being in aspects such as temperature regulation, establishing shelter and habitats for many species, while at the same time playing a role in solar radiation reflection, air and water regulation, controlling erosion, diseases, pests and natural threats. In addition, the forest plays a role in regulating global and regional climates by capturing and storing carbon.

Of particular importance is carbon sequestration through sinks such as biomass, dead leaf litter, roots and even organic matter in forest soils, especially if it is seen as a response to the effects of climate change; the Intergovernmental Panel on Climate Change (IPCC) included it when preparing scenarios (IPCC, 2007).

Most forest regulation functions depend to a great extent on biomass. For 2006, FAO (2006) reported that the stock of forest biomass on the planet was 529.5 gigatonnes (Gt) of carbon. Of this total, LAC forests store 170 Gt. When this figure is weighted by surface area, it appears that LAC stores 32 percent of the planet's existing forest carbon in an area that is only 15 percent of the world's land area. These amounts demonstrate the importance of natural forest resources from the viewpoint of global carbon sources, not only for the inhabitants of the Region, but for the planet in general.

The ecosystem services provided by the Region's forests cannot be underestimated. In 2006 an International Congress on Ecosystem Services in the Neotropics was held in the city of Valdivia, Chile, that brought together scientists from the Region working on these themes. The participants identified the main service as water regulation, particularly of the natural forests' water resources. For example, in Valdivia it was found that watersheds covered with native species had a summer stream flow index (fast flow/precipitation) between 0.65 and 0.8. In contrast, the forest where plantations were dominant presented a summer stream flow index of 0.05-0.34 (Lara and others, 2006). In other words, the forest helps retain water in the soil. In Chile there is evidence of other important regulation services such as dispersion of seeds by birds; therefore, the reduction of forest cover, its wealth or diversity, could have a negative effect on the dispersion of seeds and the natural regeneration of ecosystems (Reid and others, 2006).

Still causing controversy is the case of forest plantations and regulation services, specifically as carbon sinks (Box 3.3). Fast-growing young trees extract carbon from the atmosphere at a much greater rate (Birdsey, 1992). Consequently, it should be expected that South American forest plantations, consisting mainly of eucalyptus - a fast growing species – would mitigate the effects of global climate change. However, most of the carbon stored in the plantations will again be released into the atmosphere within ten to twenty years, when the wood is used industrially or applied to producing energy (Berndes and others, 2003). Studies suggest that the amount of carbon stored in consolidated forests (and released during land use conversion) is much greater than the amount sequestered in any plantation project (see section on forests in Chapter II). For some specialists,

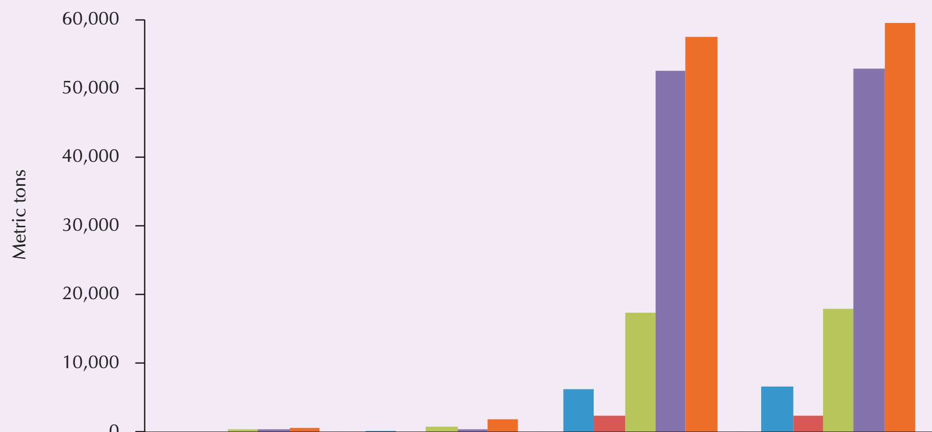
slowing down deforestation is a much more effective strategy to address global warming than establishing new plantations (Schulze and others, 2000; Fearnside, 1999, 2000).

A wide variety of cultural services are provided by forests ranging from spiritual or religious to recreational (see Box 3.2, examples of dry forests), and LAC forests are no exception. Cultural services, especially the spiritual value of forests, are particularly important for the indigenous communities inhabiting these ecosystems. Forests also have considerable value for leisure activities and a touristic economic value. Countries like Costa Rica, Belize, Guyana and Puerto Rico have various tourism activities associated with forests; most LAC countries have set aside part of their territory to protect and preserve natural forests (see section on forests in Chapter II of this report).

The Region's forests also make a contribution to human well-being by providing support services in the form of primary productivity, water recycling and photosynthesis. FAO (2006) suggests that photosynthesis could be used as a proxy indicator to quantify support services provided by forests. Based on this, when compared to the rest of the planet, LAC countries ranked highest in three of the five carbon stock categories, according to biomass types. Latin America and the Caribbean has 48 percent of the world total litter biomass, 34 percent of below-ground biomass, and 31 percent of above-ground biomass. As was to be expected, South America has the highest values in LAC for all types of biomass due to the large proportion of the sub-region's surface covered with forest (Figure 3.4; see Box 3.3 for an overview of the Region's forest plantations as carbon sinks).

FIGURE 3.4

Latin America and the Caribbean: Forest Carbon Reserves for 2005
(Millions of metric tons)



	Caribbean	Mesoamerica	South America	Total
Carbon in dead wood	42	251	6,292	6,585
Carbon in leaf litter	1	9	2,339	2,349
Carbon in below ground biomass	110	483	17,132	17,725
Soil Carbon	215	186	52,333	52,734
Carbon in above ground biomass	385	1,603	57,332	59,320

Source: United Nations Food and Agriculture Organization (FAO), 2006.

BOX 3.3

Forest Environmental Services: Forest Plantations as Carbon Sinks

Controversies arise about whether large-scale forest plantations are effective and efficient as carbon sinks. In fact, there is still considerable uncertainty about carbon measurement procedures and the system to provide credits. A question difficult to answer is to what extent large-scale forest plantation projects are, or can be, considered to be a response (Van Vliet and others, 2003). For example, an ambitions project linked to European energy companies to establish pine plantations in the Andean moorlands in Ecuador – a region of pastures essential to maintain the local hydrological cycle with high levels of biodiversity and inhabited by campesinos and indigenous people (World Rainforest Movement, 2003) — was ineffective because the balance between carbon absorbed and emitted proved to be negative for the desired purpose and affected local communities' quality of life (Vidal-Oltra, 1997). However, scientific uncertainties have not prevented – by using the Precaution Principle – experiments of this type even though their consequences have an inter-generational impact on indigenous Ecuadoreans.

Studies in the Pampean region (Argentina) also showed that establishing forest plantations as carbon sinks can have serious negative effects on soil fertility and salinity also affecting the water regime and water quality. In this region an association was observed between large-scale forest plantations and the salinization of groundwater from shallower water tables that provide potable water (Jackson and others, 2005).

Industrial forest plantations, their boom and social effects

In spite of the enormous diversity of native South American trees, almost throughout the subcontinent large-scale industrial forest plantations are being established with rapid-growth of exotic species, with eucalyptus being the most planted tree in the region, followed by different exotic pine species.

In 2005 there was a total of 13 million hectares of forest plantations in LAC. In South America, Brazil is the leader in producing eucalyptus, a tree that covers 75 percent of the total area planted in that country. The State of Espíritu Santo, in the southeast of Brazil, merits special attention because it has the highest percentage of its area planted with eucalyptus, and also the large amount of information available about the environmental impact of the large-scale forest plantations on the ethnic Guarani, Tupiniquim and Quilombolas communities (descendents of emancipated Africa slaves) that survive with family agriculture.

Table A: Forests Plantations in Brazil in Hectares by State (2004)

State	Eucalyptus	Pine	Araucaria	Acacia	others	Total	State Surface
Amapá	57,072	26,313	-	2,659	665	86,709	0.62%
Bahía	312,877	5,406	-	-	-	318,283	0.56%
Espíritu Santo	118,246	13	-	-	-	118,259	2.58%
Marañón	2,134	-	-	-	-	2,134	0.01%
Mato Gross o del Sur	53,679	102	-	-	-	53,781	0.15%
Minas Gerais	159,526	3,233	446	-	1,364	164,569	0.28%
Pará	40,270	797	-	-	-	41,067	0.03%
Paraná	46,482	203,280	6,396	-	179	256,336	1.28%
Río de Janeiro	1,201	-	-	-	-	1,201	0.02%
Río Grande del Sur	49,571	8,824	577	4	42	59,019	0.21%
Santa Catalina	6,697	100,073	164	-	13	106,947	1.12%
San Pablo	329,667	35,263	78	-	469	365,488	1.47%
Total	1,177,422	383,304	7,662	2,663	2,733	1,573,784	—

Source: Bracelpa (2008).

An exotic pine species (Pinus radiata) is the most planted tree in Chile where it represents almost 68 percent of the area covered by forest plantations (Table below). In spite of not being the most forested region in the country, environmental impacts associated with forest pressure are felt more intensively in the country's IX Region that was originally inhabited by the indigenous Mapuches and it is still inhabited by close to 23 percent of the ethnic community.

BOX 3.3

(Continued)

Table B: Forest Plantations in Chile in Hectares by Region(2004)

Region	Atriplex	Mezquite	Alamo	Acacias	Oregon Pine	Nothofa-gus sp.	Eucalyptus	Pine	Others	Total
I	9	23,872	-	-	-	-	288	-	665	24,825
II	29	277	-	7	-	-	2	-	725	1,040
III	17	98	1	62	-	-	1,259	1	1,158	2,595
IV	58,253	995	12	6,501	-	-	1,846	6	6,566	74,179
V	194	7	7	576	-	-	36,456	11,046	4,676	52,962
RM	-	5	1	-	-	-	10,881	993	2,524	14,404
VI	-	-	1,600	51	-	-	22,658	62,127	3,782	90,216
VII	-	-	2,839	30	43	33	20,456	361,703	3,020	388,123
VIII	-	-	901	575	275	167	183,329	606,240	345	791,831
IX	-	-	129	212	6,616	372	127,454	249,910	5,252	389,946
X	-	-	501	116	4,789	579	84,975	116,404	1,461	208,825
XI	-	-	5	-	4,732	25	-	-	34,782	39,544
XII	-	-	13	-	5	-	-	-	140	158
Total	58,501	25,254	6,008	8,130	16,459	1,176	489,603	1,408,430	65,086	2,078,647

Source: INFOR (2005)

One of the arguments most used in favour of establishing large-scale forest plantations in South America relates to providing jobs for depressed economics. However, there are fewer job opportunities in a eucalyptus plantation than in a coffee monoculture, or in traditional family agriculture. The rural worker's well-being conditions are also worse.

Table C: Aspects Related to Work and Employment in Eucalyptus and Coffee Monocultures and in Traditional Campesino Agriculture

	Eucalyptus monoculture	Coffee monoculture	Traditional campesino Agriculture
Job creation capacity	Very low (1 job/ 28-37 hectares)	High (Up to 1 job/ ha.; at harvest up to 2-3 jobs/ ha.)	High (Up to 1 job /1-2 ha.; at harvest up to 4-5 jobs/ ha.)
Unemployment risk	Medium-High	Medium-Low (more risk for day workers)	Low
Health risk	High (crops sprayed with agrotoxics)	Medium-High (Normally sprayed with agrotoxics)	Low (no agrotoxics use; food grown is healthy)
Food security	Low (family needs to buy food)	Low (family needs to buy food)	High (produces their basic food: beans, rice, maize, vegetables)

Source: Adapted from Nadai and others, 2005.

Source: Prepared by G. Schultz.

2.2 Marine and coastal ecosystems goods and services

These ecosystems make a contribution to human well-being at regional level with different types of services, including fishing and tourism. In particular, Caribbean Small Island Developing States (SIDS) depend on ecosystem tourism services, the greatest source of income for their economies.

The distribution of seagrasses in the Region (see section on seas and coasts in Chapter II of this report) is closely associated with the regional distribution of coral reefs; the support services seagrasses provide places them among the world's oceans largest primary production contributors. For example, they support the secondary production of economically important species such as fish and crustaceans (Erftemeijer and Middleburg, 1993; Jackson and others, 2001a) and, together with mangrove

roots and rhizomes, they help to stabilize sediments and to reduce turbidity and coastal erosion (Costanza and others, 1997).

The numerous species of invertebrates in seagrass help the beach formation process, as these organisms have external calcareous shells which, when they die, are deposited as marine sediments. Moreover, seagrass food production is based on carbon dioxide, converting it at a rate of 1 kg of carbon per square metre of seagrass per year (1 kg C m^{-2} y^{-1}). Much of this production enters the food chain beyond the coastline in the form of detritus (CARSEA, 2007).

An example of the variety of goods and services mangroves provide to the Region is shown in Table 3.2. For example, they play an important role in the erosion and accumulation cycle along the coasts of Guyana, Suriname and French Guiana. All the coasts of Guyana and French Guiana are affected by the load dispersal system associated with the sediments of the Amazon River which, it is estimated, deposits about a thousand million tonnes of sediments into the ocean each year (Augustinus, 1978; Pastakia, 1991; UNEP, 2007b; Royal Haskoning, 2007). In French Guiana it is estimated that 10 percent of this sediment load reaches the coast as suspended load (Rudant, 1994), and mangroves help to trap these sediments. In Guyana this sediment load, often called “sling mud”, is trapped by the mangrove forest aerial root systems and significantly reduces wave energy, the “overtopping” associated with exceptionally high tides and subsequent flooding (Royal Haskoning, 2007; IDS-SEES, 2008). This function is critically important, especially when there are rising sea levels, and particularly for a country like Guyana where coast-produced goods account for 60 percent of gross domestic product (GDP) (Ministry of Finance, 2008). In most countries, mangroves buffer the effect that ocean currents, the wind and the waves would have on lands adjoining coastal areas, especially important during storms and hurricanes.

Other mangrove support services are related to recycling nutrients and maintaining the breeding habitats of many

TABLE 3.2

Examples of Goods and Services Provided by Mangroves

Type	Goods/Service	Examples
Provision	Fuel	Firewood Charcoal
	Construction	Timber for scaffolding Beams, poles, flooring, panelling. Dock piles Thatch, matting
	Fishing	Poles for fish traps Shelters for attracting fish Flots for fishing Fish poison Tannins to preserve nets and lines
	Food	Fish Crustaceans Moluscs Others types of fauna Vegetables (propagules, fruits and leaves) Sweetmeats (propagules) Condiments (barks) Honey Fermented drinks
	Household items	Furniture glue Waxes Household utensils Incense Matchsticks
	Textiles, leather	Fur, skins Synthetic fibers (e.g. Rayon) Fabric dyes Tannins to preserve leather
	Other products	Fish, shellfish and roots for the aquarium market Medicines from bark, leaves, fruit and seeds Fodder for cattle and goats Fertilizers Lime Paper Raw materials for crafts Cigarrette wrappers
Regulation	Bio-Recovery	Recycling nutrients
Cultural	Leisure	Bird watching
Support	Defense Habitats	Natural storm barriers Habitats for breeding juvenile species

Source: Prepared by A. Singh.

marine organisms, both commercial and non-commercial (Mumby and others, 2004). According to FAO (2007), mangrove forests support a thriving fishing industry in Panama that could be in jeopardy due to destruction or degradation processes. Negative impacts of this type were observed in Jamaica where there was a reduction in fish catch after the mangrove area was reduced.

Mangroves also provide a variety of other provisioning goods and services. It is common for rural coastal communities to depend on mangroves as a source of food and additional income by extracting non-timber forest products (NTFPs) such as medicinal plants (noni, *Morinda citrifolia*), found in relative abundance in Caribbean mangrove forests. Furthermore, molluscs, crabs and other crustaceans are caught for local and national consumption. For example, in Ecuador each month 2 to 2.5 million molluscs are extracted from mangrove forests (Spalding and others, 1997; Lugo, 2002). In Cuba, oysters exports depend mainly on the presence and health of mangrove communities, while in Venezuela mangrove support commercial and small-scale fisheries. In Guyana *Avicennia germinans* mangrove seeds are used as food (Allan and others, 2002) while in Brazil, Colombia, Ecuador, Guyana, Peru and Venezuela mangroves are an important source of timber and fuel wood (Allan and others, 2002; UNEP-WCMC, 2007; FAO, 2007). Extracting tannins from mangrove bark (especially from the *Rhizophora mangle*) was once a common activity in Brazil, Colombia, Ecuador and Guyana for curing and drying fish nets, and for many years contributed substantially to supplying national industries (FAO, 2007).

Coral reefs are the most diverse marine environments. They provide fishery resources, biochemical compounds for medical applications, recreational areas of high economic value, oases for environmental education, coastal protection and quiet spaces for contemplation (aesthetic value) (Birkeland, 1997; Jackson and others, 2001b; Hoegh-Guldberg and others, 2007; Knowlton and Jackson, 2008). Indirectly, coral reefs provide spaces for a very large number of species as well as habitats for organisms in a larval, juvenile and adult state that can migrate to other regions. Coral reefs have a significant "option use value" potential. Examples are organisms belonging to those environments that have been identified and exploited for medicinal and industrial purposes. Soft corals and gorgonians naturally produce terpenoids that are being tested for their antibacterial functions, while gorgonian corals contain notable amounts of prostaglandins used to help induce birth labour, and for birth control (Carté, 1996).

In the case of provision services, coral reefs are a source of high quality protein to which access can be had by small-scale fishing vessels and subsistence fishers using canoes and rowboats. Some fish species associated with coral reefs, such as snapper, grouper, Caribbean spiny lobsters and queen conch shells, have historically been traded (including internationally) in several countries of the Region (FAO, 2007a; CRFM 2005, 2006, 2007).

Coral reefs, particularly those that extend parallel to the coastline as in fringing and barrier reefs, provide a series of support services. For example, they protect the mainland coastlines from erosion and from hurricane and storm damage. UNEP (2008) stresses that coral reefs protect more than 20 percent of Caribbean coastlines from storm force, winds and waves.

It is estimated that the annual contribution of coral reef ecosystems to the fishing industry, tourism and shoreline protection is between US$3 100 and US$4 600 million (CARSEA, 2007). In general terms, it is suggested that of the world's regions, the Caribbean is most dependent on underwater coral reef tourism for jobs and income (World Tourism and Travel Council, 2003). In Belize, a study that sought to assess the impact of hurricanes and coral bleaching events on the life of the country's inhabitants showed a complex network of relationships due to the population's dependence on tourism (McField and others, 2008). The growing tourism industry in Belize equals 23 percent of the country's GDP (according to 2002 data), with a total annual value of US$ 194 million.

Coral reefs also trap carbon dioxide and release oxygen, as well as regenerating nutrients (Birkeland, 1997; Hughes and others, 2007; Mumby and others, 2007a). From an ecological point of view, they make a sizeable contribution to life on the planet; have considerable economic value; and they are socially and culturally invaluable for local communities.

3. Pressures

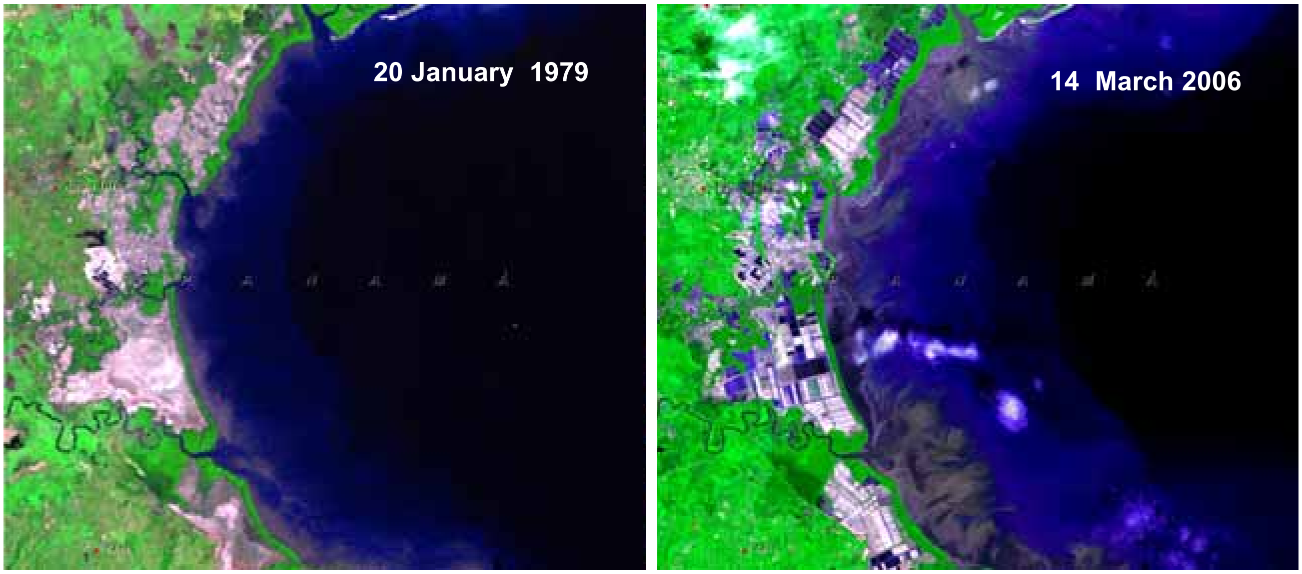
Latin America and the Caribbean is a region characterized by developing countries. These countries' economic growth, together with their exponential increase in population, adds new pressures to the least developed areas and increases pressures on those that are better developed (Harrison and Pearce, 2000), especially on forest and marine-coastal ecosystems (see Chapter II of this report). High population growth creates more demand for goods, including an increased demand for food products. Besides these human pressures, there are others due to natural events occurring in the Region.

Degradation and reduction of forests are associated with countless factors, with poverty being identified as the most significant driving force (Sunderlin and others, 2005). FAO (2006) identifies population growth, agricultural expansion, increasing demand for forest products, illegal logging, industrial development and rapid economic growth as some of the main anthropic pressures on forests. Other factors of human origin that influence deforestation and forest degradation are:

a) Inappropriate land use policies, unplanned urban development and infrastructure, and associated population growth;
b) Planting illegal crops, introducing exotic species, illegal trade in species, extensive removal of fauna and flora for sale;
c) Intensive farming practices and fertilizer use, misuse of water resources, increasing demand for food and biofuels, mining;
d) Wild fires.

Climate change is among the phenomena associated with the loss of forests, not only in terms of area, but also as to forest diversity and capacity to provide ecosystem services and functions (see Box 3.2). Pressure is also exerted on marine and coastal ecosystems (see Boxes 3.2 and 3.4 for examples on forests and mangroves).

Pressures on coral reefs and seagrass are related to tourism, which continues to rapidly expand in many countries of the Region. Red tides, sedimentation, over-exploitation of associated resources (marine species), pollution, coral extraction and human encroachment have been identified as major causes of coral reef degradation in the LAC Region (Pandolfi and others, 2003; Wolanski and others, 2003; Kleypas and others, 2006; Hoegh-Guldberg and others, 2007; Hughes and



Pressures on mangroves: Parita Bay, Panama: *In the Parita Bay, located at the western end of the Gulf of Panama, areas prone to flooding are mostly occupied by mangroves and "albinas" (i.e., scarcely vegetated ecosystems located close to the sea, highly saline, with white coloured soils, which are shown in grey colour in the image of 1979) and flooded low vegetation, of great importance for its role as breeding areas of crustaceans and fish. Much of the coastal forests were converted to pastures, or depleted for sea salt extraction and for shrimp culture. These last two were the main economic activities in the province of Cocle. Today, both industries have declined due to stiff competition in international prices of salt, and white spot syndrome virus that affected the shrimp industry in Panama in 1999. These activities left unprotected and exposed soils to erosion, salinization and desertification. The Landsat satellite image of 2006 shows the areas used for the establishment of shrimp farms and salt extraction (blue coloured geometric patterns). Source: UNEP (2010), The LAC Atlas of Our Changing Environment.*

others, 2007; Cortés, 2003; Gardner and others, 2003; Singh, 2005). While information about the rate of degradation is not available for the whole LAC Region, numerous examples show the extent of human impact. For example, estimates in Honduras suggest that 34 percent of coral reefs are threatened by stresses of anthropic origin, the most dominant being over-fishing (30%), coastal development (25%), sedimentation as a result of agricultural activities (10%), and marine activities (6%). Marine pollution, like hydrocarbon pollution, is also affecting mangroves, coral reefs and seagrasses. In Panama, for example, a considerable area of mangroves has been lost due to pollution caused in part by high maritime traffic in the Panama Canal (Spalding and others, 1997; Lugo, 2002).

In addition to anthropic pressure sources, natural events like hurricanes and the effects of climate change are posing short-term pressure on forests and marine and coastal ecosystems functioning. It is likely that natural disasters resulting from climate change will increase in frequency or intensity, as suggested by studies on hurricane intensity in the Atlantic area (Bender and others, 2010), and by statistics showing increased frequency of hydro-meteorological phenomena in LAC (see Chapter I). These include forest fires, sometimes deliberately set, whose effects are exacerbated by an increase in droughts and higher temperatures, soil erosion and mass movements.

With respect to coral reefs, these tend to break when exposed to strong wave action caused by storms and hurricanes. Likewise, an increase in sediments and runoff is common when these seasonal weather phenomena occur in coastal and inland areas subject to flooding. Excessive sedimentation can smother or bury the coral, and may also reduce the light available for resident symbiotic algae, while large quantities of fresh water could reduce salinity levels below those that allow the coral to grow. As far as mangroves are concerned, floods associated with storms could quite quickly deposit large quantities of sediments that have the potential to bury and destroy them.

BOX 3.4

Anthropogenic Pressures on Mangroves in Latin America and the Caribbean

It is estimated that in the Caribbean Small Island Developing States (SIDS) more that 80 percent of the human population live within 10 Km from mangroves. This has resulted in their removal, and it often happens that where they still exist, these habitats have become the population's garbage dumps. In recent years the composition of garbage has changed from more organic or biodegradable matter to more plastic and Styrofoam that jeopardizes the existence of plants and undermines the human well-being services the ecosystems provide.

Moreover, in countries like Haiti, Guyana, Suriname, the Dominican Republic and Jamaica, a percentage of the population depends on this resource for fuel wood and subjecting this ecosystem to another type of exploitation – deforestation. In areas where agriculture is still a predominant activity, as in Colombia, Ecuador and Guyana, mangrove ecosystems are being displaced to establish farms, including livestock raising (it is projected that this pressure will increase as the population grows and food prices rise), while one of the major threats is pollution caused by fertilizers and pesticides used in agriculture (Pastakia, 1991; Lugo, 2002).

Aquaculture is another activity identified as one of the major sources of destruction, as mangrove water bodies are converted to shrimp or prawn farms (Stevenson, 1997). For example, in Belize large strips of mangroves were replaced by aquaculture although, due to global competition, this once-flourishing economic activity is no longer feasible (in spite of the quite liberal tax incentives in the Belize Export Processing Zones). Elsewhere in the Region, in the Caribbean islands for example, aquaculture is not currently a major industry; however, it is expanding in Latin America (see also the section on aquaculture in Chapter II of this report). For example, Guyana and Suriname are seeking to expand their aquaculture industry and have begun to use some of their mangrove areas. Such initiatives will result in further exposing the mangroves to more future pressure, and in reducing their total size. Notwithstanding this, as the countries of the Region embark on aquaculture, they should be made aware of the short-term economic gains and the long-term consequences on ecosystems, as is evident in Belize.

Tourism-related activities have also an impact on mangroves in known and emerging tourism destinations in LAC. In countries like Mexico, Colombia, Barbados, Bahamas, Trinidad and Tobago and the Cayman Islands, one of the threats to mangroves is the ever expanding tourism industry development, as land is cleared to build more hotels, spas and piers, although better environmental regulations should reduce some of these impacts. However, at present there is a weak legal framework with small and rarely applied penalties, so that these developments continue to grow virtually at full strength.

Source: Pastatia, 1994; Lugo, 2002.

With respect to the islands and lowland areas of the LAC region, perhaps the greatest threat facing their marine ecosystems is the rise in sea level associated with changing weather patterns. Projections made for the Caribbean region estimate that there will be a sea level rise of at least 5 mm per year during the next 100 years because of global warming caused by greenhouse gases (GHG) (Nurse and Sem, 2001; IPCC, 2007). This change in sea level will have serious consequences for the coastal resources of the Caribbean states including mangrove forests, and for the stability of beaches, coral reefs and seagrasses.

As these ecosystems are exposed to natural events such as hurricanes, the capacity of habitats to continue performing their functions may be compromised. For example, in 1989 a large part of the mangroves in the British Virgin Islands suffered damages from Hurricane Hugo. In 2004, mangroves in the Cayman Islands and Grenada felt the severe impact of Hurricane Ivan that caused more than US$1 800 million in damages, plus a major destruction of the coast and the water bodies of the central mangroves of Grand Cayman in the Cayman Islands, and the Grand Anse beach in Grenada (Government of Guyana, 2005; FAO, 2007b). In countries such as Guyana and Suriname, the displacement of masses of mud and the cycle of erosion have destroyed considerable mangrove stretches along the coastline of both countries (Howard, 2004). It is likely this situation will intensify as the sea level rises due to climate change; and as exceptionally high tides become more frequent, it is probable that the mud banks will be hit by stronger waves that increase the rate of erosion and the destruction of mangroves.

Human pressures, natural events and diseases play a significant role in degrading ecosystems, making it more difficult for them to recover after natural events, and reducing their normal resilience to the effects of storms and others events (Bellwood and others, 2004; Guzman and Cortes, 2007; Hughes and others, 2007; Mumby and others, 2007a).

It is clear that corals, mangroves and seagrasses are the basic building blocks of marine ecosystems and are usually intricately interconnected through the movement of associated organisms during different stages of their life cycles. However, natural and anthropic pressures are causing them to degrade and, therefore, present direct risks to the health and overall stability of the affected ecosystems, as well as to adjacent ecosystems with which living organisms are exchanged.

4. Consequences of Environmental Changes and their Relation to Human Well-Being

Human beings have benefited from the many forest goods and services such as seagrasses, mangroves and coral reefs from which they derive economic, spiritual and cultural benefits. How they are used, associated with naturally occurring phenomena such as hurricanes and the effects of climate change, has caused a number of impacts and in many cases threatened the ability of these habitats to continue providing such services. Since both forest and marine-coastal ecosystems in LAC play an invaluable role for both the Region and the planet, the pressures placed on these ecosystems have direct and indirect, short- and long-term consequences for human well-being, as is mentioned in section 3 of this chapter. It is, therefore, imperative that these ecosystems keep on performing their duties, given that an interruption could adversely affect human existence, particularly of populations that depend directly on having access to the products and services that forests and seas provide (Sunderlin and others, 2005).

However, as mentioned in Chapter II and in section 4 of this chapter, the degradation, destruction or reduction of these ecosystems has had direct, indirect and negative effects on people's livelihoods. Over the years there has been some improvement in LAC in terms of income, nutrition or health, due in part to the exploitation of natural resources. Economic exploitation of natural resources through agriculture, fishing and forestry activities benefits people by developing the economy and improving the quality of life and food security, and by alleviating poverty. However, the rate at which these resources are extracted has increased, thus exherting more pressure on ecosystems and reducing their ability to provide services and, therefore, ultimately affecting and endangering the well-being of human populations in LAC.

For example, pressures on dryland ecosystems can result in reduced grass cover, in reorganizing assemblages of

species (with the loss of native species and an invasion by exotic species), in soil degradation and erosion as well as in nutrient loss. Changes like these will perhaps reduce productivity and accessibility to ecosystems' goods and services and negatively affect human well-being (Brown and others, 1997; Bisigato and others, 2005). Desertification is also among the processes that have an impact on biodiversity loss and affects local communities' quality of life and economic development. Over the long term, this could result in, or intensify, poverty or food and water shortages. Similarly, deforestation and land use changes can also increase atmospheric carbon emissions. The IPCC (2007) estimates that close to 20 percent of global carbon emissions are due to clearing vegetation, some of which originate in the LAC Region (see section on forests in Chapter II). This increase of carbon emissions into the atmosphere has human health implications.

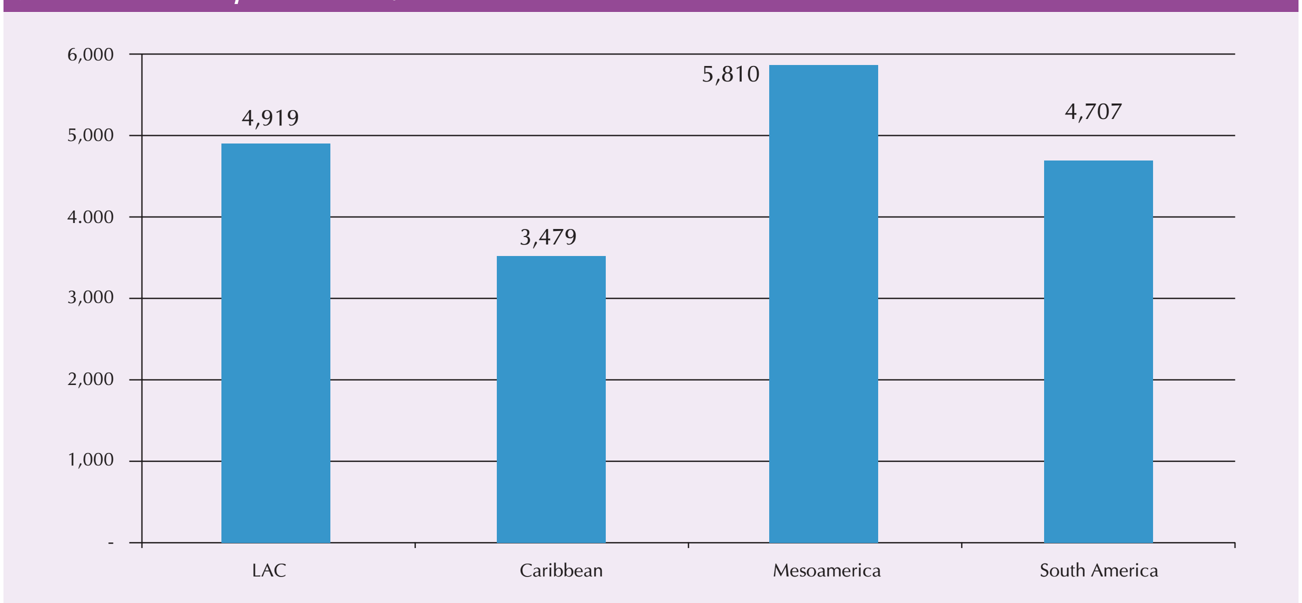
4.1 Availability of goods and services

At present there are considerable differences in income between the countries of the Region (Figure 3.5; see also Chapter I of this report). The expansion of agriculture and forestry as a result of foreign trade has had an impact on local economies and on the environment, as well as on access by communities to goods and services provided by local ecosystems. As mentioned in section 3 of this chapter, in most countries of the Region there has been an increase in per capita income derived from forest exploitation, both in the form of supplementary domestic income and in terms of economic activity. For example, Peru's exports of forest products have increased over the past decade from US$16 million in 1995 to US$168 million in 2005. The OAS (2007) predicts that this will continue, accentuating changes in the way soil is used that will have significant impacts on its composition, on the hydrological regime, and on food availability, thereby affecting human well-being.

While not very abundant in the Small Island Developing States of the Caribbean, mangroves make an important contribution to the social and economic stability of certain sectors of society. A study of the economic contribution of a mangrove swamp in the south of the island of St. Lucia revealed local and national financial savings due to the capacity of mangroves to sustain small-scale charcoal production, thereby reducing the community's and the nation's dependence on imported, and much more expensive, propane gas for cooking (Hudson, 1997). Hudson (1997) also notes the contribution of the St. Lucia mangroves to livestock grazing, particularly during the dry season when the pastures are cut off and depleted. This example demonstrates the importance to society of this ecosystem which, should it be destroyed or degraded, would affect the livelihood of people who depend on it for their survival (see Box 3.5).

FIGURE 3.5

Latin America and the Caribbean: Gross Domestic Product per Capita 2008, by Sub-Region
(Constant market prices in US$)



Source: Prepared by UNEP with data from ECLAC (Economic Commission for Latin America and the Caribbean), 2009.

BOX 3.5

Consequences of Environmental Changes on Access to Goods and Services Provided by Mangroves

The presence of mangroves (an estimated 3 740 000 hectares) is related to the location of commercial fisheries (FAO, 2003). Given the capacity of mangroves to provide food and shelter for a wide range of organisms, including juveniles of several species of commercial fish and invertebrates that when grown migrate to other marine habitats, it is no surprise that the declines observed in mangrove areas are associated with coincidental declines reported in the total Caribbean fish catch, as well as declines in the organisms of interest to fisheries and closely associated with mangroves (Ellison and Farnsworth, 1996). Nearly 680 species of bony fish of interest to commercial fishing, including 69 kinds of sharks, depend on coastal wetlands and mangroves for certain stages of their life cycle. One hectare of mangroves in the Pacific can produce from 1 100 to 11 800 kilograms of fish, shrimp, crabs and molluscs. Furthermore, the mangrove fishing industry is worth between US$900 and US$12 400 per hectare (World Rainforest Movement, 2002). The fishing industry is also a major provider of jobs for processing and selling fish. It is estimated that more than 200 000 people in the Caribbean region are employed in fishing, either full or part time (Millennium Ecosystem Assessment, 2005).

The introduction of Tilapia mossambica into Puerto Rican mangrove estuaries has displaced native species of commercial importance and this has led to an ecosystem shift in these areas. In Caribbean Small Island States mangroves are cut down mainly to make room for urban infrastructure and tourism. In Barbados deforestation of mangroves has caused the local extinction of at least one species (FAO, 2007b), and a loss of vital habitat and food is expected not only of those organisms that remain in the mangroves throughout their life, but also of a number of marine species that use the sheltered mangrove habitat as a breeding area, bringing food to their young and protecting them from predators.

People living on the Pacific coast of southern Colombia, like other poor coastal communities where mangroves are being converted, are facing most of the costs associated with having fewer ecosystem services, including a decline in forest resources, less protection of shorelines from storms, low fishery production, and water quality degradation due to pollution caused by using oil palm to produce biofuels. It is reported that species and groups of commercially important species have been fully exploited or are over exploited in the area. For example, the exploitation of Pianguas (conch), the best source of income for local women who are heads of households, has been banned in some areas and in others it is a closed season during several months a year.

Many mangrove forests are under pressure from over exploitation leading to their resilience against a rising sea level being reduced. The importance of sediment flow in determining the response of mangroves to higher sea levels is well established in literature. Ellison and Stoddart (1991), Ellison (1993), and Parkinson and others (1994) suggest that if sea level rates continue to rise mangroves would not continue to increase in area in islands (high or low lying) where there is little sediment supply. Snedaker and Meeder (1994) suggest that mangroves in low islands may be able to adapt to higher rates.

The resilience of mangroves to a rise in sea level is also conditioned by the composition and state of their mass, and by other factors such as tide regimes and the supply of sediments (Woodroffe, 1995; Ewel and others, 1998; Farnsworth and Ellison, 1997). In some protected coastal sites, flooding of low-lying coastal land can even promote the progressive expansion of mangroves as sea levels rise (Richmond and others, 1997), while the increase in raise keeps pace.

Source: FAO, 2003; World Rainforest Movement, 2002; Millennium Ecosystem Assessment, 2005; FAO, 2007b; Pérez and others, 1999; Alleng, 1998; Suman, 1994; Ellison and Stoddart, 1991; Ellison, 1993; Parkinson, and others, 1994; Snedaker and Meeder, 1994; Woodroffe, 1995; Ewel and others, 1998; Farnsworth and Ellison, 1997; Richmond and others, 1997.

As to forests, deforestation reduces availability of goods and services such as fuel wood, textiles and wood, particularly for communities that depend on this type of fuel to produce charcoal for cooking or for heating.

With respect to marine ecosystems such as coral reefs and seagrasses, the pressures on them have exacerbated their decline and this, in turn, severely affects human well-being. From the economic standpoint, seagrasses, mangroves and coral reefs maintain commercial and recreational fishing, greatly benefiting the Region's economy. The estimated combined total value of coastal ecosystems' goods and services is more than US$12 000 million (Costanza and others, 1997). By using as a proxy indicator the Ecosystem Services Product (ESP) suggested by Martinez and others (2007), the total value of the Region's coastal ecosystems is given as US$ 6.48 million per year. However, because of the lack of reliable information it is difficult to get a complete estimate of these goods and, therefore, it is very likely they are underestimated. Despite their importance, many of these services have not been explicitly valued in global markets and governments, and thus organizations and individuals have little incentive to conserve them. The rate of degradation of key interconnected marine ecosystem components (such as coral reefs, seagrasses and mangroves) may well result in lower production, whether of food, fuel, shelter, or for aesthetic purposes (see Box 3.6).

In addition, there are obvious consequences of a reduction in ecosystem resources, of less biodiversity and of ecosystem changes. In the case of large oceanic pelagic migratory fish species, overfishing has led to sharp declines of these resources throughout the whole distribution range. Although international efforts are being made and measures have been taken to manage the low stocks of Atlantic fish such as bluefin tuna and blue and white marlins, these efforts have been inadequate, and there are few signs of recovery (ICCAT, 2007). The reduction in the quantities of these large predators has the potential to lead to a huge change in marine ecosystems and this would have potentially dramatic consequences for the survival of species lower down in the food chain.

BOX 3.6

Consequences of Reef Degradation on the Human Well-Being of Populations in the Caribbean Region

It is predicted that Caribbean coral reef degradation will reduce fisheries production levels by at least 45 percent, with a consequent loss in public revenue estimated at more than US$140 million per year (UNEP, 2008). This will increase poverty levels in the Region as well as its dependence on imported supplies of fresh and processed fish products. Given the growing demand for fish, it is unlikely that the Caribbean countries will be able to meet the high cost of importing these products.

In the case of the coral reefs of Jamaica, diseases and overfishing have both contributed to heavy reductions in populations of key species that feed on algae, such as the diadem sea urchin (Diadema antillarum) and the clownfish (Scarus spp.) respectively (Mumby and others, 2007b), so that many coral reefs are invaded by excessive algae growth that produces a fall in trophic levels (Singh, 2005). The decrease in the quality of coral reefs in Jamaica has been accompanied by a precipitous drop in public revenue from fishing and diving tourism. A recent study demonstrated the critical threshold levels of dependence of Caribbean coral reefs. This was based on the extent of coral cover and grazing intensity of algae to limit excessive growth and a shift towards a landscape where algae predominate (Mumby and others, 2007b) These authors claim that if remedial action had been taken a decade earlier, when coral reef coverage reached 30 percent, recovering the reefs would have required a two to threefold increase in algae grazing intensity. Other Caribbean islands showing declines in catches of reef fish could suffer similar long-term consequences in reducing resources and biodiversity. In general, less biodiversity in the reef ecosystem makes it less resilient to other pressures, whether natural or anthropic.

The deterioration of coral reefs will result in a quality of life loss for local residents. There will be a decline in consumable and tourism resources, now coastal communities' two main sources of income. Coastal erosion will become more pronounced to the extent that protective reef crests are degraded and are unable to reduce the strength of incoming waves (pers. obs.). Coral reefs, the source of eggs, larvae, juveniles and adults for these and other environments will disappear, environmental services and others will begin to weaken and will probably no longer be available. Some of these services are of utmost importance, such as the accumulation of carbon dioxide and nutrient recycling (regulation services), and establishing the structure in which many other organisms live (support services).

Caribbean tourism depends heavily on the availability of white sandy beaches, clear blue waters, and the beauty and biodiversity of reefs and other ecosystems. However, the combined effects of overfishing, extensive development of coastal infrastructure, excessive sedimentation, and an increase in the amount of nutrients, are having a negative impact on the health of a range of ecosystems, whose interconnection has made the Caribbean a popular tourist destination. As Caribbean attractions diminish and disappear, so too will the tourists. In particular, there will be fewer diving tourists who spend between 60 and 80 percent more money during their stays in the Caribbean than any other tourists, meaning they supply about 17 percent of the total revenue from tourism (UNEP, 2008). Given this, it is estimated that the expected reef health loss will reduce the Region's revenues from diving tourism by about US$300 million per year (UNEP, 2008).

Source: UNEP, 2008; Singh, 2005; Mumby and others, 2007b

4.2. Impact of climate change on availability of ecosystem services

Besides human activities, it is likely that events associated with climate change magnify the deterioration of many features of forest, coastal and marine environments directly related to human well-being.

According to estimates in the Stern report (2007) by 2025 there will be a 70 percent increase in the number of people facing severe difficulties in having access to potable water. By 2020 nearly four million people will be at risk of not having access to potable water and, if the current trend continues, that number could increase to 50 million by 2050. A one degree Celsius rise in temperature would make Andean glaciers melt and increase risks of flooding during the rainy season, and less potable water would be available in the dry season; given their geographical location and their large populations, cities like Quito, Lima and La Paz would be those most directly affected (see also the urban and water resources sections in Chapter II).

Assessing the impact of climate vulnerability on the main rivers of the Americas poses a unique challenge for water security, taking into account that nearly 70 percent of all rivers, lakes and other water sources (such as the Amazon River) are transnational by crossing the borders of from two to eight countries. There are multiple examples in LAC. A study published in 2007 by UNESCO and OAS identified more than 70 main rivers that cross borders (UNESCOIHP/OAS, 2007). The list includes the Yrenda-Toba-Tarija (SAYTT) aquifer system in the River Plate shared by Argentina, Bolivia and Paraguay. In this system, 75 percent of rainfall evaporates within that region, while only 25 percent reaches the basin’s rivers; therefore, any alteration in evaporation

caused by changes in temperature could have a severe impact on water availability, and possibly leading to potential conflicts over water resources (Vaughan and others, 2007). Other examples of transboundary aquifers are the Guarani aquifer, shared by Argentina, Brazil, Paraguay and Uruguay, categorised among the world's largest aquifers; the Great Lakes; the Artibonito (between Haiti and the Dominican Republic); and others (Vaughan and others, 2007).

Biodiversity is also being affected by deforestation and global warming. An average rise in global temperature of between 1 and 2 C (above pre-industrial levels) could lead to the disappearance of between 15 and 40 percent of species, which in turn would affect people who depend on them for food. A decrease in the average water balance in the tropical floodplains could put at risk nearly 1 900 plant species, 263 fishes, 85 reptiles, 440 birds and 195 mammals that inhabit the region (ANA/GEF/UNEP/OAS, 2005; Vaughan and others, 2007). At the present rate, temperatures are predicted to rise by 2 to 3 C over the next 50 years. In this scenario Amazonia, seen as the region with most of the planet's biodiversity, would inevitably be affected (Box 3.7) with long-term global consequences for human well-being, and in the short term would also affect the inhabitants of the Region and of Amazonia. According to Stern (2007), Amazonia is home to a million people of 400 different ethnic groups who depend on the forest as a source of income, for medicinal needs and other types of resources. Climate change has also become evident at country level, and when associated with population pressures the scenario is alarming. For example, it is expected that tropical forests in central and southern Mexico and in northern Brazil will be converted into grasslands and arid areas. In addition, by 2050 nearly 50 percent of agricultural land in these countries will probably be unfit for use due to desertification and salinization processes that will affect some areas (Stern, 2007).

Temperature changes will also affect agriculture, as crops depend on temperature and rainfall patterns. Consequently, any change in temperature will have an impact on their reproduction patterns and threaten the viability of species that are essential to maintain sustainable agricultural production. This includes pollinators native to crops and microorganisms that maintain soil fertility and productivity. Pollinization is essential to reproduce many wild plants and crops, and it is estimated that globally its economic value ranges between US$30 000 and US$60 000 million (Stern, 2007).

Many of the effects of climate change on agriculture will depend on the degree to which human beings can adapt to these changes, both concerning technology and changing lifestyles.

BOX 3.7

Amazonian Forests Faced with Global Climate Change Scenarios

Today Amazonian forests are considered to be among the largest carbon sinks in the planet's tropical region, but this could change dramatically should the climate change scenarios prepared using global circulation models be confirmed.

In essence, variations in temperature and the amount and seasonality of rainfall towards a warmer, drier climate would mean the balance between the carbon fixed by Amazonian forests through photosynthesis and that released through respiration processes would cease to be positive, so that this enormous tropical ecosystem mass would become a source of carbon emission into the atmosphere.

Additionally, over the next hundred years central Amazonia could go from being a humid tropical forest to a seasonal dry forest, or even a seasonal savannah with a climate similar to that in the dry phase of the El Niño phenomenon. Because plants would not be able to adapt quickly to these changes, species typical of Amazonian forests would disappear, giving way to communities resistant to prolonged drought, such as those in the plains of Colombia and Venezuela.

The impact of this shift would have enormous consequences on the hydrological balance of the Amazon River basin because the disappearance of the forests would reduce by between 10 and 15 percent the amount of rain water entering the basin. There would also be an increase in global carbon emissions into the atmosphere. But perhaps the change that would be the most difficult to reverse would be the disappearance of the region's biodiversity, considered to be one of the planet's most diverse.

Whatever the scenario, any changes should take place at a rate slow enough to allow species to adapt, but this is unlikely to happen.

Source: Killen, 2007.

As to coral reefs, the El Niño phenomenon and climate change have been identified as contributing to their worldwide degradation, and LAC is no exception (Guzmán and others, 1990; Jackson and others, 2001b; Pandolfi and others, 2003; Wolanski and others, 2003; Kleypas and others, 2006; Hoegh-Guldberg and others, 2007; Hughes and others, 2007). In regions like the eastern tropical Pacific, El Niño is a major cause of coral death (Glynn and others, 2001; Cortés, 2003; Guzman and Cortes, 2007). This will probably increase as climate change (due to increased water temperature and lower alkalinity) places such additional stress on coral reefs that their existence is endangered (Pelejero and others, 2005; Kleypas and others, 2006; Hoegh-Guldberg and others, 2007). Atypical temperatures can also cause phenomena such as coral bleaching that affect ecosystems in LAC. Where bleaching does not kill the corals, those that survive do not completely revert to their previous state, and suffer from stunted growth, reduced reproduction, production of carbonate skeletons, and an inability to repair damaged tissues.

Some studies suggest that the reduction in marine diversity, such as coral reefs, will have a potentially severe impact on society and on the economies in the areas in question. These impacts will increase because of a loss of resilience, a decline in the health of marine ecosystems and water quality, reduced fisheries potential, the loss of recreational opportunities, fewer jobs and/or reduced carbon capture (Nellemann and others, 2008).

Studies also show that the mangrove forests in some Caribbean islands will disappear as a result of rising sea levels. For example, it is projected that a one metre rise in sea level in Cuba would put more than 300 hectares of mangroves at risk, representing about 3 percent of the country's forests (Perez and others, 1999). Under similar conditions Alleng (1998) predicts the total collapse of the Port Royal mangrove wetland in Jamaica that has shown a low migration capacity over the past 300 years. Suman (1994) foresees that rapidly rising sea levels will adversely affect mangroves in Puerto Rico, where 62 percent have already been lost because of direct human activities (see Chapter IV of this report). Changes are foreseen in the amount of sediment flows associated with changes in temperature and water depth due to rising sea levels, with a resulting adverse impact on the mangroves' productivity and physiological functions. Because the mangroves would lose their ability to protect the coastline, the economic costs would be substantial.

The Special Report on the Regional Impacts of Climate Change (Nurse and others, 2001), IPCC (2007) and FAO (2007) concluded that the challenges posed by climate change have been further aggravated in some Caribbean islands by changing ecosystems to develop tourism infrastructure. The consequence is that, given their limited capacity to adapt, these are among the world's most vulnerable countries.

Some of the threats climate change poses to Caribbean countries are:

- More salt water intrusion;
- Floods;
- Soil degradation;
- Destruction of agricultural crops, homes and lifestyles;
- Destruction of vital physical and social infrastructure;
- Fresh water pollution;
  Misappropriation of valuable resources.

These vulnerabilities become more severe when other factors are included (for example, more than 90 percent of populations in island states live in areas susceptible to flooding).

4.3 Vulnerability of populations to the impact of environmental changes

4.3.1 Health and changes to ecosystems

Most ecosystem changes have occurred to satisfy the strong growth in demand for food, water, fibres, fuel and electricity. And although some positive environmental exploitation benefits were reported (many in the case of forest and coastal marine ecosystems in LAC), human well-being is affected by the degradation caused by overexploitation. There is evidence of the considerable direct and indirect harmful effects (direct: floods, water shortages, landslides; indirect: changes in pest patterns; malnutrition; shortage of traditional medicines; mental health problems and intestinal

diseases). For example, a fifth of the diseases reported in LAC can be attributed to environmental changes (Periago and others, 2007).

Human activities are altering the structure and function of ecosystems in aspects such as increased variations and extremes in temperature, humidity and vegetation cover, and even altering trophic flows. In many cases, access to food sources is affected, while in others human activity has caused the reappearance of vector-borne diseases that could potentially also affect human beings. For example, growing global warming helps diseases to spread. Other environmental changes also affect natural predator populations of species that in many cases help or transmit such diseases. This results in an increase in populations of species such as mosquitoes, flies, rats or bats. In turn, human populations living very near these areas, especially the forests or coastal zones where emerging diseases and algal toxins that affect fauna, are more vulnerable and prone to such health problems as yellow fever transmitted by these vector agents. Besides yellow fever, changes in forest ecosystems due to deforestation can potentially induce the recurrence of vector-borne epidemics and affect their distribution patterns, as happens with Leishmaniasis and malaria (see Boxes 3.8 and 3.9). In the case of malaria, no major reduction is yet seen in the number of cases in LAC (see Figure 3.6), and some people think that these epidemics can also be made worse by climate change. These and other emerging diseases affect not only health but also have the potential to influence trade, tourism and lifestyles (Epstein and others, 2003).

Water related health issues include water-borne diseases such as cholera caused by the pathogen *Vibrio cholerae.* Since 2002, LAC countries have seen a decline in the number of cholera cases reported in the Region (Figure 3.7), most likely as a result of good public health policy intervention. Despite the progress made, 30 percent of rural populations in LAC have no access to basic sanitation services, and those most vulnerable to these diseases are rural communities where potable water is

BOX 3.8

Diseases and Deforestation in Paraguay

In Paraguay's eastern region - where most of the population, production and services are concentrated — about 50 percent of the forests (equivalent in area to 7.4 million hectares) has been felled since 1945. In 2000 close to five percent of the total area of this region was covered by forests. In that country a link was found between the increase of the disease known as Leishmaniasis and deforestation to convert forests to agricultural and livestock activities. Of the cases of Leishmaniasis occurring in recent years, 85 percent were in the geographical area occupied by the departments of Canindeyú, Alto Paraná and San Pedro, where its presence and increase is related to colonizing agricultural development areas (Agüero and others, 2006).

Source: Prepared by R.Martínez, Agüero and others, 2006.

BOX 3.9

Health Impacts Due to Changes in Amazonian Forest Ecosystems

In Brazilian Amazonia (Vasconcelos and others, 2001) human viruses and tree viruses pathogenic to human beings are natural to the region: they include dengue, yellow fever, mayaro and oropouche, among others. There is evidence that colonization, mining, dam building, and other activities that change the environment in Amazonia affect these viruses' epidemiology, ecology, life cycles, and distribution (Vasconcelos and others, 1992).

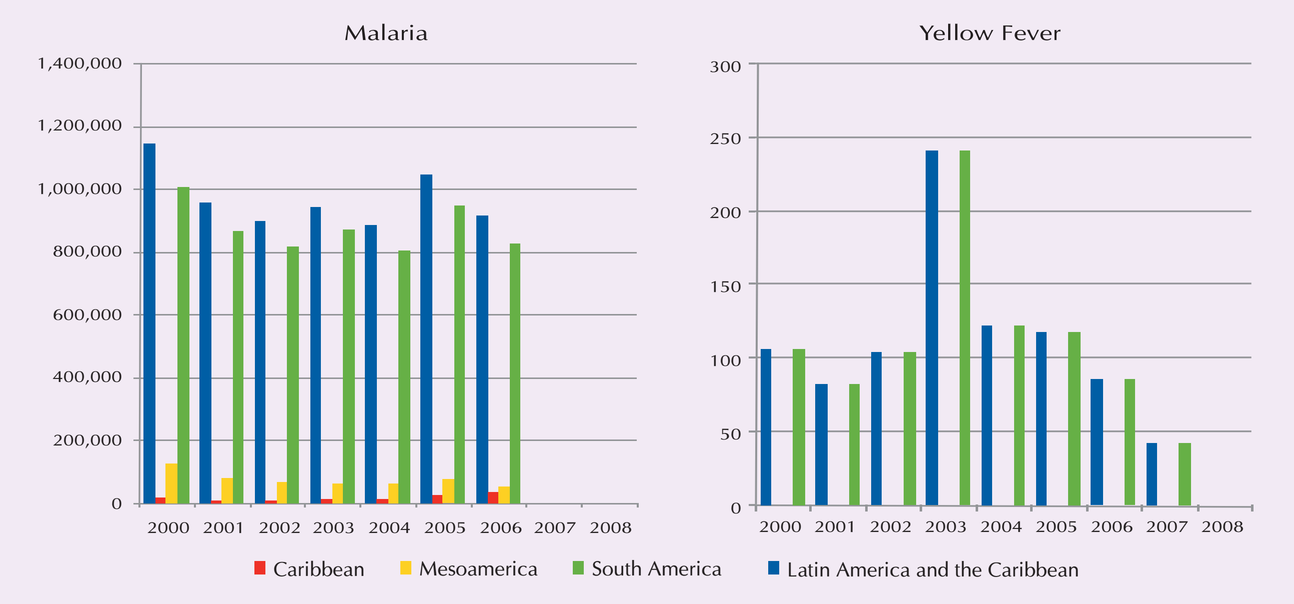
In Peru, on the other hand, Amazonia is one of the areas with a high incidence of malaria where habitat loss and deforestation are causing a loss of the region's ethnobotanical knowledge and, more importantly, of species with an anti-malarial and biocide potential and traditionally used by communities (Perez, 2002).

The shortage of resources in forest ecosystems around these population settlements affects the inhabitants' well-being and health, in part by reducing the quality and quantity of food (leaves, bark, roots, seeds, fruits, honey, among others, as well as of birds and mammals) (Montenegro and Stephens, 2006). The destruction of ecosystems and habitat and species loss results in a change in the eating patterns of all local populations, not only indigenous populations, and can cause health problems that include chronic malnutrition. The loss of traditional medicinal species affects health, and undoubtedly makes the populations increasingly dependent on Western medicine.

Source: Adapted from UNEP, 2008.

FIGURE 3.6

Latin America and the Caribbean: Reported Cases of Malaria and Yellow Fever, 2000-2007



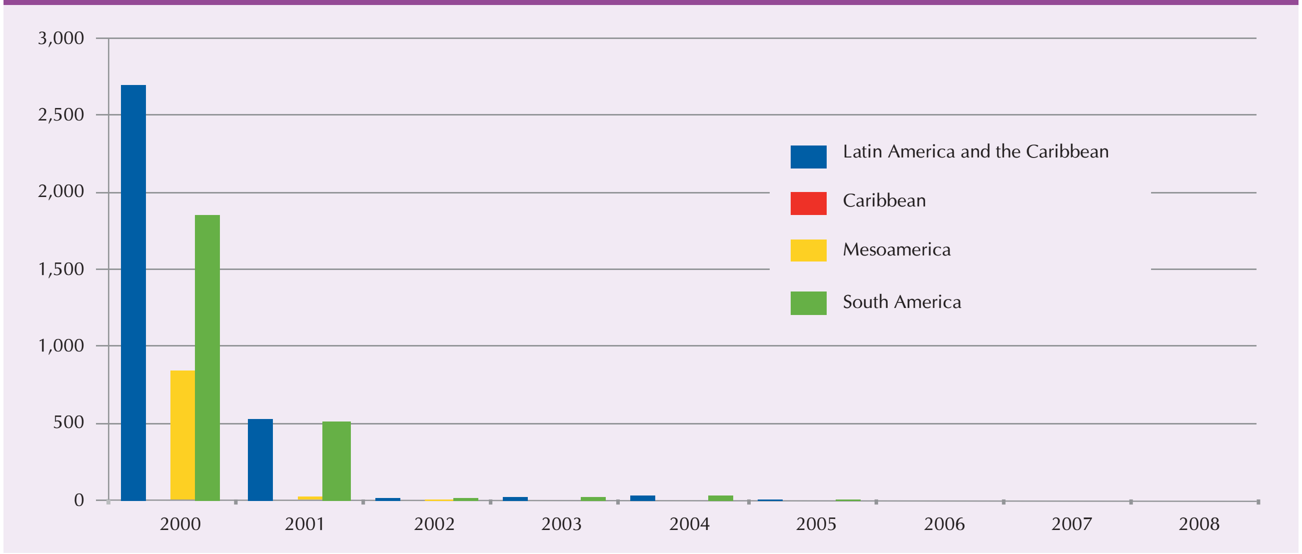
Source: Pan-American Health Organization (PAHO), 2008.

not available or there is no easy access to it. In addition to inadequate access, climate change may increase the temperature of water bodies, thus making them support microbial activities that help the cholera strain to reproduce. Moreover, an increase in nutrients can promote the spread of cholera. The pathogen *Vibrio cholerae* is associated with marine life, and cholera outbreaks are often associated with coastal algae bloom, and some are related to nitrogen pollution (Colwell and Hug, 2001; Cottingham and others, 2003).

Not only is the quality of water important, so is its quantity. For example, field studies conducted by the Organization of American States (OAS) in partnership with the International Development and Research Centre of Canada (IDRC) and the Pan American Health Organization (PAHO) (IDRC-PAHO-OAS, 2007), show a correlation between the reduction in the volume of water flows and droughts, with a higher incidence of the risks associated with malaria, dengue (Box 3.10) and Chagas disease.

FIGURE 3.7

Latin America and the Caribbean: Cases of Cholera Reported from the Year 2000 (by Sub-Regions)



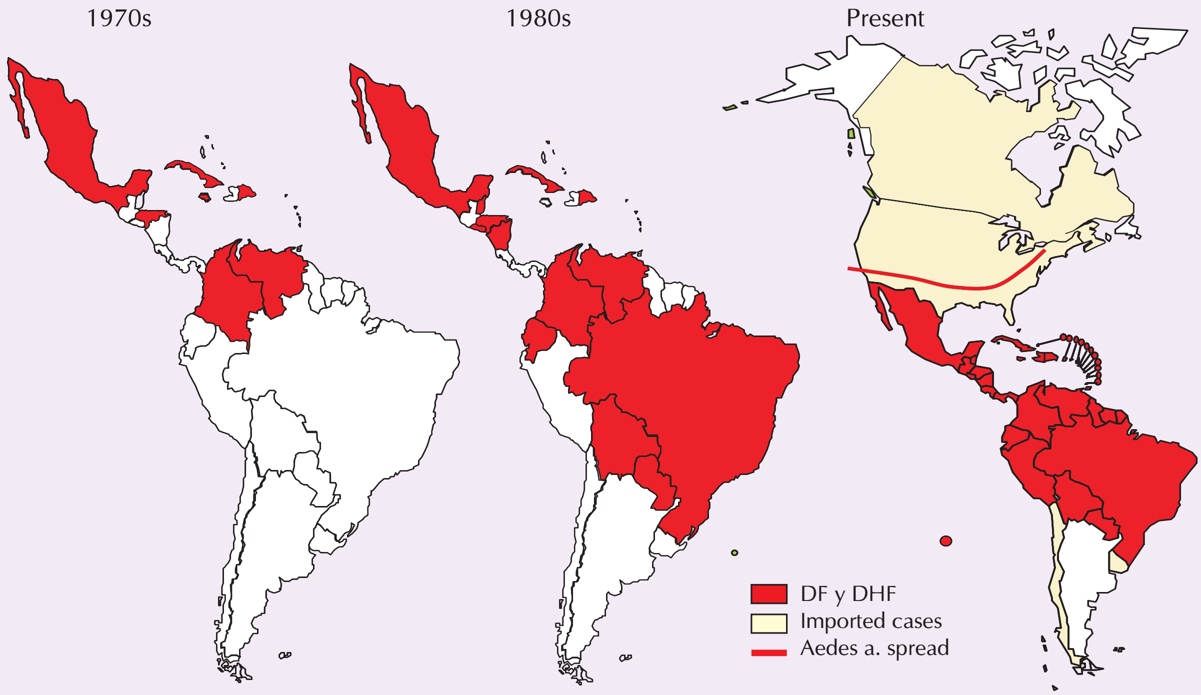
Source: Pan-American Health Organization (PAHO), http://www.paho.org/spanish/ad/dpc/cd/cholera-1990-2008.pdf

BOX 3.10

Dengue

Dengue is now the most serious vector-borne viral disease worldwide. After the transmission of dengue in the Americas was successfully interrupted until the late sixties with the Aedes aegypti eradication campaign, the vector control efforts were not sustainable in the seventies; there was a subsequent reinfestation of the mosquito with cyclical outbreaks of dengue every three to five years. From 2001 to 2007, more than 30 countries in the Americas reported a total of 4,332,731 cases of dengue, including 106,037 cases of dengue hemorrhagic fever and a total of 1,299 deaths in the same period (Case Fatality Ratio - CFR 1.2%). All four dengue serotypes are found in the Region (DEN-1, 2, 3 and 4). Among the determining factors influencing the spread of this disease are profound climate changes that cause alterations in ecosystems and create ideal conditions for the vector. Moreover, unprecedented population growth, mega-cities, unplanned urbanization and lack of basic services (potable water and garbage collection), facilitates the proliferation and persistence of the disease. PAHO/WHO proposes that the Integrated Management Strategy to prevent and control dengue be implemented to strengthen national programmes so as to reduce the socioeconomic burden of dengue epidemics by using an inter-programmatic and multisectorial approach incorporating key components such as: social communication; epidemiological surveillance; laboratory services; attention to patients; entomological services and care for the environment.

Evolution of the historic situation of cases of dengue in the Americas 1980-2007



Source: Prepared by PAHO with data from Patz and others, 2006; UNEP, 2006; Tauil and others, 2001.

Forest fires also affect human health. People living near forests are exposed to effects such as smoke inhalation that cause an increase in respiratory diseases (see the section on air quality in Chapter II). For example, the number of outpatients treated for respiratory diseases in Alta Floresta, Brazil showed a twentyfold increase in 1997-1998 during the El Niño phenomenon (CHGE, 2005) when there was a large increase in the number of forest fires in the region.

4.3.2 Health and climate change

Threats to health due to climate change are also evident with extreme weather events including storms, increases in temperature, drought and other catastrophes. More and more people are living in areas vulnerable to extreme events and it is now evident that more people are dying in LAC due to climate related natural events such as storms and floods (see Chapter I).

Another serious climate change threat is the substantial increase in the number of annual droughts in LAC, from one to four per year (see Chapter I). This has indirect implications on human vulnerability since the loss of soil fertility increases crop susceptibility to pests and may have implications for food production and availability and, therefore, affect human beings and their well-being. The Region is experiencing the economic losses due to the effects of climate change and crop diseases. For example, it is estimated that in southern Brazil there was a 30 percent reduction or loss of production due to droughts and charcoal rot disease (CHGE, 2005), causing an increase in the soybean price and putting it out of the reach of certain sectors of society that depend on this staple food. Drought results in reduced crop production which may increase the incidence of malnutrition in populations that rely on forest products and making them more vulnerable, as seen in the Solimões River region in Brazil (Box 3.11).

Also, a rise in sea level would probably affect the Small Island states in the Caribbean, causing increased mortality due to intense heat and malnutrition (Stern, 2007). More droughts could also lead to rural communities temporarily migrating to urban centres in search of jobs and, in effect, spreading malaria (Confalonieri, 2003; CHGE, 2005). In addition, there is renewed concern about cases of non-infected migrants who move to areas where the disease occurs, and then return to their places of origin where they spread the disease.

BOX 3.11

Learning to Cope: Vulnerability and Adaptation to Climate Change

An example of a place where adaptation to climate change could be expected to lessen the impact on the well-being of indigenous populations is the tri-border region (Brazil, Colombia and Peru), located in the westernmost Amazon Basin, with the main towns of Leticia and Tabatinga. It is an area of seasonal wetlands and lakes, rich in fishery resources that sustain rural and indigenous communities. In 2005-06 the region was severely affected by exceptional droughts: the level of the Solimoes river, a major tributary of the Amazon, fell by 1.5 metres following a 70 percent reduction in rainfall (one-fifth of normal). There was a huge loss of fisheries resources and the heavy impact was felt by the indigenous communities that depend on ecosystem services provided by wetlands and lakes. The devastating consequences of these exceptional droughts on the health, environment and economy of the tri-border area may have been reduced through the strategic use of groundwater, a reliable and less climate-dependent resource

Source: Vaughan and others, 2007.

5. Final Reflections

Maintaining ecosystem functions in forests and marine environments is critical for human well-being and this chapter has shown how the goods and services they provide are linked to the pressures to which they are being subjected, both by humans and by natural events, and the consequences for human well-being. The link between civilization and ecosystems is evident and, therefore, measures must be taken to sustainably manage these resources to ensure they provide goods and services not only for this generation but also for generations to come. While efforts are being made in Latin America and the Caribbean to address this problem, it is clear that the action taken is not keeping pace with the changes that are occurring. It is vital, therefore, to adopt measures to correct this inconsistency. There must be much more emphasis on raising awareness, particularly in showing the community in general as well as decision-makers, how human populations depend on local, national, regional and even global ecosystem services, and about their quantity and quality. It is of the utmost importance that scientific studies establish the bases to identify and quantify the services ecosystems provide to the regions, a subject that is still not being studied enough.

There is no doubt, as demonstrated in this chapter, that development in the LAC Region is hindered by its unsustainable use of resources. It is imperative, therefore, for decision-makers, local communities and resource managers to work together to solve the problems of improving people's well-being and promoting sustainable development. With respect to minimizing both effects on humans and pressures on ecosystems, policies and institutions have a critical role to play regarding mitigation measures and adaptation strategies by: establishing national goals consistent with social and cultural values as well as priorities; and providing people the information they need to take action. An example of this type of positive intervention can be seen in the mangroves of Belize where in February 2008 a temporary moratorium was placed on changing mangrove forests in response to the impacts on ecosystems caused by their removal and alternation (Office of the Deputy Prime Minister, 2008).

The Region must also overcome the barriers that are exacerbating the misuse of ecosystems and quickening the pace of their degradation, with the associated consequences on human well-being. Among others, cross-sectorial policies to promote sustainable use of ecosystems must continue to be strengthened so that they have the capacity and the financial resources to quantify the environmental goods and services derived from ecosystems.

Progress has undoubtedly been made in the Latin America and Caribbean Region and this should continue along the lines of expanding knowledge and using appropriate decision making tools. It is essential that continued support be given to education and training for people to recognise the importance of ecosystems functioning, and of their conservation and economic value. In this respect, it is to be hoped that steps will be taken by regional governments to apply traditional knowledge and practices about using natural resources. Although more use is being made of such knowledge, it is still undervalued and underutilized.

As far as these issues are concerned, it is important to continue development efforts and to implement formal and informal political and economic incentives to support ecosystem conservation and sustainable use, and to consider the social and cultural values of the territories' inhabitants. Progress also needs to be made in giving local populations more opportunities, limited in many cases, so that they can use new technologies and alternative and sustainable land use practices, including income-producing non-agricultural activities, to lessen pressures on the environment.

Finally, efforts must be continued to build capacities and experience, individual as well as community and institutional, to conserve and sustainably manage the ecosystems of Latin America and the Caribbean.

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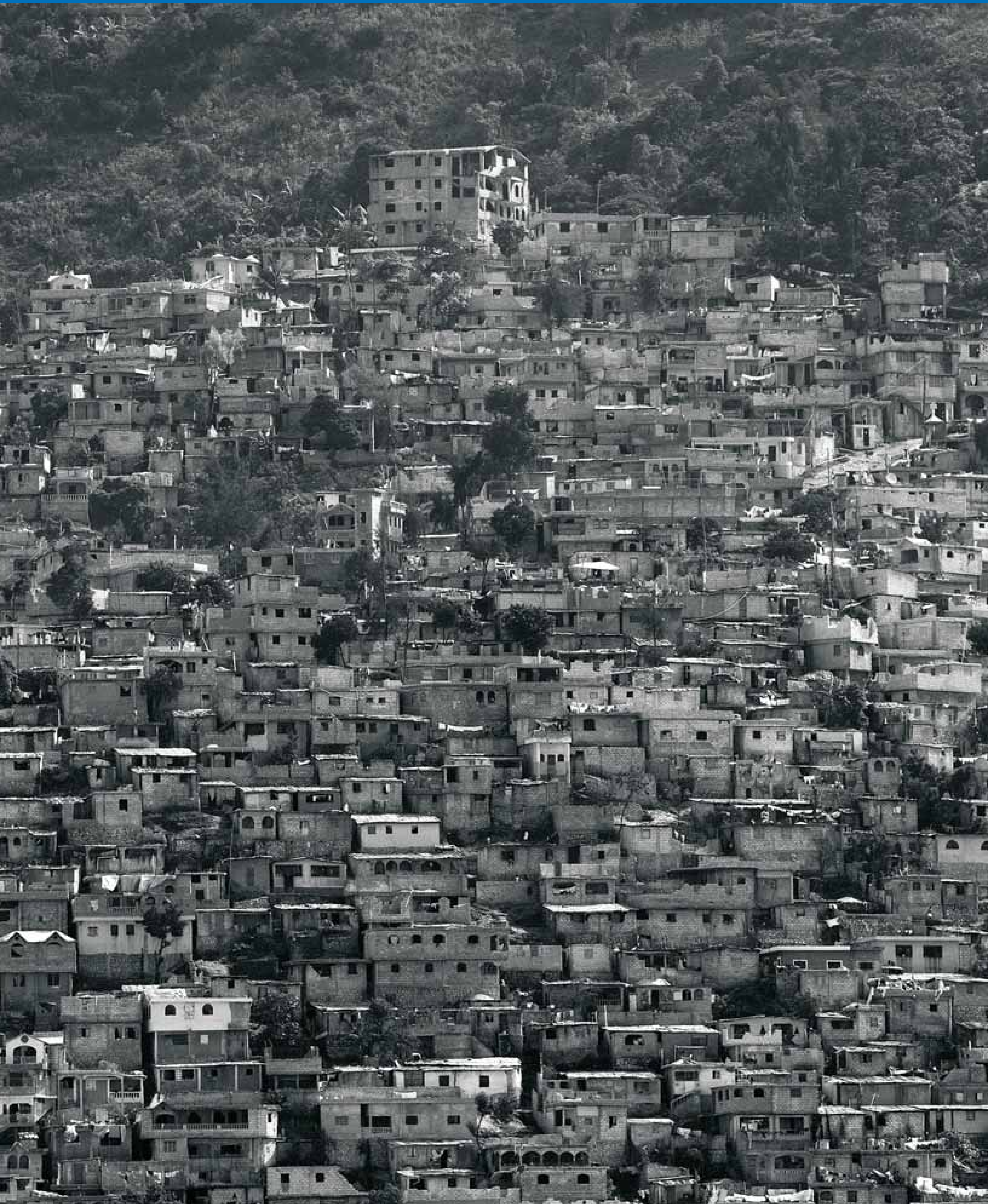


IV. Scenarios

Key messages

- **Sustainability as a strategic goal is the thread running through this chapter; it is looked at from an analytical perspective that includes how the debate evolved about the link between environment and development.** Among the characteristics **of** Latin America and the Caribbean as one of the regions with the highest relative socioeconomic advancement in the developing area is that is has the world's highest income distribution disparity; it also has the developing area's largest foreign debt per capita. With this in mind, as a starting point to design the scenarios account is taken of the Region's socioeconomic development model based on exporting natural resources and, because of its comparative advantages of relatively cheap labour and few environmental restrictions, on exploiting such resources to attract foreign investment.

  Among other relevant issues it should be borne in mind that because the Region's forests – particularly in the Amazon basin – are the planet's largest carbon sink and contain a major proportion of global biodiversity policies and action taken on land use in the Region are of vital importance.

In this context, the scenarios explore four key hypotheses that group the identified determinant driving forces, as well as market incentives, policy choices and concerns related to security and sustainable development. While attempts are constantly being made throughout the world to optimize these driving forces they sometimes become mutually exclusive, leading to conflicts when it comes to achieving different objectives.

In the scenarios presented, four narratives are used to explore uncertainties associated with these dilemmas: They are: *Relegated Sustainability; Sustainability Reforms; Unsustainability* and *Increased Conflicts; and Transition to Sustainability.* The scenarios themselves are neither predictions nor projections; they are plausible images of the future defined by using different combinations of driving forces where the economic, social and environmental costs of each of the trajectories depend to a great extent on the speed with which the objectives of sustainability and human well-being are integrated into the decision making process.

- **To develop the economy it is essential to invest in environmental and social sustainability.** For the scenarios that assume increased investment in health, education, and environmentally sustainable technologies (efficient in energy consumption and cleaner) - *Transition to Sustainability* in particular - the results concerning economic growth and the equal distribution of the wealth generated are as good as and fairer than those that do not assume the same level of investments in those sectors. Growing inequality and social fragmentation are much more evident in the *Unsustainability and Increased Conflicts* scenario.

- **Relying only on the market will mean the Millennium Development Goals and the key environment targets are unlikely to be met.** In the *Relegated Sustainability scenario,* emphasizing market forces permits rapid economic growth, but it is also seen more pressure on the environment while advances on social themes are much slower. Alternatively, in *Sustainability Reforms*, and above all in *Transition to Sustainability* where more investments are promoted on health, education and the environment, more development assistance is provided and there are new approaches to credit policies; there is also considerably more rapid progress in achieving social goals without sacrificing economic development.

- **Access to and control of energy resources continues to be an important cause of conflict** in *Relegated Sustainability* and, to a greater extent, in *Unsustainability and Increased Conflicts*. In these two scenarios limited improvement is seen in diversifying energy sources (other than fossil fuels) and in energy efficiency. On the other hand, energy sources diversification (with more participation of renewable sources), energy efficiency and regional energy cooperation are moderately promoted in *Sustainability Reforms* and strengthened in the *Transition to Sustainability* scenario.

- **Urbanization is also a key driving force for Latin America and the Caribbean.** The population's geographic distribution has, and will continue to have, a special influence in the intensive occupation of coastal or nearby areas, with a persistent move away from inland historic zones and a rapid expansion towards traditional empty spaces in the heart of the Region (Amazon and Orinoco basins).

  In each scenario the urbanization process develops qualitative differences. In *Relegated Sustainability* and *Unsustainability and Increased Conflicts,* urban expansion is uncontrolled. Urbanization is less chaotic in *Sustainability Reforms*. In *Transition to Sustainability* long-term urban development planning means that urbanization continues, especially in small and medium size cities.

- **Another notable characteristic of the Latin American socioeconomic context is the continued increase in migratory pressures** (within the Region and towards developed countries, especially North America). In *Relegated Sustainability,* increased emigration is due to various groups' deteriorating social conditions. In *Unsustainability and Increased Conflicts* there is a notable increase in migratory pressures in border areas while migration legislation becomes more restrictive. In *Sustainability Reforms* and *Transition to Sustainability* migratory pressures ease. In the last mentioned hypothesis emigration becomes a question of personal choice rather than one of necessity.

- **In some cases the action taken as part of the efforts to meet the Millennium Development Goals (MDG) and other environmental targets is counter productive.** An example is increased large-scale production of biofuels, mainly for trade, using as a pretext the need to make advances to meet climate change targets. This competes with food security and the need to protect biodiversity, since both activities vie for available land and water resources. The final result in *Relegated Sustainability* is more deforestation and the reduction of forest areas, causing more habitat loss and greater fragmentation. Under the scenario *Unsustainability and Increased Conflicts* , the important forest areas of interest to the "elites" are conserved, but there is a rapid increase in deforestation outside these protected areas. Thanks to better regulatory standards and compliance mechanisms, in *Sustainability Reforms* there is evidence of a moderate reduction in deforestation and habitat fragmentation. Mechanisms are applied in *Transition to Sustainability* to rehabilitate affected forest ecosystems and halt the loss and fragmentation of these key habitats.

