Colombia possesses 10 per cent of all species identified globally (PNUMA and GJA 2009). 614 of these are at risk (PNUMA and others 2009).

Colombia is the fourth largest of the South American countries in land area, and third in population (after Brazil and Mexico). To the east, its neighbours are Venezuela and Brazil, to the south Peru and Ecuador, and Panama sits directly northeast. It is divided into five natural regions: the Caribbean, Pacific, Andean, Orinoco, and Amazonia. In addition, Colombia contributes to two of the largest and most important watersheds in the world, those of the Amazon and Orinoco. The topographic feature most characteristic of the country is the Andean mountain range. The climate varies from extreme cold in the snowfields to very warm conditions at sea level. Colombia is one of the world’s megadiverse countries; it possesses nearly 10 per cent of all species identified globally (PNUMA and GJA 2009). Its economy is based principally on the production of coffee, emeralds, coal and petroleum.

Progress toward the millennium development goals

Colombia illustrates a notable portion of its land area covered in forest, which, according to the data reported by the United Nations for the Millennium Development Goals, has varied little between 1990 and 2005. Moreover, an increase in the percentage of protected areas, from 24.5 per cent in 1990 to 30.3 per cent in 2008 stands out, as does the decrease in CO2 emissions per capita, from 1.73 metric tons in 1990, to 1.43 metric tons in 2007 and a reduction in the percentage of the population living in informal settlements from 31.2 per cent in 1990 to 16.1 per cent in 2007. The collapse of the cocaine market after the Decree-Law 173 of 1991 led to an increase in the proportion of cultivated areas of coffee, from 8.4 per cent in 1990 to 10.3 per cent in 2008 stands out, as does the decrease in CO2 emissions per capita from 1.73 metric tons in 1990, to 1.43 metric tons in 2007 and a reduction in the percentage of the population living in informal settlements from 31.2 per cent in 1990 to 16.1 per cent in 2007.

Water pollution

Colombia is one of the countries with the greatest natural water supply in the world; even so, the majority of its water bodies show high levels of contamination, generated principally by human activity. Among the factors causing pollution are the discharge of untreated residential and industrial wastes, and wastewater from agricultural production (pesticides and fertilizers) and cattle. Other sources of contamination are rivers and marine transport, rainwater, and infrastructure and mining development (IEEM 2000). The excessive use of fertilizers and runoff from cattle farming of illicit plantations contaminate soil and water, which affects human health, estimates the extent of contamination by pesticides used in soils adjacent to the coastline as 80 per cent of the extent of the Colombian Caribbean. Moreover, inadequate public water systems in settlements along the banks of the Amazon River have raised pollution levels considerably (UKEF and OCDEA 2000).

Impacts of mining

In Colombia, the production of energy by thermal or hydroelectric stations, as well as petroleum, gas, coal, emerald, and gold extraction, create significant environmental impacts. The magnitude, frequency and type of impact vary; among them are site preparation for well drilling, deforestation, production of solid and liquid wastes, enhanced soil erosion, alterations to the landscape, greenhouse gas emissions, and water pollution. Petroleum refining has a high potential for atmospheric and water pollution, emitting sulphur dioxide and nitrogen oxides into the air, and discharging chemicals and petroleum into water bodies. In Colombia, natural gas reserves are exploited jointly with oil, principally in the province of Casanare, la Guajira, and Santander. The boom in mining development started in the 1980s, with the commencement of large projects like the extraction of nickel in Cerromatos, coal in Cerrazos, and oil in Caño Limon.
On 13 November 1985, an avalanche caused by the eruption of the Nevado del Ruiz Volcano devastated the population of Armero, in the province of Tolima. The intense heat produced by the eruption melted the snowpack accumulated at the mountain peak, and millions of cubic meters of water, mud, and volcanic ash buried Armero. An estimated 60 million tonnes of mud were deposited on the town. The event left a toll of more than 22,000 dead, more than 20,000 injured, almost 4,400 homes destroyed, 19 bridges destroyed, and millions of dollars in losses. This natural disaster caused the greatest tragedy in the history of Colombia. Beginning a year earlier, the Nevado de Ruiz had begun emitting vapour from its fumaroles, a clear sign of danger; nonetheless, no preventative measures were taken. The lack of coordination between national, regional, and local authorities; the poor transmission of the emergency and evacuation messages; logistical and technical problems, and the desire of those affected not to abandon the area created a tragedy of unprecedented proportions. In 1986, Pope John Paul II declared the area holy ground.
The Amazon region of Colombia comprises 42 per cent of the country’s land area, and is the least populated area of the country. During the 1950s through the 1970s, authorities encouraged the occupation of the region through the penetration of indigenous territories based on migratory settlement patterns, opening up the area to development based on extensive cattle raising and intensive oil production (UNEP and OTCA 2009). Presently, the majority of the region’s population lives in the provinces of Caquetá, Putumayo, Guaviare, and Amazonas. In the period between 2000 and 2007, 7,314 km² were deforested, with an average loss of 1,045 km² per year. In addition to the expansion of the agricultural frontier and the creation of new settlements, cutting for illicit crops (coca and marijuana) is one of the major causes of deforestation in the Colombian Amazon. Since 1998, when illicit crop eradication programs became more aggressive in Bolivia and Peru, the production of coca increased in Colombia. In 1985 coca plantations covered 15,500 ha, and by 2005 some 85,750 ha were established in the region (UNEP and OTCA 2009). The two satellite images show the intense deforestation that occurred between 1977 and 2002 in the areas surrounding the settlements of Orito, La Hormiga, and Puerto Asís.

El Cerrejón is one of the largest open-pit coal mining operations for export on earth. It is located in La Guajira Province in the northeast of Colombia, and the coal deposits cover approximately 69,000 ha. Extraction operations in Cerrejón began in 1986, and since then the rate of expansion has remained at about 600 ha per year. At present, solutions are being sought to respond to the socio-environmental problems identified in La Guajira: the displacement of indigenous and Afro-Colombian populations; the emergence of diseases not previously seen in the region; deforestation; air and water pollution; and soil erosion, among others.

Colombia possesses the largest reserves of coal in Latin America and is the sixth-largest exporter of coal in the world. For the Colombian economy, coal sits in second place in the export sector after petroleum and its derivatives (Corredor and others 2007). The 2007 image shows the expansion of a coal mine that existed in 1986, and the opening up of new areas for extraction.
The Great Metropolitan Area concentrates more than 50 per cent of the total population in just 4 per cent of the national territory (MIVAH and others 2006).

Costa Rica, located in Central America, borders on Nicaragua to the north and Panama to the southeast, with the Caribbean Sea to the east and the Pacific Ocean to the west. Its intercontinental—and interoceanic—position provides it with great climatic and ecological diversity. The country possesses a wide variety of climates, from the humid heat of the Caribbean to the dry heat of the Pacific Slopes, and colder conditions in the highlands. It also contains a great diversity of natural habitats: dry tropical forests, wetlands, mangrove forests, tropical rainforests, cloud forests, coral reefs, beaches, high plateaus, lakes, rivers, and grasslands. Although agricultural activity continues to be the main source of employment in most areas of the country, the contemporary economy has taken a step toward outsourcing and subcontracting, as well as governmental, tourist, and commercial services (MIVAH and others 2006).

Progress toward the millennium development goals

In Costa Rica the percentage of protected areas increased from 93% in 1991 to 2008. Regardless, forest cover diminished from 50.2 per cent in 1990, to 46.7 per cent in 2005. Annual CO₂ emissions per capita nearly doubled during this period, from 0.96 metric tons in 1990 to 1.82 metric tons in 2007, due in part to population growth and in part to an increasing private and commercial vehicular fleet in the country. As far as the percentages of the population with access to safe drinking water and sanitation services, increases from 63 to 97 per cent and 53 to 95 per cent, respectively, were recorded between 1990 and 2008.

