# ENVIRONMENTAL INDICATORS ON SELECTED ISSUES FOR LATIN AMERICA AND THE CARIBBEAN

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# PRESENTATION

Over the last decades, the level of environmental awareness has increased significantly in Latin America and the Caribbean. During this period, the countries have made progress in the area of environmental management but still face significant problems with pollution and unsustainable management of natural resources. These processes have negative consequences for the countries' economic development and affect the quality of life, particularly of the poorest segments of the population. Strengthening environmental management and achieving greater compliance with environmental laws and policies will require mobilizing resources and skills to fully understand the environmental problems, what the causes are behind them and how they develop over time.

Hence, there is a clear need for easily accessible information on important environmental conditions and trends—including trade and the environment, rapid changes in land use, industrial and municipal pollution, and changing human perceptions and values—as well as continual updates of information so progress can be monitored. It is within this context, that the participants in the Regional Policy Dialogue on Environment requested that the Bank start identifying key issues that link development to the natural environment and environmental quality. This initial endeavor will help develop a more complete set of indicators for future policy use.

For this exercise, the Bank contracted the World Resources Institute (WRI). WRI is an independent center for policy research and technical assistance on global environmental and development issues. WRI's mission is to move human society to live in ways that protect Earth's environment and its capacity to provide for the needs and aspirations of current and future generations. WRI provides objective information and practical proposals for policy and institutional change that will foster environmentally sound and socially equitable development.

The potential outcome from this report on selected environmental indicators include increased awareness of environmental trends in Latin America and the Caribbean, and the linkages between environmental and economic problems. It is also expected to increase the understanding of the long-term effects of environmental problems on people's health, income, and quality of life. As a result, we should see an increased demand for continued reporting of environmental trends.

We hope this document can be used to encourage open dialogues regarding environmental issues and their relationships to economic development.

Carlos M. Jarque
Manager, Sustainable Development Department

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# LATIN AMERICA AND THE CARIBBEAN: ENVIRONMENT DIALOGUE SUB-REGIONS

# INTRODUCTION

As they enter the 21st century, the countries of Latin America and the Caribbean face the challenge of reducing poverty while simultaneously addressing problems of environmental degradation amid continued increases in population. To help meet this challenge, the Inter-American Development Bank has established important environmental initiatives. One such initiative, the Regional Policy Dialogue, incorporates the environment among the main areas for focussed policy discussions and strategic thinking in the Bank.

This report represents a selection and analysis of key indicators that bear upon the particular set of issues that the IDB borrowing member countries are facing at this point. Some of the indicators presented in this report document the main pressures caused by economic development on the environment, specifically related to growth *(population growth and urbanization)*, production patterns of key economic sectors *(agriculture, energy, mining, and marine and coastal activities),* and human resources and welfare *(income, education, poverty and health)*. Other indicators in this report address issues related to the state of the environment, looking at the natural resource base, management pattern and environmental quality of the region *(water availability and use, biodiversity, deforestation, natural disasters and climate change)*.

The selection of these indicators is based on availability, timeliness, and relevance of the data. The timeline for the data presented in this report varies according to the issues addressed, generally covering the 1960-2000 period for historic data and the 2001-2030 period for projections of environmental trends. Since this exercise is not exhaustive or definitive for Latin America and the Caribbean, the reader is encouraged to consult other sources of data and environmental indicators, such as the Millennium Ecosystem Assessment (MA), which entails an overall evaluation of the condition of the world's ecosystems, as well as other efforts currently underway that address specific topics such as dryland degradation, freshwater, fisheries, forests, agriculture, climate, and ozone.

This report should contribute to the discussion on how to build and maintain a complete set of appropriate environmental indicators for Latin America and the Caribbean. But above all, the report was prepared to help spur the development and use of timely and accurate indicators for policy-making and implementation in the region.

More information on environmental indicators, as well as data on individual member countries, can be found at the following websites: http://www.iadb.org/sds/env and http://www.earthtrends.org.

# 1. POPULATION GROWTH

## Introduction

Population growth is one of the most basic forces influencing the quality of the natural environment. At the turn of the 21st century, the world population exceeded 6 billion and fertility in some countries remained above 5 children per woman. Growing populations place rising pressures on natural resources to provide water, food, shelter, and energy. Harvesting and obtaining these resources has several variable environment impacts. The challenge facing Latin America and the Caribbean, as in other regions of the world, is to provide growing populations with needed resources without jeopardizing the capacity of the environment to provide those resources in the future.

## Population

In Latin America and the Caribbean, as elsewhere, continued population growth raises difficult issues for environmental quality, as well as economic growth and social development. According to U.N. estimates for 2001, the region has a population of 510 million, about 8.5 percent of the world total. This figure is expected to reach 613 million by 2015 and 706 million in 2030.

Although the population is still growing, the rate of increase slowed from 2.5 percent per year in the 1950s to 1.5 percent per year in the 1990s. In the latter period, population growth was fastest in the Central American and Andean subregions (1.8 percent per year) and slowest in the Caribbean (1.3 percent annually). Region-wide, population growth is expected to continue to decline, falling to 0.8 percent by 2030.

## Fertility and Age Groups

Although fertility in some LAC countries remains above an average of 4 children per woman, the trend is toward declining birth rates. The U.N. projects that regional fertility rates will fall to 2.2 children per woman by 2025 and 2.1 children per woman by 2050 (medium-variant forecast).

Due to high birth rates in recent decades, the age structure of the LAC population shifted toward the younger age classes (less than 25 years old). These younger age classes contain a relatively large share of the population, while the older age classes (older than 65) are comparatively small. In the coming decades, the age structure of the population will shift again, with relatively more people entering the older age classes, especially the prime working years of 20-45 years of age.

## Implications

Despite falling growth rates, the population of Latin America and the Caribbean will continue to increase in the coming decades. Most of this growth will be in the age groups seeking jobs, higher education, and im-

proved standards of living. Larger numbers of people (producers and consumers) will place more demands on the environmental resource base. The increased demand for ecosystem products will require paying more attention to consumption patterns: how much and what is consumed, and how to dispose of waste products.

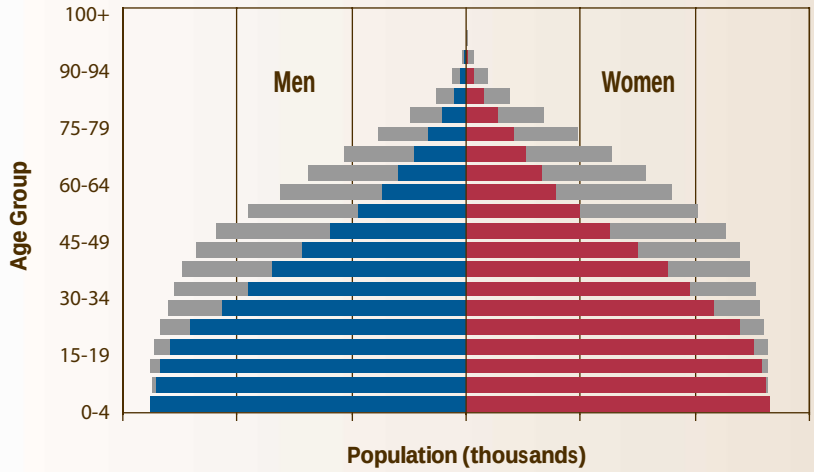
**Population and Growth Rate in Latin America and the Caribbean, 1970-2030 (in thousands)**

| Country/ Subregion | Year 1970 | 2000 | 2030 | Mean Annual Growth Rate 2000-30 |
|---|---|---|---|---|
| Bolivia | 4,212 | 8,329 | 14,000 | |
| Colombia | 22,561 | 42,321 | 62,695 | |
| Ecuador | 5,970 | 12,646 | 18,641 | |
| Peru | 13,193 | 25,662 | 37,201 | |
| Venezuela | 10,721 | 24,170 | 36,548 | |
| **Andean** | **56,656** | **113,127** | **169,085** | **1.3%** |
| Belize | 123 | 241 | 396 | |
| Costa Rica | 1,731 | 4,023 | 6,238 | |
| El Salvador | 3,598 | 6,276 | 9,554 | |
| Guatemala | 5,243 | 11,385 | 21,441 | |
| Honduras | 2,592 | 6,485 | 11,392 | |
| Mexico | 50,596 | 98,881 | 134,912 | |
| Nicaragua | 2,123 | 5,074 | 9,353 | |
| Panama | 1,506 | 2,856 | 3,918 | |
| **Central America** | **67,513** | **135,222** | **197,204** | **1.2%** |

| Country/ Subregion | Year 1970 | 2000 | 2030 | Mean Annual Growth Rate 2000-30 |
|---|---|---|---|---|
| Argentina | 23,962 | 37,032 | 48,896 | |
| Brazil | 96,021 | 170,115 | 225,161 | |
| Chile | 9,496 | 15,211 | 20,240 | |
| Paraguay | 2,350 | 5,496 | 10,104 | |
| Uruguay | 2,808 | 3,337 | 4,016 | |
| **Southern Cone** | **134,638** | **231,192** | **308,417** | **0.9%** |
| Bahamas | 170 | 307 | 433 | |
| Barbados | 239 | 270 | 299 | |
| Dominican Republic | 4,423 | 8,495 | 11,522 | |
| Haiti | 4,520 | 8,222 | 12,730 | |
| Jamaica | 1,869 | 2,583 | 3,389 | |
| Trinidad and Tobago | 971 | 1,295 | 1,518 | |
| Guyana | 709 | 861 | 1,080 | |
| Suriname | 372 | 417 | 544 | |
| **Caribbean** | **13,273** | **22,450** | **31,516** | **1.1%** |
| **LAC REGION** | **272,080** | **501,992** | **706,222** | **1.1%** |
| **WORLD** | **3,696,148** | **6,055,049** | **8,111,979** | **0.9%** |