- **In the four hypotheses, ever increasing pressures are seen on water resources as 2050 approaches**, although it is possible to distinguish differences between them. In *Relegated Sustainability* and in *Unsustainability and Increased Conflicts* the quality and quantity of surface and groundwater become worse. In *Sustainability Reforms* water extractions can be halted by investing in water saving technologies, thus achieving a substantial improvement in how economic sectors use this resource. In *Transition to Sustainability* special efforts are made to manage conflicts in this area, to make the use of water more efficient, and to change people's behaviour about how they use water.

- **When analysing global and regional processes, the Region's decision-makers must systematize how an integrated approach is applied to better respond to socioeconomic and environmental problems on regional and national sustainable development agendas. This would enable the Region to better deal with global economic crises such as that unleashed in 2007, as well as to meet other global challenges.**

1. Introduction and Background

How can the economic, socio-political and environmental reality of Latin America and the Caribbean be changed by 2050? What are the key driving forces or factors of such changes? What implications will the potential transformations referred to earlier have for the Region's sustainable development? In a very brief summary this chapter gives the answers to the above questions by preparing and analysing various possible scenarios for Latin America and the Caribbean.

The use of ***environmental and socioeconomic scenarios*** as a key decision making tool acquires particular relevance in a global and regional context such as the present, marked by increasing economic, social and environmental uncertainty. To the extent that they refer to basic sustainability themes, the uncertainty factors ***(key uncertainties)*** in the scenarios may prove to be crucial.

Scenarios can sometimes be confused with forecasts and predictions but, according to the GEO methodology, they are neither one nor the other. They are simply alternative images about how the future may evolve under different plausible combinations of key factors or ***driving forces*** such as population, economic growth, technological development, economic policies, environmental management, trade agreements, and others.

The accumulated effects of changes in basic sustainable development areas within a specific scenario may, under determined circumstances, result in a qualitative leap or ***turning point*** in the trajectory of the scenario in question, that is say, they may cause an essential transformation of the scenario and leave the way open for a new path to be followed that could strengthen, weaken or move away from earlier trends.

The scenarios must be prepared with the necessary detail when making the basic characterization of the object under study at different spatial and temporal scales; they must be plausible, coherent and reflect – as far as possible – how the disciplines of the natural, social and

other sciences are integrated. They have a ***qualitative component***, where experts in different branches of learning explain what they know about the driving forces, their potentialities and inter-relationships; and a ***quantitative component*** fundamentally based on the results of statistical models and that, as a guiding element, takes into account the basic assumptions defined in the qualitative analysis.

Scenarios, therefore, are stories told with narrative and numerical information that may help decision-makers to direct happenings along sustainable paths and avoid those that may have adverse consequences.

Where the environment is concerned, the proper use of the scenarios helps decision-makers facing environmental challenges to take timely action on mitigation and adaptation strategies while they provide an overall look at the links between such challenges, their implications and the inertia of ecological and socioeconomic systems.

This chapter of the GEO LAC -3 report on socioeconomic and environmental scenarios continues earlier studies on this theme coordinated by the UNEP Regional Office for Latin America and the Caribbean. This effort complements and updates Chapter 4 "Regional Development Scenarios" of the report *GEO Latin America and the Caribbean Environment Outlook 2003*.

A starting point to prepare this chapter was all the information processed and compiled since 2004 by the *Regional GEO Scenarios Team*, as part of the regional contribution to the fourth global report GEO-4 (2007). This information includes both qualitative analyses, expressed in the narrative texts, and quantitative analyses.

As a general reference, this chapter assesses the regional trajectories of the four scenarios built on a global scale between 2000 and 2050, as shown below.

Relegated Sustainability (RS)

In this scenario economic growth takes priority over social and environmental objectives so that policies and practices are fundamentally directed at developing markets. When it comes to reducing consumption of raw materials by product unit, the effects of dematerializing the economy are to a great extent compensated by increased economic activity. Everything becomes merchandise, including natural resources and

TABLE 4.1

Basic Background for GEO LAC -3 Scenarios

GEO 3 Global	GEO LAC 2003	GEO 4 Global 2007	GEO LAC -3
Markets first	Unregulated market	Markets first	Relegated Sustainability
Policy first	Reforms	Policy first	Sustainability Reforms
Security first		Security first	Unustainability and Increased Conflicts
Sustainability first	Great Transitions	Sustainability first	Transition to Sustainability

Source: Prepared by the authors.

basic goods such as water, biological diversity and culture. Environmental degradation increases because there are more environmental externalities. In international trade people are considered as objects and there is more inequality and corruption.

Sustainability Reforms (SR)

New policies and regulations are introduced to mitigate the adverse effects of more than two decades when policies that gave preference to expanding unregulated markets predominated. High economic growth is combined with the application of Keynesian fiscal policies to ease the most serious social and environmental problems; however, because the market approach still predominates in this scenario, there are still tensions and limits when it comes to making a significant advance in this direction. Scientific and technological capacities in the countries of the Region are used to a great extent in prioritized areas, and relevant institutions are strengthened. Although advances are made to protect the environment, especially on controlling urban pollution, natural resources management problems persist, particularly on territorial management.

Unsustainability and Increased Conflicts (UIC)

This is a regional context marked by socioeconomic and political fragmentation with "islands of wealth" surrounded by a "sea of poverty" as an expression of growing disparities. Natural resources are predominantly controlled and appropriated by the power elites and large corporations. Violence is exacerbated and there is a considerable increase in socio-political conflicts with great migratory pressures in border areas. As security conditions worsen repressive control mechanisms proliferate. Environmental degradation increases, although some natural resources of interest to the elites are preserved; and health problems increase.

Transition to Sustainability (TS)

A more integrated approach produced a combination of economic, social and environmental dimensions of sustainable development, with greater emphasis on human development. As far as economic activity is concerned, there is more dematerialization and regional economic integration increases. Migratory pressures are reduced and more basic needs are met without endangering natural resources conservation. The decision making structure is more balanced; there are significant changes in consumption patterns and good progress is made in solving priority environmental problems. Progress is also made on preparing a common regional environmental agenda.

To express the high degree of uncertainty implicit in the process of building scenarios this chapter explores, as well as the four basic trajectories summarized above, four alternative trajectories that introduce *turning points* in the middle of the 2000-2050 period.

According to the criterion of the regional team's experts, the four alternative trajectories presented in Table 4.2 were selected, as representative cases to assess sustainability within the set of possible combinations.

This chapter's fundamental link with other sections of the regional report is based on analysing the Region's environmental priorities as defined in the initial chapters, and on the outlook assessment made of them in the different scenarios considered. Therefore, the scenarios presented in this chapter provide important lessons for decision-makers.

Like GEO-4, published in 2007, sustainability as a strategic objective is the thread running through this chapter. The background to this analysis outlook is how, in the twenty years since the report *Our Common Future* was published by the United Nations World Commission on the Environment and Development (1987)[1], the debate evolved about the link between the environment and development.

1 *Also in this respect, as basic references there are regional studies and research about the challenges of sustainable development in Latin America and the Caribbean. See, for example, UNDP, 1990; O. Sunkel and N. Gligo (Eds.), 1980*

TABLE 4.2

Alternative Regional Trajectories that Introduce Turning Points in GEO LAC -3

TRAJECTORIES	From 2000 to 2025	From 2025 to 2050
A	*Relegated Sustainability*	*Sustainability Reforms*
B	*Relegated Sustainability*	*Unsustainability and Increased Conflicts*
C	*Unsustainability and Increased Conflicts*	*Transition to Sustainability*
D	*Sustainability Reforms*	*Transition to Sustainability*

Source: Prepared by the authors.

2. Driving Forces, Key Uncertainties and Basic Ideas Behind the Hypotheses

2.1. Driving forces

Besides being diverse, the *driving forces* of the Region's socioeconomic, political and environmental changes in the coming decades are interrelated in different ways. The impact of some of them goes far beyond regional borders and is felt in other regions and countries through international trade and financial, cultural and other exchanges that have been greatly strengthened in the present context of globalization.

Characteristics of Latin America and the Caribbean include a high degree of disparity in how the world's income is distributed, and the largest per capita foreign debt. Other key socioeconomic processes in the Region are urbanization, migration to other regions, and between countries of the Region, and renewed integration efforts between countries.

As far as the environment is concerned, among the relevant themes to be kept in mind is that the Region's forests – in particular those located in the Amazon basin – are the planet's largest carbon sink and contain a considerable proportion of the world's biological diversity; they also underscore the importance of policies and actions related to land use changes in a region where there are abundant fresh water resources and mining-energy supplies.

Given their geographic location and status as developing nations, the countries in the Latin America and Caribbean Region face different levels of vulnerability when confronted with extreme natural phenomena such as climate and seismic events (volcanic eruptions and earthquakes). Recent scientific evidence shows that, in the foreseeable future, some of these challenges and their associated risks will tend to become worse when phenomena such as climate change occur, caused to a great extent by the accumulated impact of human activity.

There are still obstacles in the Region, such as: applying economic policies that have high social and environmental costs; the lack of political will to achieve sustainable development; out of control urbanization; limited institutional capacities; emigration – above all of skilled workers – and technological and financial restrictions that not only worsen the socioeconomic and environmental situation, but also reduce the countries' capacity to respond in terms of adapting to and mitigating global environmental problems.

The dynamics of the links between these economic, political, social and environmental themes in Latin America and the Caribbean confirms the need, when building scenarios for 2050, to analyse this diversity of factors as important *driving forces*.

2.1.1 Economic dimension

The following are fundamental economic *driving forces*:

- The dynamics of economic growth, its quality, and the contribution made by the different socioeconomic sectors;
- Trade and financial trends such as the evolution of the foreign debt and direct foreign investments;
- Technological progress or retreat in predominant production and consumption patterns, innovation/ competition indicators, and the technological gap;
- Energy dynamics, i.e. the presence of different sources (fossil fuels, biofuels, nuclear energy and others) in the regional energy balance, the advance or retreat in energy efficiency, as well as the link between energy and sustainable development.

Integration trends or regional economic fragmentation refer to the evolution of sub-regional agreements such as the South American Common Market (MERCOSUR), the Andean Community of Nations (CAN), the Union of South American Nations (UNASUR), the Caribbean Community (CARICOM), the Central American Integration System (SICA) and the Bolivarian Alternative for the Americas (ALBA), among others.

2.1.2 Socio-political dimension

In the social plan, mention may be made of the following *driving forces*:

- The population's behaviour, that is to say, population dynamics, the urbanization process and migration flows;
- Disparities and poverty;
- Food security challenges;
- Human development evolution, measured with the assistance of the Human Development Index and different social indicators;
- Cultural challenges, including the cultural impact of globalization and the dangers and opportunities for native cultures;
- Institutional development, governability, and other factors such as social participation, democracy and corruption.

2.1.3 Environmental dimension

Concerning the environment, taken as a starting point are the Region's environmental priorities defined in earlier sections of this report, with special reference to key themes such as:

- Land use changes;
- Vulnerability to climate change;
- Desertification and drought;
- Loss of biodiversity;
- Exhaustion and pollution of water sources;
- Deforestation and soil erosion;
- Waste and hazardous waste management;
- Costs of environmental protection, among others.

These environmental priorities are also *driving forces* of future changes.

Endogenous and exogenous *driving forces* may be identified in each of the three analysis plans (economic, social and environmental). The endogenous are those whose behaviour can fundamentally be explained by regional or local factors (for example, integration initiatives within the regional framework), while the exogenous basically owe their performance to factors that are global or external to the Region (for example, petroleum prices in international markets, the dynamics of foreign markets, and climate change as a global challenge). Nevertheless, it should be taken into account that, as a result of present globalizing trends, and since they are often intermixed, it is becoming increasingly difficult to separate endogenous and exogenous *driving forces*.

Regional scenarios become more uncertain due to the Region's socioeconomic realities, its dependent insertion into the world economy and, above all, the dynamics of many *driving forces* defined outside the Region (exogenous). This, in turn, means that the scenarios are important in decision making and shows the need for regional and local responses that will mitigate or solve problems affecting sub-regions, countries and communities in the area.

While many countries in the Region have similar socioeconomic and environmental challenges, it should not be forgotten that there are also differences between sub-regions and countries, and even great disparities within countries. All the details of this diversity of challenges, problems and options cannot be included in a study of the Region as a whole such as that suggested in this chapter; however, basic methodological instruments and tools are provided that may be used to replicate the experience of the scenarios on a sub-regional, national, and even on a local scale.

Although the three analysis plans mentioned above (economic, socio-political and environmental) will be analysed separately when the scenarios are presented, for didactic reasons it should be taken into account that there is a close *cause and effect* link between developments in these three fields of activities. Because of its non-linear and multi-faceted nature this is a very complex relationship and, in the final analysis, corresponds to the economic trends of the determinant role played by interconnections in the equation.

Despite the determinant role of the economic variables and policies, how social and environmental variables evolve may, under determined conditions and with determined thresholds having been crossed, act as either economic growth catalysers or obstacles, as shown by the set of scenarios offered in this chapter.

2.2 Key uncertainties and basic ideas behind the hypotheses

The basic assumptions for the Region's scenarios were defined by taking as a reference the GEO-4 (2007) methodological base and including the necessary adjustments in accordance with the situation in Latin America and the Caribbean. This analysis generally keeps to the five basic dimensions used in the GEO-4 (2007) report: 1) Institutional and socio-political framework; 2) Population trends; 3) Economy and markets; 4) Science and technology; and 5) Values system. These dimensions, that summarize the scenarios' driving forces, are examined in the light of a set of *critical uncertainties* for the four basic scenarios (see Table 4.3).

TABLE 4.3

Basic Ideas Behind the Hypothesis

Dimensions	Key Critical Uncertainties	*Basic suppositions*			
		Relegated Sustainability (RS)	Sustainability Reforms (SR)	Unsustainability and Increased Conflicts (UIC)	Transition to Sustainability (TS)
Institutional and socio-political frameworks	*What is the level and what is the nature of the partnerships established with the different stakeholders in the countries (governments, private sector and other civil society organizations)?*	Great dynamism of inter-company partnerships and the links between governments and the private sector, especially on Research and Development, as well as commercial activities.	High. Similar to the RS scenario, but with more links between governments and the private sector about social goals and environmental quality.	Low, in a general sense, although elite power partnerships are strengthened (governments, large transnational enterprises and military and paramilitary forces).	High, as a reflection of a greater integration of efforts between the different stakeholders in the economic, social and environmental spheres.
	What is the level and what is the nature of partnerships between countries?	High between countries that have signed free trade agreements.	High, because of more dynamism of traditional integration schemes.	Very low, due to the high degree of regional fragmentation.	High, due to the new integration modalities, more equal and that go beyond the economic-trade sphere and develop social and environmental cooperation.
	What is the level and what is the nature of public participation in management?	Low, because of galloping deregulation.	Medium, above all fixing certain environmental quality and equity goals.	Minimum, given the predominance of the transnational private sector and large national capital.	High, based on agreement and participation.
	What is the power relationship between the government, the private sector and civil society?	More private.	More government presence than in RS.	More private (especially transnational).	More balanced.
	What is the level and what is the sectorial distribution of government investments?	Low, in relation to private investments. Military costs increase.	Medium, with greater emphasis on the health, education and reduction of pollution sectors.	Minimum, with greater emphasis on military spending.	High, with greater emphasis on integrating economic, social and environmental investments.
	What degree of integration is there between economic, social and environmental policies?	Low.	Medium. More integration of policies linked to certain social and environmental goals.	Very low. Very disjointed policies.	Very high.
Population trends	*What is the population dynamics?*	Population growth slows and the population ages. Family planning is conditioned by economic pressures and the high cost of living.	Population growth slows and the population ages. Family planning is conditioned by economic pressures and related policies.	Greater growth of vulnerable populations. Mortality tends to increase due to epidemic diseases.	Population grows more slowly than in the other scenarios. Family planning for better well-being.
	What is the basic urbanization characteristic?	Uncontrolled expansion, above all in megacity suburbs.	Grows, above all in medium cities and in suburban areas, but tends to be less chaotic.	Expansion with tendency towards a slow down.	Continues, especially in medium and small cities.
	What is the fundamental trend of migratory flows to the U.S.A./Europe?	Increased migratory pressures with more restrictions on entering destination countries.	There are fewer migratory pressures.	Substantial increase of migratory pressures, with very strong destination countries' restrictions.	Migratory pressures substantially reduced.

Basic Ideas Behind the Hypothesis *(continued)*

Dimen-sions	Key Critical Uncertainties	*Basic suppositions*			
		Relegated Sustainability (RS)	Sustainability Reforms (SR)	Unsustainability and Increased Conflicts (UIC)	Transition to Sustainability (TS)
Economy and markets	*What is the degree of market opening?*	High degree of unilateral trade opening in the Region with respect to developed countries.	High degree of trade opening, with the inclusion of some fair trade elements.	Predominance of trade protectionism and economic fragmentation.	Fair trade principles predominate.
	How does sectorial specialization behave compared to diversification of the economy?	Specialization predominates in export sectors and niches.	Sectorial specialization, but policies are promoted towards more economic diversification.	Economic diversification deriving from socioeconomic fragmentation.	Economic diversification deriving from more balanced socioeconomic policies.
	What are the dynamics of the informal economy?	Grows.	Tends to reduce the informal economy as socio-environmental reforms advance.	Grows substantially.	Notable reduction.
	What are the priorities and the degree of government intervention in the economy?	Low intervention Priority given to economic efficiency.	Medium. Selective Intervention actions are produced.	Minimum intervention, given the predominance of the transnational private sector.	Medium, but more effective than in other scenarios as to integrating economic objectives with social and environmental objectives.
Science and technology	*What are the Research and Development levels, sources and priorities?*	High level, with extensive private financing and designed for profit making.	High level, with more government financing than in RS, favouring socio-environmental investments.	Limited and concentrated in segments of interest to the power elites (some government and transnational sectors), such as security.	High, coming from diverse sources and with a more balanced sectorial direction. Cleaner production developed.
	What are the priorities of energy technologies?	Fossil fuels and biofuels (with an unsustainable approach).	Practices, although limited, are introduced to promote energy sustainability.	Fossil fuels and biofuels (with unsustainable approach). Priority given to supplying the power elites.	Predominance of policies directed at energy sustainability that favour equity and environmental quality.
	What are the trends of technology transfer?	Elevated among transnationalized segments. Growing restrictions in the broadest sense.	High between transnational segments. Certain actions that favour transference in prioritized areas.	Restricted.	Elevated.
	How does the relationship between homogenization and cultural diversity perform?	Predominance of homogenization, as a market function.	Cultural homogenization predominates, as a market function. Some policies favour diversity.	Diversity, as a function of socioeconomic fragmentation.	Predominance of cultural diversity.
Values system	*How does the relationship between individualism and collectivity/ community perform?*	Predominance of individualism.	Although individualism still predominates, some policies boost community values.	Predominance of individualism, but collectivity prevails in some vulnerable communities.	Community values predominate.
	What are the protected areas policies?	Economic interests limit broadening these areas and there is no guarantee areas already existing will be sustainably managed.	Protected areas are expanded, but sustainable management is still not assured.	Protection of some areas of interest to the elites (forests, genetic resources, beaches, etc.)	Significant advances in sustainable management of these areas.

Source: Prepared by the authors, taking as a reference the contents of table 9.1, from: UNEP, GEO-4 Global Environment Outlook. Environment for Development, 2007, p. 403-404.

TABLE 4.4

Transversal Themes in Regional Scenarios

Transversal themes	Relegated Sustainability (RS)	Sustainability Reforms (SR)	Unustainability and Increased Coflicts (UIC)	Transition to Sustainability (TS)
Economic Dimension				
● Energy sustainability	- -	+	- - -	++
● Regional integration	- -	+	- - -	++
● External debt	++	++	+++	+
Social Dimension				
● Equity	- -	+	- - -	++
● Poverty	++	-	+++	- -
● Food security	- -	+	- - -	++
● Deregulated urbanization	+++	-	++	- - -
● Migratory pressures for socioeconomic reasons	++	-	+++	- - -
Environmental Dimension (Challenges)				
● Land degradation	++	+	+++	-
● Limited access to water (quantity and quality)	++	+	+++	-
● Vulneratility to climate change	+++	++	+++	- -
● Habitat loss and fragmentation	+++	+	++	- -
● Coastal degradation and pollution	+++	+	++	-
● Air pollution	++	-	+++	- - -

Source: Prepared by the authors.
Note: +++: Significant increase; ++: Medium increase; +: Small increase
- - - : Signifficant reduction; - - : Medium reduction; - : Small reduction.

3. Four Futures

It must be emphasized that all the quantitative information needed to prove the consequences of different combinations of driving forces synthesized in the scenarios is not always available. That is why an attempt has been made with analytical and qualitative arguments to complement, as far as possible, the statistics provided by the models used. Even so, this assessment of the implications of the four plausible futures is far from being a final result.

It is worth noting that the implications of the four basic scenarios are not limited to the Region since, because of its economic, social and environmental weight at global level, they also have repercussions on other regions and globally.

3.1. Relegated Sustainability (RS)

3.1.1 Economic dimension

Privatization and market deregulation continue as this scenario's principal driving forces. When it is a matter of reducing consumption of raw materials by product unit the effects of a dematerialized economy are to a great extent compensated by increased economic activity. The trend is towards dynamic GDP growth but signs of fragility and volatility persist as a backdrop. In effect, the quality of economic growth tends to be compromised by worsening social and environmental conditions.

The Region's economic structure is maintained without drastic changes compared to 2000 and it continues to be highly dependent on primary products and on industries that specialize in extracting and exporting natural resources (fundamentally in South America), and on the maquilas or off-shore manufacturing assembly plants (especially in Mesoamerica and some Caribbean countries).

Tourism continues to increase in the Region in the first twenty years of the 2000-2050 period, principally in the Caribbean basin. After 2020 this sector begins to suffer from the accumulated impact of worsening environmental conditions.

There is a dynamic increase in flows of remittances, possibly exceeding Official Development Assistance

(ODA) and direct foreign investment, especially in Mesoamerica and Caribbean countries.

The regional foreign debt remains high and debt amortization and interest payments reduce even further the availability of resources to finance sustainable development policies. Argentina, Brazil and Mexico account for close to two-thirds of the Region's total debt. The debt is also high in Mesoamerica and the Caribbean due to climate change impacts including increased intensity of extreme events, pests, and others.

Deregulation, speculation and consequent market volatility increase the Region's economic vulnerability. In these conditions recurrent episodes of economic crises become increasingly devastating, as happened in Mexico (1995), Southeast Asia (1997), Brazil (1999), Argentina (2001), and in the United States (2008). Events similar to the financial crisis triggered in the United States in September 2008 as a result of the growing deregulation of finances, have a contagious effect on the world economy and once again highlight the vulnerabilities of Latin America and the Caribbean to economic crises originating both within and outside the Region.

The advance of trade liberalization is seen in different commercial treaties and agreements including free trade agreements (FTA) with developed countries. These agreements tend to compromise economic integration efforts in traditional plans that become badly eroded.

More foreign technology penetrates through imports and direct foreign investment while there is less research and innovation capacity in Latin American and Caribbean countries. Intellectual property associated with genetic resources and indigenous people's traditional knowledge is included in the market economy under conditions favourable to transnational companies.

In the energy sector, the threat of exhausting the reserves of best-quality petroleum and the high prices of hydrocarbons favour the large-scale promotion of biofuels produced from raw materials such as maize, sugar cane, oil palm, soybeans, and others. It is in the interest of transnational corporations to rapidly exploit these types of biofuels as they try to obtain massive amounts of this energy source, even at the cost of social goals (for example, food security[2]) and environmental goals (for example, the health of ecosystems[3]) causing, among other consequences, serious adverse effects on subsistence agriculture.

No substantial advances have been made in the Region at industrial-scale production of second-generation biofuels, but their boom in industrialized countries – especially after 2020 – affects Latin American and Caribbean exporters of first-generation fuels.

3.1.2 Socio-political dimension

Because of certain assistentialist policies applied by various governments in response to worsening social disturbances poverty shows a marked increase until 2030-2035, followed by a moderate reduction until the middle of the century. There is more inequality in income distribution and the purchasing power of most of the population remains very low. Compliance with the *Millennium Development Goals* becomes less likely.

Privatization of social services shows a sustained increase until 2025. The market introduces innovative mechanisms on health and education although they are not within reach of people with low incomes. Public social security tends to disappear and is privatized. There is less respect for human and labour rights. The

2 Food prices tend to increase as agricultural products (e.g. cereals and other foods) are used as raw materials to obtain biofuels at large-scale.

3 Among other adverse environmental consequences there is a tendency to overexploit fresh water resources, there is more soil deterioration and biological diversity losses increase.

use of information and communications technologies makes it easy to interfere with, and violate citizens' privacy.

A lower birth rate slows the population increase while the population continues to age. Family planning is conditioned by economic pressures and the high cost of living. Urban expansion, basically in megacity suburbs, is uncontrolled.

Migratory pressures (within the Region and towards developed countries in North America and Europe) increases due to worsening social conditions, but with different sub-regional patterns. The United States-Mexico border becomes an increasingly sensitive area, considering the restrictions imposed by the border wall built by the United States. Some migrations in South America take place within the same sub-region. In the Caribbean islands, the Common Market allows people to move between them.

Growing corruption, institutional weaknesses and the lack of financial resources have a negative impact on governments' capacity to apply sustainable policies. The lack of financial resources by governments is often intensified because they are unable to make efficient use of their resources, while the low taxes paid by transnational corporations and other large economic groups, continues to be a serious impediment to implementing social and environmental policies.

3.1.3 Environmental dimension

Everything becomes merchandise including, among other, resources such as water, biological diversity, culture, environmental services. Environmental degradation and pressures on natural resources continue to grow as a result of increased environmental externalities.

Soil degradation continues because croplands (including large-scale production of agricultural raw materials to obtain liquid biofuels) and grassland areas expand. Combined with multiple other pressures, this affects biological diversity. Deforestation, in particular of native forests, increases and causes more biodiversity loss and habitat fragmentation. Unsustainable and uncontrolled use of soil and biological diversity causes the deterioration, in many cases irreversible, of the goods and services they provide for human beings.

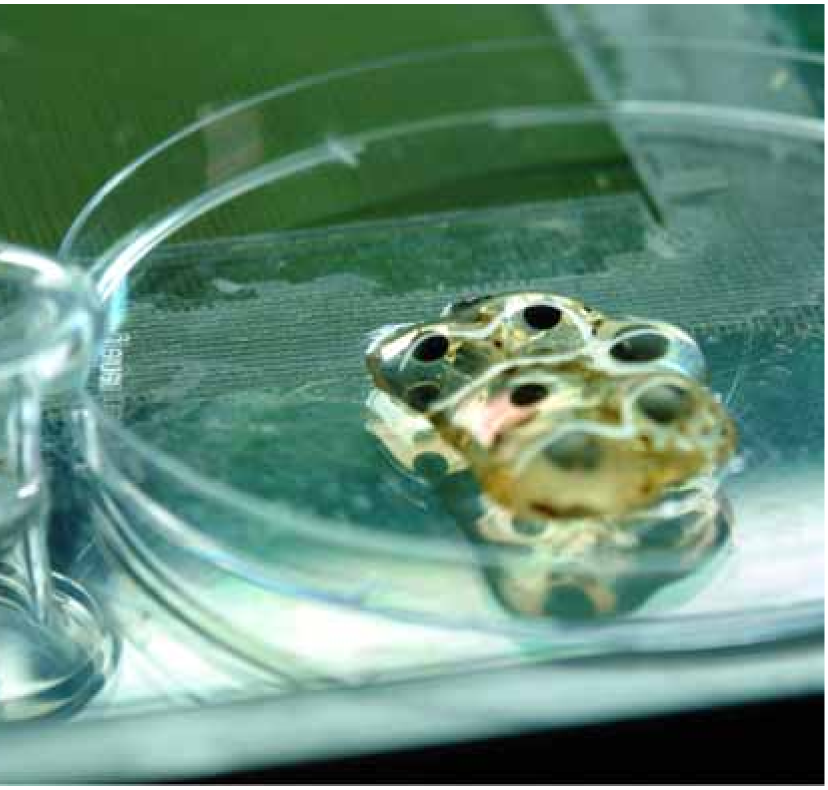
There is more chemical pollution and, as a consequence of uncontrolled urbanization and policies that encourage consumption, waste production per inhabitant increases.

Air pollution increases although in some critical areas such as Mexico City, Santiago, and Sao Paulo, many market standards and mechanisms are designed to reduce it.

Growing coastal areas urbanization increases coastal degradation and pollution. Tourism also has a greater impact on ecological systems. There is more environmental deterioration in marine ecosystems and water basins.

There is a decrease in the quality and quantity of surface and ground waters and this tends to worsen with marine pollution and sea intrusion caused by climate change, while economic growth brings an increased demand for water and puts growing pressures on water resources, including social and regional conflicts.

There is more vulnerability to climate change and a very limited response capacity, particularly in the Small Island States of the Caribbean, and low coastal areas of Central and South America. Some extreme phenomena such as hurricanes tend to be more intense and devastating. As climate change has an impact on infrastructure, food security and the insurance sector, forecasts and perceptions of climate influences are changing.



3.2. Sustainability Reforms (SR)

3.2.1 Economic dimension

From the beginning of the 21st century new policies and regulations are introduced to partially mitigate the adverse impacts of more than two decades when policies predominated that gave preference to expanding unregulated markets.

More money is available for budgets as a result of a differentiated and more effective tax collection system, and small businesses are treated favourably by being given government financial support. Keynesian type fiscal policies are introduced to alleviate the most serious social and environmental problems; however, due to the market approach still predominating in this scenario, and the adverse effects of the foreign debt in many countries, making an advance in this direction faces persistent tensions and limitations.

There is a gradual change in the regional economic structure towards productions with more added value and service activities. Economic growth is dynamic and policies are implemented to encourage more social and environmental sustainability that have a positive –though still limited– impact on the quality of longer-term growth because they encourage more education and work force training; there is also compliance with some environmental goals.

There is a considerable increase in tourism and, although *sun and beach tourism* predominates, some environmentally less aggressive tourism models are promoted such as *health tourism, events tourism*, and others. Conflicts persist between tourism and other economic activities, such as fishing. Efforts to regulate Caribbean tourism are stifled because of the cost of growing competition between island states. The development of *cruise* tourism also hinders regulating efforts.

Global financial trends continue to affect economic, social and environmental development in the Region. A mixed panorama is outlined in relation to the foreign debt that continues to be a serious obstacle to economic growth, mainly in the poorest countries; given that payments to service the debt (amortizations and interests) considerably limit financing of social and environmental policies.

More jobs are available for those with scientific and technological capacities and institutions in these fields are strengthened. In seeking new sources of income, governments begin to recognize the role of applied research. As a consequence, local and regional research and development capacities improve, as does the transfer of technology within sub-regions; however, having equal access to technology continues to be a serious challenge. Decision-makers demand more scientific information. Some regional and national institutions promote the transfer of advanced technology and reduce the brain drain.

Regional integration is revitalized by different agreements and organizations such as the South American Common Market (MERCOSUR), the Central American Integration System (SICA) the Andean Community of Nations (CAN), the Union of South American Nations (UNASUR), the Association of Caribbean States (AEC), the Caribbean Community (CARICOM), the Amazon Cooperation Treaty Organization (OTCA) and the Bolivarian Alternative for the Americas (ALBA), including new agreements between existing integrationist schemes, and others.

Prices of energy resources remain high, but regional initiatives are promoted on energy cooperation, connection and integration including the transfer of technologies to promote saving energy and renewable resources, with the active participation of some countries in the Region that produce hydrocarbons such as Venezuela, Brazil, Ecuador, Trinidad and Tobago, and Bolivia.

3.2.2 Socio-political dimension

There is less disparity between countries in terms of socioeconomic development and per capita income compared to the beginning of the 21st century. This is due to the countries' better income distribution policies and more social spending in most of the Region.

An advance is made in applying policies designed to achieve the *Millennium Development Goals* (MDG) concerning health, education and poverty alleviation. By using income distribution policies poverty reduction becomes an achievable objective. However, a reduction by half the percentage of people who live in extreme poverty –considered as a principal MDG with effects on the dynamics of the other goals– will only be achieved after 2020.

Social security cover improves but gaps remain, especially in the informal sector. There is less discrimination against women, a trend is seen to include ethnic and socially marginalized groups, and advances are made on human rights. Although still an important challenge, the quality of water and sanitation services improves.

Population growth slows as family planning is conditioned by a combination of relevant economic pressures and policies. Urbanization continues, above all in medium size cities and in suburban areas, but it tends to be less chaotic. Policies are introduced to confront the population's progressive ageing but problems persist, such as the lack of an effective pensions system.

As social and economic tensions lessen, migratory pressures are reduced. This is helped by adopting better policies on the environment and income redistribution. Nevertheless, there is continued migration due to the occurrence of extreme climate events.

The Region's institutional capacity is strengthened and this is translated into significant advances in implementing transparent public policies and a considerable increase in coordination between national and local governments. Advances are made on decentralization within a framework of more national and regional integration. Encouragement is given to establishing networks of social organizations.

Administrative structures are developed on the principle of efficient public policy implementation. Governments play a more active role in applying development policies that satisfy the needs of the majorities. Democracy is promoted through a variety of participation channels at different levels; there is also less corruption.

Culture is recognized not only for its commercial values but also for its social values. The "national identity" notion is strengthened with social policies that take account cultural and ethnic aspects, and regional cultures are empowered.

3.2.3 Environmental dimension

Governments and societies are more aware of the urgency of environmental problems, and of the need to implement effective and fair social and environmental policies. Environmental protection is considered as one of the priority themes in government programmes, to improve equality by recognising its link to such themes as access to energy, potable water and quality of life. Advances are made in environmental education.

Although from an integration perspective environmental sustainability is an objective, it fails to be a priority and, therefore, **there is no holistic approach to environmental policy objectives that take account of productive systems' complete life cycles.**

Therefore, policies concerning environmental problems are still geared towards isolated actions when faced with such externalities as the reaction to public pressure, rather than being the result of integrated strategic planning.

To ensure more access to international markets and as part of the efforts to meet certain international environmental quality goals, more use is made of ISO standards, voluntary regulations and certification systems.

There is more application of economic and regulatory instruments to control pollution and manage solid wastes, mainly in areas with low environmental standards. As a consequence, in prioritized urban areas considerable reductions are made in air and water pollution; however, problems persist concerning sustainable management of natural resources.

The application of better regulations and compliance mechanisms brings a moderate reduction of soil degradation, deforestation and habitat fragmentation. Even so, biological diversity continues to decline, mainly as a result of climate change and continued agricultural and livestock expansion.

Regional negotiating initiatives emerge to solve conflicts about shared water basins, particularly in South America. The population's improved quality of life is accompanied by a substantial expansion of water services to residential and commercial sectors.

Expanding production by the agricultural and industrial sectors also leads to an increased demand for water which, to a large extent, is compensated by investments in new water-saving technologies; the result is a considerable increase in efficiency of use, mainly in agriculture.

In spite of the great efforts made to protect aquatic ecosystems, a large amount of untreated sewage is discharged into surface waters and, in many zones, causes water quality to deteriorate.

Stimulating renewable energy sources tends to reduce the Region's vulnerability to the volatility of energy prices but at the same time less use is made of fossil fuels. Some controls are placed on the development of liquid biofuels produced from food biomass and other agricultural raw materials, in order to reduce adverse social and environmental impacts, but non-governmental organizations and social movements remain on the alert about this energy source option.

Research and Development on advanced technologies on the use of different forms of biotechnologies is stimulated by some governments in the Region, especially in countries with the greatest technological potentialities, but so far no significant advances have been made on industrial-scale production of second-generation biofuels.

There is more awareness of the impacts of climate change and, therefore, governments make greater efforts to increase adaptation capacity.

Coastal areas continue to be developed for tourism purposes; this results in new urbanizations, more degradation of the coasts and a growing vulnerability of populations to the impacts of climate change, especially in the Caribbean and Mesoamerica. Nevertheless, some steps are being taken to help adapting to climate change and to protect mangroves in vulnerable zones.

Climate change adaptation technologies are promoted in high priority areas. Outstanding among them are information technologies on: regional, national and local climate monitoring; energy; water management and alternative agriculture technologies; and cleaner production technologies. In addition, new regulations are introduced on the use of biotechnology.

3.3 Unsustainability and Increased Conflicts (UIC)

3.3.1 Economic dimension

This is a regional context marked by socioeconomic and political fragmentation. In the predominant development style the market is given priority and social and environmental problems are exacerbated. It is a highly polarized context in which governments, local elites and corporations exercise a monopolistic control of the market and decide prices. Raw materials production continues to be the Region's most important economic sector, especially in South America, and an accelerated rise in the foreign debt has a contractive impact on fiscal policies.

The Region suffers a sharp loss of GDP dynamism in very fragile and volatile conditions and with growing socio-political disturbances. The informal economy also shows a dramatic increase, especially in Mesoamerica and in some Andean countries.

There is considerable weakening of basic and applied research and it is concentrated in the same areas to which the elites give priority. Scientific research takes place within corporations and in some specialized centres in wealthy countries. More conflicts arise concerning intellectual property rights.

The intensive use of fossil resources by the energy sector, the trend towards exhausting supplies of the best quality petroleum, and more tensions and growing conflicts for control of the remaining hydrocarbon reserves, all encourage the promotion of large-scale biofuels production in the interests of transnational corporations and local elites.

3.3.2 Socio-political dimension

Violence becomes endemic and is fed and exacerbated by a considerable increase in regional, ethnic and religious conflicts. Government and corporate elites feel their interests are threatened and, to preserve their privileges, establish strong partnerships among themselves and with military forces. As security conditions worsen there is a proliferation of control mechanisms based on repression with military and police technologies being developed and perfected.

Much socioeconomic fragmentation takes place and "islands of wealth" appear surrounded by a "sea of poverty". There is a sharp rise in poverty and disparities and, consequently, compliance with the *Millennium Development Goals* is less likely.

There is a dynamic growth in population growth towards the middle of the 21st century, above all in the poorest areas, but a drastic slowdown of growth is expected in the post-2050 period; it is even possible there will be an absolute reduction in population because of the trend for mortality to rise as health indicators rapidly deteriorate and epidemics proliferate,

In border areas, for example, between the United States and Mexico, there is a sharp increase in migratory pressures. Legislation on migration becomes more restrictive; however, the elites continue to be very mobile and agreements are promoted to facilitate the flow of workers when they are needed.

Institutions are weakened and it is more difficult to implement coherent policies. Politicians become more involved in business and that determines an increase in nepotism, corruption and clientism.

The elites, who tend to concentrate in isolated and protected urban settlements, encourage a culture based on increasing consumption. How to survive is a matter of crucial importance for poor sectors of the population and this leads to a resurgence of religious beliefs.

Subcultures are created, especially among excluded members of society, and family and community values are strengthened within these subgroups. Social mobility is very limited.

3.3.3 Environmental dimension

No concern is shown about environmental sustainability because the elites do not consider it to be a priority while the excluded sectors face other more pressing anxieties, such as how to survive. The power elites and large corporations control and appropriate natural resources and there is no compliance with many international agreements on the environment.

Environmental degradation worsens. However, because they are of interest to the elites and transnational corporations, natural resources such as key forest areas in South America and Mesoamerica and the abundant water resources of the Southern Cone are preserved. Deforestation increases outside the protected areas and there is an accelerated loss of habitats and disappearance of species.

In these conditions the massive production of biofuel in the interests of the large transnational corporations and the local elites causes serious impacts, both social (for example, a worsening food crisis) and environmental (for example, fragile ecosystems' serious health problems) due to the use of unsustainable formulas of biofuels production and utilization. This fever for biofuels encourages the use of genetically modified organisms, and invasive high-productivity plant species are introduced that have serious adverse socio-environmental effects.

There are more frequent and intense extreme events and soil degradation intensifies in numerous areas. Although some coastal enclaves are preserved, in general coastal degradation increases and there is a notable reduction in the services those ecosystems provide.

Surface and ground water pollution worsens because of a lack of compliance with national regulations. There is less rainfall in arid and semiarid areas and this, together with increased water consumption, puts pressure on water resources availability, particularly in these areas. There is a notable increase in the number of people living in water basins suffering from a severe shortage of water, and in the volume of sewage discharged into rivers.

3.4. Transition to Sustainability (TS)

3.4.1 Economic dimension

Advances are made to achieve a dematerialized economy, and per capita GDP shows dynamic and sustained growth; this is caused by the positive impact of social and environmental investments on economic growth combined with a slowdown in population growth.

In the agricultural sector priority is given to assessing land potential and planning land use in ecosystems. The sustainable approach to agriculture becomes generalized. Agricultural development is not governed by market forces, but by a more integrated approach that considers priorities to be food security and reducing externalities by such means as encouraging organic agriculture and introducing appropriate crops. This development model allows rural and urban life to coexist. Action on development priorities and associated decisions is based on planning.

Less environmentally aggressive tourist modalities are developed, particularly in the Caribbean. Global and local tourism continues to grow but the tourist market is

more diversified and without the concentration and excessive number of tourists in a few destinations as occurred at the beginning of the 21st century. Consumers' preferences change towards more small-scale tourism meaning that this activity exerts less pressure on coastal areas.

Progress in achieving greater socioeconomic integration is particularly vigorous in key areas of the energy sector and is based on new regional and sub-regional efforts similar to the Petrocaribe initiative; these efforts include joint projects to promote renewable sources.

In general, there is substantial investment to develop alternative energy sources and improve energy efficiency; there are also fewer social conflicts due to rising energy prices.

Production of biofuels is governed by a precautionary approach and ethical criteria and in some countries, for example Brazil, careful consideration is given to its social and environmental implications. Some countries in the area promote Research and Development of advanced technologies on the use of bioenergy in its different forms; but industrial-scale production of second-generation biofuels is still limited in the Region.

Better advantage is taken of the results of science and technology to be used in priority areas. Governments, still facing pressure from certain socioeconomic challenges, give priority to applied research to discover new income sources.

More weight is given to the role of science in supporting sustainable development decision making, and significant advances are seen in adopting policies based on scientific development. Nevertheless, the Region continues to depend to a great extent the on the support of technologies from the North.

Fair technology transfer treatment is promoted. Depending on local and regional needs, priority is given to innovation by using appropriate technologies and, with the backing of scientific research, development niches are identified. Horizontal cooperation on science and technology is strengthened, a process in which several countries, such as Brazil, Mexico and Venezuela, play a key role.

Research and Development priority areas adapt to the impact of climate change (extreme events, rising sea level) and technologies are generated on mitigation, access to information, communication, new materials, biotechnology, energy, water, alternative agriculture, human and environmental health, cleaner technologies (cleaner production, reducing pollution and waste, among others) and nanotechnology. Encouragement is also given to developing new integrated planning methodologies, integrated assessment of natural resources and ecosystems, and social research.

Increased military costs are discouraged to free additional resources for social and environmental investments. As socioeconomic conditions improve in most countries in the area, the foreign debt becomes manageable, that is to say, it represents a very low proportion of the GDP and income from exports, and this helps to finance sustainable development investments.

3.4.2 Socio-political dimension

More emphasis is placed on human development. There is more satisfaction of elemental necessities without jeopardizing natural resources conservation. A notable advance is made in applying policies designed to achieve the *Millennium Development Goals* (MDG) on health, education, poverty relief, and to promote gender equality.

Education, family planning, information dissemination, and health services are strenghtened in Latin America and Caribbean countries that maintain high rates of demographic growth at the beginning of the 21st century. In turn, this lessens the socioeconomic gap between these countries and the rest of the Region as 2050 approaches.

There are still geographic differences in production and commercial activities, with lower levels of per capita income in Central America and the Andean region. However, income redistribution policies are introduced and there is a marked increase in social spending.

Equity in income distribution is at its highest ever, and contributing to this trend is the application of a differentiated and fairer tax collection system. There is a significant reduction of the informal sector, and mechanisms are applied to guarantee equity in land distribution and use.

Poverty reduction is significant but, as a regional average, the reduction by half the number of people who live in extreme poverty is only achieved around 2018, so that the first MDG is not met and this, in turn, influences the behaviour and dynamics of the other goals.

There are more guarantees about respecting human rights, and women are increasingly more integrated into economic, social and political processes.

Demographic growth slows, family planning accounts for people's well-being and fewer migratory pressures are felt. The size of the average family is stabilized at a level that tends to counteract the accelerated ageing of the population. Migration is an option rather than a necessity. Countries in the Region have fewer barriers against those who want to move across their borders.

Urbanization continues, mostly in cities of small and medium size, and urban policies are diversified. Long-term planning is taken into account when cities are developed.

There is a more balanced decision making structure and political parties tend to be more representative of social interests, thus favouring democracy and revitalizing citizen participation channels. There is more coordination between national and local governments; in addition, local authorities have more prerogatives and receive resources in consonance with their responsibilities.

Regional organizations –political as well as economic and cultural– are restructured and revitalized. There is an increase in access to, and transparency of, public information. In the political life, the formulation of environmental policies includes representation from civil organizations.

3.4.3 Environmental dimension

Significant advances are seen in solving environmental problems. A dynamic point of equilibrium is achieved in natural resources management. Economic instruments are applied in the Region to guarantee local payment for environmental services (e.g. water), while the international community pays for regional, but globally beneficial, environmental services. More economic instruments are used to control pollution and environmental degradation. Local resources are administered by the respective communities and regional decisions and regulations are adopted to protect goods and services that bring global benefits.

The sustainability component is adopted, generally to design development strategies. To achieve the sustainability of their development models, governments adopt concrete policies to promote applied research; they also put into effect conservation, natural disasters preparation, health monitoring, and early warning systems. More resources are available for sustainable development. Encouragement is given to the use of natural ecosystems instead of technologies developed by humans (e.g. promoting forests instead of water treatment plants) as a sustainable practice that presupposes an important change in socioeconomic thinking.

Notable changes, promoted by awareness campaigns, are seen in consumption patterns based on cultural values.

Although there are still conflicts about the control of strategic natural resources –such as water, oil and biodiversity in border zones– governments are quite capable of preventing and managing such conflicts. Effective mechanisms are devised to guarantee fair and equitable access to shared resources.

Special efforts made to introduce "education related to the water resource" in schools from an early age are successful and lead to a marked change in how the population uses water. Local governments and business groups also launch campaigns to encourage saving water; appropriate technologies are developed for that purpose. Thanks to the combined effect of these efforts, the increase in water consumption is slowed, in spite of the dynamics of economic and population growth.

Mechanisms are applied to recover, rehabilitate and reconstruct degraded ecosystems, especially in mineral-producing countries, for example, Mexico, Venezuela, and Andean countries, or in areas affected by deforestation in Mesoamerica and South America. Agrochemicals are progressively replaced by the use of organic substances and, supported by biotechnological development, more efficient pest and disease controls are applied.

There is a marked improvement in how Region's protected areas system is managed, thus reducing key habitat loss and fragmentation and to a large extent guaranteeing the integration and connectivity of biological corridors, in terrestrial as well as in marine and fresh water ecosystems. A well structured regional network of genetic banks is developed as part of a global network. As a consequence, in a general sense there is less loss of biological diversity, although there is still a notable effect on some species that are highly vulnerable to phenomena such as climate change and agricultural development.

Mechanisms are created to protect the intellectual property of traditional indigenous knowledge and to regulate fair and equitable access to genetic resources, with the crucial participation of some South American countries. Furthermore, the extensive application of the United Nations Convention on Biological Diversity (CBD) leads to a considerable drop in biopiracy.

Countries comply more with international environmental conventions and protocols. Also, local Agenda 21 is applied, both as to commitments and to develop useful compliance statistics, especially about cities, and with general civil society participation.

A regional Agenda 21 is prepared for the "Johannesburg + 20" World Summit (2022) where reference is made to regional priorities in relation to equity, access to energy and sustainable development. This regional programme document is based on the priorities discussed by the Forum of Ministers of the Environment of Latin America and the Caribbean during its 23rd meeting in November 2021.

4. Implications of the Four Futures

The consequences inferred from the four basic scenarios cover both the socioeconomic and environmental areas; that is to say, during the first half of the 21st century they have an impact on the fundamental sustainable development areas.

4.1. Socioeconomic implications of the scenarios

The socioeconomic implications of the four scenarios are shown by analysing the dynamics of a set of basic indicators such as population and how it increases, the extent of urbanization, per capita GDP, government expenditures on fundamental areas of human development such as education and health; disparities and poverty; child malnutrition; military costs; flows of remittances; the demand for energy; and the population affected by water stress.

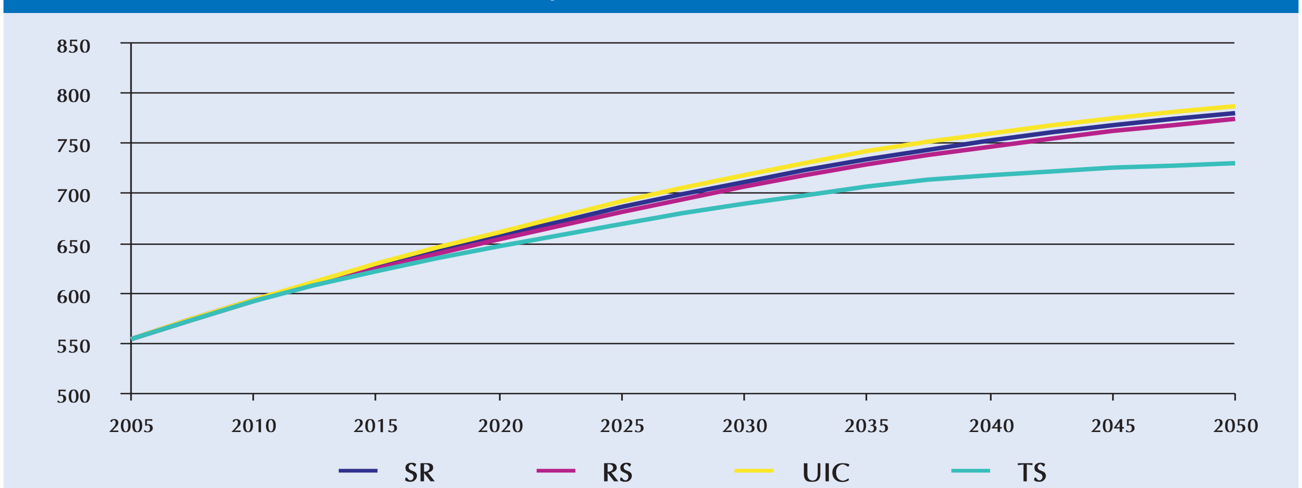
- The ***population*** of Latin America and the Caribbean grows in the four scenarios presented, although the trend is for a slowdown in growth. The largest population, in 2050, is seen in the scenario of *Unsustainability and Increased Conflicts (UIC)*, where the figure of 786 million is reached –an increase of 42 % over 2005– as a consequence of a high birth rate in the poorest population segments.

  The lowest population, towards the end of the period, is registered in the *Transition to Sustainability (TS)* scenario, that is, 7% less than in *UIC*. To a great extent this responds to the impact on the birth rate of investments made in education and diversification of the roles of women in society (see Figure 4.1).

- As to the ***degree of urbanization,*** it should be stressed that in all the scenarios projected for Latin America and the Caribbean population growth is accompanied by a significant urban population increase. As 2050 approaches, the urban population is about 78% of the total population in the *Relegated Sustainability (RS)*, *Sustainability Reforms (SR)* and *Transition to Sustainability (TS)* scenarios, although in each of the three trajectories there are qualitative differences in this process: uncontrolled in *RS*; less chaotic in *SR;* and more balanced in *TS*. In the case of *Unsustainability and Increased Conflicts (UIC)* the figure is 77%; with a striking worsening of socioeconomic and environmental conditions in cities (see Figure 4.2).

FIGURE 4.1

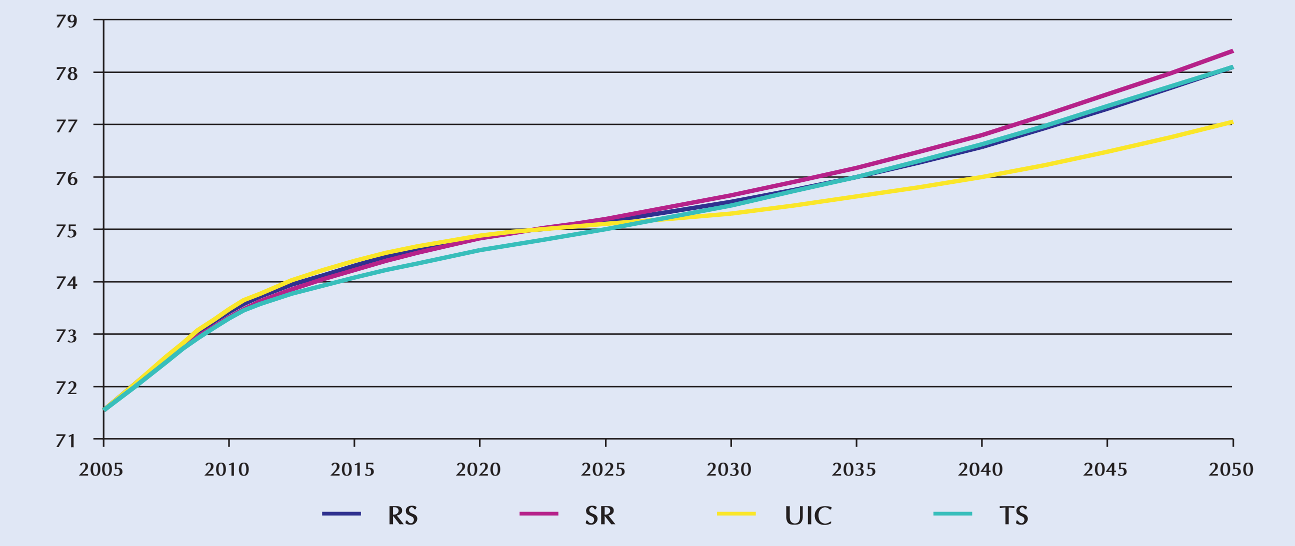
Latin America and the Caribbean: Total Population *(Millions of inhabitants)*



Source: Database GEO4-UNEP (Results produced by International Futures – IFs).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

FIGURE 4.2

Latin America and the Caribbean: Urban Population *(Percentage of total population)*



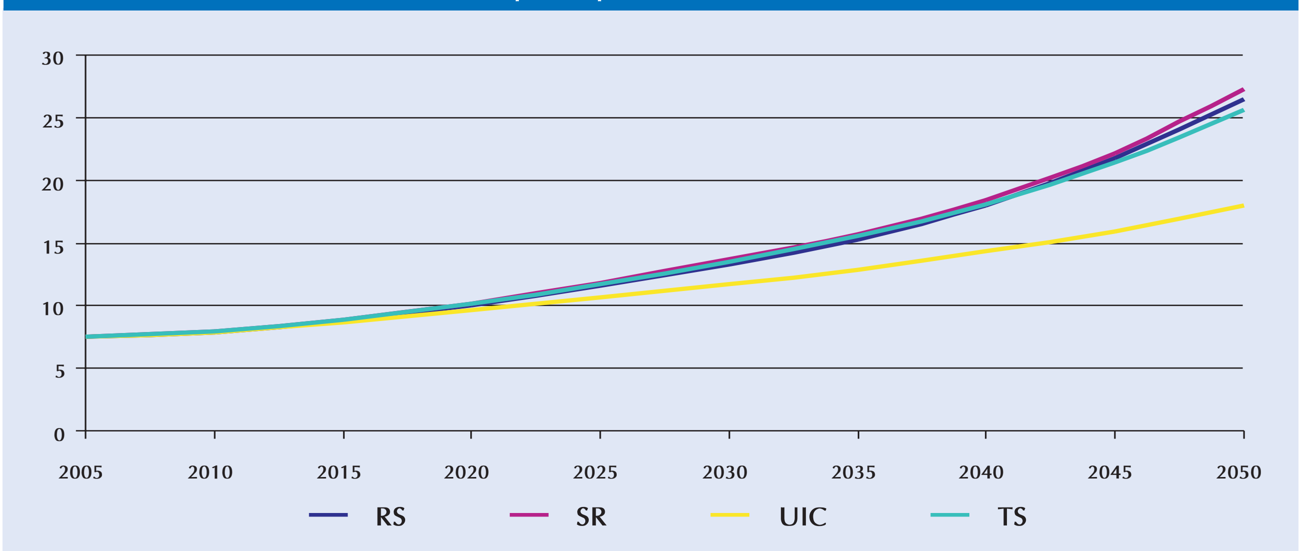
Source: Database GEO4-UNEP (Results produced by International Futures – IFs).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

- As 2050 approaches, the **per capita *GDP*** rises in all the scenarios, more than tripling in relation to 2005 in the *Relegated Sustainability (RS), Sustainability Reforms (SR)* and *Transition to Sustainability (TS)* scenarios. While in *RS* this trend expresses the priority assigned to the still fragile and volatile economic growth, in *SR* –and to a much greater extent in *TS*– the growth of this indicator reflects the positive impact of social and environmental investments on the dynamics of the economy.

The *Unsustainability and Increased Conflicts* (UIC) scenario shows the lowest growth levels, In effect, in this scenario the dynamism of the economy tends to be compromised by the deterioration of the social and environmental indicators, and in view of the possibility of growing social conflicts and disturbances that are often a consequence of this situation (see Figure 4.3).

FIGURE 4.3

Latin America and the Caribbean: GDP per Capita *(Thousands of dollars, 2000)*



Source: Database GEO4-UNEP (Results produced by International Futures – IFs, expressed in dollars PPP, 2000).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

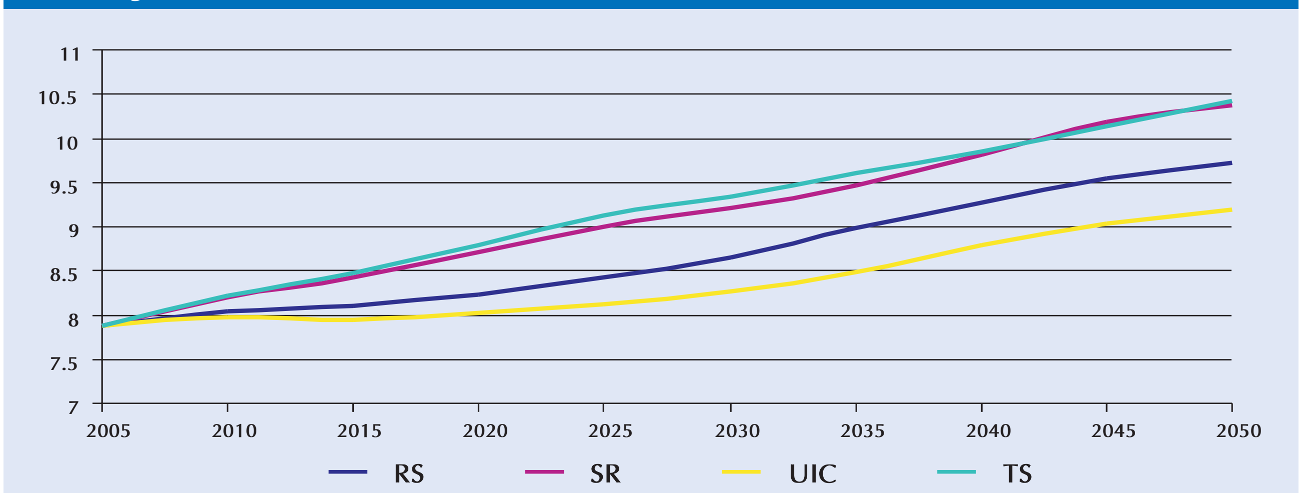
- The ***government costs on health and education*** in Latin America and the Caribbean as a percentage of the GDP continues to grow in the four scenarios presented; however, there is a notable difference in the dynamics in each scenario. The *Transition to Sustainability (TS)* scenario shows more is spent on health and education at the end of the period (10.4% of the GDP in 2050), followed by *Sustainability Reforms (SR)* (10.3%). The *Relegated Sustainability (RS)* and *Unsustainability and Increased Conflicts (UIC)* scenarios show the lowest levels of this indicator for the middle of the 21 century with 9.1% and 9.7% of GDP respectively (see Figure 4.4).

- As 2050 approaches, the regional population living in ***conditions of poverty*** shows the highest levels in *Unsustainability and Increased Conflicts (UIC)* and in *Relegated Sustainability (RS)*. The most rapid growth in poverty up to 2035 is shown in UIC; in *RS* it takes place up to 2030 although it is less dynamic than in UIC. From 2030-2035 the number of poor people is reduced both in *RS* and in *UIC*, although it is most notable in the former. Towards the end of the period, this behaviour is the result of certain actions –particularly assistentialist– taken by various governments to mitigate poverty in view of growing social problems and the potential for new conflicts to arise as result. Even so, the number of poor people in mid-century shown in *UIC* is 10% higher than the 2005 level.

  In *Sustainability Reforms (SR)* and *Transition to Sustainability (TS)* this indicator shows a trend to decline so that the level of poverty in 2050 indicates a drop of 76% in *SR,* and 83% in *TS,* in relation to 2005 (see Figure 4.5).

FIGURE 4.4

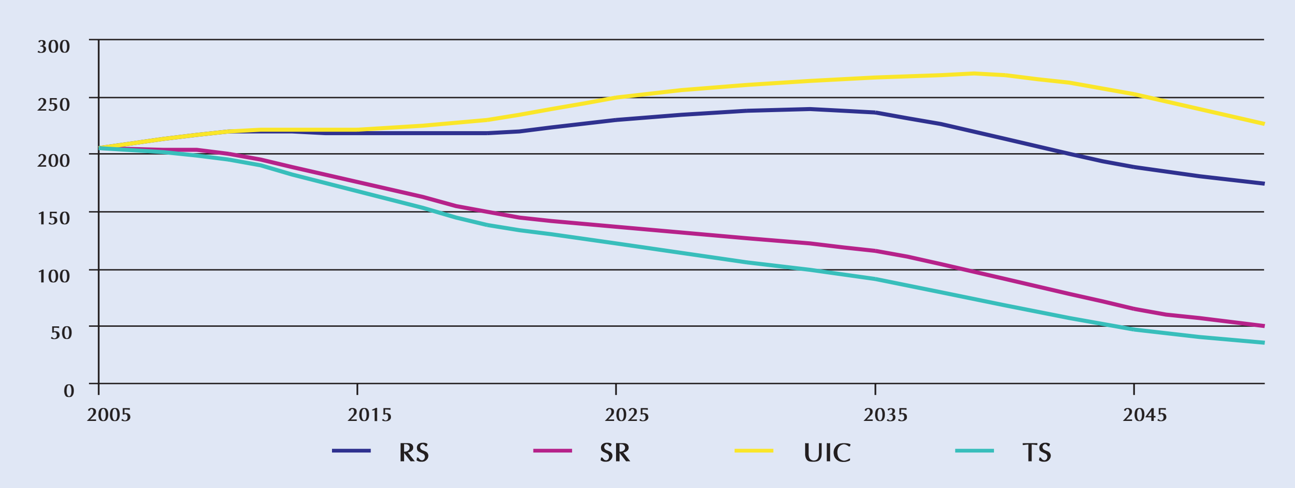
Latin America and the Caribbean: Government Spending on Health and Education
(Percentage of GDP)



Source: Database GEO4-UNEP (Results produced by International Futures – IFs).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

FIGURE 4.5

Latin America and the Caribbean: Population Living in Poverty Conditions
(For18 countries) (Millions of people)



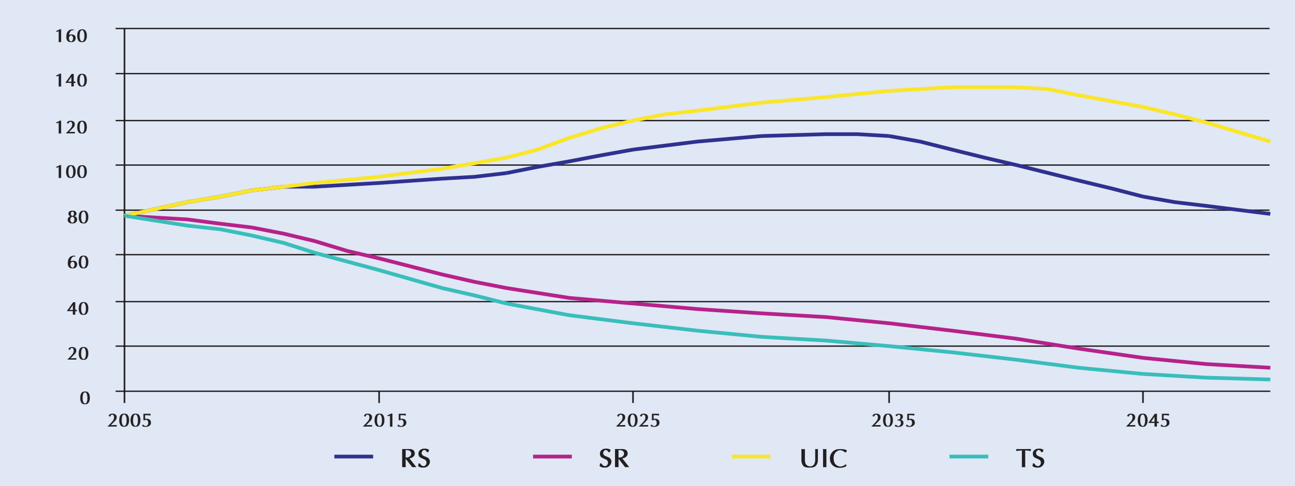
Source: GEO4-UNEP database (Results produced by the GEO-LAC Regional Team from results of International Futures – IFs).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

- For the four scenarios the evolution of the number of people living in ***conditions of extreme poverty*** shows trajectories very similar to those corresponding to the number of poor people in the 2005-2050 period, with more deterioration in *Unsustainability and Increased Conflicts (UIC)* –an increase of 43% in 2050 over 2005– and a very significant improvement in *Transition to Sustainability (TS)* with a 94% contraction in that period (see Figure 4.6).

- ***Equity***, as measured by the Gini coefficient, shows an improvement in *Transition to Sustainability (TS)* as a result of policies designed to favour better income distribution; it remains relatively stable in *Sustainability Reforms (SR);* and worsens in *Relegated Sustainability (RS)* and, more notably, in *Unsustainability and Increased Conflicts (UIC)* due to growing social polarization in this scenario (see Figure 4.7).

FIGURE 4.6

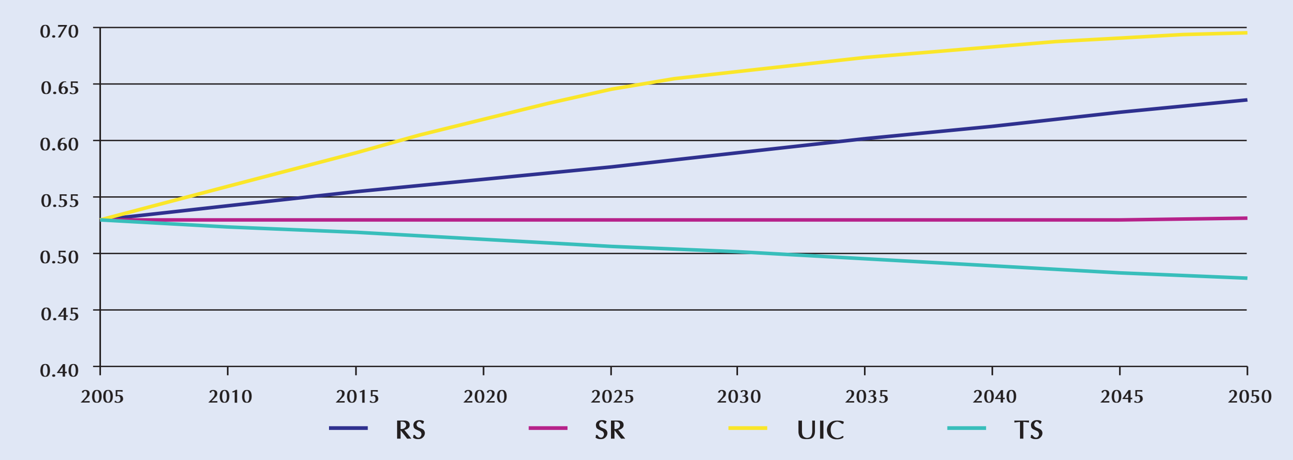
Latin America and the Caribbean: Population Living in Extreme Poverty Conditions
(For 18 countries) (Millions of people)



Source: GEO4-UNEP database (Results produced by the GEO-LAC Regional Team from results of International Futures – IFs).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

FIGURE 4.7

Latin America and the Caribbean: GINI Coefficient
(Weighted average for 18 countries)

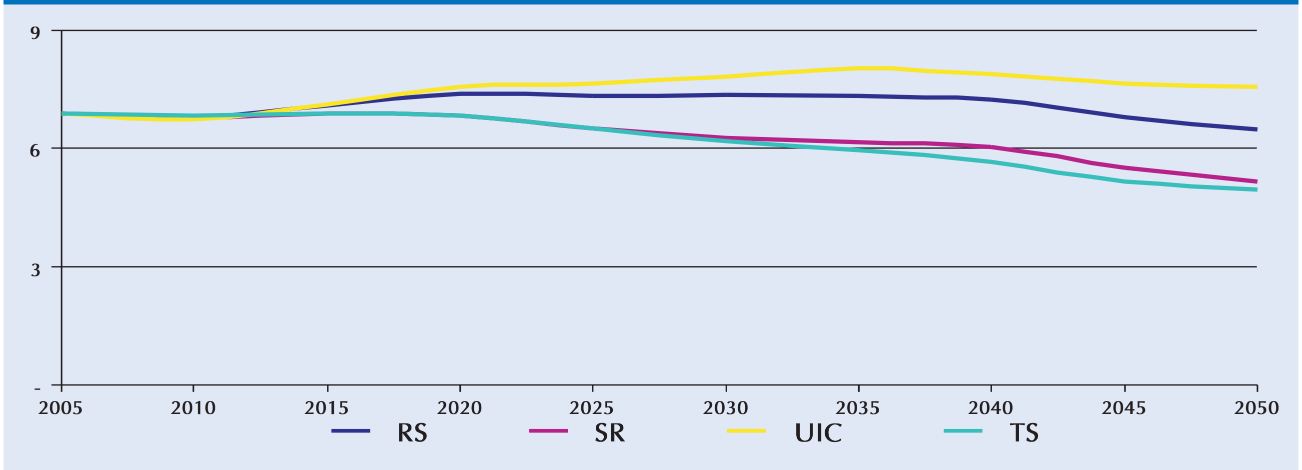


Source: GEO4-UNEP database (Results produced by the GEO-LAC Regional Team from results of International Futures – IFs).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

- ***Child malnutrition*** shows a sharp drop towards 2050 in the *Transition to Sustainability (TS)* and *Sustainability Reforms (SR).* In these scenarios the figures are, respectively, 4.9% and 5.2% of the total number of children in the Region, compared to 6.9% in 2005. The *Unsustainability and Increased Conflicts (UIC)* scenario in particular shows the most unfavourable trajectory of this indicator's behaviour with child poverty at 7.6% at the end of the period examined (see Figure 4.8).

FIGURE 4.8

Latin America and the Caribbean: Child Malnutrition
(Percentage of all children)



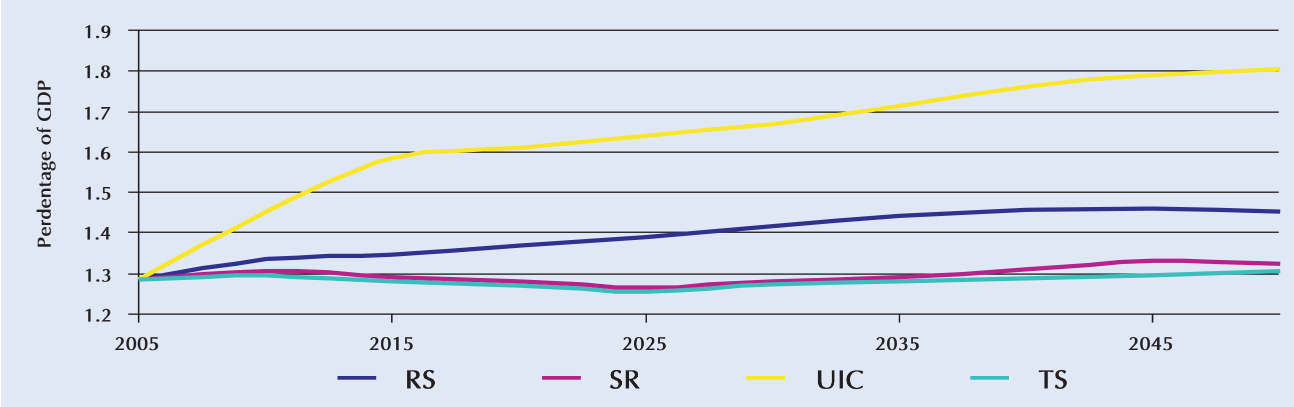
Source: GEO4-UNEP database (Results produced by IMPACT - International Model for Policy Analysis of Agricultural Commodities and Trade).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

- The amount of governments' ***military spending*** as a percentage of GDP remains relatively stable in *Sustainability Reforms (RS)* and *Transition to Sustainability (TS),* because this type of outlay is not promoted in these scenarios. However, the indicator grows in *Relegated Sustainability (RS)* because this instrument is used as a factor to counteract possible economic recessions. In *Unsustainability and Increased Conflicts (UIC)* military spending accelerates because it is a key tool to maintain the power of the elites in this socio-political and economic fragmentation context (see Figure 4.9).

- As 2050 approaches the flow of workers' ***remittances*** to Latin America and the Caribbean is marked by a sustained rise in the four scenarios. In *Relegated Sustainability (SR),* the scenario receiving most of these flows, this indicator increases from US$30 000 million in 2005 to US$112 000 million in mid-century, that is to say, an increase of almost 3.7 times. In the *Unsustainability and Increased Conflicts (UIC)* scenario the fewest remittances are received at the end of the period but, even so, there is a 2.7 times increase (see Figure 4.10).

FIGURE 4.9

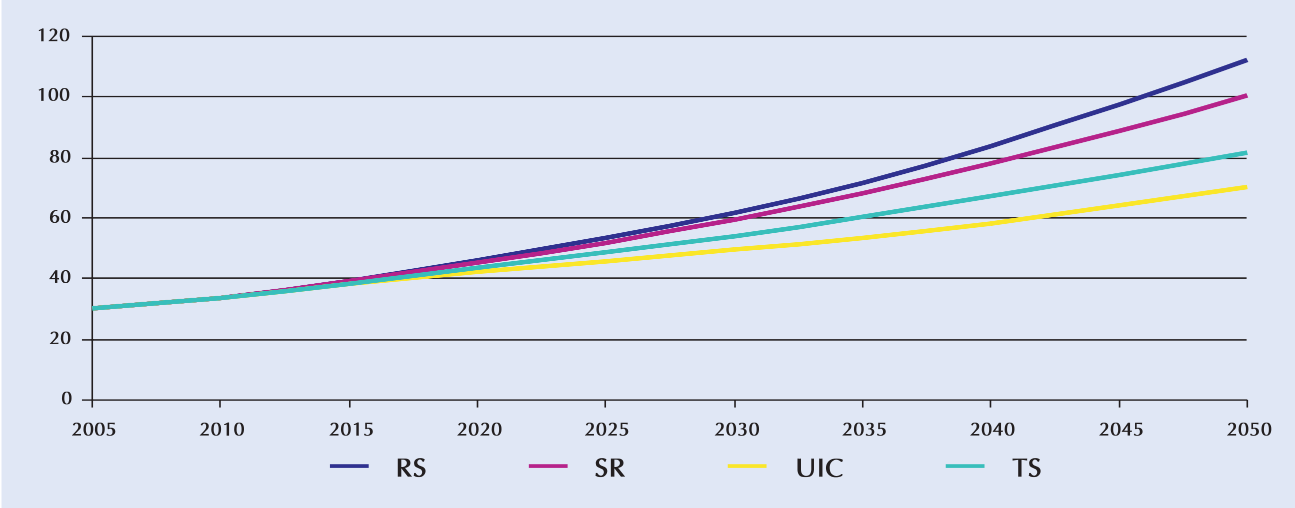
Latin America and the Caribbean: Military Spending by Governments
(Percentage of GDP)



Source: GEO4-UNEP database (Results produced by the GEO-LAC Regional Team from results of International Futures – IFs).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

FIGURE 4.10

Latin America and the Caribbean: Remittances Received, 2000
(Thousands of millions of dollars)



Source: GEO4-UNEP database (Results produced by the GEO-LAC Regional Team from results of International Futures – IFs).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

- ***The regional demand for primary energy*** as a sustainability indicator shows important transformations in the different scenarios around 2050. The highest dynamism of this sector is seen in *Relegated Sustainability (RS),* where the energy demand –after almost doubling between 2000 and 2025– shows a fourfold accumulated increase for the whole period (2000-2050); the proportion of fossil fuels in the energy balance grows from 78% in 2000 to 85% in 2025 and 86% in 2050. At the other extreme is the *Transition to Sustainability (TS)* scenario showing the smallest growth in demand for energy and a reduced demand for fossil fuels from 78% in 2000 to 60% in 2050 (see Figure 4.11).

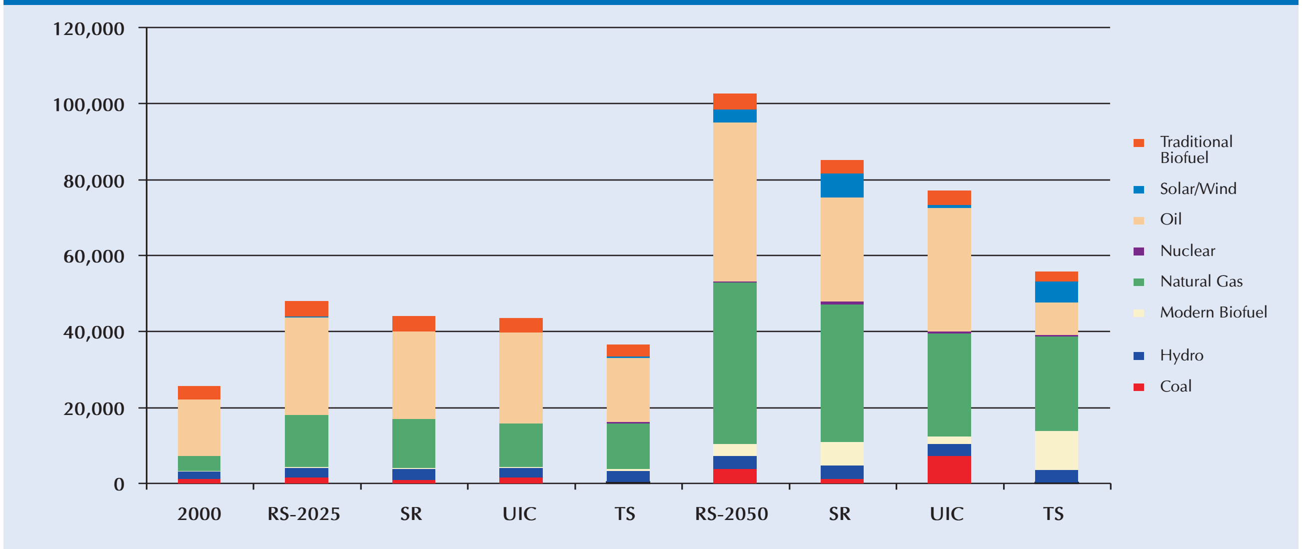
- The ***number of people living under water stress*** increases in all the scenarios between 2005 and 2050, although more vigorously in *Unsustainability and Increased Conflicts (UIC),* and in *Relegated Sustainability (RS),* with increases of 78% and 54%, respectively.

  In *Sustainability Reforms (SR)* this indicator rises by 43%, but the people are in a better position to confront the shortage of water thanks to diverse intervention policies such as establishing national early warning systems on droughts or extreme events, together with more effective national coordination to develop water supply, among other measures.

  In *Transition to Sustainability (TS)* this indicator increases by 23% between 2005 and 2050 as an indication that there are still pressures on water resources, many of which accumulated in earlier periods and have not been completely resolved in spite of changes in consumption patterns under this scenario (see Figure 4.12).