**Proportion of urban population living in slums (percentage)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Proportion of urban population living in slums</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>10%</td>
</tr>
<tr>
<td>2000</td>
<td>9%</td>
</tr>
<tr>
<td>2008</td>
<td>8%</td>
</tr>
</tbody>
</table>

**Carbon dioxide (CO₂) emissions (metric tons of CO₂ per capita)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Emissions (metric tons of CO₂ per capita)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>0.96</td>
</tr>
<tr>
<td>2000</td>
<td>1.39</td>
</tr>
<tr>
<td>2008</td>
<td>2.50</td>
</tr>
</tbody>
</table>

**Proportion of protected terrestrial and marine areas (percentage)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Proportion of protected terrestrial and marine areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>15%</td>
</tr>
<tr>
<td>2000</td>
<td>85%</td>
</tr>
<tr>
<td>2008</td>
<td>65%</td>
</tr>
</tbody>
</table>

**Proportion of population with access to improved sources of drinking water and sanitation facilities (percentage)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Access to Drinking Water</th>
<th>Access to Sanitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>40%</td>
<td>97%</td>
</tr>
<tr>
<td>2000</td>
<td>95%</td>
<td>90%</td>
</tr>
<tr>
<td>2008</td>
<td>98%</td>
<td>95%</td>
</tr>
</tbody>
</table>

**Forest cover in the Greater Metropolitan Area of the Central Valley (thousands of ha)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Forest Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>159.6</td>
</tr>
<tr>
<td>2000</td>
<td>160.5</td>
</tr>
<tr>
<td>2008</td>
<td>162.8</td>
</tr>
</tbody>
</table>

Vulnerability to drought and flooding has increased in Costa Rica as a product of both natural fluctuations in climate, generally associated with the El Niño Southern Oscillation (ENSO), and human-driven factors such as inappropriate agricultural practices and deforestation. Displaced urban development, increased population growth, and inadequate development of productive activities cause soil degradation, a process associated not only with poor water management and loss of forest cover, but also with acute variations in precipitation cycles (MIVAH and others 2006). The use of land in Costa Rica’s Greater Metropolitan Area for agricultural and cattle production causes erosion problems, and the use of agrochemicals (pesti- cides and fertilizers) contaminates the soil. The effects of this pollution are particularly intense in areas dedicated to annual crops and ornamental plants, followed by coffee and sugar cane fields, and pastures (MIVAH and others 2006).

Soil degradation

Deforestation in the Valle Central

The Central Valley of Costa Rica is located in the mountainous core of the country, where parts of its four out of seven provinces are situated. Costa Rica experienced rates of population growth and deforestation that were among the highest in the world. Over a period of 50 years, the population quintupled, during the same period 11,000 km² of forest, a 10% of the nation’s land area, was cleared (Romilla and Rosero 2004). Between 1973 and 1988, the country lost 22 per cent of its forests. Population growth is a key factor for the country’s deforestation, yet it is not the sole cause; economic, cultural, and technological variables also intervene and accelerate the process. Among them are - the expansion of agricultural frontiers for export crops, the extension of cattle-producing land, the exploitation of high-value tropical hardwoods, and of finished products for export. Presently, 26 per cent of the country’s forested areas are located within national parks and similar reserves (MIVAH and others 2006).

Pressures on water resources in the Greater Metropolitan Area (GMA)

There are major challenges that affect the water resources in the Greater Metropolitan Area of Costa Rica’s Central Valley. Rapid urban and population growth are placing growing pressure on the drinking water supplies, which needs to be addressed to ensure future supplies in the long-term. For instance between, 1996 and 2000, the extraction of subterranean water from the metropolitan area nearly quadrupled, reaching 62.5 per cent of the available volume, with a level of stress on the water resource similar to that found in very arid countries (MIVAH and others 2006). Moreover, water supplies continue to be contaminated by wastewater, industrial and agricultural effluent, agrochemicals, solid waste, and fecal matter. Since the 1990s the water quality of aquifers has shown signs of deterioration as nitrate levels have increased as a result of contamination by pesticides and fertilizers, and infiltration from septic tanks in the area (MIVAH and others 2006).
San José Province, with an estimated population density of 7,856 inhabitants per km² in 2007 (INEC 2007), forms part of the Greater Metropolitan Area (GMA) of Costa Rica, which also includes the surrounding urban areas of Alajuela, Cartago, and Heredia. The GMA, with more than two million inhabitants, concentrates more than 50 per cent of the total population in just 4 per cent of the national territory; further, it contains 70 per cent of the country’s vehicular fleet, 85 per cent of the industry, and generates more than 60 per cent of national earnings. The increase in the metropolitan population and its economic activity has had serious consequences for the long-term sustainability of the region. In 1992, the forest cover of the GMA represented 59.7 per cent of the total land area; by 1997 it had been reduced to 39.7 per cent. Forest cover within protected areas remains stable, unlike that found within the ring of urban development and outside of protected areas. In the 1975 image, wooded areas separated urban centres, while in the 2009 image the cities have merged into the GMA, creating a single unbroken urban expanse from which green areas have disappeared.
Cuba is the largest island of the Greater Antilles. To the north lie the United States and the Bahamas, to the south is Jamaica, to the east is the island of Hispaniola (the Dominican Republic and Haiti), and to the west sits Mexico.

Around 75 per cent of the land surface of Cuba is made up of plains, where almost all the population and economic activities of the country are located. Three mountain ranges are located in the centre, east and west of the country and surface and subterranean water resources are limited. The climate of Cuba is humid tropical and the island is periodically affected by hurricanes. Great diversity and a high degree of endemism characterize Cuban flora and fauna. Sugar cane cultivation and sugar production are the base of the national economy and have played a key role in its social and cultural development. The Cuban Revolution, in 1959, changed the economic structure of the country to one based on socialism.

Progress toward the millenium development goals

In relation to the seventh Millennium Development Goal, Cuba has made important progress, such as increasing the national forest from 18.7 per cent in 1990 to 48.5 per cent in 2007, and increasing the coverage of protected areas from 12.5 per cent in 1990 to 15.5 per cent in 2008. Similarly, annual CO₂ emissions per capita dropped, from 3.15 metric tons in 1990 to 2.41 metric tons in 2007. Efforts to improve the quality of life of the population have raised the percentage of residents with access to potable water and sanitation facilities: from 82 per cent in 1990, to 94 per cent in 2008; and from 40 per cent to 91 per cent, respectively, over the same period.

Pressures on water resources

Sixty-seven per cent of the national territory is formed of highly porous karst limestone, and it is here that the country’s 165 most critical watersheds, hydrogeological regions, and river reaches are located. The recharge of aquifers depends in large part on the rains. In Cuba, tropical storms and the rearward flooding contrast with rounds of drought. The overexploitation of aquifers, poor water management, climatic instability, and saltwater intrusions all put groundwater resources at risk. Among these, the Zapata River watershed and the groundwater of the southeastern Cuban Island basin have suffered severe changes from overuse, resulting in salinization of its aquifer. Most of those are in direct contact with the ocean, and in the last few decades, between 1970 and 2000, hydrologists measured displacement of the freshwater lens by saltwater intrusion, reaching values of 5 m to 5 m/c.².

