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AGRICULTURE, RURAL DEVELOPMENT, LAND, DROUGHT AND DESERTIFICATION: OUTCOMES, TRENDS AND CHALLENGES FOR SUSTAINABLE DEVELOPMENT OF LATIN AMERICA AND THE CARIBBEAN *

* Figures and tables included in this document are a preliminary version.

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INTRODUCTION

This document examines the principal issues facing agricultural and rural development in Latin America and the Caribbean, as well as the region's situation with regard to the environment and natural resources, for the 1990-2005 period.

The presentation is organised around five types of issues: (i) productive development; (ii) deforestation; (iii) land degradation and desertification; (iv) social and demographic factors, poverty, income and employment, and population changes; and (v) climate change and natural disasters.

Analysis of developments to date indicates positive developments in agriculture, while at the same time highlighting major deficiencies and cause for serious concern with regard to social issues, the environment and natural resources.

The positive record on agricultural production is based on a small number of products, producers and markets, thus raising questions as to the degree to which the current means of growth can be sustained.

In the social sphere, despite slight improvements, one sees persistently high rates of poverty and indigence, as well as pronounced income concentration.

Demographically, there have been major changes, including reduction and rapid aging of the rural population, seriously jeopardising the generational continuity of rural life and the potential for technological modernisation in rural areas.

In terms of the environment and natural resources, the region continues to suffer from intense deforestation, which, in the period since the turn of the century, has become more acute. Deforestation is closely associated with loss of biodiversity, land degradation and desertification. Only four countries show positive changes in amounts (increase/recovery) of forestland, although the region as a whole has taken important steps to increase protected areas.

In regard to climate change, recent reports make it clear that deforestation, land degradation and desertification have become more severe, leading to a loss of biodiversity, while accentuating extreme climatic phenomena.

The new international scenario, which includes growing demand from emerging markets such as China, along with greater environmental and social demands from the markets of the developed world, presents major challenges, as well as new opportunities, for the region's countries. The increasing scarcity of water, rising energy prices, and climate change all have an impact on cost and price structures, affecting the comparative advantages that the region has enjoyed until now. One of the major challenges facing the region at present is reorganising its productive system so as to protect and empower resources, while bringing small producers into the economy in attempts to move toward reducing and eliminating rural poverty and indigence.

I. THE IMPORTANCE OF AGRICULTURE IN THE REGION

Agriculture's role in the overall economy (the percentage of gross domestic product attributable to agricultural value added) stabilised around 6.3% in 2005. During the period under examination here (1990-2005), the figure fluctuated between 6.0% and 6.5%.

In the course of those 15 years, agricultural value added rose 47.7%, due to the combined effects of overall growth (close to 60% in South America, 51% in Central America and 28.8% in Mexico) —more than enough to offset the 10% reduction in the Caribbean (see table 1).

These phenomena can be attributed to the dynamic expansion of certain productive activities oriented to foreign markets and to higher-income segments of domestic markets. These include beef, soy, sugarcane for human consumption (as well as, increasingly, for biofuel production) and, to a lesser extent, tropical and temperate-zone fruits.

Table I.1
LATIN AMERICA AND THE CARIBBEAN: VARIATIONS IN AGRICULTURAL VALUE ADDED, 1990-2005
(Millions of dollars at 2000 prices)

	1990	2005	Variation 1990-2005
Caribbean	6 178.3	5 570.3	-9.8
Central America	7 158.3	10 813.1	151.1
Mexico	18 367.9	23 660.1	128.8
South America	64 593.4	102 189.0	158.2
Latin America and the Caribbean	96 298.0	142 232 6	147.7

Source: Economic Commission for Latin America and the Caribbean (ECLAC), Panorama 2005. El nuevo patrón de desarrollo de la agricultura en América Latina y el Caribe (LC/W.30), Santiago, Chile, 2005; and "Indicadores para el seguimiento de la agricultura y la vida rural, Plan Agro 2000-2015 (actualización 2007)", 2007, unpublished.

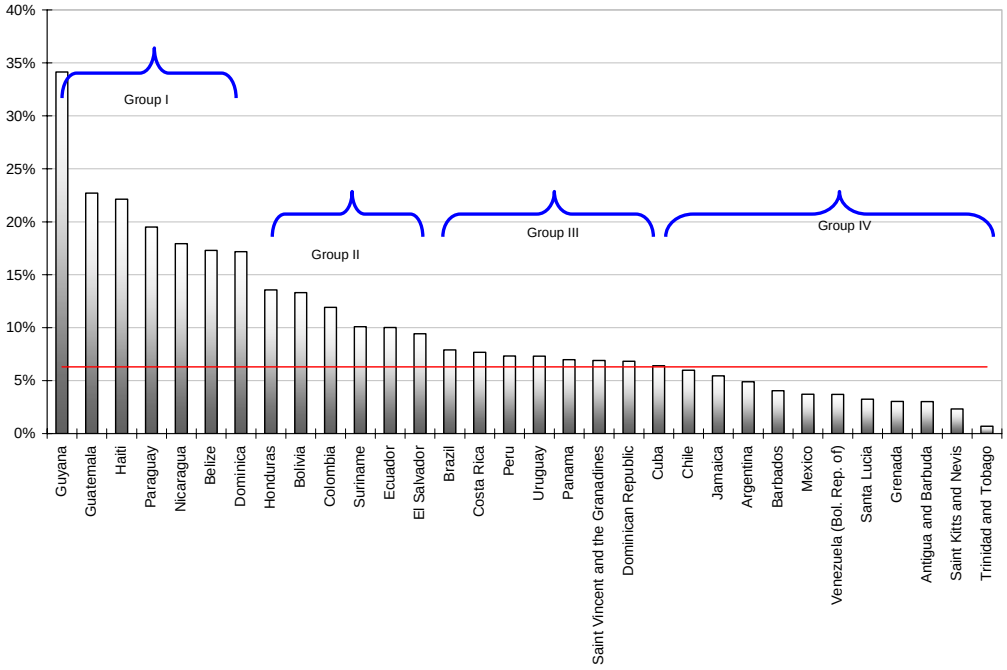
The importance of agriculture and its contribution to the overall economy differs considerably from one country to another. Thus, the average cited above fails to reflect the great diversity in the region, ranging form Guyana's 34.1% of GDP to Trinidad and Tobago's 0.7%.

The region's countries can be classified in four groups, according to the importance of agriculture and rural activities. The first category, in terms of the economic importance of agriculture, includes Guyana, Guatemala, Haiti, Paraguay, Nicaragua, Belize and Dominica, where agriculture represents between 34.1% and 17.2% of GDP. The second group includes Honduras, Bolivia, Colombia, Suriname, Ecuador and El Salvador, where agriculture is somewhat less important, representing between 13.6% and 9.4% of GDP. The third group includes Brazil, Costa Rica, Peru, Uruguay, Panama and St. Vincent and the Grenadines, where agriculture represents between 13.5% and 6.9% of GDP. The fourth group is comprised of Cuba, Chile, Jamaica, Argentina, Barbados, Mexico, the Bolivarian Republic of Venezuela, Saint Lucia, Granada, Antigua and Barbuda, Saint Kitts and Nevis, and Trinidad and Tobago, where the sector represents between 6.4% and 0.7% of GDP.

Agriculture accounts for more than the average proportion of the national economy in Brazil (7.9%), Costa Rica (7.7%), Peru (7.3%), Uruguay (7.3%), Panama (7.0%), St. Vincent and the

Grenadines (6.9%), the Dominican Republic (6.8%) and Cuba (6.4%). In the remaining countries, agriculture accounts for less than 6.3% of GDP (see figure I.1).

Figure I.1
LATIN AMERICA AND THE CARIBBEAN (32 COUNTRIES): CONTRIBUTION OF AGRICULTURE TO TOTAL GROWTH
(Ratio of agricultural value added to GDP, percentages)



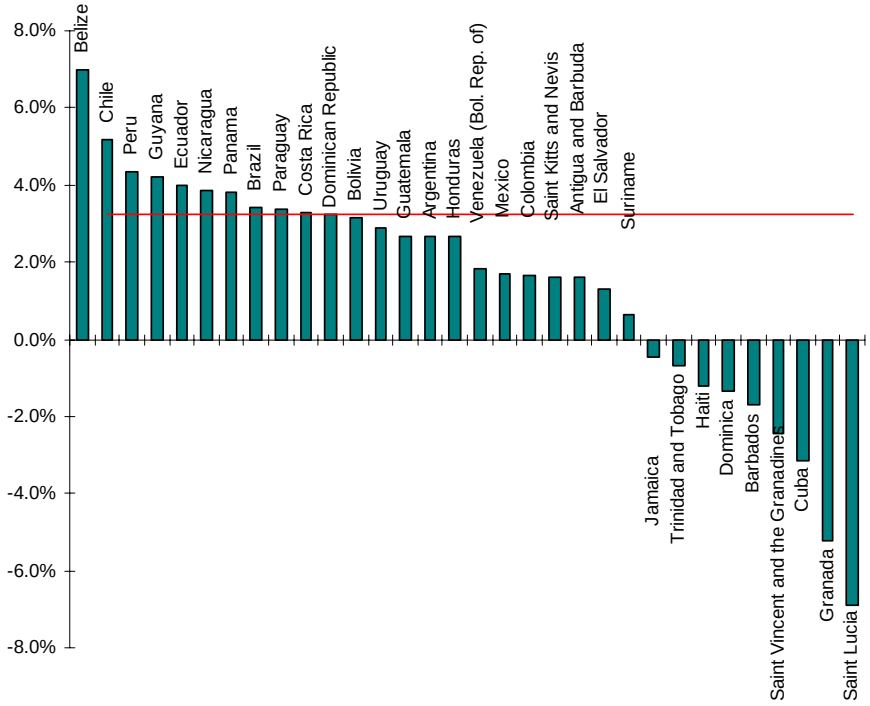
Source: Economic Commission for Latin America and the Caribbean (ECLAC), "Indicadores para el seguimiento de la agricultura y la vida rural, Plan Agro 2000-2015 (actualización 2007)", Santiago, Chile, 2007, unpublished.

Agriculture expanded rapidly during the 1990s, and at an even faster pace during the initial years of the present century, with the sector's value added growing at an average annual rate of 3.2% between 2000 and 2005 —faster than the economy as a whole.

In this case too, however, the average fails to reveal highly significant differences between countries, as the following grouping indicates:

- Category I: Countries whose growth rates are above the average: Belize, Bolivia, Brazil, Chile, the Dominican Republic, Ecuador, Paraguay, Saint Kitts and Nevis and Uruguay.
- Category II: Countries whose growth rates are around the regional average: Argentina, Honduras and Peru.
- Category III: Countries whose growth rates are positive but below the average: Nicaragua, Guatemala, Mexico, Antigua and Barbuda, Colombia, Costa Rica, El Salvador, the Bolivarian Republic of Venezuela and Cuba.
- Category IV: Countries with negative rates of expansion for the agricultural sector: Guyana, Haiti, Dominica, Saint Vincent and the Grenadines, Jamaica, the Bahamas, Barbados, Trinidad and Tobago, Saint Lucia and Granada.

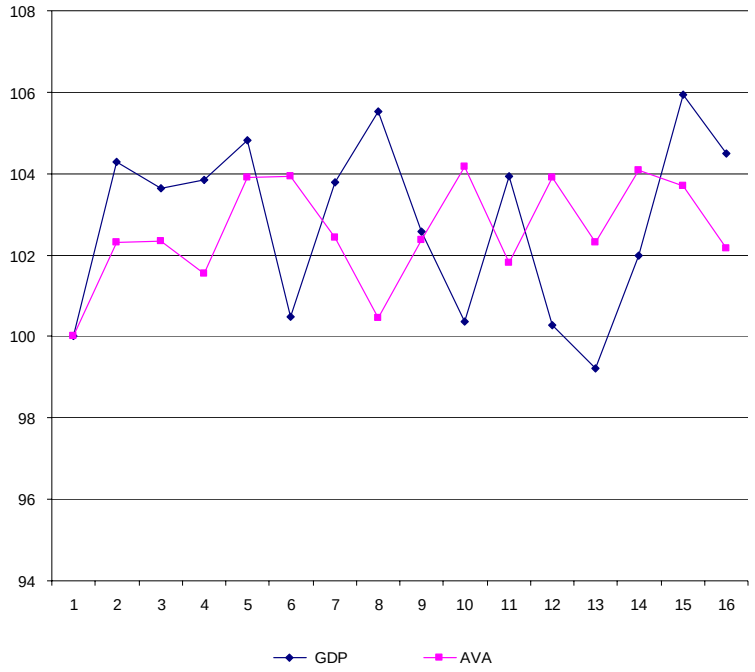
Figure I.2
LATIN AMERICA AND THE CARIBBEAN (33 COUNTRIES): GROWTH RATES OF AGRICULTURAL VALUE ADDED, 2000-2005



Source: Economic Commission for Latin America and the Caribbean (ECLAC), "Indicadores para el seguimiento de la agricultura y la vida rural, Plan Agro 2000-2015 (actualización 2007)", Santiago, Chile, 2007, unpublished.

The sector's performance tends to be countercyclical, as seen in figure I.3 (in which 1990 serves as the baseline year for agricultural value added and GDP), due to a series of factors including different response times for certain activities associated with biological processes, climatic factors and the existence of productive units that are only partially linked to markets. These rhythms can also be attributed to the fact that agricultural activity responds more slowly to changing economic conditions than do other economic activities. Thus, when GDP declines, the sector's value added also drops, but not as quickly as occurs in other sectors.

Figure I.3
LATIN AMERICA AND THE CARIBBEAN: VARIATIONS IN AGRICULTURAL VALUE ADDED AND GDP



Source: Economic Commission for Latin America and the Caribbean (ECLAC), "Indicadores para el seguimiento de la agricultura y la vida rural, Plan Agro 2000-2015 (actualización 2007)", Santiago, Chile, 2007, unpublished.

II. THE REGION'S POSITION IN INTERNATIONAL RANKINGS

The value of the Latin American and Caribbean gross output places the region close to the top of the world's regional rankings. Seventy-five of the region's products appear among the top 20 on the list, while 23 are among the five most important products at the global level.

Table II.1
LATIN AMERICA AND THE CARIBBEAN: LEADING PRODUCTS BY GROSS OUTPUT VALUE

	Top 20 ranking	Top 5 ranking
Latin America and the Caribbean	75	23
South America	45	16
Central America	9	
Mexico	12	7
Caribbean	9	

Source: Food and Agriculture Organization of the United Nations, Major Food and Agricultural Commodities and Producers [online database] http://www.fao.org/es/ess/top/country.html?lang=en.

Brazil, Argentina and Mexico are either among the largest, or are the largest, producers of numerous important products. Brazil is the world's largest producer of sugarcane and coffee, and the second largest producer of soy, beef, chicken, tobacco and cassava.

Argentina is the third largest producer of soy and sunflowers, the fifth largest corn producer and the second largest producer of transgenic soy. Mexico is the largest producer of avocados, the third largest producer of oranges and chicken, and the fourth largest producer of corn and sorghum.

The great food powers are not the only ones that occupy important places in the international rankings. In fact, many of the region's countries are among the 20 largest producers of a number of products worldwide. Ecuador is the fourth largest banana producer, Colombia the fourth largest coffee producer, and Peru the second largest producer of asparagus (see table II.2).

Table II.2
LATIN AMERICA AND THE CARIBBEAN (19 COUNTRIES): RANKING IN WORLDWIDE AGRICULTURAL OUTPUT

Country	Highest ranking in the list of major world producers	Other prominent positions in the list of major world producers
Argentina	3rd in soybean, sunflower, lemons and limes	5th in maize, 6th in sorghum
Brazil	1st in sugar cane and coffee	2nd in beef and chicken, soybean, tobacco and cassava
Mexico	1st in avocado, 3rd in oranges and chicken meat	4th in maize and sorghum
Chile	9th in grapes	11th in apples, 13th en tomatoes
Colombia	2nd in plantains, 4th in coffee	7th in sugar cane, 10th in bananas
Costa Rica	7th in bananas and pineapples	13th in coffee
Cuba	11th in plantains	14th in fresh vegetables, 17th in sugar cane
Ecuador	4th in bananas	10th in plantains
El Salvador	17th in coffee	
Grenada	6th in cardamom	
Guatemala	8th in coffee, 13th in bananas	14th in sugar cane
Haiti	13th in mangos and yams	20th in plantains
Honduras	9th in coffee	14th in bananas
Jamaica	17th in yams	
Nicaragua	16th in coffee	
Paraguay	13th in cassava	
Peru	2nd in asparagus, 6th in plantains	17th in potatoes
Uruguay	19th in meat	
Venezuela (Bolivarian Rep. of)	18th in sugar cane	

Source: Food and Agriculture Organization of the United Nations, Major Food and Agricultural Commodities and Producers [online database] http://www.fao.org/es/ess/top/country.html?lang=en.

Though the region produces a wide range of products of international importance, only a few of the countries' agricultural sectors show the strength that the sector in the overall region exhibited during the period under examination. That strength is concentrated in a small number of products, led by cattle, soy, corn, sugarcane, and a number of fruits produced principally for export and for the high-income segments of domestic markets.

The foods cited are produced by a relatively small group of producers that constantly incorporate new technologies and have access to significant capital. Other than the highest-income sectors of the domestic markets, these products are targeted at a few foreign markets, with the following countries leading the list: China (soy), United States (fruit, sugarcane flowers and other products) and the European Union (fruits and oil-bearing plants).

III. SOURCES OF AGRICULTURAL GROWTH

A. SOIL USE

According to the most recent available data, there are 859.9 million hectares of wooded land (2005) and 720.0 hectares of land dedicated to agriculture.[1] Of the latter, 557.7 million hectares are grazing lands and land entirely dedicated to growing grass for cattle, especially beef, while 162.3 million represent permanent and temporary crops, not counting cultivable land that is fallow.

Until the mid-twentieth century, agricultural expansion was almost entirely in the form of an advancing agricultural frontier. The "green revolution" of the 1940s to 1970s, which spread throughout Latin America and the Caribbean, introduced new technologies to the region. This led to greater use of modern inputs and, in turn, to major changes in the production of some grains, although only in certain geographic areas. Even today, however, the advance of the agricultural frontier continues to be a significant source of increasing production.

During the period under examination, nearly 63.9 million hectares of wooded land were lost, while beef cattle production increased by 68.1 million head, and the surface area dedicated to soy (the most dynamic crop) grew by 22.3 million hectares.

The expansion of the region's agriculture is a reaction to international demand and to the high price trends that favour these products, as well as to increased domestic demand for beef and chicken, among other products. At the international level, the increase in Asian demand (China, in particular) has had repercussions for many products, with soy and soy products especially affected. Meanwhile, domestic demand for higher-value products such as meat and dairy products is currently increasing, along with the demand for biofuels —a situation with significant implications for soil use patterns.

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[1] Agricultural land is divided into the following categories:
(i) Arable land: land with annual crops (areas producing double crops are counted only once), land temporarily devoted to grazing or hay, commercial and family vegetable growing operations, and temporarily fallow land (less than 5 years). Not included in this category is land abandoned in the process of migratory agriculture. Moreover, it should be noted that data on arable land does not specify the proportion that is cultivable. (ii) Perennial crops: land devoted over prolonged periods of time to particular crops that do not require replanting after each harvest, such as cacao, coffee and rubber. This category includes land devoted to bush-grown flowers, fruit trees, nuts and grapes, but not trees grown for wood. (iii) Permanent grassland: land permanently (5 years or more) devoted to herbaceous forage plants, whether cultivated or wild (wild or pasture grassland).

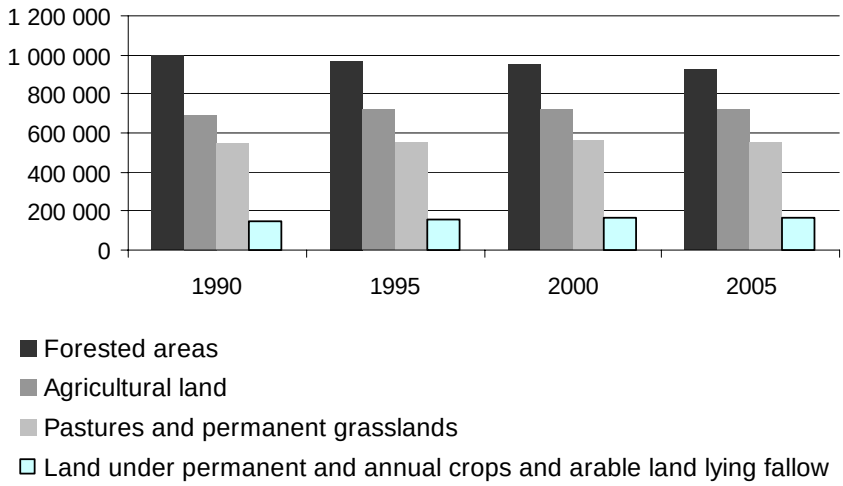
Soil use has undergone major changes. The land area dedicated to corn, which was larger before the expansion of soy growing, has increased, but at a far lower rate, adding 1.3 million hectares. During the same period, the area devoted to wheat declined by 1.5 billion hectares (see table III.1 and figure III.1).

Table III.1
LATIN AMERICA AND THE CARIBBEAN: VARIATIONS IN THE AREAS SOWN WITH PRINCIPAL CROPS
(Thousands of hectares)

	1990	1995	2000	2005	1990-2005
Maize	24 893.93	29 245.08	26 652.67	26 210.90	1 316.7
Rice	6 171	6 922.82	6 379.68	6 761.9	590.9
Wheat	10 673.99	7 941.70	9 241.15	9 127.1	-1 546.98
Soybean	18 04.63	19 075.35	24 206.58	40 340.3	22 299.0
Sugar cane	7 908.61	8 139.38	8 321.59	8 845	936.39

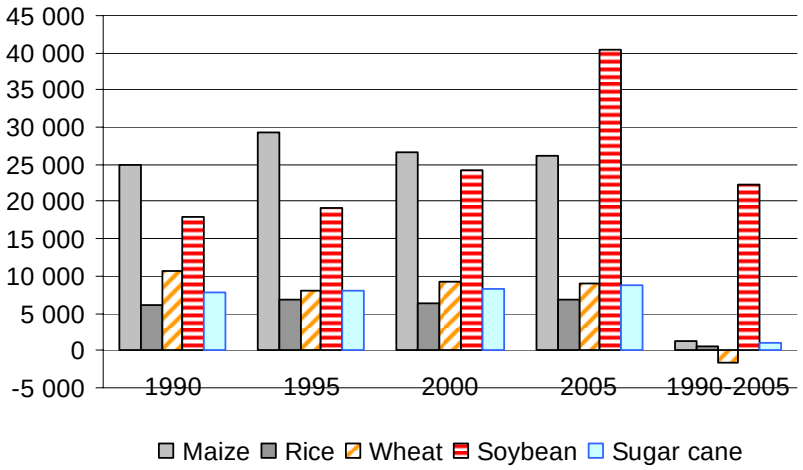
Source: FAO Statistical Databases (FAOSTAT).