FIGURE 4.11

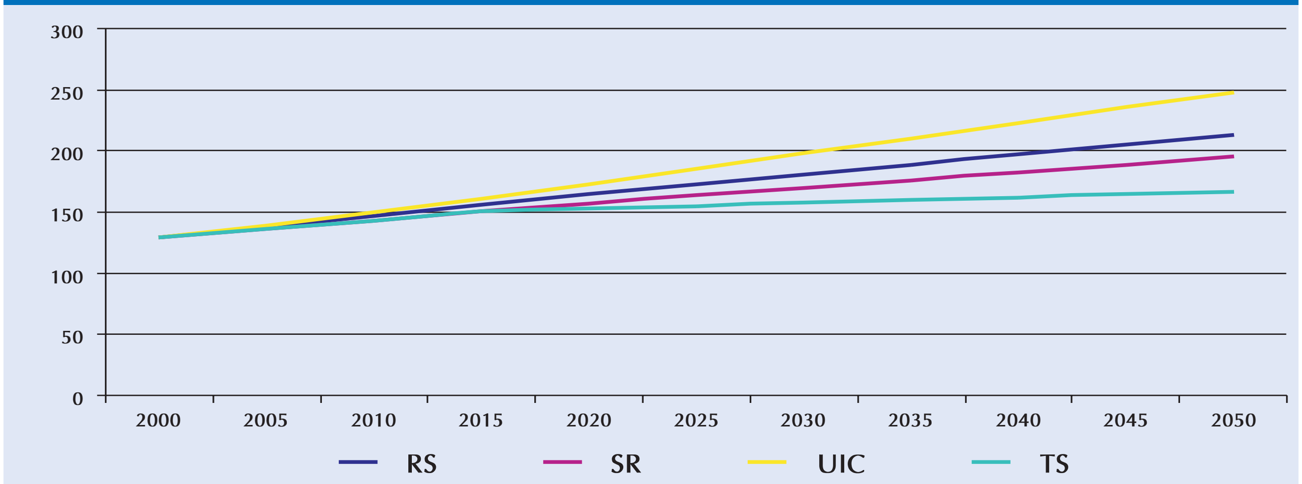
Latin America and the Caribbean: Primary Energy Use *(In PJ)*



Source: Database GEO4-UNEP (Results produced by IMAGE - Integrated Model to Assess the Global Environment).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

FIGURE 4.12

Latin America and the Caribbean: Population Living Under Water Stress
(Millions of inhabitants)



Source: GEO4-UNEP database (Results produced by WaterGap – Water Global Assessment and Prognosis).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

4.2 Environmental implications

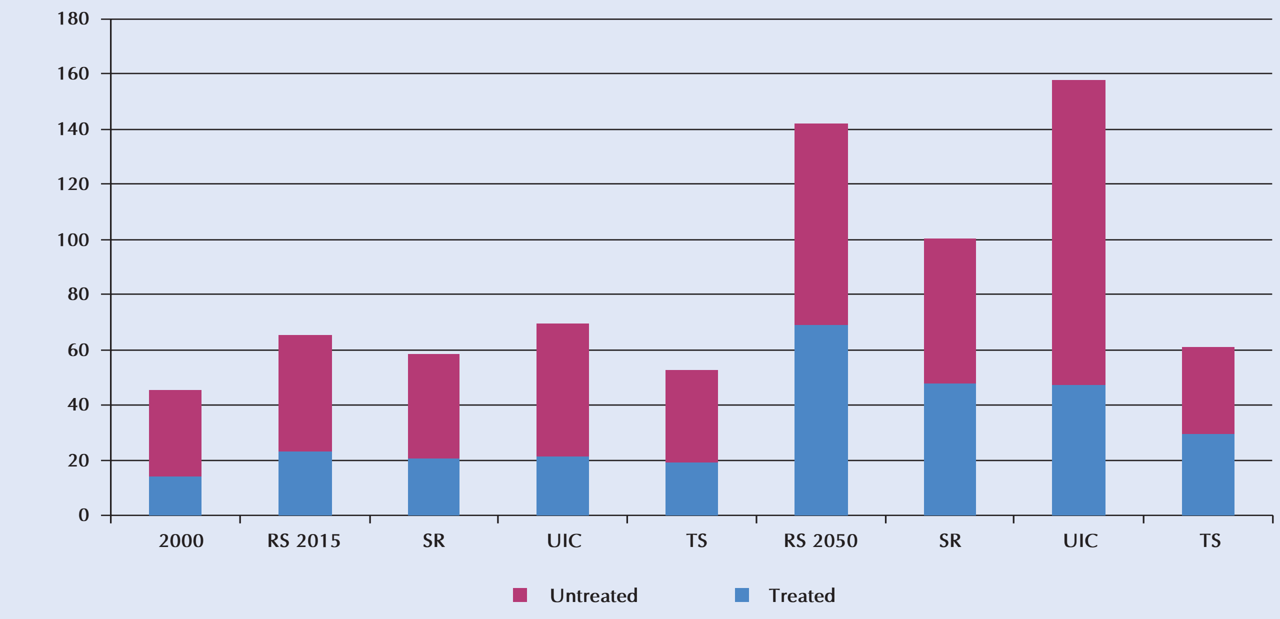
Concerning the environment, of special note among the four basic scenarios is the comparative analysis made of various key indicators such as the amount of sewage and the extent to which it is treated, the loss of biological diversity, emissions of greenhouse gases and other air polluting gases such as sulphur oxide, as well as the depletion of the Region's fisheries.

- There are notable differences in the scenarios about the amount of ***sewage*** produced by socioeconomic activities and the degree to which water is treated. Towards 2050, slightly more than 50% of the sewage in *Relegated Sustainability (RS), Sustainability Reforms (SR) and Transition to Sustainability (TS)* is untreated, compared to 70% in 2000. In *RS* economic growth is accompanied by an expansion of the capacity of treatment plants but, at the same time, there is a significant increase in sewage (3.1 times) due a higher demand for water by municipalities and industry. Most sewage is discharged into seas, rivers and other water bodies, causing deterioration in their quality and having serious adverse effects on aquatic ecosystems.

  While in *SR* the amount of sewage expanded 2.2 times in 2000-2050 there was a substantial increase sewage treatment capacity in order to protect the availability of water; however, this trend only managed to slow down the rate of untreated sewage discharge. The increase in sewage in *TS* (30%) is the lowest among the four scenarios considered, to a large extent to be due to conservation action together with the massive construction of sewage treatment plants. The *UIC* is the gloomiest scenario because it shows the amount of sewage at a record level (growing 3.3 times in 2000-2050) with untreated sewage at 70% of the total (see Figure 4.13).

FIGURE 4.13

Latin America and the Caribbean: Sewage (Treated and Untreated)
(Thousand millions of cubic meters)



Source: GEO4-UNEP database (Results produced by WaterGap - Water Global Assessment and Prognosis).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflicts TS= Transition to Sustainability.

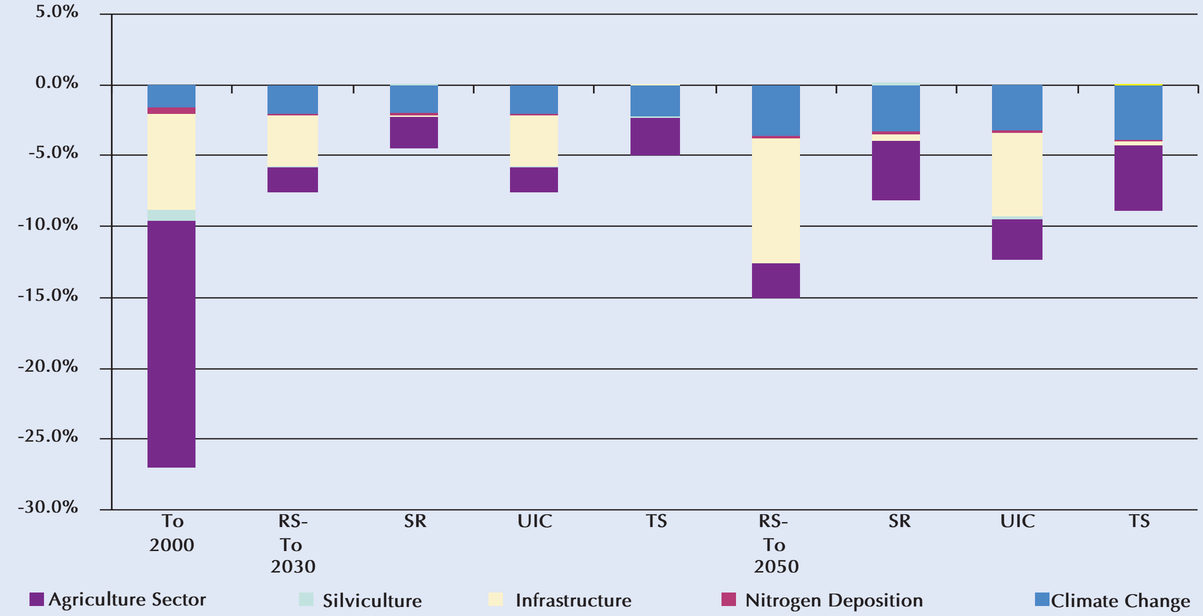
- ***Biodiversity***, measured with the *"mean abundance of original species"* shows more deterioration in *Relegated Sustainability (RS),* where there is a drop of 15% towards 2050, and in *Unsustainability and Increased Conflicts (UIC)* with a drop of 12% in the same period. In both cases, infrastructure construction is the factor with the most bearing and in *RS* it explains about 58% of biodiversity loss, while in the second case it is close to 48%. Other factors that influence the results of these two scenarios, although on a smaller scale, are agricultural sector activities and the impacts of climate change.

  The smallest declines in biodiversity are recorded in *Sustainability Reforms (SR)* and in *Transition to Sustainability (TS),* with reductions of 8% in *SR* and almost 9% in *TS.* In both these scenarios the factors with the most influence on the loss of species are agriculture (53% of the problem in both scenarios) and climate change (the cause of 41% of the disappearance of species in *TS* and 30% in *SR*) (see Figure 4.14).

- The dynamics of the Region's ***carbon equivalent emissions*** in the period 2000-2050 demonstrates the contribution made in the different scenarios to the generation of greenhouse gases and, therefore,

FIGURE 4.14

Latin America and the Caribbean: Causes of the Decline in Mean Abundance of Original Species *(Percentage)*



Source: Database GEO4-UNEP (Results produced by GLOBIO).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

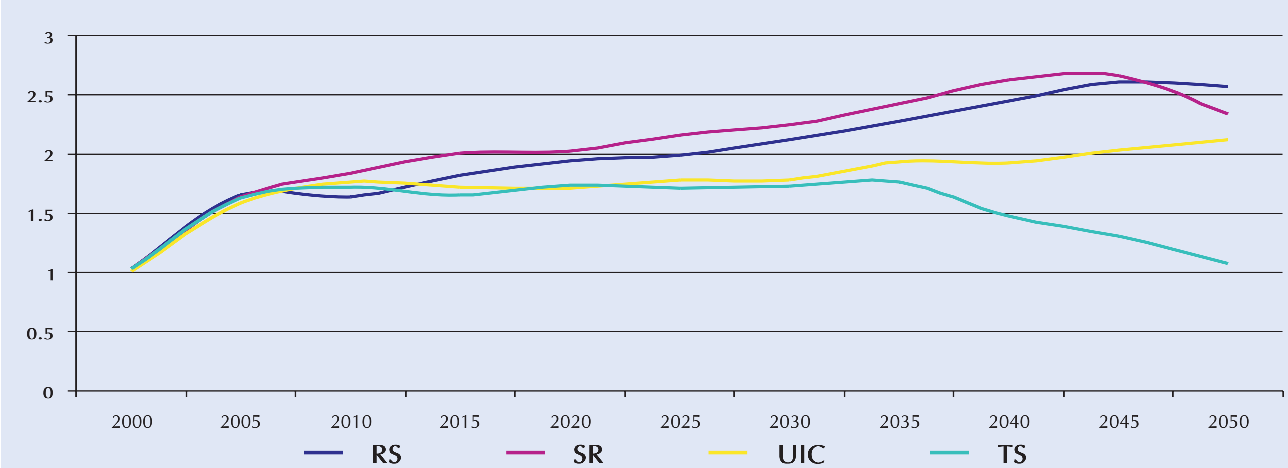
to global climate change. The two most dynamic trajectories are in *Relegated Sustainability (RS)* and *Sustainability Reforms (SR)*, with increases in emissions of 60% and 40%, respectively. In both cases the behaviour of this indicator is, to a great extent, due to the rapid growth in demand for energy and an energy balance composition where fossil fuels predominate and are combined with emissions caused by land use changes. The *SR* trajectory shows a drop in emissions towards the end of the period as a result of changes in the energy consumption structure in favour of non-fossil fuels, as well as certain improvements in energy efficiency.

Carbon equivalent emissions in *Unsustainability and Increased Conflicts (UIC)* increase by 30%; they are not higher because of economic and social fragmentation which tends to slow economic growth and limit the satisfaction of most of the population's basic energy needs. In *Transition to Sustainability (TS)* emissions tend to decline, falling by 30% between 2000 and 2050 in spite of a dynamic GDP; this shows the results of changes in the energy production and consumption patterns seen in this scenario designed to promote renewable energy sources and energy efficiency (see Figure 4.15).

- The ***anthropogenic sulphur oxide (SOx) emissions*** trend brings additional atmospheric pollution elements to the Region until 2050 because, in addition to other implications, gases are dealt with that have a negative effect on human health and cause acid rain. There is more dynamism in generating these emissions in *Relegated Sustainability (RS)* and *Unsustainability and Increased Conflicts (UIC)* with increases of 60% and 70%, respectively in 2000-2050; in *Sustainability Reforms (SR)*, after growing between 2000 and 2030, a decline sets in until 2050, while the *Transition to Sustainability (TS)* scenario shows a marked tendency to reduce these emissions, with an accumulated drop of around 50% towards 2050 (see Figure 4.16).

FIGURE 4.15

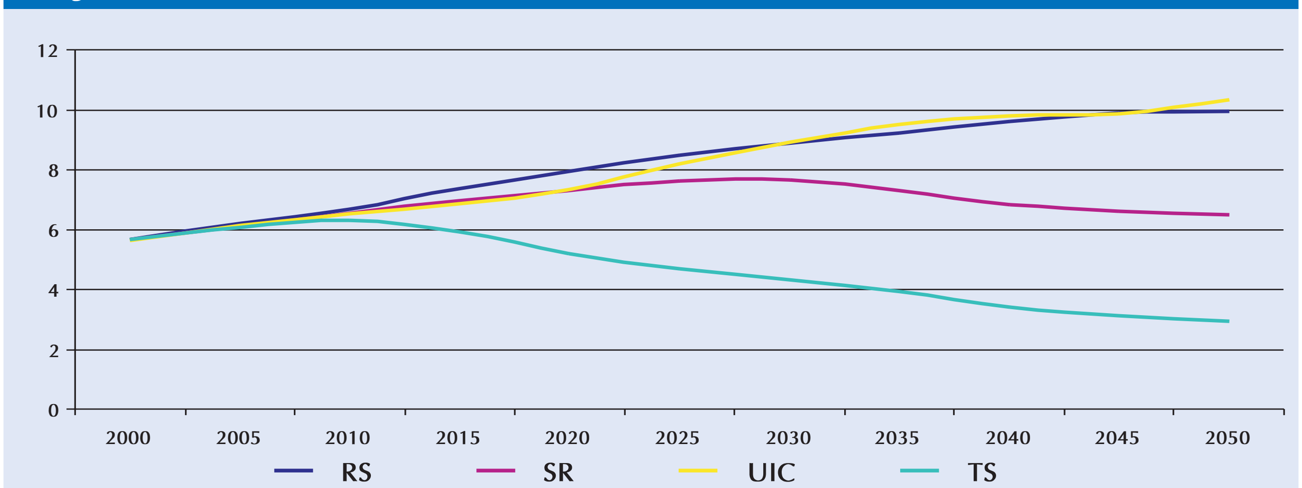
Latin America and the Caribbean: Total CO_2 Equivalent Emissions
(In PgC)



Source: GEO4-UNEP database (Results produced by IMAGE).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

FIGURE 4.16

Latin America and the Caribbean: Anthropogenic Emissions of SO_x Equivalent
(In TgS)



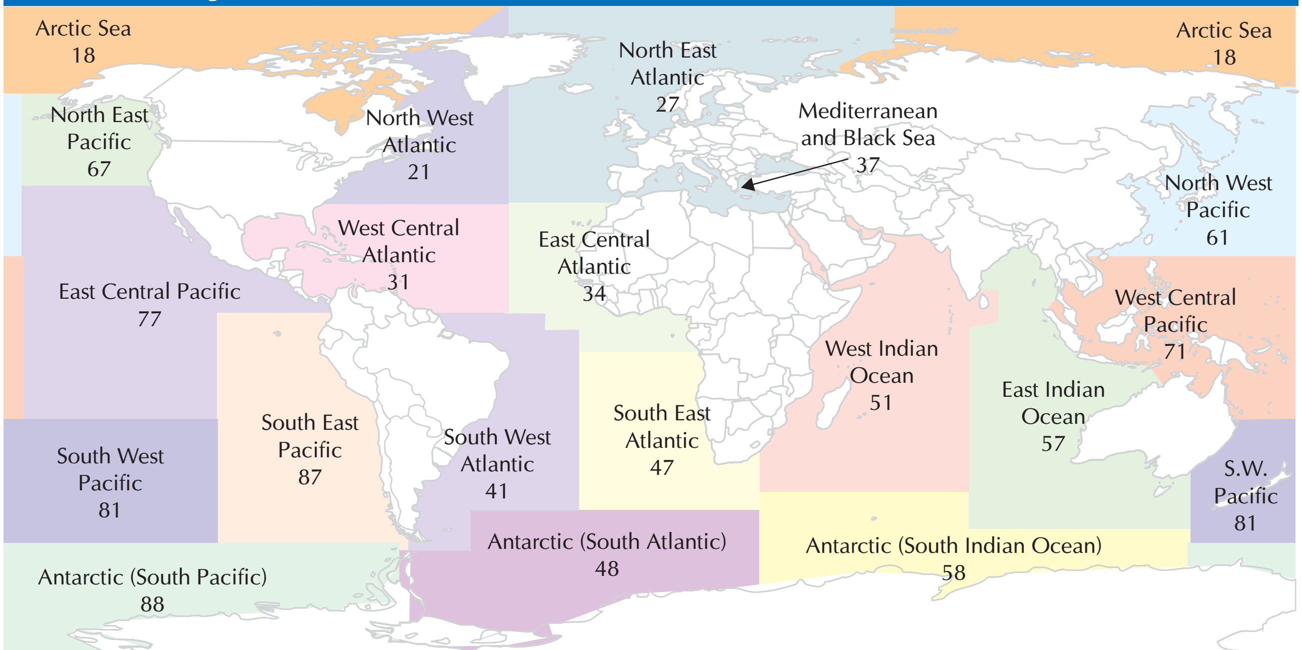
Source: GEO4-UNEP database (Results produced by IMAGE).
Notes: RS= Relegated Sustainability; SR= Sustainability Reforms; UIC= Unsustainabitily and Inrceased Conflics TS= Transition to Sustainability.

- A comparison of the ***Fisheries Depletion Index (DI)*** between 2000 and 2050 for the four scenarios reveals changes in conservation conditions during the period in the four FAO areas of relevance to Latin America and the Caribbean. The greatest reductions in the *DI* (more depletion) are shown in *Relegated Sustainability (RS)* and in *Sustainability Reforms (SR)* in the two FAO areas located on the Region's Atlantic coast (FAO 31 and FAO 41). In these two areas there is less depletion than in the *Transition to Sustainability (TS)* scenario.

In the two Pacific coast areas (FAO 77 and FAO 87) in the four scenarios the *DI* shows a rather similar degree of marked deterioration in fisheries. The increased depletion shown in *Transition to Sustainability (TS)* is at least in part due to two contrasting trends: on the one hand there is recuperation of less vulnerable species, while on the other there is greater loss of some more vulnerable species (see Figures 4.17a and 4.17b).

FIGURE 4.17a

FAO Marine Regions



Source: Database GEO4-UNEP (Results produced by EcOcean).

FIGURE 4.17b

Latin America and the Caribbean: Changes in the Fisheries Depletion Index (DI) (2000 – 2050) in FAO Marine Areas 31, 41, 77 and 87 and Under Different Scenarios

Source: Database GEO4-UNEP (Results produced by EcOcean).
Note: (RS: Relegated Sustainability, SR: Sustainability Reforms; UIC: Unsustainability and Increased Conflicts, and TS: Transition to Sustainability). The positive changes in the DI indicate a reduced depletion risk, while the negative changes indicate an increased risk of depletion.

In all the scenarios and areas, increased fish catches involves biodiversity interactions, as it can be appreciated in the Caribbean (see FAO 31), where it is likely that the trophic level will continue declining, as it has been happening since the 1950s[4].

The quantitative information needed to ground in the consequences of different combinations of the driving forces summarized in the scenarios is not always available. Therefore, by using analyses and qualitative arguments an attempt has been made to complement, as far as possible, the statistics taken from the models employed. Even so, this assessment of the implications of the four plausible futures is far from being a final result.

4 CARSEA 2007. Caribbean Sea Ecosystem Assessment (CARSEA). A sub-global component of the Millennium Ecosystem Assessment (MA), J. Agard, A. Cropper, K. Garcia eds., Caribbean Marine Studies, Special Edition, 2007. 104 pp.

5. Four Alterntive Futures with Turning Points

Taking into account the 50-year analysis period (2000-2050) it is plausible to consider that the trajectories of each of the four basic scenarios *(RS, SR, UIC* and *TS)* could be diverted at a given moment over that period as a result of an accumulation of impacts and the inter-relationships that influence all levels of the decision making process.

Therefore, besides assessing the regional trajectories of the four global-level scenarios built between 2000 and 2050 (see GEO-4), four alternative regional trajectories are explored that introduce *turning points* in the middle of the period considered (2025) as an expression of the high degree of uncertainty implicit in this scenarios building exercise (see Figure 4.18).

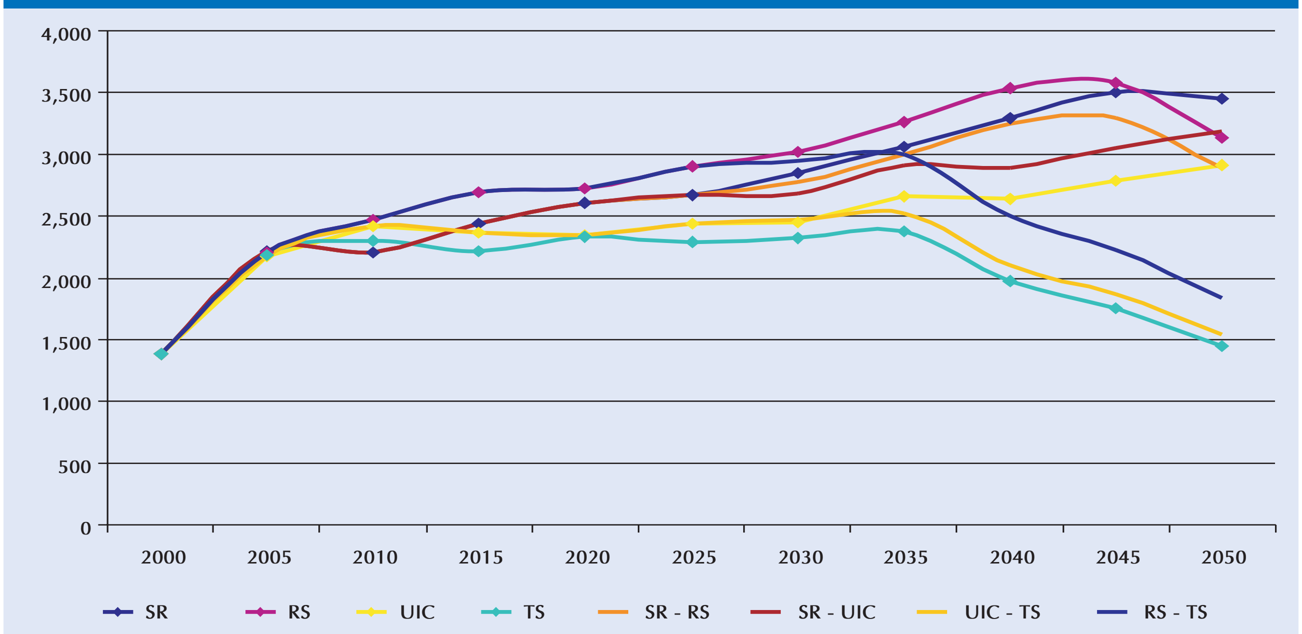
Starting with sustainability as a strategic objective, this exercise builds four plausible alternative trajectories to show that the economic, social and environmental benefits (or costs) of each of them depends, to a great extent, on the speed (or slowness) and the degree of integration (or fragmentation) with which the objectives of sustainability and human well-being are included in the decision making process, as indicated in Table 4.5.

As it may be supposed, the four alternative trajectories built are not the only feasible combinations. In the opinion of the experts who took part in this process, they are simply a representative set of options that depart from the well delineated trajectories of the four basic scenarios.

The time when the *turning point* is reached could also vary for each alternative trajectory, although in this case the same year is taken (2025) to simplify the illustration (See Box 4.1).

FIGURE 4.18

Latin America and the Caribbean: CO_2 Emissions, 2000-2050
(Millions of tons)



Source: Prepared by the authors.
Notes:

Basic scenarios:	*Alternative trajectories with turning points:*
RS: Relegated Sustainability	*RS-SR: Relegated Sustainability – Sustainability Reforms.*
SR: Sustainability Reforms	*RS-UIC: Relegated Sustainability – Unsustainability and Increased Conflicts.*
UIC: Unsustainability and Increased Conflicts.	*UIC-TS: Unsustainability and Increased Conflicts – Transition to Sustainability*
TS: Transition to Sustainability.	*SR-TS: Sustainability Reforms - Transition to Sustainability*

TABLE 4.5

Alternative Trajectories with Turning Points

From 2000 to 2025	From 2025 to 2050	Sustainability / Human well-being as objectives of the decision making process
A. Relegated Sustainability	*Sustainability Reforms*	At first significantly underestimated and then gradually included.
B. Relegated Sustainability	*Unsustainability and Increased Conflicts*	At first significantly underestimated and then ignored.
C. Unsustainability and Increased Conflicts	*Transition to Sustainability*	Ignored to begin with, then recognized as a desired alternative. Very costly trajectory towards sustainability.
D. Sustainability Reforms	*Transition to Sustainability*	Gradually included, then considered in a more integrated manner, as a trend.

Source: Prepared by the authors.

5.1 Main results

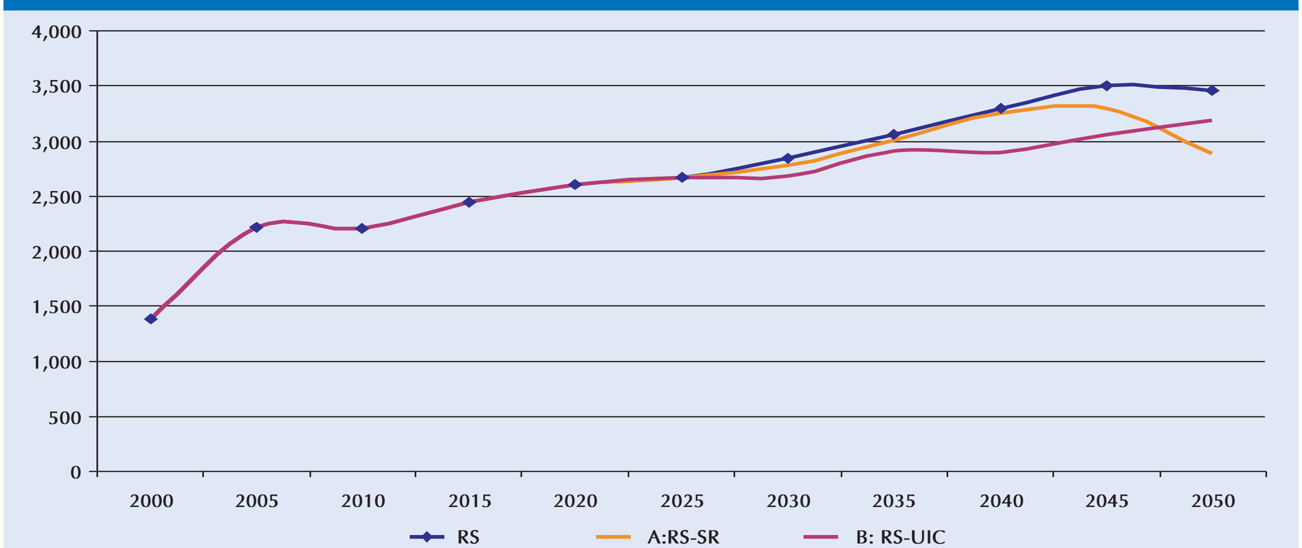
The *A* trajectory (moving from *Relegated Sustainability* to *Sustainability Reforms*) records a maximum emissions level in 2045, after which it decreases. (See Figures 4.18 and 4.20)

Trajectory B (moving from *Relegated Sustainability* to *Unsustainability and Increased Conflicts*) is the only alternative trajectory in which there is hardly any interruption in the growth of CO_2 emissions over the course of the 50 years. Consequently, among the four alternative trajectories this is the one that shows the greatest level of regional emissions in 2050. This result corresponds to what is shown in Box 4.5, signalling that in trajectory B the sustainability objective is initially underestimated (until 2025) and then unknown (see Figures 4.18 and 4.19).

Trajectory C (moving from *Unsustainability and Increased Conflicts* to *Transition to Sustainability*) shows the lowest level of emissions in 2050 among the four alternative trajectories; though it should not be forgotten (as indicated in Table 4.5) that, because of the growing asymmetries and conflicts that would affect the majority of the population during the first part of the period (until

FIGURE 4.19

Latin America and the Caribbean: Alternative Trajectories 2000 – 2050
Initial Scenario: Relegated Sustainability (RS) *(Millions of CO_2 tons)*



Source: Prepared by the authors
Note: RS Relegated Sustainability; A: Relegated Sustainability to Sustainability Reforms, B: Relegated Sustainability to Unsustainability and Increased Conflicts.

BOX 4.1

Brief Technical Note on Building Alternative Trajectories with Turning Points

These four alternative trajectories were selected, according to the criterion of the regional team experts, as representative cases –to assess sustainability– within the set of possible combinations.

The alternative trajectories (with turning points) represented in Table 4.5, may be built for different indicators. As an example, in this case use is made of the possible behaviour of CO_2 emissions as one of the indicators that allow assesing the degree of environmental sustainability.

The statistical baseline to build the alterative trajectories consists of the basic scenario data taken from the UNEP Report: GEO4 Global Environment Outlook for Development.

These data were adjusted for each new trajectory on the basis of the expected dynamics of CO_2 emissions according to the turning point selected. For example, in the case of trajectory A (Relegated Sustainability – Sustainability Reforms) data are taken on RS scenario emissions for 2000-2025 and then, to complete the series until 2050 the SR scenario growth rates for 2025-2050 are applied.

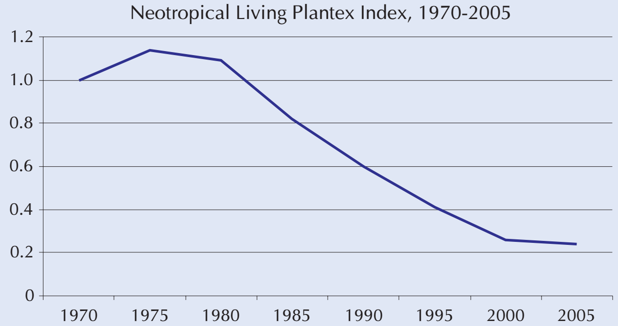
Trajectories with turning points are common in studies on socioeconomic and environmental indicators, especially in cases where there are marked changes in the evolution trends. As an example, in this respect, a review may be made of the behaviour of the CO and SO_2 emissions in the metropolitan area of Mexico City from 1990 to 2007. In both cases most emissions are recorded for 1991 after which, as the result of a set of actions designed to improve air quality in that Mexican megacity, there is a sustained fall until the end of the period. The behaviour of these indicators shows a certain similarity to the above-mentioned A trajectory (RS-SR) although these cases are real examples and correspond to isolated indicators while the A trajectory has been devised using a combination of the two scenarios for the 2000-2050 period.

Another example of a turning point is the behaviour of the Neotropical Living Planet Index for 1970-2005, although in this case far from improving –unlike the previous example– the environmental quality indicator considered (biological diversity) deteriorates over the period analysed.

The Neotropical Living Planet Index, taken from the report Living Planet 2008[a] of the World Wildlife Fund (WWF), shows the trends of terrestrial and fresh water species of the biogeographic kingdom corresponding to the Latin America and Caribbean Region. The Index records a drop of 76% between 1970 and 2005[b] for a sample of 202 populations of 144 neotropical species, to a large extent reflecting the impact of globalization trends and the socioeconomic situation of the Region concerning regional biodiversity resources. It should be borne in mind that, as pointed out in the WWF report, the pressure on the environment has been displaced towards tropical zones and other regions where developing countries predominate.

The trajectory of this Index for 1970-2005 shows a turning point towards the end of the 1970's and the beginning of the 1980's; following a 14% growth of biodiversity in 1970 and 1975, a downward turn in these resources began, first gradually and then abruptly, in the following 30 years and accumulated in a drop of 79% between 1975 and 2005.

Neotropical Living Plantex Index, 1970-2005



These growth (1970-1975) and drastic reduction (1975-2005) stages of biodiversity in Latin America and the Caribbean generally coincide with the behaviour of regional socioeconomic trends in those periods; from a significant increase at the beginning of the 1970's to a "lost decade for growth" and the foreign debt crisis in the 1980's, then to pass to a pattern of volatile, fragmented and highly dependent economic growth of the external economic situations predominating from the 1990's to the present day.

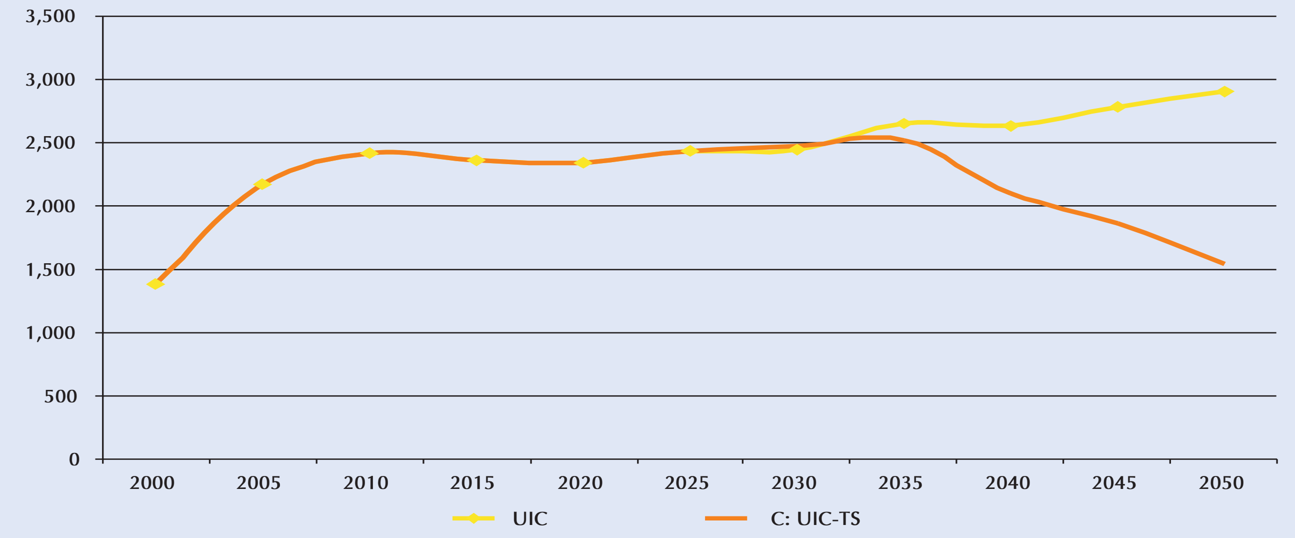
a- See WWW report Living Planet 2008. Technical Note: The Living Planet Index is a global indicator designed to follow up on the state of world biodiversity since it registers the trends over time of a large number of species populations. This Index is based on the trends of almost 5 000 populations of 1 686 species of mammals, birds, reptiles, amphibians and fishes all over the world. Changes in the population of each species are averaged and presented in relation to 1970, the year to which a value of 1, 0 has been assigned.

b- On a global scale this index shows a reduction of almost 30% in that period.

Source: Prepared by the authors.

FIGURE 4.20

Latin America and the Caribbean: Alternative Trajectories 2000 – 2050
Initial Scenario: Unsustainability and Increased Conflicts (UIC) *(Millions of CO_2 tons)*



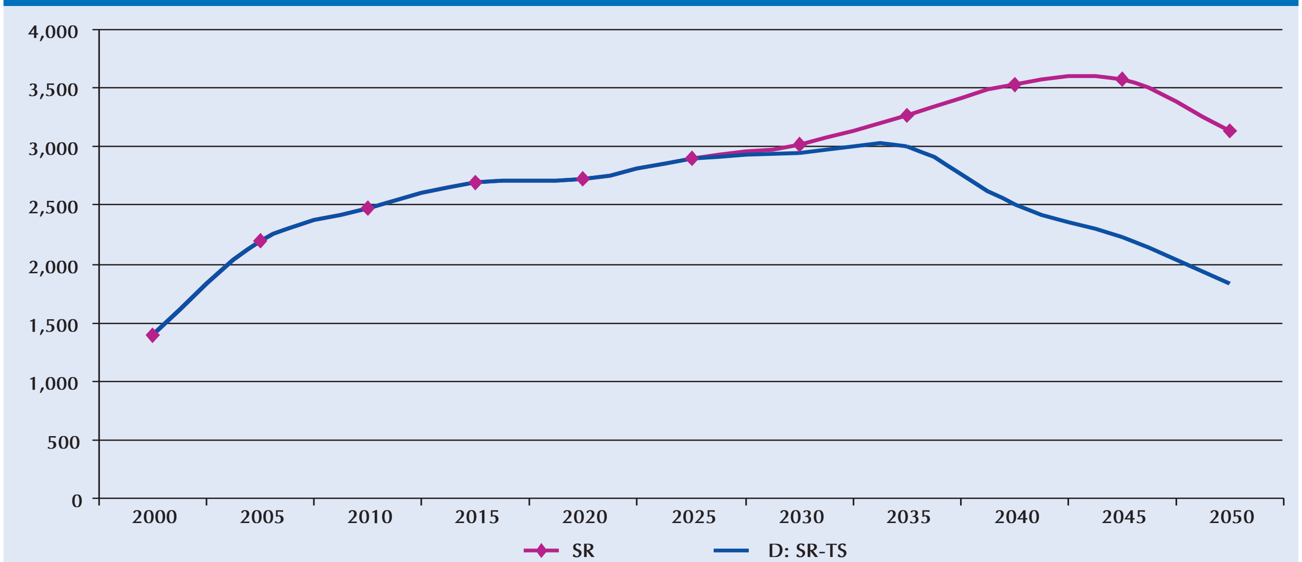
Source: Prepared by the authors.
Note: UIC: Unsustainability and Increased Conflicts; UIC-TS: Unsustainability and Increased Conflicts - Transition to Sustainability

2025) in which a greatly fragmented socioeconomic scenario predominates, this is an extremely costly route to move toward sustainability (see Figures 4.18 and 4.20).

Trajectory D (moving from *Sustainability Reforms* to *Transition to Sustainability*) shows the best results in terms of emissions (from 2035) as a response to an approach in which the sustainability objective is gradually inserted at first and, later on, insertion is more inclusive. For this trajectory the level of emissions towards the end of the period exceeds the amount in the classic *Transition to Sustainability* scenario (see Figures 4.18 and 4.21).

FIGURE 4.21

Latin America and the Caribbean: Alternative Trajectories 2000 – 2050
Initial Scenario: Sustainability Reforms (SR) *(Millions of CO_2 tons)*



Source: Prepared by the authors.
Note: SR:SR-TS: Sustainability Reforms; SR-TS: Sustainability Reforms - Transition to Sustainability

6. Final Reflections

Implementing economic policies and programmes in Latin America and the Caribbean has historically meant putting additional pressures on social conditions and natural and environmental resources.

The analysis of the possible *Four Futures* presented about the socioeconomic and environmental evolution of Latin America and the Caribbean for the period 2000-2050, and the focus on four additional alternative trajectories with *turning points*, is only the first approximation to a set of plausible trends that become inter-related over the course of the five decades to show images that provide lessons about the Region's sustainability.

Standing out above all is the necessity for the Region to take timely actions on sustainable development. As shown by the trajectories that include *turning points*, the economic, social and environmental benefits (or costs) in each of the trajectories described depend, to a great extent, on the speed (or slowness) and the degree of integration (or fragmentation) with which sustainability and human well-being objectives are included in the decision making process.

Financial resources used for social and environmental purposes should not be conceived as burdensome costs that weaken economic growth; quite the contrary, social and environmental investments often have positive long-term effects on the quality and strength of economic growth, as demonstrated in the *Transition to Sustainability* scenario. Thus, for example, a country's or region's investments in education and training would have a positive long-term impact on economic dynamics, and on assimilating new knowledge as a key factor in ongoing technological transformations.

Response strategies to deal with national, regional and global environmental challenges affecting the Region require that mitigation and adaptation action be taken on such problems in a context of sustainability that combines economic, social and environmental aspects. Policies and programmes that attempt to tackle environmental challenges in an isolated and fragmented manner would be condemned to fail or –in the best of cases– would have very limited results, as shown by some of the environmental actions taken in the *Relegated Sustainability* scenario.

Regional socioeconomic trends for 2000-2050 to a great extent define the driving forces or key factors for the Region's environmental performance during that period; however, environmental variables should not be considered as passive elements that only receive the impact of economic and social driving forces; they themselves are also agents for changing the economic, social and environmental situation.

Thus, for example, in the *Relegated Sustainability* scenario the unsustainable expansion of the agricultural frontier by practising monoculture, introducing invasive species, or other such actions, seriously affects the health of those ecosystems; this then has negative repercussions on socioeconomic development by affecting agriculture's natural resources. The same happens with other socioeconomic activities such as tourism, fishing, and mineral extraction.

Developing socioeconomic and environmental scenarios shows decision-makers how necessary it is, when designing sustainable development strategies, to consider the inertia of ecological and socioeconomic systems. Although the sustainability component is firmly included in the earliest phases, as happens in *Transition to Sustainability*, the resulting favourable changes do not take place suddenly; time is required to make a gradual transition to a new phase.

Given of the relevance of studying scenarios in Latin America and the Caribbean as a developing region, there is a need to strengthen technical and institutional capacities in these areas to enable multidisciplinary work to be carried out both on the qualitative component (preparing narratives) and on the quantitative component (using models as an analysis tool) and to integrate both aspects. At a regional level there is also a need to promote the use of the scenarios in decision making and this, above all else, presupposes a familiarization with this instrument which, as mentioned earlier, includes different forecasts and projections.

This regional study could serve as a starting point to prepare sub-regional, national and local scenarios on priority aspects. In no case should the regional scenarios be interpreted as being the mechanical combination of trends in different sub-regions or countries.

The great dynamism of the changes that occur in the present-day world, and the increasingly greater understanding of the driving forces and the links between them, make it advisable to constantly update the scenarios used, so that they may retain their usefulness and operating capability (see Box 4.2).

BOX 4.2

Global Consequences of the Four Futures in Latin America and the Caribbean

- *Themes concerning poverty and inequity are particularly relevant in Latin America and the Caribbean that has the world's most inequality in income distribution. According to data from the World Bank and ECLAC, the Gini Coefficient for the Region is 0.5712, followed by sub-Saharan Africa (0.4541) and East Asia and the Pacific (0.4314)[a]. Inequality and poverty increase considerably in Relegated Sustainability (RS) and in Unsustainability and Increased Conflicts (UIC). Some improvement is seen in Sustainability Reforms (SR) and there is a notable reduction in Transition to Sustainability (TS).*

- *Latin America and the Caribbean has a third of the total developing countries' debt and is the region that annually transfers more resources to creditors to service the debt (some 179,000 million dollars in 2007)[b]. In Relegated Sustainability (RS) and Sustainability Reforms (SR) this problem continues to be an obstacle to sustainable development in the Region; there is an important increase in Unsustainability and Increased Conflicts (UIC) and a reduction to manageable levels in Transition to Sustainability (TS).*

- *Biological diversity is a crucial component of the Region's natural resources, and it has implications not only for Latin America and the Caribbean but also for the world. It is estimated that Amazonia alone has 50% of global biodiversity and six countries in the Region (Brazil, Colombia, Ecuador, Mexico, Peru and Venezuela) are considered to be megadiverse[c]. Deforestation shows a significant increase in Relegated Sustainability (RS), causing more habitat loss and fragmentation. The most important forest areas of interest to the elites are conserved in Unsustainability and Increased Conflicts (UIC), but outside these protected areas deforestation rapidly increases. In Sustainability Reforms (SR) there is evidence of a moderate reduction in deforestation and habitat fragmentation thanks to improved regulatory standards and compliance mechanisms. With regard to Transition to Sustainability (TS) mechanisms are used to rehabilitate affected forest ecosystems by managing to reduce key habitats loss and fragmentation.*

- *With almost 28 000 cubic metres/person/year fresh water availability per inhabitant in Latin America and the Caribbean is much higher than the world average, but water resources are unequally distributed throughout the Region [d]. As 2050 approaches, in the four hypotheses there is more pressures on water resources, but it is possible to distinguish their qualitative differences. In Relegated Sustainability (RS) and Unsustainability and Increased Conflicts (UIC) there is a reduction in the quality and quantity of surface and ground waters. In Sustainability Reforms (SR) it is possible to substantially improve the use of this resource in the economic sectors by investing in water saving technologies. In Transition to Sustainability (TS) special efforts are made to manage conflicts in this area, improve water use efficiency, and change the way people use it.*

- *The Region has 10% of global oil reserves, 4.6% of natural gas reserves, 2% of coal reserves [e] and great renewable energy potential. Access to and control of energy resources continue to be important sources of conflict in the Relegated Sustainability (RS) scenario, a situation accentuated in Unsustainability and Increased Conflicts (UIC). In both hypotheses there is very little improvement in energy diversification –beyond fossil fuels– and energy efficiency is very limited. In contrast, in Sustainability Reforms (SR) energy diversification is promoted; and in Transition to Sustainability (TS) there is more use of renewable resources, and more emphasis on energy efficiency and regional energy cooperation.*

- *Latin America and the Caribbean is the most urbanized region in the developing world, with 77.3% urbanization compared to an average of 42.7% in 2005 [f] for the group of developing countries. Urbanization appears in all the hypotheses but important differences are seen. In Relegated Sustainability (RS) and in Unsustainability and Increased Conflicts (UIC) urbanization is uncontrolled. In Sustainability Reforms (SR) urbanization is less chaotic. In Transition to Sustainability (TS) urbanization continues in cities of small and medium size because it is based on long-term urban development planning.*

- *Migration is a global phenomenon that has been intensified by present globalizing trends. The number of people emigrating from the Region rises from 21 million in 2000 to almost 25 million in 2005, or 13% of the world total [g]. In the regional scenario of Relegated Sustainability (RS) the deterioration of various groups' social conditions means migratory pressures continue to increase both within the Region and towards North America and Europe. In Unsustainability and Increased Conflicts (UIC) migratory pressures increase considerably in border areas, but migration legislation is more restrictive. Migratory pressures are reduced in Sustainability Reforms (SR) and in Transition to Sustainability (TS). In the latter hypothesis emigration becomes a question of personal decision rather than one of need.*

a- Machinea, J. L. and M. Hopenhayn, 2005.
b- IMF, World Economic Outlook, April 2008.
c- UNEP (2007)
d- UNEP (2007) op. cit, p. 242.
e- BP. Statistical Review of World Energy, 2008, pp. 6, 22 and 32.
f- UNDP, Human Development Report 2007-2008.
g- ECLAC, 2006.

Source: Prepared by the authors

7. Technical Annex

This annex gives details about how scenarios were developed, both as to qualitative (narrative) and quantitative (results of the models) aspects. The more than two dozen people and organizations involved in preparing this chapter built upon the four scenarios previously introduced and further developed in GEO-3 and GEO-4, and in GEO LAC 2003.

Process

The LAC scenarios chapter expert group, six other regional groups and a global team of expert modellers met in Bangkok in September 2005 to start building the GEO-4 scenarios with a multi-scale outlook. Over the next year and a half the LAC team again met separately in Trinidad and Tobago, Peru and Cuba to further develop the scenarios. Meetings were also held in Panama and Cuba in 2008 to decide how best to integrate the narrative and the quantitative results. The LAC regional team prepared narrative descriptions of each of the four scenarios by taking the drivers and assumptions of the GEO-3 global scenarios and GEO LAC 2003 scenarios as a starting point. While taking into consideration other regions' and global influences the group's objective was to describe the four scenarios from a LAC outlook. In parallel, a suite of advanced state-of-the-art models, described below, was used to develop the quantitative estimates of future environmental change and impacts on human well-being. To check the validity and consistency of the scenarios, the narrative team interacted with the modellers to ensure that the scenarios' quantitative and qualitative components complemented and reinforced each other.

The Models

The computer models used have been published in peer-reviewed scientific literature and have been shown to be useful in linking societal changes to changes in the natural environment. The models were soft-linked with output files from one model being used as inputs to other models.

Briefly, the models are as follows:

International Futures (IF) is a large-scale integrated global modelling system (Hughes and Hillebrand 2006). The IF model serves as a thinking tool to analyse long-term country-specific, regional, and global futures across multiple and interacting issue areas. For GEO LAC -3, IF projected population trends and GDP per capita as well as providing additional information on health, education and military expenditure.

It is important to note that IF also provided projections (based on narratives) of poverty and extreme poverty for 18 countries in the Region on which, in Social Panorama 2006, ECLAC had published urban and rural poverty and extreme poverty lines data. The IF model uses a standard and generally accepted assumption about national level income distribution; this is adjusted for each country to match historical data on persons living on less than 1 and 2 dollars per day. Thanks to this information and data on future values of average per capita income and the Gini income coefficient, IF is able to calculate: 1) the perventage of the population (and total population) living on less than any level of income specified by the user and, on the other hand, 2) the income level below which falls any particular percentage of the population specified by the user.

IMAGE (Integrated Model to Assess the Global Environment) is a dynamic integrated global change assessment model developed by The Netherlands Institute for Public Health and the Environment (RIVM) (Bouwman and others 2006). IMAGE is used to study a whole range of environmental and global change problems, particularly on land use change, atmospheric pollution, and climate change. The main objectives of IMAGE are to enrich scientific understanding and support decision making by quantifying the relative importance of major processes and interactions in the society-biosphere-climate system. For GEO LAC -3, IMAGE provided estimates of energy use, greenhouse gas emissions, and changes in temperature and precipitation.

IMPACT (International Model for Policy Analysis of Agricultural Commodities and Trade) is a representation of a competitive world agricultural market for 32 crop and livestock commodities such as cereals, soybeans, roots and tubers, meats, milk, eggs, oils, oilcakes and meals, sugar and sweeteners, fruits and vegetables, and fish. It was developed in the early 1990s as a response to concerns about a lack of vision and consensus regarding action required to feed the world in the future, reduce poverty, and protect the natural resource base. For GEO LAC -3, IMPACT generated projections for crop area, livestock numbers, production, demand for food, feed and other uses, prices, trade and children's nutrition.

WaterGAP (Water – Global Assessment and Prognosis) is a global model developed at the Centre for Environmental Systems Research of the University of Kassel that computes both water availability and water use on a 0.5 global grid (Alcamo and others 2003; Döll and others 2003). The model is designed to serve as a basis for assessing current water resources and water uses, and to have an integrated outlook about the impacts of climate change and socioeconomic drivers on the future water sector. For GEO LAC -3, WaterGAP provided estimates of water use (for irrigation and in the domestic, manufacturing, and electricity production sectors), water availability, and water stress.

EcoOcean is a new model developed by the University of British Columbia Fishery Centre to explore scenarios for the world's oceans (Alder and others 2007). It is based on the well-known Ecopath with Ecosim (EwE) ecological modelling software. EwE uses two main components: Ecopath - a static, mass-balanced snapshot of marine ecosystems, and Ecosim - a time dynamic simulation module for policy exploration based on an Ecopath model. The EcoOcean model was constructed using 43 functional groups common to the world's oceans including FAO's 19 marine statistical areas. The groups were selected with special consideration for exploited fish species but are intended to include all major groups in the oceans. The fish groups are based on size categories and feeding and habitat characteristics. Fishing is the most important driver for the ecosystem model simulations. The five major fishing fleet categories are: demersal, distant water fleet, baitfish tuna (pursed seine), tuna long-line and small pelagic. This classification is used to distinguish different fishing methods based on historical information. For GEO LAC -3, EcoOcean provided estimates of the Depletion Index for fisheries.

The **GLOBIO** model simulates the impact on biodiversity of multiple pressures (Alkemade and others 2006). The model relies on a database of field studies relating magnitude of pressure to magnitude of biodiversity impact. This database includes separate measures of mean species abundance (MSA) and of mean species richness (MSR) of original species of ecosystems, each in relation to different degrees of pressure. The entries in the database are all derived from peer-reviewed studies, either of change over time in a single plot, or of response in parallel plots undergoing different pressures. An individual study may have reported species richness, mean species abundance, or both. Rows are classified by pressure type, taxon under study, biome and region. For GEO LAC -3, GLOBIO provided estimates of changes in mean species abundance in terrestrial ecosystems.

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V. Policies and Options for Action

Key messages

- **Environmental policies need to be included in development policies.** Although there have been advances in recent decades to take the environmental dimension into account when development policies are considered, as well as in establishing institutions and standards to allow such policies to be translated into government plans, programmes and projects, these environmental policies have shown insufficient to halt the Region's environmental degradation. This is because, first of all, environmental policies have not been able to call into question economic policies aimed at exporting raw materials and that pose enormous pressure on natural resources and, second, because the benefits of conserving ecosystems and the services they offer have not been sufficiently internalized. As result, the sectorial approach prevails over the transversalization of environmental issues in development and sectorial policies.
- **Conflicts with environmental implications have recently multiplied in the Region.** On the one hand, the effects of the prevailing development pattern are so serious that States lack enough regulatory and administrative capacity to address them; and, on the other, new rights established in national legislations and international standards are hindered by the failure of government institutions to take action; this failure to act has led sometimes to violent confrontations with tragic results.

- **An increasingly important role is played by civil society.** Recent changes in the economies and political systems of countries in the Region have led to a rethinking of how, in view of the new demands, the interests of social and other stakeholders can be framed so that they are fair and balanced. Civil society has been organized into a series of groups and movements both to exchange information and to question decisions by authorities that have adverse effects on the environment, even going so far as to reverse such decisions. However, isolated or momentary successes have had no real impact on environmental policies. Citizens need to improve their negotiating capacity and, when planning public and private activities, they should use tools such as strategic or integrated environmental assessments; they must also take corporate socio-environmental responsibility to ensure the inclusion of civil society's participation mechanisms in public policies and in decision making.

- **The global crisis scenario determines opportunities and threats.** The environment faces both threats and opportunities in the scenario of the global economic crisis triggered in 2008. The nature and intensity of the crisis allows its causes to be uncovered and opportunities that could reverse it identified, notable among which is the need to make more efficient use of natural resources and to speed up the transition to alternative and more sustainable energy sources as a means of making production more competitive.

1. Introduction

As emphasized in earlier chapters of this report, the situation now facing the Region and the planet as a whole requires sweeping adjustments to be made to prevailing development policies, and perhaps a change of course is needed on the way environmental policy has been addressed.

In light of the crisis in the international financial system, and the immediate global economic recession it caused, UNEP launched (March 2009) its «Global Green New Deal» (GGND) as part of the «Green Economy» initiative; it warned that steps must be taken to prevent mishandling the enormous resources the international community announced it is prepared to allocate for the biggest economic recovery in history, so that they are not used to support the inefficient , unsustainable and unfair commercial pattern that caused the crisis and, instead, proposed an alternative path summarized in three broad goals:

1) To make a significant contribution to the global economic recovery; preserve and create jobs; and protect vulnerable groups;
2) To promote sustainable and inclusive growth and meet the Millennium Development Goals (MDGs), especially to end extreme poverty by 2015; and
3) To reduce carbon dependency and ecosystem degradation that are key stumbling blocks on the road towards a sustainable world economy (UNEP, 2009b).

Regardless of how intensely each of the countries in the Region has suffered the effects of the global crisis, it is necessary that they retrace the path along which advances have been made and prioritize the challenges that should guide the settling of their own policies and instruments to ensure that, from this particular moment of opportunity, they can sustain their development.

Among the general issues to be dealt with hereafter, special attention must be paid to the following:

- Integration and coherence between sectorial and environmental policies; investment in social and environmental sustainability to be strengthened while ensuring that these initiatives will not put economic growth at risk but, on the contrary, will guarantee it, promote it and make it sustainable.
- Population growth and urbanization are together an important driving force to promote changes in ecosystems and human well-being. It is essential that governments implement effective land use

BOX 5.1

The Global Green New Deal

The Global Green New Deal of UNEP proposes the following three spending categories for the investments to address this emergency situation: 1) spending on incentive measures in 2009-2010; 2) changes in domestic policies; and 3) changing the way international policies are devised, recognizing that many less developed countries do not have their own resources and, therefore, will have to rely on foreign aid and support, both financial and non-financial.

Among the tax incentives proposed in the first category it is suggested that priority be given to investing in: sustainable transport and renewable energy in developing countries; measures to improve agricultural productivity; managing freshwater resources and sanitation because of their demonstrable and exceptional social benefits.

In the area of national policy reforms it is proposed to substantially reduce perverse subsidies (e.g. for fossil fuels) and instead create positive and appropriate tax incentives to encourage a greener economy and address some common issues pertaining to land use, urban policy and integrated freshwater resources management. Domestic policy responses should be based on effective monitoring and responsibility and should also include the principles of environmental accounting.

Among the proposed changes about how international politics are devised, it is suggested attention be paid to the areas of trade, aid, improving the global carbon market, creating global markets for ecosystem services, and coordinating technology and policy.

Source: UNEP 2009b.

policies and instruments for both urban territories, where eight out of ten people now live, and rural areas that harbour virtually all the Region's life systems and resources that make social reproduction possible. A considerable part of the investment should be used for local development to provide the stability needed to give inhabitants of rural areas decent living conditions and opportunities to develop and progress.

- It is essential that energy sources (other than fossil fuels) be diversified to improve efficiency and enhance regional energy cooperation.
- To prevent and mitigate negative water use, ways must be sought to promote and maximise best water saving and sustainable use practices.
- Major changes must be promoted in production and consumption patterns so that unsustainable practices in developed countries are not imitated, and a return to the more simple lifestyles that still persist in parts of the Region is encouraged; these countries should be given the opportunity to satisfy social needs by having access to environmental goods and services, clean and sustainable resource management, and by being allowed to develop a culture of intergenerational solidarity founded on a respect for nature.

This chapter includes suggestions about elements to be used to expand the discussion on the framework for development policies and to provide tools which, when the time comes, could be used to explore new directions by learning lessons taken from relevant concrete experiences and by identifying opportunities that will enable governments in the Region to take action.

2. The Environment in Public Policies

This chapter provides an account of the trends that have, to a very great extent, characterized the Region's environmental policies and the challenges they must face if they are to help to produce a development model leading to: economic growth; the conservation of natural and cultural heritage; the sustainable use of resources; closing the inequality gap that now threatens peaceful coexistence; and ensuring a more balanced and proactive relation with other stakeholders in the international community.

2.1 From the «fight against poverty,» to the «right to live well» as development models

As indicated in Chapter I of this report, structural adjustments made in the Region since the 1980s led to the downsizing of States and their participation in the economy. Relations with the international financial system were restructured with huge outflows of resources, resulting in inflation and public spending cuts that affected investment in strategic sectors of the economy; social spending and emerging environmental policies were also cut and left behind dysfunctional and denationalized local economies; this led to social disintegration, increasing pressure on nature and its resources, and a realignment of roles that called for natural resources to be delivered to transnational capital, management of the national economy to be put in the hands of local business sectors, leaving the majority of the population dependent on welfare policies, and direct transfers of questionable structural effect.

Today, the threat of climate change and its impact, already evident in different parts of the world, adds an additional element of urgent concern so that consideration must be given to the structural transformation of regional economies now adapted to the different global warming phenomena. Countries in Latin America and the Caribbean face the pending task of escaping from impoverishment and short-term growth, as well as from the traditional extractive and primary products trap, but now with the environment as an additional element. This could make it harder for many to escape while for others it might be seen as a unique opportunity. The latter is the option proposed by UNEP in the GGND and in Poverty-Environment Initiative (PEI)[1] developed jointly by UNEP and UNDP.

The growth rates experienced by some of the Region's economies and the improvement of social indicators recorded from the 1990's have, in some cases, led to the course already chosen being confirmed; however, in the early years of this century the intense movements experienced by several countries challenged this pattern of accumulation.

In the first case, countries like Chile, Colombia, Peru, Costa Rica, Panama, Mexico and even Brazil, aside from the balance that may be the result of this option's social and environmental impacts, have endorsed the general direction taken by the above-mentioned exogenous model. This was possible because they promoted modernization and competition processes, particularly in their agricultural economies, and by strengthening the position of their exported products in international markets; also important are their links to transnational capital investments associated with their mining sectors and with financing capital. Essential components in the direction taken by the economy in this group of countries

1 *The Poverty-Environment Initiative applies a methodology for the work of integrating the environmental dimension in the fight against poverty. This methodology is already used in several countries, mainly in Africa. Since 2008, this work has extended to Latin America and the Caribbean. For more information, see www.unpei.org and www.pobrezaambiente.org.*

are the Free Trade Agreements (FTAs) signed with several world powers (e.g. the U.S., the European Union, China and Japan), that have favoured this mechanism as a framework for trading with the rest of the world.

In the second case, despite having also travelled along contradictory paths of structural adjustment and having achieved different growth rates, these countries found that the model was unable to prevent the persistent impoverishment of the majority of the population (ECLAC, 2007). This led to their questioning the unsustainable premises of the primary products-export structure that did not allow them to advance beyond their enclave-type economies, to achieve a reasonable level of production diversification, to benefit from technology transfer, to provide decent jobs, or to add local value to their production.

In several of these countries, emerging social sectors staged strong protests[2] demanding that: privatization contracts for water services be revoked; sovereign rights over natural resources be recovered; their economics be productively reactivated; and a boost be given to prioritizing their domestic markets, particularly in regard to agricultural production and food security and sovereignty and including greater concern for the environment. The challenge for these nations and the emerging debate about the outlook for structural change have highlighted the challenge of making a transition from a «poor low-carbon country» to a «rich low-carbon country» instead of from a «poor low-carbon country to a «rich high-carbon country»(Urioste, 2008).

This impression of how things have changed has resulted in various countries making very significant constitutional reforms; the new constitutional texts (notably in the cases of Ecuador and Bolivia) underscore their natural and cultural plurality as founding values, with extensive chapters on expressing, appreciating and recognizing the rights of indigenous peoples as well as environmental rights in a context which, for the first time in Latin America's post-colonial history, accepts the challenge of building States with a legal, political and economic plurism to reflect their natural and socio-cultural diversity.

Indeed, the Ecuadorian Constitution (2008) «recognizes the right of people to live in a healthy and ecologically balanced environment that ensures sustainability and good living, *sumak kawsay.*» For its part, the Bolivian Constitution (2009) brings together the plurality of the country that the constitution recognizes as multinational, and says that «the State assumes and promotes as ethical and moral principles of a plural society: *ama qhilla, ama llulla, ama suwa* (do not be lazy, do not lie or steal), *suma qamaña* (live well), *ñandereko* (harmonious life), *teko kavi* (good life), *ivi maraei* (land without evil) and *qhapaj nan* (noble road or life)»[3] . What should be emphasized here, beyond the recognition of the value of natural diversity and cultural plurality as attributes of the countries of the Region, is the new all-inclusive inspiration demanding that development policies be formulated.

Another key issue when designing new models is the criticism made of the centralism that has been characteristic of decision making in some countries and with increasingly diverse regional realities that make the idea of political decentralization go hand in hand with defining schemes that seek to institutionalize different types of citizen participation throughout the development process, from the planning stage to implementing and evaluating programmes, plans and projects.

It appears from this experience that making «combating poverty» part of the development model prevailing in the Region has also been questioned. Policies to reduce poverty rates in the countries of the Region have consistently shown the limitations of this approach by being disassociated from others that seek to promote economic growth to meet social development objectives; the last mentioned, in turn, have shown that their structural effect on reducing poverty is not an automatic consequence of growth itself if the redistributive policies of surpluses generated are not an organic and explicit part of the overall design and that, whether actively or passively, they have maintained the dual nature of their societies. This assertion has been even more dramatic in countries that have kept social spending relying on unsustainable percentages of international cooperation resources.

From social disintegration and social dualism to assessing socio-cultural diversity and urban-rural integration

At this point a brief stop will be made in the analysis of the effects of migration (rural-urban) on economic

2 *Remember the iconic «Water War» (De la Fuente, 2000) and «Gas War» (Tintaya, 2004) who lived Bolivia in the early years of the last decade.*

3 *The expressions in the languages Quechua, Aymara, Guaraní, and Chiquitano Moxeño (majority indigenous languages) have been taken verbatim in the new Bolivian constitution*

restructuring and the demographic change that has taken place in recent decades in the Region. It might be generally agreed that the chronic lack of policies to promote rural development, and how dazzled governments are about *modernizing* their societies, has mistakenly led to agrarian-peasant economies being condemned due to a lack of awareness about the complexity of the rural world and its potential to contribute to the synergic development of the economy as a whole and, at the same time, condemning as unfeasible its possible and necessary competitive transformation and leading to rural areas being systematically abandoned.

The resulting changes have translated into increased urban population, and a new structure of job generation and wages explained by the workforce becoming informal and feminized, especially in service sectors and the domestic market, a transformation characterized by the emergence of the *popular urban economy* (Wanderley, 2003). Moreover, the structure of the economy during this period reflects a highly volatile productive base that creates jobs but not income, tries to diversity but fails to make a solid entry into the global market, and does not generate savings, productive investment or sustainable economic growth.
In this context, the unstoppable emergence of new social stakeholders, among them indigenous peoples and original communities recently recognized as *legal persons* for inclusion in the legal economy of most countries of the Region, shows how complex are the responses the new situation requires.

The demands of the indigenous and still predominantly rural populations have changed significantly from those related to social and economic rights to others that are more political and integrated, and have to do more with their self-identification as distinct cultures and peoples that want to exercise their individual and collective rights on an equal footing with other sectors of society. Thus the struggle for recognition of their land rights (see Box 5.2), having access to their original lands and the natural resources they have traditionally used, how they manage them, their practices and customs, their organization and authorities, their traditional knowledge[4] and value systems, is now evident in a way that is unprecedented in the continent's republican history.

According to the above analysis, the new structural transformation in most of the Region's countries faces the challenge of changing a subsistence agricultural economy to one that is a model of systemic competitiveness, based on a new urban-rural concept and relationship, and that opens regional links with new dynamic markets. This can be achieved by transforming natural resources by including technological and symbolic added value, providing decent jobs and working conditions to correct present international trade imbalances, and by not repeating other countries' recent

4 *For example, recent archaeological investigations have uncovered the spectacular results of the management systems of water resources in ecosystems as diverse as Lake Titicaca and the plain of Moxos. In the first case, there is evidence of at least 40 000 hectares of suka kllus or waru warus; these are ridged fields called «camellones» built by the Tiwanaku culture on the perimeter of the Titicaca Lake (1500 BC - 1200 AD), where yields have been obtained of up to 10 tonnes of potatoes per hectare (PROSUKO, 2008). The second is a vast plain of clay soil watered by several rivers of the Amazon basin in the department of Beni (Bolivia), where the Moxos culture (1000 BC - 1400 AD) developed a hydraulic system based on channels slopes, embankments, lakes and ridges that allowed floods and droughts to be controlled, as well as maintaining an extensive system of farming and agriculture in a basin of more than 180 000 km2 (Painter, 2009).*

BOX 5.2

The Recognition of Indigenous Land Rights

After the Law of Agrarian Reform Law was adopted (INRA, 1996) about 53% of titled land in Bolivia became communal property and Community Territories of Origin (TCO) or designated indigenous territories covering very extensive areas but generally with a low population density. During this period titles were given to 149 TCOs for 15.5 million of Bolivia's 108 million hectares. This area is larger than the whole of Nicaragua, the largest country in Central America (about 13 million hectares) and home to approximately six million people of whom two million live in rural areas and four million in cities. Colombia (with an area of 114 million hectares) has 710 Indigenous Reservations on a total area of 35 million hectares of Amazonian lands and plains, home to about 940 000 people belonging to 86 indigenous groups. They are 2.2 per cent of Colombia's total population estimated at 43 million; of these groups 29% live in rural areas and most of them are considered to be mestizos (mixed ancestry) and campesinos, (www.acnur.org based on data from DANE, 2005). Unlike Bolivia's new Constitution, in these reservations the indigenous peoples of Colombia do not have a right to the exclusive use and exploitation of renewable natural resources (Political Constitution of Colombia, art. 330.

Source: Chumacero, 2009.

experiences –China, India or Vietnam– whose agricultural economies became part of the industrial sector but where environmental standards are very low.

Indigenous people, usually associated with rural isolation and the traditional agricultural universe, are now increasingly moving to a new urban situation to which they bring many of their own methods of organization, customs and traditions; in many cases they make up a significant percentage of the population in intermediate cities where their socio-cultural networks play an important role in articulating the new popular urban economies described above and which, among other functions, serve to link rural production to urban markets as well as multiplying and diversifying services such as transportation and trade that make such a link possible.

From rampant and uncritical consumerism to a new model of production and austere, sufficient and sustainable consumption

The background to the above is made up of the multiple cultures and ways of life that today coexist in Latin American and Caribbean societies and how they are systematically changing current production and, more especially, consumption models of the most influential sectors and developed countries.

While it is true that society's initiatives are often limited, induced or influenced by structural conditions (e.g. the energy matrix) in each country, it is equally clear that many decisions made by society and individuals, dictate how each country finally determines its ecological footprint. These decisions directly relate not only to levels of education and information to which the population has access, but also to ethics and levels of awareness that have more to do with the way things are and how they are being done, the way a particular community lives and thinks at a given moment in history, as shown by how it holds fast to community and family values inherited from past generations by sharing them with its contemporaries, and by its ability to critically evaluate and transform them.

In this respect, it should be emphasized the importance of having social reproduction mechanisms in the framework of the hard-to-escape trend of cultural globalization /homogenization[5] that is today affecting

the world. In this regard stress should be placed on the public policies that are the responsibility of States, organizations that represent society, families and individuals with respect to at least two key areas: the media and education.

From stand alone to regional action in international negotiations

Finally, among the general issues of the present critical review of development policies and their role in environmental concerns, mention must be made of the international global and regional context and the changes taking place in what is an asymmetric and unequal, but increasingly interdependent, interaction between the countries of the Region, and between them and the rest of the international community.

On one hand, the indisputable findings of the scientific community have helped to disprove the uncertainty that until recently some countries used as a pretext for failing to comply with their responsibilities under international instruments related to the reduction of greenhouse gas emissions to prevent the undeniable human-induced phenomenon of climate change; the next step is to take procedural measures to modify their production and consumption models so that they can be assessed over the short, medium and long term. However, in view of the results of the last Conference of the Parties on Climate Change (Copenhagen, December 2009), a major effort

5 *See the UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Expressions, 2005.*

is clearly required to achieve a binding agreement that would require each country to assume its own responsibilities.

On the other hand, the failure of World Trade Organization (WTO) international negotiations has been attributed to the developed world's resistance to abandon its policy of subsidizing agricultural production, not only to benefit global competition between the developing world's agricultural economies, but to achieve what could be a fairer balance by opening up unsuspected opportunities for the countries of the Region in world trade and for their own domestic needs. In this respect, it is important to highlight the measures Brazil adopted in the first months of 2010 by charging high taxes on subsidized agricultural products from developed countries, a measure that was also extended to such thorny issues as the pharmaceutical industry and intellectual property rights[6].

In addition to this example, it is worth analysing the results of the Summit of the Americas on Sustainable Development (Santa Cruz, Bolivia, 1996) or the Region's recent economic integration agreements and politics by forming such regional economic blocs as: Southern Common Market (MERCOSUR), Andean Community of Nations (CAN), Bolivarian Alternative for the Peoples of Our America - Treaty of Commerce of the People (ALBA-TCP), Caribbean Community (CARICOM), Central American Integration System (SICA), to recent political agreements such as the Union of South American Nations (UNASUR) and the Commonwealth of Latin American and Caribbean regional integration body recently established (February 2010) by the 32 countries of the Rio Group and CARICOM to express with one voice the interests of Latin American and Caribbean countries.

Although it remains to be seen whether these new schemes are effective and are able to make use of efficient instruments –for example concerning environmental policy– it is to be hoped that the political will that drives them can be translated into policies and commitments on all the themes on the international agenda, including directing development and trade and environmental policies, and that they will take advantage of the different successful sub-regional agreements already being applied, such as the environmental agreements of MERCOSUR and CARICOM, among others.

6 See Osava, 2010, IPS, http://www.ipsnoticias.net/nota.asp?idnews=94963

2.2 The Environmental Policy: from sectorial emphasis to transversal emphasis

Ever since, more than twenty years ago, the countries of the Region began to build environmental agendas, they have made undeniable progress in terms of establishing an increasingly broad and complex *regulatory framework* and associated *policies, plans, programmes* and *projects* as well as *institutions* to assume responsibility for implementing the action proposed in such instruments. These advances have been described in the many national and sub-national GEO Reports produced for the Region that take account not only of the achievements but also of the difficulties, shortcomings or inconsistencies in the overlapping synergies between these components that could, in each case, affect the sustainability of environmental management.

With regard to the regulatory framework, the cornerstone on which to base all further action consists of the general laws on the environment and their respective regulations from which different levels of legislation and regulations have been developed over a broad range of specialized topics such as: environmental quality standards and environmental assessment procedures that apply to public and private projects in the different productive sectors (mining, oil, industry) and services (energy, transport); establishing policies, strategies and institutions for natural and cultural heritage preservation (protected areas, genetic resources, traditional knowledge); and even instrumental aspects of sectorial policy such as participation and consultation mechanisms of the social sectors involved in the various areas (Jacobs , 2002) of environmental education and communication, trade policy or fiscal policy.

At this point, however, and in spite of the important differences between national experiences that make it impossible to generalize at the risk of committing unintentional injustices when mentioning success stories, or of neglecting to point out difficulties, it may be said that in most cases environmental policy has been restricted to the *sectorial* aspect of public policies, without having achieved the necessary transversalization that should become an obligatory and permanent component of the other sectorial policies and instruments.

As stated in Chapter I of this report, it is clear that competition for resources and the relative importance of the decisions taken by governments have always outweighed the arguments of immediate returns and the short-term goals of projects that have not always been given adequate consideration to and/or included the issue of social and environmental sustainability; the result is often ineffective environmental regulations that display the weakness of the institutions responsible for applying them.

It should be taken into account that, despite the strength of their institutional systems, some countries do not have an effective environmental policy; this can be either because the authorities lack the political will or the ability to influence sectors that have placed their own self-interests above the regulations and the majority's social interests; however, other countries with relatively weak institutions have made significant progress in environmental policy after having secured a commitment from the various sectors involved. It appears that now the overall challenge is to achieve *transversalization*, maintaining the integrated and holistic environmental perspective in general development policies[7] and those resulting from the crisis that is forcing the adoption of urgent measures to mitigate its effects on the Region's economies, its social fabric and environmental health, which demand broad and effective coordination with all sectors of society.

However, what has been stated should not be understood as belittling any of the advances achieved and, much less, any public-environmental institutions whose capacities must be strengthened in terms of human resources, logistics and finances if national

7 *Sustainable Development Summit, Action Plan, Johannesburg, 2002.*

legislation and public administration statutes are to be effective. On the contrary, advances must be made in getting policy-makers and those responsible in the different sectorial areas to include the theme in each country's development policies and strategies.

When considering desirable medium- to long-term outcomes, from now on particular emphasis should be placed on training human resources to be responsible for taking government action and for the public information and communication policies designed to present the general public with «common sense» environmental policy goals; this will build an interested critical mass and a *social control* capability to enable account rendering institutions to present transparent government action by acting as monitors to ensure the sustainability of development decisions and actions, and to prevent the imposition of spurious minority interests or of those that make illegal commitments on behalf of the state (Osorio Vargas, 2006).

To ensure that this design extends from local projects to major national policies and plans and, of course, to transboundary and regional enterprises, the proposed institutions should allow the public to participate in all the stages of planning development projects, and at all levels of political and administrative decentralization. Actions and initiatives should have specific objectives and be backed by mechanisms to check the results. It is also important to build on already-existing institutions [8] and include the item on the agendas of companies, business councils, trade unions, campesino organizations, neighbourhood associations, NGOs, and civil society networks, as well as in areas of public-private-social dialogue and consultation such as Development Councils, Inter-ministerial Committees, and Management Committees.

From the same point of view it is desirable that the most sensitive and responsible sectors committed to the environment move from an «environmentalist» position to one that considers multi-dimensional development and the decisions that make it possible. This would do away with the suggestion of partiality that at times stigmatizes environmental objectives without taking into account legitimate aspirations concerning the sustainable use and exploitation of natural resources in socio-economic development activities and, therefore, to some extent helping to isolate the most committed community. To this end, emphasis placed on resource conservation and environmental quality should be a proactive ecosystem approach that seeks a better balance between WHAT to do concerning the environment and HOW to do it in all areas of interest, particularly the economic and social.

In that regard, work on the environment requires new and stronger partnerships to be forged not only among those already convinced and whose work in the sector is non-competitive and inclusive; but there is also a need for more partnerships between public and private stakeholders prepared to make greater efforts to ensure compliance with the law and who will consider the costs and benefits of taking an integrated approach to their daily activities and when making policy decisions that involve environmental commitments. To guarantee that public policies are integrated it is equally important to consider innovative practices and scientific findings that global society has developed in all areas to ensure a constant exchange of experiences and reciprocal learning.

8 *In each country the different stakeholders have expressed themselves in different ways, according to their distinct own characteristics and conditions. For example, business organizations in Argentina (BCSD), Bolivia (CEDES), Colombia (CECOD), or national chapters of the World Business Council for Sustainable Development (WBCSD , or NGO networks and other expressions of civil society that make up an extensive network of stakeholders in the Region.*

3. Tools for Action

Specific suggestions made in this section are based on concrete cases that exemplify how the different points raised are applied; this is an attempt to provide substantive and methodological elements that will allow shortcomings to be dealt with and advantage to be taken of the new opportunities now appearing in the Region.

BOX 5.3

Ecological Land Use Planning in Mexico (OET)

The history of the Mexican experience with institutional OET dates from the 1980's and has advanced so that it now covers a good portion of the country.

Despite its interesting contributions, implementing it as a policy tool has been conditioned in certain areas of the country by its detachment from urban planning and from exploiting strategic resources.

While the law grants legal authority for land use planning to municipalities, most land use ordinances have been made by state governments with no jurisdiction to do so.

Ecological Land Use Planning (OET) has been helped by the practice of indigenous communities planning land use in their territories; although not illegal, this could lead to jurisdictional issues being raised with their municipalities and making it necessary for both parties to come to an agreement.

Because the legal framework is ambiguous, many of the land use plans made by state governments should, in fact, be dealt with by federal authorities.

Experience assessed to date shows that it is essential to:

- *Promote municipal authorities' participation in discussions about and the development of OET, particularly in community systems to prevent conflicts;*
- *Promote discussion about the methodological foundations of OET to explicitly place urbanization processes and the regulation of areas of strategic natural resources on OET agendas, and*
- *Review the legal methodology used to issue an OET in order to improve the regulations.*

Source: Azuela, 2006.

3.1 Approach to land use planning

The territory is a socio-geographic space that has been built both culturally and historically by the interaction between human beings and between them and nature; it includes multiple environmental, economic, political, institutional, social and cultural dimensions. The territory is, therefore, associated with a sense of identity and belonging where people are considered to be historic human beings still in the process of being constructed.