**Source:** UN Population Division, 1998.

**LAC Population Distribution by Age, Current in 2000 (blue/red area) and Projected to 2025 (grey area)**




**Source:** UN Population Division, 1998.
**Note:** Each bar represents a 5-year age group.

# 2. URBANIZATION

## Introduction

Nearly three-quarters of the population of Latin America and the Caribbean lives in cities. Urban areas occupy 62 million hectares, or approximately 3.2 percent of the total land area. While providing critical opportunities for humans to develop economically, socially, and culturally, cities transform the landscape, placing demands on ecosystem goods and services, and concentrating industrial and municipal waste and pollution.

## Urban and Rural Populations and Growth Rates

Some 340 million people live in urban areas of the LAC region. Urban populations have grown at an average rate of 2.7 percent per year since 1970. This extremely rapid growth is slowing somewhat, and is expected to fall to 1.0 percent by 2030. In contrast, the population of rural areas has remained mostly constant, and in some cases has even declined.

## Population Growth in Urban Agglomerations

The ten most populous cities in LAC are found in six countries in three of the four subregions. The three largest—Mexico City, São Paulo, and Buenos Aires—are among the world's ten most populous cities, with inhabitants numbering from 12.6 to 18.1 million. Growth rates for the region's largest cities are expected to range from 0.4 to 1.5 percent per year over the next 15 years.

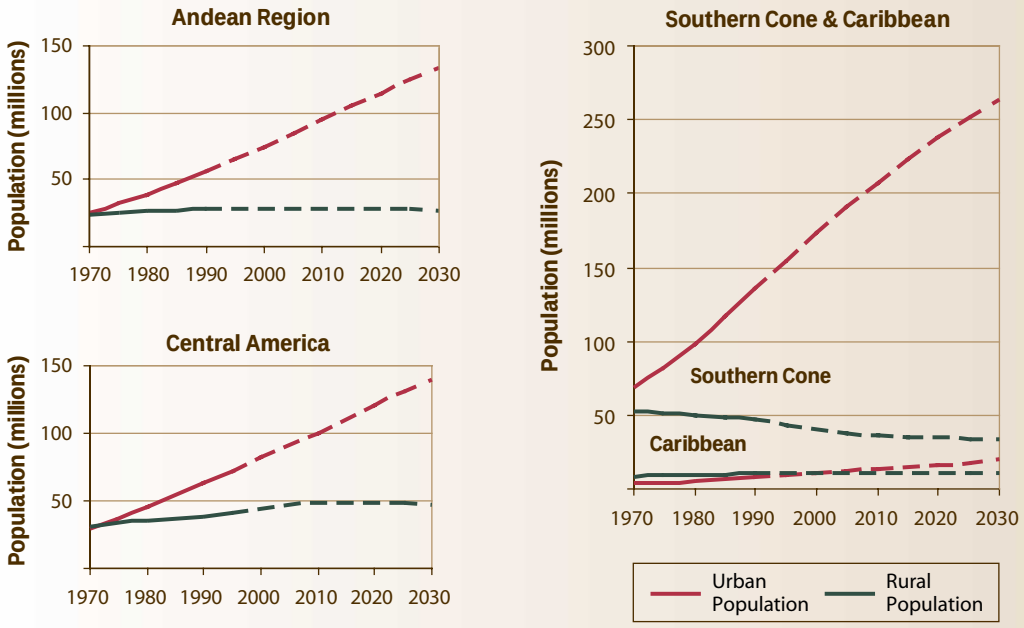
LAC's fastest growing cities (amongst those with a population greater than 750,000) are distributed throughout the subregions. These cities, ranging in size from 1.0 to 3.6 million people, are expanding exceptionally quickly, with growth rates running from 4.0 to 7.3 percent per year.

Small and medium-sized cities (less than 500,000 inhabitants) are home to nearly 35 percent of the region's people. Almost half of all city dwellers live in these less populous cities. Although smaller urban areas face less dramatic environmental problems, the combined ecological footprint of several smaller cities may be as great or even greater than that of a large city.

## Implications

Although important centers of human development, cities often are characterized by rapid and unplanned development that can have harmful economic and environmental impacts. Inadequate housing, poor public transportation systems, air and water pollution, inadequate waste disposal, and land degradation, are all urgent challenges that will face the region's urban areas in the coming decades.

## LAC Population Growth in Urban and Rural Areas, 1970-2030




**Source:** UN Population Division 1999.

## The Ten Largest Cities in Latin America, 2000

| | | 2000 Population (millions) | World Rank | Projected Annual Growth Rate 2000-2015 |
|---|---|---|---|---|
| 1. | Mexico City, Mexico | 18.1 | 2 | 0.4% |
| 2. | São Paulo, Brazil | 17.8 | 4 | 0.9% |
| 3. | Buenos Aires, Argentina | 12.6 | 10 | 0.7% |
| 4. | Rio de Janeiro, Brazil | 10.6 | 18 | 0.7% |
| 5. | Lima, Peru | 7.4 | 26 | 1.5% |
| 6. | Bogotá, Colombia | 6.3 | 34 | 1.5% |
| 7. | Santiago, Chile | 5.6 | 37 | 1.1% |
| 8. | Belo Horizonte, Brazil | 4.2 | 49 | 1.2% |
| 9. | Guadalajara, Mexico | 3.9 | 56 | 0.8% |
| 10. | Porto Alegre, Brazil | 3.7 | 62 | 1.2% |

**Source:** UN Population Division, 1999.

## The Ten Fastest Growing Cities Over 750,000 in LAC, 1985-2000

| | | 2000 Population (millions) | Annual Growth 1985-2000 |
|---|---|---|---|
| 1. | Toluca, Mexico | 1.2 | 7.3% |
| 2. | Guatemala City, Guatemala | 3.2 | 6.8% |
| 3. | Santa Cruz, Bolivia | 1.1 | 5.4% |
| 4. | Santiago, Dominican Rep. | 1.5 | 5.2% |
| 5. | Valencia, Venezuela | 1.9 | 4.8% |
| 6. | Tijuana, Mexico | 1.2 | 4.7% |
| 7. | Port-au-Prince, Haiti | 1.8 | 4.4% |
| 8. | Santo Domingo, Dominican Rep. | 3.6 | 4.1% |
| 9. | Cali, Colombia | 2.7 | 4.1% |
| 10. | São José dos Campos, Brazil | 1.0 | 4.0% |

**Source:** UN Population Division, 1999.

# 3. INCOME, POVERTY, AND EDUCATION

## Introduction

In Latin America and the Caribbean, as in the rest of the world, the relationship between poverty and environmental degradation can be mutually reinforcing. Poor people often suffer disproportionately from air and water pollution, natural disasters, and lack of tenure and control over the resources they depend on for their livelihoods. Poverty, especially pronounced in the rural areas of the region, can aggravate problems of environmental degradation, as poor people often have little choice but to continue to deplete already scarce resources, such as wood fuel and fish stocks.

## Income

Per capita gross domestic product (GDP) in the region is nearly the same as the world average. Over the past 35 years, per capita income has grown, on average, at an annual rate of 1.4 percent. Significant subregional variations exist, with per capita GDP well below the world average in the Caribbean and well above average in the Southern Cone.

## Poverty

The entire region struggles with income inequalities that are among the most extreme in the world. In four countries—Ecuador, El Salvador, Guatemala, and Honduras—more than half the population lives on less than US$2 per day. In another six countries (Bolivia, Mexico, Paraguay, Peru, Trinidad and Tobago, and Venezuela), more than 30 percent survives on this meager income.