Figure III.1
LATIN AMERICA AND THE CARIBBEAN: VARIATIONS IN LAND USE
(Thousands of hectares)



Source: FAO Statistical Databases (FAOSTAT).

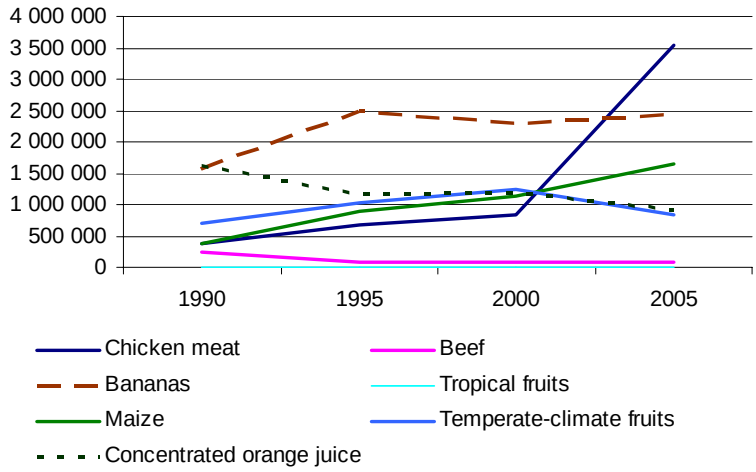
Figure III.2
LATIN AMERICA AND THE CARIBBEAN: VARIATIONS IN THE AREAS SOWN WITH PRINCIPAL CROPS
(Thousands of hectares)



Source: FAO Statistical Databases (FAOSTAT).

There was also rapid expansion in certain other crops, where production has increased in response to rising demand in domestic and foreign markets. The value of exports is a good indicator of increased foreign demand (see figure III.3). In this context, the explosive growth of chicken and corn exports stands out, as well as the recovery in banana exports.

Figure III.3
LATIN AMERICA AND THE CARIBBEAN: VARIATIONS IN EXPORTS OF THE PRINCIPAL AGRICULTURAL PRODUCTS
(Thousand of dollars)



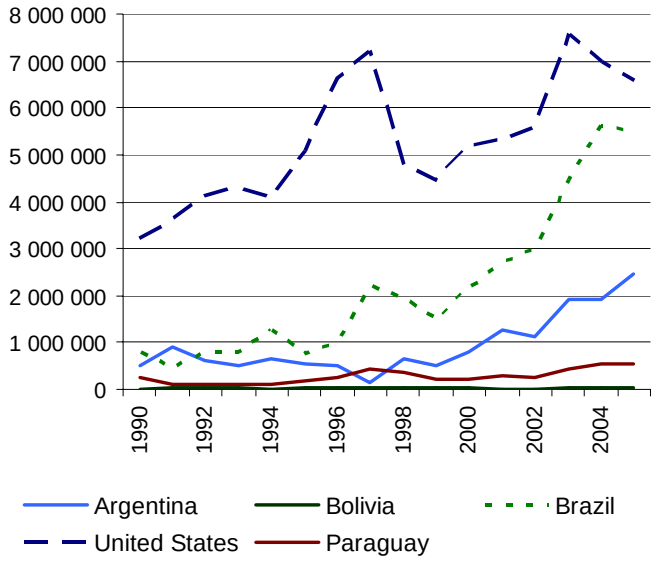
Source: FAO Statistical Databases (FAOSTAT).

B. THE EXPANSION OF SOY GROWING

Soy has been the region's "star" product in recent decades. Between 1990 and 2005, production increased by 62.5 million tons, almost double the increase in the United States during the same period.

The greatest stimulus to production was the combination of increasing international demand and favourable prices. While the appearance and spread of transgenic soy has been an important factor driving agricultural growth, especially in Argentina and the United States, the growing demand from China has been an even more significant determining factor in recent years (see figure III.4, which also shows the response of producing countries such as Argentina, Brazil and Paraguay). As indicated in the figure, soy exports from the United States began to decrease in 2003, in tandem with a significant increase in Brazil and Argentina and a somewhat smaller increase in Paraguay.

Figure III.4
PRINCIPAL SOYBEAN EXPORTERS
(Thousands of dollars)



Source: FAO Statistical Databases (FAOSTAT).

In addition to increases in the volume of production between 1990 and 2005, the area devoted to soy grew by 22.3 million hectares, largely at the expense of native forest and, to a lesser extent, by taking over areas being used to grow less profitable crops. Soy production is typified by constant technological progress, both from within the region and elsewhere, and the adoption of these new technologies has placed the region's countries among the largest producers on the international scene.

One of the most notable technological changes in agriculture has been the introduction of transgenic soy, accompanied by zero-tillage practices —first in Argentina, then in parts of Brazil and throughout most of Paraguay. Under this technique, weeds are controlled with the herbicide Glyphosate, a compound that is absorbed more quickly than other such products and that has come to be widely used. In Argentina alone, an estimated 100 million litres of Glyphosate are used annually.

In short, there has been a remarkable increase in area devoted to soy, as a result of strong foreign demand. Growing of the crop has become highly technified and is in the hands of very well capitalised medium-sized and large producers with extensive capacity to adapt to technological changes.

1. Brazil

Between 1990 and 2005, the amount of land devoted to soy in Brazil increased by 12.5 million hectares. This region is located in the central-western part of the country, in areas with native forests considered to be of little commercial value —particularly in the Cerrado region. Although in 1970 less than 2% of the soy was grown in this region, it accounted for 20% by the 1980s and 40% by the 1990s. Between 1990 and 2005, the states of Mato Grosso, Mato Grosso do Sul and Goiás accounted for 46.3% of the area devoted to soy in Brazil. All told, soy growing increased by 372% during this period.

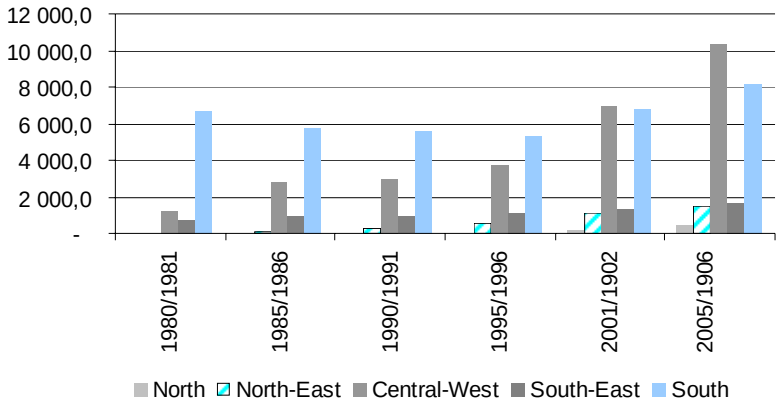
The contribution of technological progress has also been important, raising soy production from 1.75 to 2.51 tons per hectare. The Brazilian Agricultural Research Enterprise (EMBRAPA) has played a decisive role in these developments.

Table III.2
BRAZIL: INCREASE IN LAND SOWN WITH SOYBEAN, 1990-1991 TO 2004-2005
(Thousands of hectares)

Principal producing regions	**1990/1991**	**1995/1996**	**2000/2001**	**2004/2005**
Central-West Region				
Mato Grosso	1 100,0	1 905,2	3 120,0	6 105,2
Mato Grosso do Sul	1 013,1	845,4	1 064,5	2 030,8
Goiás	790,0	909,4	1 540,0	2 662,0
Total for Central-West Region	2 903,1	3 660,0	5 724,5	10 798,0
South Region				
Paraná	1 966,0	2 311,5	2 818,0	4 148,4
Santa Catarina	300,0	222,4	196,0	350,0
Rio Grande do Sul	3 269,4	2 804,0	2 970,0	4 090,1
Total for South Region	5 535,4	5 337,9	5 984,0	8 588,5
Total for Brazil	9 742,5	10 663,2	13 969,8	23 301,1

Source: Brazilian Agricultural Research Enterprise (EMBRAPA).

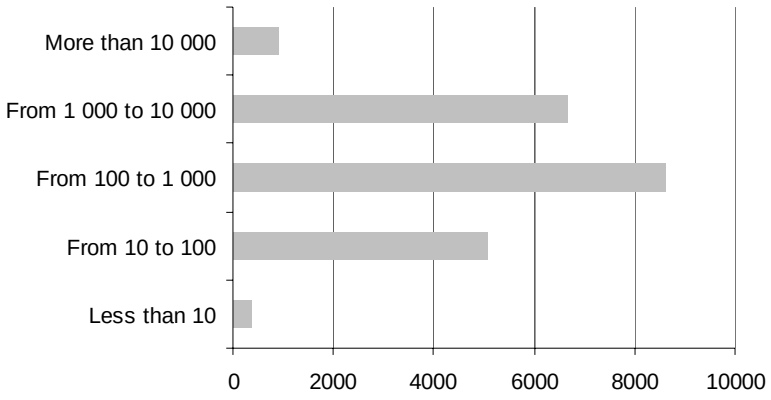
Figure III.5
BRAZIL: INCREASE IN LAND SOWN WITH SOYBEAN, 1980-1981 TO 2004-2005
(Thousands of hectares)



Source: Brazilian Agricultural Research Enterprise (EMBRAPA), on the basis of Companhia Nacional de Abastecimento (CONAB), April 2006 survey.

Much of the soy is grown by producers whose land is in the 100- to 1,000-hectare or 1,000- to 10,000-hectare category (see figure III.6).

Figure III.6
BRAZIL: SOYBEAN OUTPUT BY PLANTATION SIZE
(Thousands of tons)



Source: Brazilian Agricultural Research Enterprise (EMBRAPA), "Criação de empregos no complexo soja," on the basis of the 1996 agricultural census.

The characteristics of soy have made it an increasingly desirable crop for producers with access to extensive capital and the capacity to rapidly incorporate new technology, which involves intensive use of agrochemicals and machinery. However, the extension of the agricultural frontier has placed soy plantations farther and farther from the country's ports. This increases transportation costs, and hence greenhouse gas emissions. Moreover, an estimated 60% of the airplane fuel sold in Brazil is for fumigation of soy and sugarcane.

2. Argentina

Soy growing is expanding faster in Argentina than anywhere in the world (between 1990 and 2005, the amount of land devoted to soy increased by 10.4 million hectares, from 5 to 15.4 million hectares), driven by the use of transgenic soy.

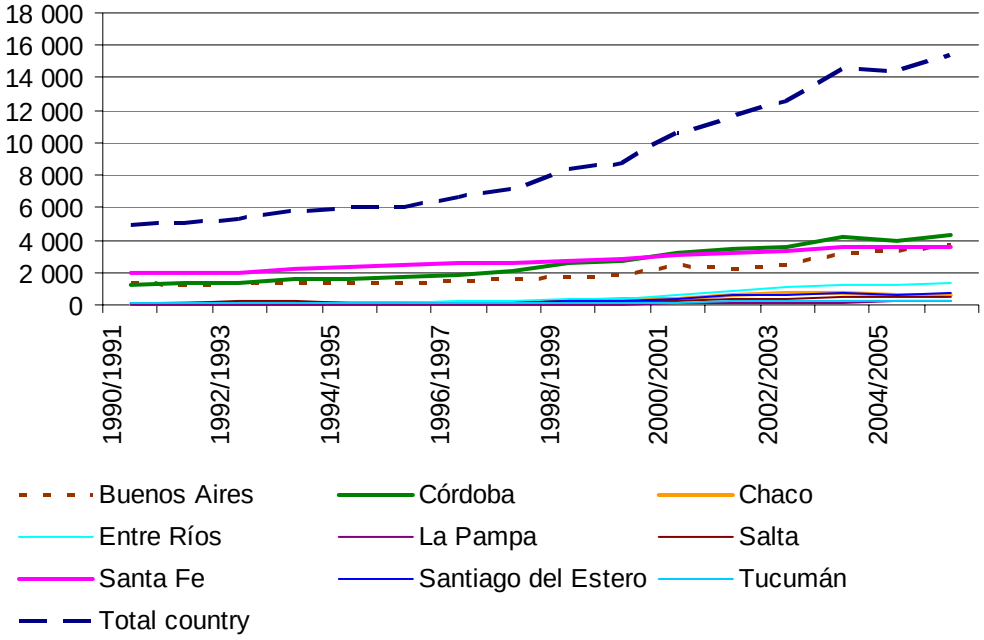
Córdoba, Buenos Aires and Santa Fe —and, to a lesser extent, Entre Ríos— accounted for the greatest increase in soy-growing area, while Chaco and Santiago (along with Entre Ríos) saw greatest percentage expansion (see table III.3 and figure III.7). While Córdoba, Santa Fe and Buenos Aires were the first to reflect this expansion, the other areas followed suit beginning in 2000, influenced by the crop's high profitability and increased foreign demand. This growth has occurred largely at the expense of native forests in those provinces.

Table III.3
ARGENTINA: INCREASE IN LAND SOWN WITH SOYBEAN, 1990-2005
(Hectares and percentages)

Province	Hectares	Percentages
Buenos Aires	2 396 800	182.5
Córdoba	3 093 718	247.5
Chaco	592 309	1 184.6
Entre Ríos	1 247 900	2 277.2
La Pampa	164 700	549.0
Salta	381 500	399.5
Santa Fe	1 566 290	78.8
Santiago del Estero	647 080	892.5
Tucumán	200 518	241.6

Source: Ministry of Economic Affairs, Department of Agriculture, Livestock, Fisheries and Food.

Figure III.7
ARGENTINA: INCREASE IN LAND SOWN WITH SOYBEAN, 1990-1991 TO 2004-2005



Source: Ministry of Economic Affairs, Department of Agriculture, Livestock, Fisheries and Food.

According to the 2004 report on desertification published by the Secretariat of Environment and Sustainable Development of the Ministry of Health and Environment, "Argentina in the most recent decades is probably facing one of the heaviest periods of deforestation in its history, aggravated by the fact that currently the deforested land is being planted with soy monocultures. Though the practice of direct planting is widespread in the country, cultivating techniques that cause deterioration of the soil and ultimately lead to desertification are still in use. Moreover, precipitation in the regions where the agricultural frontier is advancing most markedly acts as a limiting factor for agriculture. This and the potential deterioration of the soil are causing increasing uncertainty about the profitability and long-term sustainability of this type of production."

According to some estimates of lost forestland and conversion to soy, the provinces most affected are Entre Ríos and Santiago del Estero (see table III.4).

Table III.4
ARGENTINA: CONVERSION OF FOREST LAND FOR SOYBEAN PLANTATIONS, ESTIMATES, 1998-2004
(Hectares)

Province	Estimated forest losses
Santiago del Estero	629 059
Formosa	37 713
Salta	360 505
Chaco	207 153
Córdoba	227 500
Tucumán	45 600
Entre Ríos	700 00
Total	2 207 529

Source: C.N. Benbrook, *Rust Resistance, Run Down Soils, and Rising Cost Problems Facing Soybean Producers in Argentina*, technical paper, Nº 8, 2005.

A number of Argentine researchers have remarked on this issue, noting that the areas being converted to soy have fragile soils resulting from the clearing of land, where organic material generally does not constitute over 2% of the soil, thus making fertilisers necessary.[2]

Argentina (where the transgenic variety is universally used) is the world's second largest producer of transgenic soy. However, it is estimated that 160 million litres of Glyphosate were used last season, provoking intense controversy about this system. Advocates of zero-tillage and Glyphosate claim that the method prevents soil erosion, and that the chemical is more degradable than other herbicides. Those who question the system point to the crop's resistance to the herbicide, and to the effects that this may have on microscopic flora and fauna. They also assert that, given the huge volumes used, the benefit of greater degradability becomes insignificant.

Finally, the results of the last agricultural census in Argentina show that between 1988 and 2002 the average size of soy plantations grew from 375 to 509 hectares.[3] The producers are modern growers using new and highly capital-intensive technologies. Most of the producers grow the crops on rented land. Large consortia and firms that provide services in other segments of the production chain are also involved in growing soy. As in Brazil, technological change has raised productivity (from 2.2 to 2.7 tons per hectare).

[2] See G. Gallopín et al., "Análisis sistémico de la agriculturización en la pampa húmeda argentina y sus consecuencias en regiones extra-pampeanas: sostenibilidad, brechas de conocimiento e integración de políticas," *Environment and Development* series, No. 118 (LC/L.2446-P), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), December 2005; and Alicia da Veiga, "La soja y la expansión de la frontera agrícola Argentina," online at http://www.inta.gov.ar/suelos/info/documentos/informes/Exp_Front.pdf.

[3] G. Gallopín et al., "Análisis sistémico de la agriculturización en la pampa húmeda argentina y sus consecuencias en regiones extra-pampeanas: sostenibilidad, brechas de conocimiento e integración de políticas," *Environment and Development* series, No. 118 (LC/L.2446-P), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), December 2005.

3. Paraguay

Between 1991 and 2002, the role of farms of under 50 hectares has decreased, while that of large operations —particularly operations of over 1,000 hectares— has increased astronomically. In 2002, though these large operations represented a mere 1.1% of the actual number of soy-growing operations, they accounted for 21.6% of the land area devoted to soy.

Table III.5
PARAGUAY: VARIATIONS IN THE AREA SOWN WITH SOYBEAN, 1992-2002

	1991				2002				Variation	
Farm	Quantity		Area cultivated		Quantity		Area cultivated		Number of plantations	Area
Size of plantation (hectares)	Number of plantations	Percentage	Hectares	Average	Number of plantations	Percentage	Hectares	Average	Percentage	Percentage
Less than 10	6 835	25.6	13 761	3.7	5 510	19.8	11 484	2.1	-18.8	-16.5
From 10 to 20	8 239	30.6	11 529	4.5	7 550	27.2	36 255	4.8	-8.4	-8.4
From 20 to 50	7 222	27.0	86 495	12.0	6 105	22.0	85 573	14.0	-15.5	15.5
From 50 to 100	2 424	9.1	79 954	33.0	3 834	13.8	193 405	50.4	58.2	58.2
From 100 to 200	1 329	5.0	86 709	65.2	2 811	10.1	270 014	96.1	111.5	111.5
From 200 to 500	767	2.9	103 819	135.4	1 268	4.6	261 408	206.2	65.3	65.3
From 500 to 1 000	2 13	0.8	505 88	237.5	4 10	1.5	147 985	360.9	92.5	92.5
More than 1 000	1 38	0.5	937 28	679.2	3 18	1.1	276 481	869.4	230.4	295.0
Total	**26 717**	**100.0**	**552 455**	**20.7**	**278 06**	**100.0**	**1 282 855**	**46.1**	**4.1**	**132.2**

Source: Ricardo Pedretti, *Inversión en programas de diferenciación y diversificación de productos oleaginosos en Paraguay*, Ministry of Agriculture, 2005.

C. EXPANSION OF CATTLE RAISING

Information on cattle raising in recent decades suggests that its expansion is closely associated with deforestation. Between 1990 and 2006, there was an increase of 68.1 million head of beef cattle in Latin America and the Caribbean. Brazilian cattle accounted for 60 million of these, while Argentina's stock decreased by 2 million, and Mexico's by 2.4 million. There was a decrease of 900,000 head in the Caribbean, and a slight increase in Central America.

The number of head of cattle in the rest of South America (i.e., excluding Brazil and Argentina) also increased —by approximately 14 million head. The countries most important in this growth were the Bolivarian Republic of Venezuela, Uruguay, Bolivia, Colombia and Peru. In all of these except Uruguay and (to a lesser extent) Colombia, there was a considerable reduction of forestland.

Analysis of data on cattle and forestland shows a link between increased cattle raising and decreases in forestland, since in many countries the two phenomena coincide (Brazil, the Bolivarian Republic of Venezuela, Bolivia, Colombia, Ecuador, Guatemala, Paraguay, Peru, Nicaragua and Haiti).

In Argentina, Costa Rica and Mexico, however, both forestland and number of head of cattle decreased, while Chile and Uruguay saw simultaneous increases in both forestland and cattle.

Available information suggests that what is occurring follows the classic strategy of creating grazing land by clearing woods. Unlike what occurred in previous historical periods, however, there is a simultaneous expansion of high-profit agricultural activity, including soy in Bolivia, Brazil and Paraguay.

As indicated above, soy growing has expanded at the expense of native forest in the provinces where soy has recently been introduced, and at the expense of cattle raising and other less profitable agricultural activities.

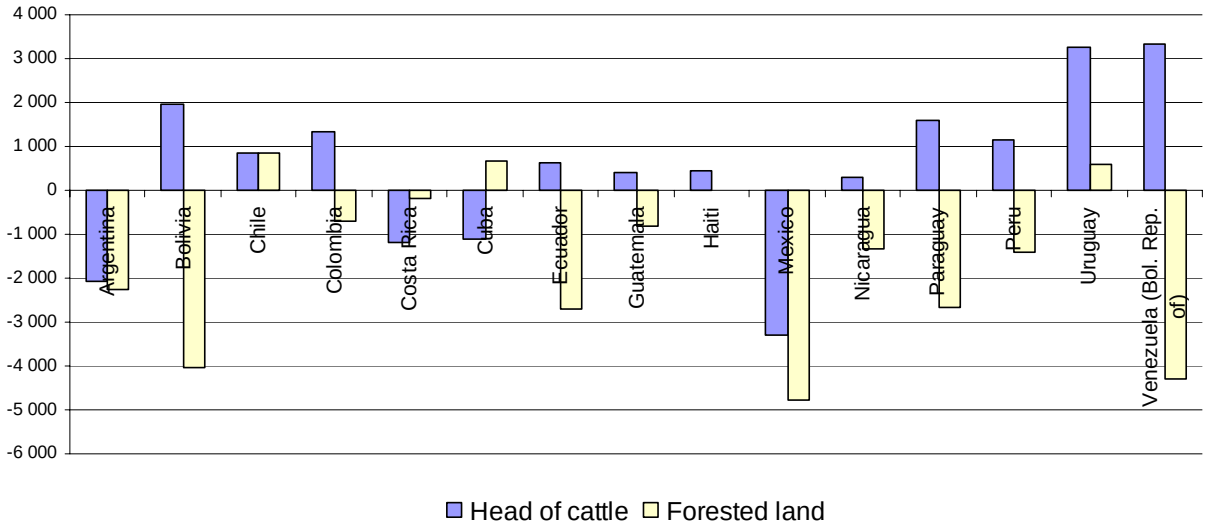
Finally, in Chile and Uruguay, policies to subsidise exotic species for the forestry industry have had positive results, helped by the opening of new markets for beef exports.