Soil degradation

Cuban soils have natural limiting properties, affecting its agricultural production, however the proportion of surface soil whose fertility has been affected by inappropriate human activities is even larger. Landuse changes from agricultural techniques that involve clearing and burning the land, as well as the disposal of domestic and agricultural wastes are responsible for erosion, loss of organic matter, soil compaction, salinization, and contamination of Cuban soils. More than 2.9 million ha are affected by erosion, 0.7 million by increased soil acidity, 1 million by salinization, 2 million by compaction and 2.7 million face infiltration problems (IAMA and others 2009). Sixty per cent of the surface area of the country is presently affected by one or more factors that can lead to processes of desertification, and the majority of Cuban soils are low in nutrients, tend to be acidoil, and suffer from a drastic reduction in organic material. Further, both highly localized rainfall events and the frequency and intensity of the rains over recent years favour processes of desertification and salinization, especially in lowland areas.

National water use, 2007

Drinking water supply 1679.23
Irrigation 3753.52
Industry 229.3
Sanitation 410.6
Loss 573.8

Source: Prepared with data from INRH 2010.

Primary nickel production (Thousands of tonnes)


Source: Prepared with data from INRH 2009.

Air quality is severely compromised in the city of Havana; in Moa and Baracoa from nickel mining; in Santa-Cruz del Norte due to petroleum and natural gas extraction, and in the Mariel zone because of its proximity to a large cement plant.

Soil degradation, by type (Millions of ha)

Soil (S) Sanitation (S) Water (S) Irrigation (S) Industry (S) Loss (S)

Source: Prepared with data from INRH 2010.

Forest cover increased from 18.7 per cent in 1990 to 24.8 per cent in 2005 (United Nations 2010).

Proportion of land surface covered by forest (Percentage)

1990 2000 2005


Proportion of population with access to improved sources of drinking water and sanitation facilities: (Percentage)

2000 2005


Proportion of protected terrestrial and marine areas (Percentage)

2000 2005 2008

Source: Prepared with data from INRH 2010.

Proportion of urban population living in slums (Percentage)

1990 2000 2007

Source: Prepared with data from INRH 2010.

Proportion of population with access to approved sources of drinking water and sanitation facilities: (Percentage)

1990 2000 2008

Source: Prepared with data from INRH 2010.

Carbon dioxide (CO₂) emissions (Metric tons of CO₂ per capita)

1990 2000 2008

Source: Prepared with data from INRH 2010.

Loss 573.8

Source: Prepared with data from AMA and others 2009.

Soil degradation, by type (Thousands of tonnes)

1990 2000 2007

Source: Prepared with data from AMA and others 2009.

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1990 2000 2007

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Proportion of population with access to approved sources of drinking water and sanitation facilities: (Percentage)

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Source: Prepared with data from INRH 2010.

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Source: Prepared with data from INRH 2010.

Proportion of urban population living in slums (Percentage)

1990 2000 2007

Source: Prepared with data from INRH 2010.

Proportion of population with access to improved sources of drinking water and sanitation facilities: (Percentage)

1990 2000 2008

Cuba is the sixth largest world producer of nickel. Nickel and cobalt make up the country’s largest source of export revenue, at nearly 990 million dollars (AMA and others 2009). Open-pit nickel mining is concentrated mainly in the northeastern provinces, in the Nícaro-Moa Baracoa region, where there are large deposits formed by a mineral that contains around 45 per cent iron, 1.5 per cent nickel, and 0.14 per cent cobalt. Here, the René Ramos Latour (Nícaro), Pedro Soto-Alba (Moa), and Ernesto Che Guevara (Moa) factories operate. The different pollutants emitted by the processing of these minerals represent a contamination risk for aquifers, as well as surface waters, air, and the region’s biodiversity. At least 1,350 ha of coastal waters in the municipality of Moa, in the eastern province of Holguín, show high levels of contamination due to the activity of the nickel industry and the dumping of toxic wastes in the area’s rivers (Chavez 2008). The 2005 satellite image of the Moa mine shows the development of extractive activities since 1985, with new mining areas, an artificial inland reservoir, and greater amounts of sediment are visible in coastal waters near the mine.
Visitors to the Dominican coast continue dumping garbage into the rivers and over cliffs. This trash reaches the large number of uses that it is exposed to has put at risk the availability and quality of the volcanoes. Dominica has exuberant forests, many rivers, and a tropical climate. The population is concentrated along the coast, because of the mountainous terrain located in the central part of the island. The Dominican economy is based on tourism and agriculture, favoured by the fertile volcanic soils.

**Dominica**

Its forest cover, of 61.3 per cent, is the highest of all Caribbean island States (UN 2010).

Dominica is located in the Caribbean, and sits to the south of the island of Guadeloupe and to the north of the island of Martinique. It is the largest of the Windward Isles, and has a coastline of some 153 km. It has highly mountainous topography and soil of volcanic origin, stemming from the island’s 11 volcanoes. Dominica has exuberant forests, many rivers, and a tropical climate. The population is concentrated along the coast, because of the mountainous terrain located in the central part of the island. The Dominican economy is based on tourism and agriculture, favoured by the fertile volcanic soils.

Coastal degradation

Due to the mountainous topography of the island, the majority of its inhabitants live along the narrow coastal plains. Thus, together with the increasing number of tourists who visit the island each year, puts heavy pressure on coastal ecosystems. The island’s west coast has been especially affected. The population is vulnerable to coastal erosion, storm surges produced by hurricanes, and to the increase in sea level produced by climate change. Recent decades have witnessed the beaches of Dominica, resulting in sand and rock losses during each event. After a hurricane, the beaches recover to some degree, but not completely. Natural disasters are not the sole factors affecting the beaches; people also have an important role in this process. Sand removal, massive tourism, and construction of buildings and levees very close to the water all cause beach erosion.

Vulnerability to natural disasters

Among all the countries on Earth, Dominica is one of those most prone to natural disasters. Moreover, it is particularly vulnerable because of its small area and terrain, and underlying geology. Events such as hurricanes, tropical storms, earthquakes, volcanic eruptions, landslides, floods, and drought affect all the island. The majority of the population lives along the coast, putting them at greater risk from natural disasters, and 90 per cent of the population lives within 5 km of a volcano. The storm surges from hurricanes, along with the unprotected character of some coasts, increase the vulnerability of coastal populations. Dominica has one of the highest concentrations of volcanic activity in the world, with 11 potentially active volcanoes on the island. The country’s high level of economic dependence on agriculture and tourism is strongly affected by natural disasters. In 1995, 100 per cent of the banana crop was lost, and coastal areas suffered great damage because of hurricanes Luis, Marilyn, and Iris (UDEP and CARICOM 2000). Hurricane Dean, in 2007, caused damages in the agricultural, housing, and communications sectors. That same year an earthquake destroyed houses and a portion of the public infrastructure of the island.

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Important Environmental Issues

**Water pollution**

Dominica is well known for its great abundance of surface water and groundwater; however, the large number of uses that it is exposed to has put at risk the availability and quality of the resource. Despite multiple efforts by the government, a significant number of communities along the Dominican coast continue dumping garbage into the rivers and over cliffs. This trash reaches the coast and is moved by marine currents, putting at risk the health of the population, biodiversity and maintenance of recreational and fishing activities. Based on the garbage collected during beach cleanup efforts, it has been established that 40 per cent of the waste comes from terrestrial activities. Sediments, chemical effluents, agricultural inputs, wastewater, and solid waste are only some of the contaminants found in the water bodies of Dominica.

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Dominican Republic

52 per cent of the country’s area is susceptible to a very high degree of soil degradation.

The Dominican Republic is part of the Greater Antilles, on the island of Hispaniola, which it shares with Haiti to its west. To its north lies the Atlantic Ocean, to the south the Caribbean Sea, and to its east sits the U.S. territory of Puerto Rico. The country’s terrain is highly mountainous, and benefits from ample water resources. It has a tropical climate, with two wet seasons each year, and a seasonal drought in the months of March and April. The country is periodically affected by tropical storms and hurricanes. It has a high level of biodiversity, the island’s flora includes some 6,000 species, 34 per cent of which are endemic. Historically an agricultural country, the financial services, tourism and industrial sectors have dominated the country’s economy in recent years.