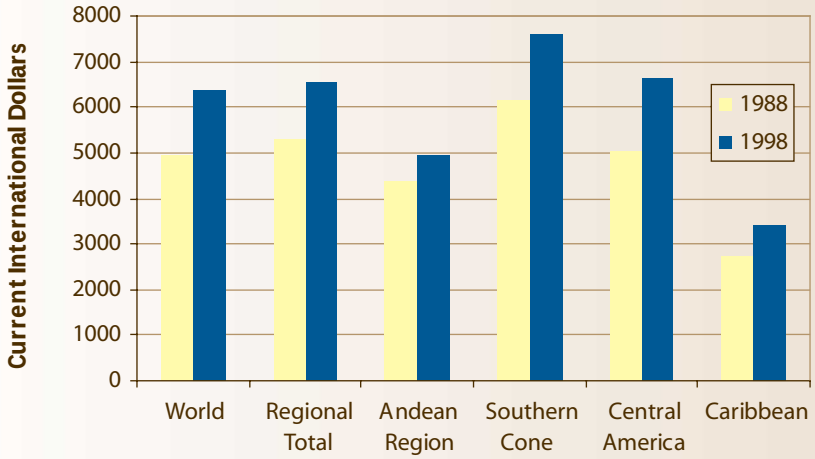
## Education

Adult illiteracy rates (or the percentage of people aged 15 and over who cannot read) declined in the region during the 1990s, from 14 to 11 percent for men and from 17 to 13 percent for women. These rates are considerably lower than the global average for low-income countries (29 percent for men and 38 percent for women, as of 1999). However, basic literacy is not sufficient to equip people for the relatively higher-skilled jobs being created in the industry and service sectors.

## Implications

Although economic growth and rising household incomes can help LAC countries address environmental issues, the widening gap between rich and poor will impede progress. Efforts to eliminate poverty—with improved education, health care and sanitation, job creation, and market and tenure reform—can help spur environmental improvements as well as economic opportunities. Poor peoples' contributions to conservation and environmental protection should be encouraged by policies that promote sound land and water management practices and investments in enhanced productivity.

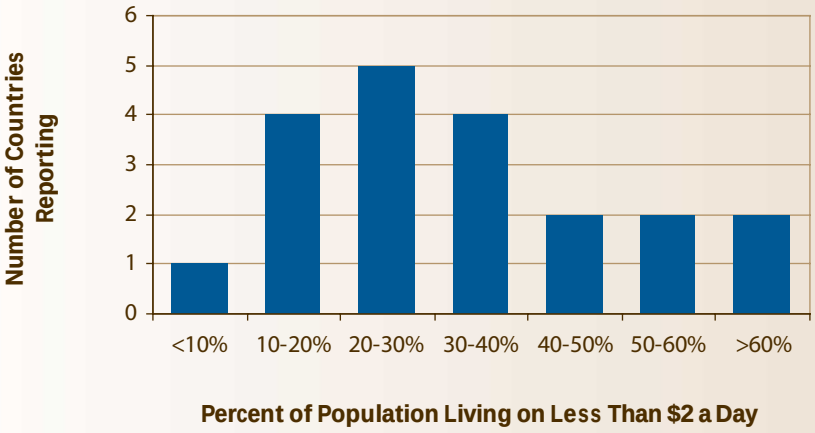
## Gross Domestic Product (PPP) Per Capita, 1988 and 1998




**Source:** World Bank 2000.

**Note:** Gross Domestic Product is converted to international dollars to equalize the purchasing powers of different currencies. PPP = Purchasing Power Parity

## International Poverty Rates in Latin America and the Caribbean: Percent of Population Living on Less Than $2 a Day




**Source:** World Bank 2000.

**Note:** No data available for Argentina, Bahamas, Barbados and Belize. Data are converted to International Dollars to equalize the purchasing powers of different currencies.

# 4. HEALTH AND ENVIRONMENT

## Introduction

Living a long and healthy life is a powerful personal and social goal, sustained by health care and public and private medical services. Important basic indicators, such as trends in life expectancy and the share of the population with access to safe drinking water and adequate sanitation, provide insight into the quality of living conditions and human health.

## Health

Life expectancy in the LAC region has mirrored global trends, with steady increases since the 1950s. Within the region, as worldwide, women live longer than men. Both men and women in Latin America and the Caribbean live longer than the average global life expectancy. As of 2000, life expectancy was 73 years for women (compared to a world average of 67) and 66 years for men (compared to a world average of 64).

## Clean Water, Sanitation, and Waste Management

In areas where clean water and safe sanitation services are lacking, diarrheal diseases and cholera can cause serious illness and death. Within all LAC subregions, access to safe drinking water in rural areas is below the global average. Urban residents do better, with all subregions except the Caribbean at or above the global average. Over 80 percent of the urban population in LAC has access to adequate sanitation, equaling or surpassing the world average. Access to sanitation in rural areas also is above the world average, though it remains far below the World Health Organization (WHO) standard of 100 percent. Among LAC subregions, the rural population of the Caribbean has the greatest access to adequate sanitation (61 percent), but this figure is still nearly 25 percentage points below access to adequate sanitation in urban areas.

Disposal of solid waste, especially in smaller cities, was identified in a recent survey, as one of the region's most important environmental health problems. Waste scattered in streets and parks, as well as illegal or poorly managed waste disposal sites, is a highly visible problem and a concentrated location for disease vectors.

## Air Quality

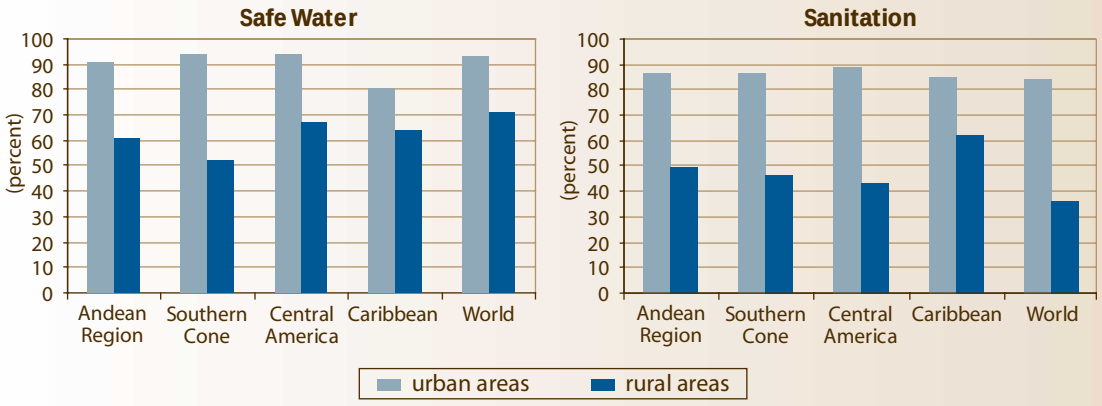
Air quality in many cities of this region is poor. Several LAC cities exceed WHO guidelines for health-damaging air pollutants, including total suspended particulates, sulfur dioxide, and nitrogen dioxide. These emissions are responsible for elevated rates of respiratory diseases and cancer as well as significant economic damages. The transportation sector is one of the largest contributors to poor air quality. Car ownership rose substantially in the 1990s, providing increased mobility for trips to work, shop, visit, and recreation, but also creating more traffic, congestion, noise, and higher levels of air pollution. Public transport may be able to

offset some of these problems. Rail, tram, or subway systems serve at least one city per country within most subregions, except the Caribbean.

## Implications

Continued lack of access to basic systems to manage water, sanitation, and air quality is a fundamental problem for human health and the environment in the LAC region. Longer life expectancy in urban areas is an indication of improved living conditions, but poor access to safe drinking water and sanitation facilities persists in rural areas. Policies and investments that strengthen both rural and urban infrastructure are sorely needed throughout the region.

**Access to an Improved Water Source and Adequate Sanitation by Subregion, 2000**




**Source:** World Bank 2001; UN Population Division 1998.
**Note:** Calculations exclude the following countries due to lack of data: Belize, Barbados, Bahamas, Guyana, Suriname, and Trinidad and Tobago.

**Concentration of Key Pollutants in Major Cities, 1990-2000**

| City | Population in 2000 (thousands) | Total Suspended Particulates (micrograms per cubic meter) | Sulfur Dioxide (micrograms per cubic meter) | Nitrogen Dioxide (micrograms per cubic meter) |
|---|---|---|---|---|
| Cordoba, Argentina | 1,423 | 97 | .. | 97 |
| Rio de Janeiro, Brazil | 10,582 | 139 | 129 | .. |
| São Paulo, Brazil | 17,755 | 86 | 43 | 83 |
| Santiago, Chile | 5,538 | .. | 29 | 81 |
| Bogota, Colombia | 6,288 | 120 | .. | .. |
| Guayaquil, Ecuador | 2,293 | 127 | 15 | .. |
| Quito, Ecuador | 1,754 | 175 | 22 | .. |
| Mexico City, Mexico | 18,191 | 279 | 74 | 130 |
| Caracas, Venezuela | 3,151 | 53 | 33 | 57 |
| **WHO Guidelines** | | **90** | **50** | **50** |

**Source:** WRI 1998.
**Note:** Air pollution data are for the most recent year available in 1990-98; total suspended particulates data are from 1990-95; most data are for 1995.

# 5. WATER AVAILABILITY AND USE

## Introduction

The Latin America and Caribbean region is well-endowed with water resources. Major river systems, including the Amazon, Orinoco, and Parana, contain more than 30 percent of the world's continental surface water. Other areas of the region, however, are considered drylands. Lack of water in these areas, as well as increasing demands from industrial activity, agricultural expansion, and households, points to water availability as a growing concern for the region, particularly in the Caribbean subregion.

