Environmental Sustainability

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Abstract and Keywords

This chapter examines the progress in the development of peripheral economies Latin America and the Caribbean in resolving the problems of the biosphere, and whether new forms of development must be devised, first analysing the relationship between styles of development and the environment. Second, it considers the state of the environment and natural resources arising from this relationship, and third, examines whether existing policies and current international challenges might provide the region with a new opportunity for more sustainable development.

Keywords: sustainable development, environmental economy, Latin America, natural resources, Caribbean

6.1 Introduction

> The exceptional (economic) impetus gained over the last few decades, until recent times, is the consequence not only of impressive technical progress but also of irrational exploitation of natural resources-above all, of energy—which, in its turn, has had a marked influence on the orientation of technique … Until recent times technological research had not concerned itself with the adverse effects of technique on the environment … Thus, the repercussions of development on the biosphere are very serious.

These prescient words were written by Raul Prebisch in 1980 in a context of oil crisis, thus incorporating environmental issues in his characterization of the structure of peripheral capitalism. He also noted that the ambivalence of technology—its enormous contribution to human welfare, thanks to the steady upward trend of productivity, in opposition to its damaging repercussions on the biosphere—was considered to be an exogenous element by economists, and required deliberate action to resolve these contradictions which escaped the regulatory operation of market laws.

There has been progress since then: on the one hand there has been the development of the environmental economy; on the other, governments in the region are more conscious of the state's role, so that either from conviction or from a variety of national and international pressures, action has been taken not to achieve the “major adjustments in the operation of the system” (Prebisch 1980) question is whether this has contributed or will contribute to progress in the development of peripheral economies—Latin America and the Caribbean—resolving the problems of the biosphere, or whether new forms of development must be devised. To find an answer, we analyze, (p. 131) first, the relationship between styles of development and the environment; second, the state of the environment and natural resources arising from this relationship; and third, whether existing policies and current international challenges might provide the region with a new opportunity for more sustainable development.

6.2 The dependence of Latin America and the Caribbean's development style on its natural assets

The development style that dominated the world in the 1980s and increasingly in Latin American countries was the “transnational” (Sunkel 1980) imitations on national governments to choose alternative development paths; homogenization of patterns of production and consumption on a world scale; internationalization of industrial production and promotion of the formation of global value chains; intensive and

continuing technological innovation; and also the intensified exploitation of natural resources and growing dependence on hydrocarbons, and the generation of wastes and pollutants on a large scale. What we now call “globalization” has accentuated the interdependence of countries. The links between international trade and the environment and between developed and developing countries (Ocampo and Martin 2004) doubtedly become part of the solution.

In a region marked by structural, social, and ecological heterogeneity, this style of development arose by exploiting comparative advantages which reinforced a pre-existing production structure, based on the exploitation of natural resources, which benefits from a bias towards investment, innovation, and technological development. On the other hand, with slow (and volatile) economic growth the region's serious poverty and inequality problems encouraged short-term priorities, further placing the environment at a disadvantage.

While the region has shown a sectoral shift to services from primary and industrial activities, the reduced weight of the latter does not mean less pressure on the environment. On the contrary, a growth strategy based on greater international integration encourages the expansion of the agricultural frontier, increasing mineral, forestry, and fisheries resources extraction, and an intensification of pollutant emissions (Table 6.1).

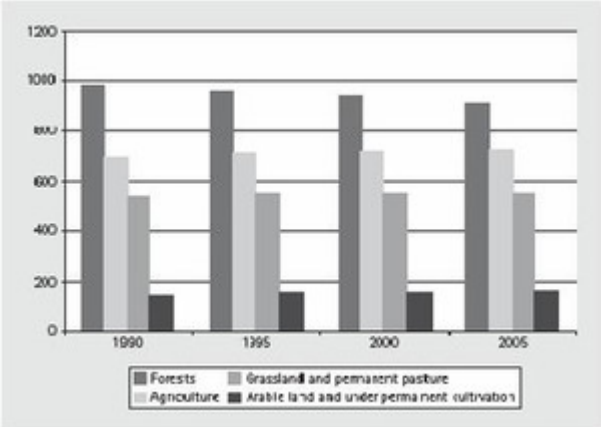

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figure 6.1 Latin America and the Caribbean: changes in soil usage (000 hectares)

Source:FAO 2007.