Progress toward the millennium development goals

The Dominican Republic has experienced a drastic loss of forest cover over the last 60 years. However, according to the indicators of the Seventh United Nations Millennium Development Goal, since 1990, the forested area of the country has remained stable at 28.4 per cent. Forest cover increased from 1.3 metric tons in 1990 to 2.12 metric tons in 2007. Some positive developments toward meeting the millennium development goals include a reduction in the proportion of the urban population living in slums from 27.9 per cent in 1990 to 16.2 per cent in 2007, and a 10 per cent increase in access to basic sanitation between 1990 and 2008.

Soil degradation

The majority of land in the Dominican Republic is best suited for forest growth, with only 25.0 per cent of soils being optimal for agriculture. As the population grows, traditional agricultural practices of shifting cultivation, extensive pasturing, and burning of forest areas intensifies, contributing to the progressive deterioration of soils by erosion, removal of vegetation cover and loss of productivity. Presently, 52 per cent (24,924 km²) of the country’s land area is highly susceptible to erosion processes. Along these lines, in 2003, SEMADERA (the State’s Secretariat for the Environment and Natural Resources) reported that 11,832 km² (25 per cent) of soils were being exhausted, and heavily impacted by processes of erosion and compaction. Furthermore, soil losses of some Dominican rivers/deltas vary between 21 and as much as 100,000 t/year. It is important to note that uncontrolled urban growth, human occupation of vulnerable or environmentally fragile areas, mining extraction, and natural disasters are also driving factors behind the severe deterioration of soils in the country.

Degradation of aquifers

The country is currently experiencing an accelerated process of deterioration of its surface and subterranean waters. Natural groundwater resources are recharged by atmospheric precipitation which decreases with the increasing intensity of droughts. The Dominican Republic has considerably increased the pressures exerted on water resources; the main provinces have high levels of water consumption. In only four years (2002–2005) water use in Santo Domingo rose from 54.0 to 92.8 m³ per inhabitant per year. The overexploitation of aquifers in coastal areas facilitates the intrusion of salt water into the fresh water lens, which, in turn, causes salinization of soils. Residential activity, industries (mining), and agroindustries are the principal water polluting agents. Lack of sewage management degrades water resources and causes health problems. One of the primary uses of water resources is in agricultural production, where the low efficiency of irrigation systems and the use of agricultural inputs (fertilizers and pesticides) worsen the situation.
Jimani, Dominican Republic

Jimani is a municipality of more than 11,000 inhabitants, located in Independencia Province, 280 km to the southeast of the capital city of Santo Domingo, near the border of Haiti. On the 24th of May 2004, Jimani was affected by torrential rains that triggered an unexpected rise in the Soliette or Blanco River, carrying off hundreds of homes, leaving thousands affected, nearly 700 people dead, interrupting basic services, damaging transportation infrastructure, and causing considerable loss of crops and livestock. The river overflowed after intense rains, 247 mm falling in just a few hours. At least 12,000 people were evacuated; nearly 200 were lodged in shelters, and approximately 900 families were affected. It is thought that deforestation in the Soliette River watershed, heavy and successive rains, human occupation of high-risk locations, and limited capacity to warn residents aggravated the magnitude of the disaster (Cocco 2004). The 2004 satellite image shows the flooding, and the quantity of mud covering the area surrounding the river's course and the town of Jimani.
Ecuador

The Ecuadorian Amazon represents 13 773 000 inhabitants (CEPAL 2009).

Progress toward the millennium development goals

Ecuador lost more than 10 per cent of its forest cover between 1990 and 2005, dropping from 48.9 per cent to 39.2 per cent. This number contrasts with an increase of more than 10 per cent in the extent of protected areas, which occurred between 1990 and 2000. The quality of life of the nation’s inhabitants has improved, between 1980 and 2000, the proportion of the population that has access to drinking water and basic sanitation has increased from 72 per cent to 94 per cent and 69 per cent to 92 per cent, respectively. Nonetheless, 2005 data shows that some 21.5 per cent of the urban population still lives in slums.

Important Environmental Issues

Deforestation

The process of deforestation in the country is currently driven by multiple factors including a national policy that encourages the occupation of large tracts of land for agricultural and hydroelectric projects. The primary cause of mangrove forests’ loss is the rapid expansion of shrimp farming. By 1998, however, it reached a height that led to the burning and deforestation of mangrove forests to establish lagoons for shrimp production. The pressure on these ecosystems, sometimes based on illegal practices, resulted in an estimated loss of more than 100 000 ha of coastal mangrove forest. In some areas, the abandonment of shrimp farming operations because of contamination or low economic returns has permitted minor regeneration of the ecosystem.

Mangrove forest destruction

The Ecuadorian coast measures some 1 229 km, of which 533 km are bordered by mangroves. Mangrove forests are among the most productive of Earth’s ecosystems, and are under constant threat, not only due to the interest in using coastal areas for other purposes, but also because of excessive demand on the products and services the ecosystem provides. In Ecuador, mangrove swamps have endured strong pressure from human use for a variety of reasons. Traditionally, local populations used mangrove forests for wood supplies for construction, pilings, firewood, and charcoal, as well as fishing activities. The primary cases of mangrove forest losses in Ecuador, however, stems from the development of non-sustainable shrimp farming practices. The shrimp industry began in 1984 as a small-scale activity, primarily occupying salt marshes. By 1998, however, it reached a height that led to the burning and deforestation of mangrove forests to establish lagoons for shrimp production. The pressure on these ecosystems, sometimes based on illegal practices, resulted in an estimated loss of more than 100 000 ha of coastal mangrove forests. In some areas, the abandonment of shrimp farming operations because of contamination or low economic returns has permitted minor regeneration of the ecosystem.