Table III.6
LATIN AMERICA AND THE CARIBBEAN (16 COUNTRIES): VARIATION IN CATTLE NUMBERS AND IN FORESTED LAND, 1990-2005
(Thousands of head of cattle and thousands of hectares)

	Variation in numbers of cattle	Variation in forested land
Argentina	-2 077 000	-2 241 000
Bolivia	1 973 841	-4 055 000
Brazil	60 054 000	-42 329 000
Chile	863 800	858 000
Colombia	1 315 895	-711 000
Costa Rica	-1 201 000	-173 000
Cuba	-1 098 900	655 000
Ecuador	611 443	-2 694 000
Guatemala	420 620	-810 000
Haiti	456 000	-11 000
Mexico	-3 291 678	-4 778 000
Nicaragua	300 000	-1 349 000
Paraguay	1 583 898	-2 682 000
Peru	1 138 998	-1 414 000
Uruguay	3 264 000	601 000
Venezuela (Bolivarian Rep. of)	3 343 339	-4 313 000
Latin America and the Caribbean	68 111 673	-68 660 000

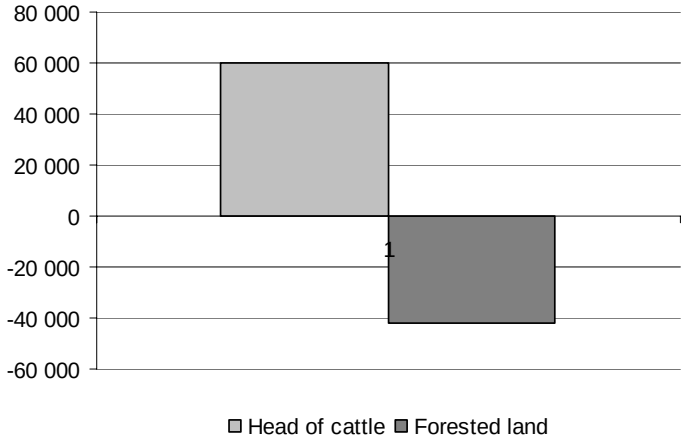
Source: FAO Statistical Databases (FAOSTAT).

Figure III.8
LATIN AMERICA AND THE CARIBBEAN (15 COUNTRIES): VARIATION IN CATTLE NUMBERS AND IN FORESTED LAND, 1990-2005
(Thousands of head of cattle and thousands of hectares)



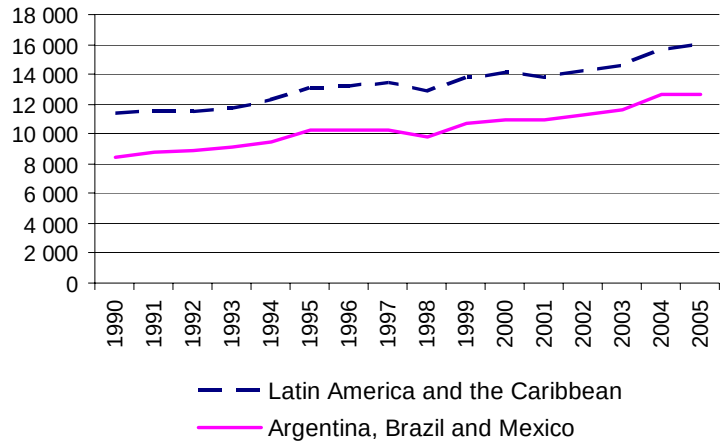
Source: FAO Statistical Databases (FAOSTAT).

Figure III.9
BRAZIL, VARIATION IN CATTLE NUMBERS AND IN FORESTED LAND, 1990-2005
(Thousands of head of cattle and thousands of hectares)



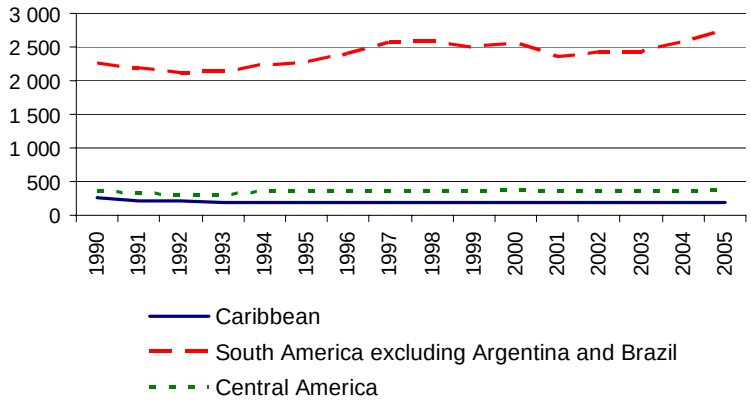
Source: FAO Statistical Databases (FAOSTAT).

Figure III.10
LATIN AMERICA AND THE CARIBBEAN: PRINCIPAL BEEF PRODUCERS
(Thousands of tons)



Source: FAO Statistical Databases (FAOSTAT).

Figure III.11
LATIN AMERICA AND THE CARIBBEAN, EXCLUDING ARGENTINA, BRAZIL AND MEXICO: MEAT PRODUCTION
(Thousands of tons)



Source: FAO Statistical Databases (FAOSTAT).

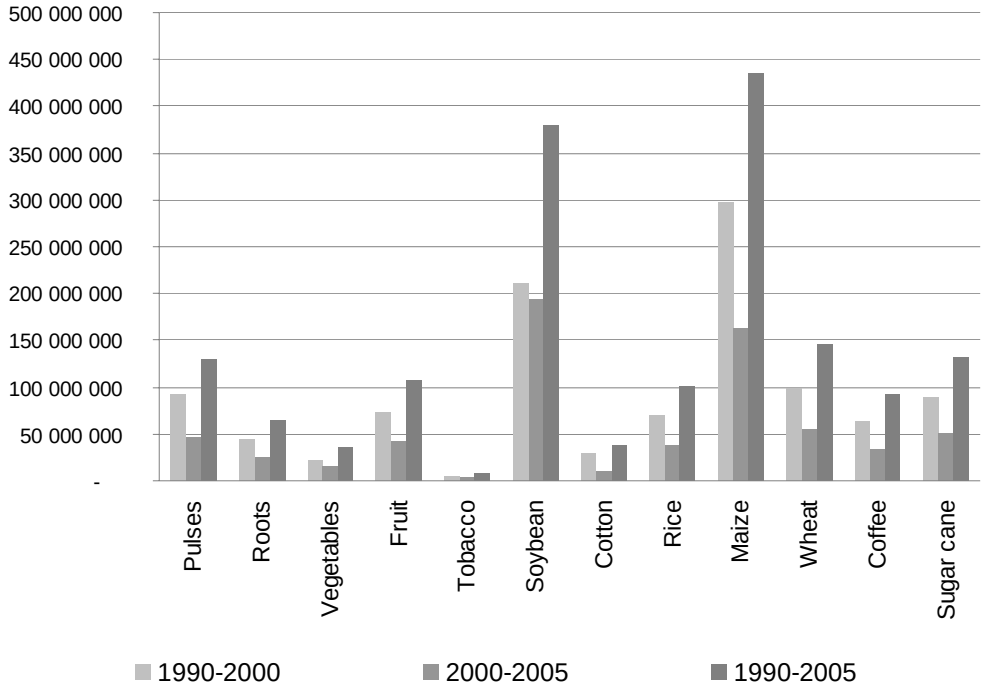
As is widely acknowledged, the expansion of cattle raising is primarily a response to domestic demand, associated with increasing incomes and changing dietary habits. Also important is the growth in foreign demand and, in some cases, opening of new niche markets for high-quality products. At the same time, the domestic and foreign demand for fresh milk, and milk products in general, is increasing.

D. OTHER CROPS

The situation is different for the cultivation of temperate-zone fruits, which increased during the period being discussed here. The amount of area cultivated declined as a result of technological advances in production, some of which involve more intensive use of chemicals.

On the other hand, the area devoted to the region's major crop —corn— has not varied greatly at the regional level over the last few years, though there are variances among individual countries that are major growers. The land devoted to corn in Argentina has increased 78% with the advent of transgenic corn. The situation in Brazil has not changed substantially, while in Mexico the area dedicated to corn declined 10%.

Figure III.12
LATIN AMERICA AND THE CARIBBEAN: VARIATIONS IN AREAS SOWN WITH THE PRINCIPAL CROPS
(Hectares)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), "*Indicadores para el seguimiento de la agricultura y la vida rural, Plan Agro 2015 (2007 edition)*", Santiago, Chile, 2007, unpublished.

Analysis of the data shows a geographic shift in cattle raising: from the southern and northern regions toward the central-western part of South America.

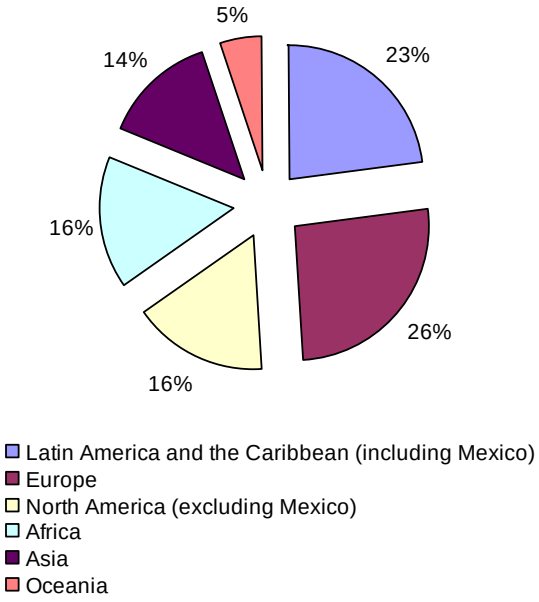
The strongest crops —soy and, over the last several years, sugarcane— are also beginning to see a geographic shift: northward in Argentina, and toward the central-western region in Brazil.

IV. DEFORESTATION

A. FOREST AREA

LAC's 924.2 million hectares of wooded land represent nearly one fourth of the world's forests. Of the regional total, 831.5 million hectares are in South America, 64.2 million in Miexico, 22.4 million in Central America and 6 million in the Caribbean. Temperate forests are estimated to account for some 52 million hectares in Argentina, Chile and Uruguay, and in higher-altitudes areas in the region's tropical countries.

Figure IV.1
WORLDWIDE FOREST COVER, BY REGION
(Percentages)



Source: Food and Agriculture Organization of the United Nations (FAO), State of the World's Forests, 2007, Rome, 2007.

For a number of decades, intense deforestation has occurred in the region as a result of the advance of the agricultural frontier for cattle raising and, in the last few years, for cultivation of crops that are in high demand in international markets. This process was particularly intense throughout the 1970s and 1980s, and has continued at a fairly rapid pace, though less intensely than in the 1970s and 1980s. The phenomenon intensified again between 2000 and 2005, reaching a higher rate than during the 1990s. The cumulative annual deforestation rate of 0.46% between 1990 and 2000 rose to 0.51% for the 2000-2005 period.

The region is currently undergoing a much more acute process of deforestation than is the rest of the world. The region's loss of forestland was more than double the worldwide rate between 1990 and 2005, at 68.7 million hectares —representing 4.6 million hectares per year, or 12,540 hectares per day. Of this total,

59 million were in South America, with some 42.3 million (61.6% of the LAC total) in Brazil alone. The remaining losses were in Bolivia, Ecuador, Paraguay and the Bolivarian Republic of Venezuela.

Although, in absolute terms, the eradication of the region's forestland is greatest in South America, the most affected area proportionately is Central America, with a decline of 19% in its wooded area. During the same period, the forested area increased 11% in the Caribbean and declined 7% in Mexico.

As a result of these changes, the region's forestland, which represented 51% of the region's total land area in 1990, declined to 47% in 2005.[4]

Table IV.1
VARIATION IN FOREST COVER, 1990-2005

	Area (thousands of hectares)			Annual variation (thousands of hectares)			Annual rate of variation (percentages)		
	1990	2000	2005	1990-2000	2000-2005	1990-2005	1990-2000	2000-2005	1990-2005
Caribbean	5 350	5 706	5 974	356	268	624	0,65	0,92	0,74
Mexico	69 016	65 540	64 238	-348	-260	-4778	-0,5	-0,4	-0,48
Central America	27 639	28 837	22 411	-380	-285	-5228	-1,47	-1,23	-1,39
South America	890 818	85 2796	831 540	-3 302	-4 251	-59278	-0,44	-0,50	-0,46
Latin America and the Caribbean	992 823	95 2879	924 163			-68660			-0,48
World	4 077 291	3 988 610	3 952 025	-8 868	-7 317		-0,22	-0,18	-0,21

Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests, 2007*, Rome, 2007.

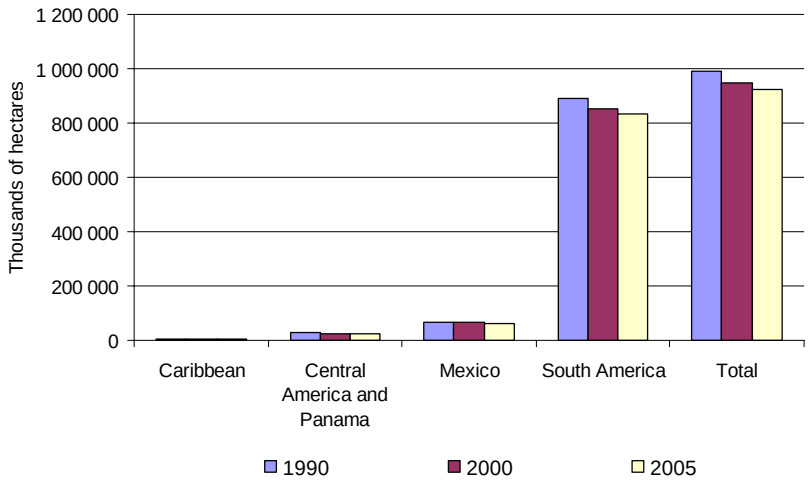
It should be noted that, in three countries —Cuba, in the Caribbean, and Chile and Uruguay in South America— forested area increased between 1990 and 2005. The expansion of forested area in Cuba, in response to public policy, has had a decisive effect on the expansion of forested areas throughout the Caribbean.

Chile and Uruguay have significantly increased commercial forest plantation under targeted public programmes. Costa Rica is the only country in the region that, after a net loss of forestland during the 1990-2000 period, recovered a large portion of its native forested area, leading to an increase in forest area over the following five years. The turnaround is due to innovative government policy designed to finance forest management and to pay for environmental services.

Analysis of the situation at the subregional level shows that forest area increased 11% between 1990 and 2005 in the Caribbean as a whole, as the result of the addition of 624,000 hectares of forestland. Cuba's 1.7% annual increase is responsible for a majority of this expansion.

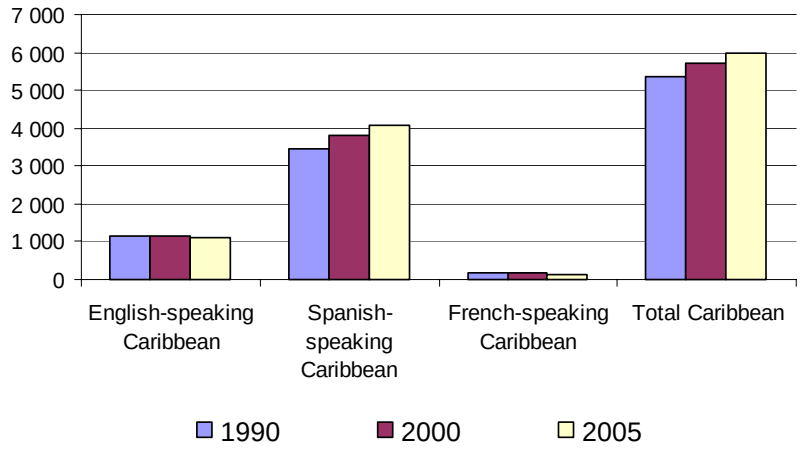
[4] Food and Agriculture Organisation of the United Nations (FAO), *State of the World's Forests, 2007*, Rome, 2007.

Figure IV.2
LATIN AMERICA AND THE CARIBBEAN: VARIATION OF FOREST COVER, 1990-2005
(Thousands of hectares)



Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007.

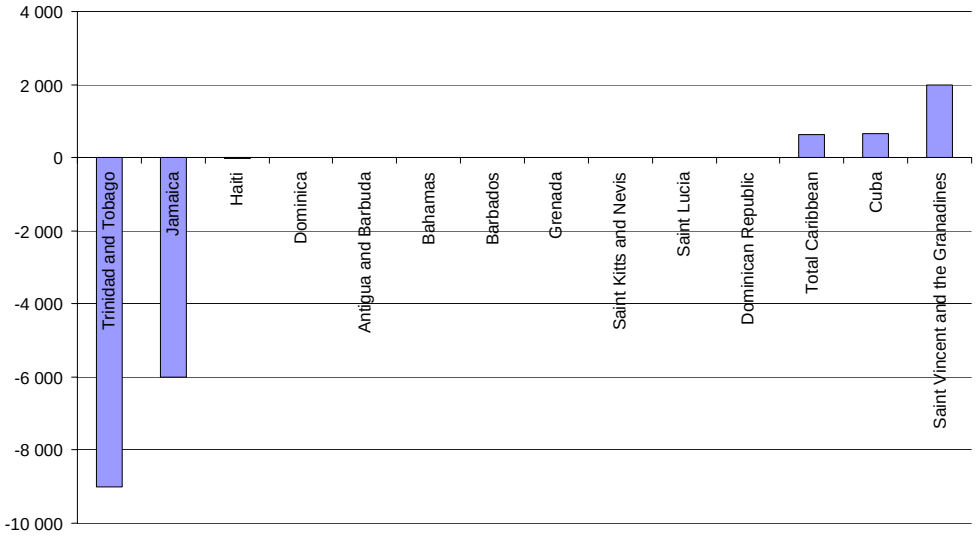
Figure IV.3
THE CARIBBEAN: VARIATION OF FOREST COVER, 1990-2005
(Thousands of hectares)



Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007.

Forestland decreased slightly in the English-speaking Caribbean between 1990 and 2005, due to the decrease in Trinidad and Tobago, Jamaica, the United States Virgin Islands and Anguilla. The only English-speaking country in the Caribbean showing an increase was Saint Vincent and the Grenadines, while the remaining countries showed no change.

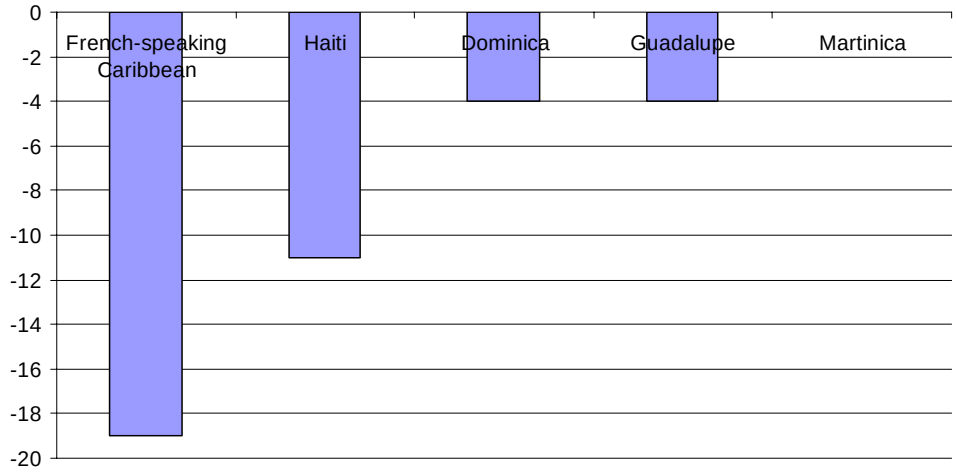
Figure IV.4
THE ENGLISH-SPEAKING CARIBBEAN (17 COUNTRIES AND TERRITORIES): VARIATION OF FOREST COVER, 1990-2005
(Thousands of hectares)



Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007; and forestry databases.

Finally, there was a relatively widespread decline in forested area in the French-speaking Caribbean. This phenomenon was particularly pronounced in Haiti, but was also evident, to a lesser extent, in Guadaloupe and Martinique.

Figure IV.5
THE FRENCH-SPEAKING CARIBBEAN (4 COUNTRIES AND TERRITORIES): VARIATION OF FOREST COVER, 1990-2005
(Thousands of hectares)

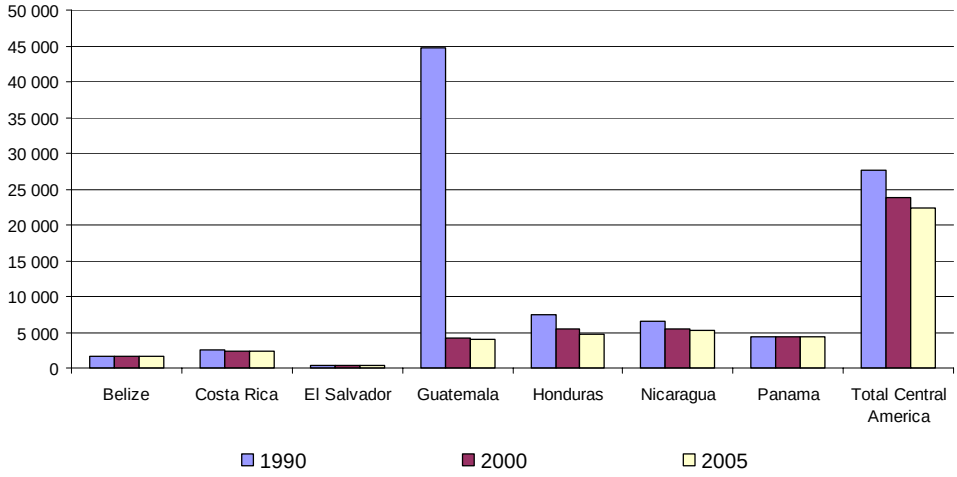


Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007.

In Central America and Panama, the country with the greatest loss of forestland for the 1990-2005 period was Honduras, followed by Guatemala and Nicaragua in second and third place.

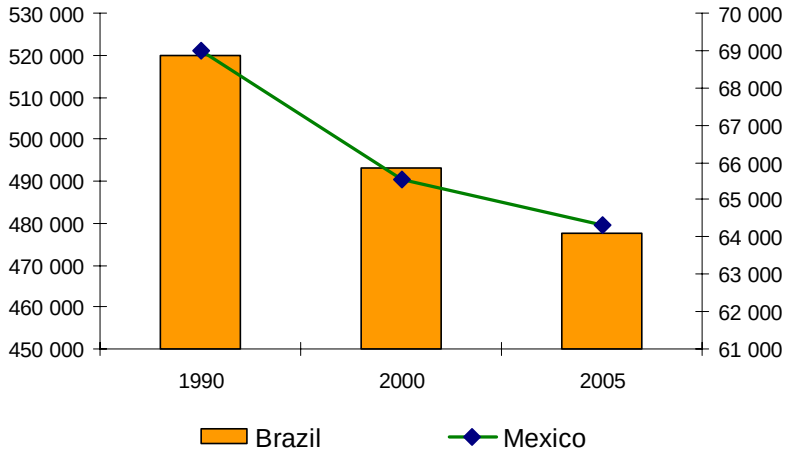
Because of Brazil's size, scant attention is generally given to the situation in other countries that have lost major amounts of forest (e.g., Argentina, the Bolivarian Republic of Venezuela, Bolivia, Ecuador, Paraguay and Peru).