## Water Supply and Use

Total internal water resources available per capita vary widely among the LAC subregions. For the year 2000, Central America had less than 10,000 cubic meters available per person while the Andean subregion had close to 50,000. Some countries in the Caribbean and Central American subregions had less than 5,000 cubic meters available per person in 2000.

The principal sector for water use in LAC is agriculture. In 1990, this sector was responsible for 81 percent of the water consumption. Agriculture is expected to account for a declining share of water consumption, falling to 69 percent by 2025. Conversely, the share of water consumed by the industrial sector is projected to rise considerably.

## Water Supply by River Basin

Watersheds (also known as river basins and defined as the entire area drained by a major river system or one of its main tributaries) play a critical role in the environment and economy of Latin America and the Caribbean. They provide sources of water, food, hydropower, recreational amenities, transportation routes, habitat for plants and animals, flood control, nutrient recycling, and restoration of soil fertility.

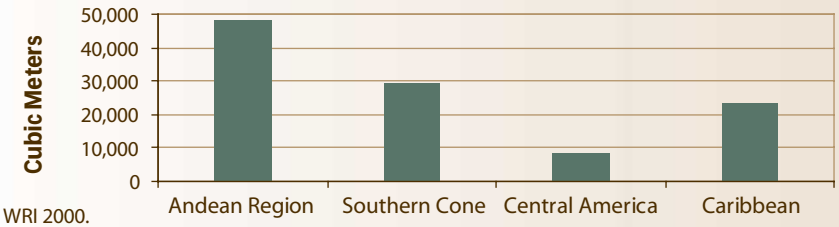
According to projections of available water supply through 2025, several large basins in the LAC region will have less than 1,700 cubic meters of water available per person per year, a level that is considered water "stressed" and indicates vulnerability to disruptive water shortages. Watersheds with less than 1,000 cubic meters available per person per year are considered to be in a state of water scarcity and could face more severe consequences for food production and economic development.

## Implications

Freshwater resources provide valuable environmental goods and services. However, rapid increases in demand, inefficient use, increases in population, rapid deforestation, and increasing climate variability will lead to stress and scarcity unless there is a shift in policies. Improved integrated water resources management, combined with

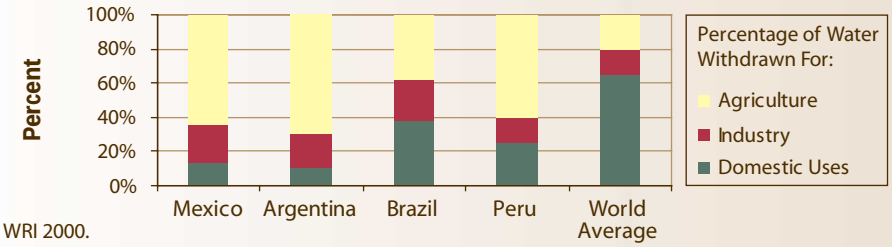
investments in sanitation and water conservation projects offer high economic, social, and environmental returns. Achieving such progress will require ambitious efforts to find the finances, develop appropriate technologies, strengthen institutions, and build public awareness of the need for and benefits of water conservation.

## Total Internal Water Resources Per Capita, 2000



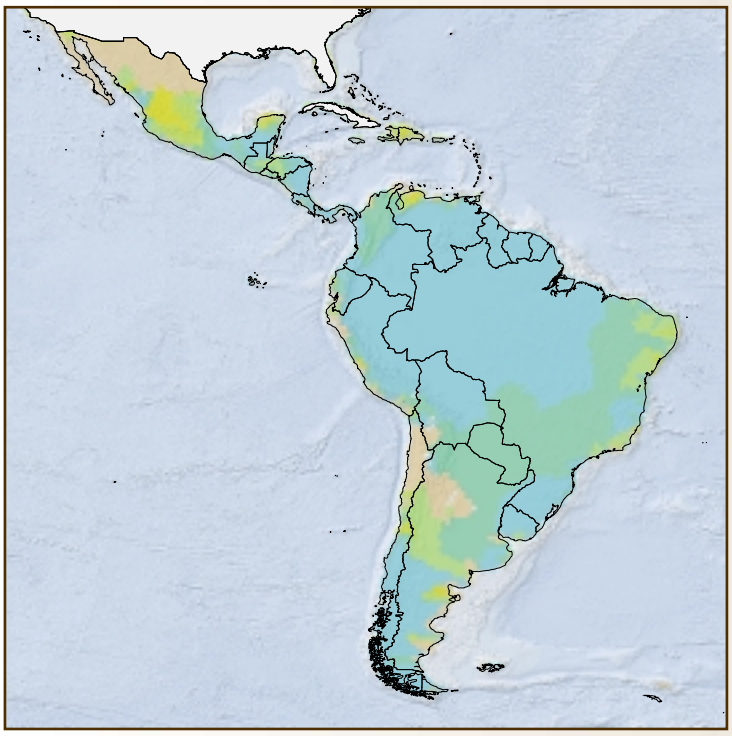

**Source:** WRI 2000.

## Water Withdrawals By Sector (selected countries)




**Source:** WRI 2000.

## Renewable Water Supply by River Basin, Projected for 2025



**Annual renewable water supply ($m^3$/person/year)**

- <500
- 500 - 1,000
- 1,000 - 1,700
- 1,700 - 4,000
- 4,000 - 10,000
- >10,000

**Source:**
CIESIN et al. 2000, Fekete et al. 1999.

**Projection:**
Geographic

# 6. CLIMATE CHANGE

## Introduction

Changing weather patterns, rising sea level, and the increasing frequency of extreme weather events could have severe impacts on Latin America and the Caribbean. The effects of global climate change are likely to be felt in many sectors, including agricultural production, biodiversity, and human health. Increasingly, the region will be confronted with questions of how to provide for human welfare in the face of potential impacts from a changing climate.

## Greenhouse Gas Emissions

In the LAC region, the most complete information available on greenhouse gas emissions is for carbon dioxide. (Few LAC countries track emissions of other greenhouse gases, such as sulfur dioxide and nitrogen oxide, which are presumed to be lower for this region.) Per capita carbon dioxide emissions from fossil fuel combustion and cement manufacturing totaled an estimated 2.8 metric tons in 1997. This figure represents only a 12 percent rise over the 1980 level of 2.5 metric tons per capita, quite a slow rate of increase. Moreover, per capita emissions of carbon dioxide in the LAC region are less than 22 percent of emissions for more industrialized countries.

In addition to modest per capita emission rates, total emissions of carbon dioxide from the region remain low, though here the rate of increase is rapid. Carbon dioxide emissions reached 1.36 billion metric tons in 1997, a 53 percent increase over 1980's level of 885 million metric tons.

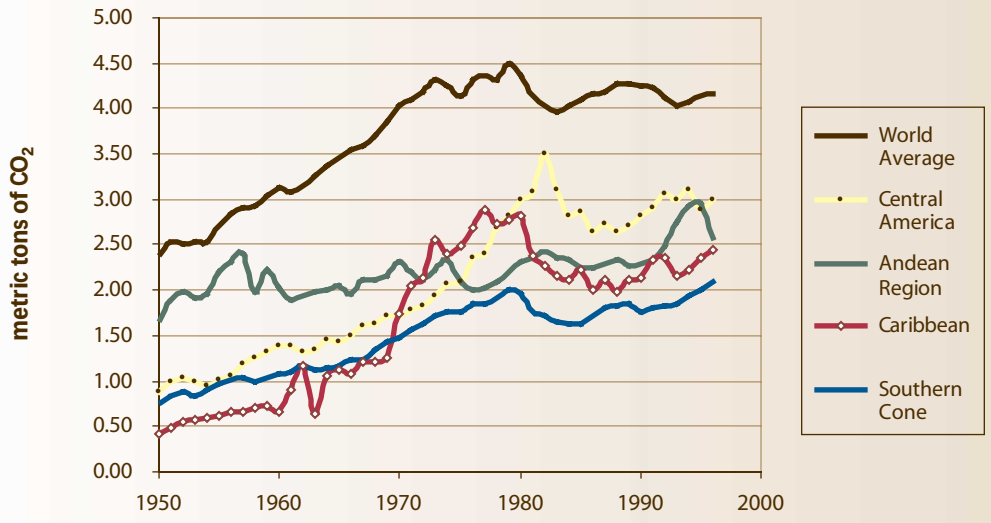
## Potential Threats

The concentration of large cities along the coasts makes the region especially susceptible to rises in the sea level. Possible environmental impacts from sea level rise include flooding and contamination, loss of fish breeding grounds, and destruction of coral reefs. Global warming also will affect agricultural and water resources with possible increases in human morbidity and mortality related to heat and the spread of tropical disease vectors.