The territory's communities make use of its natural resources to establish their methods of production, consumption and how they interact, their economic strategies and lifestyles that express practices, principles and values regulated by certain systems of social and political-institutional organization. The territory is woven from the fabric of social communities that can handle uncertainty, solve common problems and achieve shared aspirations (Jara, 2009).

Land use planning is an approach that gives a complete view of all the resources and dimensions involved in a

development process. It has three inseparable elements: land; resources; participation of all relevant stakeholders. Thus, a territorial-based planning process begins with enclosing the land (of a municipality, city, state, community, watershed, or an eco-region), enabling its application at different scales. Identifying resources includes not only making an inventory of them but, and above all, of their availability, quantity and function. In this case it is a matter of covering as widely as possible all potential resources likely to be exploited for local development: natural resources (renewable and non-renewable), water sources, present use, historic use, existing services, relief, landscape, accessibility, history, and culture. Finally, with regard to the social component, this is a matter of identifying how the population is occupied and their relationship with the territory, its organization, its authorities and management, and the risks of making improper use of existing resources.

However, what specifically characterizes this methodology is its participatory approach. This procedure entails a «bottom-up» procedure and a review of the role of traditional institutions responsible for planning, discovering how officials defined, collected and analysed the data and prepared a plan which, once approved, was passed to other officials in other institutions to be implemented. Now when plans are prepared the stakeholders who ultimately must put them into effect seek greater involvement. Planning is done by interested groups, perhaps with technical and methodological support from a planning institution which, although it still has a technically limited role, now simply facilitates the process (Van Leeuwen, 2000).

Participatory planning is characterized (FAO, 1993) as a process that:

- teaches everyone involved;
- is based on the real problems of people and/or institutions;
- benefits everyone involved;
- strengthens the power and roles of local organizations and communities;
- establishes coordination and cooperation between different levels of stakeholders;
- provides safe, timely and easy-to-understand information.

If consensual planning is to be achieved in the Region concerning the problems and needs not only of those now involved but also of those who might be affected in future, it is important that the planning process include all stakeholders with a significant and relevant role to play on the issue or problem under consideration. Only then, beginning from the planning process, will a compromise be reached between the different interested groups regarding compliance with the programme, since they themselves will identify, analyse and solve their own problems.

Several countries in the Region have used this tool to institutionalize their own land use models in an attempt to provide the methodological bases to apply them throughout the territory. The cases of Mexico and Costa Rica outlined in Boxes 5.3 and 5.4 stand out.

BOX 5.4

Land Management in Costa Rica: Legal and Operational Instruments

In 1994 Costa Rica created the National System for Sustainable Development (SINADES) to establish the legal and methodological bases for land planning (OT) at national level.

Five elements were used on which to base the scenarios for the Costa Rican legal land use system: 1) political-administrative planning; 2) geographical planning; 3) environment and natural resources; 4) socio-cultural aspects; and 5) economic aspects.

The land use scenarios proposed for 2025 identify strategic development opportunities in Costa Rica. Opportunities in the country are stressed concerning:

(1) Research, development and use of biodiversity;
(2) Tropical forests and carbon sequestration;
(3) Water resources protection, management and utilization;
(4) Environmental Tourism;
(5) Marine resources protection, management and utilization;
(6) Developing and producing advanced technology and providing highly specialized services; and
(7) Industrial production/clean agroindustry with high added value.

The current main land use problems in Costa Rica relate to vested interests or attitudes, the poor quality of existing information, institutional disarray and an outdated framework of laws and regulations. It was also seen that planning and land use tools used in Costa Rica are either not well developed or even contradictory. Another powerful obstacle identified is the present emphasis on a unilateral interpretation of the meaning of private property.

Source: Ministry of the Presidency and Planning, Costa Rica.

Urban Land Use Planning

Given how the process of expanding urbanization has developed in the Region, events have often occurred –particularly in megacities and medium sized cities– much faster than the institutional responses which, it is to be hoped, have had an *ex post* remedial role to play when many of the problems created by lack of foresight imply far most costly solutions or simply cannot be solved, meaning that immediate conflict is inevitable.

To prevent this from recurring, urban land use planning tools should be applied so that a repetition of unwanted externalities can be avoided, and solutions assured for anticipated problems for which stakeholders in all the sectors involved share responsibility.

Urban land planning allows integrated treatment to be applied to the following aspects: physical, demographic, social, economic, environmental, basic services, roads, urban landscapes, and the settlers' cultural matrix, among other variables.

Box 5.5 gives an account of an interesting experience in the Colombian capital concerning this material.

BOX 5.5

Land Planning in Bogota

The city of Bogotá is considered to be a case of a local-level environmental success in land planning and management. The Capital District authorities, together with citizens and intersectorial representatives, formulated the Environmental Management Plan 2001-2009 which, added to the establishment of a Regional Planning Board, has allowed land management that combines the demands of the population with the environmental standards included in urban management (DAMA and UNEP, 2003 and UNDP, 2008). Similarly, the creation of a Capital District Environmental System in which guidelines, standards, activities, resources and institutional competencies are outlined, as well as an Environmental Information System (SIA), has allowed the Management Plan's land planning component to be followed up, mainly where land use is concerned. These initiatives have drawn on a fund called FOFIGA that obtains its resources by imposing penalties, fines, redistributive taxes, compensatory rates, water use rates, transfers, and others.

Source: DAMA and UNEP, 2003 and UNDP, 2008.

Rural land development and natural capital and biodiversity management

In the case of rural areas –that harbour practically the whole range of biodiversity– land planning should not only help address the challenge of getting local stakeholders to solve problems, but also to abolish the prejudices, disparaging behaviour and subordination that often affect rural development policies in the high government (urban) circles responsible, among other things, for allocating resources. These policies were based on simplistic visions that viewed development processes as being linear and one-of-a-kind phenomena: humanity advances from the *old fashioned* to the *modern*, from rural to urban, from agricultural to industrial.

Table 5.1 shows a comparison between traditional and territorial approaches to rural development applied by suggesting that the sectorial view of what is rural in the first case be changed to a more integrated and holistic approximation as described in the introduction to this section. Thus, while the traditional approach what is rural and places itself within a demanding space , the territorial approach seeks to include rural issues among the multiple interactions developed with the surrounding environment to determine, both from within (worldviews and historically defined cultural practices) and from outside (urban realities and stakeholders) how to plan a type of development that interacts with the markets and applications to which it seeks to respond. The purpose is to optimize the timing and targets of investments while productivity ceases to be a purely technical issue, to become a variant with multiple determinants that make use not only of physical factors of production but also

TABLE 5.1

Alternatives to Conventional Rural Development Approaches

Traditional approach	Territorial approach
Decentralization and State Reform	Land Use
Participation and Compensation	Cooperation and Inclusion
Environmental Outlook	Sustainable Development
Agricultural Economics	Territorial Economics
Technology for Productivity	Technological Innovation and Territorial competitiveness
Passive Information Systems	Live Knowledge Management Systems
Physical Capital	Natural Capital, Human Capital, Social Capital
Urban – Rural	Smooth Urban-Rural Flow
Sectorial Emphasis, Focus on Products	Multisectorial Approach, emphasis on productive chains and clusters
Supply Policies	Demand Policies

Source: Rural development territorial approach, IICA proposal, Barril (2009).

of territorial, historical, cultural, and social organization dimensions, as well as of the capabilities and opportunities to turn these resources into real capital.

This challenge includes the need to assume the complexity of the new rurality, distinguished by several paradoxes such as the fact that it is in rural areas where there is most poverty and inequality, hunger and food insecurity alongside productive diversification (community agro-ecological diversity continues to be the largest gene bank[9]) and some degree of modernization even in traditional agricultural sectors. The exchange between the countryside and the city is unequal where migration (temporary or permanent) favours greater integration of rural goods and services into nearby markets and urban centres, increased human resources training in rural areas close to the immediate source of centuries-old traditional knowledge, and the intangible heritage of indigenous communities. The dual nature of the rural development model allows exports (commodities) to be integrated into the economy and world markets while there is increased pressure on natural resources (particularly forests) to expand the agricultural frontier for planting extensive crops and open new settlement areas, with the subsequent loss of biodiversity and the erosion of ecosystems, among other effects. This situation produces a picture of new and old stakeholders that is equally complex.

Reversing this situation calls for the adoption of a new systemic and inclusive regional vision that: 1) values the *multifunctionality* of agriculture and the rural world; 2) goes beyond the sectorial approach by recognizing the role played by the great diversity of stakeholders; 3) points to preserving productive diversification, institutional innovation, conservation of natural resources and social inclusion: for all this the obligatory starting point is a decentralization of the decision making system in favour of the «network of networks» that shapes rural, and particularly community, societies (Barril 2009). On the other hand, it is easy to deduce that adopting the territorial approach to treating different levels of rural realities can make more flexible the application of the precepts of the *Ecosystem Approach* described below.

9 *For example, the Proimpa gene bank (La Paz, Bolivia) has 3166 records for potatoes, tubers, roots and logs 4315 Andean grain quinoa. http://www.proinpa.org/*

3.1.1 The ecosystem approach

The ecosystem approach, defined by the Convention on Biological Diversity (CBD), has the following characteristics:

- **It is integrated:** The tendency now is to manage ecosystems to obtain a dominant good or service such as, for example, fish, timber or electric energy, without at the same time being fully aware of what is being lost. It is, therefore, possible that more valuable goods and services are being sacrificed than those obtained, for which usually no market value has been assigned, such as biodiversity or flood control. To ensure that tradeoffs are efficient, transparent and sustainable, an ecosystem approach considers the whole possible range of goods and services and tries to optimize the mix of benefits for a given ecosystem and between various ecosystems.
- **It redefines the boundaries that have traditionally characterized ecosystem management**. It is recognized that ecosystems function as complete entities and need to be managed as such rather than in parts. Given that ecosystems cross borders between states and countries, this often involves going beyond jurisdictional boundaries.
- **It adopts a long-term view.** Ecosystem processes and associated timescales are respected.
- **It includes people**. Social and economic information is combined with environmental information about ecosystems. This implies an explicit relationship between human needs (human well-being) and the capacity of ecosystems to satisfy them.
- **It maintains the productive potential of units**. According to this approach, management is not successful unless it preserves or increases an ecosystem's future capacity to produce the desired benefits.

The ecosystem approach can be used in many different situations of resources management. Box 5.6 presents an analysis of a wetland in Cuba that uses this approach.

Different specific tools are used to effectively implement the ecosystem approach, an example of which is payment for ecosystem services. The basic idea is to identify an ecosystem service (e.g. maintenance of the quality and quantity of water produced by a watershed) and reach a compromise between the service providers (inhabitants of the upper parts of the basin) and those who benefit from the service (towns or industries that use the water downstream). REDD - Reducing Emissions from Deforestation and Forest Degradation - is an important initiative to tackle climate change based on payment for ecosystem services schemes (see Boxes 5.12 and 5.22).

Water resources management is one of the most important areas where the ecosystem approach is applied. In this regard, the well developed methodologies of Integrated Water Resources Management (IWRM) and Integrated Watershed Management (IWM) have been prepared as instruments that are very close to this approach; the main difference is that, to ensure compliance with a larger number of variables that make the analysis more complete, the ecosystem approach does not refer only to water resources but to all the elements in the territorial, social, economic, political and cultural environment,

UNEP and IUCN carried out a study on applying the ecosystem approach to water resources in eight cases in the Latin American Region, the main conclusions of which are described in the 12 principles outlined in Box 5.7.

The study of the conditions and trends of ecosystem goods and services (Chapter II); the relationship between ecosystem services, stress factors and human well-being (Chapter III); and scenario building and analysis (Chapter IV) are part a range of tools needed to implement the ecosystem approach.

BOX 5.6

The Ecosystem Approach to Analyzing the Ciénaga de Zapata, Cuba

In the province of Matanza, Ciénaga de Zapata, that covers 4,500 km² and has a population of 9,084, besides being Cuba's largest wetlands area, is one of the largest in Latin America and the Caribbean. It is a Biosphere Reserve and a Ramsar Site. The principal economic activities are silviculture, apiculture, fishing, local industry and tourism. The services provided by this ecosystem have been modified, either directly or indirectly, by the synergetic repercussions of three pressures:

Water regime alteration (anthropic character) as a result of constructing large hydrotechnique works for dams, changing water flows and exploiting aquifers, as well as road infrastructures. Altering natural water flow patterns, together with a lowering its quality due to aquifer salinization, and pollution caused by human activities, changes how wetlands function, has a significant effect on biodiversity, causes habitat loss and reduction, fragmentation of the ecosystem and a reduction in species. As a consequence, this has had an effect on regulation and support related to the nutrient cycle and supply services by reducing food sources and water quality.

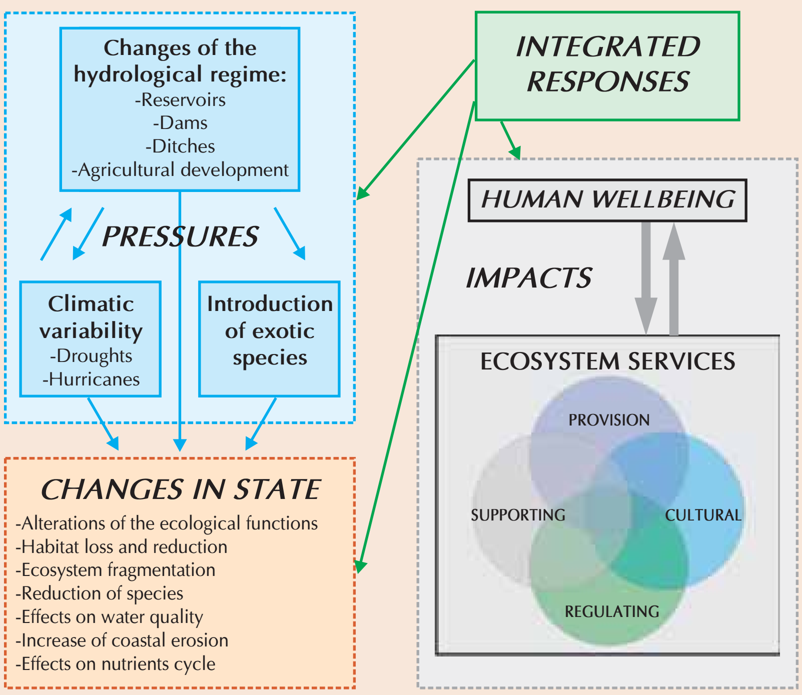
Introduction of exotic species (anthropic character) which is fundamentally due to the propagation of numerous exotic and native species of invasive behaviour, as well as the expansion of the species Clarias sp. This species was being controlled in the reservoirs' aquaculture sites but has accidentally spread during flooding and dam overflows. All this is considered to be a critical environmental problem for the Ciénaga biodiversity, and it puts a limit on specialized activities such as ecotourism and river fishing.

Climate variability (natural character) especially resulting from droughts alternating with hurricanes that cause severe damage to flora and fauna and favour large amounts of combustible material being accumulated which, during drought periods, cause extensive forest fires. The result is even more deterioration of biodiversity, environmental quality and of the ecosystem's beautiful landscape, making it less possible to develop recreation and tourism (cultural services) activities.

The effects on environmental services and the impacts on human wellbeing have been lessened by social development policies and projects designed to protect and manage, among others: resources; recreation and tourism; environmental education; scientific research and monitoring; social development; sustainable socio-economic activities; and training.

Efficient environment and natural resources management needs assessments to be made of the environment by using a systematic approach that elicits integrated responses based on: the inter-relationships between pressures; the state and how it changes; the impacts on the ecosystem's services and, therefore, on human wellbeing; and this has been demonstrated in the Ciénaga de Zapata.

Analysis of main interlinkages in the Ciénaga de Zapata



Source: GEO Cuba (UNEP 2009d)

BOX 5.7

Principles of the Ecosystem Approach Applied to Water Resources

1. *It should be left to society to choose how land, water and live resources are managed.*
2. *Management should be decentralized at the lowest appropriate level.*
3. *Ecosystem administrators should consider the effects (real or potential) of their activities on adjacent and other ecosystems.*
4. *Given the potential gains from managing such resources, ecosystems must be understood and managed in an economic context. Programmes of this type should help to:*
   - *a) Reduce market distortions that adversely affect biological diversity;*
   - *b) Provide incentives to promote conservation and sustainable use of biodiversity;*
   - *c) Include the costs and benefits in the ecosystems concerned in as much as possible.*
5. *Conservation of the structure and function of ecosystems should be prioritized in order to preserve ecosystem services.*
6. *Ecosystems should be managed within the limits of how they function.*
7. *Apply the* ecosystem approach *to the appropriate spatial and temporal scales.*
8. *Establish long-term objectives for ecosystem management, given the varying time scales and the delays that characterize ecosystem processes.*
9. *Recognize that change is inevitable.*
10. *Seek the appropriate balance between conserving and integrating biological diversity.*
11. *Take account of all relevant information, including knowledge, innovations and the practices of scientific, indigenous and local communities.*
12. *Involve all sectors of society and scientific disciplines.*

Source: IUCN-UNEP, 2006.

3.1.2 Payment for environmental services and green enterprises

Economic valuation of resources

The concept of «environmental accounts» arose when it became clear the need to describe the contribution made by the environmental subsystem to how development is perceived, as well as in designing and using instruments to achieve it. In other words, the «environmental accounts» concept is an analysis platform that applies monetary values to one or more elements of natural capital in order to adjust key macroeconomic indicators and to influence development policy decisions. Within the spectrum of environmental accounts it is recognized that the System of Integrated Environmental and Economic Accounting (SEEA) is the most appropriate model to incorporate measures that reflect the impacts of economic processes on the environment and the real contribution that natural heritage makes to development (IARNA, 2009). Box 5.8 shows how this instrument is being developed in the Region's countries.

Pagiola and others (2005) examined both the obstacles facing different payment schemes for environmental services in Colombia, Costa Rica and Nicaragua linked to a Silvo-pastoral Ecosystem Management Project of the World Bank as well as the advances achieved. The results described show that these programmes allow changes in land use as long as payments are initially defined in terms of the competition, and that there is consistent and systematic monitoring of the owners'

BOX 5.8

The System of Integrated Environmental and Economic Accounting (SEEA) in Latin America

In recent years the use of SEEA in Latin America has been revitalized. Several countries in the Region have begun to develop plans to implement the system in the next few years, although advances have been mixed. To better understand the current situation it was decided to categorize the countries of the Region into four groups and by doing so to obtain findings of interest according to the level of implementation. The first group consists of countries regarded as having made relatively good advances: Mexico, Colombia and Guatemala. The second is made up of countries that at some point developed environmental accounts exercises which, for various reasons, were not continued: Chile and Costa Rica. The third group (Dominican Republic, Panama and Nicaragua) consists of countries with somewhat more formal current plans but where advances have been incipient. The fourth is the group of countries that have no plans to prepare the accounts, have shown little interest in developing them, or had plans that never materialized.

Source: IARNA, 2009.

economic and social well-being. It was also seen that the projects' medium- and long-term financial sustainability should be linked to local resources; for example, paying environmental royalties for using water resources. Similarly, whether or not these programmes achieve their goals depends to a great extent on their level of local legitimacy and that they establish, in their different states, promotion mechanisms to show local stakeholders the importance of the objectives in terms of the common good.

Box 5.9 describes experiences of economic assessments made of environmental services in Guatemala and Costa Rica.

Internalizing costs and promoting green enterprises

The objective is to internalize environmental costs in activities and sectors where they are high, while making more profitable the activities, sectors, and technological

BOX 5.9

Regional Experiences in the Valuation of Environmental Services

Forestry Incentives Programme (Pinfor), Guatemala. *This is an economic instrument that aims to promote the country's sustainable forest production by stimulating investment in reforestation and natural forest management activities. It makes direct «forestry investment certificates» payments to landowners who carry out activities to protect forests. By 2006 these payments amounted to about $US81.6 million of which more than 50 per cent was spent on local labour, i.e. providing jobs. The programme has succeeded in including in forest activity 53,700 hectares of deforested land by planting and natural regeneration management. Most of these lands are used for crops like corn or as pastures. Also included in sustainable management plans are 130,000 hectares of natural forests (Revolorio, 2007).*

The Sierra de Las Minas Water Fund, Guatemala. *This is a technical and financial strategy driven by the Fundación Defensores de la Naturaleza (Defenders of Nature Foundation) to preserve the Sierra de Las Minas Biosphere Reserve and, at the same time, ensure a continuous supply of fresh water for users in the Motagua-Polochic complex by means of watershed conservation and sustainable management. While the Fund has become a compensation for environmental services (CES) systems, it considers various financial services that seek to achieve sustainability and provide short- medium- and long-term benefits as well as to enable those who use water resources to make their water use and management practices more efficient and sustainable. It promotes two basic mechanisms: a credit programme and a small grants programme. Because there is no general water law this initiative has been welcomed by local communities, by business, and by the international community.*

Payments for Environmental Services Programme in Costa Rica. *This financial assistance provided by the State, through the National Forestry Financing Fund (FONAFIFO), to finance reforestation, afforestation, forest nurseries, agroforestry systems, recovery of deforested areas and to make technological changes in how forest resources are used and industrialized. It is primarily meant for small and medium producers, by providing credits or other mechanisms to promote forest management (FONAFIFO, 2005). The programme has adopted a new financial scheme to allow different stakeholders to be included. Between 1997 and 2006 the number of contracts signed totalled 6 062 covering 532,668 hectares that use models on forest protection, forest management, reforestation, and planting. The protection of forests model covered a total of 471,392 hectares between 1997 and 2006, although there was a slight reduction in the last year.*

Admission fees, Costa Rica. *With 1.65 million foreign tourists visiting Costa Rica tourism revenue amounted to US$1 600 million in 2005, representing 7.4% of GDP. About 60 per cent of international tourists said they had visited protected areas. Of the country's 160 protected areas, 39 are considered to have potential for tourism while tourists now visit 32 (six of them receive large numbers of tourists). In 2004 public protected areas were visited by 800 000 people (53% foreign) and in 2005 revenue from admission fees alone was more than US$5 million (SINAC, 2006).*

Environmentally adjusted water tariff in Costa Rica. *Because the State recognizes the value of a public good (water) this is an obligatory quarterly tariff to be paid in advance to MINAET by every individual or company, and public or private water user. It not only produces income but also promotes efficient use of water resources. Before the tariff was applied the average water value benchmark was 0.0007 colons per cubic metre per year; under the new structure this rose to an average of 2.42 colons per cubic metre for surface water and 2.76 colons per cubic metre for groundwater. Amounts to be charged are established according to the flow awarded under concession and are differentiated according to use. Furthermore, in the case of groundwater, the complexity of its management is recognized, as is the value of its quality and safety and this is reflected in a higher charge.*

Source: TNC, 2008 In «Report on the State of the Central American Region on Human Sustainable Development»

TOX 5.10

The Economics of Ecosystems and Biodiversity (TEEB)

TEEB, a study on the economics of ecosystems and biodiversity, was launched by Germany and the European Commission in response to a proposal by the Ministers of the Environment of the G8+5 to develop a study on the economics of biodiversity loss. During 2010 reports will be launched and resources allocated to local authorities, businesses and citizens.

TEEB recognizes there is a global biodiversity crisis. The loss of forests, soils, wetlands and coral reefs is closely tied to their being economically invisible. Missed opportunities to invest in natural capital have worsened the biodiversity crisis. The report highlights four urgent strategic priorities:

- *Halt deforestation and degradation of forests,*
- *Protect tropical coral reefs,*
- *Protect and restore the world's fisheries,*
- *Recognize the close connection between ecosystem degradation and the persistence of rural poverty.*

TEEB emphasizes the need to access information for decision making. In this regard, the report shows that natural capital lacks measurement, monitoring and reporting systems. The first necessity is to improve and systematically use science-based indicators to measure impacts and progress, and to raise the alert about any possible abrupt ecosystem changes (or sudden collapse.) Another key need is to extend national and other accounting systems so that they consider the value of nature, and monitor how natural values depreciate or can grow in value by making the proper investments. New approaches to macroeconomic measurement should include the value of ecosystem services, especially for those that most depend on them (the GDP of the poor).

When it comes to possible solutions and instruments for better natural capital management, TEEB stresses the need to:

- *Compensate for benefits with specific payments and market mechanisms,*
- *Change environmentally harmful subsidies,*
- *Address losses by regulating prices,*
- *Use protected areas to add value,*
- *Invest in green infrastructure.*

As to the road that lies ahead, TEEB calls for those responsible for formulating and implementing public policies to lead this process of change, and to take the opportunity to forge a new consensus to protect biodiversity and ecosystems, as well as the services they provide.

Source: UNEP, 2009a.

options that have lower environmental impacts. To a great extent, this is done by making a detailed review of price distortions and policy failures, including how concessions, subsidies and tax breaks are awarded.

Unprecedented and significant efforts to move towards a «green» economy are also required. In this regard, in 2008 UNEP proposed the Green Economy Initiative that seeks to accelerate the transition towards an environmentally sustainable economy. Three documents are central to this initiative: i) the Green Economy report - to demonstrate that productive sectors *«greening»* has a positive effect on economic growth and jobs, and helps to fight poverty; ii) the report on Green Jobs that seeks to quantify and encourage the creation of decent green jobs; and iii) the assessment report on the Economics of Ecosystems and Biodiversity (TEEB); the last mentioned is outlined in Box 5.10.

In the context of this Initiative, and in order to give an immediate response to the financial and economic crisis with measures that accelerate economic recovery and, at the same time, stimulate growth according to long-term development needs, a group of relevant international agencies led by UNEP launched the GGND already mentioned in the introduction to this chapter.

The analyses made estimate that five sectors will bring higher economic returns, environmental sustainability and jobs - «green jobs»: 1) clean energy and clean technologies, including recycling; 2) rural energy, including renewable; 3) sustainable agriculture, including organic, 4) ecosystem infrastructure, reducing emissions from deforestation and environmental degradation (REDD); and 5) sustainable cities, including planning, transportation and green buildings.

3.1.3 National Protected Areas and Biological Corridors systems

Protected areas administration and management

The Second Latin American Congress of National Parks and other Protected Areas, held in Bariloche in October 2007[10], was an important milestone in reviewing the situation of the Protected Areas System in the Region and the prospects of its being strengthened and consolidated in the short term; it also considered the obstacles and limitations that still have to be faced. The theme of the most important regional forum on public, private and community efforts for the *in situ* conservation of natural wealth was strongly influenced by the discussions at the Fifth World Parks Congress (Durban, 2003) and the role played by the representatives of organizations and indigenous territories whose experiences greatly helped to redirect how conservation is practised in most countries of the Region.

During the Congress the Symposium on Governance in Protected Areas was held where it was recognized that an important advance had been made in applying different forms of governance and citizen participation in managing various protected areas and indigenous territories, reflected both in international agreements signed by Latin American countries and in national and municipal legislation. Box 5.11 describes the main challenges identified by the Congress in relation to protected areas management.

The Congress established a process to consolidate conservation areas systems. In general, although the process has been uneven, it could be seen that significant growth has taken place in the Region's area that benefits from some type of conservation[11]; this is more important given the global representation of the Region's

10 Report available at: http://cmsdata.iucn.org/downloads/memoria_bariloche.pdf

11 See Table 2.5 in Chapter II of this report.

BOX 5.11

Challenges Identified in Bariloche with Respect to Protected Areas (PA)

The declaration prepared by the Second Latin American Congress on National Parks and Other Protected Areas, held in Bariloche, Argentina, from 30 September to 6 October 2007 states that:

1. *Work still needs to be done on clarifying and contextualizing the concept of protected areas «governance»;*
2. *management of PAs does not include principles of good governance (transparency, fairness, accountability and conflict management mechanisms); there are power imbalances and inequality in having access to information;*
3. *There is no clear link between the goals of conserving PAs and management responsibilities and competencies; this makes it very difficult to measure the effectiveness of governance mechanisms and their impact;*
4. *Legal and institutional frameworks do not meet the commitments made by various countries in international treaties and limit the ability to delegate and/or share expertise on PAs that allow the multiple and diverse forms of governance to be recognized and conservation interests to take into account the rights of indigenous peoples;*
5. *Good governance requires better and more comprehensive information to be made available on the positive and negative socio-economic impacts of the PAs;*
6. *a description should be given of the many overlapping PAs responsibilities that cause inter-institutional conflicts, as well as the lapses in management and account rendering;*
7. *Multisectorial participation processes need to be consolidated and strengthened so that, besides consultations, they advance towards devolving power in order to «share» authority by recognizing and legitimizing all the stakeholders involved;*
8. *Cultural diversity needs to be reassessed, rather than simply being recognized;*
9. *The capacities of the stakeholders concerned with managing PAs are still deficient, both as to techniques and consensus building;*
10. *Budgets now allocated for governance and civil society participation are quite insufficient and not enough credit is given to the contribution made by local stakeholders who take time off from their activities;*
11. *A strategic redefinition must be made of national PA systems to enable States to create synergies between their heritage areas and the lands kept by indigenous communities.*

Source: Second Latin American Congress on National Parks and Other Protected Areas.

ecosystems and the growing awareness by societies of the global impact of preserving their natural heritage, although it must be admitted that all this effort has not succeeded in slowing down the rate of annual biodiversity loss. The Congress also assessed private sector conservation experiences over the past decade and future potentialities.

Protected areas management instruments used include: ecotourism and sustainable tourism programmes, payment for environmental services systems, programmes on selective extraction of resources (e.g. mature forest species and using non-timber forest resources), CO_2 capture and sequestration services, environmental stewardship and usage fees (for example, water resources management and conservation), among others (Eguren, 2004 .)

As can be seen in Box 5.12, the Region has been a global pioneer in applying payment for environmental services as an economic tool to promote the protection of biodiversity and conserve ecosystems. Some promising examples, which demand ongoing critical assessment, are being developed in several countries in the Region such as Bolivia, Mexico, Costa Rica and Colombia (Echavarria, 2002, Rosa and others 2003; ECLAC 2007; FAO, 2007a). In Mexico the PES market accounted for more than 500 000 hectares in 2005 (ECLAC, 2007).

Moreover, as recognized by the Congress of Bariloche, despite making substantial progress, protected areas regulation still faces a number of serious challenges on issues such as different management models, complementary economic benefit patterns and including in national accounts the value of protected biodiversity, among others.

BOX 5.12

Bolivia Developed the First Global Carbon Capture Experience

The Climate Action Project in the Noel Kempff Mercado National Park (PAC-NKM) in Santa Cruz, Bolivia, marked a turning point in the history of how environmental services are assessed by being the first national and global experience to establish a climate change mitigation mechanism — such as preventing deforestation – to allow benefits to be obtained from maintaining forests and preventing deforestation.

The project area covers 1 582 322 rich and immensely biodiverse hectares: there are five types of ecosystems, a wide variety of grasses, orchids and evergreen trees. It is inhabited by 139 species of mammals, 74 species of reptiles, 62 species of amphibians, 254 species of fish and 620 species of birds, possibly the highest number in any protected area.

In 1997, the Government of Bolivia, three energy companies (American Electric Power Company, PacifiCorp, and BP Amoco), The Nature Conservancy (TNC) and the Friends of Nature Foundation (FAN) began implementing the initiative by quantifying the carbon stored in the project area and the emissions of greenhouse gases (GHG) avoided.

In 2005, the international certification company Société Générale de Surveillance (SGS) assessed and certified the PAC-NKM design and emissions reduction in more than one million tonnes of carbon dioxide, translated into tradable credits that the Government is committed to make effective and distribute to communities.

Source: The other border, UNDP, 2008.

Biological corridors

Countries have made progress in the design not only of national land and marine biological corridors, but also of bi-national and regional/supranational corridors. However, available reports indicate very little with regard to the effectiveness and success in managing these corridors. On the contrary, they mention a series of obstacles faced by the coordinating or management bodies (especially in Central America and the Caribbean). Among the obstacles mentioned are legitimacy limitations placed on management bodies, as well as others in terms of negotiating capacity, and the inclusion of social and political stakeholders in pursuing the objectives of such initiatives and activities.

Similarly, at least three GEO national reports indicate the absence of a link between national and bi-national policies and local government initiatives as an obstacle to biological and marine corridors management (Brazil, Costa Rica, Guatemala, GEO Caribbean). There are signs suggesting that civil society is not consulted about and does not take part in managing the corridors, added to which is the incapacity of community organizations, environmental authorities in the territory and local governments to set priorities when formulating, implementing and following up on the environmental policies required if the corridor's infrastructure is to be a success.

In that sense it appears that the shortfall in this area is due more to the political strategy used to make possible the biological corridors' long-term sustainability and existence. There seems to be an implicit assumption that the weaknesses and failings of negotiations between stakeholders will automatically be corrected. This, however, is particularly difficult in the absence of the financial resources and international cooperation required to launch such initiatives.

3.1.4 Tourism

Sustainable tourism can be considered an important environmental management support instrument. In recent years an untold number of new categories have totally reshaped this activity in an attempt to mitigate and, where appropriate, reverse, the perverse environmental effects of this «smokeless industry.» Thus *ecotourism*, originally exclusive to protected areas, *nature tourism, cultural tourism* and variants of these categories have been developed with a view to providing more income to populations that usually own or live in the locations to which tourists are attracted, and generically referred to as *community tourism,* provide new opportunities to develop this important component of the Region's economies.

Because of the many facets of tourism in Latin America and the Caribbean, and the possibilities offered by its multiple attractions, it has not developed in the same way in all the countries; however, it can be said that in general it is a sector that continues to grow and contributes to the countries' respective and also growing economies. Thus, while it accounts for about 10% of Mexico's foreign currency income, in 16 Caribbean countries the sector accounts for the largest amount of foreign currency received; in 11 of them tourism provides more income than all their exported goods. Today, nearly 19 million tourists a year visit the Association of Caribbean States (ACS) area and spend about $US15 000 million. This global market share declined in the1980s but was again increasing until the tragic events of 11 September 2001 in the United States of America (Girvan, 2002).

BOX 5.13

The Importance of Tourism to the Local Caribbean Economy

The CTO, in conjunction with the Tourism Partnership Against Poverty (Pro Poor Tourism Partnership and The Travel Foundation), produced a Good Practice Guide whose main proposals are set out below:

1: Tourism and the local economy, creating alliances

- *Trade advantages: the client looks for more interactive vacations and returns,*
- *Optimization of the product: Improves the product by differentiating and on-direct competition,*
- *Permission to operate: good relations with the community and commitment to the local economy,*
- *Risk reduction: reducing health and safety risks and ensuring a good public image,*
- *Staff morale: investing locally activates recruitment, keeps staff and improves service,*
- *Sustainable Development: working with communities to increase awareness and the ability to promote and preserve local heritage and make tourism sustainable.*

2: Include local producers in the supply chain

- *Use more diverse products to distinguish the hotel's environment and promote the brand,*
- *Expanding the number of local activities improves motivation and helps to extend the stay,*
- *Promoting cost reduction if local goods or services are cheaper,*
- *Creating local partnership networks. ,*

3: Build links with local farmers

- *Buying local products provides fresh food and reduces transport costs,*
- *Diversify by using: theme nights, culinary tourism, agro-heritage tourism, and a wide range of herbal, medicinal or processed foods,*
- *Health and well-being tourism is a market niche with strong ties to agro-tourism.*

4: Employ local staff

- *Reassess hiring: make jobs available for skilled and unskilled local people,*
- *Give the lower paid staff a living wage and include health and welfare plans,*
- *Ensure qualified staff members are promoted to more specialized and better paid positions,*
- *Invest in training at all levels not only at graduate management level,*
- *Develop a policy that encourages openness about HIV and removes its stigma.*

5: Involve local people and products in tours, packages and excursions

- *Diversify the range of excursions and increase opportunities to interact with visitors,*
- *Pass some services to the community (providing guides, brochures, food, transportation, interpretation).*

6: Encourage tourists to spend locally

- *Buying local products helps to bring credibility and authenticity to the destination, and improves its ability to compete.*

7: Build partnerships with neighbouring communities

- *Expand opportunities, promote economies of scale, create an environment of prosperity and reduce negative impacts.*

8: Manage internal changes to develop local partnerships.

- *As changes are often resisted they must be anticipated from the planning stage by making the design as flexible as possible and by being ready to take timely action at all levels.*

Source: http://www.odi.org.uk/resources/download/2194.pdf (consulted April 2010)

One of the main tourism challenges is to ensure the industry's sustainability. Visitors are becoming increasingly more selective about the quality of the product. To achieve sustainability of tourism overtime requires developing and maintaining internationally accepted standards of excellence on: services, environmental quality; community involvement; respecting cultural integrity and diversity; and multi-destination tourism should take advantage of the wide variety of the countries' cultural and natural attractions (Cox, 2010).

However, besides being a promising source of income, tourism is also a fragile business, whether because of events like September 11th or of the effect of an economic recession in developed countries; then there are natural events like earthquakes, hurricanes or a permanent increase in sea and ocean levels as a result of global warming. All of these involve potentially dramatic impacts on the sector's activity, and such impacts are greater on the economies that most depend on tourism.

In this respect, the Caribbean is unique among regions because of the diversity of its attractions: sun, sea and sand, tropical jungles and rivers, spectacular mountain ranges, semi-active volcanoes, the variety of archaeology and colonial architectural and a broad spectrum of music, dances and carnivals. The Caribbean Tourism Organization (CTO) has systematized the experiences of the sector's regional development and proposed alternatives which, along with other initiatives[12], would make the sector less vulnerable. Box 5.13 presents some of the lessons learnt.

Moreover, tourism can have different impacts on management of many protected areas and biological corridors. Three case studies made by Moreno (2005) along the coast of Belize and the Bay Islands of Honduras, analysed the implications and challenges of how local communities can obtain economic benefits from ecotourism and conservation. The research determined that, together with the design of local conservation, planning and ecotourism management policies, what the author calls a «marked cultural shift» should be promoted; that is to say a series of changes in the tourism market culture to encourage sustainable practices such as waste processing, and using inputs like organic and biodegradable products to reduce the impact on the environment. Similarly, the study also draws attention to the need to organize communities and to get local business leaders and entrepreneurs to act as promoters of ecotourism rather than traditional tourism. There is a need to set up accessible credit and technical assistance programmes so that local businesses can provide alternatives to the traditional tourism that is having such a significant effect on coral reefs.

3.1.5 Adapting land policies and clearing unproductive property

As noted in the introductory chapters of this report, one of the major threats facing the Region is the increase in the deforestation rate that particularly affects forest ecosystems because the agricultural frontier is being expanded. In many cases the effects of this change in use are irreversible and, as a consequence, the habitats of countless species are damaged.

The following are some of the factors that produce a crisis scenario that countries in the Region cannot allow to continue, and for which responses will need to be provided if conflicts are to be avoided: climate change and desertification; the exhaustion of available fertile land; the recognition of the rights of indigenous peoples and communities; opening new areas to colonization; handling arbitrary land titles to companies or individuals that do not know or cannot make them productive; expanding crop production for biofuels or other substitute crops in place of food crops and often encourage it with perverse incentives, the growing demand for extra water, and other factors.

At the other extreme is the concentration of large speculative landholdings without any economic or social function and which, day by day, are protected by ambiguous or weak agrarian laws that make it hard for them to be reassigned for sustainable uses.

This situation occurs despite the urbanization of the Region's societies and agriculture's relative loss of importance in most countries, and it shows that the effects of this trend are not yet definite. In countries where traditional agriculture is still practised the farming population is often critically dependent on the land which may explain the difficulties faced by modernization and 'fight against poverty' policies; beyond the purely economic and analysis of opportunities aspects is the unavoidable consideration of cultural and identity elements. It can be said, therefore, that this is a very serious structural issue that cannot be treated lightly or with voluntarism; it requires a broader consensus if it is to be changed.

12 *The objective of the Caribbean Hotel Energy Action Program (CHENACT) is to encourage the implementation of energy efficiency (EE) practices and micro generation (MG) with renewable energy in the Caribbean hotel sector, hence improving the competitiveness of small, medium and large hotels through improved use of energy.*

The project also allows for the inter-linkages of EE, reduction in greenhouse gas emissions, MG and in and the introduction of ozone friendly technologies.

The CHENACT is managed through both the private and public sectors. The Executing Agency for this Program is the Caribbean Tourism Organization (CTO), which will carry out the activities contemplated in the Program through and with the operational and technical support of the Caribbean Hotel and Tourism Association and the Caribbean Alliance for Sustainable Tourism (CHTA/CAST).

The following organizations are also directly involved in the project:Inter-American Development Bank (IDB), Government of Barbados (MFIE), United Nations Environment Program (UNEP), Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ), Center for Development Enterprise (CDE), Barbados Light and Power (BL&P)

3.1.6 Certified forest management and community participation

Certified Forest Management is another tool that has shown enormous potential in combining the preservation of natural heritage with the economic opportunities its sustainable use offers. As it can be seen from information provided in Chapter II, despite its relatively short history, certified forest production of natural tropical forests has grown steadily both in fiscal areas and in private concessions, in indigenous territories and on community lands. Many examples testify to this in communities ranging from Michoacan (Purépecha), Mexico, to the post-conflict experiences in the Guatemalan Petén, and to the dry forests of Chiquitanía in Bolivia, where the communities concerned have assumed a long-term commitment to sustainable forest exploitation even though, to date, all the efforts and investments demanded by the certification process have not been very profitable, either when it comes to prices or to market access.

While this opportunity has been largely driven by non-governmental agencies (particularly the WWF) and the global forest consortium (FSC) it has also been an area for significant cooperation in some developed countries whose efforts so far have served to establish important networks that connect participating stakeholders throughout the entire production chain: certified producers (private or community) and/or forest managers, primary or secondary processing companies, distributors and retailers, with consumers, distributors, retailers and/or large international buyers committed to increase the responsible use of forest resources and products that have adopted Responsible Purchasing Policies and are members of the GFTN (Global Forest Trade Network) (WWF, 2007).

Despite this mechanism's yet-to-be-developed potential, important results can already be seen not only in forest areas under certified management, but also by the volume of business, by new markets being opened up and developed and, above all, by the multiplicity of the stakeholders involved.

Also, the development strategy of community natural resources management (discussed in Chapter II, Section 3.3) in the Region has very many community forest management (CFM) examples that have been certified by competent international organizations and recognized as paradigmatic examples in various international forums. Of particular relevance are examples of community forest enterprises in Mexico in San Juan Nuevo Parangaricutiro (Michoacán) and others in the states of Oaxaca, Puebla and Quintana Roo; in the Maya Biosphere Reserve in El Petén, Guatemala; traditional forest resources management by various Amazonian communities in Brazil and Peru; and several cases associated with the plans for Indigenous Land Management (ILM) of the Traditional Communal Lands (TCO) of the Bolivian Amazon, among others[13]. The ILM has been developed on the basis of two fundamental suppositions: 1) Ensuring or improving the well-being of those concerned: people living in rural and indigenous communities. 2) Helping to conserve forests to make their services available to the general public (Sabogal and others, 2008).

3.2. Managing strategic infrastructure investment

Infrastructure is and will remain the driving force for development. Substantial infrastructure investments are needed if the foundations are to be laid for a sustainable economy as one of the main sources of jobs, and that has a consequent social impact, particularly when it comes to economic recovery. However, economic considerations and a short-term outlook have often been mistaken in considering budget «savings» for large works that have had an effect on their environmental sustainability. Today, the effects of climate change and the constraints on accessing elements that in the past seemed to be readily available (water), or natural events (the phenomena of El Nino and La Nina, hurricanes, tsunamis, droughts, and floods) whose frequency and intensity have shown a dramatic increase, have highlighted the tragic consequences of the lack of foresight and senselessness of such «savings.»

In recent decades science and technology have developed options that have revolutionized the way in which old and new social demands are satisfied, opening a wide range of possibilities and budgets that have made decision making more complex but, at the same time, have also vastly increased opportunities. The use of lighter construction materials, for example using optical fibre instead of metallic conductors, additives used to quick dry cement, informatics, the possibility of using alternative energies from the domestic to the regional level, and satellite communications , as has already happened in many «pockets» of urban modernity in the

13 *For further information see: http://www2.ine.gob.mx/publicaciones/libros/431/introd.html; http://www.guate.net/centromaya/logros.htm; http://www.promab.org/index.php?page=download&op=category&id=22&title=Experiencias-en-manejo-forestal-comunitario*

Region, a world to develop that is very different from that about which planners dreamed a few decades ago. However, on the one hand the majority of the population in Latin America and the Caribbean is still without access to many of these advances and, on the other, the transition from one stage of technological applications to another –in the absence of proper planning– can create environmental liabilities so that environmental conditions become worse instead of being improved.

Therefore, focusing on the priority, the direction and the quality of investments in infrastructure is a strategic task that demands a multidimensional approach in which the criteria of scientists, technicians and specialists are as important as the voice of the social stakeholders that such works would affect, either positively or negatively.

BOX 5.14

Recycling in Brazil and Organic Production in Mexico

Recycling in Brazil

Recycling can make a significant contribution to reducing the environmental footprint of the economic sectors that have a high concentration of energy and materials. Figures for Brazil, the world leader in recycling aluminium cans, indicate that in 2006 about 10,300 million cans were collected. Recycling allows the country to save 1976 GWh per year of electricity that would have been needed to produce new aluminium and is enough to supply a city of more than one million people for one year.

Almost 170,000 people are employed in recycling aluminium cans in Brazil. According to a 2005 survey, the country has nearly 2,400 companies and cooperatives in the recycling and scrap metal trade and most of them are small or micro enterprises; in 2006 the country's recycling rate was 94%, a sharp increase from 46% in 1990. In comparison, the rate in Japan is 91%, in the Scandinavian countries 88%, and in the whole of Western Europe it is about 58%.

Brazil has also high rates of recycling other products. According to two non-profit associations: the Brazilian Micro and Small Business Support Service (SEBRAE) and the Brazilian Corporate Commitment for Recycling (CEMPRE), in 2004 the country recycled 96% of aluminium cans, 49% of steel cans, 48% of PET plastics, 46% of glass containers, 39% of tyres and 33% of paper.

CEMPRE and SEBRAE estimate that approximately 500,000 people are employed in recycling sector in Brazil.

The country has also been a pioneer in improving jobs related to recycling. While of great value to conserving resources, this can mean messy, unpleasant and even dangerous, unhealthy work and often poorly paid work. In many developing countries, recycling is carried out by an informal network of garbage dump scavengers, who collect recyclable materials to obtain an income. In many countries efforts to establish cooperatives have helped raise their pay and improve working conditions. In Brazil these garbage collectors, who recover 90% of recyclable material, have organized a national movement of 500 cooperatives and 60,000 collectors. In Belo Horizonte, one of the Brazil's largest cities, the first recycling plant run by associations of independent catadores de lixo *(garbage collectors) was inaugurated in 2005. The intention is to operate the plant without the intervention of unscrupulous middlemen and to increase the collectors' pay by approximately 30%.*

Organic production in Mexico

With the growing demand for organic products in industrial countries organic farming methods are also appearing in the developing world. In Mexico, Coyote Rojo (Red Coyote) is an organic bioregional label that began certifying producers in August 2007. It is designed to: safeguard and promote biodiversity; maintain traditional practices of caring for and exchanging seeds; protect typical production methods as well as local foods; conserve natural resources; and practise sustainable harvesting. According to one study, bioregional Coyote Rojo focuses on meeting needs in local areas, using renewable energy sources, promoting and preserving organic agriculture and developing local enterprises based on local skills, knowledge and capacities. Because the product's quality control depends on the whole production process, the assessment should cover the entire process to ensure that quality specifications are met.

The case of the Coyote Rojo label has a direct relation to the discussion about green jobs. The label capitalizes the value of the numerous varieties of maize that are specific within the bioregion and, by doing so, confronts the various threats to the «Mexican cultural icon.» The hope driving this initiative is that people will feel less pressure to migrate when they take with them the valuable knowledge of how to work the labour intensive milpa *(maize field) crops. Commercializing local varieties can both sustain rural livelihoods and help to diversity agriculture.*

Source: UNEP and others 2008, FAO 2007b; Associação Brasileira do Aluminium 2007 Brazzil Magazine 2005.

3.2.1 Green Infrastructure for economic and social development

In recent years a pattern of infrastructure development has become generalized in countries in the Region that has more to do with designs from abroad than with their own real needs (as in the cases of the Puebla Panama Plan, PPP, or the **Initiative for the Integration of the Regional South American Infrastructure (IIRSA)**, and still less with environmental considerations (Rivera, 2008).

The lack of railways, ports, airports and urban public services designed and established by complying with environmental legislation and based on criteria to minimize the impact may, contrary to what might be thought, result in exerting a lot of pressure if the resources are misused (Antunez and Galilee, 2003; Guimarães, 2003). For example, the lack of railways may lead to pressure to build roads or highways; the absence of airports involves building ballast roads; the lack of a good and efficient public transport service means the daily use of motor vehicles and, therefore, more hydrocarbons. All these examples refer to processes that can provide jobs but they in no way fit the definition of «green jobs» with which this report is concerned. However, this has been rarely analysed in the GEO reports reviewed and it needs to be further studied in the Region.

3.2.2 Green jobs

The purpose of creating green jobs - that reduce the environmental impact of corporate businesses and economic sectors so that they finally achieve sustainable levels - is part of the already-mentioned mentioned UNEP-led Green Economy initiative.

Green jobs are found in many sectors of the economy from energy supply to recycling, and from agriculture to construction and transport. These jobs help to reduce the consumption of energy, raw materials and water by using highly efficient strategies to reduce the carbon footprint on the economy and greenhouse gas emissions, and also to reduce or completely eliminate all forms of waste and pollution, and to protect and restore ecosystems and biodiversity. Green jobs make a decisive contribution to reducing the environmental footprint of economic activities. There are promising experiences in countries of the Region (Table 5.2), two of which are presented in Box 5.14.

TABLE 5.2

Relevant Initiatives on Green Jobs in the Region

Initiative	Countries
Recycling	Brazil
Biofuels	Brazil and Colombia
Energy and urban transport	Mexico, Brazil and Colombia
Organic agricultural production	Mexico
Small-scale agriculture	Brazil y Cuba
Reforestation	Mexico, Cuba, Brazil
Payment for environmental services	Bolivia, Colombia, Costa Rica, Nicaragua
Efficient lighting	Mexico
Pulp and paper	Brazil and Colombia

Source: Prepared with data from UNEP and others 2008

3.2.3 Water management

Several examples of mechanisms that contribute to managemenet of water and hydrobiological resources following the principles of the ecosystem approach already mentioned in point 3.1.1 are described hereafter.

Integrated watershed management

- Advances in watershed management or administration policies in the Region have been fairly modest. To begin with, it would appear that watershed management is still focused on guaranteeing the supply of water for agriculture, then on expanding the supply of water for human consumption in areas or geographical contexts where it has become critical, and finally on developing hydroelectric power projects.
- In the Region the case-by-case watershed management approach seems to prevail; this implies defining, one hand, specific basins requiring attention and environmental assessment mechanisms, and on the other, basins which because of strategic economic criteria, do not merit particular attention either because the environmental damage is apparently irreparable (the result of unsupervised activities), or because of sectorial interests or considerations concerning how the resource might be used or exploited in future. There is also little coordination between actions taken to deal with the consequences of industrial discharges and, in particular, domestic tap use, and water saving measures such as recharging aquifers.
- New energy demands resulting from the Latin American agro-export and agroindustrial boom were partially satisfied by hydroelectric projects in regions previously considered to be inaccessible.
- Initiatives aimed at reducing pressure on fossil fuels and to supply low-cost energy have led to hydroelectric dams being planned and developed in areas adjacent to protected areas, historic heritage zones and communities of indigenous peoples. Given that proposals for and the implementation of new hydroelectric dams have shown a top-down trend, with little multisectorial participation, this pose new pressure on how basins are used, and very few have escaped the conflicts arisen between private, and state developers and local populations and environmental groups.
- In addition, developers frequently protected by legal framework weaknesses have chosen to misuse the popular- or community-based, and seldom transparent, consultation resource and then misuse the results.
- More recently, Strategic Environmental Assessment (SEA) instruments have begun to be used in the Region to settle socio-environmental conflicts, and to assess ways of implementing hydroelectric mega projects so that possible damage to the structure and composition of watersheds is reduced.
- It is considered that, in general terms, the Region lacks mechanisms that enable policies on watershed management to be combined with other strategic water, air, land and desertification policies.

Binational Commission for the Development and Management of the Bermejo River Basin

BOX 5.15

Binational Commission for the Development and Management of the Bermejo River Basin

There are several examples of transboundary river basin management experiences. One is the establishment of the binational commission for the development and management of the Bermejo River basin in Bolivia and Argentina that flows through the Chaco to the Paraguay river.

The initiative was developed with funding from the Global Environmental Fund (GEF) and facilitated by UNEP in order to achieve harmonic management of the basin in question and, above all, to control degradation caused by land use and cross-border sedimentation.

Because the participatory process was used it was possible to include objectives concerning environmental conservation. One factor that has enhanced its legitimacy has been the involvement of local stakeholders, including small farmers and ranchers, as well as NGOs from both countries. It should be noted that action to be taken was discussed and negotiated in advance by representatives of these groups; by doing so the project managers were able to anticipate resistance to conservation activities and the specific use made of them.

Also noted is the practice of putting into effect pilot procedures before beginning the project's implementation phases. In practical terms, these pilots tests have avoided the possibility of taking action identified as being conflicting and anticipated corrective action; they have also explored the level of commitment to a set of sustainable management principles for the basin that had been were agreed in the initial stages of the project.

Source: Uitto and Duda, 2002.

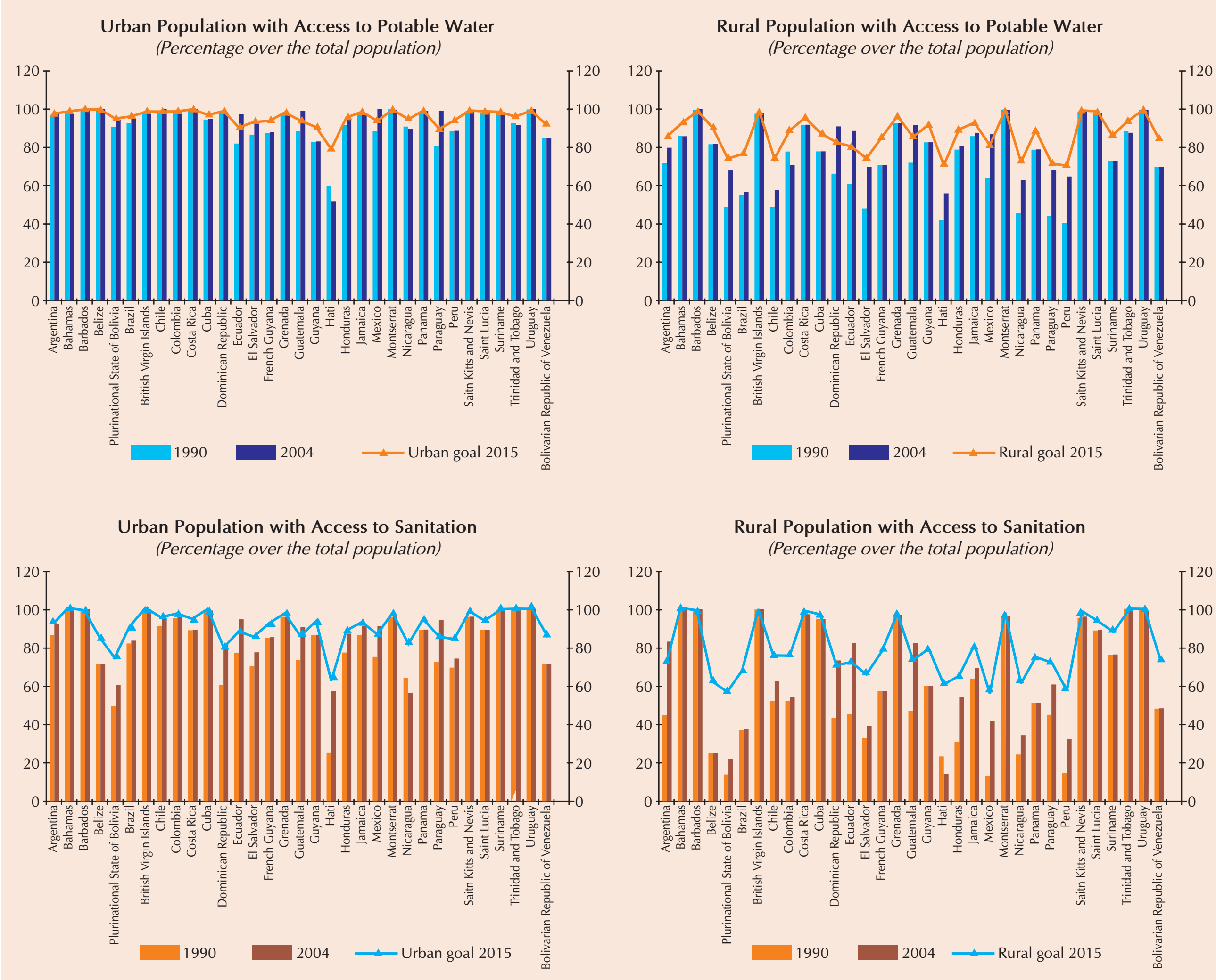
Box 5.15 shows the experience of the Binational Commission for the Development and Management of the Bermejo River Basin between Bolivia and Argentina. Other institutional bi/multinational basin management examples are the Autonomous Binational Authority of Lake Titicaca, the Tri-national Commission of the Pilcomayo River, the Amazon Cooperation Treaty, among others.

Universal coverage of drinking water and basic sanitation

In keeping with the analysis in section 5.2.1 of Chapter II, the following tables show the evolution of improved drinking water and sanitation services in urban and rural areas of Latin American and Caribbean countries, as well as projections for 2015 when, according to the

FIGURE 5.1

Latin America and the Caribbean: Urban and Rural Population with Access to Potable Water and Sanitation, 1990 and 2004. ***(Percentage over the total population)***



Source: ECLAC 2009a, based on WHO/UNICEF, Joint Monitoring Programme for Water Supply and Sanitation commitments made by the Millennium Development Goals, it is proposed to reduce by half the number of people without access to these services.

The provision of water supply and sanitation is one of the tasks with the greatest impact on the population's health and is linked to studying what sources can meet this demand on a sustainable basis. In countries whose indicators are still below expectations, it is essential to note that this may present an exceptional opportunity to create high-impact green jobs by combining the efforts made by the public, private and social sectors.

An aspect to which critical consideration should be given is how to maximize management and administration of water storage and distribution networks in urban and rural areas where there is evidence that in some cases network deficiencies endanger more than half the volume of water flowing through them. Moreover, this is particularly critical when it comes to treated water that already includes costs over and above those of collection, storage, distribution and infrastructure systems. However, the systems' inefficiency is not only a matter of the physical aspect; it is often a problem of organization and management which, once again, calls for participatory solutions.

The re-use of sewage is a key issue to be taken into account, and it is one where there is a major lag almost throughout the entire Region. In this respect, regardless of how existing purification systems perform, sewage quality can be excellent for irrigating various crops that have an important economic value; therefore, combining sanitation systems with rural development policies to guarantee final safe disposal of sewage may have a multiple impact both on community economies and on environmental health of urban and industrial consumers.

Irrigation networks for food production

This theme contemplates, on the one hand, access to the resource and, on the other, how irrigation facilities and technologies function. Given the overall reduction of water availability, full advantage should be taken of how it can be used, and systems should be adopted that allow it to be saved, and to prevent the huge losses caused by evaporation, filtration and other predictable events.

The other issue concerning water availability for irrigation has to do with the competition between food production – still critical for food security in several countries of the Region - and the demand for the resource made by industrial crops (increasingly, the production of oilseeds for biofuels). Apart from the underlying ethical choice there is the authorities' responsibility to formulate policies that prioritize human well-being and food self-sufficiency while, at the same time, mobilizing other types of resources to provide more decent and competitive jobs in this sector.

Water harvesting methods with a positive environmental impact

In cases where water availability is most critical, policies should be established to support and encourage the construction of ponds, watering holes and reservoirs to enable people to save water that would otherwise be irretrievably lost.

A case of particular relevance, especially for the Andean countries, is the collection of water from the Andean glaciers where accelerated melting is already irreversible. In this case it should be borne in mind that many medium and large cities are critically dependent on this resource for human consumption, while very few new initiatives have been suggested to increase its use at a faster rate than it disappears.

3.2.4 Sustainable Energies

Despite their natural resources that would enable them to transform their energy matrix better than any other region in the world, countries in Latin America and the Caribbean still face great challenges in developing renewable energies. Some of the main obstacles are: the absence of public policies to promote clean energy; human capital in need of training; and the lack of investment in new technologies. The Region faces challenges in several green energy areas: the use of renewable energy; sustainable production of biofuels; energy efficiency; and the carbon market:

- Worldwide US$155 000 million was invested in 2008 to develop renewable electrical energies: solar, geothermal, wind and small-scale hydropower with a lower environmental impact than large dams. Latin America attracted 12% of this investment.
- Latin America produces 40% of the world's biofuels. However, the debate over the environmental and social benefits of biofuel production (vis-à-vis fossil fuels) is far from over; recent studies highlight the complexity inherent in developing biofuels and analysing them calls for life cycle approaches (UNEP, 2009c).
- In the carbon market –a trading system in which companies, governments and individuals sell or buy emission rights and carbon dioxide reduction certificates– Latin America and the Caribbean's share in the global market remained stagnant from 2007 to 2009.

Brazil is a leading country in the development of small-scale hydropower and wind energy and it is also a global reference on the use of biofuels. After 35 years of experience in producing ethanol from sugarcane, Brazil is the world leader in biodiesel exports and also has the most efficient energy production. In addition, the country has the largest number of projects in Latin America and the Caribbean related to the carbon market in (UNEP, 2009c).

On the other hand Chile set the example for countries that are highly dependent on foreign energy. In recent years cuts in the supply of natural gas from Argentina exposed the country's energy vulnerability when the cuts were followed by one of the worst droughts in decades and by the rise in oil prices in 2008. To cope with this situation the country encouraged investment in non-conventional renewable energies such as geothermal, wind and small-scale hydropower. It is also contemplated that by 2020 nuclear energy could provide the solution to this problem. Even though oil prices have fallen, Chile is still very interested in diversifying its energy matrix.

A more recent issue that may represent a historic turning point with a global impact, and that has its epicentre in South America, is the potential of lithium to produce non-polluting and safe energy. Indeed, the largest deposits of this metal in the world are found in Salar de Uyuni (Bolivia) and there are others in the inter-Andean highland plateau in northern Chile and Argentina. The government of Bolivia is now negotiating the possibility of its *in situ* industrialization with interested countries that have developed the technology to process brine and to manufacture batteries that are already being used with several high-efficiency prototypes.

Regarding energy efficiency, a recent ECLAC study reviews the situation in 26 countries in the Region and among its findings emphasizes that the mere existence of an Energy Efficiency Act does not guarantee that, in practice, satisfactory results will be achieved on the use of energy. This is due to the difficulties the State faces in controlling and, if the law so stipulates, punishing illegal behaviour.

Economic barriers and cultural-historical reasons - for example, the custom in Latin America and Caribbean societies of paying less for the services they use than the real market prices – mean that energy efficiency measures are not properly enforced; also, a lack of human resources (for budgetary reasons) makes it difficult to put in place an efficient control and oversight system. Lessons learned are taken from ECLAC, OLADE and GTZ (2009):

- The potential to save energy remains high. In general, energy consumption can be reduced by 20-25 per cent by taking simple measures that produce quick returns;
- Institutions already in operation should be strengthened rather than new ones being created;
- To develop efficient energy programmes capacity building of decentralized institutions should be promoted;
- Promotion should be given to investing in and financing energy saving opportunities;
- On average, 75 per cent of refrigerators installed are only half as efficient as those entering the market. Large savings can be made by replacing them;
- The production of thermal and electric power for industries and large tertiary facilities offer great potential; however, because the regulations do not favour it, advantage has not yet been taken of this potential;
- Strategies are lacking on education, awareness and promotion (authorities, education sector, companies and users);
- The market for companies providing energy service needs to be developed.

Box 5.16 presents the Energy Strategy in Uruguay that includes important lessons about changing the country's energy policy to alternative resources with less of an environmental impact.

As for urban transport energy efficiency, in recent years experiences in the Region have brought very great changes to life in some of its largest cities such as Bogotà (Transmilenio), Mexico City (Metrobus), Santiago (Transantiago); these resulted from combining such factors as the political will of the authorities, the cooperation of traditional organized transportation, changing citizens' consumption patterns; the international community has even been involved by purchasing the carbon bonds issued by the cities.

BOX 5.16

Energy Strategy in Uruguay

In 2006, the Energy Strategy Guidelines for Uruguay were proposed to accelerate the process of changing how energy sources are used and to reduce the cost of oil for this South American country. The guidelines initially caused controversy because one proposal was to boost oil exploration in the country; however, they have gained support by promoting the inclusion of alternative energy sources, especially biofuels, wind energy generation and the use of biomass as a heat source for industry. The GEO Uruguay 2008 report summarizes some local initiatives in this respect that have been assessed as being successful:

a) *Projects on electricity generation from forest residues and the rice-growing industry (Velcemar, Galofer and others) with an electric generation capacity of about 30 MW,*

b) *The Botnia pulp mill which, besides generating 100% of its electricity consumption and heat, has a surplus of 32 MW that is passed to the national grid,*

c) *Projects to use wind energy to produce electricity (UTE, Agroland) with a generation capacity of 15 MW,*

d) *A project with a 1 MW electricity generation capacity (Las Rosas, Maldonado) from biogas produced in landfills,*

e) *Several biodiesel mini-plants that use oil seeds and animal fats, and*

f) *An ethanol plant using residues from the sugar cane industry.*

Source: PNUMA and CLAES, 2008.

3.2.5 Sustainable management of extractive activities

The ups and downs of this sector's activity in the Region are mainly concerned with variations in the global market for its minerals, due primarily to the industrial boom in China and India that caused an unprecedented increase in their value. In these scenarios countries such as Bolivia and Peru have seen increased foreign investment in revitalizing their mining economies with projects on a scale comparable to what occurred in tin mining at the beginning of the past century.

Advances have been made in some countries on selective extraction of materials, mainly in mining, environmental and community safety criteria have been established to allow permits to be issued for exploration and exploitation where environmental impact and technical feasibility studies have helped to improve rejection or regulation of mining projects in high-risk areas that would have an impact on human settlements (e.g, aquifer recharge areas). However, several factors suggest that mechanisms are very weak when it comes to monitoring or controlling previously authorized projects; this is usually discovered only when, for example, water sources for human consumption are polluted.

Institutional weakness is also evident when attempts are made to halt previously authorized projects that cause substantial desertification, far exceeding the guidelines issued with their initial licenses or operating permits. There is also a notable lack of action and initiatives on the environment (by both central and local governments) to mitigate the environmental and socioeconomic consequences of mining projects that had been shut down because of pollution or environmental degradation levels. Mesoamerica deserves special mention in this respect.

There are only a few examples of efforts to design an environment friendly mining policy. Among them, and as an example of the policy issues such a policy might consider, is the «Framework Agreement on Cleaner Production - Greater Mining Sector», signed in Chile by a wide range of public and private stakeholders (Box 5.17):

BOX 5.17

Clean Production Framework Agreement Greater Mining Sector

Principles:

- *Government-Industry Cooperation*
- *Gradual*
- *Complement environmental management regulatory instruments*
- *Pollution prevention*
- *Producer responsibility for waste or emissions*
- *Use of the best available technologies*
- *Transparency of markets for goods and services*

Included in the Agreement:

- *Potential for acidic waters generation*
- *Closing and abandoning mine sites*
- *Efficient energy use*
- *Efficient water use*
- *industrial liquid wastes*
- *Solid waste*

Source: http://biblioteca.unmsm.edu.pe/redlieds/Recursos/archivos/MineriaDesarrolloSostenible/ProduccionLimpia/Acuerdo_Prod.pdf

3.2.6 Protection and management of coastal areas

Coastal areas, understood as the geographical zone where most exchanges of matter and energy occur between marine and terrestrial ecosystems, are excellent spaces for regional cooperation; examples of institutional bodies established to take action in this respect are the Permanent Commission for the South Pacific (CPPS) and the Central American Alliance for Sustainable Development (ALIDES), among others.

The Regional Seas Programme of UNEP has defined a strategy that includes the following (CPPS, 2002):

- Promoting conventions, guidelines and international and regional measures to control marine pollution so as to protect and manage water resources;
- Assessing sources and trends in marine pollution and the impact on human health and on marine ecosystems' aesthetic and reactive values;
- Coordinating environmental management measures to protect, develop and exploit marine and coastal resources, and
- Supporting education and training measures designed to enable developing countries to fully participate in protecting, promoting and developing marine and coastal resources management.

The CPPS has developed a comprehensive Action Plan and created scientific mechanisms to enable participating countries (Panama, Colombia, Ecuador, Peru and Chile) to engage in extensive and interdisciplinary joint action to anticipate and mitigate the effects of ocean, meteorological, climate and hydro-biological events.

In Central America's coastal zones integrated coastal zone management (ICZM) limitations have been identified that are the result of information gaps, limited technical and financial capacity and a strong tendency to sectorialize. Recent projects, both governmental and with NGO support, offer new experiences and lessons on integrated coastal zone management. These initiatives have been supported by many ALIDES political agreements with ministerial and presidential support for ICZM, a dynamic decision making process on development and protection of coastal areas and resources, as well as on employment, in order to achieve goals established in cooperation with user groups and national, regional and local authorities (Windevoxhel, Rodriguez and Lahmann, 2001).

BOX 5.18

The Coastal and Marine Areas of Central America

The coasts of Central America have 21.6% of the Region's population and the fishing industry alone produces at least US$750 million, providing jobs and a livelihood for more than 450 000 people. Central America has eight per cent of the world's mangroves and the second largest coral barrier reef. It has approximately 110 coastal protected areas that represent much of its natural heritage. These special conditions of the Central American coasts determined that tourism, one of the three most important economic activities for four countries in the area, apply to at least 50 per cent of coastal areas.

Source: IUCN Mesoamerica.

3.2.7 Fishery resources management

It was during the 1960's that more public policies and initiatives were established to manage fisheries resources in Latin America and the Caribbean. Many of the initiatives were intended to make "rational" use of fishery resources but not to guarantee their quality and conservation. Subsequently, as is reflected in at least seven GEO reports, the subject was revived as a result of a demand made by civil society organizations in the late 1980's that commitments be made in the different multilateral environmental treaties that had some bearing on the theme (see in particular the case of Central America).

Countries with a similar coastal length and structure have to face the same obstacles regardless of their environmental performance. For example, few actions and initiatives have been taken that distinguish between the needs of marine fisheries and continental resources management In addition, there are very, very few plans to recover or rehabilitate the resources, and closed seasons are either only partially effective or do not fully meet their objectives.

The above is mostly due to the absence or weakness of port control and monitoring mechanisms, to the failure to keep up-to-date registers (either compulsory or voluntary) of private agents engaged in industrial fishing activities or records and information on artisanal fishermen, and to the lack of controls over foreign registered vessels on the high seas. However, the main problem is still that public policies and policy actions aimed at reducing illegal content do not have the financial, administrative, or logistical and human resources to ensure compliance.

Also, the problem of managing fishery resources in the area has a social origin that affects public policy. Reid and others (2005) analysed the impact of poverty reduction strategies in different coastal zones of Latin America. Deficiencies were seen in social policies designed to serve artisanal fishermen, a population sector that, compared to informal workers in urban areas, has access to fewer cooperation resources and public spending. It was also found that these strategies have focused primarily on addressing seafarers' extreme poverty while much less attention is paid to how fishery resources are managed, processed and distributed even though this would ultimately result in increasing the product's value in local and regional markets and, consequently, give the workers a better quality of life in the medium term.

BOX 5.19

Science and Participation for the Conservation and Sustainable Use of Marine Resources in Latin America; Examples of the Chilean Coast

In Chile, as elsewhere in Latin America, fisheries and coastal areas are diverse, complex and dynamic and there are constant interactions and ecological and social feedback. In these areas governability is complex and, because so many different sources of knowledge have to be integrated, there are no simple solutions about how biodiversity is used. Taking the example of artisanal fisheries management of benthic resources and coastal zoning to allow aquaculture conservation and activities shows the value of scientific research, effective community participation and makes it possible to integrate different views on using the coast as a complementary part of a sustainable use and conservation process. In this regard it is suggested that regulations or policies on the sustainable use and conservation of coastal areas be considered as adaptive tools to permit interaction between social and ecological systems that have explicit and measurable social and environmental performance targets. This means making constant assessments, introducing innovations and learning to reach the ultimate objective: long-term human well-being.

To reverse overexploitation of resources and make artisanal benthic fisheries sustainable, as part of its Law on Fisheries and Aquaculture (1991), Chile established Management and Exploitation Areas for Benthic Resources (AMERB). This tool, based on scientific research on human impacts on marine environments, gives artesanal fishermen exclusive rights to use portions of the seabed to co-manage resources with the State. Today there are about 700 AMERB in Chile, managed thanks to the involvement of fishermen's associations. The AMERB policy has been considered a success in terms of recovering benthic fish stocks that are abundant and have greater biomass resources in these areas compared to neighbouring open access areas. Recent studies have shown that allowing fishermen to monitor the AMERB results in the whole area being cared for so that better levels of biodiversity are maintained than in surrounding free access areas. Because in Chile artisanal fishermen play an important part in controlling local coastal development their participation in the direct management of the resources has also helped the sector to deal with over-exploitation and conservation. Despite the advances made by the AMERB policy, major problems remain such as the high cost of monitoring the areas. Therefore, if a system is to be successful, constant assessment is needed from which lessons can be drawn to adapt the AMERB policy and face the constant challenges that arise. It must be understood that the active participation of artisanal fishing in managing resources is a dynamic and adaptive process.

Salmon farming, concentrated in the Lakes region, is one of the fastest growing industries in Chile and, after copper, is the second largest foreign currency earner. This growth was brought to a rapid and shocking collapse because a virus appeared that not only reduced production but also contaminated vast areas of the coast and inland waters, making them unsuitable for future salmon undertakings. Suspected causes of this collapse include the lack of State control and specific regulations, and the failure to include environmental variables both when planning and developing the industry. Effects of this collapse include a significant loss of jobs, loss of coastal environmental quality, and the industry's rush to colonize new areas in order to continue operating. The Southern Fjords and Canals Ecoregion in Chilean Patagonia is the natural destination of the displaced salmon industry. It comprises a vast coastal area with biological wealth of local and global importance that supports other human activities such as artisanal and industrial fishing as well as the tourism industry. To reduce the potential impact of the newly installed salmon industry, the Government started macro-zoning the coast which, it is hoped, will result in preferred uses being defined and agreements reached to reduce environmental conflicts and promote the development of local industries. This opportunity was used by the scientific community and the NGOs that have been in the forefront in improving existing biological information by using planning and conservation instruments to define 28 areas to be selected as of value in conserving marine biodiversity in Patagonia. It is expected that this instrument will: a) set aside areas that are important for aquaculture conservation; b) provide a planning tool to designate and establish protected areas on the Chilean Patagonian coast. This is an interesting model that values scientific knowledge by making it an instrument for combining production and conservation activities, promoting sustainable use not only of the local salmon industry but of others such as fishing or tourism. As a result of this participatory process, a new use was defined for the coast: conservation. The next steps in this process include the effective designation of potential protected areas, strengthening good practices by local industries that depend on the coast, permanent monitoring of the effectiveness of each of these practices, as well as specifying mechanisms that include lessons learned.

Achieving biodiversity conservation and the rational use of coastal areas will ultimately determine the future sustainability of marine productivity, whether by directly extracting resources, indirectly through cultivation, or by providing support for productive activities at sea. The above examples show that effective solutions are possible, and that an explicit expression of scientific research is needed to understand the processes that maintain and have an impact on marine ecosystems. The different direct local users should be included and take an active part; all this should be expressed in public policies and environmental regulations that may be improved by continuously adding new information to make the coastal industries of the continent more sustainable.

Contribution: Stefan Gelcich (Pontificia Universidad Catolica de Chile) and Barbara Saavedra (Wildlife Conservation Society).

3.3 Policy and fiscal incentives

Economic instruments are included in environmental policies as tools to understand how market signals influence economic agents. There is a wide range of economic instruments that could perhaps be applied to environmental policy objectives (pollution charges, creating tradable permits markets, and payment for environmental services). These schemes operate at a decentralized level and apply economic logic to solving environmental problems.

The Region has relatively little experience in using these instruments. The principles of environmental protection are still viewed by many in the productive sectors and by governments as an outside imposition and a source of additional costs that impede development. The result is a political economy in which preference is still not given to environmental sustainability issues. However, applications of noteworthy economic instruments are beginning to appear, particularly in countries with well developed institutions. Application fees for environmental services are common, as are contributions for public expenditure on environmental services. Relevant cases are described in Box 5.20.

Analysing the effectiveness of the cases listed above, and in the light of the constraints identified, shows that action is needed on three fronts:

a) Provide, together with the fiscal authorities, new outlets for political and institutional action together;
b) Adapt existing institutional and legal framework to facilitate how environmental management instruments operate between different levels of government and ensure they are consistent with other sectorial policies, and
c) Consolidate the preparation of national and local statistics and environmental information.

BOX 5.20

National Case Studies and Tools Examined

Brazil

- *Financial compensation for oil exploration.*
- *Payment for water use rights.*
- *Industrial effluents tariff.*
- *Tax on the Movement of Goods and Services (ICMS) and the environmental criteria of transfer to municipalities.*
- *Recognition and awards for improved environmental performance by industries (non-governmental initiative).*

Barbados

- *Deposit-refund system for mass consumption bottles.*
- *Environmental tariff on imported durable goods.*
- *Differentiated rates for solid waste collection.*
- *Tax exemption for solar water heaters.*
- *Tax incentives for hotels to build rainwater storage tanks and imported water-saving equipment .*

Chile

- *Compensation system for particulate emissions in the metropolitan area.*
- *Differential pricing for collecting domestic solid waste.*
- *Individual transferable fishing quotas.*
- *Ozone and organic agriculture ecolabelling.*

Colombia

- *Retributive charge for water pollution applied at basin level by the Regional Autonomous Corporation (CAR).*

Guatemala

- *Guatemala water use permit.*
- *Certification schemes (organic agriculture and ecotourism).*
- *Incentives (subsidies) for reforestation.*
- *Preferential rates for financing clean production projects.*
- *National fund for environmental projects.*
- *Single rates for municipal services: water and energy.*
- *Beautification and solid waste collection.*

Jamaica

- *Users charged according to volume of water extracted.*

Mexico

- *Mexico zero tariff and accelerated depreciation for control and pollution prevention equipment.*
- *Gasoline surcharge.*
- *Fees for using or exploiting public goods: flora, fauna, hunting.*
- *Fees for industrial wastewater discharge.*
- *Deposit/refund systems for used batteries, tyres and lubricants.*
- *Concessions on financing and subsidies for projects on planting and forest management in devastated forest areas.*

Venezuela

- *Deposit/refund systems for mass consumption bottles.*
- *Corporate tax exemption for investments in pollution control and prevention.*
- *Deforestation tax.*
- *Tariff system on industrial waste in the metropolitan area of Caracas based on volume.*

Source: UNDP / ECLAC, 2003.

3.4 Strengthen and Adapt Environmental Regulations

As far as justice is concerned, although in most countries there are very few initiatives and little action taken on environmental justice, some countries have prepared initiatives that would give the competent authorities broad powers and allow them to make binding resolutions. Also, while some legal and administrative authorities have mechanisms to ensure compliance with judgments and rulings, the definition of initiatives is associated with the obstacles and gaps with which administration of justice systems have to deal: a lack of financial and human management resources; very low rates of claims brought to trial or processed; very little administrative decentralization; few locations where complaints may be made or summonses served; poor understanding by legal, penal and administrative authorities of matters concerning the protection of the environment.

In all cases there is still much to be done to be able to streamline mechanisms and establish long-term strategies given that there are degraded ecosystems where the rate of recovery is very slow, or where private entities must assume the financial costs of environmental damage caused by production activities that have ignored national environmental legislation.