Figure IV.6
CENTRAL AMERICA (7 COUNTRIES): VARIATION OF FOREST COVER, 1990-2005
(Thousands of hectares)



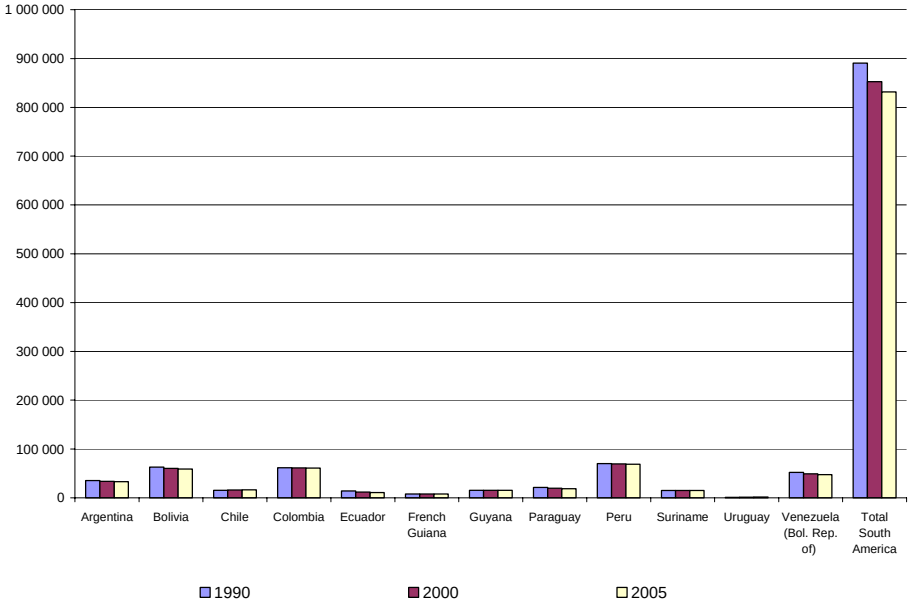
Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007.

Figure IV.7
BRAZIL AND MEXICO: VARIATION OF FOREST COVER, 1990-2005
(Thousands of hectares)



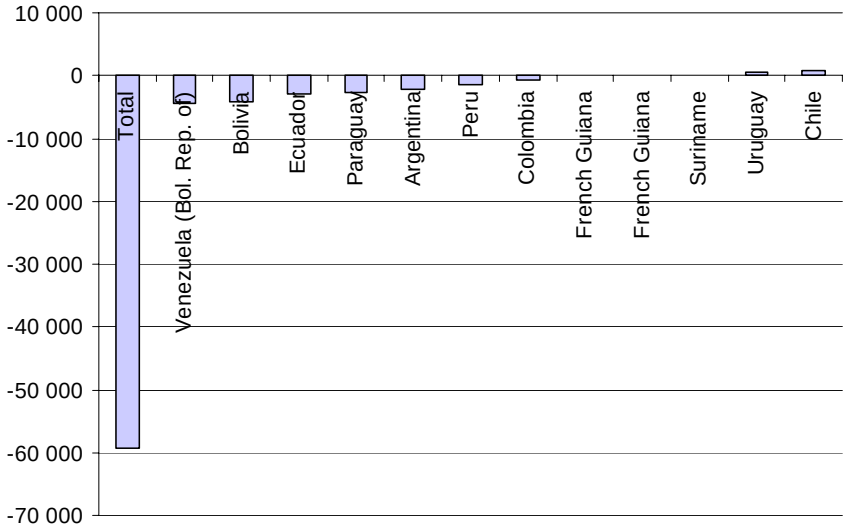
Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007.

Figure IV.8
SOUTH AMERICA (12 COUNTRIES AND TERRITORIES): VARIATION OF FOREST COVER, 1990-2005
(Thousands of hectares)



Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007.

Figure IV.9
SOUTH AMERICA (12 COUNTRIES AND TERRITORIES): VARIATION OF FOREST COVER, 1990-2005
(Thousands of hectares)



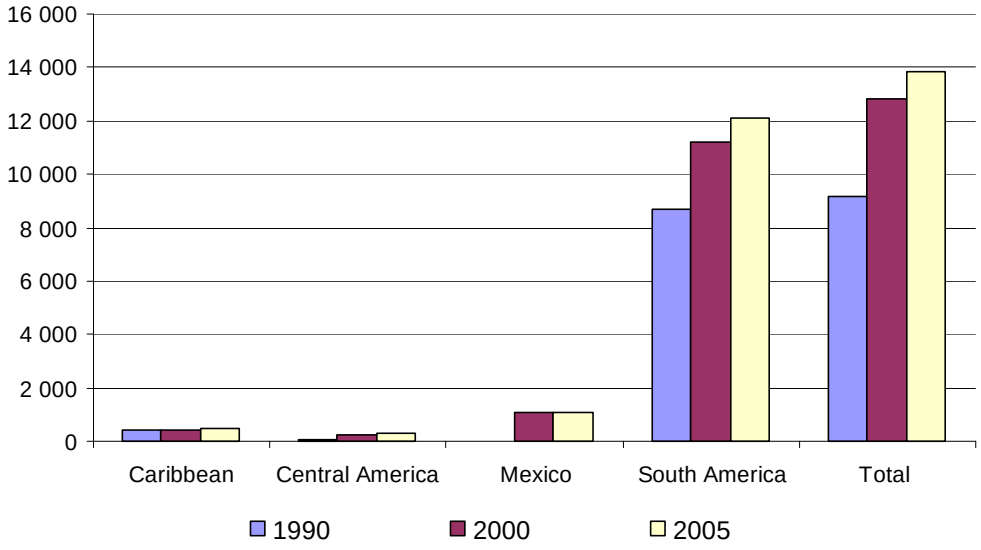
Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007.

B. FOREST PLANTATIONS

Forest plantations represent only 1.4% of forestland in Latin America and the Caribbean, as compared with 4% worldwide. The 1.6% annual expansion of planted woodland areas between 1990 and 2005 was not sufficient to compensate for the annual loss of native forests. Except for a small percentage of cases, forest plantations are devoted to two species: eucalyptus (48%) and pine (46%), both of which are fast-growing species grown primarily for the cellulose industry.

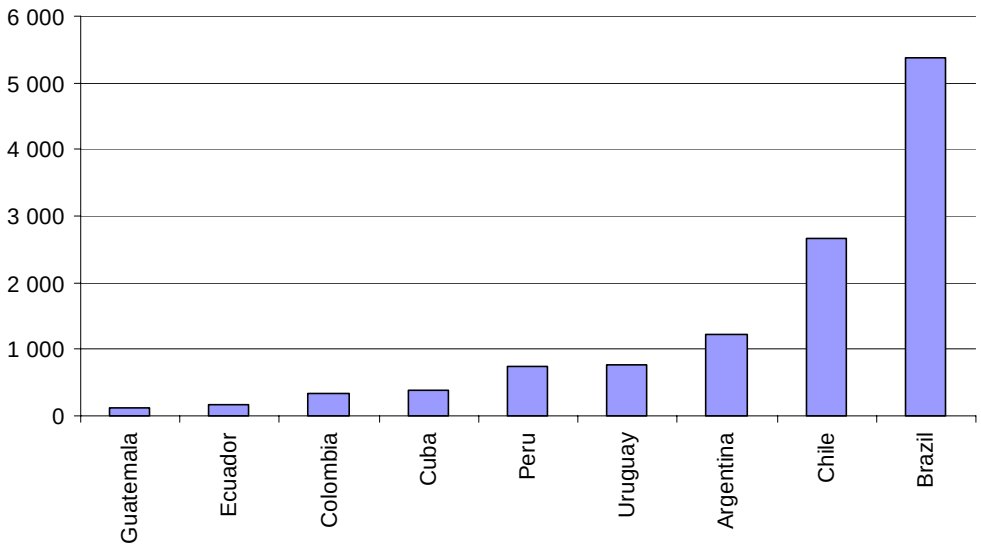
The majority of the region's forest plantations are in South America, with Brazil accounting for the largest share, followed by Chile, Argentina and Uruguay, in that order. In the Caribbean, Cuba has the largest area of planted forestland, as well as the highest rate of expansion, while Guatemala leads Central America in terms of area covered by forest plantations (see figure IV.10).

Figure IV.10
LATIN AMERICA AND THE CARIBBEAN: VARIATIONS IN FOREST PLANTATIONS, 1990-2005
(Thousands of hectares)



Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007.

Figure IV.11
LATIN AMERICA AND THE CARIBBEAN: FOREST PLANTATIONS, 2005
(Thousands of hectares)



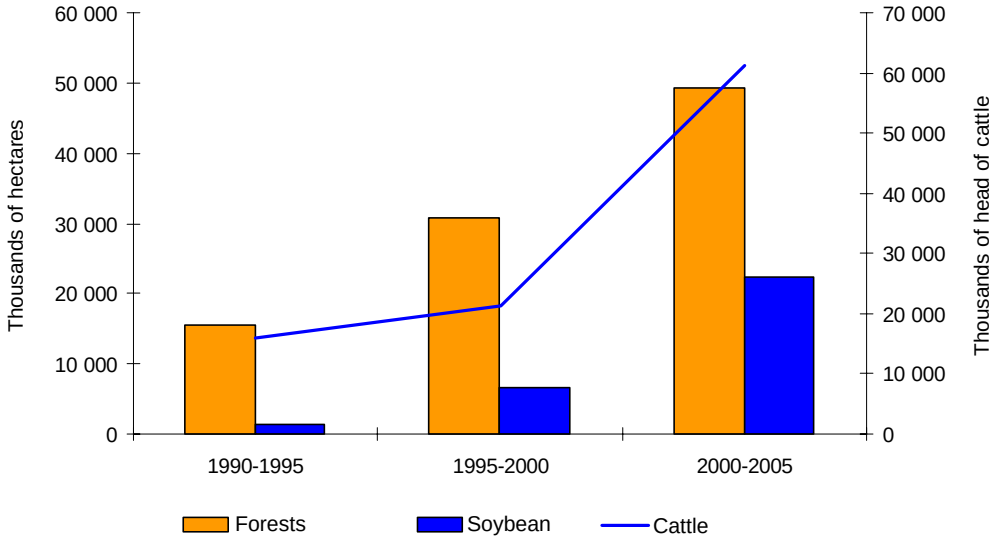
Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007.

C. CAUSES OF DEFORESTATION

As has been indicated, the principal cause of deforestation is the advancing agricultural frontier resulting from cattle raising. In recent years, the increased cultivation of crops such as soy, in response to high international demand, has been an added factor. Indeed, soy is spreading dramatically, and all indications are that this will continue as global demand increases, with China being a major player.

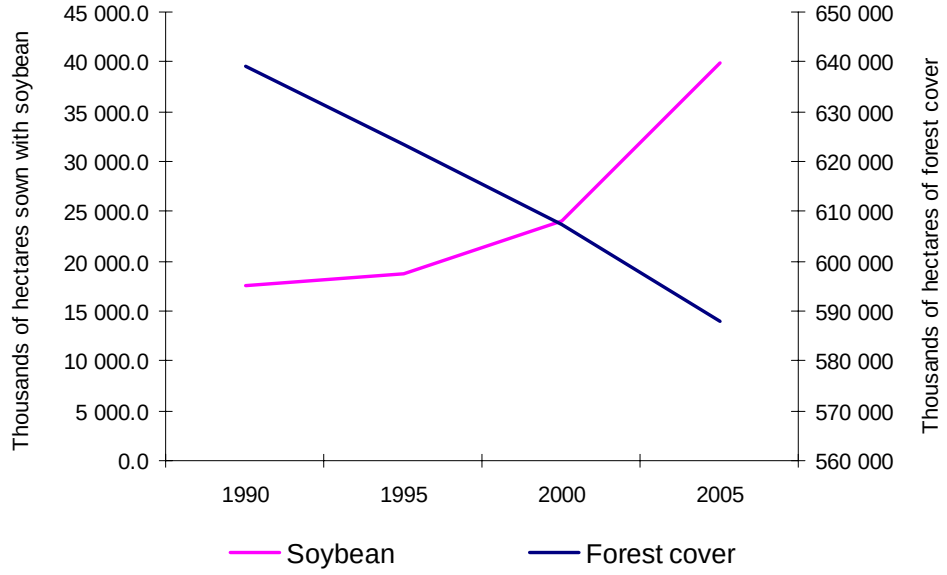
The number of head of beef cattle in the region (as indicated earlier) increased by 68.1 million between 1990 and 2005, while land planted in soy expanded by 22.4 million hectares (see figure IV.12).

Figure IV.12
SOYBEAN PRODUCING COUNTRIES: DECLINE IN FOREST COVER AND VARIATION IN NUMBERS OF CATTLE, 1990-2005
(Thousands of hectares and thousands of head of cattle)



Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007; and FAO Statistical Databases (FAOSTAT).

Figure IV.13
PRINCIPAL SOYBEAN PRODUCERS: VARIATION IN AREAS SOWN WITH SOYBEAN AND FOREST COVER, 1990-2005
(Thousands of hectares)

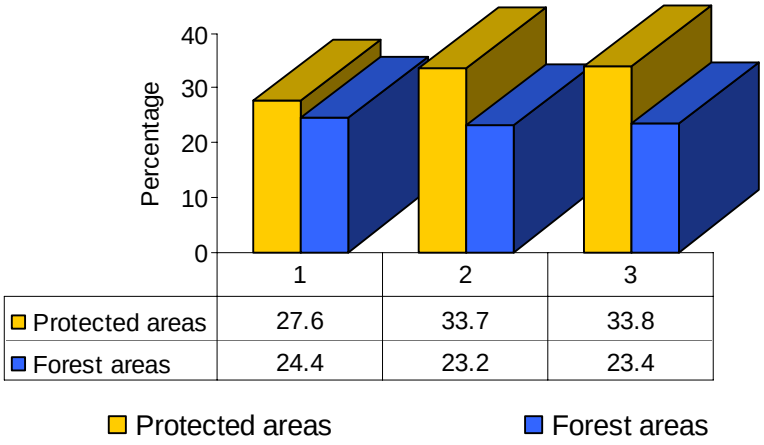


Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007; and FAO Statistical Databases (FAOSTAT).

D. PROTECTED AREAS DESIGNED TO PRESERVE BIODIVERSITY

In recent years, the Latin American and Caribbean region has made an important contribution by setting aside areas to preserve biodiversity. Already, by 1990, 27.6% of the world's protected areas were in this region, and by 2005 this figure had increased to 33.8%, while, at the same time, the proportion of forested areas decreased (see figure IV.14).

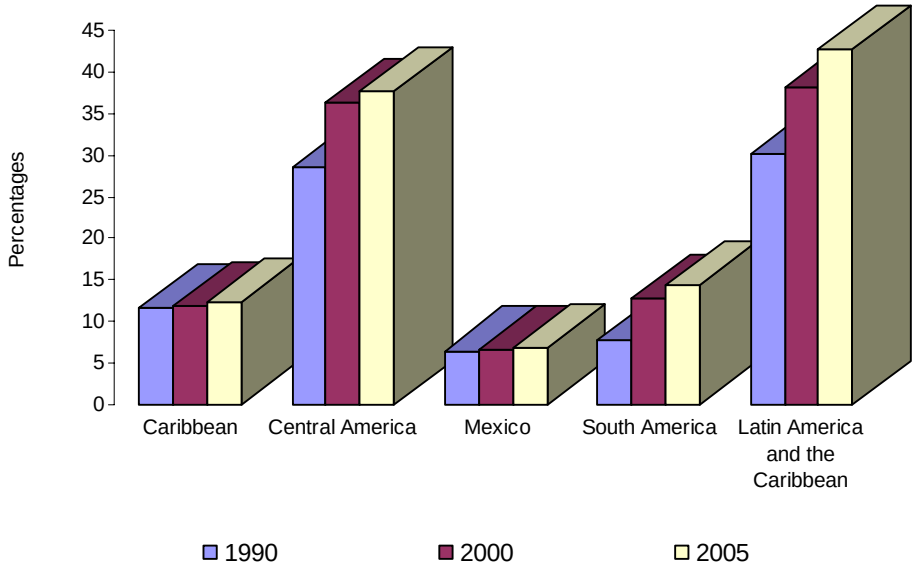
Figure IV.14
LATIN AMERICA AND THE CARIBBEAN: PROTECTED AREAS AND FOREST COVER COMPARED WITH WORLDWIDE TOTAL, 1990-2005
(Percentages)



Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007.

Breaking this into subregions reveals that the amount of protected area is increasing fastest in South America (72.1% during the period under examination), though Central America's progress is comparable in relative terms, since its protected areas grew by approximately 10%, from 28.5% of all forestland in 1990 to 37.8% in 2005 (see figure IV.15).

Figure IV.15
LATIN AMERICA AND THE CARIBBEAN: VARIATION IN PROTECTED AREAS, 1990-2005



Source: Food and Agriculture Organization of the United Nations (FAO), *State of the World's Forests 2007*, Rome, 2007; and FAO Statistical Databases (FAOSTAT).

E. FOREST RESOURCES DEVOTED TO PRODUCTIVE ACTIVITIES

Twelve percent of forested area is dedicated to productive activities in LAC. This is less than half the worldwide percentage (32%). In Central America and the Caribbean, most of this area (90% and 82%, respectively) is devoted to firewood, while in South America firewood accounts for less area, with industrial uses accounting for more. In 2005, for the first time, more wood was used for industrial purposes than as fuel.

F. ENVIRONMENTAL SERVICES AND PROTECTION OF THE ENVIRONMENT

The forest area devoted to environmental protection and services constitutes 11% of the region's forested area, a greater percentage than in the world as a whole (9%). The most important contribution to environmental protection is the contribution that forests make to soil retention and to preventing erosion. Under the environmental services category are areas for recreation and for the preservation of biodiversity; permit systems to control hunting; and services such as waterway protection and cleanup, as well as other activities associated with the regulation of water basins. The development of special markets by government and civil society is yet another type of environmental service —e.g., the market for credits to prevent deforestation and to retain carbon in the form of trees.

A number of the region's countries are leading the way in exploring innovative ways of paying for environmental services, including waterway cleanup. Though no general conclusions can be drawn, given the incompleteness of information, it is clear that payments for such services —including protection

of biodiversity— can often exceed expenditures for carbon retention and protection of hydrological basins and waterways.

Two cases in the region merit particular attention. One is Mexico, which is one of the countries at the head of global efforts to develop innovative policies to pay for these services. In 2005, over 500,000 hectares of Mexican forest were accorded special protection, under programmes in which owners of forests are paid for sound management, for their contribution to clean water supplies, and for their contribution to mitigating the effects of climate change.

Costa Rica has also adopted policies and created programmes to pay for environmental services that contribute significantly to reversing the loss of forestland.

G. PRELIMINARY ESTIMATE OF CARBON RETENTION

Forests cover 29% of the earth's land surface and contain 60% of the carbon produced by plant cover, i.e. 340 petagrams (Pg) of carbon in living and dead vegetation at the surface and immediately below the surface of the earth, plus 618 Pg within the mineral layer. Of the total amount of carbon stored in the first meter of soil depth worldwide, 36% is under forest cover. According to studies in different types of forests, the majority of carbon pools are in tropical forests (62%). Though available information is incomplete, estimates have been made of carbon pools and carbon flux in forest vegetation —above- and below-ground living and dead mass, woody debris, and carbon pools in the topsoil to one meter of depth (see table IV.2).

Table IV.2
ESTIMATED CARBON POOLS, 2000
(Petagrams (Pg), or billions of tons)

Region/country	Carbon pools (Pg) [a]		Carbon flux (Pg/year)
	Vegetation	Soils	
Boreal zone			
Former USSR	63	111	+0.3 a +0.5
Canada	12	211	+0.08
Alaska	2	11	…
Subtotal	77	333	+0.48 ± 0,2
Temperate zone			
United States	15	21	+0.08 a + 0.25
Europe	10	18	+0.09 a + 0.12
China	17	16	-0.02
Australia	9	14	Trazas
Subtotal	51	69	+0.26 ± 0.1
Tropical zone			
Asia	41 - 54	43	-0.50 a -0.90
Africa	52	63	- 0.25 a -0.45
Latin America	119	110	-0.50 a -0.70
Subtotal	212	216	-1.65 ± 0.40
Total	340	618	- 0.90 ± 0.5

Source: S. Brown, "Present and potential roles of forests in the global climate change debate", 2000.

[a] 1 Pg = 1015 grams, one billion tons.

An average of 138 tons of carbon per hectare are stored above ground in the Latin American and Caribbean region's forests, in addition to 128 tons underground. These figures are consistent with estimates made in field studies concerning the region, in both tropical and temperate forests. Two studies in Argentine Patagonia concluded that the carbon stored in forests varies from 98 to 155 tons per hectare.[5] Much higher figures have been found in other research, such as a 2000 study in Manaos (Brazil), which estimated a capacity of 447 tons per hectare, of which 162 tons (36%) were soil deposits.

One way of calculating the value of carbon is to use the 2007 prices transacted in formal markets under the rules of the Kyoto Protocol to the United Nations Framework Convention on Climate Change, as well as in markets that are using other new mechanisms to prevent deforestation.

According to the World Bank, carbon emission reduction certificates (CERs) were valued at an average of US$ 10.9 for 2007, or 52% of the 2005 price.[6] In 2006, the minimum price was US$ 6.8. In frameworks other than the Kyoto Protocol, prices averaged US$ 4.1 per certificate, but it should be borne in mind that instruments in these systems fluctuate greatly —between US$ 0.45 and US$ 45, depending on the nature of the project (including factors such as security and objectives). The price of credits traded to prevent deforestation has, in the past, ranged from US$ 8 to US$ 12, while prices for 2008 are hovering around US$ 18.

An initial estimate of the value of stored carbon and the cost of the deforestation associated with its elimination was made based on the information below.

Clearing of tropical forests —those most affected by deforestation— releases at least 100 tons of carbon per hectare into the atmosphere. The 2007 report of the Intergovernmental Panel on Climate Change for Latin America and the Caribbean is based on simulations that assume 109 tons per hectare.[7] In the 15-year period between 1990 and 2005, the region lost 68.7 million hectares of forest, meaning that 6 billion 866 million tons of carbon were released into the atmosphere, an amount that translates into 25 billion 129.56 million tons of carbon dioxide.[8]

The value of carbon can vary between US$ 6.8 dollars per ton of CO2 (US$ 24.88 per ton of carbon) and US$ 2.73 per ton of CO2 (equivalent to US$ 10 per ton of carbon), the lowest figures paid in the market.

If calculations are based on a price of US$ 2.73/tCO2 (US$ 10/tC), then the 25 billion 129.56 million tons of carbon released into the atmosphere by deforestation between 1990 and 2005 have a value of US$ 68 billion 604 million, translating into an annual loss of US$ 4 billion 573.6 million. If the calculation is based on a price of US$ 6.8/tCO2 (the lowest paid for carbon credits in 2006), the total amount is US$ 170 billion 881 million, and the annual amount is US$ 11 billion 392 million (see table IV.3).