## Implications

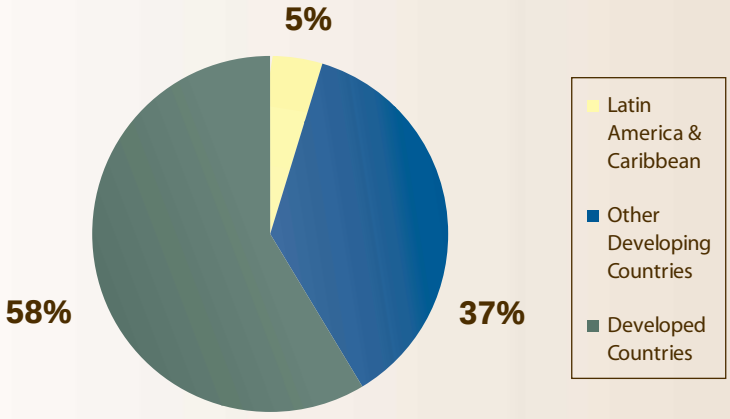
Developing countries are expected to become the primary producers of greenhouse gas emissions by 2020. The principal source of these emissions in the region will be fossil fuel used for transportation and electricity generation as well as logging and land clearing for agricultural expansion. Policies to support economic and social development in the face of global climate change will need to address increased energy efficiency, use of alternative fuels, and adaptations to climate change.

## Carbon Dioxide Emissions Per Capita, 1950-1996




**Source:** CDIAC, 1999.

## Global Share of $CO_2$ Emissions, 1996




**Source:** CDIAC, 1999.

# 7. ENERGY PRODUCTION AND CONSUMPTION

## Introduction

Energy use is an essential component of economic growth and development. Fuel is needed to power transportation and for commercial, residential, and industrial uses. Energy production and consumption in Latin America and the Caribbean is comparatively low, although these are rising in concert with global trends.

## Overall Energy Production and Consumption

Energy production in the LAC region totaled nearly 800 million metric tons of oil equivalent in 1997. This represents an increase of about 40 percent relative to the 1987 level. Energy consumption increased by 30 percent over this same period, but remains low relative to consumption in high-income countries. The intensity of energy use varies across the region. Much of the region's energy consumption is concentrated in Argentina, Brazil, Mexico, and Venezuela. In these countries, and across the region, the sectors consuming the most energy are industry (region-wide average of 38 percent) and transportation (32 percent on average).

## Renewable Energy

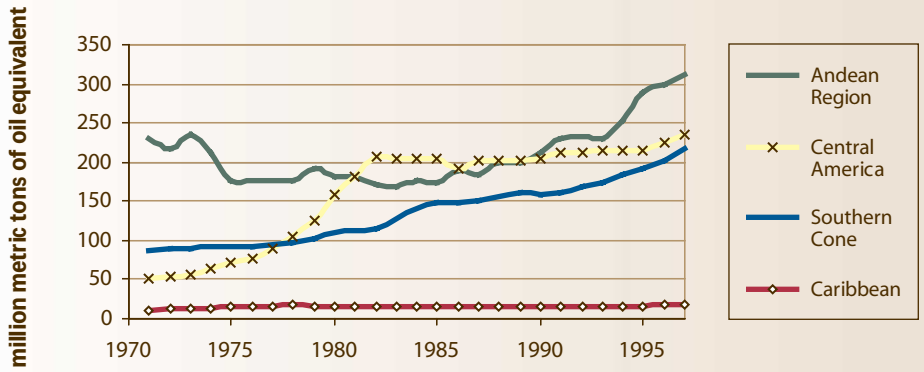
Use of renewable sources to produce energy increased by approximately 20 percent between 1987 and 1997. Growth of renewables was especially fast in the Caribbean and the Southern Cone subregions. The region as a whole relies heavily on hydroelectricity, a carbon-emission-free source of energy. In the ten years preceding 1997, hydroelectric power production increased by about half. Several countries, including Bolivia, Guatemala, and Paraguay, more than doubled their use of hydropower during this period. However, projected sources of electric power generation in LAC through 2020 show a declining contribution from hydropower (on a percentage basis) and rising use of natural gas to generate electricity.

Another important source of renewable energy in the region is biomass and biological wastes such as wood, crop wastes, and animal wastes. Some countries experienced large increases in the use of these fuels, ranging from 40 to 138 percent between 1987 and 1997. In other countries, however, the use of biofuels declined.

## Implications

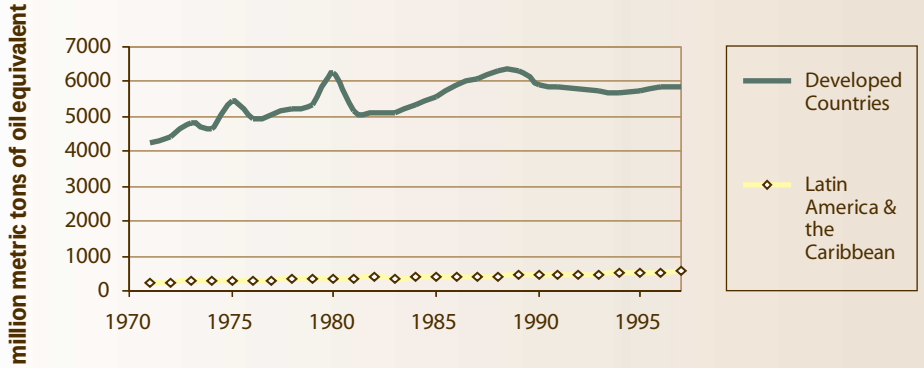
The development and use of energy is costly and often a source of environmental pollution. Energy exploration, mining, transport, and consumption have important effects on the environment, including air pollution, greenhouse gas emissions, land use change, and degradation of water resource quality. However, there are ample opportunities within the region to increase energy efficiency and reduce harmful pollution while also promoting economic development.

## Total Indigenous Energy Production, 1971-1997



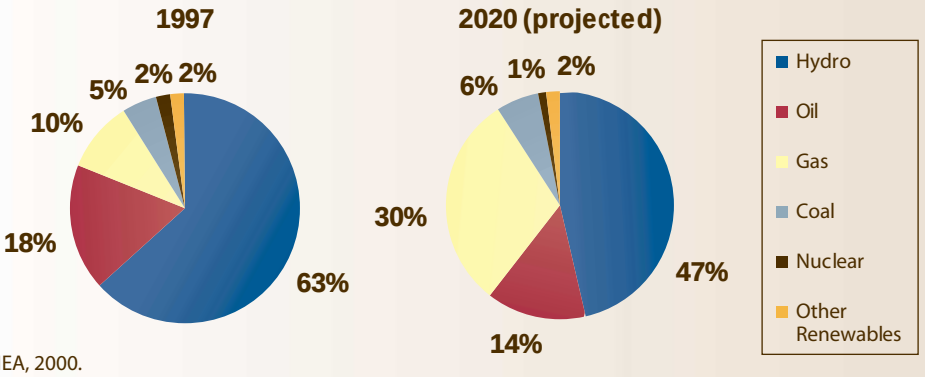

**Source:** IEA, 1999.

## Total Energy Consumption From All Sources, 1971-1997




**Source:** IEA, 1999.

## LAC Electricity Generation By Sector




**Source:** IEA, 2000.
**Note:** Regional estimates include countries not affiliated with IDB.

# 8. NATURAL DISASTERS

## Introduction

Natural disasters—including earthquakes, floods, fires, volcanic eruptions, tropical storms, hurricanes, and avalanches—kill and injure thousands of people every year. These calamities also can wreak serious environmental and economic damage, endangering or even destroying people's ability to earn a living. Many consider the LAC region to be increasingly vulnerable to damage from natural disasters as a result of shifting human settlements as well as more severe and frequent weather events due to global climate changes.

## Number and Type of Natural Disasters

Worldwide, the number of geophysical disasters such as earthquakes and volcanic eruptions, reported over the last decade, has remained essentially constant. In contrast, the number of hydro-meteorological disasters, such as floods and tropical storms, has more than doubled since 1966.

The Pacific coast of Latin America is especially vulnerable to natural disasters. Between January 1995 and June 2001, there were 156 significant earthquakes in the region (magnitude of 6.5 or greater on the Richter scale, or ones causing fatalities, injuries, and substantial damage). The largest of these earthquakes occurred along the Pacific coast in Chile, Mexico, and Peru. The most recent significant earthquake, recorded at 6.6 magnitude, occurred in June 2001 on the coast of Peru near Arequipa, killing 95 people and injuring 1,500.

## Estimated Damage from Natural Disasters

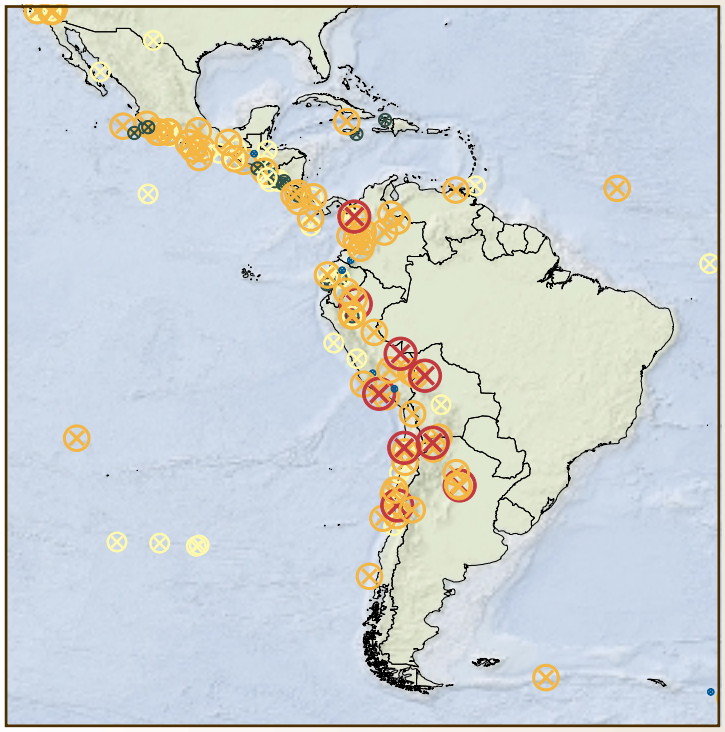
The United Nation's Economic Commission for Latin America and the Caribbean (ECLAC) reports that, during the early 1990s, natural disasters (including storms and floods, earthquakes, and volcanic eruptions) claimed approximately 6,000 lives and caused economic losses of at least US$1.5 billion annually in the region.