From the 1970s to the present day, more than 150 million hectares have been incorporated into agricultural production, although the intensity of change has declined considerably in recent years (Table 6.1 and Figure 6.1). Between 1990 and 2005, 4.5 million hectares per year of forest area was lost, representing around 7% of the region's area recorded in 1990 (FAO 2007) in humid tropical zones. Mexico's and Central America's (p. 132) (p. 133) production structure has shifted toward ‘in-bond’ (*maquila*) manufacture to the detriment of natural resources, which contrasts with the fact that Central America is the subregion that has experienced the greatest pressure on forests. The intensification and modernization of agriculture, particularly in South America, and the push by the forest products industry based on plantations, partly explains this reduced pressure. Flourishing monoculture agriculture for export, for example soya, is linked to the expansion of the agricultural frontier, greater use of fertilizers and pesticides, and greater concentration of

landownership, with severe social and ecological impacts. Besides, once the most productive lands have been occupied, changes in soil usage occur over more fragile ecosystems and with greater biological diversity.

Table 6.1 Physical indicators for Latin America and the Caribbean: average annual growth rates (%)

Units	**1980–84**	**1985–9**	**1990–94**	**1995–9**	**2000**	**2005–9**	
Agricultural area	000 hectares	0.40	0.50	0.50	0.20	0.1[a]	-
Volume of agricultural production	000 metric tons	3.30	-3.00	4.70	-1.10	6.1[b]	-
Fertilizer consumption	Tonnes	-0.40	2.40	4.30	7.60	9.00	4.0[c]
Cattle stocks	000 head	1.00	1.60	1.20	0.5[d]	-	-
Volume of production of industrial roundwood	000 m^3	1.30	4.00	3.40	2.00	2.4[b]	-
Firewood production	000 m^3	1.50	1.20	1.50	1.20	0.4[b]	-
Fish production	Metric tonnes	5.90	6.90	11.10	-4.10	-15.9[e]	-

(marine catch)							
Fish production (aquaculture)	Metric tonnes	38.70	23.80	18.20	11.40	38.1[e]	-
Mining production (volume) including petroleum	000 tons	1.30	3.50	3.20	2.40	2.60	-0.4[f]
Mining production (volume) excluding petroleum	000 tons	-1.80	7.20	3.30	1.20	4.90	1.4 f
Carbon Dioxide (CO_2) emissions	Tonnes	0.80	3.10	3.10	3.60	2.8[a]	-
Population growth (%)	000	2.10	1.90	1.80	1.60	1.30	1.30

Gross Domestic Product: accumulated increase	Million $US at constant prices of year 2000	0.20	2.10	4.10	3.00	2.00	5.2 g

(a) 2000–5

(b) 2000–2

(c) 2005–6

(d) 1995–8

(e) 2000–1

(f) 2005–7, [g] 2005–8

Source: Authors, based on Environmental Statistics and Indicators (BADEIMA); Sustainable Development Indicators (BADESALC); Economic Statistics and Indicators (BADECON) and Annual Statistical Yearbook for Latin America and the Caribbean, 2008, ECLAC.

Around 12% of the forest areas of Latin America and the Caribbean is used for production. However, while in Central America and the Caribbean the principal use is firewood, in South America exploitation is principally industrial. In 2005, industrial usage was greater than that for firewood. Forestry has experienced an extraordinary boom since the 1990s, principally in South America. The leading exporters of forest products are Guyana, Chile, Brazil, and Uruguay. The Caribbean, Central America, and Mexico are net importers. All the littoral countries of Latin America and the Caribbean are net exporters of fish products; they represent more than 8% of Guyana's GDP, almost 5% of Surinam, 4% of Ecuador, and 3% of Panama and Chile (FAO 2006)net exporter of metals and (p. 134) hydrocarbons. The continent's production of zinc, aluminium, and copper represents 28, 22, and 19% respectively of world production.

In summary, primary products represent around 35% of regional exports, a proportion which climbs to 47% if Mexico is excluded. If manufactures based on natural resources are also included, such as petrol refining, processed forest, and agricultural products and metals, the percentage of exports increases to 54% with Mexico included, and jumps to 72% if it is excluded (Table 6.2). In countries like Venezuela, Jamaica or Ecuador it reaches 90%, while Chile, Bolivia, and Trinidad and Tobago easily exceed 80%. It might be thought that higher prices for raw materials favor the stability of the quantum, which would relieve environmental pressures, but its growth has been maintained within its trend.