Glacial melting

In Ecuador, glaciers play a key role in the hydrologic system, both as buffers to weather and climate events and by creating reservoirs and sources of fresh water. Presently these occupations are under ever-growing threat, mainly due to anthropogenic causes, such as agriculture, plantation forestry, and tourism, and more recently from changes in climate. The retreat of the country’s glaciers and Andes, has accelerated over the last 25 years. This phenomenon is tightly linked to global climate change. In the last decade, researchers documented a retreat of 10 per cent in all the snowfields of Ecuador, coinciding with the hottest and driest years. In 1997-1998 when the El Niño (ENSO) phenomenon was active, a further acceleration in the melting rate was recorded. Similarly, during the period between 2005 and 2007 the precipitation shortage that caused drought throughout Ecuador influenced the ongoing process of glacial retreat.
The Ecuadorian Amazon represents 48 per cent of the national territory and hosts less than 5 percent of the population. Nonetheless, during the five years between 2000 and 2005 it exhibited a rate of deforestation of 388 km² per year. Historically the region has been seen as an inexhaustible, cornucopian land of natural resources. An agrarian reform, which began in the 1960s, led to a disorganized and arbitrary process of colonization of the Ecuadorian Amazon, which continued in the 1970s with the exploration and extraction of petroleum. During this period, access roads were built from the capital, Quito, to settlements in the Amazon, such as Lago Agrio and Coca, and a series of secondary roads gave access to oilfields. The colonization of these areas promoted the use of land for basic agriculture and cattle raising. In addition, the wood products industry, responsible for one-third of the deforestation, and the establishment of monocrops, like African palm, contributed to increasing the destruction and fragmentation of great swaths of forest, and to biodiversity loss. Comparing the 1977 and 2002 images, one observes the increase in deforestation around these highways. The passage to the left of the highway, which leaves Lago Agrio, is the road that connects the city to Quito.
The Cotopaxi Volcano in the Andean Cordillera is located some 75 km to the southeast of the city of Quito. It is the second highest peak in the country, at 5,897 m (the tallest being Chimborazo), and one of the tallest active volcanoes on Earth, exceeded only by Ojos del Salado, on the border between Chile and Argentina. The Cotopaxi Glacier has considerable economic, social, and environmental importance, since its meltwaters provide freshwater to the capital for both human and industrial consumption, in addition to supplying part of Quito’s electrical needs. The retreat of the Cotopaxi Glacier has accelerated in the last 25 years, increasing the “glaciovolcanic” risk and threatening the water resource base of the region. This phenomenon is tightly linked with global climate change. The ice mass decreased 30 per cent between 1956 and 1976, and another 38.5 per cent between 1976 and 2006. Comparing the 1986 and 2007 images, the viewer can see a notable reduction in the extent of the glacier at the summit of the volcano.
The Gulf of Guayaquil, where the city of the same name is located, is situated in the southwest of Ecuador, and has a unique character, based on its physical geography, floristic richness, and attractiveness to commerce and tourism. This region is characterized by the presence of mangrove forests, which provide a variety of environmental services, including the protection of the coast from storm surges, water filtration, a refuge for many bird species, and the provision of habitat for a variety of marine species of commercial importance. In Ecuador, shrimp farming constitutes the backbone of the fishing industry. The boom in shrimp farming, peaking in 1985, brought as a consequence the progressive conversion of the mangroves of the Gulf of Guayaquil to shrimp raising lagoons, carried out illegally in some occasions. Between 1984 and 2006, 33,927 ha of mangrove forest were destroyed, and 86,380 ha of lagoons for shrimp farming were established. In the 2007 satellite image, the increase in shrimp aquaculture is evident (blue squares located in the green areas of the image), in areas formerly covered by mangroves.
El Salvador

About 30 per cent of the country’s total population lives in the San Salvador Metropolitan Area (OPAMSS 2010).

El Salvador is the smallest of the Central American countries. It borders Honduras to its north and east, Guatemala to the west, and the Pacific Ocean to the south. The majority of El Salvador is characterized by steep terrain and a tropical climate. El Salvador possesses one of the highest population densities in the world (more than 250 people per km²), which has placed heavy pressure on natural resources and caused a significant reduction in native vegetation cover. El Salvador is highly vulnerable to natural disasters, including earthquakes, hurricanes, and volcanic eruptions. The principal underpinnings of El Salvador's economy are agriculture, business, and industry.

Progress toward the millennium development goals

Forest cover in El Salvador diminished from 18.1 per cent in 1990 to 14.4 per cent in 2005. El Salvador is currently the most highly deforested country in Central America, and less than 1 per cent of its land area is set aside in protected areas. Between 1990 and 2007 per capita CO2 emissions have more than doubled from 0.49 metric tons to 1.10 metric tons. The country has a very high population density, and 70 per cent of the urban population lived in slums. On the other hand, in 2005, reports indicated that 28.9 per cent of the urban population lived in slums. On the other hand, in 2005, reports indicated that 28.9 per cent of the population with access to potable water and basic sanitation has improved, the percentage of the population with access to improved sources of drinking water and sanitation facilities has improved, from 74 and 75 per cent, respectively, in 1990, to 87 per cent for both indicators in 2008.

Soil degradation

Estimates suggest that more than 50 per cent of soils in the country are being managed in ways that are contrary to their natural use. Human activities are the main cause of soil degradation in the country, primarily due to agricultural techniques employed without conservation practices, and to deforestation, which has reduced vegetative cover and weakened protection against erosion. More than 75 per cent of El Salvador’s soils exhibit some degree of erosion and 40 per cent of these are severely eroded, totalling some 55 million tonnes of soil lost per year (UNEP and MARN 2007). Furthermore, high rates of poverty cause the population to depend heavily on natural resources, increasing rates of both deforestation and erosion, which lead to processes of desertification (Ayala and others 2005). Currently, processes of desertification affect 17.25 per cent of El Salvador’s land area, with Las Colinas, San Miguel, Santa Ana, Ahuachapín, Usulután, Morazán, and Chalatenango the most affected departments (Ayala and others 2006).

Important Environmental Issues

Rapid population growth and the concentration of the population in urban areas have caused disordered development and an increase in vehicular traffic in El Salvador. This is compounded by insufficient provision of basic services, creating problems of air, water, and soil pollution. Inadequate solid and liquid waste disposal practices contribute to and exacerbate the problems associated with rapid urbanization and population growth due to overconsumption, limited environmental education on solid waste disposal, and limited municipal investment in waste management (UNEP and MARN 2007). The country’s urban areas generate 3187 metric tonnes of solid waste daily (UNEP and others 2006). Furthermore, very little treatment or processing of wastewater occurs; 95 per cent of wastewater is discharged directly into water bodies without treatment, and 50 per cent of these waters have high levels of chemical and biological contamination (UNEP and others 2006).

Deforestation

El Salvador’s original land cover was dominantly forest due to the combination of soil composition, range of temperatures and precipitation. In spite of this, El Salvador is the most deforested country in Central America, with only 2 065 km² of forests (including mangroves), 12.6 per cent of total land area (UNEP and MARN 2007). Estimates also show more than 75 per cent of remaining coniferous forests are severely degraded as well as 25 per cent of mangroves (36 083 ha). The main causes of the conversion and destruction of forests are to establish urban development projects, subdivisions and human settlements (UNEP and MARN 2007). The social and economic pressures of a country with a high population density and a high demand for timber resources used as cooking fuel and land for agriculture and pasture activities have increased the rate of deforestation to an estimated average of 4.500 ha per year. The number of recorded forest fires has also increased, from 17 in 1996 to 118 in 2002, worsening the future prospects of the country.

Pollution

Estimated urban solid waste production by department (tonnes)

Soil surface by degree of erosion risk (thousands of ha)
The Lempa River watershed is the most important catchment in El Salvador, with an approximate area of 18,240 km² that incorporates parts of three countries: Guatemala (14 percent), Honduras (30 percent) and El Salvador (56 percent). The Cerrón Grande Reservoir, on the Lempa River, is the largest in the country, with an area of 135 km² and a volume of 2,180 million m³. It was built in 1973 as a reservoir for the Cerrón Grande hydroelectric plant, 78 km north of San Salvador. Its waters are used for the generation of energy, irrigation, livestock, and as a water source for human consumption and industrial use. Deforestation in the upper portion of the watershed has increased erosion and sedimentation, between 10 and 25 million tonnes per year, around the river and the lake (FAO 2000). The surrounding municipalities also contribute to the pollution of the lake, via the production of solid and organic wastes. This has caused serious eutrophication of the reservoir waters, driving algae blooms, which are visible in the 2002 image as green areas in the south central portion of the reservoir.
The San Salvador Metropolitan Area (SSMA), is composed of 14 municipalities, and has a population of about 2 million inhabitants or more than 30 per cent of the country’s total population (OPAMSS 2010). The urban area of the SSMA developed in the flattest part of the Valley of El Salvador, bounded by El Boquerón, the Balsamo Mountains, and Lake Llopango. Despite these clear natural limits, the periphery of San Salvador has grown in a rapid, uneven, and uncontrolled manner, expanding in every direction permitted by the topography, sometimes occupying areas that are vulnerable to natural disasters. In 30 years, the area occupied by the city has almost doubled, from 5200 ha in 1966 to about 10000 ha in 1995 (OPAMSS 2010).