The ten largest natural disasters in Latin America and the Caribbean in the 20th century, in terms of economic losses, each caused damage valued from US$1.4 billion to US$4 billion. Topping this list was the 1985 Mexican earthquake. In terms of lives lost, the region's most severe natural disaster was the 1970 Peruvian earthquake, with more than 66,000 lives lost.

## Implications

Primary causes of vulnerability to natural disasters in the region include rapid urbanization, widespread poverty, poor land use management, and ineffective public policies. The success of efforts to reduce damage from natural disasters in this region depends on adopting an approach that incorporates pre-disaster reduction of risks and early-warning monitoring and communication as well as post-disaster recovery.

## Significant Earthquakes in Latin America and the Caribbean



**Seismicity (Mb)**

- Less than 5
- 5 - 5.5
- 5.5 - 6
- 6 - 6.5
- Greater than 6.5

**Source:**
NEIC 2001.
**Projection:**
Geographic
**Note:**
'Significant' Earthquakes are defined by NEIC to be Earthquakes of magnitude 6.5 or greater or ones that caused fatalities, injuries or substantial damage.

## Ten Largest Natural Disasters in LAC According to Economic Loss, 1900-1999

| Country | Type of Disaster | Year | Economic Loss $US (000s) |
|---|---|---|---|
| Mexico | Earthquake | 1985 | 4,000,000 |
| Colombia | Earthquake | 1999 | 2,900,000 |
| Argentina | Flood | 1998 | 2,500,000 |
| Brazil | Drought | 1978 | 2,300,000 |
| Dominican Rep. | Hurricane (Georges) | 1998 | 2,193,400 |
| Venezuela | Flood | 1999 | 2,000,000 |
| Honduras | Hurricane (Mitch) | 1998 | 2,000,000 |
| Mexico | Hurricane (Arlene, Beatriz) | 1993 | 1,670,000 |
| Chile | Earthquake | 1985 | 1,500,000 |
| Mexico | Hurricane (Gilbert) | 1988 | 1,350,000 |

**Source:** IFRC, 2001.

## Ten Largest Natural Disasters in LAC According to Loss of Human Life, 1900-1999

| Country | Type of Disaster | Year | Number of Lives Lost |
|---|---|---|---|
| Peru | Earthquake | 1970 | 66,794 |
| Guatemala | Flood | 1949 | 40,000 |
| Venezuela | Flood | 1999 | 30,000 |
| Chile | Earthquake | 1939 | 30,000 |
| Guatemala | Earthquake | 1976 | 23,000 |
| Colombia | Volcano (Nevado del Ruiz) | 1985 | 22,800 |
| Honduras | Hurricane (Mitch) | 1998 | 14,600 |
| Nicaragua | Earthquake | 1972 | 10,000 |
| Argentina | Earthquake | 1944 | 10,000 |
| Argentina | Earthquake | 1949 | 10,000 |

**Source:** IFRC, 2001.

# 9. MINERALS AND MINING

## Introduction

The countries of Latin America and the Caribbean are endowed with a diversity of minerals including metals, industrial minerals, and fossil fuels. In several countries, the mining, processing, and marketing of mineral commodities play significant roles in supporting national economies. Opportunities are available for export revenues, business developments, investments by domestic and foreign investors, and joint-venture projects. The mining industry, however, will come under increasing scrutiny from local communities that bear the burden of mining waste and pollution. More stringent environmental regulations and controls will be necessary to curb environmental damages to human health, to address land tenure issues and the rights of indigenous communities, and to preserve ecosystem goods and services.

## Trends in Regional Production

In 1998, LAC produced nearly 40 percent of the world's silver and copper; 20-30 percent of the world's bauxite, tin, iron ore, and zinc; and 15 percent of the world's lead and nickel. The region also was globally significant for its production of steel, crude oil, natural gas, petroleum refinery derivatives, and coal. Generally rising production of these resources in recent years (1985-1998) has boosted Latin America's economy and position in the global mining industry. Mining activity is found principally in the Andean subregion, along the central Pacific coast.

## Trends in National Production

The region has increased its share of world gold production, with regional mining centered in Guyana, Venezuela, and most of the Andean countries. As of 1998, the bauxite industry has expanded in Brazil and Venezuela, primarily for domestic aluminum production. Output of crude oil also was at its peak in 1998 in six countries: Argentina, Brazil, Colombia, Ecuador, Mexico, and Venezuela. Colombia, Mexico, Venezuela, and Brazil have led coal production over the past two decades, and coal mined in the region has taken an increased share of local markets.

## Implications

Economic growth in LAC, characterized by increased privatization, joint-venture projects, and reduced trade barriers, along with growing awareness of environmental protection, is leading to the formation of more comprehensive environmental regulations for all Latin American industries, including mining and energy. The actual implementation of these new regulations will require greater attention on the part of the mining sector—for industrial profitability as well as for environmental protection.

## Selected Active Mines in Latin America and the Caribbean

- Silver
- Copper
- Iron
- Nickel
- Lead
- Tin
- Zinc
- Multiple Commodities

**Source:**
McFaul et al., 2000.
**Projection:**
Geographic
**Note:**
The mines shown in this map are a subset of the Mineral Resources Data System (MRDS) data set. Only active, producing mines with the listed minerals as major commodities are shown.

The MRDS database does not contain any entries listing bauxite as a distinct commodity.

## Trends in LAC Mineral Production According to Percentage of World Output (a), 1985-1998

| Commodity | 1985 | 1990 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|
| Silver | 35 | 35 | 33 | 40 | 42 | 39 |
| Copper | 26 | 26 | 33 | 36 | 37 | 38 |
| Bauxite | 20 | 24 | 30 | 30 | 32 | 30 |
| Tin | 25 | 28 | 31 | 32 | 29 | 24 |
| Iron Ore | 17 | 21 | 22 | 22 | 22 | 24 |
| Zinc | 17 | 17 | 20 | 21 | 21 | 20 |
| Lead | 15 | 13 | 16 | 16 | 16 | 15 |
| Nickel | 6 (b) | 11 | 14 | 15 | 16 | 15 |
| Crude Oil | 12 | 11 | 12 | 14 | 12 | 15 |
| Gold | 10 | 9 | 10 | 12 | 12 | 13 |
| Petroleum Products | 7 | 9 | 7 | 8 | 8 | 10 |
| Aluminum | 8 | 10 | 10 | 10 | 10 | 9 |
| Cement | 7 | 7 | 6 | 7 | 7 | 8 |
| Steel | 5 | 5 | 6 | 6 | 7 | 7 |
| Coal | 1 | 1 | 1 | 1 | 1 | 2 |

**Source:** Doan et al. 1998.
**Note:** a) By volume; b) Estimated

# 10. SUSTAINING AGRICULTURAL PRODUCTION

## Introduction

Agriculture has historically played an important role in the economic and social development of the region. Emphasis has recently shifted from a focus solely on production and productivity growth to a wider concern with food security and the long-term capacity of agriculture lands to produce food, fiber, and other ecosystem goods and services.

## Extent and Composition of Agricultural Land

The region contains approximately 6.2 million square kilometers of agricultural land or about 17 percent of the global total. Of the other six world regions, only Asia and Europe have more agricultural land (29 percent and 21 percent, respectively). The majority of the agricultural land in the region is permanent pasture (nearly 80 percent) with the remaining 20 percent primarily annual cropland. Only a very small amount of land is in permanent crops.

Agricultural production for the region, including both crops and livestock, increased during the 1998-2000 period relative to the base period. The indexes for both periods are close to the average production values for the globe. Total average production of cereals, roots and tubers, and meat increased between the late eighties and late nineties. The largest increases were in meat production, increasing by 41 percent for Central America and the Caribbean, and by 80 percent for South America.