3.5 Socio-Environmental Policies

3.5.1 Sustainable consumption and production

The Marrakech Process is a global action campaign based on multiple stakeholders interacting to promote sustainable consumption and production (SCP) and to establish a "Global Framework for Action on SCP", known as the ten year framework of programmes (10YFP), in response to the Johannesburg Implementation Plan (JIP) of the World Summit on Sustainable Development (2002). The United Nations Environment Programme (UNEP) and the United Nations Department of Economic and Social Affairs (UNDESA) are the lead agencies in this global process in which an active part is taken by national governments, development agencies, the private sector, civil society and other stakeholders. The Marrakech Process operates through international, regional and national dialogue committees. In Latin America and the Caribbean, the Regional Council of Government Experts on Sustainable Consumption and Production is a technical body established by the Forum of Ministers of the Environment of Latin America and the Caribbean (Decision 12/2003) to identify and propose effective and efficient policy implementation mechanisms, strategies and integrated programmes that promote and facilitate the adoption of sustainable consumption and production patterns in our societies.

The Fifth Meeting of the Council of Government Experts of LAC for Sustainable Consumption and Production held in 2009 approved the regional priorities proposed for inclusion in the ten year framework programme summarized in Table 5.3. These are reflected in the preparatory documents for the meetings of the Commission on Sustainable Development 2010 – 2011 where Sustainable Consumption and Production will be one of the five topics discussed. Regional priorities identified in Table 5.3 were presented for approval at the Forum of Ministers of Environment in April 2010.

TABLE 5.3

Priority SCP Programmes in Latin America and the Caribbean

Programme	Policies and measures
1. National Sustainable Consumption and Production strategies and policies	● *Include and formulate the theme of SCP in development policies, programmes and strategies.* ● *Strengthen processes to inform, educate and train the population about SCP (check the language and how concepts are transmitted; broaden participation by other organizations and civil society stakeholders; use the SCP Regional Information Network as an instrument to strengthen South-South cooperation).* ● *Quantify costs and benefits associated with implementing SCP in national and sub-regional initiatives.* ● *Promote corporate social responsibility and include concepts of the producers' extended responsibility and life cycle analysis in companies producing large-scale consumer goods that have major environmental and social impacts.*
2. Improving the production sector of small and medium enterprises	● *Prioritize sub-regional sectors linked to environmental or ecosystem services (each region will define priority sectors to be included in the ten year framework of programmes before the end of 2009).* ● *Create or strengthen mechanisms and economic instruments to support sustainability in productive sectors, and improve their productivity and competitiveness.* ● *Define specific SCP indicators in the framework of the Latin American and Caribbean Initiative for Sustainable Development (ILAC).*
3. Sustainable public procurement	● *Promote high-level political leadership to boost sustainable public procurement and that involves and integrates the governing body responsible for national public procurement.* ● *Adopt a strategy to gradually include environmental and social criteria in the procurement of priority goods and services.* ● *Ensure the inclusion and sustainability of the SMEs in SPP programmes by establishing policy measures and specific instruments.* ● *Establish a multisectorial mechanism to facilitate participation, assessment and monitoring of sustainable public procurement by ministries of the economy and finance.*
4. Sustainable lifestyles	● *Adapt and apply policies to encourage the provision of sustainable goods and services at prices all members of society can afford.* ● *Ensure education programmes include sustainable consumer education.* ● *Carry out studies and apply systematic mechanisms to identify and understand what drives consumption in the Region.*
5. Information and knowledge management network	● *Strengthen the REDPYCS Information Network (Sustainable Production and Consumption Network) as a reference tool of quality and prestige to distribute information linking different society stakeholders, and strengthening the capacities needed to help change toward sustainable production and consumption patterns.*

Source: Recommendation of the Forum of Ministers of the Environment of Latin America and the Caribbean and the Fifth Meeting of SCP Experts, Colombia 2009.

3.5.2 Environmental Culture and Education for Sustainable Development

Most of the action taken in this respect, as seen in the GEO Reports consulted, consists of making changes to, or partially adapting, primary and secondary education programmes to introduce what are considered to be key environmental issues. They include items related to recycling and reusing solid waste, natural environment assessment, water resource use, waste disposal and treatment, and the impact of anthropocentric activities on the environment. However, very few assessments have been made about the impact and effectiveness of curricular reforms made in the more specialized environmental education programmes. Also, given the lack of long-term follow-up initiatives, these programmes tend to disappear when the administrations that proposed and began to implement them are no longer in office.

Thus, the emphasis on environmental education in the Region seems to focus on a specific age group on the assumption, perhaps inadvertent, that the adult and youth populations do not need to be taught about the environment.

In this context, and according to various publications, Cuba seems to be a stronghold of environmental education for the Region. Since the 1990s and in the framework of Agenda 21 and the spirit of Rio 92, an Environmental Education Strategy was developed along with an Action Plan for the different territories or geographies. As indicated in the *Urban Environment Outlook Report GEO 2004 Havana,* as part of the Strategy the city implemented a Special Environmental Awareness Programme for the province and, for the capital, put into effect an Environmental Training Network. These programmes have focussed on making an integrated approach to intergenerational environmental education. On the one hand, both children and adolescents are given environmental education lessons in their schools as part of a science curriculum and this is reinforced in their communities by training committees located in the different neighbourhoods. At the same time an awareness programme and the Network's anticipated mechanisms, have made it possible to reach the adult population and, among other efforts, involve it in celebrating World Environment Day, International Day for the Preservation of the Ozone Layer, and World Water Day (Delegation of the Ministry of Science, Technology and Environment, 2004).

3.5.3 Private sector participation

Environmental initiatives and actions designed to arrange ways and means of interaction with the industrial, trade and business sectors so as to reduce the levels of environmental degradation identified in national and sub-national GEO reports can be classified in four main categories: (a) adherence to green standards and certification schemes; (b) eco-efficiency and solid waste co-processing; (c) action on the use of cleaner technologies and changes in production methods; and (d) developing corporate environmental responsibility schemes.

Assuming that classification is agreed, GEO reports suggest there is a degree of equilibrium among most developed countries in the Region concerning the actions outlined in the four above-mentioned categories, while other countries focus on certification schemes and industrial and forestry activities aimed at reusing resources (Mladinic and Ruz, 2005).

In the first case, the focus is on developing mixed systems to reduce environmental degradation caused by extractive and productive activities, something that

comes to the forefront when analyzing production processes and technology substitution, where a private and an institution-public counterpart usually interact or where compensatory mechanisms are developed, on taxation for example (see the case of Colombia) (Lerda and others, 2003).

On the other hand, countries in the second group still hope to include participation by private stakeholders, particularly in the industrial sector, by means of market instruments and certification systems that enable increased value to be added to the product with the use of green stamps or productive sustainability stamps.

Special mention should be made of the design and implementation of corporate environmental liability schemes in the Region as a new approach to understanding the agreements and types of cooperation with private operators concerning environmental conservation objectives (Amit and others, 2004). The GEO sub-national reports, specifically the GEO cities reports, take into account the different efforts made to include private stakeholders' contributions in the community context and in co-management processes with municipal or city authorities on, for example, solid waste management, reprocessing discharges, establishing and maintaining wooded areas, among others; however, the implementation of these schemes should not be taken as a licence to pollute while private agents continue to observe the law in force.

In the case of Brazil, corporate responsibility schemes originated in the 1960s. Until the 1990s corporate social responsibility (CSR) was basically limited to activities aimed at mitigating the social problems facing the country concerning poverty and socially vulnerable slums. CSR schemes were subsequently transformed by adding the expectations of citizens and different interested groups, including those advocating environmental conservation and reducing levels of environmental degradation caused by productive activities. Nowadays priorities are considered to be such issues as education, community involvement and environmental responsibility.

In this context, initiatives such as the Brazilian Business Centre for Sustainable Development - CEBEDS (Brazilian branch of the World Business Council for Sustainable Development, WBCSD) that brings together fifty of the largest companies based in Rio de Janeiro, or the ETHOS Institute for Social Responsibility with more than 700 companies based in Sao Paulo, are examples of efforts by members of the business community to show their commitment to environmental policies; the latter was established as a centre to develop national environmental standards and a good practices documentation centre (Correa and others, 2004). Action is also taken by Brazilian professional business bodies, for instance the Industry Federation of the State of Sao Paulo - the largest in the country – that play an important role in promoting environmental issues, cleaner production and in developing legislation, policies and environmental certification patterns. Finally the experience of the Sao Paulo's Stock Exchange Corporate Sustainability Index (ISE) is relevant. The ISE was created in 2005 to recognize companies with a firm commitment to environmental sustainability and social responsibility and its foundation was based on three international indicators – environmental, social and economic-financial – to which another three indicators have been added: corporate governance, general characteristics and the nature of the product.

3.6 Monitoring and responsibility for environmental management

As already mentioned, there is evidence in the Region of a persistent lack of relevant and up-to-date information and knowledge. The state of the environment (see Chapter II) shows how necessary it is to make society in general, and particularly decision-makers, more aware of and knowledgeable about the benefits of ecosystems and the services they offer, what affects them and any associated costs, especially over the long term. There are many different information needs, ranging from basic data on ecosystem goods and their services, pressures caused by productive activities, human well-being indicators, among others, to more elaborate information and knowledge that will enable predictive models to be produced so that scenarios can be built and trends anticipated, and to make informed and transparent decisions.

Strengthening national environmental indicators, Environmental Information Systems (EIS) and Systems of Integrated Environmental and Economic Accounting (SEEA)

Basic environmental official statistics are key ingredients of environmental and sustainability indicators that make up the EIS. In addition, greater efforts are needed toward the adoption of integrated environmental and economic accounting systems (e.g. SEEA), which presents systematic and interrelated stock and flow accounts for the environment and the economy (UN, 2010). In this regard, Box 5.8 describes how this instrument developed in different countries throughout the continent[14].

Producing and updating statistical information following international standards

Advances in producing statistics must meet data quality criteria according to international environmental statistics standards, and constantly promote the achievement of statistical harmonization and conciliation. In this regard, UNEP and ECLAC, together with the countries, have worked together on the Agenda for Statistics Conciliation of the Millennium Development Goals (MDGs)[15], and on coordinating and harmonizing the indicators of the Latin American and Caribbean Initiative for Sustainable Development (ILAC)[16] with those of the seventh MDG.

Strengthening and implementing Information and Communication Technology (ICT) for the environment

Information and communication technology can play a central role in ecosystem management. ICT is particularly relevant in very large ecosystems in areas of difficult access shared by countries and which, in various ways, threaten their sustainability. The Amazon is the most emblematic example in this respect. Box 5.21 illustrates the many ways ICT can be applied to maintain the Region's environmental sustainability.

14 For a more complete analysis, consult http://www.infoiarna.org.gt/media/File/publicaciones/propias/doc_tecnicos/26_st.pdf

15 www.cepal.org/mdg

16 www.geodatos.org

BOX 5.21

Some ICT Contributions to Environmental Sustainability in the Region

It is difficult to spell out the many ways in which ICT can be applied in environmental protection areas. They range from monitoring fishing vessels by using satellite images to prevent illegal fishing, to monitoring individual endangered species with global positioning satellite systems that provide insight into their behaviour, migration routes and, as a consequence, on how to design protection measures In Chile, for example, pumas are marked with collars equipped with GPS as part of a project to save the huemul or Andean deer that seeks to determine the effect of the puma as a predator of this and other species. The Brazilian National Institute of Space Research (INPE) works with high-resolution imagery covering approximately five million square kilometres of Brazilian Amazonia and other areas of special interest such as what is called the Mata Atlántica (neotropical forest). The INPE has several follow-up programmes to monitor deforestation in Amazonia and has developed new applications of real time deforestation monitoring that are beginning to identify areas where degradation begins, and to detect fires.

With regard to bioprospecting – the systematic search for bioactive substances that allow new biodiversity-based commercial products to be developed such as pharmaceuticals, nutrients, cosmetics, etc.— the development of data processing systems in combination with other advanced technologies allows millions of tests to be done very quickly to identify active compounds, antibodies or genes and, therefore, to determine their potential use.

No less important has been the development of geographical information systems (GIS), that allow georeferenced data to be stored and analysed so that different environmental and socioeconomic variables can be managed; this helps to design and implement investment policies and projects such as those meant to meet the goals related to drinking water and sanitation, monitoring air, water and soil quality, and ecological land use. In Mexico the National System of Environmental and Natural Resources (SNIARN) of the Ministry of the Environment and Natural Resources is an example of how GIS and other programmes and procedures are integrated to collect, organize and disseminate information about the environment and the country's natural resources.

Source: United Nations, 2010 and SEMARNAT (www.semarnat.gob.mx)

4. Effective Policies and Instruments: Opportunities and Barriers

4.1 Including sustainable development principles in policies and programmes

Significant challenges are faced in implementing institutional mandates and new legislation, as well as in including sustainable development principles in decision making and in sectorial policies. This occurs, as mentioned in Chapter I, even though Latin America and the Caribbean have made substantial progress on environmental legislation and establishing institutions whose mandates are directly related to environmental issues.

When conflicts arise between different policy objectives, in most countries of the Region sectorial objectives tend to prevail over environmental objectives. The latter, promoted by less important new or recently established institutions with little policy making capacity and without the resources needed to meet all their commitments, are likely to take second place to politically important and well established sectorial policies whose impact the population can measure and comprehend. Many institutions are only beginning to understand and include environmental and sustainable development in their decision making. There are still coordination and coherence shortcomings in public decisions and policy making which, to meet sectorial objectives, increase degradation: for example, subsidized credit is offered to raise livestock in areas subject to deforestation; infrastructure projects are promoted by assessing and internalizing their environmental and social costs without considering technological alternatives that have less of a negative impact.

The effective inclusion of sustainable development principles in polices and programmes is a long and complex process that must take into account the particular features of each country and government, and of each type of policy proposed. The report on the seventh Millennium Development Goal, published by the United Nations, outlines some relevant lines of action (United Nations, 2010):

- Ensure that decision-makers are more aware of the environment's economic and social importance as part of the countries' heritage.
- Achieve better levels of coordination and coherence of public action to ensure that development is sustainable.
- Establish the bases for a development model that internalizes the external costs of environmental degradation, as well as the external benefits of activities that do not damage the integrity of ecosystems.

4.2 Climate change

Climate change is now one of the most pressing challenges - a driving force for change, as recognized in Chapters I and IV - facing countries in the Region as they make their way towards sustainable development. Chapter III (section 5.2) points out that climate change has had, and will continue to have, a significant effect on ecosystem goods and services and on human well-being, as well as on production and consumption patterns. It is most urgent that this be included in public policies (development, environmental and sectorial) and in the instruments used to apply them.

It is expected that the main effects of climate change will be: more frequent extreme events; changes in agricultural productivity; rising sea levels; a change in the incidence of pests and diseases; and water stress (ECLAC, 2009b).

Repercussions on the productive sectors - agriculture in particular; tourism and fishing - also influence the countries' capacity to attract foreign exchange.

On the other hand, degradation processes take place in at least part of the territory in all Latin American and Caribbean countries and include: land degradation; salinization; soil compaction; erosion; depletion or advanced loss of nutrients; or accumulation of toxic substances, all of which can be made worse by extreme climatic conditions.

The lack of economic valorization of ecosystem services (lacking effective markets or prices), particularly those affected by climate change, leads to ecosystem degradation not being internalized as a loss of national capital; this means that responses, if any, are slow. The notion of loss typically only appears much further down the production chain, unfolding its negative effects only on commodities and goods that have a price. Therefore, the delay of any remedial action can be very significant.

Even though adaptation to climate change is an issue of great importance for the Latin American and Caribbean region; it is only as of very recently, that first studies have started quantifying the economic costs of expected climate change impacts (studies are currently being completed for Mexico, Barbados, Bolivia, Central America, the Caribbean and South America). At present, the ongoing climatic changes are so gradual that it is difficult to differentiate between climate change and the climate variability experienced in the past. A prudent approach would be early adaptation as this would allow future costs to be better distributed over time.

Nevertheless, from (short term oriented) point of view, adaptation measures may appear inappropriate or unnecessary. The pursuit of a more prosperous future, by means of technological advances, usually go against decisions on adaptation so that, when gradual changes appear over long periods, the need for answers does not appear urgent to governments which - independently of the crisis - tend to favour short-term decisions with high discount rates. It will not be easy to strike the right balance between cost, opportunity, irreversibility, perception and the adjustment of decision making mechanisms.

Of particular relevance is the situation in the Caribbean and Central America where populations face a future of increased vulnerability that challenges their survival. Because climate change is already taking place all policies in these sub-regions must be made with a sense of urgency; it is, therefore, much more effective to take timely and concerted action than to delay. Climate policies should be embedded in policies and development strategies of the Caribbean and Central American countries. These should include policies to reduce poverty and ensure food security, as well as sectorial policies when developing tourism, agriculture and fisheries in addition to other activities. And beyond making assessments and taking strategic measures, there are still too few consistent integrated risk management practices being applied in the Caribbean and Central America; such practices must be developed at all levels including: applying building codes, placing restrictions on constructions in flood prone areas; developing natural defences (e.g. mangroves); diversifying tourism; applying water conservation techniques, and others.

Timely adaptation will allow gradual and appropriate cost management by avoiding costs being transferred from producers to consumers, from the private to the public sector, and from present to future generations.

The implementation of the policy framework chosen by the governments of the Region should be complemented by action and the support of international aid agencies and donors; this requires developed countries to make a commitment to engage in adaptation activities. More international, regional and national financing is being made available for adaptation but it is still insufficient to cover the estimated needs.

Of the total funds committed for climate change projects (including GEF funds) to the end of 2009, it is estimated that less than 15 per cent or US$560 million is applied to global level adaptation and 20 per cent US$113 million to adaptation in the Region). Funds for global and regional mitigation are much higher and, therefore, continued promotion must be given to the allocation of resources for national, regional and global level adaptation. While projects to reduce emissions from deforestation and degradation (REDD) are more geared towards mitigation, such projects could provide new opportunities for Latin American countries (see Box 5.22). The UN-REDD Programme is one of the many projects included in the REDD initiative; others are the Forest Carbon Partnership Facility (FCPF) of the World Bank (Daviet and others 2009, World Bank 2009); Climate Works, consisting of enterprises supported by multilateral cooperation. However, some projects receive bilateral cooperation funds, for example those financed by the Agency for Development Cooperation of Norway (NORAD). Discussions are continuing about the REDD programme and others such as REDD^{+} (including reforestation) and REDD^{++} that recognizes agro-forestry projects, land use changes or sustainable forest management projects included in REDD schemes (Parker and others 2009). The discussion about REDD^{++}, also known as REALU (Reducing Emissions from All Land Uses) is perhaps of most benefit to Latin American countries.

Adaptation also entails opportunities to pursue sustainable development, such as better infrastructure, research and development of crop varieties, development of payment for environmental services, better management of watersheds, among others.

Many of the adaptation measures are inherent in development policies. In this regard, it is recommended that monitoring be strengthened and information produced for early warning systems, and that good land use instruments be improved.

Among adaptive mechanisms that could prove to be more effective is requiring insurance for production and

BOX 5.22

The UN-REDD Programme to Reduce Deforestation and Forest Degradation

The UN-REDD (Reducing Emissions from Deforestation and Degradation) implemented by UNEP, UNDP and FAO, aims to build countries' capacities to participate in a future REDD mechanism. The programme seeks to create the conditions whereby the carbon stored in forest systems can have an economic value for both a country and for local people who use forests. By doing so the programme helps to establish incentives for forest conservation and sustainable management. In general terms, the UN-REDD programmes work in some of the following areas:

1) *Defining deforestation scenarios where there is no REDD mechanism.*
2) *Establishing a system to monitor and report carbon storage in forest systems .*
3) *Defining a country strategy that results in reducing emissions from deforestation and forest degradation. This may require adjusting the legislative and/or regulatory framework.*
4) *Including measures to combat deforestation and forest degradation in national and sectorial plans*
5) *Defining a system for the transparent and cost effective distribution of benefits.*
6) *Building local technical capacity to implement REDD programmes. This includes disseminating information about REDD.*

The free and informed participation of local and indigenous communities is of paramount importance in UN-REDD. The programme has internal control mechanisms that ensure participation by groups that depend on forests for their subsistence and development. The UN-REDD Programme is now working with nine pilot countries: Bolivia, Indonesia, Panama, Papua New Guinea, Paraguay, Democratic Republic of Congo, Tanzania, Vietnam and Zambia.

For further information see www.un-redd.org.

for the safe infrastructure operation (ports, highways, transport, and telecommunications). While the different analyses were being made with the countries to prepare CSD 15 and 16 ECLAC (ECLAC-UNDP 2007) some South-South cooperation possibilities were identified, such as those mentioned below, that could prove to be very productive:

- In the different countries prepare a register of initiatives in order to improve capacity to prevent and respond to natural disasters and concerning adaptation and mitigation. In addition, develop a website that offers countries support by providing documents and studies on issues related to discussions concerning how climate develops and operates.
- Undertake specific studies to assess the economic impacts of climate change in the various sub-regions by examining different economic scenarios to determine adaptation needs and mitigation opportunities. With support provided by the government of the United Kingdom, studies of this type have been initiated throughout the Region. Extending these studies would also allow: natural heritage losses caused by climate change to be assessed, even if only partially; and an estimate to be made of the costs of preventing natural disasters and the fiscal vulnerability of countries in the Region. Methodological standardization would make it possible to compare results and obtain a regional view of these problems.
- Implement programmes to support policy development in such areas as: energy efficiency in industries and buildings including low-cost housing construction; clean production; the use of biofuels by industry; better regulation of competitive export sectors; and internalizing externalities when assessing public and private investment projects.
- Promote and share experiences about developing projects for the carbon market, particularly in the case of Action Programmes, Grouped Projects and REDD projects.
- Cooperate to adapt institutions and national financial facilities to the specific requirements of climate change mitigation projects.
- Increase the number of regional accredited organizations whose costs of operation and management are lower than those outside the Region and that are aware of its specific characteristics.
- Coordinate positions to increase the relative weight of the Region in having access to international funds for capacity building and technology transfer.
- Agree on adjustments that should be made to the carbon markets, including assessing operations to finance adaptation.
- Coordinate policies to stimulate lower carbon content investments.

The Region has ample opportunities to advance its own agenda on climate change supported by cooperation that would be of mutual benefit to both the environment and economic development.

Negotiations on the United Nations Framework Convention on Climate Change introduced variations in global commitments which, in addition to expanding developed countries' commitments, may include commitments by sectors based on accountability and capacity criteria (GDP per capita and emissions per capita) in developing countries. Future negotiations could demand that more developing countries reduce emissions in order to maintain climate security and stabilize emissions: this would have repercussions on countries in the Region. In this likely international scenario, the Region should have baseline measuring mechanisms to accurately reflect the progress made.

Although mechanisms and specific areas of use were not defined during the Copenhagen Conference (December 2009), the countries in Annex 1 of the United Nations Framework Convention on Climate Change decided to begin fundraising to support climate change adaptation and mitigation measures, and to reduce emissions from deforestation and degradation in developing countries; it is estimated that US$30 000 million will be raised between 2010 and 2012 and this will reach US$ 100 000 million per year from 2020. In this regard, the IMF announced (March 26, 2010) the creation of a "Green Fund" to channel capital contributions from industrialized countries in the form of Special Drawing Rights (SDRs) and which, to guarantee its credibility, will be independently administered.

It is important for the Region that environmental services payment mechanisms acknowledge the contributions made by forest conservation and proper soil management to climate security and the emissions mitigation effort. Reducing emissions from deforestation and forest degradation should be part of the climate regime's market mechanisms. Even if there is a possibility of an increase in emissions reduction certificates due to minor changes in land use, a greater reduction effort in the developed world should be envisaged in response to this increased offer that would have international economic (stabilizing the price of the reductions) and climate benefits.

The Region does not have equal weight internationally and, if it is to participate in global negotiations with its own regional agenda, its coordination mechanisms will have to be improved so that coordinated initiatives may be presented on economic and environmental improvement, and to establish agreed priorities on having access to international cooperation adaptation and mitigation funds.

4.3 Migration and urban growth

According to the United Nations Programme for Human Settlements (UN-Habitat), the world today has 40 urban "mega regions" where 18 per cent of the population lives. They also account for 66 per cent of economic activity and 85 per cent of scientific and technological advances, with the effects already described in the urban section of Chapter II.

The report "The State of Cities in Latin America"[17] presented at the Fifth World Urban Forum (Rio de Janeiro, March 2010) states that "urban based economic activities" represent over 50 per cent of the world's gross product, and more than 80 per cent of the most urbanized countries in the Region.

Its cities are concentrations of wealth, power, communication, science, technology, and culture. According to the study, however, it is in them that the more dramatic forms of social inequality are also found.

17 Available at http://www.onuhabitat.org/

A quarter of the 471 million people in Latin American cities live in slums, the "favelas" in Brazil, the "villas miserias" in Argentine or the "barrios de tugurios" to use some of the Region's many ways of describing them.

This situation demands that the countries of the Region significantly increase investments to improve basic services and housing conditions and, because it is in these activities where most jobs are found, to provide employment. Nonetheless, if the solutions are to be effective efforts must be coordinated between central, provincial and municipal governments, civil society and the private sector and, above all, with the participation of the interested population.

However, not everything in this scenario is a problem. The counterpart to migration and the pressures it causes in the receptor sites is the development of an extensive and complex social and economic network that would enable a host of services to be provided at the migrants' reception centres while, at the same time, it would revitalize the economies in the communities they left, not only from investments made in public and collective goods and financed by remittances from the migrants, but because there would be more connection between rural and urban markets; this would apply even though such remittances are beyond the scope of institutional rules and regulations because they are registered as part of the "informal" economy. However, this is very fertile ground for the entrepreneurial creativity of those who had to leave their homes precisely because they had nothing to lose.

4.4 Trade and environment

International trade, as already pointed out in Chapter I and in various parts of this chapter, is largely based on the growth of the Region's economies. This activity is intensive in the use of the goods and services provided by ecosystems. Historically, both governments and the private sector had considered environmental issues to be a threat that might cause them to lose competitiveness because of the impact on costs, and as non-tariff barriers to free trade.

There is now greater appreciation of the opportunities provided by the relationship between trade and environment in which climate change is an important factor. Markets in developed countries are placing additional conditions on imports; an example is the practice now taking place of labelling in terms of carbon footprint. In addition, global initiatives like the Green Economy (see section 1 of this chapter), promoted by the United Nations Environment Programme, point to an alignment of production practices (including trade) and the protection of the environment and ecosystems.

The current leadership and growth of international trade in countries like China and India (rather than Europe and North America) might counteract the trends and perhaps relax stringent environmental requirements.

However that may be, and as shown in Chapter II, environmental degradation in Latin America and the Caribbean continues to increase despite the efforts made by governments and international cooperation. Reversing this trend requires more political will to ensure a greater allocation of resources, and more private sector involvement in solving environmental problems.

Governments are responsible for providing the right incentives and the economic and voluntary instruments that may perhaps improve environmental management and, on the other hand, the private sector should include better environmental management in their companies to take advantage of its possible international competitive benefits. In many countries of the Region there is still unequal participation by these stakeholders, or their participation is seen as being conflicting; however, in so far as dialogue between these social stakeholders is strengthened, solutions to environmental challenges will be more sustainable, cheaper and easier to implement.

4.5 Science and technology

Science is practised in the great majority of countries in the Region whenever there is a need to adopt or adapt a technology; that is to say, a scientific model is built only when technological development demands it. In the Region the loss of the relative importance of science and the resources allocated to it, compared to the rise of technology and its resources, inevitably leads to mistakes being made in how financial resources are used and in environmental management.

There is still a long way to go before national scientific strategies are produced to address environmental issues that are based on scientific knowledge of the territory and the behaviour of ecosystems. The main challenges facing environmental sustainability and scientific strategies and policies in Latin America and Caribbean countries lie in carrying out new and more in-depth research on the natural heritage so as to learn about the attributes and behaviour of ecosystems and discover new development opportunities.

At the same time, if a more harmonious relationship is to be achieved between society and the physical environment, research and education are needed on alternative social behaviours that take into account the new ways in which natural resources are used. Current environmental challenges, in particular on the sustainability of development, determine the type of research and training agenda needed if advances are to be made on these issues. The larger-scale development of alternative energies, or building nuclear power plants for electricity generation, are just some examples of what is needed to help to achieve sustainable development; in this regard considerable and long-term efforts are required in terms of research, training and national and regional technological development.

Moreover, it is essential to strengthen local research to promote local and sub-national development in each country by recognizing every locality's identity that depends on its specific conditions. A model to produce, disseminate and adopt technology should be based on a long-range scientific strategy. The creation of such a model would mean encouraging research on local natural resources, and including knowledge of local empirical science about the area's own cultures.

A key challenge is regional development of research programmes based on academic and institutional integration. Countries in the Region cannot afford to create scientific institutions, whether institutional or networks, with resources that are limited, dispersed, and not properly integrated. The only possibility of improving how resources can be used is to investigate and agree on how to use and manage shared ecosystems, resources, and cultures, and now to deal with issues concerning shared borders.

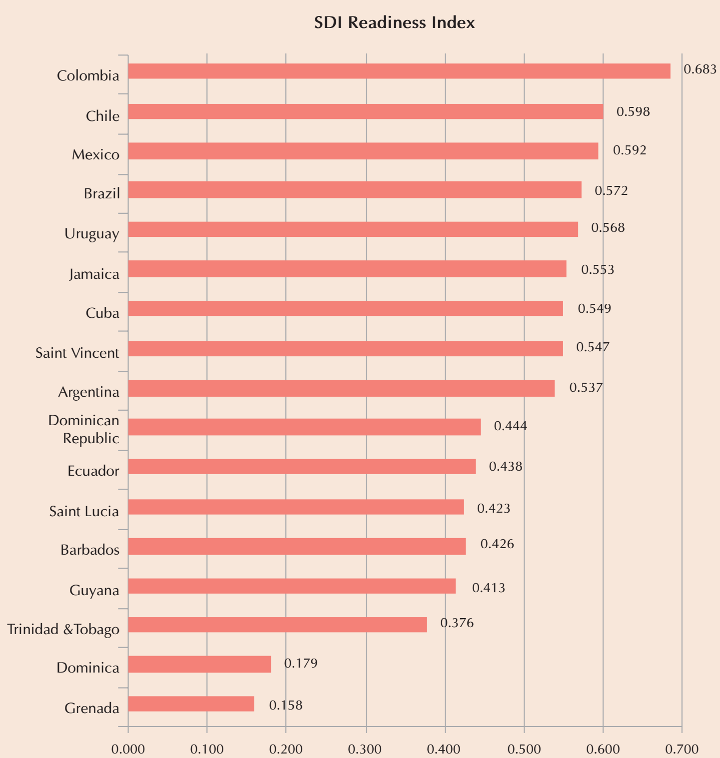
In terms of technology, emphasis is placed on information technologies that should be based on: spatial data infrastructures (known as SDI, see Box 5.23); innovations in remote sensing technologies, especially for regional, national, and local monitoring; energy technologies; technologies for water management and alternative agriculture; and cleaner production technologies.

BOX 5.23

Spatial Data Infrastructure in Latin America and its Potential Role in Sustainable Development

A specific topic closely related to the generation of knowledge and information is the appearance in the Region of Spatial Data Infrastructures (SDIs), particularly in response to several natural disasters in recent years. An example is Hurricane Mitch that struck Central America in 1998 and encouraged the growth of several nodes (clearinghouses, spatial data distribution agencies) in Central American countries (Central American Geographic Information Project, PROCIG). Other recent experiences, such as the increasingly active hurricanes in the Caribbean, the earthquake in Peru in 2007, or the floods in the Province of Santa Fe in Argentina, have also promoted the creation of regional, national and local Spatial Data Infrastructure initiatives in Latin America and the Caribbean, with a clear focus on preventing or mitigating the effects of extreme events, whether natural or caused by human beings, as well as global changes.

The SDI Readiness Index measures how prepared a country is to share local, national, regional or global geographic information. Some countries have great potential to share geographic information in the interest of national and regional priorities and, in particular, in order to support the Region's decision making about sustainable development, while others are working to improve their capacity to do so.



This potential is expressed as a composite index that includes organizational factors (vision, institutional leadership, legal framework); information (availability of digital mapping and metadata); technological (Web connectivity, technology infrastructure, and capacity to use geospatial software, either open-source or proprietary); human resources (educational level, SDI culture, individual leadership); financial resources (government sources, private or return on investment - ROI). Most factors are obtained by means of questionnaires applied to SDI authorities in the countries reviewed, except for Web Connectivity, Technology Infrastructure and Educational Level that were taken from a regular UNDESA survey to calculate a global Electronic Government Index. Because of their mainly qualitative nature, a compensatory fuzzy logic model was applied to integrate the factors due to their mainly qualitative nature. The SDI Readiness Index measures the countries' preparedness to provide timely geographic information to spatially model the behaviour of the environment and its impact.

Source: adapted from Delgado, T. and Delgado, M., 2008. PROCIG: http://www.procig.org/principal.htm

5. Final Reflections

If greater environmental sustainability is to be achieved in Latin America and the Caribbean it is not enough to seek economic growth with environmental concerns in mind. The lack of harmony between society and nature is a reflection of social interactions. Environmental sustainability is based on and is a consequence of an equitable society.

The growth of exports remains the main driving force of environmental degradation in LAC. A dependence on the model of increased exports of raw materials and the failure to develop alternative models led to scientific and technological models being maintained that do not include environmental sustainability.

Heavy pressure is put on the environment by the growth of population and increased consumption, particularly in a context of a persistence of poverty, extreme poverty and inequality.

The main challenge still facing the Region is to reduce poverty and inequality. This means the environmental dimension has remained in second place despite the strong impact of environmental degradation on the quality of life of the most vulnerable people.

A new social pact is required to meet the Region's challenges. A balance will have to be maintained between the different stakeholders with governments, civil society and the private sector as equal participants. In this regard, stakeholders could take advantage of the global economic slowdown to refocus their business plans and sustainable development objectives, and accelerate the transformation to a green economy and sustainable prosperity. Implementation efforts should begin immediately if the radical changes that many experts consider necessary are to be made in the energy and transport sectors' consumption and production patterns (UNEP, 2010).

Above all, however, a more supportive position must be adopted to reduce inequality and poverty and make a more equitable distribution of current income from exploiting the natural resources on which current economic growth is based. The five sectors[1] that are the focus of the Global Green New Deal may, together with other socio-economic measures, play an important role in revitalizing the regional economy by providing jobs while accelerating the fight against climate change, degradation of the environment and poverty.

Scientists warn about the real possibility of crossing the "point of no return" in terms of consuming the planet's resources. This warning makes it crucial that all sectors of society understand the importance of this limit so as to decide when to backtrack in order to operate within safe limits. Doing so will require learning from the past, improving analytical tools, developing sustainable solutions to environmental challenges and, most important of all, achieving higher economic growth while using fewer resources that have less of an environmental impact (UNEP, 2010).

18 The five sectors are: 1) clean energy and clean technologies, including recycling; 2) rural energy, including renewable; 3) sustainable agriculture, including organic, 4) ecosystem infrastructure, reducing emissions from deforestation and environmental degradation (REDD); and 5) sustainable cities, including planning, transportation and green buildings.

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Statistical Annex

Latin America and the Caribbean

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
LAND																
Land area	1	1000 ha	2,027,462.0	2,027,462.0	2,027,462.0	2,027,462.0	2,027,462.0	2,027,462.0	2,027,462.0	2,027,462.0	2,027,462.0	2,027,462.0	2,027,462.0	2,027,462.0	2,027,462.0	
Arable land and permanent crops	2	1000 ha	150,044.0	160,667.0	161,410.0	162,075.5	162,669.6	162,660.7	164,156.9	164,019.0	164,406.0	166,755.0	166,912.0	167,123.6	168,131.0	
Arable land tillage	3	1000 ha	131,940.6	140,881.0	141,590.0	142,108.5	142,597.6	142,629.7	144,110.9	144,196.0	144,625.0	147,444.0	147,424.0	147,562.7	148,836.1	
Permanent Crops	4	1000 ha	18,103.0	19,786.0	19,816.0	19,967.0	20,072.0	20,031.0	19,687.3	19,234.1	19,142.1	19,310.0	19,487.0	19,560.9	19,294.9	
Non arable land and non permanent crops	5	1000 ha	1,877,418.0	1,866,795.0	1,866,052.0	1,865,386.5	1,864,792.4	1,864,801.3	1,863,305.1	1,863,443.0	1,863,056.0	1,860,707.0	1,860,550.0	1,860,338.4	1,859,331.0	
Permanent meadows and pastures		1000 ha	540,798.0	551,983.0	553,460.0	554,458.0	555,331.3	555,036.5	549,966.8	549,977.0	549,236.5	550,226.5	550,541.8	549,972.8	550,130.0	
Arable land and permanent crops per capita	6	ha/ 100 Inhab	33.8	33.2	32.3	32.0	31.6	31.1	31.0	30.6	30.2	30.3	29.9	29.6	29.4	
Farming Area	7	1000 ha	690,842.0	712,650.0	714,870.0	716,533.5	718,000.9	717,697.3	712,067.3	711,757.2	712,674.7	715,855.5	716,328.8	715,971.4	717,137.0	
Irrigated farming area	8	1000 ha	16,794.0	18,039.0	18,282.0	18,431.0	18,490.0	18,591.0	18,611.0	2,016.0	2,747.5	2,833.2	6,176.4	6,362.5	1,813.5	
Fertilizer consumption	9	kt								12,706.0	15,865.9	17,224.7	14,768.5	15,336.8	21,496.2	
Nitrogen	10	kt								4,851.8	5,806.8	5,874.5	5,418.3	5,631.4	9,777.6	
Phosphate	11	kt								4,012.9	5,257.9	5,859.9	4,750.0	4,958.0	6,180.1	
Potash	12	kt								3,841.7	4,801.9	5,491.3	4,600.8	4,748.1	5,539.9	
Fertilizer consumption for arable land		Metric t per ha								0.1	0.1	0.1	0.1	0.1	0.1	
FOREST																
Forest area, total	13	1000 ha	992,822.1	970,350.0	961,361.0	956,866.5	952,372.2	947,877.6	943,134.6	938,391.2	933,648.2	928,905.0	924,162.0	919,348.8	914,605.6	
Plantations	14	1000 ha	8,707.0					12,237.0					13,138.0			
Natural Forest	15	1000 ha	984,114.0					935,639.0					911,024.0			
Proportion of land area covered by forest	16	%	48.5					46.8	46.5	46.3	46.1	45.8	45.6	45.3	45.1	
Annual average change in Forest Area	17	%						-0.5					-0.5			
Forest area under Forest Management Plans FRA (Forest Resource Assessment)	18	1000 ha						36,297.0								36,297.0
Proportion of forest area under Forest Management Plans FRA	19	%						1.8								
Roundwood production	20	1000 m³	356,510.4	396,839.5	396,936.1	399,210.1	418,385.5	424,989.1	412,692.5	420,997.6	449,996.7	446,268.8	463,803.4	447,570.5	462,112.2	
Industrial roundwood production	21	1000 m³	121,229.0	144,460.4	140,951.4	141,754.4	156,028.6	158,826.6	145,513.7	151,625.3	178,614.5	172,292.8	186,944.7	171,403.6	182,914.0	
Fuelwood and charcoal production	22	1000 m³	235,281.4	252,379.1	255,984.7	257,455.7	262,356.9	266,162.5	267,178.8	269,372.3	271,382.3	289,976.5	289,418.6	287,791.5	291,329.6	
Wood-based panels production	23	1000 m³	4,934.6	6,112.2	7,915.2	7,407.7	8,476.5	9,383.2	9,940.2	10,615.0	12,119.6	13,761.6	13,726.2	14,837.4	15,389.8	
Paper and paperboard production	24	1000 m³	10,828.5	12,501.1	13,762.4	13,624.2	13,837.4	14,498.4	15,507.3	15,771.9	16,601.2	17,949.2	18,811.8	16,513.7	16,636.4	
BIODIVERSITY																
Protected area, number	25	No.	1,891	2,436	2,508	2,571	2,617	2,655	2,658	2,696	2,696	2,633				4,287
Protected area, total area	26	1000 ha	146,999.9	192,370.2	208,133.7	211,802.0	212,091.2	215,736.1	216,451.5	216,523.0	216,523.0	215,881.1				
Strict nature reserves / Wilderness areas, number	27	No.	267	293	301	301	301	301	300	294	294					
Strict nature reserves / Wilderness areas, total area	28	1000 ha	9,646.7	10,543.7	10,820.9	10,820.9	10,820.9	10,820.9	10,811.6	10,811.6	10,811.6	9,386.3				
National parks, number	29	No.	479	564	563	570	573	574	575	566	566					
National parks, total area	30	1000 ha	54,148.4	66,664.1	67,322.2	68,469.0	68,558.4	68,558.4	68,573.4	68,391.8	68,391.8					
Natural monuments, number	31	No.	87	133	127	128	129	129	130	130	130					
Natural monuments, total area	32	1000 ha	3,596.8	9,822.1	9,752.8	9,734.2	9,735.3	9,735.3	9,735.8	9,735.8	9,735.8					
Habitat / Species management area, number	33	No.	429	610	665	713	754	791	792	793	793					
Habitat / Species management area, total area	34	1000 ha	12,716.0	15,115.4	14,957.2	15,149.7	15,159.3	18,802.5	18,811.9	18,763.0	18,763.0					
Protected landscapes and seascapes, number	35	No.	225	295	302	303	304	304	305	299	299					
Protected landscapes and seascapes, total area	36	1000 ha	18,553.7	22,037.5	22,505.2	22,510.7	23,328.4	23,328.4	23,329.0	22,341.3	22,341.3					
Managed resource protected area, number	37	No.	406	543	553	559	559	559	559	557	557					
Managed resource protected area, total area	38	1000 ha	50,587.9	70,408.7	71,535.9	72,218.2	72,218.2	72,218.2	72,218.2	72,197.4	72,197.4					
Total Number of threatened species	39	No.						4,373		4,543	5,910	8,157		8,543		9,204
Number of threatened species. Annual Change Rate.		%								1.9	30.1	38.0		2.3		3.8
Number of threatened mammal species	40	No.						516		538	531	534		527		620
Number of threatened bird species	41	No.						662		669	671	820		792		796
Number of threatened reptile species	42	No.						281		282	282	298		383		380
Number of threatened amphibian species	43	No.						35		31		1,254		1,280		1,346
Number of threatened fish species	44	No.						148		167		660		920		1,040
Number of threatened molluscs species	45	No.								55		81		81		81
Number of threatened invertebrate species	46	No.						155		102		101		120		511
Number of threatened plant species	47	No.						2,595		2,699		4,409		4,440		4,430

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
FRESHWATER																
Proportion of population with access to drinking water services	48	%	82.8	86.1				89.2		88.3		91.0				
Proportion of population with access to drinking water services, rural	49	%	60.4	65.7				70.0								
Proportion of population with access to drinking water services, urban	50	%	92.6	93.9				95.3								
Proportion of population with access to sanitation services	51	%	67.4	71.7				75.1		74.1		77.1				
Proportion of population with access to sanitation services, rural	52	%	35.9	41.3				46.4								
Proportion of population with access to sanitation services, urban	53	%	80.7	82.8				84.7								
Total freshwater fish production	54	kt	481.4	605.8	634.8	639.0	681.2	722.5	742.2	802.1	831.3	881.6	879.9	903.7		
Freshwater fish production, catch	55	kt	432.1	507.5	461.0	452.4	455.0	471.5	476.5	496.0	513.6	544.4	530.1	542.2		
Freshwater fish production, aquaculture	56	kt	49.3	98.4	173.8	186.6	226.2	251.0	265.7	306.1	317.7	337.2	349.8	361.6		
Proportion of total water resources used	57	%	2.5	2.1				5.0								
Total withdrawal extraction	58	1000 Km^3	22,174.0	120,997.0				265,030.0				16.6	26.6			
Withdrawal extraction per capita	59	m^3 /Inhab	50.0	250.4				507.3				0.0	0.0			
Agricultural withdrawals extraction	60	%	86.0	69.7				70.7								
Industrial withdrawals extraction	61	%	6.9	11.5				10.4								
Domestic withdrawals extraction	62	%	7.1	18.8				19.1								
COASTAL AND MARINE AREAS																
Total marine fish production	63	kt	15,265.6	20,665.2	18,483.0	11,720.7	17,462.2	19,084.6	16,213.7	17,360.2	13,903.0	18,543.5	17,848.1	15,633.4		
Total marine fish production, catch	64	kt	15,139.1	20,489.4	18,221.0	11,479.6	17,388.7	18,997.1	16,141.7	17,270.9	13,781.7	18,426.9	17,657.8	15,416.6		
Total marine fish production, aquaculture	65	kt	126.5	175.7	262.0	241.2	73.5	87.5	72.0	89.3	121.3	116.6	190.3	216.8		
Marine protected areas	66	1000 ha	27,735.8	33,784.9	34,043.4	34,182.6	34,653.7	36,131.1	36,139.8	36,230.1	36,230.1	36,667.4	37,808.9	37,808.9		
Mangroves, total area	67	1000 ha	4,425.5					4,147.6					4,045.6			
ATMOSPHERE																
CO2 Emissions	68	kt	303,861.0	342,861.0	370,355.0	379,441.0	381,667.0	378,101.0	383,080.0	369,499.0	372,919.0	390,009.0				
CO2 Emissions per capita	69	t /Inhab	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7				
CO2 Emissions per $1 GDP (PPP)	70	t/Mill US$ 2000 PPP	103.6	99.1	98.5	98.7	99.1	94.3	94.9	91.4	90.4	89.2				
From gas fuels	72	kt	52,230.0	56,364.0	65,416.0	72,846.0	74,603.0	72,456.0	76,194.0	78,101.0	82,725.0	88,889.0				
From liquid fuels	73	kt	211,138.0	239,733.0	251,354.0	253,889.0	254,854.0	250,060.0	254,917.0	240,972.0	238,583.0	248,728.0				
From solid fuels	74	kt	22,579.0	27,030.0	30,227.0	30,644.0	30,413.0	30,765.0	29,124.0	28,271.0	30,059.0	30,291.0				
Emissions of particles	75	kt	182.5	174.1	195.5	201.9	200.6	203.4	199.2	190.1	194.4	235.8				
Emissions of sulphur oxides (SO2)	76	kt				4,169.1	4,019.1				3,868.3	4,084.4	4,260.2	4,421.9		
Emissions of nitrogen oxides (NOx)	77	kt				7,954.8	7,922.8				8,439.6	8,943.2	9,893.1	10,004.0		
Emissions of hydrocarbon (HC)	78	kt				2,101.1	1,123.7				3,297.1	2,843.7	1,461.3	1,440.9		
Emissions of carbon monoxide (CO)	79	kt				27,160.4	23,440.3				25,925.6	26,421.9	25,303.8	29,472.5		
Emissions of methane, total	80	kt	92,115.9	869.9	928.6	83,319.6		81,859.8		79,776.4			201.9			
From energy	81	kt	35,525.4	392.4	410.8	43,499.5		42,660.6		40,752.0			0.7			
From agriculture	82	kt	52,987.5	344.0	364.8	38,976.4		38,500.1		38,843.3			138.3			
From other sources	83	kt	3,311.3	131.4	153.0	534.3		373.9		181.2			62.9			
Consumption of ozone-depleting substances, total	84	ODP tn	33,278.0	37,578.2	33,228.8	30,366.7	31,297.7	29,437.2	25,726.3	17,846.1	17,876.3	19,460.1	14,290.9	11,582.6	7,217.8	
Consumption of ozone-depleting substances, Chlorofluorocarbons (CFCs)	85	ODP tn	32,646.9	32,847.9	28,154.8	24,860.9	26,261.9	22,389.4	18,963.3	12,709.9	12,764.9	13,551.4	8,611.3	6,318.8	890.7	
Consumption of ozone-depleting substances, Hydrochlorofluorocarbons (HCFCs)	86	ODP tn	429.6	1,034.6	1,172.4	1,296.8	1,978.6	3,210.2	2,568.4	1,925.7	1,986.9	2,943.0	2,777.7	3,044.6	4,052.4	
Consumption of ozone-depleting substances, Methyl bromide	87	ODP tn	201.5	3,695.7	3,901.6	4,209.0	3,057.2	3,837.6	4,194.6	3,210.5	3,124.5	2,965.7	2,901.9	2,219.2	2,274.7	
HUMAN SETTLEMENT																
Population density	88	Inhab/km	21.6	23.5	24.3	24.7	25.1	25.4	25.8	26.1	26.5	26.8	27.1	27.5	27.9	28.2
Urban population	89	1000	311,165.0	352,028.0				394,378.0					432,624.0			

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Percent of population living in urban areas	90	%	70.2	72.8				75.5					77.6			
Annual growth rates of the urban population	91	%	5.5	2.5				2.3					1.9			
Rural population		1000	132,389.0	131,240.0				128,086.0					125,129.0			
Percent of population living in rural areas		%	29.8	27.2				24.5					22.4			
Annual growth rates of the rural population		%	0.1	-0.2				-0.5					-0.5			
Number of cities greater than 750.000 population	92	No.	68	70				70					70			
Population of urban aglomerations comprising 750.000 or more inhabitants	93	%	25.8	26.8				27.6					28.5			
Number of cities with population between 500.000 and 1 million	94	No.	44	51				55					61			
Population of urban aglomerations with population between 500.000 and 1 million	95	%	9.9	10.5				10.1					10.6			
Number of cities with population between 1 and 5 million	96	No.	34	37				42					44			
Population of urban aglomerations with population between 1 and 5 million	97	%	21.8	21.4				21.8					21.8			
Number of cities with population between 5 and 10 million	98	No.	2	2				3					4			
Population of urban aglomerations with population between 5 and 10 million	99	%	5.2	3.6				5.0					6.3			
Number of cities greater than 10 million population	100	No.	3	4				4					4			
Population of urban aglomerations comprising 10 million or more inhabitants	101	%	13.6	16.0				15.3					14.8			
Proportion of urban population living in slums	102	%	35.6										31.2			
Roads total network	103	Km												3,234,783.0		3,234,783.0
DISASTERS AND VULNERABILITY																
Number of natural and technological disaster events	108	No.	71	88	64	82	89	111	95	113	79	108	107	74	106	7
Floods	109	No.	22	22	20	19	19	37	29	38	33	26	27	31	37	6
Cyclones/ hurricanes/ typhoons	110	No.	11	27	9	20	17	9	23	20	6	27	35	5	25	0
Earthquakes	111	No.	5	9	5	3	7	3	6	1	5	5	4	1	9	0
Landslides and avalanches	112	No.	1	4	2	6	4	6	3	5	4	3	2	2	2	0
Extreme temperatures	113	No.	2	3	2	1	1	7	3	3	2	7	0	3	5	0
Volcanic eruptions	114	No.	1	2	3	3	4	2	1	4	1	0	2	6	1	1
Drought		No.	2	1	3	5	1	6	5	5	1	5	4	1	1	1
Technological disasters	116	No.	27	20	20	25	36	41	25	37	27	35	33	25	26	
Estimated damages due to natural and technological disaster events	117	Mill $	21,295.7	65,849.4	872.9	36,924.8	6,815.2	1,051.8	9,455.4	51,588.9	1,429.2	9,089.7	23,787.7	367.5	7,724.1	545.0
Floods	118	Mill $	146.2	14.5	257.1	1,996.7	3,616.8	331.3	1,070.9	442.1	1,092.9	308.0	558.1	214.8	3,380.0	545.0
Cyclones/ hurricanes/ typhoons	119	Mill $	90.7	5,701.4	447.8	12,526.1	827.5	279.5	1,188.6	925.8	100.0	8,778.6	11,574.5	2.7	2,244.1	0.0
Earthquekes	120	Mill $	20.5	22.8	154.0	0.0	2,249.0	0.0	2,148.6	0.0	116.3	0.0	5.1	0.0	2,100.0	0.0
Landslides and avalanches	121	Mill $	0.0	0.0	0.0	0.0	0.0	75.0	0.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0
Extreme temperatures	122	Mill $	2.3	10.0	4.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Volcanic eruptions	123	Mill $	0.0	0.7	8.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	0.0	150.0	0.0	0.0
Drought	124	Mill $	36.0	100.0	2.0	402.0	122.0	356.0	36.4	210.0	120.0	3.1	1,650.0	0.0	0.0	0.0
Technological disasters	125	Mill $	21,000.0	60,000.0	0.0	22,000.0	0.0	0.0	5,000.0	50,000.0	0.0	0.0	10,000.0	0.0	0.0	
Number of people afected due to natural and technological disaster events	126	No.	2,670,370	539,038	2,871,686	15,530,553	2,893,383	550,208	10,497,209	1,575,273	3,212,582	3,927,961	6,943,637	1,128,869	7,819,529	5
Floods	127	No.	169,411	285,035	1,082,621	369,300	1,382,229	486,707	621,730	565,474	597,882	592,115	756,381	570,823	4,588,530	
Cyclones/ hurricanes/ typhoons	128	No.	3,500	223,503	800,200	4,239,723	265,001	62,570	6,037,820	799,300	10,100	998,752	6,106,002	240,700	839,034	
Earthquekes	129	No.	14,299	0	53,115	0	1,205,933	0	1,940,528	0	178,603	253	27,645	16,470	505,211	
Landslides and avalanches	130	No.	0	0	0	0	0	0	0	0	0	1,200	0	0	0	
Extreme temperatures	131	No.	0	25,000	0	0	0	0	0	0	1,839,888	2,139,467	0	0	884,572	
Volcanic eruptions	132	No.	0	5,000	4,200	0	0	0	0	128,150	0	0	0	300,213	0	
Drought	133	No.	2,483,160	0	931,200	10,920,000	40,000	0	1,896,596	82,000	35,000	192,500	52,990	0	1,000,000	
Technological disasters	134	No.		500	350	1,530	220	931	535	349	551,109	3,674	619	663	2,182	5
Proportion of population in poverty		%	47.0	54.2	51.2	46.0	43.9	39.8	41.2	45.9	41.1	41.6	38.8	33.7		

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Employed Population below 1$ PPP per day	135	%	12.8					8.1	9.8	8.4	8.1	5.9				
Poverty gap coefficient	136	%	20.4	24.0	20.8	18.7	19.2	15.2	18.4	19.7	17.5	18.5	16.4	12.3		
Share of youth unemployed to youth population, both sexes	137	%	6.1	7.0	8.3	9.1	9.6	6.8	8.7	8.5	9.4	9.0	6.3			
ENVIRONMENT AND HUMAN HEALTH																
Infant mortality rate	138	* 1000 Inhab	45.2	36.8				30.4					24.3			
Life expectancy at birth females	139	Years	70.7	72.5				74.1					75.5			
Life expectancy at birth males	140	Years	64.3	66.0				67.7					69.1			
Calories availability	141	Kcal/daily per Inhab	2,682.7	2,780.3	2,806.6	2,819.8	2,847.6	2,845.0	2,853.1	2,860.5	2,890.1		2,960.5		2,775.5	
Reported Cases of Dengue	142	No.	0	328,556	410,233	729,420	476,346	395,624	636,617	1,000,642	462,616	268,598	429,213	562,263	902,216	872,603
Reported Cases of Malaria	144	No.	0	0	0	1,287,918	1,229,495	1,146,042	953,942	897,777	942,877	883,102	1,046,955	916,465	0	
Reported Cases of Cholera	145	No.	0	75,665	17,919	57,294	9,674	2,694	525	17	25	28	5	0	0	0
SOCIOECONOMICS TRENDS																
Total Population at midyear	146	1000	443,559.0					522,458.0	529,750.0	536,812.0	543,756.0	550,696.0	557,747.0	564,964.0	572,261.0	579,571.0
Average annual growth rate of population	147	%	2.0					1.6	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Adult literacy rate, total	148	%	88.0				79.9	88.0	92.0	89.7		89.7	91.4	89.9	91.6	
Male	149	%	90.4				74.1	88.7	92.9	91.4		92.4	89.4	92.3	92.4	
Female	150	%	85.8				85.9	87.4	91.3	88.2		90.3	85.9	88.2	90.9	
School life expectancy	151	Year					13.1	13.2	13.4	13.4	13.2	13.0	13.1	13.2	13.3	12.9
Male	152	Year					12.9	13.0	13.2	13.2	12.9	12.8	12.8	12.9	12.9	12.8
Female	153	Year					13.3	13.4	13.6	13.6	13.4	13.3	13.4	13.6	13.7	13.2
Telephone lines	154	* 100 Inhab	11.2	15.7	17.9	19.2	20.5	22.3	23.3	19.6	19.3	20.5	20.7	18.6	18.7	
Cellular subscribers	155	* 100 Inhab	0.1	0.9	2.7	4.3	8.0	12.2	16.1	19.1	23.5	32.0	43.4	58.1		
Internet users	156	* 100 Inhab		0.1	0.6	1.2	2.0	3.9	5.7	8.3	9.9	11.7	15.2	14.8		
Size of vehicle fleet		No.	34,385,042.0	45,974,728.0	50,320,797.0	55,388,686.0	58,243,217.0	57,444,963.0	63,334,086.0	68,196,900.0	72,253,056.0	77,051,262.0	81,211,111.0	96,149,429.0	95,830,457.0	104,516,132.0
Energy use per capita	157	kt oil equivalent	1,036.3	1,037.9	1,053.2	1,037.8	1,078.8	1,074.0	1,107.4	1,128.2	1,153.7	1,151.0	1,150.6	1,136.6	1,132.7	1,133.2
Energy imports, net (% of energy use of commercial energy)	158	%	-34.0	-38.0	-43.6	-41.6	-37.7	-40.0	-41.2	-39.5	-39.8	-40.9				
Energy intensity of gross domestic product	159	1.000 Barrels / million constant dolar GNP	2.2	2.2	2.2	2.2	2.2	2.1	2.1	2.2	2.0	2.1	2.1	2.1	2.0	2.0
Renewable energy supply	160	kboe	835,403.7	899,613.4	923,561.2	908,382.0	950,158.4	942,447.2	944,100.7	981,930.8	1,063,437.9	1,094,688.1	1,138,868.9	1,173,336.1	1,233,675.7	1,298,621.3
Non-renewable energy supply		kboe	2,504,627.9	2,866,228.7	3,299,804.5	3,423,725.2	3,500,293.8	3,494,864.3	3,448,938.6	3,498,763.0	3,609,387.1	3,720,154.7	3,906,796.8	3,994,119.8	4,116,838.0	4,230,209.0
Combustible renewables and waste (% of total energy)	161	%	20.3	16.9	15.6	14.7	14.4	14.2	14.1	14.1	13.8	13.1				
Total primary energy production per capita	162	TJ / Inhab	61.4	64.7	68.1	71.5	69.8	70.4	69.9	69.3	69.2	73.3	72.9	76.4		
Total primary energy production, Geothermal	163	Tjoul	84,948.2				72,752.9	87,275.8	96,522.3	97,418.4	152,591.8	140,873.3	131,495.9	166,022.7	181,440.2	172,429.2
Total primary energy production, hydropower	164	Tjoul	2,142,560.8				2,178,089.6	2,254,090.7	2,117,612.0	2,225,921.8	2,400,124.2	2,533,853.5	2,747,913.0	2,795,916.0	2,857,463.9	
Total primary energy production, sugar cane bagasse	165	kboe		314,705.0			256,916.0	219,410.0	241,800.0	258,427.0	279,694.0	282,759.0	297,772.0	325,799.0	362,028.0	389,001.0
Total primary energy production, coal	166	metric tons					55.4	63.5	68.0	62.8	67.7	74.9	82.1	90.2	95.2	97.7
Total primary energy production, natural gas	167	Mm3		139,748.0			180,304.5	180,071.9	178,433.7	191,024.4	202,691.9	220,200.9	244,042.1	258,913.6	257,729.8	268,671.0
Total primary energy production, firewood	168	kboe		385,200.0							395,368.0	404,356.0	416,833.7			
Total primary energy production, oil	169	1000 Barrels per day		2,980,457.0			3,398,729.0	3,488,504.0	3,515,996.0	3,490,021.0	3,435,399.0	3,602,711.0	3,786,846.0	3,768,542.0	3,620,458.0	3,601,786.0
Electricity Production	170	GWh	609,473.0	769,832.0	865,043.0	891,679.0	914,001.0	962,243.0	951,966.0	978,841.0	1,021,433.0	1,072,211.0	1,117,193.0	1,173,990.0	1,223,133.0	1,247,569.0
From coal sources	171	% of total	3.8	4.1	4.8	4.8	5.1	4.7	4.8	4.9	5.4	4.8	5.4			
From hydroelectric sources	172	% of total	63.4	63.8	61.9	60.9	60.1	60.0	56.5	57.1	56.4	56.2	57.2			
From gas sources	173	% of total	9.7	10.6	10.9	11.9	12.6	13.7	15.8	17.1	18.5	19.5	18.5			
From nuclear sources	174	% of total	2.0	2.3	2.5	2.2	2.3	2.1	3.1	3.0	3.0	2.6	2.4			
From oil sources	175	% of total	18.9	17.1	17.8	18.1	17.7	17.4	17.5	15.6	13.8	14.1	13.6			
Gross domestic income per habitant (Atlas method)	176	$	78,680.0	105,910.0	119,600.0	121,480.0	122,920.0	128,200.0	127,670.0	113,670.0	93,440.0	103,350.0	114,700.0	104,400.0		

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Gross domestic product, annual growth	177	%		0.4	5.3	2.5	0.4	3.9	0.4	-0.4	2.2	5.9	4.7	5.5	5.5	
Agriculture, value added	178	% of GDP	5.7	5.4	5.2	5.2	5.3	5.2	5.4	5.6	5.7	5.5	5.4	5.3	5.2	
Industry, value added	179	% of GDP	28.5	27.5	28.2	28.0	27.5	27.4	26.9	26.5	26.5	26.8	26.6	26.6	26.3	
Service, value added	180	% of GDP	60.8	59.9	59.4	59.7	60.3	60.4	60.8	61.5	61.5	61.3	61.6	61.7	62.0	
Exports of goods and services	181	% of GDP	21.6	26.2	26.2	25.7	26.6	28.3	26.6	27.6	28.5	30.2	30.7			
Imports of goods and services	182	% of GDP	18.7	26.9	28.5	29.8	29.0	29.8	28.7	25.6	26.3	28.2	28.4			
Total Debt Service (% of GNP)	183	% of GDP	6.0	6.7	8.2	6.5	7.4	8.7	7.0	7.1	8.4	7.7	6.2			
GDP public spent on education	184	% of GDP					4.2	4.4	4.5	4.5	4.9	4.5	5.2	4.0		
GDP expenditure on RD		% of GDP	0.5	0.6	0.4	0.4	0.4	0.5	0.6	0.6	0.1					
Physicians	187	No.	237,761	341,271	354,560	473,777	793,913	333,274	441,502	826,736	326,626	486,164	961,212	415,170	454,322	

Notes:

1 Includes information for all countries 1990-2007

2 Excluded due for lack of information Anguilla (1990-2007)

3 Excluded due for lack of information Anguilla (1990-2007)

4 Excluded due for lack of information: Anguilla (1990-2007), Netherlands Antilles (1990-2007), Aruba (1990-2007), Cayman Islands (1990-2007), Montserrat (1990-2007) and Turks and Caicos (1990-2007)

5 Excluded due for lack of information Anguilla (1990-2007)

6 Excluded due for lack of information: Anguilla (1990-2007), Guadeloupe (1990-2007), Cayman Islands (1990-2007), Martinique (1990-2007) and Guyana (1990-2007)

7 Excluded due for lack of information Anguilla (1990-2007)

8 Excluded due for lack of information: Anguilla (1990-2007), Antigua and Barbuda (1990-2007), Netherlands Antilles (1990-2007), Aruba (1990-2007), Dominica (1990-2007), Grenada (1990-2007), Cayman Islands (1990-2007), Virgin Islands (United States) (1990-2007), British Virgin Islands (1990-2007), Montserrat (1990-2007), Saint Kitts and Nevis (1990-2007) and Turks and Caicos (1990-2007)

9,10, 11, 12 Excluded due for lack of information Guyana (2002-2007)

13 Excluded due for lack of information: Anguilla (1990-2007), Netherlands Antilles (1990-2007), Aruba (1990-2007), Barbados (1990-2007), Cayman Islands (1990-2007), Virgin Islands (United States) (1990-2007) and Turks and Caicos (1990-2007)

14 Excluded due for lack of information: Anguilla (1990, 2000 and 2005), Antigua and Barbuda (1990, 2000 and 2005), Netherlands Antilles (1990, 2000 and 2005), Aruba (1990, 2000 and 2005), Barbados (1990, 2000 and 2005), Dominica (1990, 2000 and 2005), Grenada (1990, 2000 and 2005), Cayman Islands (1990, 2000 and 2005), Virgin Islands (United States) (1990, 2000 and 2005), British Virgin Islands (1990, 2000 and 2005), Montserrat (1990, 2000 and 2005), Puerto Rico (1990, 2000 and 2005), Dominican Republic (1990, 2000 and 2005), Saint Kitts and Nevis (1990, 2000 and 2005), Saint Lucia (1990, 2000 and 2005), Saint Vincent and the Grenadines (1990, 2000 and 2005), Turks and Caicos (1990, 2000 and 2005), Belize (2000 and 2005), Guyana (2000 and 2005) and Venezuela (2000 and 2005)

15 Excluded due for lack of information: Anguilla (1990, 1995, 2000 and 2005), Antigua and Barbuda (1990 and 2005), Netherlands Antilles (1990, 1995, 2000 and 2005), Aruba (1990, 1995, 2000 and 2005), Barbados (1990, 1995, 2000 and 2005), Dominica (1990, 2000 and 2005), Grenada (1990, 2000 and 2005), Guadeloupe (1990), Cayman Islands (1990, 1995, 2000 and 2005), Virgin Islands (United States) (1990, 1995, 2000 and 2005), British Virgin Islands (1990, 2000 and 2005), Montserrat (1990, 2000 and 2005), Puerto Rico (2005), Dominican Republic (2005), Saint Kitts and Nevis (1990 and 2005), Saint Lucia (1990 and 2005), Saint Vincent and the Grenadines (1995 and 2000), Turks and Caicos (1990, 1995, 2000 and 2005), Belize (2005), Guyana (2005) and Venezuela (2005)

16 Excluded due for lack of information: Anguilla (1990, 1995 and 2007), Netherlands Antilles (1990 and 2007), Aruba, Barbados (1990 and 2007), Cayman Islands (1990 and 2007), Virgin Islands (United States) (1990 and 1997) and Turks and Caicos (1990 , 1995 and 2007)

17 Excluded due for lack of information Aruba (2000-2005)

18 Includes information for the following countries: Cuba (2000 and 2008), Guadeloupe (2000 and 2008), Haiti (2000 and 2008), Jamaica (2000 and 2008), Martinique (2000 and 2008), Puerto Rico (2000 and 2008), Dominican Republic (2000 and 2008), Trinidad and Tobago (2000 and 2008), Bolivia (2000 and 2008), Brazil (2000 and 2008), Colombia (2000 and 2008), Ecuador (2000 and 2008), French Guyana (2000 and 2008), Guyana (2000 and 2008), Paraguay (2000 and 2008), Peru (2000 and 2008), Suriname (2000 and 2008), Uruguay (2000 and 2008) and Venezuela (2000 and 2008)

19 Includes information for the following countries: Cuba (2000), Guadeloupe (2000), Haiti (2000), Jamaica (2000), Martinique (2000), Puerto Rico (2000), Dominican Republic (2000), Trinidad and Tobago (2000), Bolivia (2000), Brazil (2000), Colombia (2000), Ecuador (2000), French Guyana (2000), Guyana (2000), Paraguay (2000), Peru (2000), Suriname (2000), Uruguay (2000) and Venezuela (2000)

20 Includes information for the following countries: Bahamas (1990-2007), Cuba (1990-2007), Guadeloupe (1990-2007), Haiti (1990-2007), Jamaica (1990-2007), Martinique (1990-2007, Puerto Rico (1990-2007), Dominican Republic (1990-2007), Trinidad and Tobago (1990-2007), Bolivia (2000), Brazil (2000), Colombia (2000), Ecuador (2000), French Guyana (2000), Guyana (2000), Paraguay (2000), Peru (2000), Suriname (2000), Uruguay (2000) and Venezuela (2000)

21 Includes information for the following countries: Bahamas (1990-2007), Cuba (1990-2007), Guadeloupe (1990-2007), Haiti (1990-2007), Jamaica (1990-2007), Martinique (1990-2007), Puerto Rico (1990-2007), Dominican Republic (1990-2007) and Trinidad and Tobago (1990-2007)

22 Includes information for the following countries: Cuba (1990-2007), Guadeloupe (1990-2007), Haiti (1990-2007), Jamaica (1990-2007), Martinique (1990-2007), Puerto Rico (1990-2007), Dominican Republic (1990-2007) and Trinidad and Tobago (1990-2007)

23 Includes information for the following countries: Cuba (1990-2007), Costa Rica (1990-2007), Guatemala (1990-2007), Honduras (1990-2007), Mexico (1990-2007), Nicaragua (1990-2007) and Panama (1990-2007)

24 Includes information for the following countries: Barbados (2005 and 2007), Cuba (1990-2007), Jamaica (1990-2007), Martinique (1990-2007), Dominican Republic (1990-2007), Costa Rica (1990-2007), El Salvador (1990-2007), Guatemala (1990-2007), Mexico (1990-2007), Panama (1990-2007), Argentina (1990-2007), Bolivia (1990-2007), Brazil (1990-2007), Chile (1990-2007), Colombia (1990-2007), Ecuador (1990-2007), French Guyana (1990-2007), Guyana (1990-2007), Paraguay (1990-2007), Peru (1990-2007), Uruguay (1990-2007) and Venezuela (1990-2007)

25 Excluded due for lack of information Anguilla and Aruba (1990-2008)

26 Excluded due for lack of information Anguilla and Aruba 1990-2004

27 Includes information for the following countries: Cayman Islands (1990-2003), Dominican Republic (1995), Trinidad and Tobago (1990-2003), Belize (1990-2003), Costa Rica (1990-2003), Guatemala (1990-2003), Honduras (1990-2003), Mexico (1990-2003), Nicaragua (1990-2003), Argentina (1990-2003), Brazil (1990-2003), Colombia (1990-2003), Ecuador (1990-2003) and French Guyana (1995-2003)

28 Includes information for the following countries: Cayman Islands (1990-2003), Dominican Republic (1995), Trinidad and Tobago (1990-2004), Belize (1990-2004), Costa Rica (1990-2004), Guatemala (1990-2004), Honduras (1990-2004), Mexico (1990-2004), Nicaragua (1990-2004), Argentina (1990-2004), Brazil (1990-2004), Colombia (1990-2004), Ecuador (1990-2004) and French Guyana (1990-2004)

29, 30 Excluded due for lack of information: Anguilla (1990-2003), Aruba (1990-2003), Grenada (1990-2003), Jamaica (1990-2003), Martinique (1990-2003), Puerto Rico (1990-2003), Dominican Republic (1991-2003), Saint Lucia (1990-2003), Saint Vicente and the Grenadines (1990-2003), French Guyana (1990-2003) and Uruguay (1990-2003)

31, 32 Excluded due for lack of information: Anguilla (1990-2003), Antigua and Barbuda (1990-2003), Netherlands Antilles (1990-2003), Aruba (1990-2003), Bahamas (1990-2003), Cuba (1990-2003), Dominica (1990-2003), Grenada (1990-2003), Guadeloupe (1990-2003), Haiti (1990-2003), Cayman Islands (1990-2003), Martinique (1990-2003), Puerto Rico (1990-2003), Dominican Republic (1996-2003), Saint Kitts and Nevis (1990-2003), Saint Vicente and the Grenadines (1990-2003), Trinidad and Tobago (1990-1997), Costa Rica (1990-2003) and El Salvador (1990-2003), Bolivia (1990-2003), French Guyana (1990-2003), Guyana (1990-2003) and Suriname (1990-2003)

33, 34 Excluded due for lack of information: Anguilla (1996-2003), Antigua and Barbuda (1996-2003), Netherlands Antilles (1996-2003), Aruba (1996-2003), Grenada (1996-2003), Haiti (1996-2003), Jamaica (1996-2003), Dominican Republic (1996-2003), Saint Kitts and Nevis (1996-2003), El Salvador (1990-1994), Ecuador (1990-2003), French Guyana (1990-2003) and Peru (1990-2003)

35, 36 Includes information for the following countries: Cuba (1990-2001), Guadeloupe (1990-2003), Haiti (1990-2003), Jamaica (1999-2003), Martinique (1990-2003), Montserrat (1990-2003), Dominican Republic (1990-1995), Trinidad and Tobago (1990-2003), Belize (1996-2003), Guatemala (1990-2003), Honduras (1994-2004), Mexico (1990-2003), Panama (1990-2003), Argentina (1990-2003), Brazil (1990-2003), Colombia (1990-2003), Ecuador (1990-2003), French Guyana (1990-2003), Peru (1990-2003), Uruguay (1990-2003) and Venezuela (1990-2003)

37, 38 Includes information for the following countries: Cuba (1990-2001), Dominica (1990-2003), Grenada (1990-2003), Jamaica (1999-2003), Montserrat (1990-2003), Dominican Republic (1995), Saint Lucia (1990-2003), Trinidad and Tobago (1990-2003), Belize (1990-2003), Costa Rica (1990-2003), Guatemala (1990-2003), Mexico (1990-2003), Nicaragua (1991-2003), Panama (1990-2003), Argentina (1990-2003), Bolivia (1990-2003), Brazil (1990-2003), Colombia (1990-2003), Ecuador (1990-2003), Peru (1990-2003), Suriname (1990-2003) and Venezuela (1990-2003)

39,40,41,42, 43, 44 Includes information for all countries: 2000, 2002-2004 and 2008

45 Includes information for all countries: 2002, 2004 and 2008

46,47 Includes information for all countries: 2000, 2002, 2004 and 2008

48 Excluded due for lack of information: Netherlands Antilles (1990, 2002 and 2004), Aruba (1990), Cuba (1990), Grenada (1990), Guadeloupe (1990), Cayman Islands (1990, 2002 and 2004), Islas Virgins (States Unites) (1990, 2002 and 2004), British Virgin Islands (1990), Jamaica (1990); Martinique (1990, 2002 and 2004), Puerto Rico (1990, 2002 and 2004), Saint Vincent and the Grenadines (1990, 2002 and 2004), Turks and Caicos (1990), Belize (2003), Costa Rica (2003), El Salvador (2003), Guatemala (2003 and 2004), Honduras (2003), Mexico (2003), Nicaragua (2003), Panama (2004), Argentina (2002) and French Guyana (1990)

49 Excluded due for lack of information: Anguilla (1990 and 2004), Antigua and Barbuda (1990), Netherlands Antilles (1990, 2002 and 2004), Aruba (1990), Cuba (1990), Dominica (1990), Grenada (1990), Guadeloupe (1990), Cayman Islands (1990, 2002 and 2004), Islas Virgins (States Unites) (1990, 2002 and 2004), British Virgin Islands (1990), Jamaica (1990), Martinique (1990, 2002 and 2004), Montserrat (1990), Puerto Rico (1990, 2002 and 2004), Saint Kitts and Nevis (1990), Saint Lucia (1990), Saint Vincent and the Grenadines (1990), Turks and Caicos (1990), Belize (2003), Costa Rica (2003), El Salvador (2003), Guatemala (2003 and 2004), Honduras (2003), Mexico (2003), Nicaragua (2003), Panama (2004),Argentina (2002), French Guyana (1990), Suriname (1990) and Uruguay (1990)

50 Includes information for the following countries: Anguilla (2002 and 2004), Antigua and Barbuda (2002 and 2004), Aruba (2002 and 2004), Bahamas (1990, 2002 and 2004), Barbados (1990, 2002 and 2004), Cuba (2002 and 2004), Dominica (1990, 2002 and 2004), Grenada (2002 and 2004), Guadeloupe (2002 and 2004), Haiti (1990, 2002 and 2004), British Virgin Islands (1990, 2002 and 2004), Jamaica (1990, 2002 and 2004), Montserrat (2002 and 2004), Dominican Republic (1990, 2002 and 2004), Saint Kitts and Nevis (2002 and 2004), Saint Lucia (2002 and 2004), Saint Vincent and the Grenadines (2002 and 2004), Trinidad and Tobago (1990, 2002 and 2004), Turks and Caicos (2002 and 2004), Belize (1990, 2002 and 2004), Costa Rica (1990, 2002 and 2004), El Salvador (1990, 2002 and 2004), Guatemala (1990, 2002 and 2004), Honduras (1990, 2002 and 2004), Mexico (1990, 2002 and 2004), Nicaragua (1990, 2002 and 2004) and Panama (1990, 2002 and 2003)

51 Excluded due for lack of information: Anguilla (1990), Antigua and Barbuda (1990), Netherlands Antilles (1990, 2002 and 2004), Aruba (1990, 2002 and 2004), Cuba (1990), Grenada (1990), Guadeloupe (1990), Cayman Islands (1990, 2002 and 2004), Islas Virgins (States Unites) (1990, 2002 and 2004), British Virgin Islands (1990), Jamaica (1990), Martinique (1990, 2002 and 2004), Montserrat (1990), Puerto Rico (1990, 2002 and 2004), Saint Kitts and Nevis (1990), Saint Lucia (1990), Saint Vincent and the Grenadines (1990), Turks and Caicos (1990), Belize (2003), Costa Rica (2003), El Salvador (2003), Guatemala (2003 and 2004), Honduras (2003), Mexico (2003), Nicaragua (2003), Panama (2004), Argentina (2002) and French Guyana (1990)

52 Excluded due for lack of information: Anguilla (2004), Netherlands Antilles (2002 and 2004), Aruba (2002 and 2004), Cuba (1990), Grenada (1990), Guadeloupe (1990), Haiti (1990), Cayman Islands (1990, 2002 and 2004), Islas Virgins (States Unites) (1990, 2002 and 2004), British Virgin Islands (1990), Jamaica (1990); Martinique (1990, 2002 and 2004), Montserrat (1990), Puerto Rico (1990, 2002 and 2004), Dominican Republic (1990), Saint Lucia (1990), Saint Vincent and the Grenadines (1990) and Turks and Caicos (1990), Belize (1990), Costa Rica (1990), Guatemala (1990 and 2004), Honduras (1990), Mexico (1990), Panama (1990 and 2004), Argentina (2002), French Guyana (1990), Peru (1990) and Suriname (1990)

53 Excluded due for lack of information: Anguilla (1990), Antigua and Barbuda (1990), Netherlands Antilles (1990, 2002 and 2004), Aruba (1990, 2002 and 2004), Cuba (1990), Grenada (1990), Guadeloupe (1990), Cayman Islands (1990, 2002 and 2004), Islas Virgins (States Unites) (1990, 2002 and 2004), British Virgin Islands (1990), Jamaica (1990), Martinique (1990, 2002 and 2004), Montserrat (1990), Puerto Rico (1990, 2002 and 2004), Saint Kitts and Nevis (1990), Saint Lucia (1990), Saint Vincent and the Grenadines (1990), Turks and Caicos (1990), Guatemala (2004), Panama (2004), Argentina (2002) and French Guyana (1990)

54 Excluded due for lack of information: Anguilla (1990-2006), Antigua and Barbuda (1990-2006), Netherlands Antilles (1990-2006), Aruba (1990-2006), Bahamas (1993-2006), Barbados (1990-2006), Dominica (1990-2006), Cayman Islands (1990-2006), British Virgin Islands (1990-2006), Montserrat (1990-2006), Saint Kitts and Nevis (1990-2006), Saint Lucia (1990, 1991 and 2006), Trinidad and Tobago (2004-2006) and Turks and Caicos (1990-2006), Belize (1992-2003), Chile (1995-1997 and 1999-2006) and French Guyana (1992-1996)

55 Excluded due for lack of information: Anguilla (1990-2006), Antigua and Barbuda (1990-2006), Netherlands Antilles (1990-2006), Aruba (1990-2006), Bahamas (1990-2006), Barbados (1990-2006), Dominica (1990-2006), Grenada (1990-2006), Guadeloupe (1990-2006), Cayman Islands (1990-2006), British and American Virgin Islands (1990-2006), Martinique (1990-1992 and 1994-2006), Montserrat (1990-2006), Puerto Rico (1990-2006), Saint Kitts and Nevis (1990-2006), Saint Lucia (1990-2006), Saint Vincent and the Grenadines (1990-1995 and 1998-2006), Trinidad and Tobago (1990-2006), Turks and Caicos (1990-2006), Belize (1991 and 1995-2006), Chile (1995-1997 and 1999-2006) and French Guyana (1990-2006)) and French Guyana (1992-1996)