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5 Martina Chidiak, Alejandra Moreyra and Carlos Greco, Captura de carbono y desarrollo forestal sostenible en la Patagonia argentina. Sinergias y desafíos, Washington, D.C., Inter-American Development Bank, October 2004.

6 Karan Capoor and Philippe Ambrosi, *State and Trends of the Carbon Market 2007*, Washington, D.C., World Bank, 2007; K. Hamilton et al., "State of the Voluntary Carbon Market 2007: Picking up Steam," *New Carbon Finance*, 17 July 2007.

7 Intergovernmental Group of Experts on Climate Change, *Climate Change 2007: Impacts, Adaptation and Vulnerability, 2007*, Chapter 13.

8 Carbon has a molecular weight of 12, while carbon dioxide has a molecular weight of 44; thus, a factor of 3.66666 must be applied.

Table IV.3
LATIN AMERICA AND THE CARIBBEAN: LOSSES DUE TO THE RELEASE OF CARBON TO THE ATMOSPHERE BECAUSE OF DEFORESTATION, ESTIMATES, 1990-2005

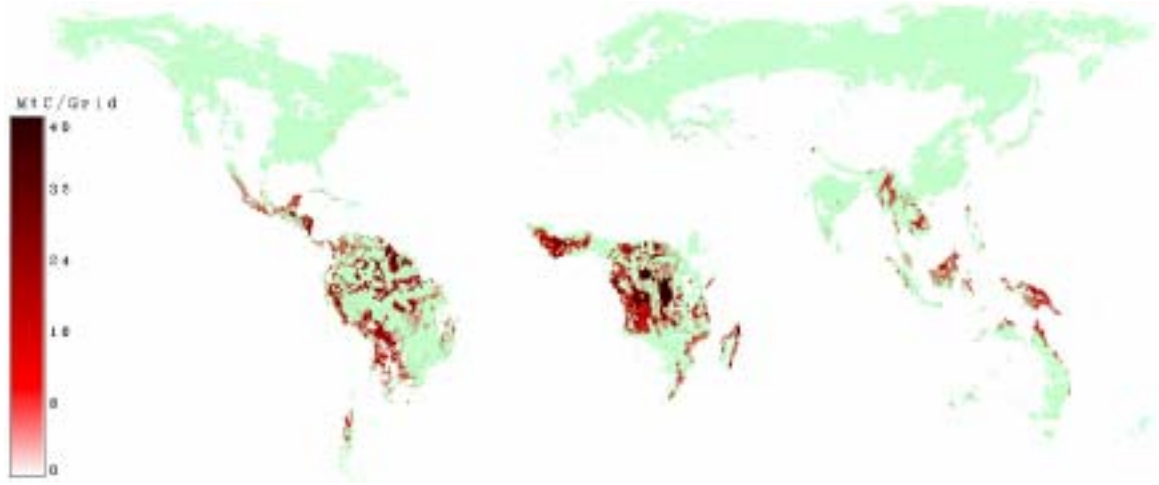
Estimates	Loss in 1990-2005	Annual loss	Agricultural loss/value added (percentages)
	Millions of dollars		
At a price of US$ 2.73 per ton of CO2 (US$ 10 per ton of carbon)	68 604	4 573.6	3.3
At a price of US$ 6.8 per ton of CO2 (US$ 24.88 per ton of carbon)	170 881	11 392	8.1

Source: Economic Commission for Latin America and the Caribbean (ECLAC).

To these figures must be added the increase in methane emissions as a consequence of the increase in cattle raising during the period (68.1 million head). According to estimates in Latin America, made in the context of identifying methane markets, each animal produces an average of some 44 kilograms of methane yearly in a semi-extensive production system. This implies a release of almost 200,000 tons of methane into the atmosphere each year —methane being a much more toxic gas than CO2, and more costly to eliminate.

Research conducted in 2006, in Austria, by a team of scientists modelling the hypothetical impact of different carbon pricing levels on deforestation concluded that an incentive of US$ 6/hectare per five-year period in areas threatened by deforestation would reduce deforestation by 50%,[9] while a tax of US$ 12 per hectare on deforested land would have the same effect (see map IV.1).

Map IV.1
DEFORESTATION: HYPOTHESIS WITHOUT A CARBON PRICE [a]



Source: Georg E. Kindermann and others, "Predicting the deforestation trend under different carbon prices", FEEM Working Paper, Nº 29, 2006.

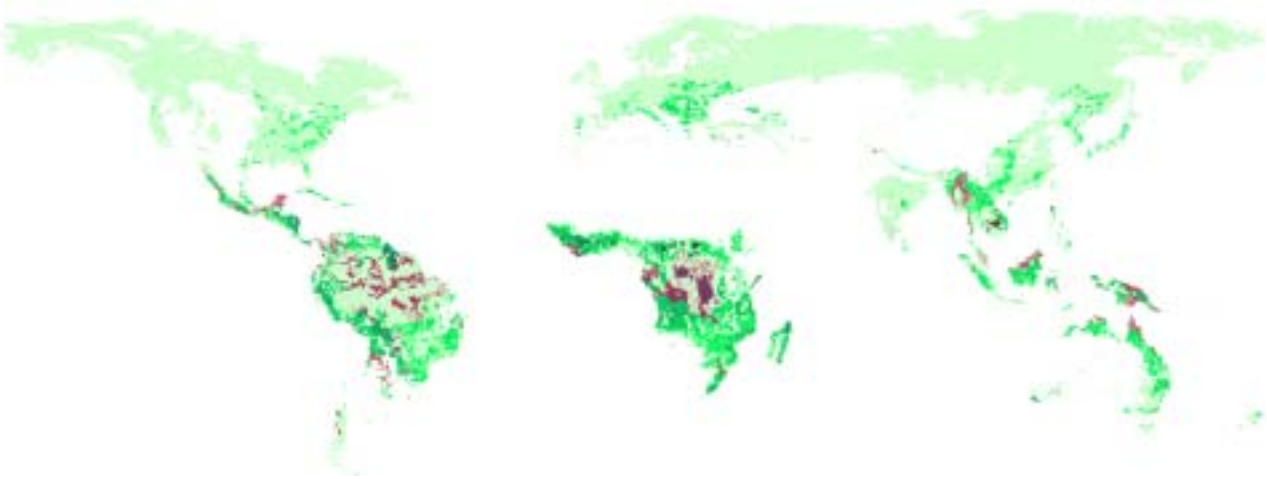
Note: MtC/Grid: Millions of tons of carbon per unit area.

[a] The colour green indicates areas with forest cover; red indicates deforested areas.

[9] Georg E Kindermann et al., "Predicting the deforestation trend under different carbon prices," *FEEM Working Paper*, Nº 29, 2006.

A more rigorous calculation would have to also consider losses due to changes in soil use, and application of fertilisers and other substances, and would need to subtract, from the loss side, the carbon stored in the vegetation replacing the forests, which is considerably less than the carbon lost from the clearing of wooded land but varies depending on whether the land is converted to grass, planted forest, agricultural crops, or other uses.

Map IV.2
DEFORESTATION: HYPOTHESIS WITH A CARBON PRICE (US$ 12 PER TON) [a]



Source: Georg E. Kindermann and others, "Predicting the deforestation trend under different carbon prices", FEEM Working Paper, Nº 29, 2006.

Note: MtC/Grid: Millions of tons of carbon per unit area.

[a] The colour green indicates areas with forest cover; red indicates deforested areas.

V. DESERTIFICATION AND DROUGHT

A. CONCEPTUAL CONSIDERATIONS

The Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa defines desertification as "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities" (Article 1a). "Arid, semi-arid and dry sub-humid areas" in turn refers to non-polar and sub-polar regions in which the ratio of annual precipitation to potential evapotranspiration falls within a range from 0.05 to 0.65 (Article 1g).

Degradation is defined as "reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes,

including processes arising from human activities and habitation patterns." In Latin America and the Caribbean, land degradation affects all types of ecosystems.

In this same context, "land" is defined as "the terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes that operate within the system" (Article 1a and 1e).

Three types of desertification-promoting human activities can be distinguished: deforestation, use of soil without regard for its capacities, and excessive artificialisation or improper exploitation of ecosystems (through various forms of mechanisation, irrigation, fertilisation, pest control and phytogenetic improvement).

From the socioeconomic point of view, desertification may be considered a process of degradation that significantly reduces the fertility of soils, directly affecting food supply and the survival of human groups in rural areas who are dependent on agriculture.

In addition, there is a close link between desertification and poverty, and between these phenomena and migratory patterns. The poor tend to occupy lower-quality and more fragile land, and in order to survive must make intense use of the scarce resources they possess, which only aggravates the fragility of the resources, reduces their productivity and ultimately exhausts them. When this occurs, segments of the population are forced to migrate to other areas in search of activities capable of sustaining them.

In describing what occurs in these cases, one refers to the economic or social "desert," and to abandoned land. Depending on the characteristics of the territory affected and the degree of harm caused, it may be possible to manage the ecosystem in a way that actually restores it, by abandoning the land, imposing time lags on its use, or through appropriate soil restoration measures and sustainable management practices to reverse the process of degradation.

Drought is a meteorological and hydrological concept not to be confused with desertification, which is described above.[10] Drought and desertification do affect each other as aggravating or mitigating factors, but can also be considered to be independent processes. Mitigating the effects of drought does not necessarily arrest the causes of desertification, just as controlling the processes of degradation that lead to desertification does not reduce episodes of drought. In any case, the effects of drought are much more evident in the short term than is the case with land degradation, which tends to occur imperceptibly over longer periods.

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[10] The concept of "desertification" is always defined, while that of "drought" rarely is —probably because it is considered to be obvious. From a meteorological perspective, drought can be defined as an abnormal and recurrent climatic condition that occurs in all climate regions of the earth. This phenomenon is characterised by a marked reduction in the amount of precipitation, which can produce serious hydrological imbalances. In hydrological terms, drought is considered to exist when there is less than the average seasonal precipitation for the region, which translates to an abnormal level of supply in waterways and in surface or subterranean water reserves. In such cases, the reduction in hydrological resources exceeds a specified level for a given period of time. Such a definition incorporates available data and consumption rates, based on the system's normal supply (use for domestic, industrial, and agricultural irrigation purposes). The effects are reflected in crop yields and, as the drought intensifies, it produces a significant impact on communities and their economies (hydroelectric energy, supply of drinking water, industrial use, etc.). See the Spanish science and online technology portal (TECNOCIENCIA), at: http://www.tecnociencia.es/especiales/sequia/quees.htm.

B. THE STATE OF THE REGION

Latin America and the Caribbean encompass 20.18 million square kilometres, one fourth of which is arid land. It is estimated that 75% of the arid, semi-arid and sub-humid land is affected by degradation, while the same is deemed to be true for 75% of the region's cultivated land.

Sources of data that could provide a general understanding of desertification in Latin America and the Caribbean are relatively scarce. Some countries have no reliable general data on the proliferation of land degradation, or on the populations affected. Moreover, official documents often do not include figures on the extent of the problem at the national level, thus making regional calculations of the problem difficult.

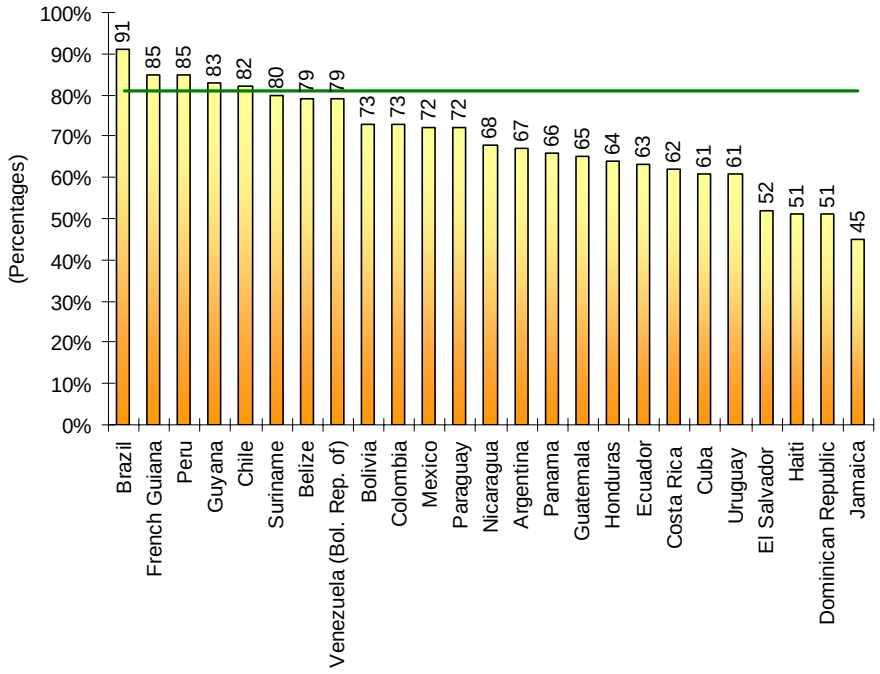
It is possible, however, to identify different degrees of degradation and vulnerability, ranging from foci of desertification in low tropical areas to severe degradation in arid highland areas that are more than 4,000 metres above sea level.

The region includes areas with a wide range of climatic conditions: arid and semi-arid areas in northern Mexico, semi-arid and sub-humid areas in the Caribbean islands (Antigua, Granada, Jamaica, St. Vincent and the Grenadines, St. Kitts and Nevis), the Guajira region of Colombia and of the Bolivarian Republic of Venezuela, facing the Caribbean, northeastern Brazil, and Paraguay's Gran Chaco. There are also high-altitude arid zones in the Andean countries and along the South American coasts, from Ecuador to Chile. Finally, extensive areas of Argentine and Chilean Patagonia have been degraded by unsustainable productive practices.

All of the region's countries are affected by one or more process of degradation in at least some of their territory: soil degradation, salinisation, compaction, erosion, exhaustion or advanced nutrient loss, and accumulation of toxic substances —all of which are aggravated by extreme climatic phenomena. According to the United Nations Food and Agriculture Organisation (FAO) *World Soil Resources Report*, of 2000, all of the region's countries suffer from serious soil degradation affecting significant proportions of their land, ranging from 62% in Costa Rica to 92% in Brazil.

Eight Central American ecological systems, or 45% of the subregion, are in sub-humid, arid and semi-arid zones —in southern Guatemala, most of El Salvador, southeastern Honduras and western Nicaragua, as well as extensive areas of Costa Rica and Panama. Considering climatic factors, three of these systems are highly vulnerable: the arid forests of the Pacific coast (50,101km^2), the scrub forests of the Motagua Valley in Guatemala (2,363km^2) and the pine and oak forests of Central America (127,910km^2). It is these forests —in El Salvador, Guatemala, Honduras and Nicaragua— as well as the scrub forests of the Montagua Valley, that are most threatened by human activity.

Figure V.1
LATIN AMERICA AND THE CARIBBEAN (19 COUNTRIES AND TERRITORIES): LAND SHOWING SOME TYPE OF DEGRADATION, 2002
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Food and Agriculture Organization of the United Nations (FAO), *World Soil Resources Report, 2000*.

The poor population lives and works on hillsides that are unsuitable for agriculture, thus increasing the vulnerability of the areas they inhabit. This becomes a vicious circle, since as the soils are degraded, the poor *campesinos* are forced to expand their growing to even more fragile areas.[11]

The Caribbean islands, being in the tropics, are affected by extreme climatic phenomena that jeopardise not only biodiversity, but also the local inhabitants. Among other things, the islands undergo marked seasonal variations in precipitation, and most areas suffer from prolonged droughts, causing major agricultural losses. The droughts are followed by torrential rains that aggravate erosion and eat away at the coastline.

Some of the Caribbean islands are of volcanic origin (Dominica, St. Lucia, St. Vincent and the Grenadines), while others are the result of coral formations (Antigua and Barbuda, Barbados, parts of Jamaica and the Dominican Republic). Since all constitute more recent and fragile formations than do the continental landmasses, they are highly vulnerable to land degradation from erosion.

Serious soil loss is occurring in the islands of St. Kitts and Nevis due to excessive grazing, while Jamaica and some other islands have problems created by both legal and illegal bauxite mining, as well as

[11] COWI/CATIE, "The Sixth Regional Meeting in the Framework of the United Nations Convention to Combat Desertification (UNCCD). Synthesis —Conference Paper," Inter-American Development Bank, October 2000.

by the construction of houses on very steep hillsides. In Barbados, the district of Scotland in the north, where there are remains of native and semi-natural forests, suffers from extensive erosion, while a similar, though somewhat less severe, situation is present in St. Vincent and the Grenadines. One fourth of Antigua is nearly devoid of vegetation and is highly vulnerable to further deterioration.

As Reynold Murray and Philbert Brown indicate, St. Vincent and the Grenadines and Jamaica are focal points for the Convention to Combat Desertification, while Granada suffers from serious erosion caused by rain, since its soils are volcanic and only sparsely covered by vegetation. One third of Dominica's territory suffers from degradation, and Anguilla, St. Lucia and St. Kitts and Nevis have lost much of their plant cover as a result of the hurricanes that strike these areas. The small size of the territories and the effects of population pressures make soil degradation unpreventable, especially in the smaller islands.

Hispaniola, the island shared by the Dominican Republic and Haiti and inhabited by 14 million people, represents an extreme case of degradation, with acute deterioration taking the form of soil degradation and biodiversity loss, particularly in the area with the greatest population pressure (in Haiti).

In addition to the well-known case of northeastern Brazil, the Chaco region (a biogeographic zone covering one million square kilometres in Argentina, Bolivia, Brazil and Paraguay) is affected by acute soil degradation and a marked reduction in biodiversity (see table V.1).

Table V.1

LATIN AMERICA AND THE CARIBBEAN (25 COUNTRIES): AREAS OF DESERTIFICATION AND POPULATION, 2003

(Thousands of kilometres, thousands of inhabitants and percentages)

Total area		Deserts				Drylands				Population			
		Hyper-arid		Arid		Semi-arid		Humid and sub-humid		Country total	Total drylands	Percentage of drylands	Percentage at risk of desertification
Country	(thousands of km²)	Population (thousands of inhabitants)	Population density	Population (thousands of inhabitants)	Population density	Population (thousands of inhabitants)	Population density	Population (thousands of inhabitants)	Population density	(thousands of inhabitants)	(thousands of inhabitants)		
Argentina	2 780	2 641	5	1 099	4	2 056	4	1 494	5	33 404	4 649	14	15
Belize	22	-	-	-	-	-	-	-	-	205	-	-	-
Bolivia	1 093	765	7	181	7	1 133	13	1 595	12	40 768	2 909	7	7
Brazil	8 563	452	11	292	-	2 198	29	14 938	27	36 336	17 428	48	49
Chile	759	1 233	5	2 912	16	692	14	2 210	21	13 652	5 814	43	47
Colombia	1 139	-	-	20	18	262	18	208	26	33 962	490	1	1
Costa Rica	52	-	-	-	-	-	-	-	-	3 289	-	-	-
Cuba	111	-	-	-	-		-	-	-	10 616	-	-	-
Dominican Republic	50	-	-	-	-	-	-	-	-	7 691	-	-	-
Ecuador	255	18	3	497	43	1 050	71	2 666	67	10 196	4 213	41	41
El Salvador	21	-	-	-	-	-	-	-	-	5 718	-	-	-
Guatemala	110	-	-	-	-	-	-	-	-	10 243	-	-	-
Guyana	210	-	-	-	-	-	-	-	-	742	-	-	-
Haiti	27	-	-	-	-	-	-	-	-	6 365	-	-	-
Honduras	115	-	-	-	-	-	-	-	-	5 257	-	-	-
Jamaica	11	-	-	-	-	-	-	-	-	2 131	-	-	-
Mexico	1 960	6 351	10	1 941	11	5 974	22	34 540	63	89 593	42 455	47	51
Nicaragua	131	-	-	-	-	-	-	-	-	4 216	-	-	-

Table V.1 (concluded)

Total area		Deserts				Drylands				Population			
		Hyper-arid		Arid		Semi-arid		Humid and sub-humid		Country total	Total drylands	Percentage of drylands	Percentage at risk of desertification
Country	(thousands of km²)	Population (thousands of inhabitants)	Population density	Population (thousands of inhabitants)	Population density	Population (thousands of inhabitants)	Population density	Population (thousands of inhabitants)	Population density	(thousands of inhabitants)	(thousands of inhabitants)		
Panama	76	-	-	-	-	-	-	-	-	2 469	-	-	-
Paraguay	400	-	-	-	-	-	-	7	-	4 788	7	-	-
Peru	1 295	-	-	-	-	-	-	-	-	3 278	-	-	-
Suriname	145	-	-	-	-	-	-	-	-	425	-	-	-
Trinidad and Tobago	5	-	-	-	-	-	-	-	-	1 199	-	-	-
Uruguay	179	-	-	-	-	-	-	-	-	2 953	-	-	-
Venezuela (Bol. Rep. of)	929	101	18	171	25	351	30	1 134	38	19 232	1 656	9	9
Total	20 541	21 402	12	8 037	13	17 352	15	62 563	32	372 897	87 952	24	25

Source: Food and Agriculture Organization of the United Nations (FAO), TERRASTAT database, 2003.

C. THE COSTS OF DESERTIFICATION

Land degradation and desertification represent a loss of natural capital, including soil, water, flora and fauna—losses difficult to calculate. Literature on the subject emphasizes the importance of measuring both the direct and indirect effects of these processes, and their interaction over time. Unfortunately, the information required to make such assessments is not readily accessible.

According to various authors, analysis of direct effects in the locality where the degradation or desertification occurs must be supplemented by studies on environmental costs, taking into account effects on reservoirs and on the recharging of aquifers, as well as the social costs of poverty.[12]

Any systematisation of methods to measure the costs of desertification must consider the following indicators: (i) loss of productivity; (ii) reduction of available water; (iii) loss of forest resources; and (iv) costs of management.[13]

Data on these phenomena do exist, and can be used to estimate costs. A study on desertification in Brazil attributes reduction in output to the effects of desertification. The finding is based on a comparison of actual production and the hypothetical production that would have taken place in the absence of desertification.[14]

Among the few studies that assess the impact of land degradation is the research conducted by the Global Mechanism of the United Nations Convention to Combat Desertification, which includes two Latin American countries —Chile and Mexico— in addition to China, Ethiopia, Indonesia, Rwanda and Uganda.[15] This research shows that the costs of degradation are extremely high —as much, perhaps, as 3% to 7% of gross agricultural output.

These figures seem to be confirmed by other studies, some of which arrive at even more extreme estimates. In Costa Rica, the cost of degradation in 1991 was estimated to be between 5% and 13.3% of agricultural value added,[16] and estimates for other countries in the region are of a similar order of magnitude.