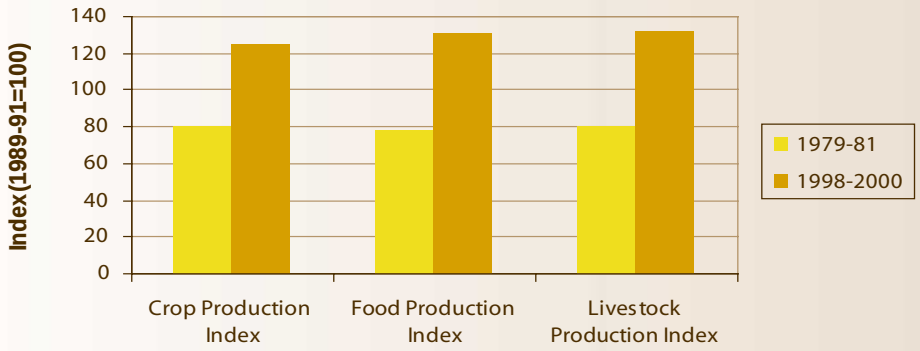
## Condition of Agricultural Land

Experience shows that cropland can be managed for increases in short-term production and for long-term sustainable yields. A map overlaying yield in cereal crops (rice, wheat, maize, and sorghum) and soil nutrient balances shows spatial patterns in the distribution of soil fertility. Areas of stable or increasing cereal crop yields with positive or only marginally negative nutrient balances are found in the Southern Cone and the Andean subregions. Potential trouble spots, or areas in which yields are stable or decreasing with larger nutrient deficits, are scattered throughout the region, predominately in the Southern Cone.

## Implications

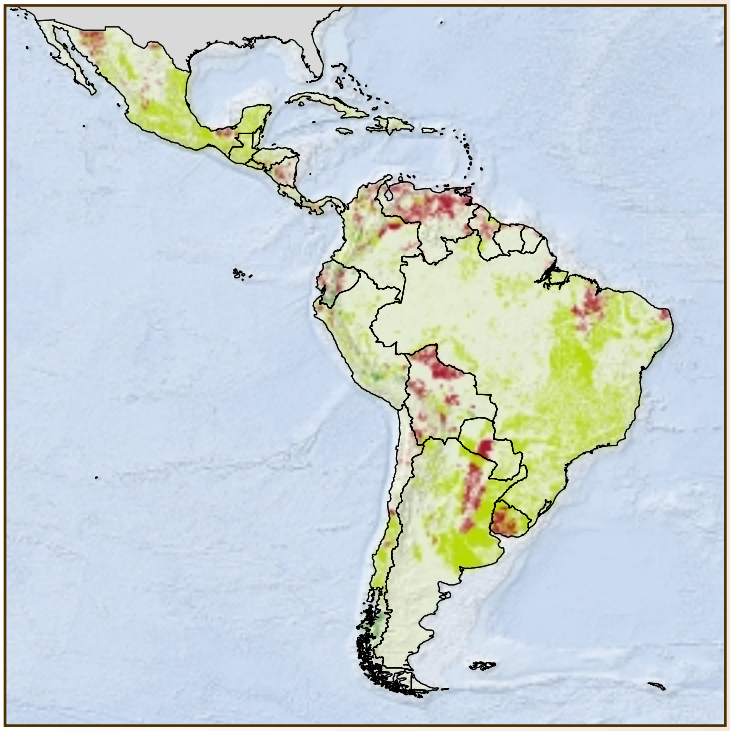
The productive capacity of agricultural lands in the LAC region will not be sustainable over the long term without widespread changes in conservation. Policies and practices must be implemented to maintain soil fertility and replenish nutrient stocks to degraded lands if crop and food production is to meet social, ecological, and economic goals.

## Agricultural Output Index for Latin America and the Caribbean, 1979-81 and 1998-2000




**Source:** World Bank 2001.
**Note:** The FAO indices of agricultural production show the relative level of the aggregate volume of production for each year in comparison with the base period 1989-91.

## Potential Trouble Spots and Bright Spots for Soil Fertility in Latin America and the Caribbean



Potential bright spots
Some negative trends
Potential trouble spots
Not applicable

**Source:**
Sebastian and Wood 2000.
**Projection:**
Geographic
**Note:**
Cereal nutrient balances are estimated as the difference between mineral and organic fertilizer application and crop residue recycling for cereals (inputs) and the nutrients extracted in cereal grain (outputs). Nutrient balances were allocated to specific geographic areas using subnational 1993-95 production statistics and information on climate, soil, and elevation. Cereal yield trends are based on subnational 1975-95 data for rice, wheat, maize, and sorghum. The map of potential trouble spots and bright spots combines the information on nutrient balances and cereal yield trends.

# 11. BIODIVERSITY

## Introduction

The Latin America and Caribbean region is known for its biotic richness. Its vast tropical zones contain nearly 70 percent of the world's tropical rainforests, the most floristically diverse of all ecosystems. The region's rainforests contain 40 percent of the world's plant and animal species. The primary threat to maintaining biodiversity is loss of habitat through the conversion of land to agriculture and urbanized areas, inappropriate logging and mining, invasive species, and excessive hunting and fishing.

## Land Use and Conservation

Land with protected status in the region has increased over the past 75 years, from a base of essentially zero to more than 2 million square kilometers by the 1990s. However, during this period, about 6.3 million square kilometers of land were converted to agriculture and urban uses. The majority of protected area in the region is forest; however, grasslands and agricultural lands also include protected areas.

The spatial distribution of the protected land varies across the region. For example, in Central America protected areas are interspersed throughout agricultural land while in South America many protected areas are found along the Amazon border. Agricultural pressures on biodiversity and habitat are likely to be intense in the interspersed sites, while pressures on more concentrated areas of protected land may depend on patterns of frontier settlement. The Mesoamerican Biological Corridor represents one of the first world projects to manage large tracts of land for biodiversity conservation, including national parks and public lands as well as private lands.

## Status of Species

Habitats in the LAC region sustain some of the most species-rich environments in the world. The numbers of threatened species in the region, however, continues to rise. For example, 290 species (8 percent) of neotropical birds are considered at risk of extinction. BirdLife International has identified 596 key areas in Latin America (excluding the Caribbean) which, if adequately protected, would help ensure the survival of 97 percent of the threatened bird species. These areas are scattered throughout the region, with concentrations in the Andean subregion and along the southeastern Brazilian coast.

## Ecotourism

Ecotourism represents a way for host countries to capture some of the economic value associated with aesthetic and biological appreciation of biodiversity. In the LAC regional economy, international tourism accounted for more than US$41 billion in 1999, double the level of 1990. Worldwide, approximately 20 percent of international travel is classified as nature-related tourism. Ecotourism may be even more prevalent in LAC, especially in countries such as Brazil and Peru, which report that over 40 percent of tourists visited natural sites (in 1998

and 2000, respectively). This expanding nature-based travel can generate significant revenues and provide a tangible economic return on investment in biodiversity conservation, but also may place considerable environmental pressures on the very resources it is meant to protect.

## Implications

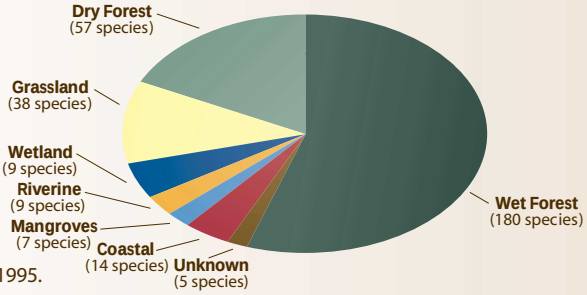
Expanding the amount of land with protected status will help to preserve habitat for species survival. Efforts to identify new sites and protect known sites as well as to manage all lands effectively will help to guarantee the integrity of habitats required to sustain biodiversity and to limit the numbers of species at risk of extinction. New and innovative financial instruments will be needed to channel public and private resources toward the conservation of biodiversity.

### Key Areas for Threatened Birds in Latin America and the Caribbean

Key Area

**Source:**
Wege and Long 1995.
**Projection:**
Geographic

### Key Habitats for Threatened Birds in Latin America




**Source:** Wege and Long, 1995.

# 12. DEFORESTATION AND FIRE

## Introduction

Forests fulfill numerous functions in the Latin America and Caribbean region. They provide timber, fuel, and food as well as sites for recreation and tourism. They offer watershed protection, habitat for plants and animals, and storage for vast amounts of carbon. Conflicts regarding the priority of these goods and services are on the rise, as the extent of natural forest area in the region continues to shrink.

## Forest Extent and Change

LAC is the most forested region in the world. FAO estimates that in 2000, forests covered nearly 900 million hectares of the region's land area. Rates of forest loss, however, are dramatic. During the 1990s, the Southern Cone alone lost 2.7 million hectares of forest cover, which amounts to an annual deforestation rate of 0.41 percent. In some countries, especially Brazil, extensive tracts of forest were destroyed. In smaller countries, such as Haiti and El Salvador, losses are not as large in absolute terms, but the rates of deforestation in these two countries (5.7 and 4.6 percent, respectively) are among the highest in the world.

## Forest Goods and Services

Many goods and services provided by forests in LAC are in deteriorating condition. The capacity of the forest to supply clean water is being compromised by loss of forest cover as well as soil erosion and sedimentation. Maintenance of biodiversity, and diversity-dependent goods such as biopharmaceuticals, is threatened by conversion of forest habitat, habitat fragmentation, logging, and invasion by exotic species. The capacity to store carbon also is declining as forests are cleared and land is degraded. Forest-based production of fiber is on the rise, with harvesting from both natural forests and plantations. However, gains in fiber production may be contributing directly to losses in other forest goods and services, as natural forests are cleared and converted to plantations.