56 Excluded due for lack of information: Anguilla (1990-2006), Antigua and Barbuda (1990-2006), Netherlands Antilles (1990-2006), Aruba (1990-2006), Bahamas (1990-2006), Barbados (1990-2006), Dominica (1990, 1991, 2005 and 2006), Grenada (1990-2006), Haiti (1990-2006), Cayman Islands (1990-2006), Virgin Islands (United States) (1990-2005), British Virgin Islands (1990-2006), Montserrat (1990-2006), Saint Kitts and Nevis (1990-2006), Saint Lucia (1990, 1991 and 2006), Saint Vincent and the Grenadines (1990-2006), Trinidad and Tobago (1990-2006), Turks and Caicos (1990-2006), Belize (1990, 1994 and 1998-2003), Nicaragua (2002-2004), Argentina (1990 and 1991), Chile (1990-2006), Ecuador (1995 and 1996), French Guyana (1992-1996) and Suriname (1990-2006)

57 Includes information for the following countries: Antigua and Barbuda (1990), Barbados (2000), Cuba (1995 and 2000), Dominica (1995 and 2000), Haiti (1990 and 2000), Jamaica (1995 and 2000) , Trinidad and Tobago (1995 and 2000), Belize (1995 and 2000), Costa Rica (1995 and 2000), El Salvador (1990 and 2000), Guatemala (2000), Honduras (2000), Mexico (2000), Nicaragua (2000), Panama (2000), Argentina (1995 and 2000), Bolivia (2000), Brazil (1995 and 2000), Chile (2000), Colombia (2000), Ecuador (2000), Guyana (2000), Paraguay (2000), Peru (1990 and 2000), Suriname (2000), Uruguay (2000) and Venezuela (2000)

58 Includes information for the following countries: Barbados (2000), Cuba (1995 and 2000), Haiti (1990 and 2000), British Virgin Islands (1995 and 2000), Dominican Republic (1995 and 2000), Trinidad and Tobago (1995 and 2000), Belize (1996 and 2000), Costa Rica (1995 and 2000), El Salvador (1990 and 2000), Guatemala (2000), Honduras (2000), Mexico (2000), Nicaragua (2000), Panama (2000), Argentina (1995 and 2000), Bolivia (2000), Brazil (1995 and 2000), Chile (2000), Colombia (2000), Ecuador (2000), Guyana (2000), Paraguay (2000), Peru (1990 and 2000), Suriname (2000), Uruguay (2000) and Venezuela (2000)

59 Includes information for the following countries: Antigua and Barbuda (1990), Barbados (2000), Cuba (2000), Haiti (1990 and 2000), Jamaica (2000), Dominican Republic (2000), Trinidad and Tobago (2000), Belize (2000), Costa Rica (2000), El Salvador (1990 and 2000), Guatemala (2000), Honduras (2000), Mexico (2000), Nicaragua (2000), Panama (2000), Argentina (2000), Bolivia (2000), Brazil (2000), Chile (2000), Colombia (2000), Ecuador (2000), French Guyana (2000), Paraguay (2000), Peru (2000), Suriname (2000), Uruguay (2000) and Venezuela (2000)

60 Includes information for the following countries: Antigua and Barbuda (1990), Barbados (2000), Cuba (1995 and 2000), Haiti (1990 and 2000), Jamaica (1995 and 2000), Dominican Republic (1995 and 2000), Trinidad and Tobago (1995 and 2000), Belize (1996 and 2000), Costa Rica (1995 and 2000), El Salvador (1990 and 2000), Guatemala (2000), Honduras (2000), Mexico (2000), Nicaragua (2000) and Panama (2000), Argentina (1995 and 2000), Bolivia (2000), Brazil (1995 and 2000), Chile (2000), Colombia (2000), Ecuador (2000), Guyana (2000), Paraguay (2000), Peru (1990 and 2000), Suriname (2000), Uruguay (2000) and Venezuela (2000)

61 Includes information for the following countries: Antigua and Barbuda (1990), Barbados (2000), Cuba (1995 and 2000), Haiti (1990 and 2000), Jamaica (1995 and 2000), Dominican Republic (1995 and 2000), Trinidad and Tobago (1995 and 2000), Belize (2000), Costa Rica (1995 and 2000), El Salvador (1990 and 2000), Guatemala (2000), Honduras (2000), Mexico (2000), Nicaragua (2000) and Panama (2000), Argentina (1995 and 2000), Bolivia (2000), Brazil (1995 and 2000), Chile (2000), Colombia (2000), Ecuador (2000), Guyana (2000), Paraguay (2000), Peru (1990 and 2000), Suriname (2000), Uruguay (2000) and Venezuela (2000)

62 Includes information for the following countries: Antigua and Barbuda (1990), Barbados (2000), Cuba (1995 and 2000), Haiti (1990 and 2000), Jamaica (1995 and 2000), Dominican Republic (1995 and 2000), Trinidad and Tobago (1995 and 2000), Belize (1996 and 2000), Costa Rica (1995 and 2000), El Salvador (1990 and 2000), Guatemala (2000), Honduras (2000), Mexico (2000), Nicaragua (2000), Panama (2000), Argentina (1995 and 2000), Bolivia (2000), Brazil (1995 and 2000), Chile (2000), Colombia (2000), Ecuador (2000), Guyana (2000), Paraguay (2000), Peru (1990 and 2000), Suriname (2000), Uruguay (2000) and Venezuela (2000)

63, 64 Includes information for all countries 1990-2006

65 Includes information for the following countries: Bahamas (1990-2006), Cuba (1990-2004), Martinique (1990-2006), Puerto Rica (1996-2006), Dominican Republic (1990-1997, 2000-2006), Saint Kitts and Nevis (1990-1191), Mexico (1994 and 1998-2006), Nicaragua 1990-2006), Brazil (1990-2006), Chile (1990-2000), Colombia (1990-2006), Ecuador 1990-(2002), Guyana (1990-2000), Peru (2000-2006) and Venezuela (1991-2001)

66 The information in agregated by the source to regions.

67 Includes information for all countries: 1990, 2000 and 2005

68 Excluded due for lack of information: Anguilla (1990-2004), Virgin Islands (United States) (1990-2004), Puerto Rico (1990-2004) and Turks and Caicos (1990-2004)

69 Excluded due for lack of information: Anguilla (1990, 2000-2004), Virgin Islands (United States) (1990, 2000-2004), Puerto Rico (1990, 2000-2004) and Turks and Caicos (1990, 2000-2004)

70 Excluded due for lack of information: Anguilla (1990-2004), Aruba (1990-2004), Bahamas (1990-2004), Barbados (1990-2004), Cuba (1990-2004), Dominica (1990-2004), Guadeloupe (1990-2004), Cayman Islands (1990-2004), British and American Virgin Islands (1990-2004), Martinique (1990-2004), Montserrat (1990-2004), Puerto Rico (1990-2004), Saint Lucia (1990-2004), Turks and Caicos (1990-2004), Guyana (1990-2004)

72,73 Excluded due for lack of information: Anguilla (1990-2004) and Turks and Caicos (1990-2004)

74 Excluded due for lack of information: Anguilla (1990-2004), British Virgin Islands and Turks and Caicos (1990-2004)

75 Excluded due for lack of information: Anguilla (1990-2004), Antigua and Barbuda (1990-2004), Netherlands Antilles (1990-2004), Aruba (1990-2004), Bahamas (1990-2004), Dominica (1990-2004), Guadeloupe (1990-2004), Isla Cayman (1990-2004), British and American Virgin Islands (1990-2004), Martinique (1990-2004), Montserrat (1990-2004), Puerto Rico (1990-2004), Saint Kitts and Nevis (1990-2004), Saint Lucia (1990-2004), Saint Vincent and the Grenadines (1990-2004), Turks and Caicos (1990-2004), Belize (1990-2004) and French Guyana (1990-2004)

76,77,78,79 Excluded due for lack of information: Anguilla (1993, 1994, 1998, 1999 and 2003-2006), Antigua and Barbuda (1993, 1994, 1998, 1999 and 2003-2006), Netherlands Antilles (1993, 1994, 1998, 1999 and 2003-2006), Aruba (1993, 1994, 1998, 1999 and 2003-2006), Bahamas (1993, 1994, 1998, 1999 and 2003-2006), Dominica (1993, 1998, 2003 and 2004), Guadeloupe (1993, 1994, 1998, 1999 and 2003-2006), Isla Cayman (1993, 1994, 1998, 1999 and 2003-2006), British and American Virgin Islands (1993, 1994, 1998, 1999 and 2003-2006), Martinique (1993, 1994, 1998, 1999 and 2003-2006), Montserrat (1993, 1994, 1998, 1999 and 2003-2006), Puerto Rico (1993, 1994, 1998, 1999 and 2003-2006), Saint Kitts and Nevis (1993, 1994, 1998, 1999 and 2003-2006), Saint Lucia (1993, 1994, 1998, 1999 and 2003-2006), Saint Vincent and the Grenadines (1993, 1994, 1998, 1999 and 2003-2006), Turks and Caicos (1993, 1994, 1998, 1999 and 2003-2006), Belize (1995, 1994, 1998, 1999 and 2003-2006) and French Guyana (1995, 1994, 1998, 1999 and 2003-2006)

80 Includes information for the following countries: Cuba (1990, 1994, 1996, 1998, 2000 and 2002) and Dominican Republic (1990, 1994, 1998 and 2000), Belize (1994), Costa Rica (1990, 1996, 2000 and 2005), El Salvador (1994), Guatemala (1990), Mexico (1990, 1992, 1994, 1996, 1998, 2000 and 2002), Panama (1994), Bolivia (1990, 1994, 1998 and 2000), Brazil (1990 and 1994), Chile (1990 -1998), Colombia (1990-1994), Paraguay (1990 and 1994) and Peru (1994)

81 Includes information for the following countries: Barbados (2002), Dominican Republic (1998 and 2002), Belize (1994), Costa Rica (1990, 1996, 2000 and 2005), El Salvador (1994), Guatemala (1990), Mexico (1990, 1992, 1994, 1996, 1998, 2000 and 2002), Panama (1994), Bolivia (1990, 1994, 1998 and 2000), Brazil (1990 and 1994), Chile (1990 -1998), Colombia (1990-1994), Paraguay (1990 and 1994) and Peru (1994)

82 Includes information for the following countries: Cuba (2002), Dominican Republic (1990, 1994, 1998 and 2000), Belize (1994), Costa Rica (1990, 1996, 2000 and 2005), El Salvador (1994), Guatemala (1990), Mexico (1990, 1992, 1994, 1996, 1998, 2000 and 2002), Panama (1994), Bolivia (1990, 1994, 1998 and 2000), Brazil (1990 and 1994), Chile (1990 -1998), Colombia (1990-1994), Paraguay (1990 and 1994) and Peru (1994)

83 Includes information for the following countries: Cuba (2002) and Dominican Republic (1990, 1994, 1998 and 2000). Note: To Mesoamerica and South America no data

84 Includes information for the following countries: Cuba (1990-2006), Dominican Republic (1992-2006), Belize (1995-2005), Costa Rica (1991-2006), El Salvador (1999-2003), Mexico (1990-2006), Panama (1995-2006), Bolivia (1994-2006), Brazil (1992-2005), Chile (1990 -2005), Paraguay (1995-2003) and Peru (1993-1996)

85 Includes information for the following countries: Cuba (1990-2006), Dominican Republic (1992-2006), Belize (1995-2006), Costa Rica (1991-1997 and 1999-2006), El Salvador (1999-2003), Guatemala (1990-2006), Mexico (1990-2006), Panama (1995-2006), Bolivia (1994-2006), Brazil (1992-2005), Chile (1990 -2005), Paraguay (1995-2003) and Peru (1993-1996)

86 Includes information for the following countries: Cuba (1998-2006), Dominican Republic (1994-2006), Belize (1995-2001, 2005 and 2006), Costa Rica (1991, 1992, 1994 and 1996-2006), Mexico (1990-2006), Panama (1995-2006), Bolivia (1994-2006), Brazil (1992-2005), Chile (1990 -2005), Paraguay (1995-2003) and Peru (1993-1996)

87 Includes information for the following countries: Cuba (1995-2006), Dominican Republic (1993-2006), Costa Rica (1990, 1991 and 1994-2006), Guatemala (2005 and 2006), Mexico (1991-2006), Panama (1994-2006), Bolivia (1994-2006), Brazil (1992-2005), Chile (1990 -2005), Paraguay (1995-1998, 2001 and 2003) and Peru (1993-1996)

88 Excluded due for lack of information: Anguilla (1990, 2000 and 2005), Antigua and Barbuda (1990, 2000 and 2005), Dominica (1990, 2000 and 2005), Guadeloupe (1990, 2000 and 2005), Cayman Islands (1990, 2000 and 2005), British Virgin Islands (1990, 2000 and 2005), Martinique (1990, 2000 and 2005), Montserrat (1990, 2000 and 2005), Saint Kitts and Nevis (1990, 2000 and 2005), Turks and Caicos (1990, 2000 and 2005) and French Guyana (1990 and 2000-2008)

89 Excluded due for lack of information: Guadeloupe (1990, 2000-2008), Cayman Islands (1990, 2000-2008), Martinique (1990, 2000-2008), Belize (1990, 1995, 2000 and 2005), Guyana (1990, 1995, 2000 and 2005), French Guyana (1990, 1995, 2000 and 2005) and Suriname (1990, 1995, 2000 and 2005)

90, 91 Excluded due for lack of information: Anguilla (1990, 2000 and 2005), Antigua and Barbuda (1990, 2000 and 2005), Netherlands Antilles (1990, 2000 and 2005), Aruba (1990, 2000 and 2005), Bahamas (1990, 2000 and 2005), Barbados (1990, 2000 and 2005), Dominica (1990, 2000 and 2005), Grenada (1990, 2000 and 2005), Guadeloupe (1990, 2000 and 2005), Isla Cayman (1990, 2000 and 2005), British and American Virgin Islands (1990, 2000 and 2005), Martinique (1990, 2000 and 2005), Montserrat (1990, 2000 and 2005), Puerto Rico (1990, 2000 and 2005), Saint Kitts and Nevis (1990, 2000 and 2005), Saint Lucia (1990, 2000 and 2005), Saint Vincent and the Grenadines (1990, 2000 and 2005), Trinidad and Tobago (1990, 2000 and 2005),Turks and Caicos (1990, 2000 and 2005), Belize (1990, 2000 and 2005), Guyana (1990, 2000 and 2005), French Guyana (1990, 2000 and 2005) and Suriname (1990, 2000 and 2005)

92, 93, 94 Excluded due for lack of information: Anguilla (1990, 1995, 2000 and 2005), Antigua and Barbuda (1990, 1995, 2000 and 2005), Netherlands Antilles (1990, 1995, 2000 and 2005), Aruba (1990, 1995, 2000 and 2005), Bahamas (1990, 1995, 2000 and 2005), Barbados (1990, 1995, 2000 and 2005), Dominica (1990, 1995, 2000 and 2005), Grenada (1990, 1995, 2000 and 2005), Guadeloupe (1990, 1995, 2000 and 2005), Isla Cayman (1990, 1995, 2000 and 2005), British and American Virgin Islands (1990, 1995, 2000 and 2005), Martinique (1990, 1995, 2000 and 2005), Montserrat (1990, 1995, 2000 and 2005), Saint Kitts and Nevis (1990, 1995, 2000 and 2005), Saint Lucia (1990, 1995, 2000 and 2005), Saint Vincent and the Grenadines (1990, 1995, 2000 and 2005), Trinidad and Tobago (1990, 1995, 2000 and 2005),Turks and Caicos (1990, 1995, 2000 and 2005), Belize (1990, 1995, 2000 and 2005), Guyana (1990, 1995, 2000 and 2005), French Guyana (1990, 1995, 2000 and 2005) and Suriname (1990, 1995, 2000 and 2005)

95 Excluded due for lack of information: Belize (1990, 1995, 2000 and 2005), Costa Rica (2000 and 2005), El Salvador (1995 and 2000), Panama (2000 and 2005), Ecuador (1990, 1995, 2000 and 2005), Guyana (1990, 1995, 2000 and 2005), French Guyana (1990, 1995, 2000 and 2005), Paraguay (1990, 1995, 2000 and 2005), Peru (1990, 1995, 2000 and 2005), Suriname (1990, 1995, 2000 and 2005), Uruguay (1990, 1995, 2000 and 2005) and Venezuela (1990, 1995, 2000 and 2005). Note: To the Caribbean no data.

96 Includes information for the following countries in the years 1990, 1995, 2000 and 2005: Cuba, Haiti, Puerto Rico, Dominican Republic, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela

97 Includes information for the following countries: Cuba (1990, 1995, 2000 and 2005), Haiti (1990, 1995, 2000 and 2005), Dominican Republic (1990, 1995, 2000 and 2005), Costa Rica (2000 and 2005), El Salvador (1995, 2000 and 2005), Mexico (1990, 1995, 2000 and 2005), Panama (2000 and 2005), Argentina (1990, 1995, 2000 and 2005), Bolivia (1990, 1995, 2000 and 2005), Brazil (1990, 1995, 2000 and 2005), Chile (1990, 1995, 2000 and 2005), Colombia (1990, 1995, 2000 and 2005), Ecuador (1990, 1995, 2000 and 2005), Paraguay (1990, 1995, 2000 and 2005), Uruguay (1990, 1995, 2000 and 2005) and Venezuela (1990, 1995, 2000 and 2005)

98 Includes information for the following countries: Argentina (1990, 1995, 2000 and 2005), Brazil (1990, 1995, 2000 and 2005), Chile (1990, 1995, 2000 and 2005), Colombia (1990, 1995, 2000 and 2005) and Peru (1990, 1995, 2000 and 2005). Note: no data for the Caribbean and South America

99 Includes information for the following countries: Brazil (1990 and 2005), Chile (2000 and 2005) Colombia (1995, 2000 and 2005) and Peru (1990, 1995, 2000 and 2005). Note: no data for the Caribbean and South America

100, 101 Includes information for the following countries: Mexico (1990, 1995, 2000 and 2005), Argentina (1990, 1995, 2000 and 2005) and Brazil (1990, 1995, 2000 and 2005)

102 Includes information for the following countries: Anguilla (1990, 2001 and 2005), Antigua and Barbuda (1990, 2001 and 2005), Dominica (1990 and 2001), Grenada (1990, 2001 and 2005), Haiti (1990, 2001 and 2005), Jamaica (1990, 2001 and 2005), Martinique (1990, 2001 and 2005), Dominican Republic (1990, 2001 and 2005), Saint Lucia (1990, 2001 and 2005), Trinidad and Tobago (1990, 2001 and 2005), Argentina (1990 and 2005), Bolivia (1990 and 2005), Brazil (1990 and 2005), Chile (1990 and 2005), Colombia (1990 and 2005), Ecuador (1990 and 2005), French Guyana (1990 and 2005), Guyana (1990 and 2005), Paraguay (1990 and 2005), Peru (1990 and 2005), Suriname (1990 and 2005) and Venezuela (1990 and 2005)

103 Includes information for the following countries: Antigua and Barbuda (1996, 1998 and 2002), Bahamas (1990-2000), Barbados (1990-1996, 1998-2004), Cuba (1990-2000), Grenada (1994-2000), Haiti (1990-2000), Jamaica (1990-1996, 1998-2000, 2003-2005), Puerto Rico (2000, 2001 and 2004), Dominican Republic (1990-1996, 1999 and 2000), Saint Kitts and Nevis (1996-1999), Saint Lucia (1990-1999), Saint Lucia (1998-2003), Saint Vincent and the Grenadines (1998-2003), Trinidad and Tobago (1990-2000), Belize (1995-2005), Costa Rica (1990-2004), El Salvador (1990-2000), Guatemala (1990-2000), Honduras (1990-2000), Mexico (1990-2000 and 2002-2005), Panama (1990-2000), Argentina (2000 and 2003), Bolivia (1990-1997 and 1999-2004), Brazil (1990-2000, 2003 and 2004), Chile (1990-2001), Colombia (1990-2005), Ecuador (1990-2004), French Guyana (1990-2000), Paraguay (1990-1996, 1999 and 2000), Peru (1990-2004), Suriname (1990-1996 and 1999-2003), Uruguay (2004) and Venezuela (1990-2000)

108 Excluded due for lack of information: Antigua and Barbuda (1990-2007), Aruba (1990-2007), Cayman Islands (1990-2007), Virgin Islands (United States) (1990-2007), British Virgin Islands (1990-2007), Martinique (1990-2007), Montserrat (1990-2007), Saint Kitts and Nevis (1990-2007), Saint Lucia (1990-2007), Saint Vincent and the Grenadines (1990-2007) and French Guyana (1990-2007)

109 Excluded due for lack of information: Antigua and Barbuda (1990-2008), Netherlands Antilles (1990-2008), Aruba (1990-2008), Dominica (1990-2008), Cayman Islands (1990-2008), Virgin Islands (United States) (1990-2008), British Virgin Islands (1990-2008), Martinique (1990-2008), Montserrat (1990-2008), Saint Lucia (1990-2008), and Turks and Caicos (1990-2008)

110 Excluded due for lack of information: Aruba (1990-2008), Ecuador (1990-2007), French Guyana (1990-2007) and Guyana (1990-2007)

111 Includes information for the following countries for the years 1990-2007: Barbados, Cuba, Dominica, Guadeloupe, Martinique, Dominican Republic, Saint Lucia, Trinidad and Tobago, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru and Venezuela

112 Includes information for the following countries in the years 1990-2007 : Haiti, Puerto Rico, Saint Lucia, Trinidad and Tobago, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Peru and Venezuela

113 Includes information for the following countries in the years 1990-1995 and 1997-2007 : Belize, El Salvador, Guatemala, Mexico, Argentina, Bolivia, Brazil, Chile, Paraguay, Peru and Uruguay

114 Includes information for the following countries: Guadeloupe (1990-2007), Montserrat (1990-2007), Saint Vincent and the Grenadines (1990-2007) and Trinidad and Tobago (1990-2007), , Costa Rica (1990-2003 and 2005-2008), El Salvador (1990-2003 and 2005-2008), Guatemala (1990-2003 and 2005-2008), Mexico (1990-2003 and 2005-2008), Nicaragua (1990-2003 and 2005-2008), Argentina (1990-2003 and 2005-2008), Chile (1990-2003 and 2005-2008), Colombia (1990-2003 and 2005-2008), Ecuador (1990-2003 and 2005-2008) and Peru (1990-2003 and 2005-2008)

116 Excluded due for lack of information for the years 1990-2007: Antigua and Barbuda, Aruba, Cayman Islands, Virgin Islands (United States), British Virgin Islands, Martinique, Montserrat, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines and French Guyana

117 Excluded due for lack of information French Guyana (1990-2007)

118, 119, 120 Includes information for all countries (1990-2007)

121 Includes information for all countries (1990-2007). Note: To the Caribbean no data

122 Includes information for all countries of Mesoamerica and South America (1990-2007)

123 Includes information for all countries (1990-2007). Note: To the Caribbean no data

124 Includes information for all countries (1990-2007)

125 Includes information for the following countries: Cuba (1990), Grenada (1990), Puerto Rico (1996), Trinidad and Tobago (1998), Argentina (1990-2007), Bolivia (1990-2007), Brazil (1990-2007), Chile (1990-2007), Colombia (1990-2007), Ecuador (1990-2007), Guyana (1990-2007), Paraguay (1990-2007), Peru (1990-2007), Suriname (1990-2007), Uruguay (1990-2007) and Venezuela (1990-2007)

126 Includes information for the following countries: Anguilla (1999), Antigua and Barbuda (1995, 1998 and 1999), Netherlands Antilles (2001 and 1995), Bahamas (1992, 2004, 2005 and 2007), Barbados (2002, 2004 and 2007), Cuba (1991, 1993-2005 and 2007), Dominica (1995, 1999, 2001, 2004 and 2007), Grenada (1990, 1999, 2004 and 2005), Guadeloupe (1999 and 2004), Haiti (1992, 1994, 1996, 1998, 2001-2004 and 2007), Cayman Islands (2002), Virgin Islands (United States) (1995), Jamaica (1991, 1993, 1996, 2002 and 2004-2007), Martinique (1990, 1993, 1994 and 2007), Montserrat (1995-1997 and 2006), Puerto Rico (1996-2004), Dominican Republic (1993, 1996, 1998, 2003-2005 and 2007), Saint Kitts and Nevis (1995, 1998 and 1999), Saint Lucia (1994, 1996 and 1999), Saint Vincent and the Grenadines (1992, 1999, 2004 and 2005), Trinidad and Tobago (1998), Belize (1995, 1998, 2000, 2001 and 2007), Costas Rica (1990, 1991, 1993, 1996, 1998, 2002 and 2007), El Salvador (1991, 1992, 1995, 1998-2006), Guatemala (1992, 1992, 1995, 1998, 1999, 2001, 2002 and 2005), Honduras (1990, 1993, 1996, 1998, 1990-2005), Mexico (1991, 1993, 1999, 2000, 2002, 2003 and 2005-2007), Nicaragua (1990, 1992-1994, 1997-1999, 2001 and 2007), Panama (1991, 1998, 2002, 2004-2006), Argentina (1991-1993, 1995, 1997, 1998, 2000, 2001 and 2003-2007), Bolivia (1990, 1993, 1994, 1996, 1997, 1999-2001, 2003 and 2004-2007), Brazil (1998, 2000-2004 and 2007), Chile (1990, 1991, 1993, 1994, 2000-2008), Colombia (1991, 1993, 1996, 1998-2000 and 2003-2007), Ecuador (1992, 1993, 1997, 2000, 2002, 2006 and 2008), French Guyana (1995 and 1996), Guyana (1996, 1997, 2005 and 2006), Paraguay (1990, 1992, 1995-1997, 1999, 2000, 2002 and 2005-2007), Peru (1990-1992, 1996, 1997, 2001-2008), Suriname (1990, 1993, 1996, 1997, 2004 and 2006), Uruguay (1991-1993, 1998-2002, 2004 and 2007) and Venezuela (1991-1994, 1998, 2003, 2004 and 2007)

127 Includes information for the following countries: Cuba (1993), Haiti (2002-2004 and 2007), Jamaica (1991, 1993, 2002 and 2006), Puerto Rico (1992, 2001 and 2003), Dominican Republic (1993, 2003, 2004 and 2007), Saint Vincent and the Grenadines (1992), Belize (1995), Costa Rica (1991, 1993, 1996, 2002 and 2007), El Salvador (1992), Guatemala (1995, 1999 and 2002), Honduras (1990, 1993, 1996 and 1999), Mexico (1993, 1999 and 2007), Nicaragua (1990 and 1999), Panama (1991, 2002 and 2004-2006), Argentina (1992, 1997, 1998, 2000, 2001, 2003 and 2007), Bolivia (1997, 2001, 2003 and 2007), Brazil (2003 and 2007), Chile (1997, 2000, 2002 and 2006), Colombia (1996, 1999 and 2004-2007), Ecuador (1992, 1997, 2002, 2006 and 2008), French Guyana (1996), Guyana (1996, 2005 and 2006), Paraguay (1990, 1992, 1995 and 1997), Peru (1997 and 2008), Suriname (1993 and 2006) and Uruguay (1992, 1992, 1997, 2000-2002 and 2007)

128 Includes information for the following countries: Anguilla (1999), Antigua and Barbuda (1995, 1999), Netherlands Antilles (1995), Bahamas (1992, 2004, 2005 and 2007), Barbados (2002 and 2004), Cuba (1993, 1996, 1999, 2001, 2002, 2004, 2005 and 2007), Dominica (1995, 1999, 2001, 2007), Grenada (1999), Haiti (1994, 2004 and 2007), Cayman Islands (2002), Virgin Islands (United States) (1995), Jamaica (1996, 2002, 2004, 2005 and 2007), Martinique (1990, 1993, 1999 and 2007), Puerto Rico (1995, 1996, 2003 and 2004), Dominican Republic (1996, 1998, 2003, 2004 and 2007), Saint Kitts and Nevis (1995, 1998 and 1999), Saint Lucia (1994 and 1999), Saint Vincent and the Grenadines (1999, 2004 and 2005), Trinidad and Tobago (2004), Belize (1998, 2000, 2001 and 2007), Costa Rica (1996 and 1998), El Salvador (1998 and 2005), Guatemala (1998, 2001 and 2005), Honduras (1998, 2001 and 2005), Mexico (1997, 2002 and 2005-2007), Nicaragua (1993, 1998, 2001 and 2007), Panama (1998), Paraguay (2002), Suriname (1990 and 2004) and Uruguay (1993 and 2002)

129 Includes information for the following countries: Barbados (2007), Haiti (2004), Martinique (2007), Republican Dominica (2004), Costa Rica (1990), El Salvador (2001 and 2006), Guatemala (1991), Mexico (2003), Panama (1991), Chile (1997, 2005 and 2007), Colombia (1999), Peru (2001 and 2007) and Suriname (1997)

130 Includes information for the following countries: Saint Lucia (1996), Bolivia (1994), Chile (1991) and Suriname (2004). Note: no data for Mesoamerica

131 Includes information for the following countries: Argentina (1995), Peru (2003) and Uruguay (2004)

132 Includes information for the following countries: Montserrat (1995-1997, 2006), Guatemala (1992), Nicaragua (1992), Argentina (1991), Chile (1991), Ecuador (2002 and 2006) and Suriname (1997)

133 Includes information for the following countries: Cuba (1998), Haiti (1992 and 2003), El Salvador (2001), Guatemala (2001), Honduras (2001, 2002 and 2004), Nicaragua (1994, 1997 and 2001) , Bolivia (1990, 1994 and 2004, Brazil (1998, 2001 and 2007), Colombia (1998), Ecuador (1997), Guyana (1997), Paraguay (1999 and 2005) and Peru (1990 and 1992)

134 Includes information for the following countries: Netherlands Antilles (2001), Bahamas (2007), Cuba (1991, 1994, 1997, 1999, 2002, 2003 and 2007), Haiti (1996, 1998, 2003 and 2007), Puerto Rico (1996 and 2004), Dominican Republic (2002-2005), Trinidad and Tobago (1998), Argentina (1992, 1993, 1995 and 2004-2006), Bolivia (1993, 1996, 1999, 2000, 2003, 2004 and 2006), Brazil (1998, 2000-2004 and 2007), Chile (1993, 1994, 1999, 2001, 2004 and 2006-2008), Colombia (1991, 1993, 1994, 1999, 2000, 2003, 2005 and 2007), French Guyana (1995), Paraguay (1996, 2000 and 2006), Peru (1996, 1997, 2002, 2003, 2005 and 2006), Uruguay (1992 and 1999) and Venezuela (1991-1994, 1998, 2003, 2004 and 2007)

135 Includes information for the following countries: Haiti (2001), Jamaica (1990, 1993, 1996, 1999, 2000 and 2004), Dominican Republic (1992, 1996, 2003 and 2004), Costa Rica (1990, 2000, 2001 and 2003), El Salvador (2000 and 2002), Guatemala (2000 and 2002), Honduras (1990-2003), Mexico (2000, 2002 and 2004), Nicaragua (2001), Panama (2000, 2002 and 2003), Argentina (2001, 2003 and 2004), Bolivia (2002), Brazil (1990, 2001, 2003 and 2004), Chile (2000 and 2003), Colombia (2003), Paraguay (1990, 2002 and 2003), Peru (1990, 2000, 2002 and 2003), Uruguay (2000 and 2003) and Venezuela (2000 and 2003)

136 Includes information for the following countries: Haiti (2001), Jamaica (1990, 1993, 1996, 1999, 2000 and 2004), Dominican Republic (1992, 1996, 2003 and 2004), Trinidad and Tobago (1992), Costa Rica (1990, 2000, 2001 and 2003), El Salvador (2000 and 2002), Guatemala (2000 and 2002), Honduras (1990-2003), Mexico (2000, 2002 and 2004), Nicaragua (2001), Panama (2000, 2002 and 2003), Argentina (2001, 2003 and 2004), Bolivia (2002), Brazil (1990, 2001, 2003 and 2004), Chile (2000 and 2003), Colombia (2003), Paraguay (1990, 2002 and 2003), Peru (1990, 2000, 2002 and 2003), Uruguay (2000 and 2003) and Venezuela (2000 and 2003)

137 Includes information for the following countries: Anguilla (2001), Netherlands Antilles (2000), Barbados (1990, 2001 and 2003), Haiti (1990), Jamaica (1990, 2003 and 2004), Puerto Rico (1990, 2000, 2002-2005), Dominican Republic (2000), Trinidad and Tobago (1990, 2000 and 2002), Costa Rica (1990, 2000, 2001 and 2003-2005), El Salvador (2002-2004), Honduras (2001-2005), Mexico (2000-2005), Nicaragua (2000, 2001 and 2003), Panama (2000 and 2002-2005), Argentina (1990, 2000, 2001 and 2003-2005), Brazil (1990 and 2001-2004), Colombia (1990 and 2004), Ecuador (1990, 2000-2003 and 2005), Paraguay (1990 and 2001), Peru (1990, 2000, 2001 and 2003-2005) and Venezuela (2000-2003)

138 Excluded due for lack of information in the years 1990, 2000 and 2005 : Anguilla, Antigua and Barbuda, Dominica, Guadeloupe, Cayman Islands, British Virgin Islands, Martinique, Montserrat, Saint Kitts and Nevis, Turks and Caicos and Guyana

139 Excluded due for lack of information in the years 1990, 2000 and 2005 : Anguilla, Antigua and Barbuda, Dominica (1990, 2000 and 2005), Guadeloupe, Cayman Islands, British Virgin Islands, Martinique, Montserrat, Saint Kitts and Nevis, Trinidad and Tobago and Guyana

140 Excluded due for lack of information in the years 1990, 2000 and 2005 : Anguilla, Antigua and Barbuda, Dominica, Guadeloupe, Cayman Islands, British Virgin Islands, Martinique, Montserrat, Saint Kitts and Nevis, Trinidad and Tobago and Guyana

141 Excluded due for lack of information: Anguilla (1990, 2000-2003, 2005 and 2007), Aruba (1990, 2000-2003, 2005 and 2007), Guadeloupe (1990, 2000-2003, 2005 and 2007), Cayman Islands (1990, 2000-2003, 2005 and 2007), Virgin Islands (United States) (1990, 2000-2003, 2005 and 2007), British Virgin Islands (1990, 2000-2003, 2005 and 2007), Martinique (1990, 2000-2003, 2005 and 2007), Montserrat (1990, 2000-2003, 2005 and 2007), Puerto Rico(1990, 2000-2003, 2005 and 2007), Turks and Caicos (1990, 2000-2003, 2005 and 2007), Guyana (2007) and French Guyana (1990, 2000-2003 and 2005)

142 Excluded due for lack of information: Anguilla (1997 and 1998), Netherlands Antilles (1995-2007), Aruba (1997, 1998, 2001, 2003 and 2005), Bahamas (1996, 1997 and 1999-2002), Cuba (1995, 1996, 1998, 1999 and 2006), Dominica (1997 and 2002), Guadeloupe (1997, 1998, 2001 and 2004), Haiti (1995-2007), Cayman Islands (1996, 1997, 2000 and 2001), Virgin Islands (United States) (1995-2006), British Virgin Islands (1996, 1997, 1999 and 2002), Montserrat (1997-1999), Saint Kitts and Nevis (1997 and 1998), Saint Lucia (1998 and 2000), Turks and Caicos (1995-2002), Belize (1996), Argentina (1995-1997), Chile (1995-2002), Guyana (1995-1997), Paraguay (1995-1997), Suriname (1999) and Uruguay (1995-2002)

143 Excluded due for lack of information: Argentina (1990-2007), Chile (1990-2007), Ecuador (2001-2007), Guyana (1990-2007), French Guyana (1990-1197 and 1999-2007), Paraguay (1990-2007), Suriname (1990-2007), Uruguay (1990-2007) and Venezuela (1990-1993, 1996, 1997, 2000, 2001 and 2007). Note: no data for the Caribbean and Mesoamerica

144 Includes information for the following countries in the years de 1998-2006: Haiti, Dominican Republic, Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guyana, Guyana, Paraguay, Peru, Suriname and Venezuela

145 Includes information for the following countries: Belize (1992-1999), Costa Rica (1992-1997), El Salvador (1991-1996 and 1998-2000), Guatemala (1991-2002), Honduras (1991-2001), Mexico (1991-2001), Nicaragua (1991-2000), Panama (1991-2000), Argentina (1992-2000), Bolivia (1991-1998), Brazil (1991-2001, 2004 and 2005), Chile (1991-1994 and 1996-1998), Colombia (1991-2000 and 2004), Guyana (1992 and 1993), French Guyana (1991-1993), Paraguay (1993 and 1996), Peru (1991-2002), Suriname (1992) and Venezuela (1991-1993 and 1996-2000). Note: To the Caribbean no data

146, 147 Excluded due for lack of information: Guadeloupe (1990, 2000-2006), Cayman Islands (1990, 2000-2006), Martinique (1990, 2000-2006) and French Guyana (1990 and 2000-2008)

148 Includes information for the following countries: Netherlands Antilles (2004), Aruba (2000), Cuba (2000), Dominican Republic (2002), Trinidad and Tobago (2004), Costa Rica (2000), El Salvador (2004), Guatemala (2002), Honduras (2001), Mexico (1990, 2000, 2002-2004 and 2005), Nicaragua (2001), Panama (1990 and 2000), Argentina (2001), Bolivia (2001), Brazil (2000 and 2004), Chile (2002), Colombia (2004 and 2005), Ecuador (1990 and 2001), Paraguay (2004), Peru (2004 and 2005), Suriname (2004) and Venezuela (1990 and 2001)

149 Includes information for the following countries: Netherlands Antilles (2004), Aruba (2000), Cuba (2000), Dominican Republic (2002), Trinidad and Tobago (2004), Costa Rica (2000), El Salvador (2004), Guatemala (2002), Honduras (2001), Mexico (1990, 2000, 2002-2004 and 2005), Nicaragua (2001), Panama (1990 and 2000), Argentina (2001), Bolivia (2001), Brazil (2000 and 2004), Chile (2002), Colombia (2004 and 2005), Ecuador (1990 and 2001), Paraguay (2004), Peru (2004 and 2005), Suriname (2004) and Venezuela (1990 and 2001)

150 Includes information for the following countries: Netherlands Antilles (2004), Aruba (2000), Cuba (2000), Dominican Republic (2002), Trinidad and Tobago (2004), Costa Rica (2000), El Salvador (2004), Guatemala (2002), Honduras (2001), Mexico (1990, 2000, 2002-2004 and 2005), Nicaragua (2001), Panama (1990 and 2000), Argentina (2001), Bolivia (2001), Brazil (2000 and 2004), Chile (2002), Colombia (2004 and 2005), Ecuador (1990 and 2001), Paraguay (2004), Peru (2004 and 2005), Suriname (2004) and Venezuela (1990 and 2001)

151 Includes information for the following countries: Anguilla (2000-2008), Netherlands Antilles (1999-2002), Aruba (1999-2008), Barbados (1999-2001), Cuba (1999-2008), Dominica (1999-2008), Grenada (2002-2008), Cayman Islands (2000, 2001), British Virgin Islands (1999-2008), Jamaica (2000-2003), Montserrat (2002-2008), Dominican Republic (2003, 2004), Saint Kitts and Nevis(2000-2005), Saint Lucia (2003-2008), Saint Vincent and the Grenadines (2000-2005), Trinidad and Tobago (1999-2005), Turks and Caicos (2002-2005), Belize (2003 and 2008), Costa Rica (1999-2005), El Salvador (1999-2008), Guatemala (2002, 2003 and 2008), Honduras (2004), Mexico (1999-2008), Nicaragua (2001-2003), Panama (1999-2008), Argentina (1999-2005), Bolivia (1999-2003), Brazil (1999-2005), Chile (1999, 2000 and 2002-2005), Colombia (1999-2008), French Guyana (2003-2005), Paraguay (1999-2005), Peru (2000-2006), Suriname (2002), Uruguay (1999-2008) and Venezuela (2000, 2002-2004 and 2008)

152 Includes information for the following countries: Anguilla (2000-2004), Netherlands Antilles (1999-2004), Aruba (1999-2004), Barbados (1999-2001), Cuba (1999-2004), Dominica (1999-2004), Grenada (2002-2004), Cayman Islands (2000, 2001), British Virgin Islands (1999-2004), Jamaica (2000-2003), Montserrat (2002-2004), Dominican Republic (2003, 2004), Saint Kitts (2000-2005), Saint Lucia (2003-2004), Saint Vincent and the Grenadines (2000-2005), Trinidad and Tobago (1999-2005), Turks and Caicos (2002-2005), Belize (2003 and 2004), Costa Rica (1999-2005), El Salvador (1999-2004), Guatemala (2002, 2003 and 2004), Honduras (2004), Mexico (1999-2004), Nicaragua (2001-2003), Panama (1999-2004),

Argentina (1999-2005), Bolivia (1999-2003), Brazil (1999-2005), Chile (1999, 2000 and 2002-2005), Colombia (1999-2004), French Guyana (2003-2005), Paraguay (1999-2005), Peru (2000-2004), Suriname (2002), Uruguay (1999-2004) and Venezuela (2000, 2002-2004 and 2004)

153 Includes information for the following countries: Anguilla (2000-2008), Netherlands Antilles (1999-2002), Aruba (1999-2008), Barbados (1999-2001), Cuba (1999-2008), Dominica (1999-2005), Grenada (2002-2005), Cayman Islands (2000, 2001), British Virgin Islands (1999-2005), Jamaica (2000-2003), Montserrat (2002-2008), Dominican Republic (2003, 2004), Saint Kitts (2000-2008), Saint Lucia (2003-2006), Saint Vincent and the Grenadines (2000-2005), Trinidad and Tobago (1999-2005), Turks and Caicos (2002-2005), Belize (2003 and 2004), Costa Rica (1999-2005), El Salvador (1999-2008), Guatemala (2002, 2003 and 2008), Honduras (2004), Mexico (1999-20068, Nicaragua (2001-2003), Panama (1999-2008), Argentina (1999-2005), Bolivia (1999-2003), Brazil (1999-2005), Chile (1999, 2000 and 2002-2005), Colombia (1999-2008), French Guyana (2004 and 2005), Paraguay (1999-2005), Peru (2000-2008), Suriname (2002), Uruguay (1999-2008) and Venezuela (2000, 2002-2004 and 2008)

154 Excluded due for lack of information: Anguilla (1990, 2002 and 2008), Antigua and Barbuda (2003 and 2008), Netherlands Antilles (2000-2008), Aruba (2003, 2004 and 2006-2008), Bahamas (2005 and 2006-2008), Barbados (2006-2008), Cuba (2006-2008), Dominica (2005 and 2006-2008), Grenada (2005 and 2006-2008), Guadeloupe (2002-2006-2008), Haiti (2005 and 2006-2008), Cayman Islands (2002-2006-2008), Virgin Islands (United States) (2002, 2005 and 2008), British Virgin Islands (2000, 2001 and 2003-2008), Jamaica (2008), Martinique (2002-2006), Montserrat (2001-2008), Puerto Rico (2005 and 2008), Saint Kitts and Nevis (2003, 2005 and 2008), Saint Lucia (2003-2006), Turks and Caicos (1990, 2000 and 2001), Guatemala (2008), Panama (2008), Bolivia (2008), Brazil (2008), French Guyana (2008) and Guyana (2002-2008)

155 Excluded due for lack of information: Anguilla (2004), Antigua and Barbuda (2004), Netherlands Antilles (2000-2002, 2004), Aruba (2004), Bahamas (2004), Barbados (2004), Cuba (2004), Dominica (2004), Grenada (2004), Guadeloupe (2004), Haiti (2004), Cayman Islands (2002, 2004), Virgin Islands (United States) (2004), British Virgin Islands (2000 , 2001 and 2003-2004), Jamaica (2004), Martinique (2004), Montserrat (2004), Puerto Rico (2004), Saint Kitts and Nevis (2003, 2004), Saint Lucia (2004), Turks and Caicos (2000, 2001, 2004), Belize (1990), Costa Rica (1990), El Salvador (1990), Guatemala (1990 and 2004), Honduras (1990), Nicaragua (1990), Panama (1990 and 2004), Argentina (1990), Bolivia (1990 and 2004), Brazil (1990 and 2004), Colombia (1990), Ecuador (1990), Guyana (1990 and 2004), French Guyana (1990, 2004), Paraguay (1990), Peru (1990), Suriname (1990), Uruguay (1990) and Venezuela (1990)

156 Excluded due for lack of information: Anguilla (2002 and 2006), Antigua and Barbuda (2006), Netherlands Antilles (2000-2006), Aruba (2006), Bahamas (2006), Barbados (2006), Dominica (2005 and 2006), Grenada (2004-2006), Guadeloupe (2006), Cayman Islands (2000-2004 and 2006), Virgin Islands (United States) (2006), British Virgin Islands (2000, 2001 and 2003-2006), Jamaica (2006), Martinique (2006), Montserrat (2000-2006), Puerto Rico (2006), Saint Kitts and Nevis (2003-2006), Saint Lucia (2002, 2005 and 2006), Saint Vincent and the Grenadines (2006), Trinidad and Tobago (2006), Turks and Caicos (2000-2006), El Salvador (2006), Honduras (2006), Brazil (2006), Guyana (2006), French Guyana (2006), Suriname (2006) and Uruguay (2006)

157 Excluded due for lack of information in the years 1990, 2000-2004 : Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Dominica, Grenada, Guadeloupe, Cayman Islands, Virgin Islands (United States), British Virgin Islands, Martinique, Montserrat, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Turks and Caicos, Belize, Guyana, French Guyana and Uruguay

158 Excluded due for lack of information in the years 1990-2004 : Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Dominica, Grenada, Guadeloupe, Cayman Islands, Virgin Islands (United States), British Virgin Islands, Martinique, Montserrat, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Turks and Caicos, Belize, Guyana, French Guyana and Suriname

159 Excluded due for lack of information in the years 1990-2006 : Anguilla, Antigua and Barbuda, Aruba, Bahamas, Dominica, Guadeloupe, Cayman Islands, Virgin Islands (United States), British Virgin Islands, Martinique, Montserrat, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Turks and Caicos, Belize and French Guyana

160 Includes information for the following countries: El Salvador (1990-1996 and 2000), Mexico (1996, 1997, 1999, 2000 and 2002), Panama (1990-2003), Brazil (1990), Chile (1990) and Colombia (1990). Note: To the Caribbean no data

161 Excluded due for lack of information in the years 1990-2004 : Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Dominica, Grenada, Guadeloupe, Cayman Islands, Virgin Islands (United States), British Virgin Islands, Martinique, Montserrat, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Turks and Caicos, Belize, Guyana, French Guyana and Suriname

162 Excluded due for lack of information in the years 1990-2006 : Anguilla, Antigua and Barbuda, Aruba, Bahamas, Dominica, Guadeloupe, Cayman Islands, Virgin Islands (United States), British Virgin Islands, Martinique, Montserrat, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Turks and Caicos, Belize, Guyana and French Guyana

163 Includes information for the following countries: Costa Rica, El Salvador, Guatemala, Mexico and Nicaragua

164 Excluded due for lack of information for the years 1990 : Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Dominica, Grenada, Guadeloupe, Cayman Islands, Virgin Islands (United States), British Virgin Islands, Martinique, Montserrat, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos, Belize, Guyana and French Guyana

165 Excluded due for lack of information for the years 1990 and 2003-2005: Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Dominica, Guadeloupe, Cayman Islands, Virgin Islands (United States), British Virgin Islands, Martinique, Montserrat, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos, Belize, Chile, French Guyana, Suriname, Uruguay and Venezuela

166 Includes information for the following countries: Mexico (1999 and 2004-2006), Argentina (1999 and 2004-2006), Brazil (1999 and 2004-2006), Chile (1999 and 2004-2006), Colombia (1999 and 2004-2006), Peru (2004-2006) and Venezuela (1999 and 2004-2006). Note: To the Caribbean no data

167 Includes information for the following countries: Barbados (1995, 1996 and 2002-2006), Cuba (1995, 1996 and 2002-2006), Trinidad and Tobago (1995, 1996 and 2002-2006), Guatemala (1995), Mexico (1995, 1996 and 2002-2006), Argentina (1995, 1996 and 2002-2006), Bolivia (1995, 1996 and 2002-2006), Brazil (1995, 1996 and 2002-2006), Chile (1995, 1996 and 2002-2006), Colombia (1995, 1996 and 2002-2006), Ecuador (1995, 1996 and 2002-2006), Peru (1995, 1996 and 2002-2006) and Venezuela (1995, 1996 and 2002-2006)

168 Excluded due for lack of information for the years 1990 and 2003-2005 : Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Dominica, Guadeloupe, Cayman Islands, Virgin Islands (United States), British Virgin Islands, Martinique, Montserrat, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos, Belize and French Guyana

169 Includes information for the following countries for the years (1995, 1996 and 2002-2006): Barbados, Cuba, Trinidad and Tobago, Guatemala, Mexico, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Peru, Suriname and Venezuela

170 Excluded due for lack of information for the years 1990 -2005 : Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Dominica, Grenada, Guadeloupe, Cayman Islands, Virgin Islands (United States), British Virgin Islands, Martinique, Montserrat, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Turks and Caicos, Belize and Guyana, French Guyana and Suriname

171 Includes information for the following countries: Dominican Republic (1990-2005), Guatemala (1999-2005) and Honduras (1990-2005), Argentina (1990-2005), Brazil (1990-2005), Chile (1990-2006), Colombia (1990-2006) and Peru (2000-2005)

172 Excluded due for lack of information for the years 1990-2005 : Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Dominica, Grenada, Guadeloupe, Cayman Islands, Virgin Islands (United States), British Virgin Islands, Martinique, Montserrat, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos, Belize, Guyana, French Guyana and Suriname

173 Includes information for the following countries: Cuba (1990-2002), Dominican Republic (2003-2006), Mexico (1990-2005), Argentina (1990-2005), Bolivia (1990-2005), Brazil (1990 y1994-2005), Chile (1990-2005), Colombia (1990-2005), Ecuador (1990-2005), Peru (1990-2005), Uruguay (1990-2005) and Venezuela (1990-2005)

174 Includes information for the following countries: Mexico (1990-2005), Argentina (1990-2005) and Brazil (1990-2005). Note: no data for the Caribbean

175 Excluded due for lack of information: Anguilla (1990-2005), Antigua and Barbuda (1990-2005), Aruba (1990-2005), Bahamas (1990-2005), Barbados (1990-2005), Dominica (1990-2005), Grenada (1990-2005), Guadeloupe (1990-2005), Cayman Islands (1990-2005), Virgin Islands (United States) (1990-2005), British Virgin Islands (1990-2005), Martinique (1990-2005), Montserrat (1990-2005), Puerto Rico (1990-2005), Saint Kitts and Nevis (1990-2005), Saint Lucia (1990-2005), Saint Vincent and the Grenadines (1990-2005), Trinidad and Tobago (1990-1993 and 1998-2005), Turks and Caicos (1990-2005), Belize (1990-2005), Guyana (1990-2005), French Guyana (1990-2005), Paraguay (2000-2005) and Suriname (1990-2005)

176 Includes information for the following countries: Antigua and Barbuda (1990-2006), Bahamas (1990-2002), Barbados (1990-2002), Grenada (1990-2005), Haiti (1990-2006), Jamaica (1990-2006), Puerto Rico (1990-2001), Dominican Republic (1990-2006), Saint Kitts and Nevis (1990-2005), Saint Lucia (1990-2005), Saint Vincent and the Grenadines (1990-2005), Trinidad and Tobago (1990-2006), Argentina (1990-2006), Bolivia (1990-2006), Brazil (1990-2006), Chile (1990-2006), Colombia (1990-2006), Ecuador (1990-2006), Guyana (1990-2006), Paraguay (1990-2006), Peru (1990-2006), Suriname (1990-2006), Uruguay (1990-2006) and Venezuela (1990-2006)

177 Includes information for the following countries: Antigua and Barbuda (1990-2004), Aruba (1990-2003), Bahamas (1990-2002), Dominica (1990-2004), Grenada (1990-2004), Haiti (1990-2005), Jamaica (1990-2005), Puerto Rico (1990-2001), Dominican Republic (1990-2005), Saint Kitts and Nevis (1990-2004), Saint Lucia (1990-2004), Saint Vincent and the Grenadines (1990-2005), Trinidad and Tobago (1990-2005), Argentina (1990-2005), Bolivia (1990-2005), Chile (1990-2005), Colombia (1990-2005), Ecuador (1990-2005), Guyana (1990-2005), Paraguay (1990-2005), Peru (1990-2005), Suriname (1990-2005), Uruguay (1990-2005) and Venezuela (1990-2005)

178 Includes information for the following countries: Antigua and Barbuda (1991-2006), Bahamas (1990-2005), Barbados (1990-2006), Cuba (1990-2003), Dominica (1990-2006), Grenada (1990-2006), Haiti (2000-2006), Jamaica (1990-2006), Dominican Republic (1990-2006), Saint Kitts and Nevis (1990-2006), Saint Lucia (1990-2006), Saint Vincent and the Grenadines (1990-2006), Trinidad and Tobago (1990-2006), Argentina (1990-2006), Bolivia (1990-2006), Brazil (1990-2006), Chile (1990-2006), Colombia (1990-2006), Ecuador (1990-2006), French Guyana (1990-2006), Paraguay (1990-2006), Peru (1990-2006), Suriname (1990-2006), Uruguay (1990-2006) and Venezuela (1990-2006)

179 Includes information for the following countries: Antigua and Barbuda (1991-2006), Bahamas (1990-2005), Barbados (1990-2006), Cuba (1990-2003), Dominica (1990-2006), Grenada (1990-2006), Haiti (2000-2006), Jamaica (1990-2006), Dominican Republic (1990-2006), Saint Kitts and Nevis (1990-2006), Saint Lucia (1990-2006), Saint Vincent and the Grenadines (1990-2006), Trinidad and Tobago (1990-2006), Argentina (1990-2006), Bolivia (1990-2006), Brazil (1990-2006), Chile (1990-2006), Colombia (1990-2006), Ecuador (1990-2006), French Guyana (1990-2006), Paraguay (1990-2006), Peru (1990-2006), Suriname (1990-2006), Uruguay (1990-2006) and Venezuela (1990-2006)

180 Includes information for the following countries: Antigua and Barbuda (1991-2006), Bahamas (1990-2005), Barbados (1990-2006), Cuba (1990-2003), Dominica (1990-2006), Grenada (1990-2006), Haiti (2000-2006), Jamaica (1990-2006), Dominican Republic (1990-2006), Saint Kitts and Nevis (1990-2006), Saint Lucia (1990-2006), Saint Vincent and the Grenadines (1990-2006), Trinidad and Tobago (1990-2006), Argentina (1990-2006), Bolivia (1990-2006), Brazil (1990-2006), Chile (1990-2006), Colombia (1990-2006), Ecuador (1990-2006), French

Guyana (1990-2006), Paraguay (1990-2006), Peru (1990-2006), Suriname (1990-2006), Uruguay (1990-2006) and Venezuela (1990-2006)

181 Includes information for the following countries: Antigua and Barbuda (1990-2005), Barbados (1990-2005), Cuba (1994-1999), Grenada (1990-2005), Haiti (2000-2005), Jamaica (1990-2005), Dominican Republic (1992-2001), Saint Kitts and Nevis (1990-2005), Saint Lucia (1990-2005), Saint Vincent and the Grenadines (1990-2005), Trinidad and Tobago (1990-2005), Argentina (1990-2005), Bolivia (1990-2005), Brazil (1990-2005), Chile (1990-2005), Colombia (1990-2005), Ecuador (1990-2005), French Guyana (1990-2005), Paraguay (1990-2005), Peru (1990-2005), Suriname (1990-2005), Uruguay (1990-2005) and Venezuela (1990-2005)

182 Includes information for the following countries for the years 1990-2005: Antigua and Barbuda, Netherlands Antilles, Bahamas, Barbados, Cuba, Grenada, Haiti, Jamaica, Dominican Republic, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, French Guyana, Paraguay, Peru, Suriname, Uruguay and Venezuela

183 Includes information for the following countries: Antigua and Barbuda (1990-2005), Aruba (1991-2002), Bahamas (1990-2003), Barbados (1990-2005), Dominica (1990-2006), Grenada (1990-2006), Haiti (2000-2006), Jamaica (1990-2006), Dominican Republic (1990-2006), Saint Kitts and Nevis (1990-2006), Saint Lucia (1990-2006), Saint Vincent and the Grenadines (1990-2006), Trinidad and Tobago (1990-2006), Argentina (1990-2005), Bolivia (1990-2005), Brazil (1990-2005), Chile (1990-2005), Colombia (1990-2005), Ecuador (1990-2005), Paraguay (1990-2005), Peru (1990-2005), Uruguay (1990-2005) and Venezuela (1990-2005)

184 Includes information for the following countries: Anguilla (2001 and 2003-2005), Antigua and Barbuda (1999-2002), Aruba (1991-2005), Bahamas (1991-2000), Barbados (1991-2005), Cuba (1991-2006), Dominica (1999), Grenada (1991-2003), Haiti (1991), Cayman Islands (2005 and 2006), British Virgin Islands (2001 and 2006), Jamaica (1991 and 2000-2005), Montserrat (1999 and 2002-2004), Dominican Republic (1990-2003 and 2006), Saint Kitts and Nevis (1991-2005), Saint Lucia (1999-2005), Saint Vincent and the Grenadines (1991, 1999-2005), Trinidad and Tobago (1991, 1999-2005), Belize (1991 and 1999-2004), Costa Rica (1991, 1999-2003 and 2006), El Salvador (1991, 1999-2003, 2005 and 2006), Guatemala (1991), Honduras (1991), Mexico (1991 and 1999-2003), Nicaragua (1991 and 1999-2003), Panama (1991 and 1999-2004), Argentina (1991 and 1999-2004), Bolivia (1991 and 1999-2003), Brazil (1999-2002 and 2004), Chile (1991-2000 and 2002-2006), Colombia (1991 and 1999-2001), Ecuador (1991 and 1999-2001) French Guyana (1991 and 1999-2006), Paraguay (1991 and 1999-2004), Peru (1991, 1999 and 2001-2006), Uruguay (1991 and 1999-2006) and Venezuela (1991 and 2006)

187 Includes information for the following countries: Antigua and Barbuda (1990), Bahamas(1990), Barbados (1990), Cuba (1990, 2000 and 2002), Grenada (1990), Haiti (1990), Cayman Islands (1990), Virgin Islands (United States) (1990), Jamaica (1990, 2003), Dominican Republic (1990 and 2000), Saint Kitts (1990 and 2000), Saint Lucia (1990), Saint Vicente (1990 and 2000), Trinidad and Tobago (1990), Belize (1990 and 2000), Costa Rica (1990 and 2000), El Salvador (1990, 2000, 2002 and 2006), Guatemala (1990), Honduras (1990 and 2000), Mexico (1990 and 2000-2003), Nicaragua (1990), Panama (1990 and 2000), Argentina (1990), Bolivia (1990 and 2001), Brazil (1990 and 2000), Chile (1990 and 2003), Colombia (1990 and 2002), Ecuador (1990 and 2000), French Guyana (1990 and 2000), Paraguay (1990, 2000 and 2002), Peru (1990), Suriname (1990 and 2000), Uruguay (1990 and 2002) and Venezuela (2005)

Caribbean

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
LAND																
Land area	1	1000 ha	22,893.0	22,893.0	22,893.0	22,893.0	22,893.0	22,893.0	22,893.0	22,893.0	22,893.0	22,893.0	22,893.0	22,893.0	22,893.0	
Arable land and permanent crops	2	1000 ha	6,920.0	7,437.0	7,556.0	7,562.5	7,538.6	7,428.7	7,556.9	7,558.0	7,568.0	7,253.0	7,207.0	7,169.0	7,099.0	
Arable land tillage	3	1000 ha	5,077.0	5,527.0	5,647.0	5,657.5	5,636.6	5,562.7	5,721.9	5,746.0	5,774.0	5,792.0	5,754.0	5,716.0	5,656.0	
Permanent Crops	4	1000 ha	1,843.0	1,910.0	1,905.0	1,905.0	1,902.0	1,866.0	1,739.3	1,475.1	1,466.1	1,460.0	1,452.0	1,453.0	1,443.0	
Non arable land and non permanent crops	5	1000 ha	15,973.0	15,456.0	15,337.0	15,330.5	15,354.4	15,464.3	15,336.1	15,335.0	15,325.0	15,640.0	15,686.0	15,724.0	15,794.0	
Permanent meadows and pastures		1000 ha	6,150.0	5,518.0	5,317.0	5,281.0	5,276.3	5,260.5	4,521.8	4,515.0	4,548.0	4,486.0	4,620.0	4,648.0	4,697.0	
Arable land and permanent crops per capita	6	ha/ 100 Inhab	20.6	20.8	20.7	20.5	20.2	19.7	19.8	19.6	19.5	18.5	18.2	17.9	17.6	
Farming Area	7	1000 ha	13,070.0	12,955.0	12,873.0	12,843.5	12,814.9	12,689.3	11,892.3	11,873.2	11,851.2	11,733.0	11,820.0	11,810.0	11,790.0	
Irrigated farming area	8	1000 ha	1,269.0	1,286.0	1,289.0	1,295.0	1,301.0	1,308.0	1,308.0	17.0	17.0	7.0	7.3	0.0	24.3	
Fertilizer Consumption	9	kt								180.7	67.6	90.8	105.1	145.4	131.0	
Nitrogen	10	kt								98.9	28.8	56.4	42.4	56.5	57.2	
Phosphate	11	kt								25.1	13.1	14.0	20.6	28.3	21.1	
Potash	12	kt								57.1	26.4	21.5	42.6	61.3	54.2	
Fertilizer consumption for arable land		Metric t per ha								0.0	0.0	0.0	0.0	0.0	0.0	
FOREST																
Forest area, total	13	1000 ha	5,348.0					5,703.0					5,973.0	6,080.3	6,080.3	
Plantations	14	1000 ha	393.0					393.0					449.0			
Natural Forest	15	1000 ha	4,955.0					5,310.0					5,524.0			
Proportion of land area covered by forest	16	%	21.6					24.9	25.2	25.4	25.6	25.9	26.1	26.3	26.6	
Annual average change in Forest Area	17	%						0.6					0.9			
Forest area under Forest Management Plans FRA (Forest Resource Assessment)	18	1000 ha						1,161.0								1,161.0
Proportion of forest area under Forest Management Plans FRA	19	%						5.1								
Roundwood production	20	1000 m³	6,916.5	7,148.6	7,327.3	7,190.1	5,323.9	5,622.9	5,493.2	6,565.8	6,426.5	6,294.5	6,376.7	6,502.3	6,560.1	
Industrial roundwood production	21	1000 m³	1,227.4	1,375.1	1,333.3	1,198.0	992.0	1,480.0	1,426.0	1,417.0	1,420.0	1,318.0	1,380.0	1,382.0	1,385.0	
Fuelwood and charcoal production	22	1000 m³	5,689.1	5,773.5	5,994.0	5,992.1	4,331.9	4,142.9	4,067.2	5,148.8	5,006.5	5,146.4	5,111.2	5,246.4	5,295.8	
Wood-based panels production	23	1000 m³	149.0	149.0	149.0	149.0	149.0	149.0	149.0	149.0	149.0	149.0	149.0	149.0	149.0	
Paper and paperboard production	24	1000 m³	136.3	64.0	78.0	187.0	187.0	187.0	187.0	154.7	163.4	157.4	161.9	158.7	157.4	
BIODIVERSITY																
Protected area, number	25	No.	455	530	486	491	493	493	493	531	531	520				
Protected area, total area	26	1000 ha	1,899.4	2,805.7	921.4	925.5	1,117.3	1,117.3	1,117.3	1,188.8	1,188.8	1,109.9				
Strict nature reserves / Wilderness areas, number	27	No.	17	19	17	17	17	17	17	11	11					
Strict nature reserves / Wilderness areas, total area	28	1000 ha	9.0	18.5	9.2	9.2	9.2	9.2	9.2	9.2	9.2	7.0				
National parks, number	29	No.	61	70	57	57	57	57	57	48	48					
National parks, total area	30	1000 ha	1,119.3	1,661.1	417.9	417.8	417.8	417.8	417.8	236.2	236.2					
Natural monuments, number	31	No.	18	24	18	19	19	19	19	19	19					
Natural monuments, total area	32	1000 ha	14.2	17.2	1.5	1.6	1.6	1.6	1.6	1.6	1.6					
Habitat / Species management area, number	33	No.	193	221	216	219	220	220	220	221	221					
Habitat / Species management area, total area	34	1000 ha	548.1	723.9	191.5	195.6	199.7	199.7	199.7	150.9	150.9					
Protected landscapes and seascapes, number	35	No.	21	35	27	27	28	28	28	22	22					
Protected landscapes and seascapes, total area	36	1000 ha	1,054.1	1,225.8	1,158.1	1,158.1	1,975.7	1,975.7	1,975.7	988.0	988.0					
Managed resource protected area, number	37	No.	147	163	154	155	155	155	155	153	153					
Managed resource protected area, total area	38	1000 ha	130.8	146.8	130.8	130.8	130.8	130.8	130.8	110.0	110.0					
Total Number of threatened species	39	No.						851		862	1,154	1,348		1,447		1,697
Number of threatened species. Annual Change Rate.		%								0.6	33.9	16.8		3.6		8.3
Number of threatened mammal species	40	No.						48		48	51	51		61		83
Number of threatened bird species	41	No.						100		100	102	130		97		95
Number of threatened reptile species	42	No.						125		125	125	128		132		129
Number of threatened amphibian species	43	No.						14		10		174		178		180
Number of threatened fish species	44	No.						9		16		282		380		405
Number of threatened molluscs species	45	No.								3		3		3		3
Number of threatened invertebrate species	46	No.						18		15		15		22		233
Number of threatened plant species	47	No.						545		545		565		574		569

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
FRESHWATER																
Proportion of population with access to drinking water services	48	%	71.9	80.5				82.3		86.2		82.8				
Proportion of population with access to drinking water services, rural	49	%	60.9	69.0				73.1								
Proportion of population with access to drinking water services, urban	50	%	91.1	90.0				88.9								
Proportion of population with access to sanitation services	51	%	66.9	69.2				71.6		69.2		73.5				
Proportion of population with access to sanitation services, rural	52	%	54.8	56.5				57.1								
Proportion of population with access to sanitation services, urban	53	%	77.9	79.8				83.3								
Total freshwater fish production	54	kt	27.9	37.6	48.1	47.0	48.2	39.0	33.6	37.6	33.3	37.1	28.2	30.8		
Freshwater fish production, catch	55	kt	17.2	11.8	9.6	7.2	6.0	3.9	3.9	4.9	4.9	5.2	3.9	4.0		
Freshwater fish production, aquaculture	56	kt	10.8	25.8	38.5	39.9	42.2	35.1	29.7	32.8	28.3	31.9	24.3	26.8		
Proportion of total water resources used	57	%	1.2	3.7				5.7								
Total withdrawal extraction	58	1000 Km^3	985.0	14,757.0				13,370.0				16.6	26.6			
Withdrawal extraction per capita	59	m^3 /Inhab	29.3	412.6				354.1				0.4	0.7			
Agricultural withdrawals extraction	60	%	94.0	72.9				67.7								
Industrial withdrawals extraction	61	%	0.6	1.2				9.4								
Domestic withdrawals extraction	62	%	5.4	25.8				23.0								
COASTAL AND MARINE AREAS																
Total marine fish production	63	kt	238.8	144.8	161.0	166.7	156.5	177.7	198.1	167.7	145.6	134.7	105.7	110.3		
Total marine fish production, catch	64	kt	237.4	143.2	158.9	166.6	156.3	177.1	197.3	166.5	144.9	133.9	104.5	109.1		
Total marine fish production, aquaculture	65	kt	1.3	1.6	2.1	0.2	0.2	0.6	0.8	1.2	0.8	0.9	1.2	1.2		
Marine protected areas	66	1000 ha	4,081.2	4,514.0	4,516.1	4,516.1	4,704.3	4,702.8	4,702.8	4,736.1	4,736.2	4,736.2	4,736.2	4,736.2		
Mangroves, total area	67	1000 ha	794.3					784.6					783.0			
ATMOSPHERE																
CO2 Emissions	68	kt	26,570.0	29,941.0	30,222.0	29,538.0	31,653.0	32,731.0	34,301.0	34,607.0	28,435.0	28,534.0				
CO2 Emissions per capita	69	t /Inhab	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.7	0.7				
CO2 Emissions per $1 GDP (PPP)	70	t/Mill US$	416.7 2000 PPP	425.5	395.2	368.2	375.5	370.0	378.7	368.2	296.1	289.8				
From gas fuels	72	kt	2,742.0	3,558.0	3,800.0	4,510.0	5,252.0	5,467.0	5,964.0	6,222.0	6,598.0	6,934.0				
From liquid fuels	73	kt	22,022.0	24,798.0	24,716.0	23,734.0	25,087.0	26,024.0	26,983.0	26,914.0	20,135.0	20,104.0				
From solid fuels	74	kt	370.0	467.0	466.0	569.0	533.0	433.0	527.0	580.0	838.0	622.0				
Emissions of particles	75	kt	18.0	21.1	23.2	23.3	23.6	23.9	23.4	22.3	21.7	20.8				
Emissions of sulphur oxides (SO2)	76	kt				433.7	380.5				561.0	570.3	520.9	594.9		
Emissions of nitrogen oxides (NOx)	77	kt				475.4	492.0				509.3	507.5	529.4	532.8		
Emissions of hydrocarbon (HC)	78	kt				132.2	32.6				29.3	29.1	28.5	25.6		
Emissions of carbon monoxide (CO)	79	kt				954.3	703.0				998.0	1,094.2	841.1	1,055.2		
Emissions of methane, total	80	kt	441.4			524.0		555.6		384.8						
From energy	81	kt	10.7			17.6		16.4		118.0						
From agriculture	82	kt	71.8			125.8		140.1		161.7						
From other sources	83	kt	67.3			71.2		73.8		105.2						
Consumption of ozone-depleting substances, total	84	ODP tn	1,789.0	1,841.4	1,753.7	1,582.1	1,905.9	1,629.7	1,618.5	1,350.8	1,107.0	1,117.2	683.9	654.7	271.1	
Consumption of ozone-depleting substances, 85 Chlorofluorocarbons (CFCs)	ODP tn	1,782.4	1,670.9	1,605.1	1,317.1	1,703.7	1,366.9	1,385.7	1,187.7	993.7	982.9	544.4	464.4	141.3		
Consumption of ozone-depleting substances, Hydrochlorofluorocarbons (HCFCs)	86	ODP tn	6.6	44.4	22.6	38.6	49.5	60.5	70.6	62.3	43.4	82.3	99.1	156.0	123.1	
Consumption of ozone-depleting substances, 87 Methyl bromide	ODP tn		126.1	126.0	226.4	152.7	202.3	162.2	100.8	69.9	52.0	40.4	34.3	6.7		
HUMAN SETTLEMENT																
Population density	88	Inhab/km	143.1	152.4	155.9	157.6	159.3	160.9	162.6	164.2	165.8	167.3	168.9	170.4	171.9	173.4
Urban population	89	1,000.0	18,110.0	20,763.0				23,002.0					25,040.0			

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Percent of population living in urban areas	90	%	53.9	58.1				60.9					63.2			
Annual growth rates of the urban population	91	%	2.5	2.7				2.0					1.7			
Rural population		1,000.0	15,465.0	15,002.0				14,756.0					14,581.0			
Percent of population living in rural areas		%	46.1	41.9				39.1					36.8			
Annual growth rates of the rural population		%	0.1	-0.6				-0.3					-0.2			
Number of cities with more than 750,000 inhabitants	92	No.	4	4				4					4			
Population of urban aglomerations comprising 750.000 or more inhabitants	93	%	22.1	23.4				24.6					25.7			
Number of cities with population between 500.000 and 1 million	94	No.	1	1				1					2			
Population of urban aglomerations with population between 500.000 and 1 million	95	%	4.3	3.8				3.4					6.2			
Number of cities with population between 1 and 5 million	96	No.	4	4				4					4			
Population of urban aglomerations with population between 1 and 5 million	97	%	46.7	46.7				46.7					46.9			
Number of cities with population between 5 and 10 million	98	No.														
Population of urban aglomerations with population between 5 and 10 million	99	%														
Number of cities greater than 10 million population	100	No.														
Population of urban aglomerations comprising 10 million or more inhabitants	101	%														
Proportion of urban population living in slums	102	%	27.5										25.0			
Roads total network	103	Km												142,327.0		142,327.0
DISASTERS AND VULNERABILITY																
Number of natural and technological disaster events	108	No.	16	23	10	18	17	7	14	18	16	36	20	7	30	0
Floods	109	No.	2	1	1	0	1	3	2	4	7	4	4	4	7	0
Cyclones/ hurricanes/ typhoons	110	No.	10	19	0	8	14	0	7	9	3	23	14	2	16	0
Earthquakes	111	No.	0	0	1	0	0	0	0	0	1	2	0	0	3	0
Landslides and avalanches	112	No.	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Extreme temperatures		No.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Volcanic eruptions	114	No.	0	1	2	0	0	0	0	0	0	0	0	1	0	0
Drought		No.	0	0	0	1	0	1	1	0	0	2	0	0	0	0
Technological disasters	116	No.	4	2	6	9	2	3	4	5	5	4	2	0	4	
Estimated damages due to natural and technological disaster events	117	Mill $	21,000.0	3,270.4	33.0	21,696.5	827.0	6.0	661.5	81.2	44.7	8,431.7	2,185.0	0.0	1,622.7	0.0
Floods	118	Mill $	0.0	0.0	0.0	0.0	0.0	0.0	146.0	21.5	44.7	0.0	0.0	0.0	0.0	0.0
Cyclones/ hurricanes/ typhoons	119	Mill $	0.0	3,270.4	0.0	6,516.5	827.0	0.0	515.5	59.7	0.0	8,428.6	2,185.0	0.0	1,622.7	0.0
Earthquekes	120	Mill $	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Landslides and avalanches	121	Mill $	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Extreme temperatures	122	Mill $	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Volcanic eruptions	123	Mill $	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drought	124	Mill $	0.0	0.0	0.0	180.0	0.0	6.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
Technological disasters	125	Mill $	21,000.0	0.0	0.0	15,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Number of people afected due to natural and technological disaster events	126	No.	2,500	228,503	4,065	1,805,917	265,074	0	5,909,681	348,728	262,734	1,039,775	2,513,992	5,200	582,527	0
Floods	127	No.	0	0	0	0	0	0	9,480	63,339	217,408	41,285	0	5,000	91,947	
Cyclones/ hurricanes/ typhoons	128	No.	2,500	223,503	0	985,595	265,001	0	5,900,187	285,270	10,100	998,192	2,513,976	0	490,308	0
Earthquekes	129	No.	0	0	0	0	0	0	0	0	0	253	0	0	101	
Landslides and avalanches	130	No.	0	0	0	0	0	0	0	0	0	0	0	0	0	
Extreme temperatures	131	No.	0	0	0	0	0	0	0	0	0	0	0	0	0	
Volcanic eruptions	132	No.	0	5,000	4,000	0	0	0	0	0	0	0	0	200	0	
Drought	133	No.	0	0	0	820,000	0	0	0	0	35,000	0	0	0	0	
Technological disasters	134	No.			65	322	73		14	119	226	45	16		171	
Proportion of population in poverty		%						46.9		44.9		54.4	47.5	44.5		

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Employed Population below 1$ PPP per day	135	%	2.0					2.0	53.9		2.0	2.6				
Poverty gap coefficient	136	%						22.1		20.5		27.0	23.0	21.1		
Share of youth unemployed to youth population, both sexes	137	%	13.1	13.8	14.2	10.6	7.2	10.5	13.5	9.1	9.0	9.3	9.3			
ENVIRONMENT AND HUMAN HEALTH																
Infant mortality rate	138	* 1000 Inhab	45.0	37.9				31.9					26.3			
Life expectancy at birth females	139	Years	70.1	71.1				72.1					73.0			
Life expectancy at birth males	140	Years	65.7	66.4				67.1					68.1			
Calories availability	141	Kcal/daily per Inhab	1,173.5	2,189.5	2,305.5	2,329.6	2,354.7	2,408.8	2,423.3	2,600.0	2,632.0		2,774.1		2,180.6	
Reported Cases of Dengue	142	No.	0	11,270	11,432	25,766	8,490	9,264	28,308	16,861	14,283	8,429	19,019	16,860	32,211	11,965
Reported Cases of Malaria	144	No.	0	0	0	36,455	4,785	18,130	10,875	11,133	11,366	13,157	25,615	36,264	0	
Reported Cases of Cholera	145	No.									0	0	0	0	0	0
SOCIOECONOMICS TRENDS																
Total population at midyear	146	1000	33,578.0					37,755.0	38,138.0	38,514.0	38,887.0	39,255.0	39,616.0	39,978.0	40,330.0	40,679.0
Average annual growth rate of population	147	%	1.4					1.2	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9
Adult literacy adult, total	148	%					79.9	97.3		94.1		97.8			95.3	
Male	149	%					74.1	97.5		94.0		97.8			94.5	
Female	150	%					85.9	97.1		94.2		97.8			96.0	
School life expectancy	151	Year					12.4	12.4	12.6	12.8	12.9	13.0	13.3	13.4	13.7	13.5
Male	152	Year					12.2	12.2	12.4	12.5	12.4	12.6	12.8	13.0	12.9	13.0
Female	153	Year					12.6	12.6	12.8	13.0	13.3	13.5	13.8	13.9	14.6	14.0
Telephone lines	154	* 100 Inhab	22.7	30.2	33.2	35.5	38.0	41.8	43.6	32.2	29.6	31.0	29.4	25.0	22.0	
Cellular subscribers	155	* 100 Inhab	0.6	2.5	3.8	3.9	6.2	6.5	9.9	14.9	18.6	24.6	31.8	60.3		
Internet users	156	* 100 Inhab		0.1	0.5	0.7	1.4	2.9	4.0	6.3	7.8	10.4	13.2	7.5		
Size of vehicle fleet		No.	0	0	0	936,083	1,090,833	1,294,998	1,436,165	1,611,023	1,680,382	1,746,756	1,900,564	1,971,011	2,121,244	2,429,562
Energy use per capita	157	kt oil equivalent	982.6	877.8	858.1	790.7	808.9	816.5	872.7	881.5	904.5	944.1	966.4	966.1	972.6	964.4
Energy imports, net (% of energy use of commercial energy)	158	%	33.6	31.4	34.3	34.4	28.6	24.4	23.0	15.4	-3.8	-3.5				
Energy intensity of gross domestic product	159	1.000 Barrels / million constant dolar GNP	1.9	2.1	2.1	2.2	2.1	2.1	2.2	2.2	2.0	2.1	2.2	2.2	2.2	2.1
Renewable energy supply	160	kboe	60,777.4	45,555.7	47,084.0	43,068.0	44,291.8	38,899.4	37,870.1	38,147.0	38,157.3	34,276.3	35,547.3	31,707.3	31,722.3	32,902.6
Non-renewable energy supply		kboe	170,722.6	161,383.4	183,274.5	189,905.8	203,031.6	214,244.3	219,794.9	242,351.8	250,037.9	227,978.3	274,226.2	294,282.7	302,918.0	281,743.1
Combustible renewables and waste (% of total energy)	161	%	15.3	12.5	12.2	11.1	11.0	10.7	10.2	9.8	9.2	9.2				
Total primary energy production per capita	162	TJ / Inhab	0.0					0.0	0.0	0.0	0.0	0.0				
Total primary energy production, Geothermal	163	Tjoul														
Total primary energy production, hydropower	164	Tjoul	5,142.2				9,527.5	6,759.5	5,452.0	7,201.5	9,216.4	10,553.2	12,097.2	10,875.3	10,993.6	
Total primary energy production, sugar cane bagasse	165	kboe		23,036.0			23,369.0	18,849.0	19,389.0	19,642.0	19,322.0	16,684.0	15,398.0	12,737.0	8,382.0	9,140.0
Total primary energy production, coal	166	metric tons					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total primary energy production, natural gas	167	Mm^3		7,826.0			13,746.9	16,137.0	17,225.9	19,786.5	27,558.0	29,132.5	34,034.2	42,571.6	44,036.0	43,455.0
Total primary energy production, firewood	168	kboe		26,875.0							21,400.0	18,755.0	21,346.5			
Total primary energy production, oil	169	1000 Barrels per day		59,411.0			63,891.0	68,562.0	67,812.0	78,439.0	83,097.0	73,784.0	79,057.0	78,138.0	67,855.0	70,577.0
Electricity Production	170	GWh	26,145.0	29,576.0	34,275.0	35,265.0	35,425.0	37,105.0	39,428.0	42,654.0	44,526.0	44,657.0	44,016.0	46,682.0	49,493.0	50,109.0
From coal sources	171	% of total	0.2	0.7	0.8	2.1	1.8	0.7	1.4	1.5	6.4	4.7	2.9			
From hydroelectric sources	172	% of total	3.8	3.5	3.2	3.5	4.8	3.3	2.5	3.2	3.8	4.6	5.4			
From gas sources	173	% of total	13.6	14.5	14.5	14.6	14.6	14.6	14.2	13.6	14.4	14.3	15.9			
From nuclear sources	174	% of total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
From oil sources	175	% of total	77.3	78.8	78.6	77.2	76.4	79.0	79.6	79.4	73.3	74.5	74.8			
Gross domestic income per habitant (Atlas method)	176	$	47,150.0	55,090.0	60,780.0	62,080.0	65,920.0	69,860.0	70,560.0	60,930.0	40,080.0	44,640.0	48,800.0	30,450.0		