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[12] E. Barbier, "The economic determinants of land degradation in developing countries," *Philosophical Transactions of the Royal Society*, Nº 352, 1998; S. Pagliola, "The global environmental benefits of land degradation control on agricultural land," *World Bank Environment Paper*, Nº 16, Washington, D.C., World Bank, 1999; S. Scherr, "Soil degradation: a threat to developing country food security by 2020?", *IFPRI Food, Agriculture and Environment Discussion Paper*, Nº 27, 1999; A. Warren, "Land degradation is contextual," *Land Degradation and Development*, Nº 13, 2002.

[13] Heitor Matallo, "Algunas cuestiones relativas a la economía de la desertificación," *Pobreza, desertificación y degradación de recursos naturales* (LC/G.2277-P), C. Morales and S. Parada (eds.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), 2005. United Nations Publication, Sales No.: S.05.II.G.178.

[14] H. Matallo and R. Vasconcelos, "Estimativa de perdas econômicas provocadas pelo processo de desertificação na região do semi-arido do NE," *Desertificação*, H. Matallo and C. Schenkel, Brasilia, UNESCO, 1999.

[15] L. Berry, J. Olson and D. Campbell, "Assessing the Extent, Cost and Impact of Land Degradation at the National Level: Findings and Lessons Learned from Seven Pilot Case Studies," 2003.

[16] R. Solórzano et al., *Accounts Overdue: Natural Resource Depreciation in Costa Rica*, Washington, D.C., World Resources Institute.

A more recent estimate of soil loss —and losses associated with water erosion— cites much higher values, however. A meeting in Argentina that was coordinated by the Secretariat for the Convention to Combat Desertification, with an agenda organised by the Argentine government, discussed indicators and points of reference for desertification in the region, and estimated the cost of desertification based on known erosion parameters associated with losses in water, forests and biodiversity.[17]

Losses from erosion were calculated at 7.5 tons per hectare per year, and the cost of restoring degraded land was set at US$ 10 per hectare. Each ton of eroded soil was also considered to reduce water storage and retention capacity by 20%. Thus, each ton of soil lost is assumed to cause a decline of 0.2 cubic metres in available water, due either to increased runoff or because of overflow of rivers and reservoirs. The water was valued at US$ 5 per cubic metre.

The cost of the losses in water resources plus the impact of physical loss of soil totalled US$ 27 billion 525 million dollars —the ultimate estimated cost of desertification in the countries considered.

VI. EXTERNALITIES AND COSTS

As mentioned above, the costs of deforestation and desertification are extremely high. The most conservative estimates predict that deforestation will lead to annual losses of 3.3% of the value added of the region's agricultural sector, with 3% of this due to desertification. Added to these costs are those associated with the effects of methane emissions resulting from increased cattle raising, as it expands into former forested areas and reduces biodiversity.

More in-depth study is needed on the internal and external effects of agriculture, as well as on its global effects (see table VI.1).

Table VI.1
ENVIRONMENTAL PROBLEMS IN AGRICULTURE, ONSITE AND OFFSITE

	Onsite effects	**Offsite effects (externalities)**	**Global effects (externalities)**
Intensive agriculture (high-potential areas)	Soil degradation (salinization, loss of organic matter)	Groundwater depletion Agrochemical contamination Loss of biodiversity	Greenhouse gas emissions Animal diseases Loss of crop biodiversity
Extensive agriculture (less-favoured areas)	Nutrient depletion Soil erosion	Downstream effects of soil erosion Hydrological changes such as loss of water retention in upstream areas Pasture degradation in common-property areas	Reduced carbon sequestration from deforestation and carbon dioxide emissions from forest fires Loss of biodiversity

Source: World Bank, "Making agricultural systems more environmentally sustainable", *World Development Report 2008: Agriculture for Development*, Washington, D.C., 2007.

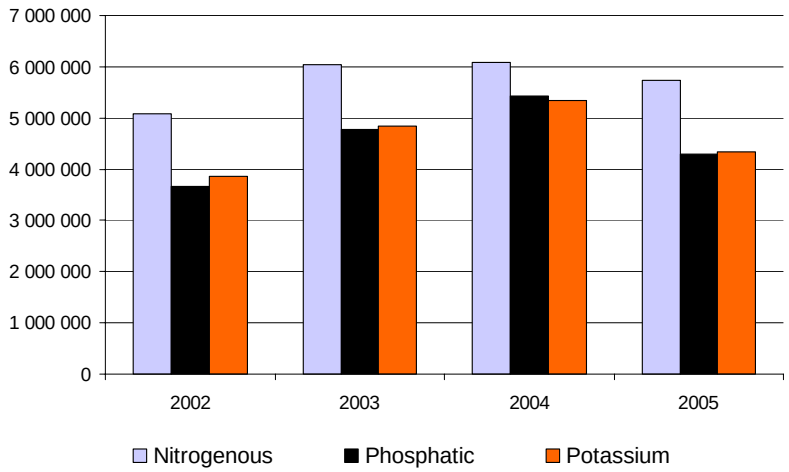
[17] In an unpublished work by Heitor Matallo; the estimate was produced in the framework of the regional program on indicators and points of reference, and was applied to all of the LAC countries.

VII. USE OF CHEMICAL INPUTS

A. FERTILISERS

Data on the use of fertilisers is scant, and covers only the 2002-2005 period. Although a trend in the use of these products cannot yet be identified, it is possible to calculate the volume used. Between 5 and 6 million tons of nitrogen fertilisers, between 3.7 and 5.4 million tons of phosphate fertilisers, and between 3.9 and 5.3 million tons of potassium fertilisers were used in Latin America and the Caribbean between 2002 and 2005. These levels are relatively low in the context of the region as a whole, although usage varied from country to country.

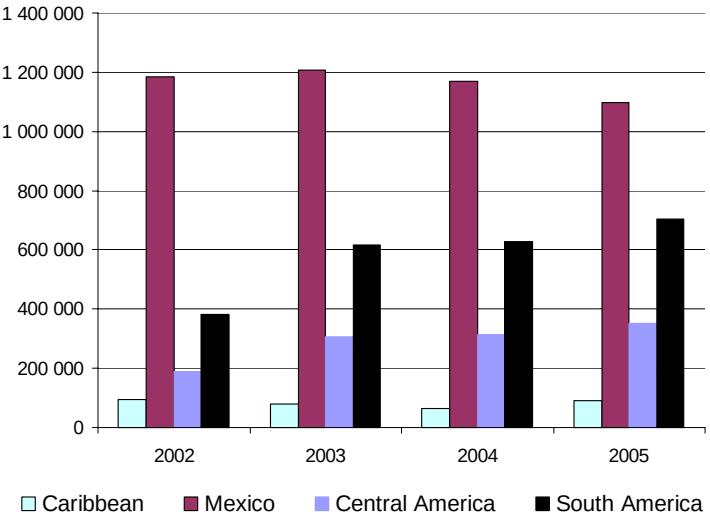
Figure VII.1
LATIN AMERICA AND THE CARIBBEAN: FERTILIZER USE, 2002-2005
(In tons)



Source: FAO databases (FAOSTAT).

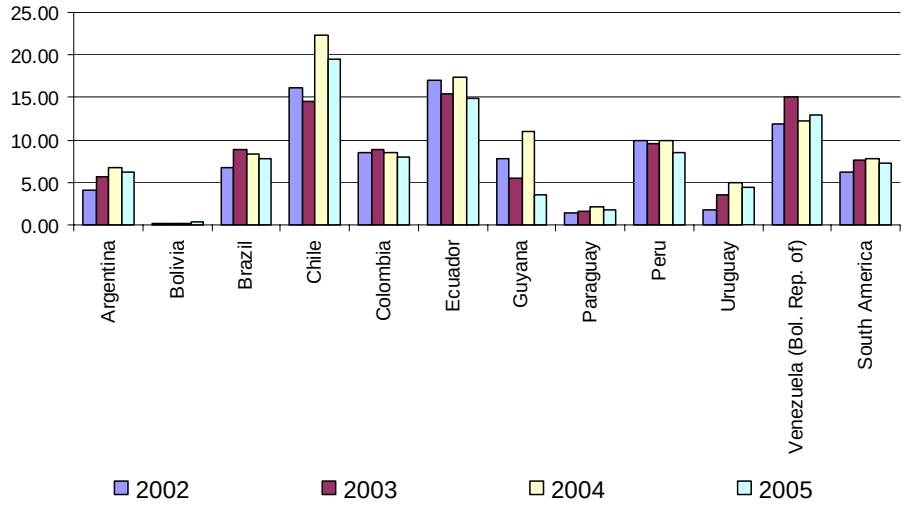
Data on the use of each type of fertiliser in the region reveal that nitrogen fertilisers are used principally in South America and Mexico. The countries that use the highest number of tons per hectare are Chile, Ecuador and the Bolivarian Republic of Venezuela. Figures for Argentina and Brazil are below the average for South America, despite the fact that these countries have the most modern approaches to agriculture. While they have naturally fertile soils, intensive exploitation can be expected to bring increasing use of these fertilisers.

Figure VII.2
LATIN AMERICA AND THE CARIBBEAN: NITROGENOUS FERTILIZER USE, 2002-2005
(Thousands of tons)



Source: FAO Statistical Databases (FAOSTAT).

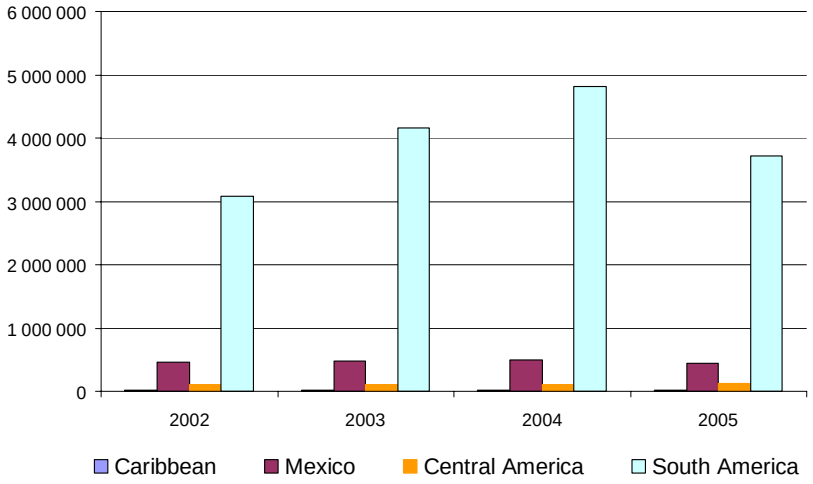
Figure VII.3
SOUTH AMERICA (11 COUNTRIES): INTENSITY OF NITROGENOUS FERTILIZER USE, 2002-2005
(Tons per hectare)



Source: FAO Statistical Databases (FAOSTAT).

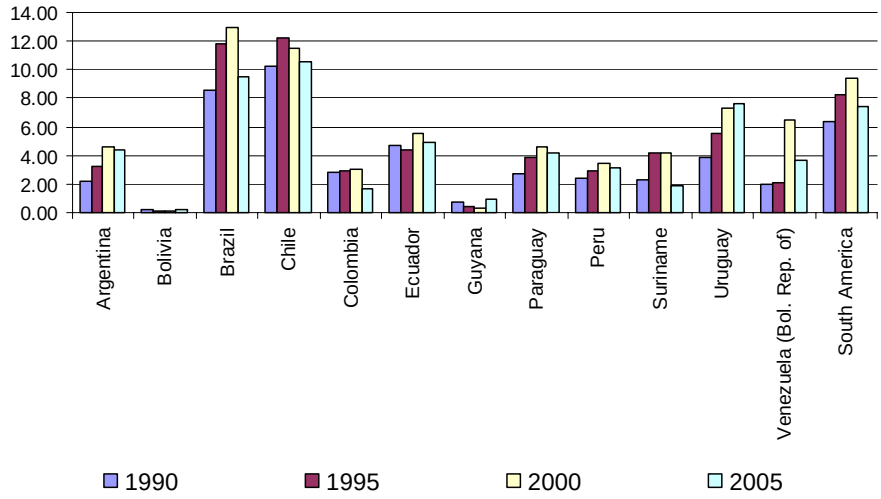
In the use of phosphate fertilisers, the difference between the South American countries and others in LAC is even greater, because of the characteristics and nutrient content of the soils involved. Chile and Brazil are the heaviest users of these fertilisers (see figure VII.4), while Chile has a programme that subsidises their use to improve soil quality, especially in the southern part of the country.

Figure VII.4
LATIN AMERICA AND THE CARIBBEAN (11 COUNTRIES): PHOSPHATIC FERTILIZER USE, 2002-2005
(Thousands of tons)



Source: FAO Statistical Databases (FAOSTAT).

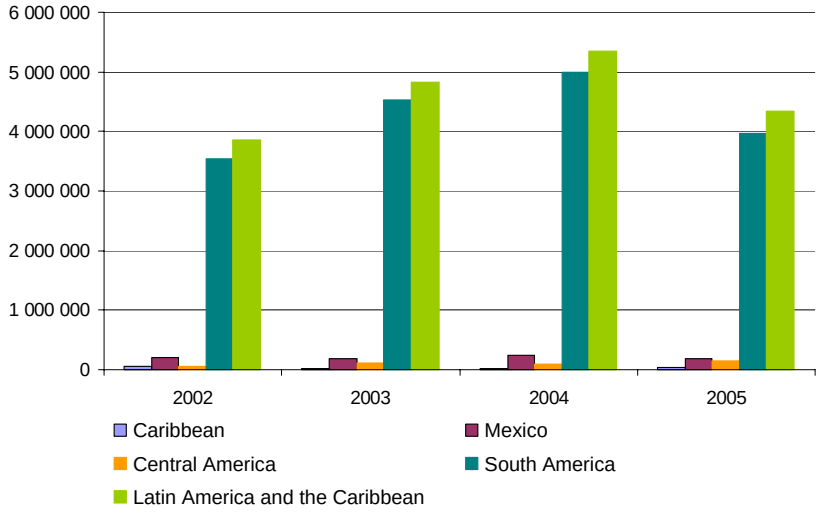
Figure VII.5
SOUTH AMERICA (12 COUNTRIES): INTENSITY OF PHOSPHATIC FERTILIZER USE, 1990-2005
(Tons per hectare)



Source: FAO Statistical Databases (FAOSTAT).

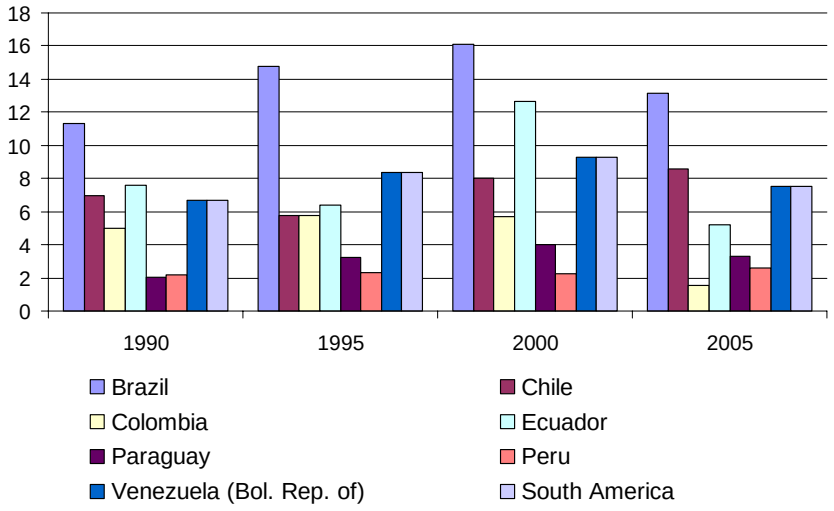
The use of potassium fertilisers is confined almost entirely to South America, based on the chemical characteristics of the region's soils (see figure VII.6). The highest use is found in Brazil, followed by Ecuador, Chile and Colombia, except for the year 2005 (see figure VII.7).

Figure VII.6
LATIN AMERICA AND THE CARIBBEAN: POTASSIUM FERTILIZER USE, 2002-2005
(Thousands of tons)



Source: FAO Statistical Databases (FAOSTAT).

Figure VII.7
SOUTH AMERICA (7 COUNTRIES): INTENSITY OF POTASSIUM FERTILIZER USE, 2002-2005
(Tons per hectare)



Source: FAO Statistical Databases (FAOSTAT).

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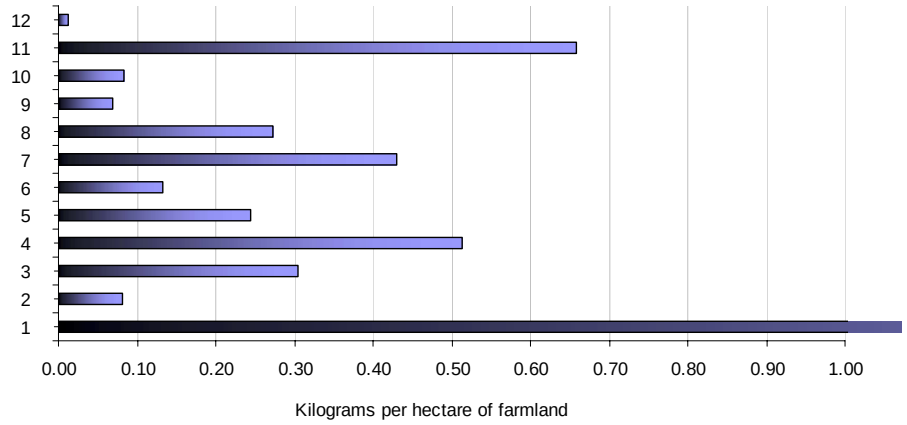
B. INSECTICIDES

Information on the use of insecticides is lacking, and is primarily to be found in the databases of the United Nations Food and Agriculture Organisation (FAO), which contain information on a limited number of countries. According to these sources, Belize, Suriname and Costa Rica are the most intense users of these chemicals (see figure VII.8).

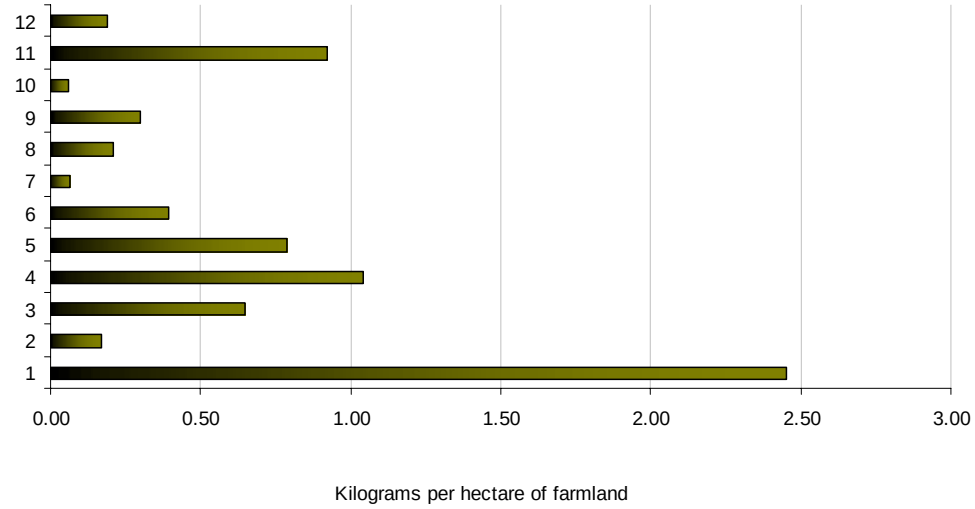
Figure VII.8
LATIN AMERICA AND THE CARIBBEAN (13 COUNTRIES): INTENSITY OF INSECTICIDE USE, 2001
(Kilograms per hectare of farmland)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), "Indicadores para el seguimiento de la agricultura y la vida rural, Plan Agro 2000-2015 (actualización 2007)", Santiago, Chile, 2007, unpublished, on the basis of FAO Statistical Databases (FAOSTAT).

Herbicides are used most heavily in Belize, Costa Rica and Suriname (see figure VII.9). No information is available for other countries of interest, such as Argentina.

Figure VII.9
LATIN AMERICA AND THE CARIBBEAN (12 COUNTRIES): INTENSITY OF HERBICIDE USE, 2001
(Kilograms per hectare of farmland)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), "Indicadores para el seguimiento de la agricultura y la vida rural, Plan Agro 2000-2015 (actualización 2007)", Santiago, Chile, 2007, unpublished, on the basis of FAO Statistical Databases (FAOSTAT).

[a] Values for insecticides relate to 2001 except in the cases of Colombia, Haiti, Honduras, Peru and Suriname, where they relate to 2000.

VIII. DEMOGRAPHIC AND SOCIAL FACTORS

A. DEMOGRAPHIC FACTORS

A number of major demographic changes have occurred in the region, including a reduction in, and aging of, the rural population (as measured by census data).