It is now clear that it is possible to talk of two regional patterns of specialization. First, that of South America, based on natural resources as the driving force of development; second, that of Mexico, Central America, and the Caribbean, where low-and medium-level technology-based manufactures, using cheap labor, have gained ground vis-à-vis the previous dependence on the natural assets. For this last group, tourism is a growing component in the development model. Both development patterns have their environmental consequences. The first, as well as the possible exhaustion of natural resources (e.g. several fish stocks), generates important environmental liabilities. It also produces important environmental externalities like air, water, and soil contamination, and, no less importantly, it can provoke a loss of a region's natural heritage. The second of these patterns itself has both direct and indirect externalities, the latter associated with the process of precarious urbanization to accommodate the workforce. Finally, massive tourism has had important consequences for the sustainability of the coast and the very fragile marine and territorial ecosystems that exist in that environment.

The environmental consequences of foreign direct investment (FDI) are difficult to evaluate. On the one hand it has had a crucial role in helping define huge export projects which exploit natural resources, and in the increasingly competitive trajectory of environmentally sensitive industries (Romo Murillo 2007). On the other, it can bring better environmental practices, and has facilitated the development of public service enterprises, particularly water and sanitation, in many countries that have granted concessions to private transnational firms. Finally, there is no clear evidence that Latin America has encouraged environmental havens; specific studies show that when investing

in the region, it is legal security, the rules about investment protection, country risk, quality of the labor force, etc. that are the key issues, well above a concern with environmental norms and their laxity. Also, the presence of foreign capital and the importance of exports in total firm sales notably increase the likelihood of environmental investments, together with the larger size of firms, their age, the strictness of the environmental controls, and local social pressures (Ferraz and Seroa da Motta 2001).

The fundamental origin of the energy that feeds this development model and contributes to its pressures is petroleum. Although its role has diminished since the 1970s, it still represents 45% of energy supply. In 2005 fossil fuels provided around 70% of regional energy, and they will gain ground as a component of the energy matrix in coming years (p. 135) (p. 136) because of the growth of gas and coal. Hydro-energy represented only a small part of the energy supply at the beginning of the 1970s, thereafter increasing progressively and stabilizing at around 9%. The reform process and investment dynamics, together with the greater availability of gas, advanced the development of combined thermal cycle to the detriment of hydroelectricity (Acquatella 2008; Altomonte 2008). Above all, the region continues to be (relatively) one of the cleanest in terms of energy supply. Hydroelectricity is four times greater than the world average. Renewable energy, principally biomass, while reducing its proportion, continues to represent around 18 of supply, and biofuels are notably being developed under Brazil's leadership. Other sources of renewable energy such as solar, wind, geothermal, and tidal, while at an early stage, show great potential.

Table 6.2 Latin America and the Caribbean: trade composition by category, 1990–2006 (%)

	1990		**2000**		**2006**	
	Including Mexico	Excluding Mexico	Including Mexico	Excluding Mexico	Including Mexico	Excluding Mexico
Exports						
Primary products	49.1	49.7	27.5	41.1	35.9	47.0
Industrialized goods	49.8	49.1	70.9	56.2	61.6	49.5
Based on natural resources	22.0	24.5	17.3	27.6	18.3	24.6
Low technology	9.6	10.3	11.8	8.6	8.1	6.2
Medium technology	15.6	12.2	25.3	14.0	23.1	14.8
High technology	2.6	2.0	16.6	6.0	12.1	3.9

Other transactions	1.2	1.3	1.5	2.6	2.6	3.5
Total	100.0	100.0	100.0	100.0	100.0	100.0
Imports						
Primary products	18.6	21.1	9.6	13.5	10.9	14.2
Industrialized goods	76.8	77.4	88.0	85.2	85.9	81.7
Based on natural resources	19.8	20.3	15.9	20.1	17.4	18.9
Low technology	10.0	9.0	14.9	12.2	12.6	10.9
Medium technology	34.1	35.5	35.6	33.9	35.4	34.3
High technology	12.9	12.7	21.6	19.0	20.5	17.5

Other transactions	4.6	1.5	2.4	1.3	3.1	4.1
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Based on ECLAC (2008b).