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Gross domestic product, annual growth	177	%		3.7	4.3	3.4	5.3	4.8	2.0	3.2	3.0	3.6	8.0	9.4	6.2	
Agriculture, value added	178	% of GDP	8.6	7.6	7.3	6.6	6.6	6.4	6.5	6.3	6.2	5.8	5.1	4.8	4.8	
Industry, value added	179	% of GDP	29.1	26.4	27.1	26.6	27.1	27.3	26.5	26.6	27.0	27.0	26.7	26.9	26.0	
Service, value added	180	% of GDP	59.7	61.6	61.6	62.3	62.2	62.1	63.3	63.6	63.6	64.0	64.6	64.2	64.8	
Exports of goods and services	181	% of GDP	39.0	59.1	57.2	59.1	60.4	62.9	64.5	38.3	47.3	47.9	41.4			
Imports of goods and services	182	% of GDP	41.2	75.4	77.2	77.4	79.0	79.1	79.3	47.7	51.1	49.9	43.9			
Total Debt Service (% of GNP)	183	% of GDP	6.5	6.0	4.4	3.4	3.7	4.2	4.4	4.9	6.9	5.9	4.6			
GDP public spent on education	184	% of GDP					4.0	3.7	4.3	4.2	4.2	5.0	5.3	4.6		
GDP expenditure on RD		% of GDP			0.4	0.4	0.4	0.4	0.4	0.4	0.1					
Physicians	187	No.	45,239	63,616	70,897	78,741	73,219	68,521	82,271	82,108	82,863	99,526	85,910	86,439	103,895	

Notes:

1 Includes information for all countries 1990-2005

2 Excluded due for lack of information Anguilla (1990-2005)

3 Excluded due for lack of information Anguilla (1990-2005)

4 Excluded due for lack of information: Anguilla (1990-2005), Netherlands Antilles (1990-2005), Aruba (1990-2005), Cayman Islands (1990-2005), Montserrat (1990-2005) and Turks and Caicos (1990-2005)

5 Excluded due for lack of information Anguilla (1990-2005)

6 Excluded due for lack of information: Anguilla (1990-2005), Guadeloupe (1990-2005), Cayman Islands (1990-2005), Martinique (1990-2005)

7 Excluded due for lack of information Anguilla (1990-2005)

8 Excluded due for lack of information: Anguilla (1990-2002), Antigua and Barbuda (1990-2002), Netherlands Antilles (1990-2002), Aruba (1990-2002), Dominica (1990-2002), Grenada (1990-2002), Cayman Islands (1990-2002), Virgin Islands (United States) (1990-2002), British Virgin Islands (1990-2002), Montserrat (1990-2002), Saint Kitts and Nevis (1990-2002) and Turks and Caicos (1990-2002)

9 Excluded due for lack of information Guyana (2002-2005)

10 Includes information for the following countries: Barbados (2002-2005), Cuba (2002-2005), Jamaica (2002-2005) and Trinidad and Tobajo (2002-2005)

11 Excluded due for lack of information: Guyana (2002-2005)

12 Includes information for the following countries: Barbados (2002-2005), Cuba (2002-2005), Jamaica (2002-2005) and Trinidad and Tobajo (2002-2005)

13 Excluded due for lack of information: Anguilla (1990-2005), Netherlands Antilles (1990-2005), Aruba (1990-2005), Barbados (1990-2005), Cayman Islands (1990-2005), Virgin Islands (United States) (1990-2005) and Turks and Caicos (1990-2005)

14 Includes information for the following countries: Bahamas (1990,2000 and 2005), cuba(1990,2000 and 2005), Guadeloupe (1990, 2000 and 2005), Haiti (1990, 2000 and 2005), Jamaica (1990, 2000 and 2005), Martinique (1990, 2000 and 2005) and Trinidad and Tobago (1990, 2000 and 2005)

15 Includes information for the following countries: Antigua and Barbuda (1990 and 2005), Bahamas (1990, 1995 and 2005), Cuba (1990, 1995 and 2005), Dominica (1995), Grenada (1995), Guadeloupe (1995, 2000 and 2005), Haiti (1990, 1995, 2000 and 2005), British Virgin Islands (1995), Jamaica (1990, 1995, 2000 and 2005), Martinique (1990, 1995, 2000 and 2005), Montserrat (1995), Puerto Rico (1990, 1995 and 2000), Dominican Republic (1990, 1995 and 2000), Saint Kitts and Nevis (1995 and 2000), Saint Lucia (1995 and 2000), Saint Vincent and the Grenadines (1995 and 2000), Trinidad and Tobago (1990, 1995, 2000 and 2005)

16 Excluded due for lack of information: Anguilla (1990, 1995 and 2000), Netherlands Antilles (1990 and 1995), Aruba, Barbados (1990 and 1995), Cayman Islands (1990 and 1995), Virgin Islands (United States) (1990 and 1995) and Turks and Caicos (1990 , 1995 and 2000)

17 Excluded due for lack of information Aruba (2000-2005)

18 Includes information for the following countries: Cuba (2000 and 2008), Guadeloupe (2000 and 2008), Haiti (2000 and 2008), Jamaica (2000 and 2008), Martinique (2000 and 2008), Puerto Rico (2000 and 2008), Dominican Republic (2000 and 2008), Trinidad and Tobago (2000 and 2008)

19 Includes information for the following countries: Cuba (2000), Guadeloupe (2000), Haiti (2000), Jamaica (2000), Martinique (2000), Puerto Rico (2000), Dominican Republic (2000), Trinidad and Tobago (2000)

20 Includes information for the following countries: Bahamas (1990-2006), Cuba (1990-2006), Guadeloupe (1990-2006), Haiti (1990-2006), Jamaica (1990-2006), Martinique (1990-2006), Puerto Rico (1990-2006), Dominican Republic (1990-2006), Trinidad and Tobago (1990-2006)

21 Includes information for the following countries: Bahamas (1990-2006), Cuba (1990-2006), Guadeloupe (1990-2006), Haiti (1990-2006), Jamaica (1990-2006), Martinique (1990-2006), Puerto Rico (1990-2006), Dominican Republic (1990-2006) and Trinidad and Tobago (1990-2006)

22 Includes information for the following countries: Cuba (1990-2006), Guadeloupe (1990-2006), Haiti (1990-2006), Jamaica (1990-2006), Martinique (1990-2006), Puerto Rico (1990-2006), Dominican Republic (1990-2006) and Trinidad and Tobago (1990-2006)

23 Includes information for Cuba (1990-2006)

24 Includes information for the following countries: Barbados (2005 and 2006), Cuba (1990-2006), Jamaica (1990-2006), Martinique (1990-2006), Dominican Republic (1990-2006)

25 Excluded due for lack of information Anguilla and Aruba (1990-2004)

26 Excluded due for lack of information Anguilla and Aruba 1990-2004

27 Includes information for the following countries: Cayman Islands (1990-2003), Dominican Republic (1995), Trinidad and Tobago (1990-2003)

28 Includes information for the following countries: Cayman Islands (1990-2003), Dominican Republic (1995), Trinidad and Tobago (1990-2004)

29 Excluded due for lack of information: Anguilla (1990-2003), Aruba (1990-2003), Grenada (1990-2003), Jamaica (1990-2003), Martinique (1990-2003), Puerto Rico (1990-2003), Dominican Republic (1991-2003), Saint Lucia (1990-2003), Saint Vicente and the Grenadines (1990-2003)

30 Excluded due for lack of information: Anguilla (1990-2003), Aruba (1990-2003), Grenada (1990-2003), Jamaica (1990-2003), Martinique (1990-2003), Puerto Rico (1990-2003), Dominican Republic (1991-2003), Saint Lucia (1990-2003), Saint Vicente and the Grenadines (1990-2003)

31 Excluded due for lack of information: Anguilla (1990-2003), Antigua and Barbuda (1990-2003), Netherlands Antilles (1990-2003), Aruba (1990-2003), Bahamas (1990-2003), Cuba (1990-2003), Dominica (1990-2003), Grenada (1990-2003), Guadeloupe (1990-2003), Haiti (1990-2003), Cayman Islands (1990-2003), Martinique (1990-2003), Puerto Rico (1990-2003), Dominican Republic (1996-2003), Saint Kitts and Nevis (1990-2003), Saint Vicente and the Grenadines (1990-2003), Trinidad and Tobago (1990-1997)

32 Excluded due for lack of information: Anguilla (1990-2003), Antigua and Barbuda (1990-2003), Netherlands Antilles (1990-2003), Aruba (1990-2003), Bahamas (1990-2003), Cuba (1990-2003), Dominica (1990-2003), Grenada (1990-2003), Guadeloupe (1990-2003), Haiti (1990-2003), Cayman Islands (1990-2003), Martinique (1990-2003), Puerto Rico (1990-2003), Dominican Republic (1996-2003), Saint Kitts and Nevis (1990-2003), Saint Vicente and the Grenadines (1990-2003), Trinidad and Tobago (1990-1997)

33 Excluded due for lack of information: Anguilla (1996-2003), Antigua and Barbuda (1996-2003), Netherlands Antilles (1996-2003), Aruba (1996-2003), Grenada (1996-2003), Haiti (1996-2003), Jamaica (1996-2003), Dominican Republic (1996-2003), Saint Kitts and Nevis (1996-2003)

34 Excluded due for lack of information: Anguilla (1996-2003), Antigua and Barbuda (1996-2003), Netherlands Antilles (1996-2003), Aruba (1996-2003), Grenada (1996-2003), Haiti (1996-2003), Jamaica (1996-2003), Dominican Republic (1996-2003), Saint Kitts and Nevis (1996-2003)

35 Includes information for the following countries: Cuba (1990-2001), Guadeloupe (1990-2003), Haiti (1990-2003), Jamaica (1999-2003), Martinique (1990-2003), Montserrat (1990-2003), Dominican Republic (1990-1995), Trinidad and Tobago (1990-2003)

36 Includes information for the following countries: Cuba (1990-2001), Guadeloupe (1990-2003), Haiti (1990-2003), Jamaica (1999-2003), Martinique (1990-2003), Montserrat (1990-2003), Dominican Republic (1990-1995), Trinidad and Tobago (1990-2003)

37 Includes information for the following countries: Cuba (1990-2001), Dominica (1990-2003), Grenada (1990-2003), Jamaica (1999-2003), Montserrat (1990-2003), Dominican Republic (1995), Saint Lucia (1990-2003), Trinidad and Tobago (1990-2003)

38 Includes information for the following countries: Cuba (1990-2001), Dominica (1990-2003), Grenada (1990-2003), Jamaica (1999-2003), Martinique (1990-2003), Saint Lucia (1990-2003), Trinidad and Tobago (1990-2003)

39, 40, 41, 42, 43, 44 Includes information for all countries: 2000, 2002-2004 and 2006

45 Includes information for all countries: 2002, 2004 and 2006

46, 47 Includes information for all countries: 2000, 2002, 2004 and 2006

48 Excluded due for lack of information: Netherlands Antilles (1990, 2002 and 2004), Aruba (1990), Cuba (1990), Grenada (1990), Guadeloupe (1990), Cayman Islands (1990, 2002 and 2004), Virgin Islands (United States) (1990, 2002 and 2004), British Virgin Islands (1990), Jamaica (1990); Martinique (1990, 2002 and 2004), Puerto Rico (1990, 2002 and 2004), Saint Vincent and the Grenadines (1990, 2002 and 2004), Turks and Caicos (1990)

49 Excluded due for lack of information: Anguilla (1990), Antigua and Barbuda (2002 and 2004), Aruba (2002 and 2004), Bahamas (2002 and 2004), Barbados (1990, 2002 and 2004), Cuba (2002 and 2004), Dominica (2002 and 2004), Grenada (2002 and 2004), Guadeloupe (2002 and 2004), Haiti (1990, 2002 and 2004), British Virgin Islands (2002 and 2004), Jamaica (2002 and 2004), Montserrat (2002 and 2004), Dominican Republic (1990, 2002 y 2004), Saint Kitts and Nevis (2002 and 2004), Saint Lucia (2002 and 2004), Saint Vincent and the Grenadines (2002 and 2004), Trinidad and Tobago (1990, 2002 and 2004) and Turks and Caicos (2002 and 2004)

50 Includes information for the following countries: Anguilla (2002 and 2004), Antigua and Barbuda (2002 and 2004), Aruba (2002 and 2004), Bahamas (1990, 2002 and 2004), Barbados (1990, 2002 and 2004), Cuba (2002 and 2004), Dominica (1990, 2002 and 2004), Grenada (2002 and 2004), Guadeloupe (2002 and 2004), Haiti (1990, 2002 and 2004), British Virgin Islands (1990, 2002 and 2004), Jamaica (1990, 2002 and 2004), Montserrat (2002 and 2004), Dominican Republic (1990, 2002 and 2004), Saint Kitts and Nevis (2002 and 2004), Saint Lucia (2002 and 2004), Saint Vincent and the Grenadines (2002 and 2004), Trinidad and Tobago (1990, 2002 and 2004), Turks and Caicos (2002 and 2004)

51 Includes information for the following countries: Anguilla (2002 and 2004), Antigua and Barbuda (2002 and 2004), Aruba (2002 and 2004), Bahamas (2002 and 2004), Barbados (1990, 2002 and 2004), Cuba (2002 and 2004), Dominica (1990, 2002 and 2004), Grenada (2002 and 2004), Guadeloupe (2002 and 2004), Haiti (1990, 2002 and 2004), British Virgin Islands (2002 and 2004), Dominican Republic (1990, 2002 and 2004), Saint Kitts and Nevis (2002 and 2004), Saint Lucia (2002 and 2004), Saint Vincent and the Grenadines (2002 and 2004), Trinidad and Tobago (1990, 2002 and 2004), Turks and Caicos (2002 and 2004)

52 Excluded due for lack of information: Anguilla (2004), Netherlands Antilles (2002 and 2004), Aruba (2002 and 2004), Cuba (1990), Grenada (1990), Guadeloupe (1990), Haiti (1990), Cayman Islands (1990, 2002 and 2004), Virgin Islands (United States) (1990, 2002 and 2004), British Virgin Islands (1990), Jamaica (1990); Martinique (1990, 2002 and 2004), Montserrat (1990), Puerto Rico (1990, 2002 and 2004), Dominican Republic (1990), Saint Lucia (1990), Saint Vincent and the Grenadines (1990) and Turks and Caicos (1990)

53 Excluded due for lack of information: Anguilla (2002 and 2004), Antigua and Barbuda (2002 and 2004), Aruba (2002 and 2004), Bahamas (1990, 2002 and 2004), Barbados (1990, 20020and 2004), Cuba (2002 and 2004), Dominica (2002 y 2004), Grenada (2002 and 2004), Guadeloupe (2002 and 2004), Haiti (1990, 2002 and 2004), British Virgin Islands (2002 and 2004), Jamaica (2002 and 2004), Montserrat (2002 and 2004), Dominican Republic (1990, 2002 and 2004), Saint Kitts and Nevis (2002 and), Saint Lucia (2002 and 2004), Trinidad and Tobago (1990, 2002 and 2004), Turks and Caicos (2002 and 2004)

54 Includes information for the following countries: Bahamas (1990-1992), Cuba (1990-2006), Dominica (1992-2004), Guadeloupe (1990 and 2006), Haiti (1990 and 2006), Virgin Islands (United States) (2006), Jamaica (1990-2006), Martinique (1990-2006), Puerto Rico (1990-2006), Dominican Republic (1990-2006), Saint Lucia (1992-2005), Saint Vincent and the Grenadines (1996-1997) and Trinidad and Tobago (1990-2003)

55 Includes information for the following countries: Cuba (1990-2006), Haiti (1990-2006), Jamaica (1990-2006), Dominican Republic (1990-2006), Martinique (2003) and Saint Vincent and the Grenadines (1996-1997)

56 Includes information for the following countries: Cuba (1990-2006), Dominica (1992-2004), Guadelupe (1990-2006), Jamaica (1990-2006), Martinique (1990-2006), Puerto Rico (1990-2006), Dominican Republic (1990-2006), Trinidad and Tobago (1990-2003), Virgin Islands (United States) (2006)

57 Includes information for the following countries: Antigua and Barbuda (1990), Barbados (2000), Cuba (1995 and 2000), Dominica (1995 and 2000), Haiti (1990 and 2000), Jamaica (1995 and 2000) , Trinidad and Tobago (1995 and 2000)

58 Includes information for the following countries: Barbados (2000), Cuba (1995 and 2000), Haiti (1990 and 2000), British Virgin Islands (1995 and 2000), Dominican Republic (1995 and 2000), Trinidad and Tobago (1995 and 2000)

59 Includes information for the following countries: Antigua and Barbuda (1990), Barbados (2000), Cuba (2000), Haiti (1990 and 2000), Jamaica (2000), Dominican Republic (2000), Trinidad and Tobago (2000)

60 Includes information for the following countries: Antigua and Barbuda (1990), Barbados (2000), Cuba (1995 and 2000), Haiti (1990 and 2000), Jamaica (1995 and 2000), Dominican Republic (1995 and 2000), Trinidad and Tobago (1995 and 2000)

61 Includes information for the following countries: Antigua and Barbuda (1990), Barbados (2000), Cuba (1995 and 2000), Haiti (1990 and 2000), Jamaica (1995 and 2000), Dominican Republic (1995 and 2000), Trinidad and Tobago (1995 and 2000)

62 Includes information for the following countries: Antigua and Barbuda (1990), Barbados (2000), Cuba (1995 and 2000), Haiti (1990 and 2000), Jamaica (1995 and 2000), Dominican Republic (1995 and 2000), Trinidad and Tobago (1995 and 2000)

63, 64 Includes information for all countries 1990-2006

65 Includes information for the following countries: Bahamas (1990-2006), Cuba (1990-2004), Martinique (1990-2006), Puerto Rico (1996-2006), Dominican Republic (1990-1997, 2000-2006), Saint Kitts and Nevis (1990-1991)

66 The information in agrregated by the source to regions

67 Includes information for all countries: 1990, 2000 and 2005

68 Excluded due for lack of information: Anguilla (1990-2004), Virgin Islands (United States) (1990-2004), Puerto Rico (1990-2004) and Turks and Caicos (1990-2004)

69 Excluded due for lack of information: Anguilla (1990, 2000-2004), Virgin Islands (United States) (1990, 2000-2004), Puerto Rico (1990, 2000-2004) and Turks and Caicos (1990, 2000-2004)

70 Includes information for the following contries 1990 - 2004: Antigua and Barbuda, Grenada, Haiti, Jamaica, Dominican Republic, Saint Kitts and Nevis, Saint Vincent and the Grenadines and Trinidad and Tobago

72, 73 Excluded due for lack of information: Anguilla (1990-2004) and Turks and Caicos (1990-2004)

74 Excluded due for lack of information: Anguilla (1990-2004), British Virgin Islands and Turks and Caicos (1990-2004)

75 Includes information for the following countries: Barbados (1990-2004), Cuba (1990-2004) Grenada (1990-2004), Haiti (1990-2004), Jamaica (1990-2004), Dominican Republic (1990-2004) and Trinidad and Tobago (1990-2004)

76, 77, 78, 79 Includes information for the following contries 1993,1994,1998,1999,2003-2006: Barbados, Cuba, Dominica, Grenada, Haiti, Jamaica, Dominican Republic and Trinidad and Tobago

80 Includes information for the following countries: Cuba (1990, 1994, 1996, 1998, 2000 and 2002) and Dominican Republic (1990, 1994, 1998 and 2000)

81 Includes information for the following countries: Barbados (2002), Dominican Republic (1998 and 2002)

82, 83 Includes information for the following countries: Cuba (2002) and Dominican Republic (1990, 1994, 1998 and 2000)

84, 85 Includes information for the following countries: Cuba (1990-2006) and Dominican Republic (1992-2006)

86 Includes information for the following countries: Cuba (1998-2006) and Dominican Republic (1994-2006)

87 Includes information for the following countries: Cuba (1995-2006) and Dominican Republic (1993-2006)

88 Excluded due for lack of information: Anguilla (1990, 2000 and 2005), Antigua and Barbuda (1990, 2000 and 2005), Dominica (1990, 2000 and 2005), Guadeloupe (1990, 2000 and 2005), Cayman Islands (1990, 2000 and 2005), British Virgin Islands (1990, 2000 and 2005), Martinique (1990, 2000 and 2005), Montserrat (1990, 2000 and 2005), Saint Kitts and Nevis (1990, 2000 and 2005), Turks and Caicos (1990, 2000 and 2005)

89 Excluded due for lack of information: Guadeloupe (1990, 2000-2008), Cayman Islands (1990, 2000-2008), Martinique (1990, 2000-2008)

90 Includes information for the following countries for the years 1990, 2000 and 2005: Cuba, Haiti and Dominican Republic

91 Includes information for the following contries: Cuba (1990,1995,2000,2005), Haiti (1990,1995,2000 and 2005), and Dominican Republic (1990,1995,2000 and 2005)

92, 93 Includes information for the following contries: Cuba (1990,1995,2000,2005), Haiti (1990,1995,2000 and 2005), Puerto Rico (1990,1995,2000,2005),and Dominican Republic (1990,1995,2000 and 2005)

94 Includes information for the following contries: Haiti (1990,1995,2000 and 2005), Jamaican (1990,1995,2000 and 2005), Puerto Rico (1990,1995,2000,2005),and Dominican Republic (1990,1995,2000 and 2005)

95 The information in aggregated by the source to regions

96, 97 Includes information for the following countries for the years 1990, 1995, 2000 and 2005: Cuba, Haiti, Puerto Rico, Dominican Republic

98, 99, 100, 101 No Data

102 Includes information for the following countries: Anguilla (1990, 2001 and 2005), Antigua and Barbuda (1990, 2001 and 2005), Dominica (1990 and 2001), Grenada (1990, 2001 and 2005), Haiti (1990, 2001 and 2005), Jamaica (1990, 2001 and 2005), Martinique (1990, 2001 and 2005), Dominican Republic (1990, 2001 and 2005), Saint Lucia (1990, 2001 and 2005), Trinidad and Tobago (1990, 2001 and 2005)

103 Includes information for the following countries: Antigua and Barbuda (1996, 1998 and 2002), Bahamas (1990, 2000), Barbados (1990-1996, 1998-2004), Cuba (1990-2000), Grenada (1994-2000), Haiti (1990-2000), Jamaica (1990-1996, 1998-2000, 2003-2005), Puerto Rico (2000, 2001 and 2004), Dominican Republic (1990-1996, 1999-2000), Saint Kitts and Nevis (1996-1999), Saint Lucia (1990-1998,2003), Saint Vincent and the Grenadines (1998-2003) and Trinididad and Tobago (1990-2000)

108 Excluded due for lack of information: Antigua and Barbuda (1990-2007), Aruba (1990-2007), Cayman Islands (1990-2007), Virgin Islands (United States) (1990-2007), British Virgin Islands (1990-2007), Martinique (1990-2007), Montserrat (1990-2007), Saint Kitts and Nevis (1990-2007), Saint Lucia (1990-2007), Saint Vincent and the Grenadines (1990-2007)

109 Excluded due for lack of information: Antigua and Barbuda (1990-2008), Netherlands Antilles (1990-2008), Aruba (1990-2008), Dominica (1990-2008), Cayman Islands (1990-2008),

Virgin Islands (United States) (1990-2008), British Virgin Islands (1990-2008), Martinique (1990-2008), Montserrat (1990-2008), Saint Lucia (1990-2008), and Turks and Caicos (1990-2008)

110 Excluded due for lack of information: Aruba (1990-2008)

111 Includes information for the following countries for the years 1990-2007: Barbados, Cuba, Dominica, Guadeloupe, Martinique, Dominican Republic, Saint Lucia, Trinidad and Tobago

112 Includes information for the following countries for the years 1990-2007 : Haiti, Puerto Rico, Saint Lucia, Trinidad and Tobago

114 Includes information for the following countries: Guadeloupe (1990-2007), Montserrat (1990-2007), Saint Vincent and the Grenadines (1990-2007) and Trinidad and Tobago (1990-2007)

116 Excluded due for lack of information for the years 1990-2007: Antigua and Barbuda, Aruba, Cayman Islands, Virgin Islands (United States), British Virgin Islands, Martinique, Montserrat, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines

117 Includes information for all countries (1990-2007)

118 Includes information for the years: 1991-1993, 2001-2003

119 Includes information for the years 1992-2007

120 Includes information for Trinidad and Tobago 1997

121, 122, 123 No data

124 Includes information for Cuba (1998 and 2004)

125 Includes information for the following countries: Cuba (1990), Grenada (1990), Puerto Rico (1996) and Trinidad and Tobago (1998)

126 Includes information for the following countries: Anguilla (1999), Antigua and Barbuda (1995, 1998 and 1999), Netherlands Antilles (2001 and 1995), Bahamas (1992, 2004, 2005 and 2007), Barbados (2002, 2004 and 2007), Cuba (1991, 1993-2005 and 2007), Dominica (1995, 1999, 2001, 2004 and 2007), Grenada (1990, 1999, 2004 and 2005), Guadeloupe (1999 and 2004), Haiti (1992, 1994, 1996, 1998, 2001-2004 and 2007), Cayman Islands (2002), Virgin Islands (United States) (1995), Jamaica (1991, 1993, 1996, 2002 and 2004-2007), Martinique (1990, 1993, 1994 and 2007), Montserrat (1995-1997 and 2006), Puerto Rico (1996-2004), Dominican Republic (1993, 1996, 1998, 2003-2005 and 2007), Saint Kitts and Nevis (1995, 1998 and 1999), Saint Lucia (1994, 1996 and 1999), Saint Vincent and the Grenadines (1992, 1999, 2004 and 2005), Trinidad and Tobago (1998)

127 Includes information for the following countries: Cuba (1993), Haiti (2002-2004 and 2007), Jamaica (1991, 1993, 2002 and 2006), Puerto Rico (1992, 2001 and 2003), Dominican Republic (1993, 2003, 2004 and 2007), Saint Vincent and the Grenadines (1992)

128 Includes information for the following countries: Anguilla (1999), Antigua and Barbuda (1995, 1999), Netherlands Antilles (1995), Bahamas (1992, 2004, 2005 and 2007), Barbados (2002 and 2004), Cuba (1993, 1996, 1999, 2001, 2002, 2004, 2005 and 2007), Dominica (1995, 1999, 2001, 2007), Grenada (1999), Haiti (1994, 2004 and 2007), Cayman Islands (2002), Virgin Islands (United States) (1995), Jamaica (1996, 2002, 2004, 2005 and 2007), Martinique (1990, 1993, 1999 and 2007), Puerto Rico (1995, 1996, 2003 and 2004), Dominican Republic (1996, 1998, 2003, 2004 and 2007), Saint Kitts and Nevis (1995, 1998 and 1999), Saint Lucia (1994 and 1999), Saint Vincent and the Grenadines (1999, 2004 and 2005), Trinidad and Tobago (2004)

129 Includes information for the following countries: Barbados (2007), Haiti (2004), Martinique (2007), and Dominican Republic (2004)

130 Includes information for Saint Lucia (1996)

131 No Data

132 Includes information for Montserrat (1995-1997, 2006)

133 Includes information for the following countries: Cuba (1998), Haiti (1992 and 2003)

134 Includes information for the following countries: Netherlands Antilles (2001), Bahamas (2007), Cuba (1991, 1994, 1997, 1999, 2002, 2003 and 2007), Haiti (1996, 1998, 2003 and 2007), Puerto Rico (1996 and 2004), Dominican Republic (2002-2005), Trinidad and Tobago (1998)

135 Includes information for the following countries: Haiti (2001), Jamaica (1990, 1993, 1996, 1999, 2000 and 2004), Dominican Republic (1992, 1996, 2003 and 2004)

136 Includes information for the following countries: Haiti (2001), Jamaica (1990, 1993, 1996, 1999, 2000 and 2004), Dominican Republic (1992, 1996, 2003 and 2004), Trinidad and Tobago (1992)

137 Includes information for the following countries: Anguilla (2001), Netherlands Antilles (2000), Barbados (1990, 2001 and 2003), Haiti (1990), Jamaica (1990, 2003 and 2004), Puerto Rico (1990, 2000, 2002-2005), Dominican Republic (2000), Trinidad and Tobago (1990, 2000 and 2002)

138 Excluded due for lack of information for the years 1990, 2000 and 2005: Anguilla, Antigua and Barbuda, Dominica, Guadeloupe, Cayman Islands, British Virgin Islands, Martinique, Montserrat, Saint Kitts and Nevis, Turks and Caicos

139, 140 Excluded due for lack of information for the years 1990, 2000 and 2005 : Anguilla, Antigua and Barbuda, Dominica, Guadeloupe, Cayman Islands, British Virgin Islands, Martinique, Montserrat, Saint Kitts and Nevis, Trinidad and Tobago

141 Excluded due for lack of information for de years 1990, 2000-2003, 2005 and 2007: Anguilla, Aruba, Guadeloupe, Cayman Islands, Virgin Islands (United States), British Virgin Islands, Martinique, Montserrat, Puerto Rico, Turks and Caicos

142 Included information for the following countries: Anguilla (1995,1996,1999 and 2007), Antigua and Barbuda (1995 and 2007), Aruba (1995,1996, 1999, 2000,2002 2004, 2006 and 2007), Bahamas (1995, 1998, 2003 and 2007), Barbados (1995 and 2007) Cuba (1997,2000 and 2007), Dominica (1995,1996, 1998,2001,2003 and 2002), Grenada (1995,1996,1999,2000,2002,2003,2005-2007), Cayman Islands (1995,1998,1999,2002,2007), Virgin Islands (United States) (2007), British Virgin Islands (1995,1998,2000,2001,2003 and 2007), Jamaica (1995 and 2007), Haiti (1995 and 2007), Martinique (1995 and 2007), Montserrat (1995, 2000 and 2007), Puerto Rico (1995-2007), Dominican Republic (1995-2007), Saint Kitts and Nevis (1995,1996,1999-2007), Saint Lucia (1995-1997,1999,2001-2007), Saint Vincent and Grenadines (1995-2007), Trinidad and Tobago (1995-2007), Turks and Caicos (2003-2007)

143 No Data

144 Includes information for the following countries for the years de 1998-2006: Haiti, Dominican Republic

145 No Data

146 Excluded due for lack of information: Guadeloupe (1990, 2000-2006), Cayman Islands (1990, 2000-2006), Martinique (1990, 2000-2006) and 2000-2006)

147 Excluded due for lack of information: Guadeloupe (1990, 2000-2006), Cayman Islands (1990, 2000-2006), Martinique (1990, 2000-2006)

148 Includes information for the following countries: Netherlands Antilles (2004), Aruba (2000), Cuba (2000), Dominican Republic (2002), Trinidad and Tobago (2004)

149 Includes information for the following countries: Netherlands Antilles (2004), Aruba (2000), Cuba (2000), Dominican Republic (2002), Trinidad and Tobago (2004)

150 Includes information for the following countries: Netherlands Antilles (2004), Aruba (2000), Cuba (2000), Dominican Republic (2002), Trinidad and Tobago (2004)

151 Includes information for the following countries: Anguilla (2000-2006), Netherlands Antilles (1999-2002), Aruba (1999-2006), Barbados (1999-2001), Cuba (1999-2006), Dominica (1999-2005), Grenada (2002-2005), Cayman Islands (2000, 2001), British Virgin Islands (1999-2005), Jamaica (2000-2003), Montserrat (2002-2006), Dominican Republic (2003, 2004), Saint Kitts and Nevis(2000-2005), Saint Lucia (2003-2006), Saint Vincent and the Grenadines (2000-2005), Trinidad and Tobago (1999-2005), Turks and Caicos (2002-2005)

152 Includes information for the following countries: Anguilla (2000-2006), Netherlands Antilles (1999-2002), Aruba (1999-2006), Barbados (1999-2001), Cuba (1999-2006), Dominica (1999-2005), Grenada (2002-2005), Cayman Islands (2000, 2001), British Virgin Islands (1999-2005), Jamaica (2000-2003), Montserrat (2002-2006), Dominican Republic (2003, 2004), Saint Kitts (2000-2005), Saint Lucia (2003-2006), Saint Vincent and the Grenadines (2000-2005), Trinidad and Tobago (1999-2005), Turks and Caicos (2002-2005)

153 Includes information for the following countries: Anguilla (2000-2006), Netherlands Antilles (1999-2002), Aruba (1999-2006), Barbados (1999-2001), Cuba (1999-2006), Dominica (1999-2005), Grenada (2002-2005), Cayman Islands (2000, 2001), British Virgin Islands (1999-2005), Jamaica (2000-2003), Montserrat (2002-2006), Dominican Republic (2003, 2004), Saint Kitts and Nevis (2000-2005), Saint Lucia (2003-2006), Saint Vincent and the Grenadines (2000-2005), Trinidad and Tobago (1999-2005), Turks and Caicos (2002-2005)

154 Includes information for the following countries: Anguilla (2000,2001,2003-2005), Antigua and Barbuda (2000,2002,2004 and 2005), Aruba (2000-2002, 2005), Bahamas (2000-2004), Barbados (2000-2005), Cuba (2000-2005), Dominica (2000-2004), Grenada (2000-2004), Guadeloupe (2000,2001), Haiti (2000-2004), Cayman Islands (2000-2001), Virgin Islands (United States) (2000, 2001,2003 and 2004), British Virgin Islands (2002), Jamaica (2000-2005), Martinique (2000-2001), Montserrat (2000), Puerto Rico (2000-2004), Dominican Republic (Saint Kitts and Nevis (2003, 2005 and 2006), Saint Lucia (2003-2006), Turks and Caicos (1990, 2000 and 2001)

155 Include information for the following countries: Anguilla (2000-2005), Antigua and Barbuda (200-2005), Netherlands Antilles (2003 and 2004), Aruba (2000-2005), Bahamas (2000-2005), Barbados (2000-2005), Cuba (2000-2005), Dominica (2000-2004), Grenada (2000-2005), Guadeloupe (2000-2004), Haiti (2000-2005), Cayman Islands (2000,2001,2003 and 2004), Virgin Islands (United States) (2000-2005), British Virgin Islands (2002), Jamaica (2000-2005), Martinique (2005-2004), Montserrat (2000 and 2004), Puerto Rico (2000-2005), Dominican Republic (2000-2006), Saint Kitts and Nevis (2000-2002 and 2004), Saint Lucia (2000-2002,2004 and 2005), Saint Vincent and the Grenadines (2000-2006), Trinidad and Tobago (2000-2006) and Turks and Caicos (2002-2004)

156 Includes information for the following countries: Anguilla (2000-2005), Antigua and Barbuda (2000-2005), Aruba (2000-2005), Bahamas (2000-2005), Barbados (2000-2005), Cuba (2000-2006), Dominica (2000-2004), Grenada (2000-2003), Guadeloupe (2000-2005), Haiti (2000-2006), Cayman Islands (2005), Virgin Islands (United States) (2000-2005), British Virgin Islands (2002), Jamaica (2000-2005), Martinique (2000-2005), Puerto Rico (2000-2005), Dominican Republic (2000-2006), Saint Kitts and Nevis (2000-2003), Saint Lucia (2000, 2001, 2003 and 2004), Saint Vincent and the Grenadines (2000-2005), Trinidad and Tobago (2000-2005)

157 Includes information for the following countries: Netherlands Antilles (1990-2000-2004), Cuba (1990-2000-2004), Haiti (1990-2000-2004), Jamaica (1990-2000-2004), Dominican Republic (1990-2000-2004), Trinidad and Tobago (1990-2000-2004)

158 Includes information for the following countries : Cuba (1990-2004), Haiti (1990-2004), Jamaica (1990-2004), Dominican Republic (1990-2004), Trinidad and Tobago (1990-2004)

159 Includes information for the following countries: Barbados (1990-2006), Cuba (1990-2006), Grenada (1990-2006), Haiti (1990-2006), Jamaica (1990-2006), Dominican Republic (1990-2006), Trinidad and Tobago (1990-2006)

160 No Data

161 Includes information for the years 1990-2004 : Cuba, Haiti, Jamaica, Dominican Republic, Trinidad and Tobago

162 Includes information for the years 1990 and 2000-2006 : Barbados, Cuba, Grenada, Haiti, Jamaica, Dominican Republic, Trinidad and Tobago

163 No Data

164 Includes information for the years 1990 : Cuba, Haiti, Jamaica, Dominican Republic

165 Includes information for the following countries for the years 1990 and 2003-2005 : Barbados, Cuba, Grenada, Haiti, Jamaica, Dominican Republic, Trinidad and Tobago

166 No Data

167 Includes information for the following countries: Barbados (1995, 1996 and 2002-2006), Cuba (1995, 1996 and 2002-2006), Trinidad and Tobago (1995, 1996 and 2002-2006)

168 Includes information for the following countries for the years 1995 and 2003-2005 : Cuba, Grenada, Haiti, Jamaica, Dominican Republic

169 Includes information for the following countries for the years (1995, 1996 and 2003-2006): Barbados, Cuba, Trinidad and Tobago

170 Includes information for the following countries: Netherlands Antilles (1990-2005), Cuba (1990-2000-2004), Haiti (1990-2005), Jamaica (1990-2005), Dominican Republic (1990-2005), Trinidad and Tobago (1990-2005)

171 Includes information for the following countries: Dominican Republic (1990-2005)

172 Includes information for the years 1990-2005: Cuba, Haiti, Jamaica, Dominican Republic

173 Includes information for the following countries: Cuba (1990-2002), Dominican Republic (2003-2006)

174 No Data

175 Include information for the following countries: Netherlands Antilles (1990-2005), Cuba (1990-2000-2004), Haiti (1990-2005), Jamaica (1990-2005), Dominican Republic (1990-2005), Trinidad and Tobago (1990-1993 and 1998-2005)

176 Includes information for the following countries: Antigua and Barbuda (1990-2006), Bahamas (1990-2002), Barbados (1990-2002), Grenada (1990-2005), Haiti (1990-2006), Jamaica (1990-2006), Puerto Rico (1990-2001), Dominican Republic (1990-2006), Saint Kitts and Nevis (1990-2005), Saint Lucia (1990-2005), Saint Vincent and the Grenadines (1990-2005), Trinidad and Tobago (1990-2006)

177 Includes information for the following countries: Antigua and Barbuda (1990-2004), Aruba (1990-2003), Bahamas (1990-2002), Dominica (1990-2004), Grenada (1990-2004), Haiti (1990-2005), Jamaica (1990-2005), Puerto Rico (1990-2001), Dominican Republic (1990-2005), Saint Kitts and Nevis (1990-2004), Saint Lucia (1990-2004), Saint Vincent and the Grenadines (1990-2005), Trinidad and Tobago (1990-2005)

178 Includes information for the following countries: Antigua and Barbuda (1991-2006), Bahamas (1990-2005), Barbados (1990-2006), Cuba (1990-2003), Dominica (1990-2006), Grenada (1990-2006), Haiti (2000-2006), Jamaica (1990-2006), Dominican Republic (1990-2006), Saint Kitts and Nevis (1990-2006), Saint Lucia (1990-2006), Saint Vincent and the Grenadines (1990-2006), Trinidad and Tobago (1990-2006)

179 Includes information for the following countries: Antigua and Barbuda (1991-2006), Bahamas (1990-2005), Barbados (1990-2006), Cuba (1990-2003), Dominica (1990-2006), Grenada (1990-2006), Haiti (2000-2006), Jamaica (1990-2006), Dominican Republic (1990-2006), Saint Kitts and Nevis (1990-2006), Saint Lucia (1990-2006), Saint Vincent and the Grenadines (1990-2006), Trinidad and Tobago (1990-2006)

180 Includes information for the following countries: Antigua and Barbuda (1991-2006), Bahamas (1990-2005), Barbados (1990-2006), Cuba (1990-2003), Dominica (1990-2006), Grenada (1990-2006), Haiti (2000-2006), Jamaica (1990-2006), Dominican Republic (1990-2006), Saint Kitts and Nevis (1990-2006), Saint Lucia (1990-2006), Saint Vincent and the Grenadines (1990-2006), Trinidad and Tobago (1990-2006)

181 Includes information for the following countries: Antigua and Barbuda (1990-2005), Barbados (1990-2005), Cuba (1994-1999), Grenada (1990-2005), Haiti (2000-2005), Jamaica (1990-2005), Dominican Republic (1992-2001), Saint Kitts and Nevis (1990-2005), Saint Lucia (1990-2005), Saint Vincent and the Grenadines (1990-2005), Trinidad and Tobago (1990-2005)

182 Includes information for the following countries for the years 1990-2005: Antigua and Barbuda, Netherlands Antilles, Bahamas, Barbados, Cuba, Grenada, Haiti, Jamaica, Dominican Republic, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago

183 Includes information for the following countries: Antigua and Barbuda (1990-2005), Aruba (1991-2002), Bahamas (1990-2003), Barbados (1990-2005), Dominica (1990-2006), Grenada (1990-2006), Haiti (2000-2006), Jamaica (1990-2006), Dominican Republic (1990-2006), Saint Kitts and Nevis (1990-2006), Saint Lucia (1990-2006), Saint Vincent and the Grenadines (1990-2006), Trinidad and Tobago (1990-2006)

187 Includes information for the following countries: Antigua and Barbuda (1990), Bahamas(1990), Barbados (1990), Cuba (1990, 2000 and 2002), Grenada (1990), Haiti (1990), Cayman Islands (1990), Virgin Islands (United States) (1990), Jamaica (1990, 2003), Dominican Republic (1990 and 2000), Saint Kitts (1990 and 2000), Saint Lucia (1990), Saint Vicente and the Grenadines (1990 and 2000), Trinidad and Tobago (1990)

Mesoamerica

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
LAND																
Land area	1	1000 ha	245,469.0	245,469.0	245,469.0	245,469.0	245,469.0	245,469.0	245,469.0	245,469.0	245,469.0	245,469.0	245,469.0	245,469.0	245,469.0	
Arable land and permanent crops	1	1000 ha	33,451.0	35,151.0	35,257.0	35,461.0	35,635.0	35,345.0	35,457.0	35,496.0	35,581.0	35,753.0	35,626.0	35,087.0	35,242.0	
Arable land tillage	1	1000 ha	29,723.0	31,074.0	31,004.0	31,209.0	31,258.0	30,949.0	30,991.0	31,021.0	31,036.0	31,310.0	31,105.0	30,535.0	30,594.0	
Permanent Crops	1	1000 ha	3,728.0	4,077.0	4,253.0	4,252.0	4,377.0	4,396.0	4,295.0	4,308.0	4,334.0	4,443.0	4,521.0	4,552.0	4,648.0	
Non arable land and non permanent crops	1	1000 ha	212,018.0	210,318.0	210,212.0	210,008.0	209,834.0	210,124.0	210,012.0	209,973.0	209,888.0	209,716.0	209,843.0	210,382.0	210,227.0	
Permanent meadows and pastures	1	1000 ha	88,519.0	91,332.0	91,500.0	91,542.0	91,574.0	91,637.0	91,328.0	91,455.0	91,591.0	91,587.0	91,408.0	91,031.0	91,038.0	
Arable land and permanent crops per capita	1	ha/ 100 Inhab	29.7	28.3	27.4	27.0	26.7	26.1	25.8	25.5	25.3	25.1	24.8	24.1	23.8	
Farming Area	1	1000 ha	121,970.0	126,483.0	126,757.0	127,003.0	127,209.0	126,982.0	126,644.0	126,834.0	127,655.0	127,340.0	127,034.0	126,118.0	126,280.0	
Irrigated farming area	1	1000 ha	6,026.0	6,667.0	6,739.0	6,746.0	6,772.0	6,794.0	6,814.0	0.0	2,058.5	2,109.2	5,417.1	5,432.5	32.2	
Fertilizer consumption	2	kt								1,894.5	2,165.2	2,369.1	2,352.5	2,242.2	2,307.5	
Nitrogen	2	kt								1,094.9	1,259.0	1,319.5	1,332.0	1,282.3	1,309.0	
Phosphate	2	kt								528.4	609.6	645.7	638.7	573.3	564.3	
Potash	2	kt								271.2	296.6	403.9	381.8	386.6	434.2	
Fertilizer consumption for arable land		Metric t per ha								0.1	0.1	0.1	0.1	0.1	0.1	
FOREST																
Forest area, total	3	1000 ha	96,655.0					89,377.0					86,649.0	85,487.8	85,487.8	
Plantations	4	1000 ha	83.0					1,269.0					1,332.0			
Natural Forest	5	1000 ha	96,572.0					88,108.0					85,317.0			
Proportion of land area covered by forest	6	%	39.3					36.4	36.2	36.0	35.7	35.5	35.3	35.0	34.8	
Annual average change in Forest Area	7	%						-0.8					-0.6			
Forest area under Forest Management Plans FRA (Forest Resource Assessment)	8	1000 ha						9,361.0								9,361.0
Proportion of forest area under Forest Management Plans FRA	9	%						3.8								
Roundwood production	10	1000 m^3	78,504.3	82,520.0	85,220.2	86,254.5	87,503.6	88,032.3	87,789.5	87,200.3	87,259.6	87,996.3	88,037.2	88,335.4	89,437.2	
Industrial roundwood production	10	1000 m^3	10,131.9	9,532.6	10,954.3	11,498.0	12,127.6	12,033.6	11,290.6	10,186.6	10,087.6	10,254.6	9,710.6	9,620.0	9,770.0	
Fuelwood and charcoal production	10	1000 m^3	68,372.4	72,987.4	74,265.9	74,756.5	75,376.0	75,998.7	76,498.9	77,013.7	77,172.0	77,910.1	78,778.3	78,905.4	79,841.8	
Wood-based panels production	11	1000 m^3	642.8	232.9	435.9	450.9	492.9	536.9	648.5	521.5	511.5	562.5	493.5	512.7	663.7	
Paper and paperboard production	12	1000 m^3	2,951.4	3,232.9	3,714.0	3,875.0	3,986.0	4,067.0	4,258.0	4,189.0	4,351.0	4,891.0	5,043.1	5,768.0	5,796.0	
BIODIVERSITY																
Protected area, number	13	No.	381	556	583	592	593	597	598	598	598	538				
Protected area, total area	13	1000 ha	12,348.7	20,702.1	22,210.6	22,924.3	22,926.8	26,523.7	26,523.7	26,523.7	26,523.7	25,367.4				
Strict nature reserves / Wilderness areas, number	14	No.	56	67	69	69	69	69	69	69	69					
Strict nature reserves / Wilderness areas, total area	15	1000 ha	1,213.1	1,847.2	1,876.3	1,876.3	1,876.3	1,876.3	1,876.3	1,876.3	1,876.3	328.8				
National parks, number	16	No.	120	143	145	148	148	149	149	149	149					
National parks, total area	16	1000 ha	3,096.9	4,054.2	4,272.7	4,300.6	4,300.6	4,300.6	4,300.6	4,300.6	4,300.6					
Natural monuments, number	17	No.	21	35	35	35	36	36	36	36	36					
Natural monuments, total area	18	1000 ha	1,096.0	1,134.4	1,080.8	1,080.8	1,081.9	1,081.9	1,081.9	1,081.9	1,081.9					
Habitat / Species management area, number	19	No.	103	183	188	189	189	192	192	192	192					
Habitat / Species management area, total area	20	1000 ha	2,855.9	4,592.1	4,738.3	4,739.5	4,739.5	8,334.7	8,334.7	8,334.7	8,334.7					
Protected landscapes and seascapes, number	21	No.	13	36	49	50	50	50	51	51	51					
Protected landscapes and seascapes, total area	22	1000 ha	315.7	1,353.3	1,876.2	1,881.8	1,881.8	1,881.8	1,882.4	1,882.4	1,882.4					
Managed resource protected area, number	23	No.	68	92	97	101	101	101	101	101	101					
Managed resource protected area, total area	24	1000 ha	5,266.4	9,359.3	10,062.9	10,745.1	10,745.1	10,745.1	10,745.1	10,745.1	10,745.1					
Total Number of threatened species	25	No.						1,183		1,254	1,410	1,909		2,053		2,225
Number of threatened species. Annual Change Rate.	26	%								3.0	12.4	35.4		3.7		4.1
Number of threatened mammal species	27	No.						130		132	132	132		130		162
Number of threatened bird species	27	No.						86		86	87	125		129		129
Number of threatened reptile species	27	No.						61		61	61	73		154		154
Number of threatened amphibian species	27	No.						5		5		453		471		488
Number of threatened fish species	27	No.						99		107		204		246		281
Number of threatened molluscs species	28	No.								8		9		9		9
Number of threatened invertebrate species	29	No.						65		57		57		59		161
Number of threatened plant species	29	No.						738		798		856		855		841

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
FRESHWATER																
Proportion of population with access to drinking water services	30	%	80.9	85.9				91.4		88.8		94.9				
Proportion of population with access to drinking water services, rural	31	%	64.8	72.6				79.2								
Proportion of population with access to drinking water services, urban	32	%	89.5	93.1				96.6								
Proportion of population with access to sanitation services	33	%	57.1	66.1				73.4		73.2		77.3				
Proportion of population with access to sanitation services, rural	34	%	25.2	35.5				45.6								
Proportion of population with access to sanitation services, urban	35	%	74.7	81.1				86.4								
Total freshwater fish production	36	kt	135.0	140.9	145.6	130.2	127.9	145.7	135.8	132.5	160.1	171.9	188.6	186.3		
Freshwater fish production, catch	37	kt	120.2	130.1	120.9	108.9	101.7	117.8	100.9	92.3	106.6	113.0	108.9	107.9		
Freshwater fish production, aquaculture	38	kt	14.8	10.9	24.8	21.3	26.2	27.9	34.9	40.2	53.6	58.9	79.6	78.3		
Proportion of total water resources used	39	%	2.9	4.8				13.0								
Total withdrawal extraction	40	1000 Km^3	729.0	5,770.0				87,250.0								
Withdrawal extraction per capita	41	m^3 /Inhab	6.5	46.5				643.2								
Agricultural withdrawals extraction	42	%	46.1	80.2				75.8								
Industrial withdrawals extraction	43	%	20.2	6.7				6.3								
Domestic withdrawals extraction	44	%	33.7	13.1				18.0								
COASTAL AND MARINE AREAS																
Total marine fish production	45	kt	1,311.7	1,421.7	1,561.1	1,314.9	1,303.0	1,498.6	1,625.5	1,683.5	1,511.3	1,386.1	1,481.4	1,488.3		
Total marine fish production, catch	46	kt	1,311.6	1,419.4	1,557.6	1,310.1	1,298.7	1,491.1	1,617.4	1,674.1	1,500.8	1,369.4	1,381.7	1,365.0		
Total marine fish production, aquaculture	47	kt	0.1	2.3	3.4	4.9	4.2	7.6	8.2	9.3	10.5	16.7	99.6	123.3		
Marine protected areas	48	1000 ha	4,683.2	8,011.5	8,253.8	8,393.0	8,675.9	10,056.6	10,065.4	10,122.3	10,122.3	10,559.6	11,701.1	11,701.1		
Mangroves, total area	49	1000 ha	1,557.9					1,367.4					1,284.7			
ATMOSPHERE																
CO2 Emissions	50	kt	118,053.0	118,135.0	123,997.0	125,601.0	123,195.0	124,292.0	128,121.0	124,989.0	129,770.0	131,165.0				
CO2 Emissions per capita	51	t /Inhab	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9				
CO2 Emissions per $1 GDP (PPP)	52	t/Mill US$ 2000 PPP	134.6	122.3	115.0	111.0	104.8	99.6	102.5	99.0	101.1	98.2				
From gas fuels	52	kt	20,165.0	15,878.0	18,045.0	19,649.0	19,337.0	20,937.0	21,551.0	23,944.0	26,219.0	27,302.0				
From liquid fuels	52	kt	90,743.0	93,030.0	93,241.0	92,726.0	90,039.0	88,663.0	92,994.0	87,670.0	89,823.0	91,256.0				
From solid fuels	52	kt	2,518.0	4,317.0	5,115.0	5,256.0	5,507.0	5,896.0	5,621.0	5,917.0	6,438.0	5,883.0				
Emissions of particles	52	kt	61.7	65.2	75.7	81.1	78.2	83.4	82.4	78.4	78.5	81.0				
Emissions of sulphur oxides (SO2)	53	kt				1,773.2	1,738.4				1,607.7	1,526.1	1,669.0	1,644.1		
Emissions of nitrogen oxides (NOx)	54	kt				2,261.5	2,198.3				2,665.8	2,854.1	3,338.9	3,425.6		
Emissions of hydrocarbon (HC)	54	kt				205.2	196.4				2,279.0	1,806.9	252.2	240.7		
Emissions of carbon monoxide (CO)	54	kt				9,502.3	9,366.6				9,831.8	10,888.3	11,405.8	11,711.7		
Emissions of methane, total	54	kt	75,153.1			81,092.0		80,598.2		79,391.6			201.9			
From energy	55	kt	34,410.7			43,005.0		42,605.6		40,634.0			0.7			
From agriculture	55	kt	40,567.2			37,988.3		37,843.6		38,681.6			138.3			
From other sources	55	kt	175.1			98.7		149.0		76.0			62.9			
Consumption of ozone-depleting substances, total	56	ODP tn	12,865.6	8,773.4	8,315.7	7,221.9	7,078.3	8,150.4	7,092.3	6,139.6	5,777.4	7,280.0	5,374.2	2,812.2	2,830.4	
Consumption of ozone-depleting substances, Chlorofluorocarbons (CFCs)	57	ODP tn	12,733.1	6,267.4	5,530.9	4,227.7	4,004.4	3,934.5	3,115.6	2,828.4	2,802.9	3,824.0	2,137.8	-138.6	-338.1	
Consumption of ozone-depleting substances, Hydrochlorofluorocarbons (HCFCs)	58	ODP tn	132.5	321.0	462.6	510.5	1,169.7	1,896.2	1,210.0	833.6	775.0	1,370.1	1,248.9	1,358.9	1,496.8	
Consumption of ozone-depleting substances, Methyl bromide	59	ODP tn		2,185.0	2,322.2	2,483.7	1,904.2	2,319.7	2,766.7	2,477.6	2,199.5	2,085.9	1,987.5	1,591.9	1,671.7	
HUMAN SETTLEMENT																
Population density	60	Inhab/km	45.3	49.9	51.8	52.8	53.7	54.6	55.3	56.0	56.6	57.2	57.9	58.6	59.4	60.3
Urban population	61	1000	71,946.0	81,822.0				92,759.0					101,379.0			

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Percent of population living in urban areas	62	%	63.8	65.9				68.4					70.4			
Annual growth rates of the urban population	63	%	5.3	2.6				2.5					1.8			
Rural population	64	1000	40,788.0	42,286.0				42,882.0					42,529.0			
Percent of population living in rural areas	64	%	36.2	34.1				31.6					29.6			
Annual growth rates of the rural population	65	%	0.8	0.7				0.3					-0.2			
Number of cities with more than 750,000 inhabitants	66	No.	22	23				23					23			
Population of urban aglomerations comprising 750.000 or more inhabitants	67	%	31.8	32.8				33.4					33.9			
Number of cities with population between 500.000 and 1 million	68	No.	21	23				22					26			
Population of urban aglomerations with population between 500.000 and 1 million	69	%	20.6	20.5				16.5					18.6			
Number of cities with population between 1 and 5 million	70	No.	3	6				11					11			
Population of urban aglomerations with population between 1 and 5 million	70	%	10.1	13.9				19.9					20.1			
Number of cities with population between 5 and 10 million	71	No.	0	0				0					0			
Population of urban aglomerations with population between 5 and 10 million	71	%														
Number of cities greater than 10 million population	72	No.	1	1				1					1			
Population of urban aglomerations comprising 10 million or more inhabitants	73	%	21.3	20.6				19.5					18.5			
Proportion of urban population living in slums	74	%	27.8										23.8			
Roads total network	75	Km												464,693.0		464,693.0
DISASTERS AND VULNERABILITY																
Number of natural and technological disaster events	76	No.	19	24	16	25	38	37	26	31	18	21	36	22	30	0
Floods	77	No.	4	6	0	2	11	8	4	11	7	7	10	4	11	0
Cyclones/ hurricanes/ typhoons	78	No.	1	7	4	11	1	6	11	6	2	2	16	3	9	0
Earthquakes	79	No.	3	3	2	1	4	2	3	0	4	1	1	1	1	0
Landslides and avalanches	80	No.	0	0	1	2	0	1	0	1	2	1	2	2	1	0
Extreme temperatures	81	No.	2	1	2	1	1	1	1	1	1	1	0	3	0	0
Volcanic eruptions	82	No.	0	1	1	3	3	2	0	2	0	0	1	0	0	0
Drought	83	No.	0	1	2	2	0	3	3	2	0	2	0	0	0	0
Technological disasters	84	No.	9	5	4	3	18	14	4	8	2	7	6	9	8	
Estimated damages due to natural and technological disaster events	85	Mill $	258.7	47,564.3	453.8	6,805.3	848.4	380.8	2,543.1	1,152.7	236.3	3.6	19,421.5	10.7	3,701.4	0.0
Floods	86	Mill $	146.2	11.5	0.0	602.7	456.8	1.3	0.0	101.6	20.0	3.6	32.0	8.0	3,080.0	0.0
Cyclones/ hurricanes/ typhoons	87	Mill $	90.7	2,431.0	447.8	6,009.6	0.0	279.5	658.1	841.1	100.0	0.0	9,389.5	2.7	621.4	0.0
Earthquekes	88	Mill $	19.5	21.1	0.0	0.0	391.6	0.0	1,848.6	0.0	116.3	0.0	0.0	0.0	0.0	0.0
Landslides and avalanches	89	Mill $	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Extreme temperatures	90	Mill $	2.3	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Volcanic eruptions	91	Mill $	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drought	92	Mill $	0.0	100.0	2.0	193.0	0.0	100.0	36.4	210.0	0.0	0.0	0.0	0.0	0.0	0.0
Technological disasters	93	Mill $	0.0	45,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10,000.0	0.0	0.0	
Number of people afected due to natural and technological disaster events	94	No.	168,710	10,035	1,090,200	3,254,128	1,232,219	62,841	2,625,279	805,740	178,673	156,930	3,599,376	261,718	1,962,351	0
Floods	95	No.	154,411	10,035	0	0	1,232,189	0	0	223,680	0	19,348	7,000	4,530	1,612,500	
Cyclones/ hurricanes/ typhoons	95	No.	0	0	800,200	3,254,128	0	62,570	137,633	500,030	0	0	3,592,026	240,700	348,726	
Earthquekes	96	No.	14,299	0	0	0	0	0	1,590,550	0	178,603	0	0	16,470	0	
Landslides and avalanches	97	No.	0	0	0	0	0	0	0	0	0	0	0	0	0	
Extreme temperatures	97	No.	0	0	0	0	0	0	0	0	0	0	0	0	0	
Volcanic eruptions	98	No.	0	0	0	0	0	0	0	0	0	0	0	0	0	
Drought	99	No.	0	0	290,000	0	0	0	896,596	82,000	0	137,500	0	0	0	0
Technological disasters	100	No.					30	271	500	30	70	82	350	18	1,125	
Proportion of population in poverty	101	%	59.8	54.2	56.6	49.3	54.1	41.1	58.0	42.5	74.8	36.9	34.9	33.5		

	Nota	Unidades	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Employed Population below 1$ PPP per day	102	%	25.3					6.9	26.3	6.0	9.8	3.0				
Poverty gap coefficient	103	%	35.0	24.0		20.2	25.5	15.8	29.1	16.6	44.5	13.7	10.9	10.5		
Share of youth unemployed to youth population, both sexes	104	%	4.6	5.6	3.9	3.7	2.6	2.8	2.5	2.9	3.3	3.7	3.5			
ENVIRONMENT AND HUMAN HEALTH																
Infant mortality rate	104	* 1000 Inhab	43.0	35.5				29.4					22.8			
Life expectancy at birth females	105	Years	71.7	73.5				75.2					76.6			
Life expectancy at birth males	105	Years	65.6	67.9				70.1					71.3			
Calories availability	105	Kcal/daily per Inhab	2,929.6	2,937.4	2,926.0	2,942.4	2,972.6	2,936.5	2,951.8	2,943.8	2,959.2		2,933.7		2,923.3	
Reported Cases of Dengue	106	No.	0	103,871	90,310	70,317	215,701	59,328	32,603	80,246	58,541	58,726	102,950	85,903	131,603	157,597
Reported Cases of Malaria	106	No.	0	0	0	151,238	149,838	124,850	78,926	69,057	61,932	64,672	74,128	53,814	0	
Reported Cases of Cholera	106	No.	0	40,908	4,995	7,820	2,833	841	15	1	0	0	0	0	0	0
SOCIOECONOMICS TRENDS																
Total Population at midyear	107	1000	112,735.0					135,640.0	137,475.0	139,105.0	140,641.0	142,202.0	143,909.0	145,794.0	147,779.0	149,812.0
Average annual growth rate of population	108	%	2.0					1.8	1.3	1.2	1.1	1.1	1.2	1.3	1.4	1.4
Adult literacy rate, total	109	%	87.6					90.7	78.5	88.1		85.8	84.8	87.6	86.9	
Male	110	%	90.3					92.6	78.4	90.3		87.3	85.6	90.3	88.6	
Female	111	%	85.0					89.0	78.6	86.1		84.4	84.1	85.4	85.2	
School life expectancy	112	Year					11.7	11.9	12.0	12.0	12.3	12.5	12.6	12.2	12.3	12.1
Male	113	Year					11.8	12.0	12.0	12.1	12.4	12.4	12.4	12.1	12.1	12.8
Female	114	Year					11.6	11.9	12.0	12.0	12.3	12.7	12.8	12.3	12.5	12.0
Telephone lines	115	* 100 Inhab	5.2	7.6	9.0	9.6	10.6	11.1	11.1	11.3	12.1	13.3	14.0	14.7	17.4	
Cellular subscribers	116	* 100 Inhab	0.1	0.6	1.5	3.0	6.9	12.3	18.4	21.8	25.4	32.7	40.3	50.0		
Internet users	117	* 100 Inhab		0.1	0.6	1.1	1.7	4.2	6.2	9.2	10.4	11.7	14.4	9.8		
Size of vehicle fleet	118	No.	10,531,422	12,255,846	13,620,107	15,126,214	16,054,138	17,396,690	20,157,261	21,880,845	23,042,947	23,611,423	24,940,080	28,034,973	29,551,369	31,354,908
Energy use per capita	119	kt oil equivalent	1,236.6	1,265.5	1,272.9	1,248.3	1,266.3	1,220.4	1,230.8	1,253.0	1,287.8	1,285.9	1,277.2	1,280.4	1,291.4	1,314.0
Energy imports, net (% of energy use of commercial energy)	120	%	-46.9	-40.5	-45.6	-42.3	-37.1	-37.9	-38.2	-35.5	-38.6	-40.3				
Energy intensity of gross domestic product	121	1.000 Barrels / million constant dolar GNP	2.1	2.0	2.0	2.0	1.9	1.9	1.9	2.0	1.8	1.9	1.8	1.9	1.8	1.8
Renewable energy supply	122	kboe	114,815.3	123,837.3	128,005.8	128,244.7	132,436.8	136,413.4	135,988.2	134,256.0	162,017.2	174,341.1	184,308.3	191,407.4	186,409.5	212,513.8
Non-renewable energy supply	123	kboe	822,479.2	907,833.8	1,047,334.7	1,109,207.7	1,132,951.0	1,106,975.3	1,103,257.2	1,171,592.0	1,218,353.2	1,187,391.5	1,232,658.9	1,284,773.3	1,343,558.7	1,387,867.3
Combustible renewables and waste (% of total energy)	124	%	35.1	26.8	25.6	23.1	22.1	22.6	21.6	22.0	22.0	21.9				
Total primary energy production per capita	125	TJ / Inhab	0.1					0.1	0.1	0.1	0.1	0.1				
Total primary energy production, Geothermal	126	Tjoul	84,948.2				72,752.9	87,275.8	96,522.3	97,418.4	152,591.8	140,873.3	131,495.9	166,022.7	181,440.2	172,429.2
Total primary energy production, hydropower	127	Tjoul	310,140.6				188,976.8	198,848.1	169,917.8	155,539.9	272,050.6	328,661.9	353,503.2	381,855.0	352,594.9	
Total primary energy production, sugar cane bagasse	128	kboe		24,510.0			26,877.0	26,814.0	27,445.0	27,408.0	26,848.0	27,888.0	29,621.0	28,862.0	29,810.0	29,175.0
Total primary energy production, coal	129	metric tonS					10.4	11.4	11.7	11.0	6.6	9.6	10.4	11.1	12.1	11.1
Total primary energy production, natural gas	130	Mm³		45,709.0			61,195.9	49,211.6	46,382.4	55,014.0	57,741.4	62,770.7	65,906.3	73,476.5	78,985.0	85,577.0
Total primary energy production, firewood	131	kboe		91,166.0							98,836.0	98,913.0	102,999.8			
Total primary energy production, oil	131	1000 Barrels per day		958,710.0			1,069,207.0	1,109,950.0	1,149,063.0	1,168,646.0	1,252,044.0	1,245,525.0	1,223,400.0	1,194,179.0	1,131,883.0	1,065,976.0
Electricity Production	131	GWh	138,534.0	177,178.0	203,404.0	204,682.0	205,357.0	220,205.0	225,241.0	231,426.0	236,046.0	242,892.0	254,285.0	262,559.0	271,984.0	276,036.0
From coal sources	132	% of total	5.6	8.1	8.6	8.7	8.7	8.5	10.0	11.1	12.9	9.8	12.6			
From hydroelectric sources	132	% of total	25.4	21.9	19.9	17.8	22.1	20.8	17.8	16.3	14.1	16.3	16.7			
From gas sources	132	% of total	10.4	13.0	12.8	14.7	14.8	17.1	21.0	28.1	33.0	33.8	31.4			
From nuclear sources	133	% of total	2.1	4.8	5.1	4.5	4.7	3.6	3.7	4.0	4.2	3.6	4.0			
From oil sources	134	% of total	51.8	48.0	49.9	50.3	45.8	45.9	43.5	36.7	30.7	31.5	30.1			
Gross domestic income per habitant (Atlas method)	135	$	12,470.0	16,840.0	18,020.0	18,740.0	19,530.0	21,030.0	21,660.0	22,460.0	23,840.0	25,660.0	27,140.0	29,020.0		

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Gross domestic product, annual growth	136	%		-5.3	6.4	5.0	3.7	6.0	0.1	1.0	1.6	4.0	3.3	4.9	3.5	
Agriculture, value added	137	% of GDP	5.6	5.5	5.1	5.0	4.9	4.7	4.9	4.9	5.0	4.9	4.8	4.7	4.7	
Industry, value added	138	% of GDP	32.0	30.7	32.5	32.8	32.7	32.4	31.4	31.2	30.9	30.8	30.6	30.6	30.1	
Service, value added	139	% of GDP	59.7	61.2	59.9	59.7	59.8	60.2	61.1	61.7	62.2	62.6	63.3	63.7	64.5	
Exports of goods and services	140	% of GDP	20.2	31.4	31.3	31.6	31.5	31.8	28.5	27.8	28.7	30.4	31.0			
Imports of goods and services	141	% of GDP	21.7	29.7	32.0	34.3	33.7	34.3	31.4	30.4	31.2	33.4	33.6			
Total Debt Service (% of GNP)	142	% of GDP	4.6	9.1	10.3	6.9	7.2	9.7	7.5	6.7	6.5	7.3	5.9			
GDP public spent on education	143	% of GDP					4.4	4.8	5.1	5.2	5.7	5.4	5.5	3.5		
GDP expenditure on RD	144	% of GDP	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.4						
Physicians	145	No.	99,450	153,568	160,101	164,325	178,138	142,245	144,886	146,529	149,160	159,425	169,115	168,262	169,615	

Notas:

1 Includes information for all countries 1990-2007

2 Includes information for all countries 2002-2007

3 Includes information for all countries 1990,2000 and 2005-2007

4 Excluded due for lack of information: Belize (2000 and 2005)

5 Excluded due for lack of information: Belize (2005)

6 Includes information for all countries 1990,2005-2007

7 Includes information for all countries 2000 and 2005

8 Includes information for all countries 2000 and 2008

9 Includes information for all countries (2000)

10 Includes information for all countries for the years: 1990-2007

11 Excluded due for lack of information: Belize (1990-2007) and El Salvador (1990-2007)

12 Excluded due for lack of information: Belize (1990-2007), Honduras (1990-1994) and Nicaragua (1990-2007)

13 Includes information for all countries (1990-2004)

14 Excluded due for lack of information: El Salvador (1990-2003) and Panama (1990-1996)

15 Excluded due for lack of information for the following countries: El Salvador (1990-2004), Guatemala (2004), Honduras (1990-2004) and Panama (1990-2004)

16 Includes information for all countries (1990-2003)

17, 18 Excluded due for lack of information for the following countries: Costa Rica (1990-2003) and El Salvador (1990-2003)

19, 20 Excluded due for lack of information: El Salvador (1990-1994)

21, 22 Excluded due for lack of information: Belize (1990-1995), Costa Rica (1990-2003), El Salvador (1990-20003), Honduras (1990-1992) and Nicaragua (2000-2003)

23, 24 Excluded due for lack of information: El Salvador (1990-2003), Honduras (1990-1992) and Nicaragua (1990)

25 Includes information for all countries for the years: 2000,2002-2004,2006,2008

26 Includes information for all countries for the years: 2002-2004,2006,2008

27 Includes information for all countries for the years: 2000,2002-2004,2006 and 2008

28 Includes information for all countries for the years: 2002,2004,2006-2008

29 Includes information for all countries for the years: 2000,2002,2004,2006 and 2008

30, 31, 32 Includes information for the following countries: Belize (1990,2002 and 2004), Costa Rica (1990,2002 and 2004), El Salvador (1990,2002 and 2004), Guatemala (1990,2002 and 2004), Honduras (1990, 2002 and 2004), Mexico (1990,2002 and 2004), Nicaragua (1990,2002 and 2004) and Panama (1990, 2002 and 2003)

33, 34, 35 Includes information for the following countries: Belize (1990,2002 and 2004), Costa Rica (1990,2002 and 2004), El Salvador (1990,2002 and 2004), Guatemala (1990,2002), Honduras (1990, 2002 and 2004), Mexico (1990,2002 and 2004), Nicaragua (1990,2002 and 2004) and Panama (1990, 2002 and 2003)

36 Excluded due for lack of information: Belize (1992-2003)

37 Excluded due for lack of information: Belize (1991 and 1995-2006)

38 Excluded due for lack of information: Belize (1990,1994 y 1998-2003) and Nicaragua (2002-2004)

39 Includes information for the following countries: Belize (1995 and 2000), Costa Rica (1995 and 2000), El Salvador (1990 and 2000), Guatemala (2000), Honduras (2000), Mexico (2000), Nicaragua (2000) and Panama (2000)

40 Includes information for the following countries: Belize (1996 and 2000), Costa Rica (1995 and 2000), El Salvador (1990 and 2000), Guatemala (2000), Honduras (2000), Mexico (2000), Nicaragua (2000) and Panama (2000)

41 Excluded due for lack of information for the following countries: Belize (1990), Costa Rica (1990), Guatemala (1990), Honduras (1990), Mexico (2000), Nicaragua (2000) and Panama (2000)

42 Includes information for the following countries for the years: Belize (1996 and 2000), Costa Rica (1995 and 2000), El Salvador (1990 and 2000), Guatemala (2000), Honduras (2000), Mexico (2000), Nicaragua (2000) and Panama (2000)

43 Includes information for the following countries for the years: Belize (2002), Costa Rica (1995 and 2000), El Salvador (1990 and 2000), Guatemala (2000), Honduras (2000), Mexico (2000), Nicaragua (2000) and Panama (2000)

44 Includes information for the following countries for the years: Belize (1996 and 2000), Costa Rica (1995 and 2000), El Salvador (1990 and 2000), Guatemala (2000), Honduras (2000), Mexico (2000), Nicaragua (2000) and Panama (2000)

45, 46 Includes information for all countries: 1990-2006

47 Includes information for the following countries: Mexico (1994 and 1998-2006) and Nicaragua (1990-2006)

48 Includes information for the years 1996-2006

49 Includes information for all countries for the years: 1990,2000 and 2005

50 Includes information for all countries for the years: 1990-2004

51 Includes information for all countries for the years: 1990 and 2000-2004

52 Includes information for all countries for the years: 1990-2004

53 Excluded due for lack of information: Belize (1990-2004)

54 Excluded due for lack of information: Belize (1994,1995,1998,1999 and 2003-2006)

55 Includes information for the following countries: Belize (1994), Costa Rica (1990, 1996, 2000 and 2005), El Salvador (1994), Guatemala (1990), Mexico (1990, 1992, 1994, 1996, 1998, 2000 and 2002) and Panama (1994)

56 includes information for the years 1990-2007

57 Includes information for the following countries: Belize (1995-2005), Costa Rica (1991 and 2006), El Salvador (1999 and 2003), Mexico (1990-2006) and Panama (1995-2006)

58 Includes information for the following countries: Belize (1995 and 2006), Costa Rica (1991-1997 and 1999-2006), El Salvador (1999 and 2003), Guatemala (1990-2006), Mexico (1990-2006) and Panama (1995-2006)

59 Include information for the following countries: Belize (1995-2001, 2005 y 2006), Costa Rica (1991,1992,1994 and 1996-2006), Mexico (1990-2006) and Panama (1995-2006)

60 Includes information for the following countries: Costa Rica (1990, 1991 and 1994-2006), Guatemala (2005 and 2006), Mexico (1991-2006) and Panama (1994-2006)

61 Includes information for all countries for the years: 1990 and 2000-2008

62 Excluded due for lack of information Belize (1990,1995,2000 and 2005)

63 Excluded due for lack information Belize (1990,2000 and 2005)

64 Excluded due for lack information Belize (1990,1995,2000 and 2005)

65 Excluded due for lack information Belize (1990,2000 and 2005)

66 Excluded due for lack information Belize (1990,1995,2000 and 2005)

67 Excluded due for lack of information for the following countries: Belize (1990,1995,2000 and 2005), Costa Rica (2000 and 2005), El Salvador (1995 and 2000) and Panama (2000 and 2005)

68 Excluded due for lack information Belize (1990,1995,2000 and 2005)

69 Includes information for the following countries: Costa Rica (2000 and 2005), El Salvador (1995, 2000 and 2005), Mexico (1990, 1995, 2000 and 2005) and Panama (2000 and 2005)

70 Includes information for the years 1990-1995,2000,2005

71 Includes information for Mexico (1990,1995,2000 and 2005)

72 Includes information for all countries 1990-2005

73 Includes information for the following countries: Belize (1995-2005), Costa Rica (1990-2004), El Salvador (1990-2000), Guatemala (1990-2000), Honduras (1990-2000), Mexico (1990-2000 and 2002-2005) and Panama (1990-2000)

74 Includes information for the following countries: Belize (1997-2003), El Salvador (1998 and 2000) and Mexico (1993-2003)

75 Includes information for the following countries: Belize (1997-2003), El Salvador (1998 and 2000) and Mexico (1992-2003)

76 Includes information for the following coutries: Belize (1997-2003, Guatemala (1994 and 2002) and Panama (2000)

77 Includes information for the following countries: Belize (1997-2003), El Salvador (2002), Guatemala (1994 and 2002) and Panama (2000)

78 Includes information for all countries: (1990-2007)

79 Excluded due for lack of information: Belize (1990-2007)

80 Excluded due for lack of information: Belize (1990-2007) and Panama (1990-2007)

81 Includes information for the years (1990-1995 and 1997-2007: Belize, El Salvador, Guatemala, Mexico

82 Excluded due for lack of information for the following countries: Belize (1990-2008), Costa Rica (2004), El Salvador (2004), Guatemala (2000), Honduras (1990-2008), Mexico (2004), Nicaragua (2004) and Panama (1990-2008)

83 Includes information for the years (1990-2008)

84 Includes information for all countries (1990-2008)

85 Includes information for all countries (1990-2007)

86 Includes information for the following countries: Belize (1995,1998,2000 and 2007), Costa Rica (1990,1991-1993,1996,1998,2002 and 2007), El Salvador (1991,1992,1995,1998-2006), Guatemala (1992,1995,1998,1999,2001,2002 and 2005), Honduras (1990,1993,1996,1998-2005), Mexico (1991,1993,1999,2000,2002,2003 and 2005-2007), Nicaragua (1990,1992-1994,1997-1999,2001 and 2007) and Panama (1991,1998,2002,2004-2006)

87 Includes information for the following countries: Belize (1995), Costa Rica (1991,1993,1996,2002 and 2007), EL Salvador (1992), Guatemala (1995,1999 and 2002), Honduras (1990,1993,1996 and 1999), Mexico (1993,1999 and 2007), NIcaragua (1990 and 1999) and Panama (1991,2002 and 2004-2006)

88 Includes information for the following countries: Belize (1998, 2000, 2001 and 2007), Costa Rica (1996 and 1998), El Salvador (1998 and 2005), Guatemala (1998, 2001 and 2005), Honduras (1998, 2001 and 2005), Mexico (1997, 2002 and 2005-2007), Nicaragua (1993,1998,2001 and 2007) and Panama (1998)

89 Includes information for the following countries: Costa Rica (1990), El Salvador (2001 and 2006), Guatemala (1991), Mexico (2003) and Panama (1991)

90, 91 Includes data from 2008 are preliminary figures quoted by the source

92 Includes information for the following countries: Guatemala (1992), Nicaragua(1992)

93 Includes information for the following countries: El Salvador (2001), Guatemala (2001), Honduras (2001, 2002 and 2004) and Nicaragua (1994, 1997 and 2001)

94 Includes information for the following countries : El Salvador (1992,1999,2000,2002 and 2004), Honduras (2002 and 2003-2005), Mexico (1991,1993,1999 and 2000), Nicaragua (2000) and Panamá (2006 and 2007)

95 Includes information for the following countries: Costa Rica (1990,2000,2001 and 2003), El Salvador (2000 and 2002), Guatemala(2000 and 2002), Honduras (1990-2003), Mexico (2000,2002 and 2004), Nicaragua (2001) and Panama (2000,2002 and 2003)

96 Excluded due for lack of information for the following countries: Belize (1990 and 2000-2005), Costa Rica (2002), El Salvador (1990,2000,2001 and 2005), Guatemala (1990 and 2000-2005), Mexico (1990), Nicaragua (1990,2002,2004 and 2005) and Panama (1990 and 2001)

97 Includes information for all countries: 1990, 2000 and 2005

98 Includes information for all countries for the years: 1990,2000,2005 and 2007

99 Includes information for all countries for the years: 1990-2008

100 Excluded due for lack of information: Belize (1996)

101 Includes data from 2008 are preliminary figures quoted by the source

102 Includes information for all countries for the years: 1990,2000-2008

103 Includes information for the following countries: Belize (1992-1999), Costa Rica (1992-1997), El Salvador (1991-1996 and 1998-2000), Guatemala (1991-2002), Honduras (1991-2001), Mexico (1991-2001), Nicaragua (1991-2000) and Panama (1991-2000)