Currently, the Department of San Salvador, with a population density of 2470 people/km², is the population and economic centre of the country. The department is also the largest producer of solid waste, generating 1768 metric tonnes/day, representing 55.5 per cent of the total production of the country. Moreover, nearly 200,000 vehicles registered within the SSMA, and the accelerated growth of the industrial sector contribute to the high levels of air pollution that affect the city. In the satellite image from 2009, the expansion of the SSMA along the length of the San Salvador Valley is visible surrounding the Boqueron Volcano, as is the consequent decrease in vegetative cover, relative to the 1972 image.
The percentage of the population with access to drinking water reached 97 per cent in 2008 (UN 2010).

**Vulnerability to natural disasters**

Climate change is predicted to result in an increase in extreme climatic events, which will severely affect the islands of the Caribbean, Grenada among them. Coastal ecosystems provide important services in stabilizing the shoreline. Coral reefs displace energy from waves and storms, and create lagoons and sedimentary environments that promote the growth of mangroves and seagrass beds. The loss of these ecosystems increases the island’s vulnerability to natural disasters. In 2004 Hurricane Ivan inflicted enormous destruction in Grenada, leaving at least 28 dead, causing losses equal to 210 per cent of GDP, destroying 42 per cent of formalized area, affecting 90 per cent of tourist facilities and 52 per cent of nutmeg cultivation, and other short-cycle crops. Moreover, by undermining the agricultural sector, Hurricane Ivan (2004) and Emily (2005) turned marine-coastal resources into an attractive option for economic development, considerably increasing the pressures on them.

**Coastal and marine degradation**

Grenada has made significant advances in the management of its coastal areas. Nonetheless, its coasts are still severely affected by both biophysical and anthropogenic factors. Growing coastal development, overexploitation of resources, climate change, and extreme natural events all exert strong pressures on coastal areas, which is reflected in biodiversity loss, the decrease in populations of species of economic value for fisheries, increases in erosion, and the degradation of valuable coastal and marine ecosystems (mangroves, seagrass beds, and coral reefs). Tourist development is very intense along the southeast coast of Grenada, particularly in Grand Anse Bay. This has brought it with an increase in the number of visitors and services providers, with their consequent affects, which has made it necessary to evaluate the carrying capacity of the ecosystems of the Bay. Further, it is thought that pollution stemming from watercourse, agrochemicals, and sediment runoff produced by coastal infrastructure development that occurred during the 1980s caused the degradation of many shallow-water reefs around Grenada and the smaller Grenadines.

**Fishing and overfishing**

Studies carried out in Grenada have found that the country’s 100 km² of coral reefs are eroded by human activity, with the most common being overfishing, followed by coastal development. The hunt for ornamental species and illegal fishing create a challenge for authorities. The El Niño phenomenon also represents a threat to fisheries in Grenada. A preliminary analysis from the Grenada Division of Fisheries shows the relationship between production and this phenomenon. In the years prior to El Niño events (1992/1993, 1986/1987, 1991/1992 and 1997/1998), they documented a reduction of 25 per cent to 60 per cent in fishery yields, relative to the averages from other years. The nursery area for 17 species of demersal or bottom-dwelling coastal fish, which provides 43 per cent of the total fish catch in Grenada, are located places where mangroves, reefs, and should be may be negatively affected by sea level rise.

**Important Environmental Issues**

Grenada, with 104,000 inhabitants, concentrates the majority of its population in coastal areas, especially in St. George’s (37,257 persons), and St. Andrew’s (37,459 persons). Historically, agriculture has been one of the strongest economic sectors in Grenada, occupying about 75 per cent of the land area. The agricultural sector has been promoted, despite recognition that tourist development, concentrated in coastal areas, corresponds with increased consumer demand, beach erosion, damage to coral reefs, pollution of coastal waters, and mangrove forest destruction. Grenada is very vulnerable to water scarcity, and experienced severe droughts in 1984 and 1990, which caused serious losses. The situation is aggravated by increases in population and tourism, which is only expected to continue in coming decades. In the 2005 satellite imagery the extreme is southeast aspect of the island of Grenada is visible, as well as a number of the sites that have experienced the greatest intensity of urban and infrastructure development.

**Point Salines, Grenada**

Grenada, with 104,000 inhabitants, concentrates the majority of its population in coastal areas, especially in St. George’s (37,257 persons), and St. Andrew’s (37,459 persons). Historically, agriculture has been one of the strongest economic sectors in Grenada, occupying about 75 per cent of the land area. The agricultural sector has been promoted, despite recognition that tourist development, concentrated in coastal areas, corresponds with increased consumer demand, beach erosion, damage to coral reefs, pollution of coastal waters, and mangrove forest destruction. Grenada is very vulnerable to water scarcity, and experienced severe droughts in 1984 and 1990, which caused serious losses. The situation is aggravated by increases in population and tourism, which is only expected to continue in coming decades. In the 2005 satellite imagery the extreme is southeast aspect of the island of Grenada is visible, as well as a number of the sites that have experienced the greatest intensity of urban and infrastructure development. The upper portion of the image includes the Point Salines International Airport and the city of St. George’s.
The proportion of protected terrestrial and marine areas has increased from 26.1 per cent in 1990 to 31 per cent in 2008 (United Nations 2010).

Guatemala

is located in the northern part of the Central American isthmus. It borders to the north and west with Mexico, to the south with the Pacific Ocean, to the east with Belize and the Gulf of Mexico, and to the southeast with Honduras and El Salvador. It is a country with markedly mountainous terrain covering nearly two-thirds of its land area, and its ecological zones vary with altitude, from sea level up to mountain peaks as high as 4,211 m. An estimated 13 per cent of species in the country are endemic. In 2006, 52 per cent of the population lived in rural areas, and 48 per cent in urban centres (INE 2006). According to official statistics, approximately 43 per cent of the Guatemalan population is indigenous, the majority of Mayan origin, which account for the 22 distinct linguistic groups. Tertiary activities (services) are an important economic base for the country, representing 60 per cent of the national product.

Important Environmental Issues

Deforestation

Deforestation and degradation of forest resources is a major environmental problem in Guatemala. Between 1950 and 2003, Guatemala lost 50 per cent of its forest cover. During this period, the rate of deforestation varied between 60,000 and 70,000 ha/yr, with a total of 2,958,826 ha of forest. As a result, the availability of forest area per inhabitant was reduced from 2.22 ha to just 0.39 ha (URL and IANEA 2009). Although 74 per cent of the population depends on forested or semi-arid areas, the causes of deforestation are also linked to dominant extractive economic framework. The departments of Petén and Izabal have high levels of deforestation due to rising cattle production, African palm cultivation, illegal hardwood extraction and petroleum extraction (MARN and others 2009). The loss of forest cover occurring in Petén Sur, La Libertad and Montatnas Mayas (Petén), Chuchumatanes (Chiapas) and Manabique (Izabal) account for 30 per cent of deforestation and degradation. These areas make up only 7 per cent of the country’s land area, but are the main list of attention in efforts to reduce pressure on forest resources and avoid accelerated loss of the country’s biodiversity (URL and IANEA 2009).

Soil degradation

In the use of land beyond its capacity is one of the driving forces of degradation and deterioration of soils in Guatemala. According to the natural characteristics of the resource, in Guatemala 35 per cent of the land area is apt for agricultural cultivation, 17 per cent is appropriate for crops not requiring tilling, 41 per cent for non-agricultural crops, and 7 per cent should be protected. Nonetheless, in 2003, 15 per cent of the country’s land area was overused. The potential erosion loss from these soils is nearly seven times greater than in soils that are used at or below their production capacity. In overused areas, the erosion potential is 91 tonnes/ha/yr; while under least intensive practices rates of erosion are 14 tonnes/ha/yr (URL and IANEA 2009). The 34 exceptions of Guatemala have global importance for conservation purposes, however, increasingly these areas face a growing risk of soil degradation such as the Central American pine and oak forest and the tropical moist forest of Petén-Terrazas. These two ecoregions face potential soil loss that varies between 30 tonnes/ha/yr and 175 tonnes/ha/yr and 34 tonnes/ha/yr and 175 tonnes/ha/yr respectively.