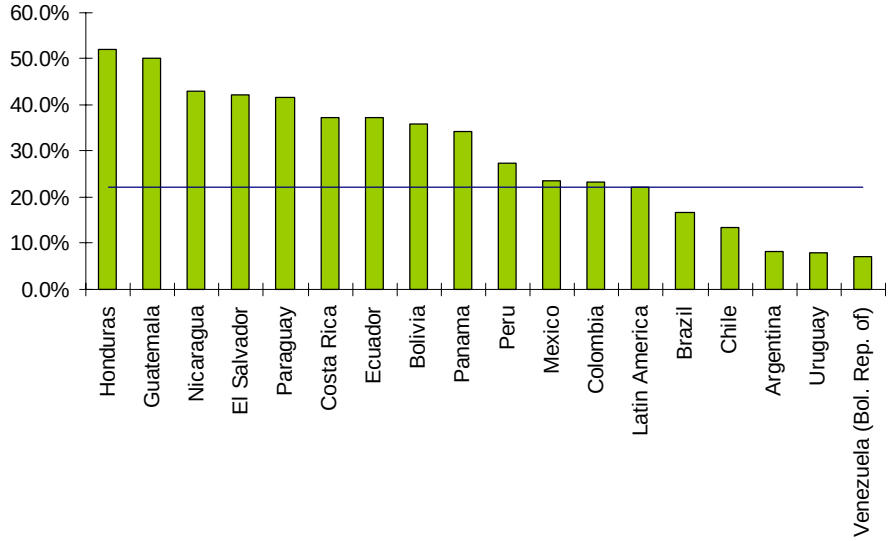
Latin America's rural population constituted 43.5% of the total population in 1970, but had dropped to 22.2% by 2005. Brazil and Mexico, which at the beginning of this period were still 40% rural, became distinctly urban countries during this time (see table VIII.1)

Table VIII.1
LATIN AMERICA AND THE CARIBBEAN (31 COUNTRIES): RURAL POPULATION AS A PROPORTION OF TOTAL POPULATION, 1970-2005
(Percentages)

	1970	1980	1990	2000	2005
Latin America	**43.5**	**34.9**	**29.4**	**24.2**	**22.2**
Argentina	20.2	17.1	14.2	10.4	8.2
Bolivia	64.6	54.5	44.4	38.2	35.8
Brazil	47.3	32.9	25.3	18.8	16.6
Chile	27.0	21.0	17.2	14.7	13.4
Colombia	42.5	35.7	30.7	25.5	23.4
Costa Rica	61.3	57.1	50.3	41.3	37.4
Ecuador	60.5	53.0	44.9	39.6	37.2
El Salvador	61.0	55.9	50.2	44.8	42.2
Guatemala	64.9	67.0	65.7	57.0	50.0
Honduras	71.0	65.1	59.6	54.7	52.1
Mexico	41.0	33.7	29.4	25.2	23.5
Nicaragua	53.2	49.9	47.5	44.6	43.1
Panama	52.4	50.2	46.2	37.8	34.2
Paraguay	62.9	58.3	51.3	44.7	41.6
Peru	41.9	35.8	31.3	28.1	27.4
Uruguay	18.0	14.9	11.1	8.7	8.1
Venezuela (Bolivarian Republic of)	28.2	21.0	16.1	9.2	7.2
Caribbean	**50.0**	**44.5**	**39.2**	**29.1**	**27.3**
Antigua and Barbuda	66.2	65.1	65.1	62.5	60.8
Barbados	58.6	59.8	55.3	50.2	47.1
Belize	48.8	50.7	51.6	52.1	51.5
Cuba	39.9	31.7	28.3	25.3	23.9
Grenada	67.7	67.4	68.2	61.7	57.5
Guyana	70.7	69.5	66.9	63.6	61.5
Haiti	80.3	75.5	69.5	61.9	58.2
Jamaica	58.5	53.2	48.5	47.9	47.8
Dominican Republic	60.4	62.6	49.1	38.3	34.4
Saint Kitts and Nevis	66.0	63.6	65.9	66.7	66.7
Saint Vincent and the Grenadines	73.3	73.0	59.1	44.9	39.7
Saint Lucia	77.0	75.2	73.3	70.5	68.4
Suriname	54.0	45.1	34.6	25.9	22.9
Trinidad and Tobago	37.0	36.9	30.9	25.9	23.8

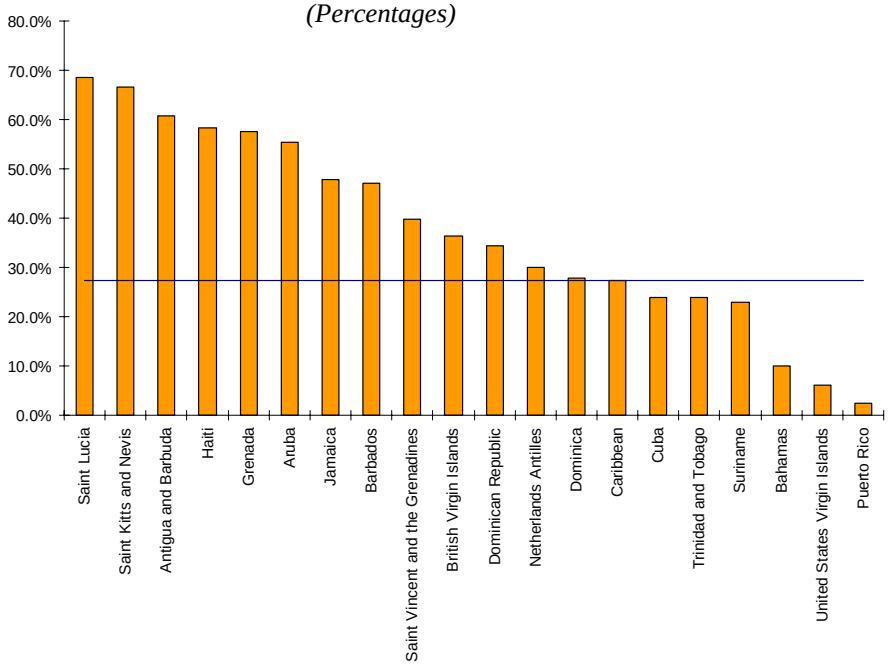
Source: Economic Commission for Latin America and the Caribbean (ECLAC), "Indicadores para el seguimiento de la agricultura y la vida rural, Plan Agro 2000-2015 (actualización 2007)", Santiago, Chile, 2007, unpublished.

Figure VIII.1
LATIN AMERICA (16 COUNTRIES): RURAL POPULATION AS A PROPORTION OF TOTAL POPULATION, 2005
(Percentages)



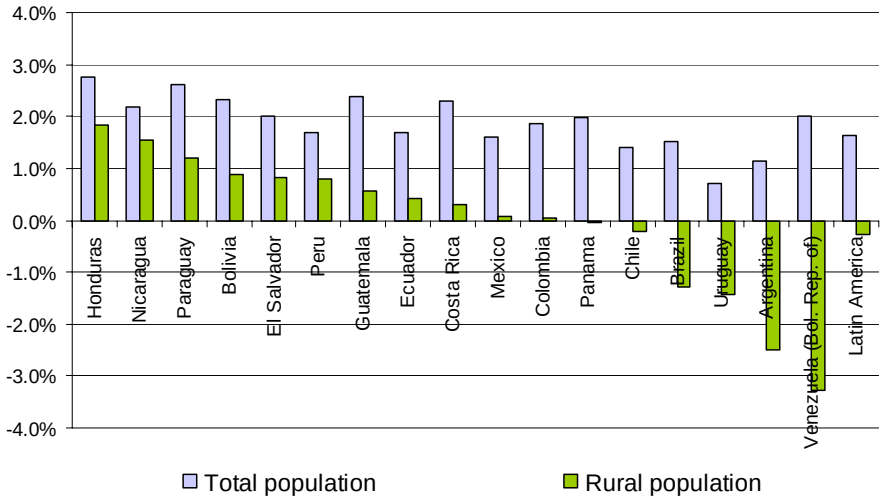
Source: Economic Commission for Latin America and the Caribbean (ECLAC), "Indicadores para el seguimiento de la agricultura y la vida rural, Plan Agro 2000-2015 (actualización 2007)", Santiago, Chile, 2007, unpublished, on the basis of FAO Statistical Databases (FAOSTAT).

Figure VIII.2
THE CARIBBEAN (18 COUNTRIES AND TERRITORIES): RURAL POPULATION AS A PROPORTION OF TOTAL POPULATION, 2005
(Percentages)



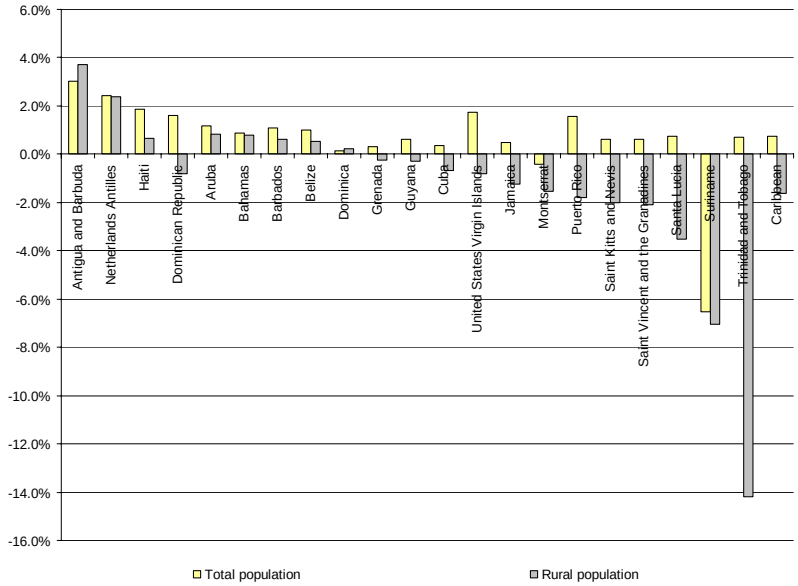
Source: Economic Commission for Latin America and the Caribbean (ECLAC), "Indicadores para el seguimiento de la agricultura y la vida rural, Plan Agro 2000-2015 (actualización 2007)", Santiago, Chile, 2007, unpublished, on the basis of FAO Statistical Databases (FAOSTAT).

Figure VIII.3
LATIN AMERICA (17 COUNTRIES): AVERAGE ANNUAL VARIATION OF TOTAL POPULATION AND RURAL POPULATION, 1990-2005
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), "Indicadores para el seguimiento de la agricultura y la vida rural, Plan Agro 2000-2015 (actualización 2007)", Santiago, Chile, 2007, unpublished, on the basis of FAO Statistical Databases (FAOSTAT).

Figure VIII.4
THE CARIBBEAN (21 COUNTRIES AND TERRITORIES): AVERAGE ANNUAL VARIATION OF TOTAL POPULATION AND RURAL POPULATION, 1990-2005
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), "Indicadores para el seguimiento de la agricultura y la vida rural, Plan Agro 2000-2015 (actualización 2007)", Santiago, Chile, 2007, unpublished, on the basis of FAO Statistical Databases (FAOSTAT).

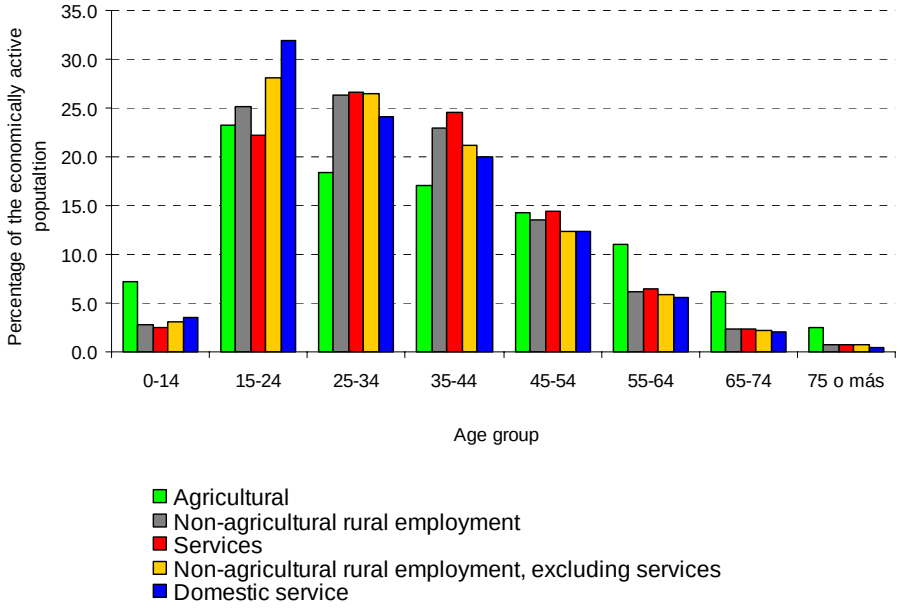
The population of agricultural workers, as a group, aged more than workers in other types of rural employment (see table VIII.2 and figure VIII.5).

Table VIII.2
LATIN AMERICA AND THE CARIBBEAN: ECONOMICALLY ACTIVE RURAL POPULATION, BY AGE GROUP AND EMPLOYMENT CATEGORY
(Percentages)

Age group	0-14	15-24	25-34	35-44	45-54	55-64	65-74	75 and over
Agricultural	7.2	23.2	18.4	17.1	14.3	11.1	6.2	2.5
Non-agricultural rural employment	2.8	25.2	26.4	23.0	13.5	6.2	2.3	0.7
Services	2.5	22.3	26.6	24.5	14.4	6.5	2.4	0.7
Non-agricultural rural employment, excluding services	3.0	28.1	26.5	21.1	12.4	5.9	2.2	0.8
Domestic service	3.5	31.9	24.2	20.0	12.4	5.5	2.1	0.4

Source: Economic Commission for Latin America and the Caribbean (ECLAC), Household Survey Data Bank (BADEHOG), on the basis of surveys for Bolivia (2004), Brazil (2005), Chile (2003), Colombia (2000), Costa Rica (2005), Dominican Republic (2005), Ecuador (2005), El Salvador (2004), Guatemala (2004), Honduras (2003), Nicaragua (2003), Panama (2005), Paraguay (2005), Peru (2003) and Mexico population census (2000).

Figure VIII.5
LATIN AMERICA AND THE CARIBBEAN: ECONOMICALLY ACTIVE RURAL POPULATION, BY AGE GROUP AND EMPLOYMENT CATEGORY, CIRCA 2005
(Percentages)

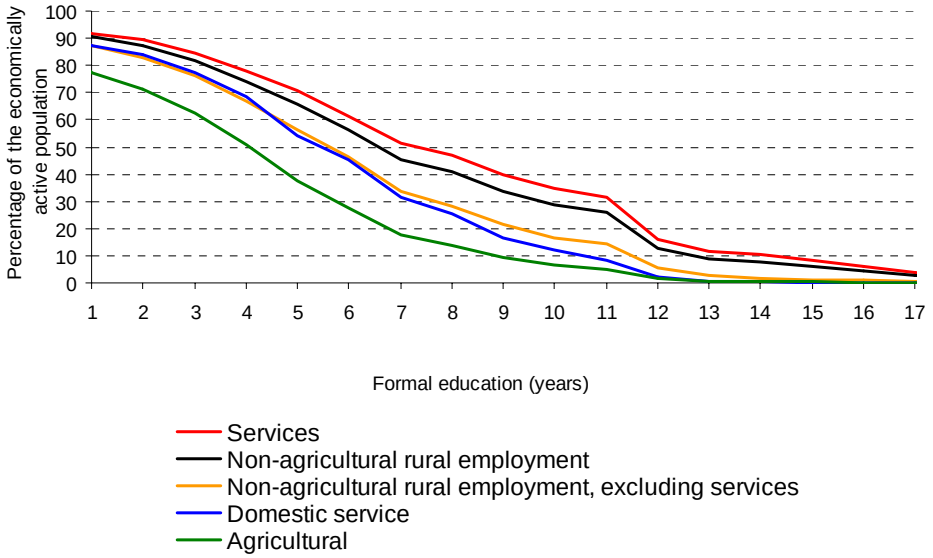


Source: Economic Commission for Latin America and the Caribbean (ECLAC), "Indicadores para el seguimiento de la agricultura y la vida rural, Plan Agro 2000-2015 (actualización 2007)", Santiago, Chile, 2007, unpublished, on the basis of Latin American and Caribbean Demographic Centre (CELADE)-Population Division of ECLAC, database of Demographic Bulletin, No. 76, Santiago, Chile, 2005.

B. EDUCATION

Agricultural workers, as a group, have less formal education than workers in other occupational categories (see figure VIII.6).

Figure VIII.6
LATIN AMERICA: YEARS OF FORMAL EDUCATION COMPLETED BY THE RURAL POPULATION, BY EMPLOYMENT SECTOR, CIRCA 2005
(Percentages)

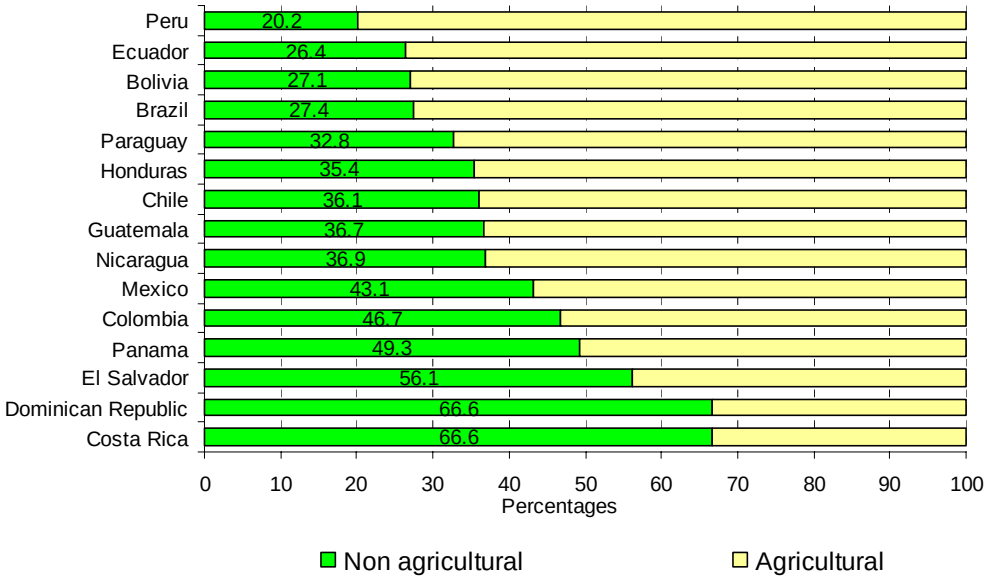


Source: Agricultural Development Unit (ECLAC), based on household surveys in Bolivia (2004), Brazil (2005), Chile (2003), Colombia (2000), Costa Rica (2005), Ecuador (2005), El Salvador (2004), Guatemala (2004), Honduras (2003), Nicaragua (2003), Panama (2005), Paraguay (2005), Peru (2003), Dominican Republic (2005) and the Mexican population census (2000), Badehog, ECLAC.

C. EMPLOYMENT

Data on the employment of rural residents reveal the increasing role of non-agricultural employment, which, in Costa Rica and the Dominican Republic, was twice the figure for agricultural employment in 2005. (see figure VIII.7).

Figure VIII.7
LATIN AMERICA (15 COUNTRIES): EMPLOYMENT OF THE RURAL POPULATION IN AGRICULTURAL AND NON-AGRICULTURAL ACTIVITIES, CIRCA 2005
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Household Survey Data Bank (BADEHOG), on the basis of survey for Bolivia (2004), Brazil (2005), Chile (2003), Colombia (2000), Costa Rica (2005), Dominican Republic (2005), Ecuador (2005), El Salvador (2004), Guatemala (2004), Honduras (2003), Nicaragua (2003), Panama (2005), Paraguay (2005), Peru (2003) and Mexico population census (2000).

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D. INCOME DISTRIBUTION

LAC has one of the highest concentrations of income in the world. This is true in both urban and rural areas, but the situation appears to be most unequal in urban areas. In fact, the income of the poorest 40% of the rural population is slightly higher than the income of the poorest 40% of the urban population, according to household, job and income surveys in the countries for which information is available. In most cases, this difference, favouring rural settings, is present both in the poorest 40% bracket and in the succeeding bracket; only in Paraguay is this the case for the wealthiest 10% of the population (see table VIII.3 and figure VIII.8)

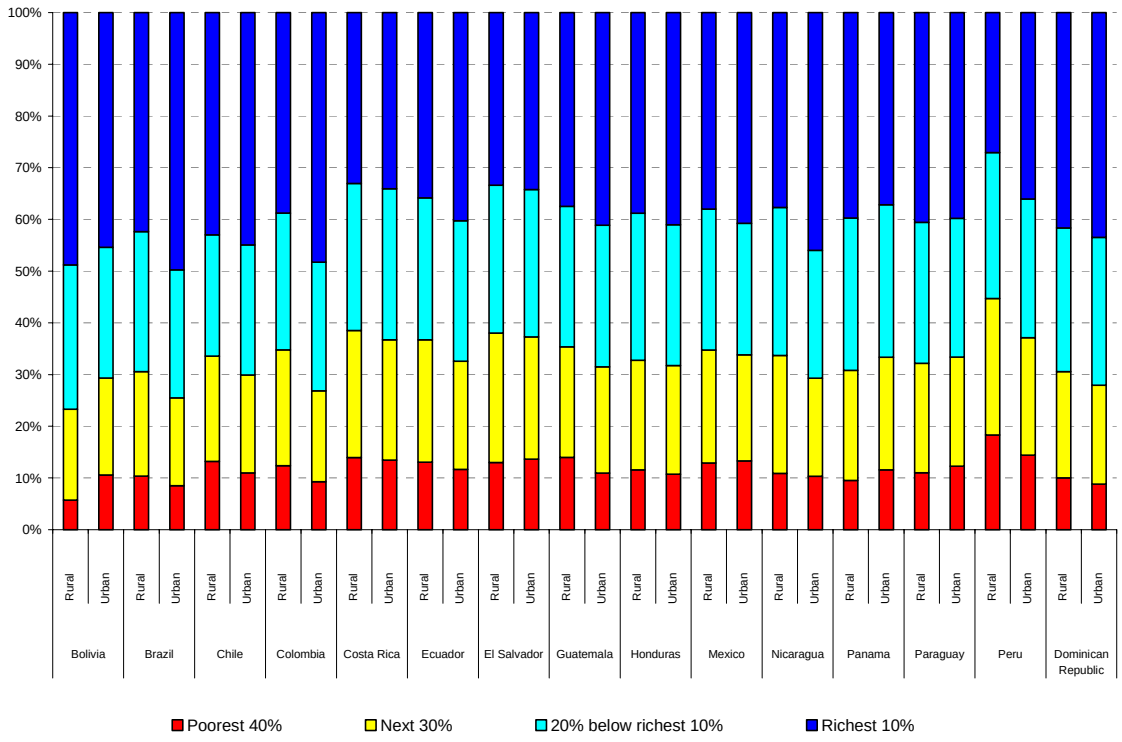
Table VIII.3

LATIN AMERICA AND THE CARIBBEAN (15 COUNTIES): INCOME DISTRIBUTION IN URBAN AND RURAL AREAS, CIRCA 2005

		Poorest 40%	Next 30%	20% below richest 10%	Richest 10%
	Rural	5.7	17.6	27.9	48.8
Bolivia	Urban	10.6	18.8	25.3	45.4
	Rural	10.4	20.2	27.1	42.4
Brazil	Urban	8.5	17.0	24.7	49.8
	Rural	13.2	20.3	23.5	43.0
Chile	Urban	11.0	18.9	25.2	44.9
	Rural	12.4	22.4	26.5	38.7
Colombia	Urban	9.3	17.6	24.9	48.3
	Rural	14.0	24.6	28.5	33.0
Costa Rica	Urban	13.4	23.3	29.2	34.1
	Rural	13.1	23.6	27.5	35.8
Ecuador	Urban	11.7	20.9	27.1	40.3
	Rural	13.0	25.1	28.6	33.4
El Salvador	Urban	13.6	23.7	28.5	34.2
	Rural	14.0	21.4	27.2	37.5
Guatemala	Urban	10.9	20.6	27.4	41.1
	Rural	11.6	21.2	28.4	38.8
Honduras	Urban	10.8	21.0	27.3	41.0
	Rural	12.9	21.8	27.3	38.0
Mexico	Urban	13.3	20.5	25.4	40.8
	Rural	10.9	22.8	28.6	37.7
Nicaragua	Urban	10.3	19.0	24.7	46.0
	Rural	9.5	21.3	29.5	39.7
Panama	Urban	11.6	21.8	29.5	37.2
	Rural	11.0	21.2	27.2	40.6
Paraguay	Urban	12.3	21.1	26.8	39.8
	Rural	18.3	26.4	28.2	27.1
Peru	Urban	14.4	22.7	26.8	36.1
	Rural	10.0	20.6	27.8	41.7
Dominican Rep.	Urban	8.8	19.1	28.6	43.5

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of special tabulations of household surveys in the relevant countries: Bolivia (2002), Brazil (2005), Chile (2003), Colombia (2005), Costa Rica (2005), Dominican Republic (2005), Ecuador (2005), El Salvador (2004), Guatemala (2002), Honduras (2003), Mexico (2005), Nicaragua (2001), Panama (2005), Paraguay (2005), Peru (2003).