## Extent and Impact of Fires

Fire is a useful tool for land clearing as well as maintaining some natural ecosystems. Very hot and frequent fires, however, can be harmful, destroying vegetation, increasing soil erosion, and releasing atmospheric pollutants. Plotting the location of fires using satellite imagery shows that the greatest incidence is around the edges of the Amazon Basin. Logging and drought renders these areas more susceptible to burning. Some parts of the region have experienced low rainfall in recent years (especially 1997 and 1998) with unusually prolonged fire seasons. Analysis of the fire data show large increases in the numbers of fires during these droughts, with notable extension of fires into areas that are generally not expected to burn.

## Implications

Logging, agricultural expansion, mining, and urbanization are primary contributors to forest loss. However, with strong political leadership as well as development and promotion of sustainable management practices, remaining forests can be conserved. Increased fire frequency, whether used as a management tool or caused by drought, will require continued monitoring to determine its extent and effects.

### Deforestation in Latin America and the Caribbean

| Country/ Subregion | Total Forest Area 2000 (000 ha) | Forest Cover Change 1990-2000 (000 ha/year) | Forest Cover Change 1990-2000 (%/year) |
|---|---|---|---|
| Bolivia | 53,068 | -161 | -0.3 |
| Colombia | 49,601 | -190 | -0.4 |
| Ecuador | 10,557 | -137 | -1.2 |
| Peru | 65,215 | -269 | -0.4 |
| Venezuela | 49,506 | -218 | -0.4 |
| **Andean** | **227,947** | **-975** | **-0.4** |
| Argentina | 34,648 | -285 | -0.8 |
| Brazil | 543,905 | -2,309 | -0.4 |
| Chile | 15,536 | -20 | -0.1 |
| Paraguay | 23,372 | -123 | -0.5 |
| Uruguay | 1,292 | 50 | 5.0 |
| **South America** | **618,753** | **-2,687** | **-0.4** |
| Belize | 1,348 | -36 | -2.3 |
| Costa Rica | 1,968 | -16 | -0.8 |
| El Salvador | 121 | -7 | -4.6 |
| Guatemala | 2,850 | -54 | -1.7 |
| Honduras | 5,383 | -59 | -1.0 |
| Mexico | 55,205 | -631 | -1.1 |
| Nicaragua | 3,278 | -117 | -3.0 |
| Panama | 2,876 | -52 | -1.6 |
| **Central America** | **73,029** | **-972** | **-1.1** |
| Bahamas | 842 | n.s. | n.s. |
| Barbados | 2 | n.s. | n.s. |
| Dominican Republic | 1,376 | n.s. | n.s. |
| Guyana | 16,879 | -49 | -0.3 |
| Haiti | 88 | -7 | -5.7 |
| Jamaica | 325 | -5 | -1.5 |
| Suriname | 14,113 | n.s. | n.s. |
| Trinidad and Tobago | 259 | -2 | -0.8 |
| **Caribbean** | **33,884** | **-63** | **-0.2** |
| **LAC Region** | **953,613** | **-4,697** | **-0.4** |
| **World** | **3,869,455** | **-9,391** | **-0.22** |

**Source:** FAO 2000.
**Note:** Values include plantations as forest. n.s. = not significant, indicating a very small value.

### Fires in Latin America and the Caribbean

**Fire**

**Source:**
Arino and Melinotte 1997.
**Projection:**
Geographic
**Note:**
Fire data were collected by NOAA's Advanced Very High Resolution Radiometer (AVHRR) satellite during daylight passes in 1993. Cells where fires occurred have been enlarged to enhance visibility.

Data are not available north of 20° latitude.

# 13. COASTAL AND MARINE RESOURCES

## Introduction

Coastal and marine ecosystems provide an enormous range of goods and services to humans. These ecosystems harbor valuable aquatic life and genetic diversity, store and cycle nutrients, filter pollutants, protect shorelines from erosion and storms, help regulate global hydrology and climate, serve as carbon sinks, and provide places for leisure and recreational activities. Despite the importance of these goods and services, many coastal and marine areas face serious problems with ecosystem degradation, resource use conflicts, and depletion of fish stocks.

## Ecosystems

Coral reefs serve as an indicator of the overall condition of coastal and marine ecosystems. The reefs within the Caribbean represent approximately 9 percent of the world total, with two-thirds at risk from pollution, sedimentation from upland deforestation, and overfishing. Reefs in other subregions experience similar degradation problems, from intense fishing pressures, sediment runoff, and nutrient pollution as well as damage from natural disasters.

## Resource Use Conflicts

Diverse users compete for coastal and marine resources in the LAC region. The fishing industry depends on commercial fish species. Plant and animal species need these rich areas for breeding and feeding. Residents of major cities near the coast rely on a stable coastline and clean water. Tourists come for rest, recreational activities, and aesthetic beauty.

Coastal areas support 60 of the region's 77 largest cities and nearly 75 percent of its inhabitants. Tourism plays a large role in the economies of coastal areas in LAC, as it does in the region as a whole (see also Issue 11: Biodiversity). Increased tourism provides more opportunities for employment and foreign exchange revenues. Scuba diving alone is expected to generate as much as US$1.2 billion in the Caribbean by 2005.

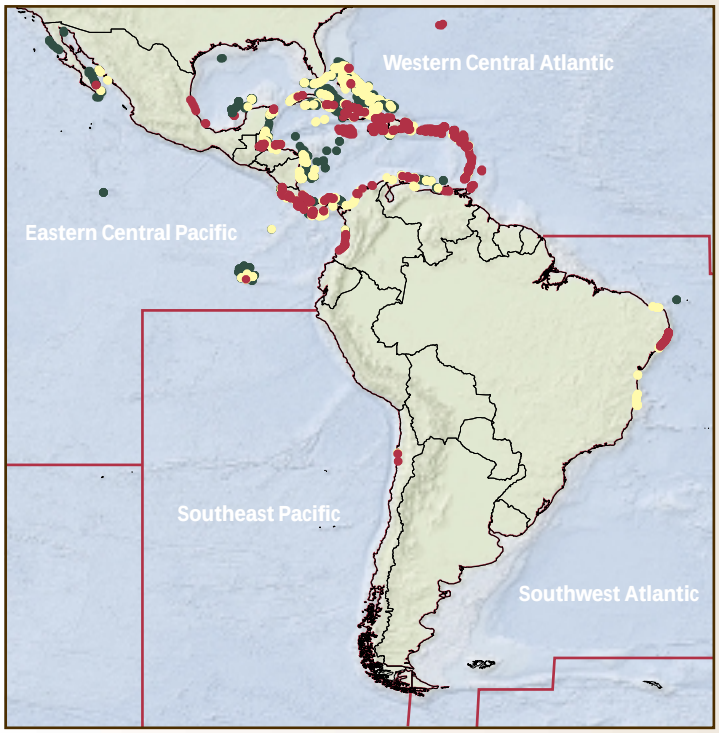
## Fisheries

Overfishing, recognized as an international problem for decades, has evolved from a relatively confined problem in a few regions, to a global problem with a predictable pattern. Production reaches and then exceeds the reproductive capacity of fish stocks, creating marked declines in these stocks and severe reductions in catch. The fisheries of LAC are without exception to this pattern. The Western Central Atlantic and the Southeast Pacific fishing areas both have experienced declines in fish landings. Catches are down more than 25 percent relative to their maximum levels. It is important to note that parties from countries outside as well within the LAC region may carry out intensive fishing.

## Implications

As human populations continue to expand and increase their standard of living, impacts on coastal and marine resources from overfishing, high pollutant loads, and conversion of land to urban uses are likely to become more severe. Stocks of fish and shellfish, as well as seaweeds and other marine organisms, will diminish, altering species composition and the biological structure of coastal and marine ecosystems. In LAC, where large numbers of people live and work along the coast, and where coastal tourism thrives, preserving and maintaining coastal and marine resources will be essential to ensuring a high quality of life.

### Reefs at Risk and FAO Fishing Areas near Latin America and the Caribbean




**Degree of Threat**

- Low
- Medium
- High

**Source:**
Bryant et. al, 1998;
FAO, 1999a and 1999b.
**Projection:**
Geographic

### Comparison of Maximum Landings to 1997 Landings in LAC Fishing Areas

| FAO Fishing Area | 1997 Landings ($10^3$ mt) | Maximum Landings ($10^3$ mt) | Year of Maximum Landings | Percentage Decline |
|---|---|---|---|---|
| **Western Central Atlantic** | 1,825 | 2,497 | 1984 | 26.90% |
| **Southwest Atlantic** | 2,651 | 2,651 | 1997 | 0% |
| **Eastern Central Pacific** | 1,668 | 1,925 | 1981 | 13.40% |
| **Southeast Pacific** | 14,414 | 20,160 | 1994 | 28.50% |

**Source:** FAO, 1999a and 1999b.

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