Pressure on water resources

In Guatemala’s annual water supply is more than 50,000 million m³ and the consumptive and non-consumptive demands on the resource do not exceed 10 per cent of this volume. Even so, the increase in water demand in cities is becoming harder to meet and is generating serious problems of overexploitation of water resources regionally. The most critical case is that of Guatemala City, with a water deficit of 1 m³ for the Municipality of Guatemala, and from 2 to 3 m³ of the surrounding municipalities that make up the metropolitan area are included. The aquifers of the valley where Guatemala City is located are becoming overdrawn at such a high rate that ground water levels are dropping by 1 to 2 meters each year, depending on location (URL and others 2009). Illnesses caused by consuming contaminated water account for between 15 per cent and 20 per cent of all deaths, and 30 per cent of infant mortality in the country (MARN and others 2009). Only 82 per cent of the rural population has access to piped water (IHE 2006), and more than a quarter of these suffer from gastrointestinal diseases. Deforestation puts additional pressure on water resources. During the decade between 1990 and 2000 the net forest loss in areas critical for water catchment and regulation was about 186,000 ha, while in the upper reaches of the watersheds, it was approximately 250,000 ha (URL and IANEA 2009).
The Department of Petén, located in the north of Guatemala and bordered by Mexico and Belize, contains 43 per cent of the country’s forest cover, and is facing alarming rates of deforestation. Close to 35 per cent of the country's deforestation is occurring in this department, which has lost 45,000 ha of forest cover annually (MARN and others 2009). During the period of 1994-2002, it was the region with the highest annual rate of population growth (6.3 per cent), primarily due to the advancement of the agricultural frontier (MARN and others 2009). Appropriation of land for agriculture in this region represents one of the gravest agrarian conflicts in the country. In Petén, forest fires, primarily resulting from land takeovers and the construction of airstrips for drug trafficking, have affected the lo- test and most protected archaeological sites within the region. It is calculated that in the Laguna de Tigre and Sierra del Lacandon National Parks (PNLT and PNSL, respectively), which are the most affected, there are 50 such airstrips. According to the National System for Prevention and Control of Forest Fires (SIPECIF), 600,000 ha of forest have been lost due to these types of incursions in the last nine years (MARN and others 2009).
Lake Atitlán is a large lake without any natural outlet, located among the mountains of southwestern Guatemala. It is situated in an ancient volcanic caldera, bounded by steep cliffs on the north and east and by three volcanoes to the southwest. The watershed of the lake supports prosperous agricultural production, such as corn, coffee, beans, and various vegetables. The state of the lake has suffered grave changes since 1968. Currently, the level of phosphate pollution is five times higher than it was in 1983, that of nitrates ten times higher than in 1968, and phytoplankton today number a thousand times more organisms per litre than in 1968 (MARN and others 2009). After decades of pollution, the lake shows signs of severe environmental stress. A serious outbreak of cyanobacteria (Lyngbya hvenomyxus) appeared in the lake, a consequence of millions of litres of household runoff and overflow from thousands of hectares of agricultural land, which has been accelerated by the introduction of dozens of invasive aquatic species. Cyanobacteria affects the trophic chains of Lake Atitlán and ultimately, the health of the people who are in contact with its waters or consume certain species from the lake (MARN and others 2009). On the 22nd of November 2009, an ASTER image from the NASA satellite Terra showed that algal blooms had affected approximately 38 per cent of the lake surface.
Lake Lachuá is located in the centre of Lake Lachuá National Park (LLNP) in the tropical rainforest of the municipality of Cobán, in Alta Verapaz. LLNP, created in 1975, has an area of 145 km² and a range of wetlands, which include aquatic ecosystems and floodplains. Lake Lachuá is a circular sinkhole, with a surface area of 400 ha, an estimated depth of 222 m, and a perimeter of 8 km. The water of the lake has a characteristic sulphurous odour because of the high levels of sulphur and calcium salts. The more than 11,000 ha of dense forest conserved in the park maintain the water quality of the aquifer and at the same time regulate the local hydrological cycle, preventing soil erosion and sedimentation. In the LLNP buffer zone there are 44 communities with an estimated population of 13,500, the majority of whom are indigenous Q’eqchi’ and base their economic activity largely on subsistence agriculture, complemented by gathering certain forest products and products from the aquatic ecosystems. LLNP offers the opportunity to develop sustainable economic activities for the communities within the park. Nevertheless, the park faces severe threats from the advancement of the agricultural frontier, illegal harvesting of forest products, and the development of road infrastructure as part of the national Franja Transversal del Norte highway project. Looking at the satellite images, an increase in deforestation is visible in lands bordering on the LLNP between 1986 and 2000.
Guyana is located in northern South America; it is bordered to the north by the Atlantic Ocean, to the south by Brazil, to the east by Suriname, and to the west by Venezuela. Its terrain is covered by a large shield landscape along the coast, which is the country’s primary agricultural area, and where the majority of the population is concentrated. The country has five geographic regions: low coastal plains; a hilly sand and clay region; a densely forested highland region; interior savanna lowlands; and the Rupununi desert savannah. Guyana has a tropical climate, characterized by seasonal precipitation, high humidity and minimal variations in temperature. The per capita GDP in the country is one of the lowest in the region, and the nation’s primary economic activity is agriculture (rice and sugar production), followed by mining (gold, diamonds and bauxite), and silviculture.

Overfishing

The fishing sector is of critical importance for social and economic wellbeing in Guyana, representing around 7 per cent of GDP (GDP 2008). However, some fishing methods are extremely destructive and need to be controlled (FAO 2005). Maritine fishing activity is focused on industrial and artisanal shrimping, while in the country’s interior fishing is mainly for subsistence, and for ornamental species. Shrimp production has been declining over the last twenty years, forcing industrial transfer to work more extensively and closer to shore, creating conflicts with artisanal fishers. Because industries have increased their fishing efforts to compensate for the decline in the fish availability, the net catch has increased while further over-exploiting the resource. In Guyana, shrimp, prawns, sharks, and leatherback turtles are some of the species that have been affected by overfishing, showing notable decreases in their populations.

Coastal degradation

In Guyana, the coastal region accounts for about 7 per cent (27 000 km²) of the total area of the country, and 77 per cent of the population lives within 100 km of the coast (Earth Trends 2003). Guyana has an estimated 80 432 ha of mangroves, which act both to stabilize the coast and protect it from storm surges and extreme weather events. Even so, a large part of coastal forest cover has been lost, because it must compete with other uses such as mining, agriculture and human settlements. Coastal degradation also promotes flooding, which may be less predictable and more frequent with the effects of climate change. These floods affect the economy, health, and agricultural production. Once cultivated, agricultural lands are unusable for at least a year, damaging the country’s economy and especially those communities whose livelihoods depend on the affected areas.