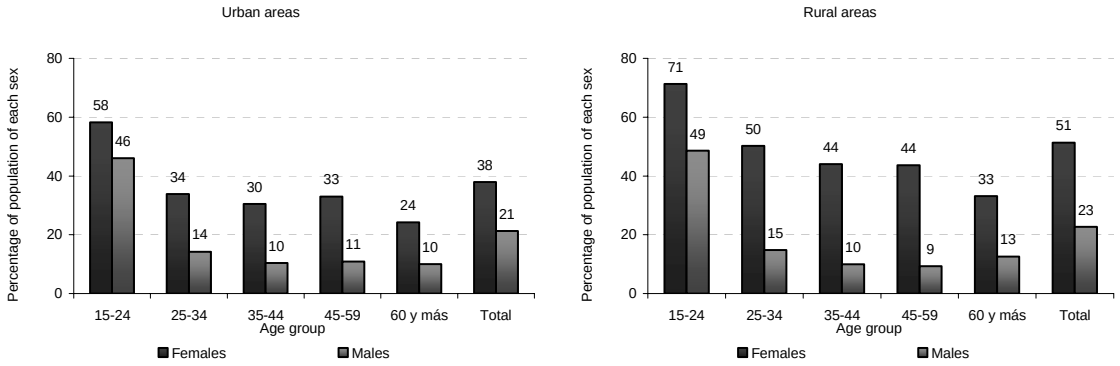
Figure VIII.8
LATIN AMERICA AND THE CARIBBEAN (15 COUNTRIES): INCOME DISTRIBUTION IN URBAN AND RURAL AREAS, CIRCA 2005
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of special tabulations of household surveys in the relevant countries: Bolivia (2002), Brazil (2005), Chile (2003), Colombia (2005), Costa Rica (2005), Dominican Republic (2005), Ecuador (2005), El Salvador (2004), Guatemala (2002), Honduras (2003), Mexico (2005), Nicaragua (2001), Panama (2005), Paraguay (2005), Peru (2003).

In terms of the urban and rural population with no income of their own, the highest percentages are among women and among the youngest inhabitants of rural areas —with 51% of men and 23% of women in these areas receiving no income, as opposed to 38% of men and 21% of women in urban areas (see figure VIII.9).

Figure VIII.9
LATIN AMERICA AND THE CARIBBEAN: NUMBER OF PEOPLE WITH NO INCOME OF THEIR OWN, BY SEX AND AGE GROUP, CIRCA 2005
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Household Survey Data Bank (BADEHOG), on the basis of survey for Bolivia (2004), Brazil (2005), Chile (2003), Colombia (2000), Costa Rica (2005), Dominican Republic (2005), Ecuador (2005), El Salvador (2004), Guatemala (2004), Honduras (2003), Nicaragua (2003), Panama (2005), Paraguay (2005), Peru (2003).

E. POVERTY AND INDIGENCE

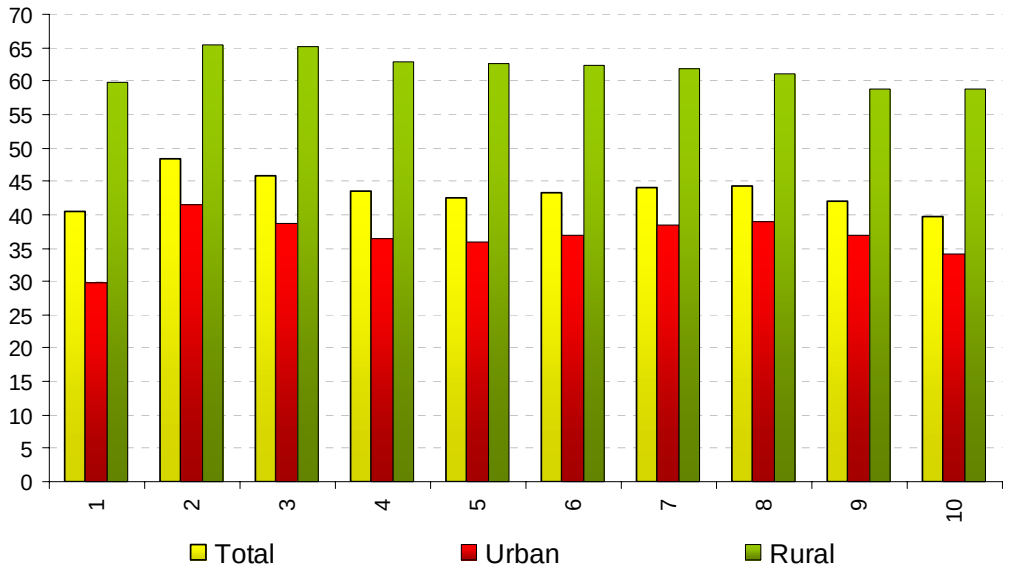
Despite the growth associated with agricultural activity, poverty and indigence continue to be more severe in rural than in urban areas. In 2005, the incidence of poverty (59%) was nearly the same as 25 years earlier, while urban poverty was 34%. The incidence of indigence has not changed in rural areas, and continues to be around 33%, while urban indigence is at 10% (see table VIII.4 and figures VIII.10 and VIII.11).

Table VIII.4
LATIN AMERICA AND THE CARIBBEAN: TRENDS IN URBAN AND RURAL POVERTY, 1980-2005
(Percentages)

	Poor population			Indigent population		
	Total (percentages)	**Urban (percentages)**	**Rural (percentages)**	**Total (percentages)**	**Urban (percentages)**	**Rural (percentages)**
1980	41	30	60	19	11	33
1990	48	41	65	23	15	40
1994	46	39	65	21	14	41
1997	44	37	63	19	12	38
2000	43	36	63	18	12	38
2001	43	37	62	19	12	38
2002	44	38	62	19	14	38
2003	44	39	61	19	14	36
2004	42	37	59	17	12	33
2005	40	34	59	15	10	33

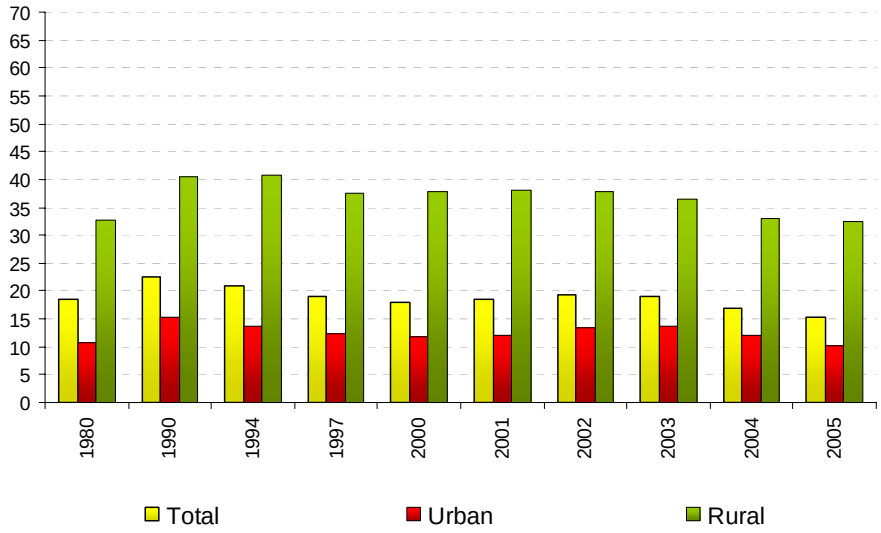
Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on special tabulations of household surveys. Estimates based on 19 economies: Argentina, Bolivarian Republic of Venezuela, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru and Uruguay.

Figure VIII.10
LATIN AMERICA: TRENDS IN URBAN AND RURAL POVERTY, 1980-2005
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on special tabulations of household surveys. Estimates based on 19 economies: Argentina, Bolivarian Republic of Venezuela, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru and Uruguay.

Figure VIII.11
LATIN AMERICA: VARIATIONS IN URBAN AND RURAL INDIGENCE, 1980-2005
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on special tabulations of household surveys. Estimates based on 19 economies: Argentina, Bolivarian Republic of Venezuela, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru and Uruguay.

IX. CLIMATE CHANGE

According to the recent report of the Intergovernmental Panel on Climate Change, there is a high probability that variations in climate and the incidence of extreme climatic phenomena will increase. In fact, there have been reports of a large number of unusual climatic phenomena in recent years, including intense rains in the Bolivarian Republic of Venezuela, floods in Argentina (in the pampa), droughts in the Amazon, storms in Bolivia and certain parts of Argentina (Buenos Aires), and an unprecedented number of hurricanes in the Caribbean

The panel also projects that tropical forest will gradually be replaced by savannah in the eastern Amazon and in central and southern Mexico. It predicts that, in both of these areas, semi-arid vegetation will be replaced by vegetation characteristic of arid zones, as a combined result of climate change and soil use patterns.

It is estimated that by the year 2050, approximately 50% of agricultural land will be severely affected by desertification and degradation due to salinisation in northeastern Brazil, and in most of central and southern Mexico. This phenomenon involves a high risk of biodiversity loss due to extinction of species in many tropical regions of Latin America.

In addition, deterioration already underway (deforestation, desertification and degradation of land) is expected to intensify, while biodiversity is lost and productivity for livestock raising and for the

most important crops declines, with adverse effects on food security. Meantime, soy yields in temperate zones are expected to increase.

A. NATURAL DISASTERS AND THEIR VICTIMS

Extreme climatic phenomena have increased in number and intensity, affecting more people and creating greater damage.

1. Floods

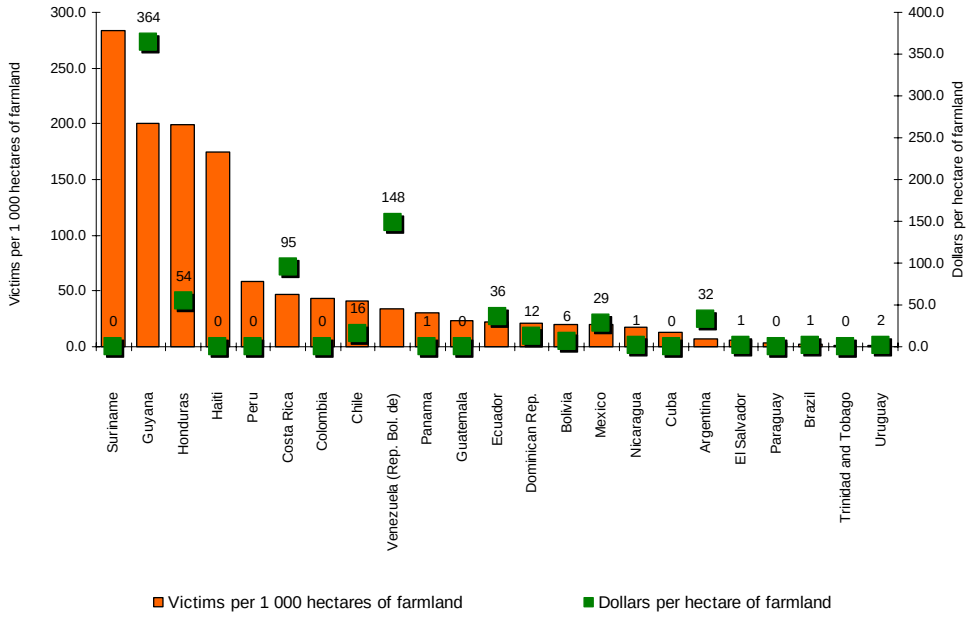
There were 235 floods in the region between 1997 and 2005, with the countries suffering most often being Brazil, Colombia, Mexico, Argentina, Haiti and the Bolivarian Republic of Venezuela. While the actual number of floods was greater in 2002 and 2003, more people were affected in 1999 (see table IX.1 and figure IX.1).

Table IX.1
LATIN AMERICA AND THE CARIBBEAN (23 COUNTRIES): FLOODS, VICTIMS AND COSTS

	Victims per thousand hectares of farmland	Dollars per hectare	Number of events
Suriname	284.1	0.0	1
Guyana	199.9	364.4	3
Honduras	199.1	54.2	8
Haiti	174.3	0.0	15
Peru	58.4	0.0	14
Costa Rica	47.1	94.6	10
Colombia	43.3	0.0	22
Chile	40.9	15.7	13
Venezuela (Bolivarian Rep. of)	34.0	148.4	15
Panama	30.3	0.6	13
Guatemala	23.6	0.0	5
Ecuador	22.2	35.9	9
Dominican Rep.	21.6	12.1	6
Bolivia	20.2	5.9	11
Mexico	19.7	28.6	21
Nicaragua	18.1	1.4	3
Cuba	12.8	0.0	7
Argentina	6.6	32.1	16
El Salvador	5.5	0.9	6
Paraguay	3.2	0.1	2
Brazil	2.2	1.3	29
Trinidad and Tobago	1.5	0.0	1
Uruguay	1.5	2.0	5

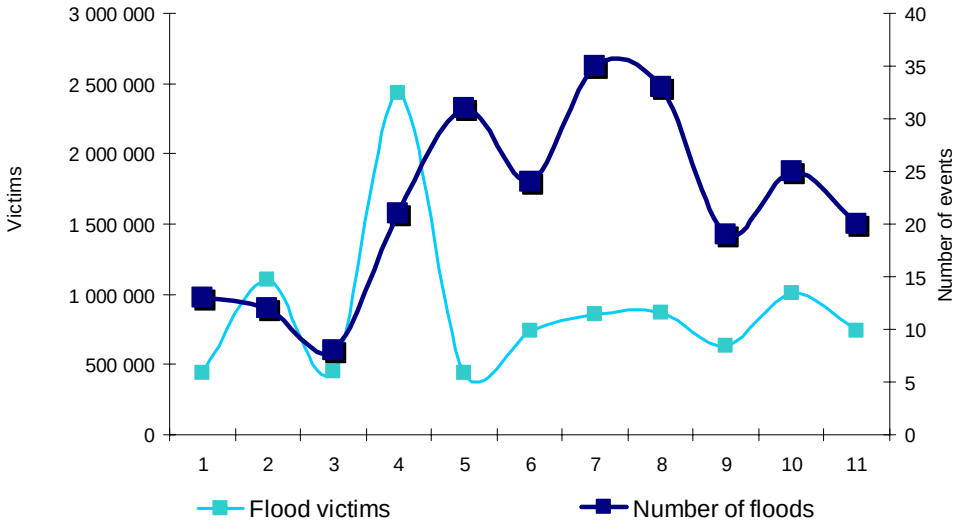
Source: Network of Institutions and Experts on Social and Environmental Statistics (REDESA).

Figure IX.1
LATIN AMERICA AND THE CARIBBEAN (18 COUNTRIES): FLOODS, VICTIMS AND DAMAGE, 1997-2005



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on "EM-DAT: The OFDA/CRED International Disaster Database" [online] www.em-dat.net.

Figure IX.2
LATIN AMERICA: FLOODS AND VICTIMS, 1996-2006

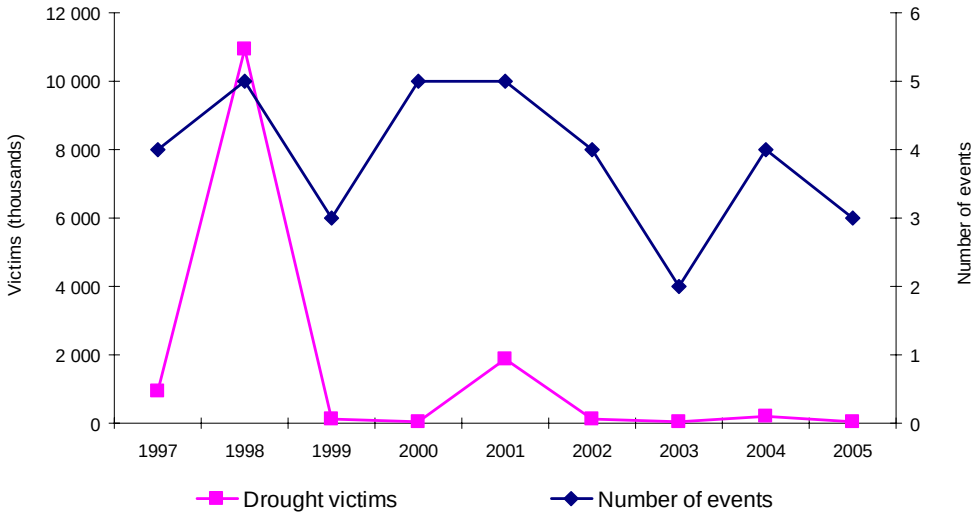


Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on "EM-DAT: The OFDA/CRED International Disaster Database" [online] www.em-dat.net.

2. Drought

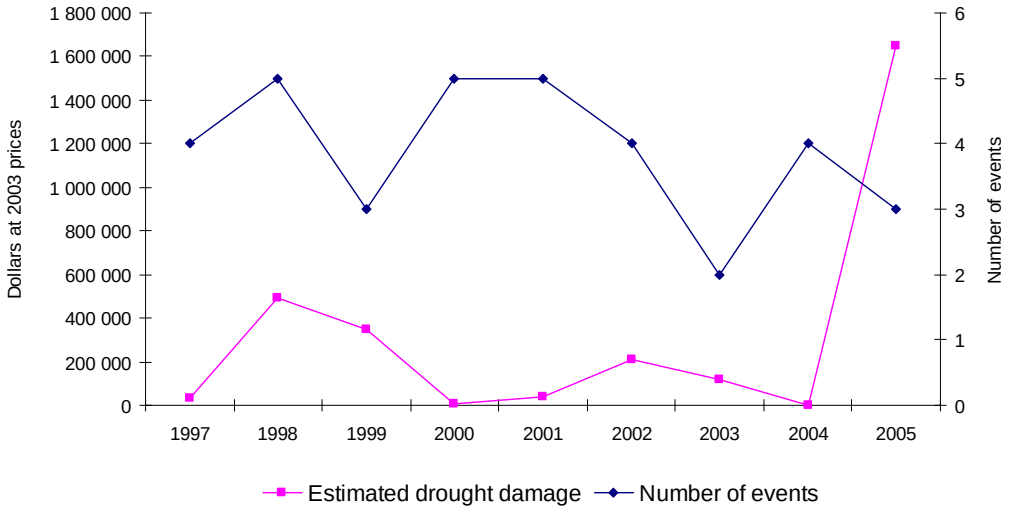
The region experienced the highest number of droughts in 2000 and 2001; however, the greatest number of people were affected in 1998, while the worst damage occurred in 2005 (see figures IX.3 and IX.4).

Figure IX.3
LATIN AMERICA AND THE CARIBBEAN: DROUGHTS AND VICTIMS, 1997-2005



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on "EM-DAT: The OFDA/CRED International Disaster Database" [online] www.em-dat.net.

Figure IX.4
LATIN AMERICA AND THE CARIBBEAN: DROUGHTS AND ESTIMATED DAMAGE, 1997-2005



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on "EM-DAT: The OFDA/CRED International Disaster Database" [online] www.em-dat.net.

X. CONCLUSIONS

Changes in agriculture in Latin America and the Caribbean between 1990 and 2005 were characterised by contradictory elements: Output increased, but poverty and indigence persisted, while environmental and natural resource problems worsened.

The positive performance in terms of output was based on a small number of goods in high demand in foreign markets, which were also sold to high-income sectors of local markets. These goods were produced by a small number of highly capitalised producers with preferential access to markets. Such concentrated growth has little effect on other economic agents, and is, by its nature, less secure.

The strongest activities in this period were cattle raising (an increase of 67 million head, mostly for domestic markets), and soy (24 million additional hectares), principally for foreign markets.

On the social front, poverty and indigence became more intense in rural areas in nearly all of the region's countries, while highly unequal income distribution persisted.

The region's urbanisation continued apace during this period. Nearly 80% of the population now lives in urban population centres, compared to 55% in the 1970s. This has resulted in a lack of intergenerational continuity in rural areas —with consequent problems in implementing educational programmes in those areas— and greater impediments to technology transfer and decisionmaking processes.

In terms of the environment and natural resources, deforestation and biodiversity loss, as well as soil degradation and desertification, have intensified. Over a period of 15 years (1990-2005) the region lost more than 68.7 million hectares of forest. Even more importantly, deforestation has gained new momentum recently. Indeed, the rate of deforestation for the 2000-2005 period is higher than it was during the 1990s. This increase coincides with an increase in the area planted with more dynamic crops, along with increased expansion of livestock production.

Nevertheless, positive developments can be seen. First, the amount of forest area protected for purposes of preserving biodiversity in the region has increased, and is now above the world average. Second, the forest cover has increased in four of the region's countries. In Costa Rica this is due to innovative programmes to restore native forests; in Cuba, to sustained public policy; and in Chile and Uruguay, to the expansion of commercial tree farming stimulated by incentives and subsidies provided by the State.

The degradation and desertification affecting most of Latin America and the Caribbean —phenomena closely associated with deforestation— continue their course, and the loss of soil is becoming practically irreversible, since restoration, even where theoretically possible, is costly.

It is highly significant that these processes are primarily affecting areas where the majority of the region's poor population lives —a population, characterised by family-based economies and scarce resources, that makes intensive use of land and water in a way that affects both the quantity and quality of these resources and accelerates the process of degradation.

As regards climate change, the October 2007 report of the Intergovernmental Panel on Climate Change predicts an intensification of undesirable natural phenomena such as floods and droughts, along

with major changes in productive structures. Most important, the report stresses the problem of increasing deforestation due to improved conditions for growing soy, for which the global demand is expected to rise, due largely to the rapid growth of the Chinese market.

Latin America and the Caribbean account for 8.4% of greenhouse gas emissions. Forty-eight percent of this amount can be traced to the fact that such a large expanse of the region is forested: if deforestation continues at the present rate, another 55 million hectares of forest can be expected to disappear by 2020, with a corresponding effect on emissions.

In short, the process of agricultural development in LAC shows signs of being socially and environmentally unsustainable, and of being a type of development of doubtful viability, given that it is based on a small number of products, producers and markets.

Markets and price mechanisms do not accurately reflect loss of natural resources, except when deterioration or exhaustion of resources becomes obvious —which generally occurs when the process is virtually irreversible. The deforestation of 68.7 million hectares of forest tends to be seen in terms of profits, as the land occupied by the forest becomes agriculturally productive. Assessment of economic growth needs to take into account costs that are hidden or are only partially reflected by price mechanisms, such as: loss of biodiversity due to deforestation and degradation of land; loss of cultural patrimony and of the traditional knowledge of peoples who inhabit affected areas; and the contamination of soil and water due to excessive use of chemicals.

The expansion of the agricultural frontier through deforestation poses a problem of successive negative externalities, since deforestation, which is in itself a loss, is followed by agricultural or livestock activity that, in turn, destroys more assets.

These imbalances, which raise doubts as to the advantages of agricultural growth, make it essential for public policy, along with efforts through alliances with the private sector, to define longer-term objectives that can help ensure sustainable resources and the welfare of the region’s inhabitants.