104 Includes information for all countries for the years: 1990,2000-2002 and 2004-2007

105 Includes information for the following countries: Costa Rica (2000), El Salvador (2004), Guatemala (2002), Honduras (2001), Mexico (1990, 2000, 2002-2004 and 2005), Nicaragua (2001) and Panama (1990 and 2000)

106 Includes information for the following countries: Belize (2003 and 2004), Costa Rica (1999-2005), El Salvador (1999-2006), Guatemala (2002, 2003 and 2006), Honduras (2004), Mexico (1999-2006), Nicaragua (2001-2003) and Panama (1999-2006)

107 Excluded due for lack of information: Guatemala (2006), Panama (2006)

108 Excluded due for lack of information the following countries: Belize (1990), Costa Rica (1990), El Salvador (1990), Guatemala (1990 and 2006), Honduras (1990), Nicaragua (1990) and Panama (1990 and 2006)

109 Excluded due for lack of information: El Salvador (2006) and Honduras (2006)

110 Excluded due for lack of information: Belize (1990 and 2000-2004)

111 Excluded due for lack of information: Belize (1990-2004)

112 Excluded due for lack of information: Belize (1990-2006)

113 Includes information for the following countries: El Salvador (1990-1996 and 2000), Mexico (1996,1997,1999,2000 and 2002) and Panama (1990-2003)

114 Excluded due for lack of information: Belize (1990-2004)

115 Excluded due for lack of information: Belize (1990 and 2000-2006)

116 Includes information for the following countries: El Salvador (1990,1999-2008), Mexico (1990,1999-2008), Nicaragua (1990,1999-2008)

117 Exluded due for lack of information: Belize (1990)

118 Excluded due for lack of information: Belize (1995 and 2003-2005)

119 Includes information for Mexico (1999-2008)

120 Includes information for the following countries: Guatemala (1995) and Mexico (1995, 1999-2008)

121 Excluded due for lack of information: Belize (1995 and 2003-2005)

122 Includes information for the following countries: Guatemala (1995,1999-2008) and Mexico (1995,1999-2008)

123 Excluded due for lack of information: Belize (1990-2008)

124 Includes information for the following countries: Guatemala (1990-2005) and Honduras (1990-2005)

125 Excluded due for lack of information: Belize (1990-2005)

126, 127 Includes information for Mexico (1990-2005)

128 Excluded due for lack of information: Belize (1990-2005)

129 Includes information for all countries for the years 1990-2006

130 Includes information for all countries for the years 1995-2007

131 Includes information for all countries for the years 1990-2007

132 Include information for all countries for the years 1990-2005

133 Includes information for the following countries: Belize (1991 and 1999-2004), Costa Rica (1991, 1999-2003 and 2006), El Salvador (1991, 1999-2003, 2005 and 2006), Guatemala (1991), Honduras (1991), Mexico (1991 and 1999-2003), Nicaragua (1991 and 1999-2003) and Panama (1991 and 1999-2004)

134 Includes information for the following countries: Belize (2002), Costa Rica (2002), El Salvador (2002), Guatemala (2002), Honduras (2002), Mexico (2002), Nicaragua (2002) and Panama (2002)

135 Includes information for the following countries: Belize (2002), Costa Rica (2003), El Salvador (2005), Guatemala (2005), Honduras (2006), Mexico (2004), Nicaragua (2006) and Panama (2004)

136 Includes information for the following countries: Belize (1990 and 2000), Costa Rica (1990 and 2000), El Salvador (1990, 2000, 2002 and 2007), Guatemala (1990), Honduras (1990 and 2000), Mexico (1990 and 2000-2003), Nicaragua (1990) and Panama (1990 and 2000)

137, 138, 139 Includes information for the years 1990-2007

140, 141, 142 Includes information for the years 1990-2005

143 Includes information for the years 1999-2005

144 Includes information for the years 1990-2002

145 Includes information for the years 1990-2007

South America

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
LAND																
Land area	1	1000 ha	1,759,100.0	1,759,100.0	1,759,100.0	1,759,100.0	1,759,100.0	1,759,100.0	1,759,100.0	1,759,100.0	1,759,100.0	1,759,100.0	1,759,100.0	1,759,100.0	1,759,100.0	
Arable land and permanent crops	2	1000 ha	109,673.0	118,079.0	118,597.0	119,052.0	119,496.0	119,887.0	121,143.0	120,965.0	121,257.0	123,749.0	124,079.0	124,867.6	125,790.0	
Arable land tillage	3	1000 ha	97,140.6	104,280.0	104,939.0	105,242.0	105,703.0	106,118.0	107,398.0	107,429.0	107,815.0	110,342.0	110,565.0	111,311.7	112,586.1	
Permanent Crops	4	1000 ha	12,532.0	13,799.0	13,658.0	13,810.0	13,793.0	13,769.0	13,653.0	13,451.0	13,342.0	13,407.0	13,514.0	13,555.9	13,203.9	
Non arable land and non permanent crops	5	1000 ha	1,649,427.0	1,641,021.0	1,640,503.0	1,640,048.0	1,639,604.0	1,639,213.0	1,637,957.0	1,638,135.0	1,637,843.0	1,635,351.0	1,635,021.0	1,634,232.4	1,633,310.0	
Permanent meadows and pastures		1000 ha	446,129.0	455,133.0	456,643.0	457,635.0	458,481.0	458,139.0	454,117.0	454,007.0	453,097.5	454,153.5	454,513.8	454,293.8	454,395.0	
Arable land and permanent crops per capita	6	ha/ 100 Inhab	36.9	36.5	35.5	35.1	34.7	34.3	34.2	33.7	33.3	33.5	33.2	32.9	32.7	
Farming Area	7	1000 ha	555,802.0	573,212.0	575,240.0	576,687.0	577,977.0	578,026.0	573,531.0	573,050.0	573,168.5	576,782.5	577,474.8	578,043.4	579,067.0	
Irrigated farming area	8	1000 ha	9,499.0	10,086.0	10,254.0	10,390.0	10,417.0	10,489.0	10,489.0	1,999.0	672.0	717.0	752.0	930.0	1,757.0	
Fertilizer Consumption	9	kt								10,630.9	13,633.1	14,764.8	12,310.9	12,949.2	19,057.6	
Nitrogen	10	kt								3,658.0	4,519.0	4,498.7	4,043.9	4,292.6	8,411.5	
Phosphate	11	kt								3,459.4	4,635.3	5,200.2	4,090.7	4,356.4	5,594.8	
Potash	12	kt								3,513.5	4,478.9	5,065.9	4,176.3	4,300.1	5,051.4	
Fertilizer Consumption for arable land		Metric t per ha								0.1	0.1	0.1	0.1	0.1	0.2	
FOREST																
Forest area, total	13	1000 ha	890,818.0	871,806.8	864,202.3	860,400.0	856,597.8	852,795.5	848,544.4	844,293.2	840,042.1	835,790.9	831,539.8	827,288.7	823,037.5	
Plantations	14	1000 ha	8,231.0					10,575.0					11,357.0			
Natural Forest	15	1000 ha	882,587.0					842,221.0					820,183.0			
Proportion of land area covered by forest	16	%	50.2					48.5	48.2	48.0	47.8	47.5	47.3	47.0	46.8	
Annual average change in Forest Area	17	%						-0.4					-0.5			
Forest area under Forest Management Plans FRA (Forest Resource Assessment)	18	1000 ha						25,809.0								25,809.0
Proportion of forest area under Forest Management Plans FRA	19	%														
Roundwood production	20	1000 m³	271,089.6	307,170.9	304,388.7	305,765.6	325,558.0	331,333.9	319,409.8	327,231.6	356,310.6	351,978.0	369,389.5	352,732.9	366,114.9	
Industrial roundwood production	21	1000 m³	109,869.7	133,552.7	128,663.8	129,058.4	142,909.0	145,313.0	132,797.1	140,021.7	167,106.9	160,720.2	175,854.1	160,401.6	171,759.0	
Fuelwood and charcoal production	22	1000 m³	161,219.8	173,618.2	175,724.9	176,707.2	182,649.0	186,020.9	186,612.7	187,209.9	189,203.8	206,920.1	205,529.1	203,639.6	206,192.0	
Wood-based panels production	23	1000 m³	4,142.8	5,730.3	7,330.3	6,807.8	7,834.6	8,697.3	9,142.7	9,944.5	11,459.1	13,050.1	13,083.7	14,175.7	14,577.1	
Paper and paperboard production	24	1000 m³	7,740.8	9,204.2	9,970.4	9,562.2	9,664.4	10,244.4	11,062.3	11,428.2	12,086.8	12,900.8	13,606.8	10,587.0	10,683.0	
BIODIVERSITY																
Protected area, number	25	No.	1,055	1,350	1,439	1,488	1,531	1,565	1,567	1,567	1,567	1,575				
Protected area, total area	26	1000 ha	132,751.9	168,862.4	185,001.8	187,952.2	188,047.1	188,095.1	188,810.4	188,810.4	188,810.5	189,403.8				
Strict nature reserves / Wilderness areas, number	27	No.	194	207	215	215	215	215	214	214	214					
Strict nature reserves / Wilderness areas, total area	28	1000 ha	8,424.6	8,678.0	8,935.5	8,935.5	8,935.5	8,935.5	8,926.2	8,926.2	8,926.2	9,050.5				
National parks, number	29	No.	298	351	361	365	368	368	369	369	369					
National parks, total area	30	1000 ha	49,932.1	60,948.8	62,631.6	63,750.6	63,840.0	63,840.0	63,855.0	63,855.0	63,855.0					
Natural monuments, number	31	No.	48	74	74	74	74	74	75	75	75					
Natural monuments, total area	32	1000 ha	2,486.5	8,670.5	8,670.5	8,651.8	8,651.8	8,651.8	8,652.3	8,652.3	8,652.3					
Habitat / Species management area, number	33	No.	133	206	261	305	345	379	380	380	380					
Habitat / Species management area, total area	34	1000 ha	9,311.9	9,799.5	10,027.4	10,214.6	10,220.1	10,268.1	10,277.4	10,277.4	10,277.4					
Protected landscapes and seascapes, number	35	No.	191	224	226	226	226	226	226	226	226					
Protected landscapes and seascapes, total area	36	1000 ha	17,184.0	19,458.4	19,470.9	19,470.9	19,470.9	19,470.9	19,470.9	19,470.9	19,470.9					
Managed resource protected area, number	37	No.	191	288	302	303	303	303	303	303	303					
Managed resource protected area, total area	38	1000 ha	45,190.7	60,902.6	61,342.2	61,342.2	61,342.2	61,342.2	61,342.2	61,342.2	61,342.2					
Total Number of threatened species	39	No.						2,339		2,427	3,346	4,900		5,043		5,282
Number of threatened species. Annual Change Rate.		%								1.9	37.9	46.4		1.4		2.3
Number of threatened mammal species	40	No.						338		358	348	351		336		375
Number of threatened bird species	41	No.						476		483	482	565		566		572
Number of threatened reptile species	42	No.						95		96	96	97		97		97
Number of threatened amphibian species	43	No.						16		16		627		631		678
Number of threatened fish species	44	No.						40		44		174		294		354
Number of threatened molluscs species	45	No.								44		69		69		69
Number of threatened invertebrate species	46	No.						72		30		29		39		117
Number of threatened plant species	47	No.						1,312		1,356		2,988		3,011		3,020

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
FRESHWATER																
Proportion of population with access to drinking water services	48	%	84.3	86.7				89.1		88.3		90.2				
Proportion of population with access to drinking water services, rural	49	%	58.0	61.1				63.7								
Proportion of population with access to drinking water services, urban	50	%	93.8	94.4				95.3								
Proportion of population with access to sanitation services	51	%	71.6	74.2				76.0		75.0		77.4				
Proportion of population with access to sanitation services, rural	52	%	38.2	41.7				44.7								
Proportion of population with access to sanitation services, urban	53	%	83.0	83.6				84.3								
Total freshwater fish production	54	kt	318.5	427.3	441.1	461.8	505.1	537.8	572.8	632.0	637.9	672.6	663.1	686.7		
Freshwater fish production, catch	55	kt	294.7	365.6	330.5	336.2	347.3	349.7	371.7	398.8	402.1	426.2	417.2	430.2		
Freshwater fish production, aquaculture	56	kt	23.8	61.7	110.6	125.5	157.8	188.1	201.2	233.1	235.8	246.4	245.9	256.5		
Proportion of total water resources used	57	%	1.0	1.3				1.2								
Total withdrawal extraction	58	1000 Km³	20,460.0	100,470.0				164,410.0								
Withdrawal extraction per capita	59	m3 /Inhab	68.8	310.7				471.0								
Agricultural withdrawals extraction	60	%	87.1	68.6				68.2								
Industrial withdrawals extraction	61	%	6.7	13.3				12.6								
Domestic withdrawals extraction	62	%	6.2	18.1				19.3								
COASTAL AND MARINE AREAS																
Total marine fish production	63	kt	13,612.9	18,935.7	16,561.2	10,020.6	15,793.6	17,251.8	14,200.5	15,285.0	11,967.4	16,728.9	15,958.1	13,698.9		
Total marine fish production, catch	64	kt	13,487.7	18,763.9	16,304.7	9,784.5	15,724.5	17,172.4	14,137.4	15,206.2	11,857.4	16,629.8	15,868.6	13,606.6		
Total marine fish production, aquaculture	65	kt	125.2	171.8	256.5	236.1	69.1	79.4	63.0	78.8	110.0	99.0	89.5	92.3		
Marine protected areas	66	1000 ha	18,971.4	21,259.4	21,273.4	21,273.4	21,273.4	21,371.6	21,371.6	21,371.6	21,371.6	21,371.6	21,371.6	21,371.6		
Mangroves, total area	67	1000 ha	2,073.3					1,995.6					1,977.9			
ATMOSPHERE																
CO2 Emissions	68	kt	159,238.0	194,785.0	216,136.0	224,302.0	226,819.0	221,078.0	220,658.0	209,903.0	214,714.0	230,310.0				
CO2 Emissions per capita	69	t /Inhab	0.5	0.6	0.6	0.7	0.7	0.6	0.6	0.6	0.6	0.6				
CO2 Emissions per $1 GDP (PPP)	70	t/Mill US$ 2000 PPP	80.0	80.4	82.9	85.3	87.5	82.7	81.9	78.1	78.2	78.4				
From gas fuels	72	kt	29,323.0	36,928.0	43,571.0	48,687.0	50,014.0	46,052.0	48,679.0	47,935.0	49,908.0	54,653.0				
From liquid fuels	73	kt	98,373.0	121,905.0	133,397.0	137,429.0	139,728.0	135,373.0	134,940.0	126,388.0	128,625.0	137,368.0				
From solid fuels	74	kt	19,691.0	22,246.0	24,646.0	24,819.0	24,373.0	24,436.0	22,976.0	21,774.0	22,783.0	23,786.0				
Emissions of particles	75	kt	102.7	87.8	96.6	97.6	98.8	96.1	93.3	89.4	94.2	134.0				
Emissions of sulphur oxides (SO2)	76	kt				1,962.2	1,900.3				1,699.6	1,988.0	2,070.3	2,182.9		
Emissions of nitrogen oxides (NOx)	77	kt				5,218.0	5,232.5				5,264.5	5,581.7	6,024.8	6,045.6		
Emissions of hydrocarbon (HC)	78	kt				1,763.7	894.7				988.8	1,007.7	1,180.6	1,174.6		
Emissions of carbon monoxide (CO)	79	kt				16,703.9	13,370.7				15,095.8	14,439.5	13,056.9	16,705.7		
Emissions of methane, total	80	kt	16,521.4	869.9	928.6	1,703.6		706.0								
From energy	81	kt	1,104.0	392.4	410.8	476.9		38.6								
From agriculture	82	kt	12,348.5	344.0	364.8	862.3		516.4								
From other sources	83	kt	3,068.9	131.4	153.0	364.4		151.1								
Consumption of ozone-depleting substances, total	84	ODP tn	18,623.4	26,963.4	23,159.4	21,562.7	22,313.5	19,657.1	17,015.5	10,355.7	10,991.9	11,062.9	8,232.8	8,115.7	4,116.3	
Consumption of ozone-depleting substances, Chlorofluorocarbons (CFCs)	85	ODP tn	18,131.4	24,909.6	21,018.8	19,316.1	20,553.8	17,088.0	14,462.0	8,693.8	8,968.3	8,744.5	5,929.1	5,993.0	1,087.5	
Consumption of ozone-depleting substances, Hydrochlorofluorocarbons (HCFCs)	86	ODP tn	290.5	669.2	687.2	747.7	759.4	1,253.5	1,287.8	1,029.8	1,168.5	1,490.6	1,429.7	1,529.7	2,432.5	
Consumption of ozone-depleting substances, Methyl bromide	87	ODP tn	201.5	1,384.6	1,453.4	1,498.9	1,000.3	1,315.6	1,265.7	632.1	855.1	827.8	874.0	593.0	596.3	
HUMAN SETTLEMENT																
Population density	88	Inhab/km	16.7	18.1	18.7	19.0	19.3	19.6	19.9	20.2	20.4	20.7	21.0	21.3	21.6	21.8
Urban population	89	1000	221,109.0	249,443.0				278,617.0					306,205.0			

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Percent of population living in urban areas	90	%	74.4	77.1				79.8					81.8			
Annual growth rates of the urban population	91	%	5.8	2.4				2.2					1.9			
Rural population		1000	76,136.0	73,952.0				70,448.0					68,019.0			
Percent of population living in rural areas		%	25.6	22.9				20.2					18.2			
Annual growth rates of the rural population		%	-0.3	-0.6				-1.0					-0.7			
Number of cities with more than 750,000 inhabitants	92	No.	42	43				43					43			
Population of urban aglomerations comprising 750.000 or more inhabitants	93	%	23.8	24.9				25.6					26.7			
Number of cities with population between 500.000 and 1 million	94	No.	22	27				32					33			
Population of urban aglomerations with population between 500.000 and 1 million	95	%	6.6	7.5				8.3					8.1			
Number of cities with population between 1 and 5 million	96	No.	27	27				27					29			
Population of urban aglomerations with population between 1 and 5 million	97	%	24.2	22.4				20.9					20.8			
Number of cities with population between 5 and 10 million	98	No.	2	2				3					4			
Population of urban aglomerations with population between 5 and 10 million	99	%	7.2	5.0				7.0					8.9			
Number of cities greater than 10 million population	100	No.	2	3				3					3			
Population of urban aglomerations comprising 10 million or more inhabitants	101	%	11.8	15.5				14.9					14.4			
Proportion of urban population living in slums	102	%	38.8										34.2			
Roads total network	103	Km												2,627,763.0		2,627,763.0
DISASTERS AND VULNERABILITY																
Number of natural and technological disaster events	108	No.	36	41	38	39	34	67	55	64	45	51	51	45	46	7
Floods	109	No.	16	15	19	17	7	26	23	23	19	15	13	23	19	6
Cyclones/ hurricanes/ typhoons	110	No.	0	1	5	1	2	3	5	5	1	2	5	0	0	0
Earthquakes	111	No.	2	6	2	2	3	1	3	1	0	2	3	0	5	0
Landslides and avalanches	112	No.	1	4	1	4	4	5	3	4	2	1	0	0	1	0
Extreme temperatures	113	No.	0	2	0	0	0	6	2	2	1	6	0	0	5	0
Volcanic eruptions	114	No.	1	0	0	0	1	0	1	2	1	0	1	5	1	1
Drought		No.	2	0	1	2	1	2	1	3	1	1	4	1	1	1
Technological disasters	116	No.	14	13	10	13	16	24	17	24	20	24	25	16	14	
Estimated damages due to natural and technological disaster events	117	Mill $	37.0	15,014.7	386.1	8,423.0	5,139.9	665.0	6,250.9	50,355.0	1,148.2	654.4	2,181.2	356.8	2,400.0	545.0
Floods	118	Mill $	0.0	3.0	257.1	1,394.0	3,160.0	330.0	924.9	319.0	1,028.2	304.4	526.1	206.8	300.0	545.0
Cyclones/ hurricanes/ typhoons	119	Mill $	0.0	0.0	0.0	0.0	0.5	0.0	15.0	25.0	0.0	350.0	0.0	0.0	0.0	0.0
Earthquekes	120	Mill $	1.0	1.7	129.0	0.0	1,857.4	0.0	300.0	0.0	0.0	0.0	5.1	0.0	2,100.0	0.0
Landslides and avalanches	121	Mill $	0.0	0.0	0.0	0.0	0.0	75.0	0.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0
Extreme temperatures	122	Mill $	0.0	10.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Volcanic eruptions	123	Mill $	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	0.0	150.0	0.0	0.0
Drought	124	Mill $	36.0	0.0	0.0	29.0	122.0	250.0	0.0	0.0	120.0	0.0	1,650.0	0.0	0.0	0.0
Technological disasters	125	Mill $	0.0	15,000.0	0.0	7,000.0	0.0	0.0	5,000.0	50,000.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of people afected due to natural and technological disaster events	126	No.	2,499,160	300,500	1,777,421	10,470,508	1,396,090	487,367	1,962,249	420,805	2,771,175	2,731,256	830,269	861,951	5,274,651	5
Floods	127	No.	15,000	275,000	1,082,621	369,300	150,040	486,707	612,250	278,455	380,474	531,482	749,381	561,293	2,884,083	
Cyclones/ hurricanes/ typhoons	128	No.	1,000	0	0	0	0	0	0	14,000	0	560	0	0	0	
Earthquekes	129	No.	0	0	53,115	0	1,205,933	0	349,978	0	0	0	27,645	0	505,110	
Landslides and avalanches	130	No.	0	0	0	0	0	0	0	0	0	1,200	0	0	0	
Extreme temperatures	131	No.	0	25,000	0	0	0	0	0	0	1,839,888	2,139,467	0	0	884,572	
Volcanic eruptions	132	No.	0	0	200	0	0	0	0	128,150	0	0	0	300,013	0	
Drought	133	No.	2,483,160	0	641,200	10,100,000	40,000	0	1,000,000	0	0	55,000	52,990	0	1,000,000	
Technological disasters	134	No.		500	285	1,208	117	660	21	200	550,813	3,547	253	645	886	5
Proportion of population in poverty		%	46.4		50.3	21.7	43.3	30.7	40.3	51.6	40.1	43.1	40.0	33.4		

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Employed Population below 1$ PPP per day	135	%	12.3					10.4	7.3	15.6	8.2	7.4				
Poverty gap coefficient	136	%	19.9		20.8	7.5	18.8	7.0	17.7	22.7	6.3	26.0	16.3	12.7		
Share of unemployed youth to youth population, both sexes	137	%	5.8	7.3	9.5	11.0	12.2	10.1	11.1	11.4	12.0	11.1	9.5			
ENVIRONMENT AND HUMAN HEALTH																
Infant mortality rate	138	* 1000 Inhab	46.1	37.2				30.7					24.6			
Life expectancy at birth females	139	Years	70.4	72.3				73.9					75.3			
Life expectancy at birth males	140	Years	63.7	65.2				66.9					68.3			
Calories availability	141	Kcal/daily per Inhab	2,608.0	2,778.1	2,809.5	2,820.0	2,846.8	2,851.4	2,856.1	2,853.2	389,792.0	201,443.0	307,244.0	459,500.0	738,402.0	703,041.0
Reported Cases of Dengue	142	No.	0	213,415	308,491	633,337	252,155	327,032	575,706	903,535	436,443	167,774	299,309	448,565	724,741	
Reported Cases of Malaria	144	No.	0	0	0	1,100,225	1,074,872	1,003,062	864,141	817,587	869,579	805,273	947,212	826,387	0	
Reported Cases of Cholera	145	No.	0	34,757	12,924	49,474	6,841	1,853	510	16	25	28	5	0	0	0
SOCIOECONOMICS TRENDS																
Total Population at midyear	146	1000	297,246.0					349,063.0	354,137.0	359,193.0	364,228.0	369,239.0	374,222.0	379,192.0	384,152.0	389,080.0
Average annual growth rate of population	147	%	2.0					1.6	1.4	1.4	1.4	1.4	1.3	1.3	1.3	1.3
Adult literacy rate, total	148	%	89.3					86.4	93.9	95.7		90.4	90.4	92.1	92.7	
Male	149	%	90.6					86.2	94.9	95.8		92.2	93.2	93.4	94.2	
Female	150	%	88.0					86.5	93.0	95.6		88.7	87.7	90.9	91.3	
School life expectancy	151	Year					13.7	13.7	14.0	14.0	13.6	13.3	13.6	14.1	13.8	13.0
Male	152	Year					13.4	13.4	13.7	13.7	13.2	13.3	13.3	13.4	13.6	12.6
Female	153	Year					14.0	14.1	14.4	14.3	13.9	13.6	13.7	14.5	14.0	13.4
Telephone lines	154	* 100 Inhab	5.9	9.3	11.6	12.3	13.1	14.2	15.3	15.4	16.4	17.2	18.8	16.1	16.6	
Cellular subscribers	155	* 100 Inhab	0.1	0.9	3.1	4.9	8.6	12.8	15.8	18.6	23.3	32.6	45.9	63.8		
Internet users	156	* 100 Inhab		0.1	0.6	1.3	2.3	3.9	5.7	8.1	10.0	11.9	15.7	17.0		
Size of vehicle fleet		No.	23,853,620	33,718,882	36,700,690	39,326,389	41,098,246	38,753,275	41,740,660	44,705,032	47,529,727	51,693,083	54,370,467	66,143,445	64,157,844	70,731,662
Energy use per capita	157	kt oil equivalent	966.5	969.5	991.4	985.0	1,037.0	1,046.3	1,085.7	1,107.1	1,128.9	1,121.1	1,121.3	1,099.2	1,088.3	1,081.4
Energy imports, net (% of energy use of commercial energy)	158	%	-35.5	-42.8	-49.5	-47.9	-44.1	-47.0	-48.7	-46.6	-43.8	-44.5				
Energy intensity of gross domestic product	159	1.000 Barrels / million constant dolar GNP	2.4	2.4	2.3	2.3	2.4	2.3	2.3	2.3	2.2	2.2	2.2	2.1	2.0	2.0
Renewable energy supply	160	kboe	659,810.9	730,220.3	748,471.5	737,069.3	773,429.9	767,134.4	770,242.3	809,527.8	863,263.4	886,070.8	919,013.3	950,221.4	1,015,543.9	1,053,204.9
Non-renewable energy supply		kboe	1,511,426.2	1,797,011.6	2,069,195.3	2,124,611.7	2,164,311.2	2,173,644.8	2,125,886.5	2,084,819.2	2,140,996.0	2,304,784.9	2,399,911.7	2,415,063.9	2,470,361.3	2,560,598.6
Combustible renewables and waste (% of total energy)	161	%	16.0	14.3	12.4	12.2	12.2	11.9	12.3	12.3	12.2	10.9				
Total primary energy production per capita	162	TJ / Inhab	0.1					0.1	0.1	0.1	0.1	0.1				
Total primary energy production, Geothermal	163	Tjoul														
Total primary energy production, hydropower	164	Tjoul	1,827,278.0				1,979,585.4	2,048,483.1	1,942,242.3	2,063,180.4	2,118,857.2	2,194,638.4	2,382,312.6	2,403,185.7	2,493,875.4	
Total primary energy production, sugar cane bagasse	165	kboe		267,159.0			206,670.0	173,747.0	194,966.0	211,377.0	233,524.0	238,187.0	252,753.0	284,200.0	323,836.0	350,686.0
Total primary energy production, coal	166	metric tons					45.0	52.1	56.3	51.8	61.1	65.4	71.7	79.1	83.2	86.6
Total primary energy production, natural gas	167	Mm³		86,213.0			105,361.7	114,723.2	114,825.5	116,224.0	117,392.5	128,297.7	144,101.5	142,865.4	134,708.8	139,639.0
Total primary energy production, firewood	168	kboe		267,159.0							275,132.0	286,688.0	292,487.5			
Total primary energy production, oil	169	1000 Barrels per day		1,962,336.0			2,265,630.0	2,309,992.0	2,299,121.0	2,242,936.0	2,100,259.0	2,283,402.0	2,484,390.0	2,496,226.0	2,420,719.0	2,465,233.0
Electricity Production	170	GWh	444,794.0	563,078.0	627,364.0	651,732.0	673,219.0	704,933.0	687,297.0	704,761.0	740,861.0	784,662.0	818,892.0	864,749.0	901,656.0	921,424.0
From coal sources	171	% of total	3.4	3.1	3.8	3.7	4.1	3.6	3.2	2.9	2.9	3.2	3.1			
From hydroelectric sources	172	% of total	78.8	80.2	78.7	77.6	75.3	75.9	73.0	74.3	73.7	72.1	73.4			
From gas sources	173	% of total	9.3	9.6	10.1	10.9	11.7	12.5	14.1	13.5	13.9	15.1	14.4			
From nuclear sources	174	% of total	2.1	1.7	1.8	1.6	1.7	1.7	3.1	2.8	2.8	2.5	2.1			
From oil sources	175	% of total	5.2	4.1	4.1	4.7	5.6	4.7	5.0	4.5	4.6	4.9	4.8			
Gross domestic income per habitant (atlas method)	176	$	19,060.0	33,980.0	40,800.0	40,660.0	37,470.0	37,310.0	35,450.0	30,280.0	29,520.0	33,050.0	38,760.0	44,930.0		

	Notes	Units	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Gross domestic product, annual growth	177	%		3.0	4.9	1.2	-1.6	2.8	0.4	-1.3	2.4	7.1	5.3	5.6	6.5	
Agriculture, value added	178	% of GDP	5.5	5.3	5.0	5.2	5.5	5.4	5.6	5.9	6.1	5.8	5.7	5.6	5.5	
Industry, value added	179	% of GDP	26.6	26.1	26.2	25.8	24.9	24.8	24.5	23.9	24.2	24.8	24.6	24.6	24.4	
Service, value added	180	% of GDP	61.5	59.1	59.1	59.6	60.4	60.4	60.4	61.2	61.0	60.3	60.5	60.6	60.6	
Exports of goods and services	181	% of GDP	21.9	17.3	17.7	15.9	16.9	19.6	18.6	26.6	27.0	28.7	29.7			
Imports of goods and services	182	% of GDP	14.3	17.8	18.9	19.3	17.0	17.6	17.9	19.0	19.6	21.6	22.5			
Total Debt Service (% of GNP)	183	% of GDP	7.4	4.8	6.6	6.3	7.8	7.9	6.8	7.6	10.4	8.2	6.5			
GDP public spent on education	184	% of GDP					4.0	4.1	4.1	3.9	3.9	3.9	3.7	3.6		
GDP expenditure on RD		% of GDP	0.5	0.8	0.4	0.3	0.4	0.6	0.7	0.7						
Physicians	187	No.	93,072	124,087	123,562	230,711	542,556	122,508	214,345	598,099	94,603	227,213	706,187	160,469	180,812	

Notes:

1,2,3,4,5 Includes information for all countries 1990-2005

6 Excluded due for lack of information Guyana (1990-2005)

7 Includes information for all countries 1990-2005

8 Includes information for all countries 1990-2002

9,10,11,12 Excluded due for lack of information Guyana: (2002-2005)

13 Includes information for all countries 2002 and 2005

14 Excluded due for lack of information: Guyana (2000 and 2005) and Venezuela (2000 and 2005)

15 Excluded due for lack of information: Guyana (2005) and Venezuela (2005)

16 Includes information for all countries: 1990, 1995, 2000 and 2005

17 Includes information for all countries 2000 and 2005

18 Excluded due for lack of information: Argentina (2000 and 2008) and Chile (2000 and 2008)

19 Excluded due for lack of information: Argentina (2000) and Chile (2000)

20,21,22 Includes information for all countries 1990-2006

23 Excluded due for lack of information: French Guyana (1990-1993) and Guyana (1990-1992)

24 Excluded due for lack of information: French Guyana (1990-2006), Guyana (1990-2006) and Suriname (1990-2006)

25, 26 Includes information for all countries (1990-2004)

27 Includes information for the following countries: Argentina (1990-2003), Brazil (1990-2003), Colombia (1990-2003), Ecuador (1990-2003) and French Guyana (1995-2003)

28 Includes information for the following countries: Argentina (1990-2004), Brazil (1990-2004), Colombia (1990-2004), Ecuador (1990-2004) and French Guyana (1995-2004)

29, 30 Excluded due for lack of information: French Guyana (1990-2003) and Uruguay (1990-2003)

31, 32 Excluded due for lack of information: Bolivia (1990-2003), French Guyana (1990-2003), Guyana (1990-2003) and Suriname (1990-2003)

33, 34 Excluded due for lack of information: Ecuador (1990-2003), French Guyana (1990-2003) and Peru (1990-2003)

35, 36 Excluded due for lack of information: Bolivia (1990-2003), Chile (1990-2003), Guyana (1990-2003), Paraguay (1990-2003) and Suriname (1990-2003)

37, 38 Excluded due for lack of information: Chile (1990-2003), Guyana (1990-2003), French Guyana (1990-2003), Paraguay (1990-2003) and Uruguay (1990-2003)

39,40,41,42,43,44 Includes information for all countries: 2000, 2002-2004 and 2006

45 Includes information for all countries: 2002, 2004 and 2006

46, 47 Includes information for all countries: 2000, 2002, 2004 and 2006

48 Excluded due for lack of information: Argentina (2002) and French Guyana (1990)

49 Excluded due for lack of information: Argentina (2002), French Guyana (1990), Suriname (1990) and Uruguay (1990)

50 Excluded due for lack of information: French Guyana (1990)

51 Excluded due for lack of information: Argentina (2002) and French Guyana (1990)

52 Excluded due for lack of information: Argentina (2002), French Guyana (1990), Peru (1990) and Suriname (1990)

53 Excluded due for lack of information: Argentina (2002) and French Guyana (1990)

54 Excluded due for lack of information: Chile (1995-1997 and 1999-2006) and French Guyana (1992-1996)

55 Excluded due for lack of information: Chile (1995-1997 and 1999-2006) and French Guyana (1990-2006) and French Guyana (1992-1996)

56 Excluded due for lack of information: Argentina (1990 and 1991), Chile (1990-2006), Ecuador (1995 and 1996), French Guyana (1992-1996) and Suriname (1990-2006)

57, 58 Includes information for the following countries: Argentina (1995 and 2000), Bolivia (2000), Brazil (1995 and 2000), Chile (2000), Colombia (2000), Ecuador (2000), Guyana (2000), Paraguay (2000), Peru (1990 and 2000), Suriname (2000), Uruguay (2000) and Venezuela (2000)

59 Includes information for the following countries: Argentina (2000), Bolivia (2000), Brazil (2000), Chile (2000), Colombia (2000), Ecuador (2000), French Guyana (2000), Paraguay (2000), Peru (2000), Suriname (2000), Uruguay (2000) and Venezuela (2000)

60, 61, 62 Includes information for the following countries: Argentina (1995 and 2000), Bolivia (2000), Brazil (1995 and 2000), Chile (2000), Colombia (2000), Ecuador (2000), Guyana (2000), Paraguay (2000), Peru (1990 and 2000), Suriname (2000), Uruguay (2000) and Venezuela (2000)

63, 64 Includes information for all countries 1990-2006

65 Includes information for the following countries: Brazil (1990-2006), Chile (1990-2000), Colombia (1990-2006), Ecuador (1990-2002), Guyana (1990-2000), Peru (2000-2006) and Venezuela (1991-2001)

66 Available Information only for the region

67 Includes information for all countries: 1990, 2000 and 2005

68 Includes information for all countries 1990-2004

69 Includes information for all countries: 1990 and 2000-2004

70 Excluded due for lack of information Guyana (1990-2004)

72, 73, 74 Includes information for all countries 1990-2004

75 Excluded due for lack of information French Guyana (1990-2004)

76, 77, 78, 79 Excluded due for lack of information: French Guyana (1995, 1994, 1998, 1999 and 2003-2006)

80, 81, 82 Includes information for the following countries: Bolivia (1990, 1994, 1998 and 2000), Brazil (1990 and 1994), Chile (1990 -1998), Colombia (1990-1994), Paraguay (1990 and 1994) and Peru (1994)

83 No data

84, 85, 86 Includes information for the following countries: Bolivia (1994-2006), Brazil (1992-2005), Chile (1990 -2005), Paraguay (1995-2003) and Peru (1993-1996)

87 Includes information for the following countries: Bolivia (1994-2006), Brazil (1992-2005), Chile (1990 -2005), Paraguay (1995-1998, 2001 and 2003) and Peru (1993-1996)

88 Excluded due for lack of information: French Guyana (1990 and 2000-2008)

89 Excluded due for lack of information: Guyana (1990, 1995, 2000 and 2005), French Guyana (1990, 1995, 2000 and 2005) and Suriname (1990, 1995, 2000 and 2005)

90 Excluded due for lack of information: Guyana (1990, 2000 and 2005), French Guyana (1990, 2000 and 2005) and Suriname (1990, 2000 and 2005)

91, 92 Excluded due for lack of information: Guyana (1990, 1995, 2000 and 2005), French Guyana (1990, 1995, 2000 and 2005) and Suriname (1990, 1995, 2000 and 2005)

93 Excluded due for lack of information: Guyana (1990, 2000 and 2005), French Guyana (1990, 2000 and 2005) and Suriname (1990, 2000 and 2005)

94 Excluded due for lack of information: Guyana (1990, 1995, 2000 and 2005), French Guyana (1990, 1995, 2000 and 2005), Suriname (1990, 1995, 2000 and 2005) and Uruguay (1990, 1995, 2000 and 2005)

95 Includes information for the following countries: Argentina (1990, 1995, 2000 and 2005), Bolivia (1990, 1995, 2000 and 2005), Brazil (1990, 1995, 2000 and 2005), Chile (1990, 1995, 2000 and 2005), Colombia (1990, 1995, 2000 and 2005) and Venezuela (1990, 1995, 2000 and 2005)

96 Excluded due for lack of information: Guyana (1990, 1995, 2000 and 2005), French Guyana (1990, 1995, 2000 and 2005) and Suriname (1990, 1995, 2000 and 2005)

97 Excluded due for lack of information: Guyana (1990, 1995, 2000 and 2005), French Guyana (1990, 1995, 2000 and 2005), Peru (1990, 1995, 2000 and 2005) and Suriname (1990, 1995, 2000 and 2005)

98 Includes information for the following countries: Argentina (1990, 1995, 2000 and 2005), Brazil (1990, 1995, 2000 and 2005), Chile (1990, 1995, 2000 and 2005), Colombia (1990, 1995, 2000 and 2005) and Peru (1990, 1995, 2000 and 2005)

99 Includes information for the following countries: Brazil (1990 and 2005), Chile (2000 and 2005) Colombia (1995, 2000 and 2005) and Peru (1990, 1995, 2000 and 2005)

100, 101 Includes information for the following countries: Argentina (1990, 1995, 2000 and 2005) and Brazil (1990, 1995, 2000 and 2005)

102 Excluded due for lack of information: Uruguay (1990 y 2005)

103 Includes information for the following countries: Argentina (2000 and 2003), Bolivia (1990-1997 and 1999-2004), Brazil (1990-2000, 2003 and 2004), Chile (1990-2001), Colombia (1990-2005), Ecuador (1990-2004), French Guyana (1990-2000), Paraguay (1990-1996, 1999 and 2000), Peru (1990-2004), Suriname (1990-1996 and 1999-2003), Uruguay (2004) and Venezuela (1990-2000)

104 Includes information for the following countries: Brazil (2000) and Peru (1994-2003)

105 Includes information for the following countries: Brazil (2000), Chile (1996 and 2000-2003) and Peru (1994-2003)

106 Includes information for the following countries: Brazil (1990, 1992, 1993, 1995-1999 and 2001-2003) and Paraguay (1995, 1998, 1999 and 2001-2003)

107 Includes information for the following countries: Brazil (1992, 1993, 1995-1999 and 2001-2003) and Paraguay (1995, 1998, 1999 and 2001-2003)

108 Excluded due for lack of information: French Guyana (1990-2007)

109 Includes information for all countries (1990-2007)

110 Excluded due for lack of information: Ecuador (1990-2007), French Guyana (1990-2007) and Guyana (1990-2007)

111 Excluded due for lack of information: French Guyana (1990-2007), Guyana (1990-2007), Suriname (1990-2007) and Uruguay (1990-2007)

112 Excluded due for lack of information: Argentina (1990-2007), French Guyana (1990-2007), Paraguay (1990-2007), Suriname (1990-2007) and Uruguay (1990-2007)

113 Includes information for the following countries: Argentina (1990-1995 and 1997-2007), Bolivia (1990-1995 and 1997-2007), Brazil (1990-1995 and 1997-2007), Chile (1990-1995 and 1997-2007), Paraguay (1990-1995 and 1997-2007), Peru (1990-1995 and 1997-2007) and Uruguay (1990-1995 and 1997-2007)

114 Excluded due for lack of information: Argentina (2004), Bolivia (1990-2008), Brazil (2004), Chile (2000), Colombia (2004), Ecuador (2004), French Guyana (1990-2008), Guyana (1990-2008), Paraguay (1990-2007), Peru (2004), Suriname (1990-2008), Uruguay (1990-2008) and Venezuela (1990-2008)

116, 117 Excluded due for lack of information: French Guyana (1990-2007)

118, 119, 120, 121, 122, 123, 124 Includes information for all countries (1990-2007)

125 Excluded due for lack of information: French Guyana (1990-2007)

126 Includes information for the following countries: Argentina (1991-1993, 1995, 1997, 1998, 2000, 2001 and 2003-2007), Bolivia (1990, 1993, 1994, 1996, 1997, 1999-2001, 2003 and 2004-2007), Brazil (1998, 2000-2004 and 2007), Chile (1990, 1991, 1993, 1994, 2000-2008), Colombia (1991, 1993, 1996, 1998-2000 and 2003-2007), Ecuador (1992, 1993, 1997, 2000, 2002, 2006 and 2008), French Guyana (1995 and 1996), Guyana (1996, 1997, 2005 and 2006), Paraguay (1990, 1992, 1995-1997, 1999, 2000, 2002 and 2005-2007), Peru (1990-1992, 1996, 1997, 2001-2008), Suriname (1990, 1993, 1996, 1997, 2004 and 2006), Uruguay (1991-1993, 1998-2002, 2004 and 2007) and Venezuela (1991-1994, 1998, 2003, 2004 and 2007)

127 Includes information for the following countries: Argentina (1992, 1997, 1998, 2000, 2001, 2003 and 2007), Bolivia (1997, 2001, 2003 and 2007), Brazil (2003 and 2007), Chile (1997, 2000, 2002 and 2006), Colombia (1996, 1999 and 2004-2007), Ecuador (1992, 1997, 2002, 2006 and 2008), French Guyana (1996), Guyana (1996, 2005 and 2006), Paraguay (1990, 1992, 1995 and 1997), Peru (1997 and 2008), Suriname (1993 and 2006), Uruguay (1992, 1997, 2000-2002 and 2007)

128 Includes information for the following countries: Paraguay (2002), Suriname (1990 and 2004) and Uruguay (1993 and 2002)

129 Includes information for the following countries: Chile (1997, 2005 and 2007), Colombia (1999), Peru (2001 and 2007), Suriname (1997)

130 Includes information for the following countries: Bolivia (1994), Chile (1991) and Suriname (2004)

131 Includes information for the following countries: Argentina (1995), Peru (2003) and Uruguay (2004)

132 Includes information for the following countries: Argentina (1991), Chile (1991), Ecuador (2002 and 2006) and Suriname (1997)

133 Includes information for the following countries: Bolivia (1990, 1994 and 2004), Brazil (1998,2001 and 2007), Colombia (1998), Ecuador (1997), Guyana (1997), Paraguay (1999 and 2005) and Peru (1990 and 1992)

134 Includes information for the following countries: Argentina (1992,1993,1995 and 2004-2006), Bolivia (1993,1996,1999,2000, 2003,2004 and 2006), Brazil (1998, 2000-2004 and 2007), Chile (1993, 1994, 1999, 2001, 2004 and 2006-2008), Colombia (1991,1993,1994,1999,2000,2003,2005 and 2007), French Guyana (1995), Paraguay (1996, 2000 and 2006), Peru (1996,1997, 2002, 2003, 2005 and 2006), Uruguay (1992 and 1999) and Venezuela (1991-1994, 1998, 2003, 2004 and 2007)

135 Includes information for the following countries: Argentina (2001,2003 and 2004), Bolivia (2002), Brazil (1990, 2001, 2003 and 2004), Chile (2000 and 2003), Colombia (2003), Paraguay (1990, 2002 and 2003), Peru (1990, 2000, 2002 and 2003), Uruguay (2000 and 2003) and Venezuela (2000 and 2003)

136 Includes information for the following countries: Argentina (2001,2003 and 2004), Bolivia (2002), Brazil (1990, 2001, 2003 and 2004), Chile (2000 and 2003), Colombia (2003), Paraguay (1990, 2002 and 2003), Peru (1990, 2000, 2002 and 2003), Uruguay (2000 and 2003) and Venezuela (2000 and 2003)

137 Excluded due for lack of information: Argentina (2000), Bolivia (1990 and 2000-2006), Brazil (2000 and 2005), Colombia (2000-2003 and 2005), Ecuador (2004), Guyana (1990 and 2000-2005), French Guyana (1990 and 2000-2005), Paraguay (1990 and 2001), Peru (1990, 2000, 2001 and 2003-2005), Suriname (1990), Uruguay (1990, 2000, 2001, 2003 and 2005) and Venezuela (2000-2004)

138, 139, 140 Excluded due for lack of information Guyana (1990, 2000 and 2005)

141 Excluded due for lack of information Guyana (2007) and French Guyana (1990,2000-2003 and 2005)

142 Excluded due for lack of information: Argentina (1995-1997), Chile (1995-2002), Guyana (1995-1997), Paraguay (1995-1997), Suriname (1999) and Uruguay (1995-2002)

143 Excluded due for lack of information: Argentina (1990-2007), Chile (1990-2007), Ecuador (2001-2007), Guyana (1990-2007), French Guyana (1990-1997 and 1999-2007), Paraguay (1990-2007), Suriname (1990-2007), Uruguay (1990-2007) and Venezuela (1990-1993,1996,1997,2000,2001 and 2007)

144 Excluded due for lack of information Chile (1998-2006) and Uruguay (1998-2006)

145 Includes information for the following countries: Argentina (1992-2000), Bolivia (1991-1998), Brazil (1991-2001,2004 and 2005), Chile (1991-1994 and 1996-1998), Colombia (1991-2000 and 2004), Guyana (1992 and 1993), French Guyana (1991-1993), Paraguay (1993 and 1996), Peru (1991-2002), Suriname (1992) and Venezuela (1991-1993 and 1996-2000)

146 Excluded due for lack of information French Guyana (1990 and 2000-2008)

147 Excluded due for lack of information French Guyana (1990 and 2000-2008)

148, 149,150 Includes information for the following countries: Argentina (2001), Bolivia (2001), Brazil (2000 and 2004), Chile (2002), Colombia (2004 and 2005), Ecuador (1990 and 2001), Paraguay (2004), Peru (2004 and 2005), Suriname (2004) and Venezuela (1990 and 2001)

151 Includes information for the following countries: Argentina (1999-2005), Bolivia (1999-2003), Brazil (1999-2005), Chile (1999, 2000 and 2002-2005), Colombia (1999-2006), French Guyana (2003-2005), Paraguay (1999-2005), Peru (2000-2006), Suriname (2002), Uruguay (1999-2006) and Venezuela (2000, 2002-2004 and 2006)

152, 153 Includes information for the following countries: Argentina (1999-2005), Bolivia (1999-2003), Brazil (1999-2005), Chile (1999, 2000 and 2002-2005), Colombia (1999-2006), French Guyana (2004 and 2005), Paraguay (1999-2005), Peru (2000-2006), Suriname (2002), Uruguay (1999-2006) and Venezuela (2000, 2002-2004 and 2006)

154 Excluded due for lack of information: Bolivia (2006), Brazil (2006), French Guyana (2006) and Guyana (2002-2006)

155 Excluded due for lack of information: Argentina (1990), Bolivia (1990 and 2006), Brazil (1990 and 2006), Colombia (1990), Ecuador (1990), Guyana (1990 and 2006), French Guyana (1990, 2005 and 2006), Paraguay (1990), Peru (1990), Suriname (1990), Uruguay (1990) and Venezuela (1990)

156 Excluded due for lack of information: Brazil (2006) , Guyana (2006), French Guyana (2006), Suriname (2006) and Uruguay (2006)

157 Excluded due for lack of information: Guyana (1990 and 2000-2004), French Guyana (1990 and 2000-2004) and Uruguay (1990 and 2000-2004)

158 Excluded due for lack of information: Guyana (1990-2004), French Guyana (1990-2004) and Suriname (1990-2004)

159 Excluded due for lack of information: French Guyana (1990-2006)

160 Includes information for the following countries: Brazil (1990), Chile (1990) and Colombia (1990)

161 Excluded due for lack of information: Guyana (1990-2004), French Guyana (1990-2004) and Suriname (1990-2004)

162 Excluded due for lack of information: Guyana (1990 and 2000-2006) and French Guyana (1990 and 2000-2006)

163 No data

164 Excluded due for lack of information: Guyana (1990) and French Guyana (1990)

165 Excluded due for lack of information: Chile (1995 and 2003-2005), French Guyana (1990 and 2003-2005), Suriname (1990-2004), Uruguay (1995) and Venezuela (1995 and 2003-2005)

166 Includes information for the following countries: Argentina (1999 and 2004-2006), Brazil (1999 and 2004-2006), Chile (1999 and 2004-2006), Colombia (1999 and 2004-2006), Peru (2004-2006) and Venezuela (1999 and 2004-2006)

167 Excluded due for lack of information: Colombia (2000), Guyana (1995, 1996 and 2002-2006), French Guyana (1995, 1996 and 2002-2006), Paraguay (1995, 1996 and 2002-2006), Suriname (1995, 1996 and 2002-2006) and Uruguay (1995, 1996 and 2002-2006)

168 Excluded due for lack of information French Guyana (1995 and 2003-2005)

169 Excluded due for lack of information: Guyana (1995, 1996 and 2003-2006), French Guyana (1995, 1996 and 2003-2006), Paraguay (1995, 1996 and 2003-2006) and Uruguay (1995, 1996 and 2003-2006)

170 Excluded due for lack of information: Guyana (1990-2005), French Guyana (1990-2005) and Suriname (1990-2005)

171 Includes information for the following countries: Argentina (1990-2005), Brazil (1990-2005), Chile (1990-2006), Colombia (1990-2006) and Peru (2000-2005)

172 Excluded due for lack of information: Guyana (1990-2005), French Guyana (1990-2005) and Suriname (1990-2005)

173 Excluded due for lack of information: Ecuador (1990-2001), Guyana (1990-2005), French Guyana (1990-2005), Paraguay (1990-2005), Suriname (1990-2005) and Uruguay (1995-2002)

174 Includes information for the following countries: Argentina (1990-2005) and Brazil (1990-2005)

175 Excluded due for lack of information: Guyana (1990-2005), French Guyana (1990-2005), Paraguay (2000-2005) and Suriname (1990-2005)

176 Excluded due for lack of information French Guyana (1990-2006)

177 Excluded due for lack of information Brazil (1990-2005) and French Guyana (1990-2005)

178, 179, 180, 181, 182 Excluded due for lack of information Guyana (1990-2006)

183 Excluded due for lack of information: Guyana (1990-2005), French Guyana (1990-2005) and Suriname (1990-2005)

184 Includes information for the following countries: Argentina (1991 and 1999-2004), Bolivia (1991 and 1999-2003), Brazil (1999-2002 and 2004), Chile (1991-2000 and 2002-2006), Colombia (1991 and 1999-2001), Ecuador (1991 and 1999-2001) French Guyana (1991 and 1999-2006), Paraguay (1991 and 1999-2004), Peru (1991, 1999 and 2001-2006), Uruguay (1991 and 1999-2006) and Venezuela (1991 and 2006)

187 Includes information for the following countries: Argentina (1990), Bolivia (1990 and 2001), Brazil (1990 and 2000), Chile (1990 and 2003), Colombia (1990 and 2002), Ecuador (1990 and 2000), French Guyana (1990 and 2000), Paraguay (1990, 2000 and 2002), Peru (1990), Suriname (1990 and 2000), Uruguay (1990 and 2002) and Venezuela (2005)

References: Statistical Annex

Variables	Source	References Statistical Annex
LAND		
Land area	FAOSTAT	FAO (Food and Agriculture Organization), 2008:FAOSTAT(http://faostat.fao.org/DesktopModules/Admin/Logon.aspx?tabID=0, consulted on April 2008).
Arable land and permanent crops	FAOSTAT	
Arable land tillage	FAOSTAT	
Permanent Crops	FAOSTAT	
Non arable land and non permanent crops	FAOSTAT	
Arable land and permanent crops per habitant	FAOSTAT	
Farming Area	FAOSTAT	
Irrigated farming area	FAOSTAT	
Fertilizer consumption	FAOSTAT	
Nitrogen	FAOSTAT	
Phosphate	FAOSTAT	
Potash	FAOSTAT	
FOREST		
Forest area, total	FAO	FAO (Food and Agriculture Organization), 2008: FAOSTAT (http://faostat.fao.org/DesktopModules/Admin/Logon.aspx?tabID=0, consulted on April 2008).
Plantations	FAO	
Natural Forest	FAO	
Proportion of land area covered by forest	FAO	
Annual average change in Forest Area	FAO	
Forest area under Forest Management Plans FRA (Forest Resource Assessment)	FAO	
Proportion of forest area under Forest Management Plans FRA	FAO	
Roundwood production	FAOSTAT	FAO (Food and Agriculture Organization), 2008:FAOSTAT (http://faostat.fao.org/DesktopModules/Admin/Logon.aspx?tabID=0, consulted on April 2008).
Industrial roundwood production	FAOSTAT	
Fuelwood and charcoal production	FAOSTAT	
Wood-based panels production	FAOSTAT	
Paper and paperboard production	FAOSTAT	
BIODIVERSITY		
Protected area, number	UNEP-WCMC	UNEP-WCMC (United Nations Environment Programme-World Conservation Monitoring Centre) http://ww.unep-wcmc.org/ (2008)
Protected area, total area	UNEP-WCMC	
Strict nature reserves / Wilderness areas, number	UNEP-WCMC	
Strict nature reserves / Wilderness areas, total area	UNEP-WCMC	
National parks, number	UNEP-WCMC	
National parks, total area	UNEP-WCMC	
Natural monuments, number	UNEP-WCMC	
Natural monuments, total area	UNEP-WCMC	
Habitat / Species management area, number	UNEP-WCMC	
Habitat / Species management area, total area	UNEP-WCMC	
Protected landscapes and seascapes, number	UNEP-WCMC	
Protected landscapes and seascapes, total area	UNEP-WCMC	
Managed resource protected area, number	UNEP-WCMC	
Managed resource protected area, total area	UNEP-WCMC	
Total Number of threatened species	IUCN	IUCN, (The International Union for Conservation of Nature), http://www.iucnredlist.org/info/stats (2008)
Number of threatened mammal species	IUCN	
Number of threatened bird species	IUCN	
Number of threatened reptile species	IUCN	
Number of threatened amphibian species	IUCN	
Number of threatened fish species	IUCN	
Number of threatened molluscs species	IUCN	
Number of threatened invertebrate species	IUCN	
Number of threatened plant species	IUCN	
FRESHWATER		
Proportion of population with access to drinking water services	PAHO	PAHO (The Pan American Health Organization), 2008: (http://www.paho.org/Spanish/SHA/coredata/tabulator/newTabulator.htm)
Proportion of population with access to drinking water services, rural	PAHO	
Proportion of population with access to drinking water services, urban	PAHO	
Proportion of population with access to sanitation services	PAHO	

Variables	Source	References Statistical Annex
Proportion of population with access to sanitation services, rural	PAHO	
Proportion of population with access to sanitation services, urban	PAHO	
Total freshwater fish production	FAO	FAO (Food and Agriculture Organization), FAOSTAT (http://faostat.fao.org/DesktopModules/Admin/Logon.aspx?tabID=0, consulted on April 2008).
Freshwater fish production, catch	FAO	
Freshwater fish production, aquaculture	FAO	
Proportion of total water resources used	UN	United Nations site for the MDG Indicators, 2008: http://mdgs.un.org/unsd/mdg/Home.aspx
Total withdrawal extraction	FAO	FAO (Food and Agriculture Organization), FAOSTAT (http://faostat.fao.org/DesktopModules/Admin/Logon.aspx?tabID=0, consulted on April 2008).
Withdrawal extraction per capita	FAO	
Agricultural withdrawals extraction	FAO	
Industrial withdrawals extraction	FAO	
Domestic withdrawals extraction	FAO	
COASTAL AND MARINE AREAS		
Total marine fish production	FAO	FAO (Food and Agriculture Organization), FAOSTAT (http://faostat.fao.org/DesktopModules/Admin/Logon.aspx?tabID=0, consulted on April 2008).
Total marine fish production, catch	FAO	
Total marine fish production, aquaculture	FAO	
Marine protected areas	UNEP-WCMC	UNEP-WCMC (United Nations Environment Programme-World Conservation Monitoring Centre), 2008: Protected Areas Programme (http://www.unep-wcmc.org/wdpa/, consulted on April, 2008)
Mangroves, total area	ECLAC	ECLAC (Economic Commission for Latin America and the Caribbean), 2008: Statistics yearbook 2007 (http://websie.eclac.cl/anuario_estadistico/anuario_2007/, consulted on April 2008).
ATMOSPHERE		
CO2 Emissions	OLADE	OLADE (Latin American Energy Organization), 2008: Energetic Statistics report (http://www.olade.org.ec/energiaCifras.html, consulted on April 2008).
CO2 Emissions per capita	UN	Millenniun Data Base, 2008: http://millenniumindicators.un.org/unsd/mdg/Data.aspx
CO2 Emissions per $1 GDP (PPP)	UN	
From gas fuels	CDIAC	http://cdiac.ornl.gov/trends/emis/overview.html
From liquid fuels	CDIAC	
From solid fuels	CDIAC	
Emissions of particles	OLADE	OLADE (Latin American Energy Organization), 2008: Energetic Statistics report (http://www.olade.org.ec/energiaCifras.html, consulted on April 2008).
Emissions of sulphur oxides (SO2)	OLADE	
Emissions of nitrogen oxides (NOx)	OLADE	
Emissions of hydrocarbon (HC)	OLADE	
Emissions of carbon monoxide (CO)	OLADE	
Emissions of methane, total	ECLAC	ECLAC (Economic Commission for Latin America and the Carib bean), 2008: Statistics yearbook 2007 (http://websie.eclac.cl/anuario_estadistico/anuario_2007/, consulted on April 2008).
From energy	ECLAC	
From agriculture	ECLAC	
From other sources	ECLAC	
Consumption of ozone-depleting substances, total	ECLAC	
Consumption of ozone-depleting substances, Chlorofluorocarbons (CFCs)	ECLAC	
Consumption of ozone-depleting substances, Hydrochlorofluorocarbons (HCFCs)	ECLAC	
Consumption of ozone-depleting substances, Methyl bromide	ECLAC	
HUMAN SETTLEMENT		
Population density	ECLAC	ECLAC (Economic Commission for Latin America and the Carib bean), 2008: Statistics yearbook 2007 (http://websie.eclac.cl/anuario_estadistico/anuario_2007/, consulted on April 2008).
Urban population at midyear	ECLAC	
Percent of population living in urban areas	CELADE	CELADE (Latin American & Caribbean Demographic Centre), http://www.eclac.org/celade/default.asp?idioma=IN (2008)
Annual growth rates of the urban population	CELADE	
Population of urban aglomerations comprising 750.000 or more inhabitants	UN	UN (United Nations), 2008: World Urbanization Prospects: http://esa.un.org/unup/p2k0data.asp
Population of urban aglomerations comprising 750,000 or more inhabitants	UN	
Number of cities with population between 500.000 and 1 million	UN	
Population of urban aglomerations with population between 500.000 and 1 million	UN	

Variables	Source	References Statistical Annex
Number of cities with population between 1 and 5 million	UN	United Nations site for the MDG Indicators, 2008: http://mdgs.un.org/unsd/mdg/Home.aspx
Population of urban aglomerations with population between 1 and 5 million	UN	
Number of cities with population between 5 and 10 million	UN	
Population of urban aglomerations with population between 5 and 10 million	UN	
Number of cities greater than 10 million population	UN	
Population of urban aglomerations comprising 10 million or more inhabitants	UN	
Proportion of urban population living in slums	UN	
Roads total network	WB	WB (World Bank), 2008: devdata query (http://devdata.worldbank.org/query/default.htm, consulted on April 2008).
DISASTERS AND VULNERABILITY		
Number of natural and technological disaster events	CRED	
Floods	CRED	
Cyclones/ hurricanes/ typhoons	CRED	
Earthquakes	CRED	
Landslides and avalanches	CRED	CRED (The Centre for Research on the Epidemiology of Disasters), 2008: EM-DAT (http://www.emdat.be/Database/terms.html, consulted on April del 2008).
Extreme temperatures	CRED	
Volcanic eruptions	CRED	
Drought	CRED	
Technological disasters	CRED	
Estimated damages due to natural and technological disaster events	CRED	
Floods	CRED	
Cyclones/ hurricanes/ typhoons	CRED	
Earthquekes	CRED	
Landslides and avalanches	CRED	
Extreme temperatures	CRED	
Volcanic eruptions	CRED	
Drought	CRED	
Technological disasters	CRED	
Number of people afected due to natural and technological disaster events	CRED	
Floods	CRED	
Cyclones/ hurricanes/ typhoons	CRED	
Earthquekes	CRED	
Landslides and avalanches	CRED	
Extreme temperatures	CRED	
Volcanic eruptions	CRED	
Drought	CRED	
Technological disasters	CRED	
Employed Population below 1$ PPP per day	WB	WB (World Bank), 2008: devdata query (http://devdata.worldbank.org/query/default.htm, consulted on April 2008).
Poverty gap at $1 a day (PPP)	WB	
Share of youth unemployed to youth population, both sexes	UN	Millennium Indicators database, 2008: http://millenniumindicators.un.org/unsd/mdg/Data.aspx
ENVIRONMENT AND HUMAN HEALTH		
Infant mortality rate	ECLAC	ECLAC (Economic Commission for Latin America and the Carib bean), 2008: Statistics yearbook 2007 (http://websie.eclac.cl/anuario_estadistico/anuario_2007/, consulted on April 2008).
Life expectancy at birth females	ECLAC	
Life expectancy at birth males	ECLAC	
Calories availability	PAHO	PAHO (The Pan American Health Organization), 2008: (http://www.paho.org/Spanish/SHA/coredata/tabulator/newTabulator.htm)
Reported Cases of Dengue	PAHO	
Reported Cases of Malaria	PAHO	
Reported Cases of Cholera	PAHO	
SOCIOECONOMICS TRENDS		
Total Population at midyear	ECLAC	ECLAC (Economic Commission for Latin Amercia and the Carib-bean), 2008: Statistics yearbook 2007 (http://websie.eclac.cl/anuario_estadistico/anuario_2007/, consulted on April 2008).
Average annual growth rate of population	ECLAC	

Variables	Source	References Statistical Annex
Adult literacy adult, total	UNESCO	UNESCO (United National Educational, Scientific and Cultural Organization , 2008: Data Centre (www.uis.unesco.org, consulted on April 2008).
Male	UNESCO	
Female	UNESCO	
School life expectancy	UNESCO	
Male	UNESCO	
Female	UNESCO	
Telephone lines	UN	Millennium Indicators database, 2008: http://millenniumindicators.un.org/unsd/mdg/Data.aspx
Cellular subscribers	UN	
Internet users	UN	
Energy use per habitant	WB	WB (World Bank), 2008: devdata query (http://devdata.worldbank.org/query/default.htm, consulted on April 2008)
Energy imports, net (% of energy use	WB	
Energy intensity of gross domestic product	ECLAC	ECLAC (Economic Commission for Latin America and the Carib bean), 2008: Statistics yearbook 2007 (http://websie.eclac.cl/anuario_estadistico/anuario_2007/, consulted on April 2008).
Renewable Energy Supply	ECLAC	
Combustible renewables and waste	WB	WB (World Bank), 2008: devdata query (http://devdata.worldbank.org/query/default.htm, consulted on April 2008).
Total primary energy production per capita	ECLAC	ECLAC (Economic Commission for Latin America and the Carib-bean), 2008: Statistics yearbook 2007 (http://websie.eclac.cl/anuario_estadistico/anuario_2007/, consulted on April 2008).
Total primary energy production, geothermal	OLADE	OLADE (Latin American Energy Organization), 2008: Energy Statistics Report (http://www.olade.org.ec/energiaCifras.html, consulted on April 2008).
Total primary energy production, hydropower	OLADE	
Total primary energy production, sugar cane bagasse	OLADE	
Total primary energy production, coal	OLADE	
Total primary energy production, natural gas	OLADE	
Total primary energy production, firewood	OLADE	
Total primary energy production, oil	OLADE	
Electricity Production	WB	WB (World Bank), 2008: devdata query (http://devdata.worldbank.org/query/default.htm, consulted on April 2008).
From coal sources	WB	
From hydroelectric sources	WB	
From natural gas sources	WB	
From nuclear sources	WB	
From oil sources	WB	
Gross domestic income per habitant (atlas method)	WB	
Gross domestic product, annual growth	ECLAC	ECLAC (Economic Commission for Latin America and the Carib bean), 2008: Statistics yearbook 2007 (http://websie.eclac.cl/anuario_estadistico/anuario_2007/, consulted on April 2008).
Agriculture, value added	ECLAC	
Industry, value added	ECLAC	
Service, value added	ECLAC	
Exports of goods and services	WB	WB (World Bank), 2008: devdata query (http://devdata.worldbank.org/query/default.htm, consulted on April 2008).
Imports of goods and services	WB	
Total Debt Service (% of GNP)	WB	
GDP public spent on education	UNESCO	UNESCO (United National Educational, Scientific and Cultural Organization, 2008: Data Centre (www.uis.unesco.org, consulted on April 2008).
Physicians	WB	WB (World Bank), 2008: devdata query (http://devdata.worldbank.org/query/default.htm, consulted on April 2008).

Acronyms

ACP .... Panama Canal Authority

ACS .... Association of Caribbean States

ACTO .... Amazon Cooperation Treaty Organization

ALBA .... Bolivarian Alternative for the Americas

ALBA-TCP .... Bolivarian Alternative for the Americas - Free Trade Agreement of the people

ALIDES .... Alianza Centroamericana para el Desarrollo Sostenible

AME................ Asociación de Municipalidades de Ecuador

AMERB .... Áreas de Manejo y Explotación de Recursos Bentónicos (Chile)

ANA .... Autoridad Nacional del Agua (Peru)

AOGMC .... Atmospheric-Oceanic Global Circulations Models

BADEIMA .... Latin America and the Caribbean environmental database - ECLAC

BDC................ Business Development Centre

BOLFOR .... Proyecto de Manejo Forestal Sostenible (Bolivia)

BP .... British Petroleum

BRTS .... Bus Rapid Transit System

CAN .... Andean Community of Nations

CAR .... Corporaciones Autónomas Regionales (Colombia)

CARICOM .... Caribbean Community

CARICOMP ..... Caribbean Coastal Marine Productivity Program

CARSEA .... Caribbean Sea Ecosystem Assessment

CAST .... Caribbean Alliance for Sustainable Tourism

CBD................ Convention on Biological Diversity

CBM .... Corredor Biológico Mesoamericano

CCAD .... Comisión Centroamericana de Ambiente y Desarrollo

CCCCC .... Caribbean Community Climate Change Centre

CDIAC .... Carbon Dioxide Information Analysis Centre

CEADS .... Consejo Empresario Argentino para el Desarrollo Sostenible

CEBEDS .... Consejo Empresarial Brasileño

CECODES .... Consejo Empresarial Colombiano para el Desarrollo Sostenible

CEDES .... Consejo Empresarial para el Desarrollo Sostenible (Bolivia)

CEF .... Comisión Federal de Electricidad (Mexico)

CEMPRE .... Compromiso Empresarial a favor del Reciclaje

CEPIS .... Pan-American Centre for Sanitary Engineering and Environmental Sciences

CEPREDENAC . Coordinación para la Prevención de Desastres Naturales en Centroamérica

CER................. Certified Emission Reductions

CES .... Compensation for Environmental Services

CETESB .... Companhia Ambiental do Estado de São Paulo

CFM................ Community-based Forest Management

CH4 .... Methane

CHENACT .... Regional Caribbean Hotel Energy Efficiency Action Program

CHGE .... Center for Health and the Global Environment

CHTA.............. Caribbean Hotel & Tourism Association

CICESE............ Centro de Investigación Científica y de Educación Superior

CIDES .... Centro Internacional para el Desarrollo Sostenible

CIMAR .... Centro de Investigación en Ciencias del Mar y Limnología

CITES .... Convention on International Trade in Endangered Species of Wild Fauna and Flora

CO .... Carbon Monoxide

CO_2 .... Cabon Dioxide

COLPOS .... Colegio de Posgraduados (Mexico)

CONABIO .... Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (Mexico)

CONAMA .... Comisión Nacional del Medio Ambiente (Chile)

CONAPO .... Consejo Nacional de la Población (Mexico)

COPERT III .... Computer program to calculate emissions from road transport

COPESCAL ...... Commission for Inland Fisheries of Latin America (FAO)

CORPAIRE .... Corporación para el Mejoramiento del Aire de Quito

COST 725 .... Establishing a European Phenological Data Platform for Climatological Applications

CPI .... Consumer Price Index

CPPS .... Comisión Permanente del Pacífico Sur

CREAF .... Centre de Recerca Ecològica y Aplicacions Forestals

CRFM .... Caribbean Regional Fisheries Mechanism

CSR .... Corporate Social Responsibility

CTO .... Caribbean Tourism Organization

CYTED .... Latinamerican science & technology development programme

DAMA .... Secretaría Distrital de Ambiente (Colombia)

DANE .... Departamento Nacional de Estadística (Colombia)

DDT .... dichlorodiphenyltrichloroethane, (pesticide)

DED .... German Development Service

DEWA .... Division of Early Warning and Assessment

DIGESA .... Dirección General de Salud Ambiental (Peru)

DOALOS .... United Nations Office of Legal Affairs/ Division for Ocean Affairs and the Law of the Sea

DPSIR .... Driving Forces - Pressures – State - Impacts - Response

DR-CAFTA .... Dominican Republic-Central America Free Trade Agreement

EBA .... Endemic Bird Areas

ECLAC .... Economic Commission for Latin America and the Caribbean

EE .... Energy Efficiency

EEZ .... Exclusive Economic Zone

EGS .... Environmental Goods and Services

EIS .... Environmental Information Systems

ERWR .... External Renewable Water Resources

ESA .... European Space Agency

ETHOS .... Instituto Ethos de Empresas y Responsabilidad Social

FAO .... Food and Agriculture Organization of the United Nations

FCPF .... Forest Carbon Partnership Facility

FDI .... Foreign Direct Investment

FOFIGA .... Fondo Financiero del Plan de Gestión Ambiental del Distrito Capital (Bogotá)

FONAFIFO ...... Fondo Nacional de Financiamiento Forestal (Costa Rica)

FRA .... Global Forest Resources Assessment

FSC .... Forest Stewardship Council

FTA .... Free Trade Agreements

FUNDADES ..... Fundación para el Desarrollo Solidario (Peru)

FUSADES .... Fundación Salvadoreña para el Desarrollo Económico y Social (El Salvador)

GDP .... Gross Domestic Product

GEA .... Grupo GEA Emprendimientos Ambientales (Peru)

GEF .... Global Environment Facility

GEO .... Global Environmental Outlook

GFTN .... Global Forest Trade Network

GGND .... Global Green New Deal

GHG .... Greenhouse Gases

GIS .... Geographic Information System

GLADA .... Global Assessment of Land Degradation and Improvement

GLC .... Global Land Cover

GLOBIO .... Global Methodology for Mapping Human Impacts on the Biosphere (UNEP)

GMO .... Genetically Modified Organisms

GPA .... The Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (UNEP)

GPS .... Global Positioning System

GRID .... Global Resource Information Database (UNEP)

GTZ .... Deutsche Gesellschaft für Technische Zusammenarbeit

GWP .... Global Water Parternship

IAvH .... Instituto de Investigación de Recursos Biológicos Alexandre Von Humboldt (Colombia)

ICRAN .... The International Coral Reef Action Network

ICT .... Information and Communication Technologies

ICZM .... Integrated Coastal Zone Management

IDB .... Interamerican Development Bank

IDEAM .... Instituto de Hidrología, Meteorología y Estudios Ambientales (Colombia)

IDRC .... International Development Research Centre

IDS .... Insitute of Development Studies

IEA .... International Energy Agency

IEA .... Integrated Environmental Assessment

IFM .... Independent Forest Monitoring

IHP .... International Hydrological Programme (UNESCO)

IICA .... Inter-American Institute for Cooperation on Agriculture

IIRSA .... Initiative for the Integration of Regional Infrastructure in South America

ILAC .... Latin American Initiative for Sustainable Development

ILM .... Indigenous Land Management

IMAGE .... Integrated Model to Assess the Global Environment

IMF .... International Monetary Fund

IMPACT .... International Model for Policy Analysis of Agricultural Commodities and Trade

INCODER .... Instituto Colombiano para el Desarrollo Rural

INE .... Instituto Nacional de Estadística

INMET .... Instituto Nacional de Meteorología (Brazil)

INPE .... Instituto Nacional de Investigación Espacial (Brazil)

INRA .... Instituto Nacional de Reforma Agraria (Bolivia)

INRENA .... Instituto Nacional de Recursos Naturales (Peru)

INVEMAR .... Instituto de Investigaciones Marinas y Costeras «José Benito Vives de Andréis»

IOM .... International Organization for Migration

IPCC .... Intergovernmental Panel on Climate Change

IRBM .... Integrated River Basin Management

ISARM .... Internationally Shared Aquifer Resources Management (UNESCO/ OEA)

ISIS .... International Species Information System

ISO .... International Organization for Standarization

IUCN .... International Union for Conservation of Nature,

IWRM .... Integrated Water Resources Management

LCCS .... Land Cover Clasification System

MADVT .... Ministerio de Ambiente, Vivienda y Desarrollo Territorial (Colombia)

MASP .... Metropolitan Area of Sao Paulo

MCMA .... Mexico City Metropolitan Area

MDG .... Millenium Development Goal

MEA .... Millenium Ecosystem Assessment

MERCOSUR .... Southern Common Market

MFIE .... Ministry of Finance, Investment, Telecommunications and Energy (Barbados)

MMA .... Ministério do Meio Ambiente (Brazil)

MODIS .... Moderate Resolution Imaging Spectroradiometer

MPA .... Marine Protected Areas

N_2O .... Nitrous oxide

NAFTA .... North American Free Trade Agreement

NGO .... Non Governmental Organization

NH_3 .... Ammonia

NORAD .... Norwegian Agency for Development Cooperation

NOx .... Mono-nitrogen oxides

NTFP .... Non Timber Forest Products

O_3 .... Ozone

OAS .... Organization of American States

ODA .... Official Development Assistance

OECD .... Organization for Economic Co-operation and Development

OET .... Ecological Land Use Planning

OLADE .... Latin-American Energy Organization

PACADIRH ...... Plan de Acción Centroamericano para el Desarrollo Integrado de los Recursos Hídricos

PAHO .... Pan American Health Organization

PARCA .... Plan Ambiental para la Región Centroamericana

Pb .... Lead

PEI .... Poverty and Environment Initiative

PEMEX .... Petróleos Mexicanos

PES .... Payment for Environmental Services

PINFOR .... Programa de Incentivos Forestales (Guatemala)

PISCO .... Partnership for Interdisciplinary Studies of Coastal Oceans

PLAGSALUD ... Proyecto Aspectos Ocupacionales y Ambientales de la Exposición a Plaguicidas en el Istmo Centroamericano (Pesticide Health project)

PM .... Particulate Matter

PPP .... Plan Puebla Panamá

PREVDA .... Programa de Reducción de la Vulnerabilidad y la Degradación Ambiental

PREVFOGO ..... Sistema Nacional de Prevenção e Combate aos Incêndios Florestais (Brazil)

PROAIRE .... Plan de Gestión de la Calidad Atmosférica (Mexico)

PROARC .... Pro Arc of Deforestation

PROCIG .... Central American Geographic Information Project

PROCONVE .... Programa de Controle das Emissões Veiculares

PROSUKO .... Programa de Suka Kollus

PRRD .... Plan Regional de Reducción de Desastres (Centroamérica)

PRUGAM .... Planificación Regional y Urbana de la Gran Área Metropolitana del Valle Central de Costa Rica

QALY .... Quality-adjusted life year

R&D .... Research and Development

REDD .... Reducing Emissions from Deforestation and Forest Degradation

REDPYCS .... Sustainable Production and Consumption Network

REDU .... Reducing Emissions from all Land Uses

RESSCAD .... Reunión del Sector Salud de Centroamérica y República Dominicana,

RFA .... Global Forest Resources Assessment

RIVM .... Instituto Nacional para la Salud Pública y el Medio Ambiente (RIVM)

RSI .... Residential Sustainability Index

SATIF .... Sistema de Alerta Temprana de Incendios Forestales (Bolivia)

SAYTT .... Sistema Acuífero Yrendá Toba Tarijeño

SCBD .... Convention on Biologycal Diversity

SCP .... Sustainable Production and Consumption

SDI .... Spatial Data Infrastructures

SEA .... Strategic Environmental Assessment

SEBRAE .... Servicio de Apoyo a las Pequeñas Empresas y Microempresas de Brazil

SEEA .... System of Integrated Environmental and Economic Accounting

SELA .... Latin American and Caribbean Economic System

SEMAPA .... Servicio Municipal de Agua Potable de Cochabamba

SEMARNAT ..... Secretaría del Medio Ambiente y Recursos Naturales (Mexico)

SGS .... Société Genérale de Surveillance

SICA .... Central American Integration System

SICAP .... Sistema Centroamericano de Áreas Protegidas

SICGAL .... Sistema de Inspección y Cuarentena para las islas Galápagos

SIDS .... Small Island Development States

SIEE .... Energy-Economic Information System

SINAC .... Sistema Nacional de Áreas de Conservación (Costa Rica)

SINADES .... National System for Sustainable Development

SINCHI .... Instituto Amazónico de Investigaciones Científicas (Colombia)

SITC .... Standard International Trade Classification

SMA/GDF .... Secretaría del Medio Ambiente del Gobierno del Distrito Federal (Mexico)

SNIARN .... Sistema Nacional de Información Ambiental y de Recursos Naturales (Mexico)

SO_2 .... Sulphur Dioxide

TCO .... Community Territories of Origin

TEEB .... The Economics of Ecosystems and Biodiversity

Tier II .... Emission Standard

TNC .... The Nature Conservancy

TRAFFIC .... Wildlife Trade Monitoring Network

TRWR .... Total Renewable Water Resources

UN DESA .... United Nations Department of Economic and Social Affairs

UN HABITAT ... United Nations Human Settlements Programme

UNAM .... Universidad Nacional Autónoma de Mexico

UNASUR .... Union of South American Nations

UNCCD, ... United Nations Convention to Combat Desertification

UNDP .... United Nations Development Programme

UNEP .... United Nations Environment Programme

UNESCO .... United Nations Educational, Scientific, and Cultural Organization

UNFPA .... United Nations Population Fund

UNHCR .... United Nations High Commissioner for Refugees

UNICEF .... United Nations Children’s Fund

UNILC .... United Nations International Law Commission

UPME .... Unidad de Planeación Minero Energética - Ministerio de Minas y Energía (Colombia)

USAID .... United States Agency for International Development

VOC .... Volatile Organic Compounds

WaterGAP .... Water – Global Assessment and Prognosis

WB .... World Bank

WCMC .... World Conservation Monitoring Centre

WDPA .... World Database on Protected Areas

WHO .... World Health Organization

WRI .... World Resources Institute

WSP .... Water and Sanitation Program

WTO .... World Trade Organization

WWAP .... World Water Assessment Programme (UNESCO)

WWF .... World Wildlife Fund

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