Mining

Guyana is rich in minerals, especially gold, diamonds, and bauxite. Commonly used methods of extraction have significant negative impacts on both the environment and society. These include deforestation, biodiversity loss, erosion and soil contamination, sedimentation and river pollution, and displacement of indigenous populations. Vegetation and surface soil layers are removed to reach mineral deposits, causing sedimentation in rivers, which in turn affects aquatic life. The fuel and oils used for mining equipment further pollute the soil and water. Some extraction processes use cyanide and mercury, both highly toxic: In 2006, 36.7 per cent of the country’s exports came from gold, 10.4 per cent from bauxite, and 3.8 per cent from diamonds (GDP 2008). The main destinations for these exports is Canada, followed by the United Kingdom and the United States. In Guyana, the mining sector continues to grow and diversify, to the detriment of the country’s natural resources and indigenous communities.

Important Environmental Issues

Average annual capture of marine fish (Thousand metric tons)

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Source: GBS 2010.

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Number of people affected by flooding

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Source: Prepared with data from UN 2010.
Beginning in 1993, Omai Gold Mines Limited, a consortium between a Canadian company and the government of Guyana, carried out operations at the Omai Gold Mine with funding from the World Bank and International Monetary Fund. Located in the Essequibo region, Omai was one of the largest open pit gold mines in the world. In 1995, waste from the mine overflowed the retention dam and over five days released 4 million m³ of cyanide-bearing tailings into the Omai River. The Omai is a short tributary stream that feeds into the Essequibo, the country’s largest river. President Cheddi Jagan declared a stretch of 50 contaminated miles of the Essequibo River as an environmental disaster zone as cyanide values along the Omai River reached a high of 28 ppm (2 ppm is considered fatal). This severe ecological disaster was one of the reasons for the closure of the mine in 2005. The 2005 satellite image shows the mine, its tailing ponds, and the deforestation in the surrounding area, in contrast to the 1977 image prior to the mine’s establishment.
The country’s soils have lost 75 per cent of their productive capacity due to intense agriculture activity (UNCCD 2006).

Haiti is part of the Greater Antilles, on the island of Hispaniola, sharing the territory with the Dominican Republic. To its north lies the Atlantic Ocean, to the south and west the Caribbean Sea, and it is bordered to the east by the Dominican Republic. Haiti is a former French colony, but in 1804 was the second country in the Americas to declare its independence, shortly after the United States. One of the main geographical characteristics of Haiti is its steep topography: some 75 per cent of the landscape is formed by mountain ranges. The climate is tropical, with two dry and two wet seasons. Haiti is frequently battered by natural disasters, including hurricanes, cyclones, and earthquakes. The primary sector is estimated to account for about 25 per cent of national GDP. From an environmental perspective, Haiti is one of the most degraded countries; it is also one of the poorest in the world.

**Vulnerability to disasters**

Haiti is highly vulnerable to natural disasters, though all areas of the country are not affected by the same kinds of disasters, nor with the same intensity. The west and south are highly prone to hurricanes, floods, and earthquakes. The Nord and Artibonit departments are particularly vulnerable to floods and earthquakes. The Nord-Ceast department faces drought risk, while the Sud-Est and Grand Anses departments are prone to hurricanes and flooding. The departments least susceptible to natural disasters are the Nord-Est and Centre. Intense deforestation, steep slopes, torrential rains, its geographic location, high population density, under-population development, and the poor state of the country’s infrastructure all increase the level of risk to its inhabitants. Further, recent experiences in the region demonstrate that the capacity for recovery following disasters is greater when ecosystems are intact (UNEP 2009). In the period between 1999 and 2008 Haiti was hit by 21 hurricanes; between 1963 and 1999 experienced 20 serious floods; and between 1904 and 2000 was struck by 5 major earthquakes. Recently, on the 12th of January 2010, the nation experienced the worst earthquakes of its 200-year history, a 7.0 on the Richter scale, which left a toll of some 220 000 dead, 350 000 injured, and hundreds of millions of dollars in economic losses (Government of Haiti 2010).

**Deforestation**

In Haiti, the unprecedented deforestation that has occurred over the course of the nation’s history has reduced forest cover to just 2.8 per cent, compared with the estimated 88 per cent of forest cover that had originally covered the country. Years of poverty, social and political instability, and periods of near-chaos have led to massive deforestation (UNEP 2009). The main causes of deforestation in Haiti at present stem from the population’s need for fuel and construction materials, and for land for agriculture. Seventy-five per cent of domestic energy needs in the country are supplied by biomass, placing the limited remaining forested area of the country under severe threat from the activities of the growing population. In recent decades mangrove forests have been considerably reduced, and it is estimated that only some 20 000 ha remain. The severity of deforestation in Haiti has diminished its biodiversity, degraded its water courses, diminished the quality of its soils, and increased its vulnerability to disasters. Deforestation, in combination with the constant occurrence of steep slopes, produces instability and landslides. Biodiversity has been strongly affected; 12 animal species have already disappeared from Haiti, 44 species of animals and plants are in danger of extinction, and another 49 are under threat.
The Dominican-Haitian border region, that is to say, the five Dominican provinces and nearly 30 Haitian communes that share the border and whose economies depend heavily on cross-border trade, are host today to some two million people. The majority of them are located on the Haitian side, the absolute population of which is four times that of the Dominican side, with a population density five times greater. The frontier economy is essentially agrarian. On both sides it is based on low-return agriculture, carried out on poor, badly irrigated soils. This bi-national relationship, which is concentrated along the border, has various distinctive characteristics that make it different from other cross-border situations. Haiti stands out at present as a country submerged in political, economic, and environmental crisis without parallel in the hemisphere, setting it substantially apart from its neighbour. Here we find some of the most unequal border relations on the face of the planet.

In the 2010 satellite image, the severe decrease in vegetative cover on the Haitian side of the border is visible, in comparison with the 1973 image.
On the 12th of January 2010, a magnitude 7.0 earthquake struck Haiti, its epicentre just 25 km west of the capital, Port-au-Prince. It was followed by a series of powerful aftershocks. The earthquake caused more than 220,000 deaths, 300,000 injured, and left a million people without homes. It is estimated that the cost of the reconstruction of Haiti could breach 1400 millions of U.S. dollars. These high costs reflect the need to establish infrastructure in the affected areas, which in many cases was nonexistent or deficient prior to the earthquake, such as water mains, sewers, and an electric grid, among others. The satellite images from 2009, on the left, lay out the scene before the earthquake, while images taken the day after the disaster show the significant damage to the city’s infrastructure, from buildings and roads destroyed along the major Boulevard Jean Jacques Dessalines, to the collapsed roofs of the Notre Dame Cathedral of Port-au-Prince and the National Palace. These images also show the improvised shelters and tents in Sylvie Cator Stadium, and along Avenue de la Liberté. Around the city and in many other areas of Haiti, reports came in of rivers changing their courses, floods, and landslides, caused by the earthquake and its aftershocks. The widespread conditions of abject poverty and levels of environmental degradation in the country undoubtedly aggravated the impact of this seismic event.
Peligre Lake is the most important reservoir in Haiti. It was created in 1956 with the damming of the Artibonite River, the country’s largest, during the construction of the Péligre Hydroelectric Dam. Located in Haiti’s Centre Department, the hydroelectricity was intended to supply energy to Port-au-Prince. Over recent decades, however, the installation has become less and less efficient, due primarily to deposition of sediments (silt) caused by erosion in the Artibonite watershed. In 2000, a study showed that 27 percent of the lake’s drainage basin was bare soil, 37 percent was cultivated or covered by scarce vegetation, and 30 percent had tree or shrub cover. Inadequate soil conservation practices by a growing number of small farmers along the upper river are one of the main causes of the erosion in the watershed, and consequently of the increase in sedimentation in the lake. Comparing the images from 1973 and 1985, a decrease in vegetative cover is visible in the watershed of the reservoir, as is the narrowing of the Artibonite’s course in the Savane Perdue delta area. Both are further reduced in the 2010 image. The increased presence of sediments from river waters is also notable in the two most recent images.