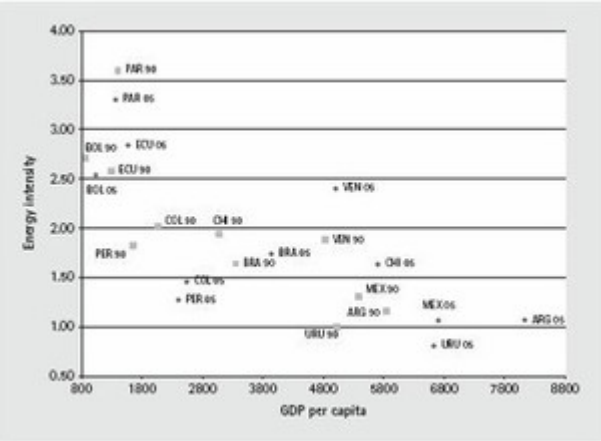

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figure 6.2 Select countries: evolution of energy intensity and GDP per capita (1990–2005)

source: From statistics and economic indicators (BADECON) and Annual Statistical Yearbook for Latin America and the Caribbean (ECLAC 2008).

Notes: LAC: The Energy Intensity Index is expressed in millions of barrels of petroleum equivalent per million US $ of GDP at constant prices of year 2000. GDP per capita is calculated in US constant $2,000.

The growth of the region's energy intensity has been practically stagnant since the 1970s, in contrast to the reductions achieved in other areas of the world; it is higher than the OECD countries, but substantially less than China. Total energy consumption (in thousands of barrels of oil equivalent) per million dollars (constant 2000 prices) was 1.59 in 1971, declining to 1.47 in 1980, following the petroleum crisis—a figure similar to the 2007 calculation of 1.46. The stagnation of the energy intensity of Latin America and the Caribbean is related to its productive and export structure, and—with the increase in per capita electricity use and fuel consumption for transport—a product (p. 137) of the population's greater acquisitive power. However, there are notable differences among subregions and countries, in terms both of energy intensity and of its evolution. So Central America, and particularly Mexico, show reduced energy intensity, while in South America it remains stable. Ecuador and Venezuela, petroleum exporters, have increased their intensity, as has Brazil (although by less), while the remaining countries have reduced it (Figure 6.2).

Total energy consumption per capita across the region is very dissimilar. While the average for Latin America and the Caribbean was 40 gigajoules in 2005, around 50% more than at the beginning of the 1970s, Central America reached 23. Trinidad and Tobago, Mexico and Venezuela consume most (159, 64, and 63 gigajoules respectively), while Haiti, Bolivia, Honduras, and Nicaragua experience the greatest shortages (under 20).

6.3 The state of the environmental and the natural resources in Latin America and the Caribbean

Latin America and the Caribbean is a region rich in natural resources and biodiversity, and contains almost a quarter of the world's forest area. In relative terms it can be regarded as an environmentally privileged region. Nevertheless, it is a region that continues to face pressures caused by antiquated production processes and territorial settlements, which have been magnified by the predominant development model. In spite of the strategies and specific policies that have reversed some deterioration and encouraged systems and technologies that minimize environmental impacts, as we will see, the balance has been negative (Gligo 1995).

6.3.1 The rural environment: biodiversity, deforestation, soil degradation, and desertification

Latin America and the Caribbean, with its climatic and physiological diversity, is the greatest source of genetic biodiversity in the world. There are more “megadiverse” countries than in other regions—Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Mexico, Peru, and Venezuela. The Amazon is considered to be the planet's lungs, and is home to 50% of the world's biodiversity. The existence of endemic species in the region is a great responsibility; their disappearance would also result in their extinction from the planet (ECLAC/UNEP 2002); moreover, numerous animal and vegetable species have an economic potential that would be lost if they disappeared. According to the *Global Environmental Outlook* “GEO-4” (UNEP 2007), the threat to (p. 138) biodiversity and ecosystems constitutes one of the four great environmental priorities for the region.

Many of the environmental problems are linked to changes in land use. In particular, deforestation to increase cultivated land and grassland is the principal cause of biodiversity loss as well as of soil degradation and desertification, and seriously affects the availability and regulation of water resources. The region is dedicating almost half its natural ecosystems to agriculture and cattle (ECLAC/UNEP 2002), and 66% of the loss of the world's forest cover, between 2000 and 2005 (GEO-4), is occurring in Latin America, principally Brazil. Soil degradation affects around 16% of the territory, being particularly severe in Central America; the erosion of the Andean and Central American mountain zones, the desertification that affects 25% of the surface, and the contamination of water resources have a very negative impact on the genetic heritage.

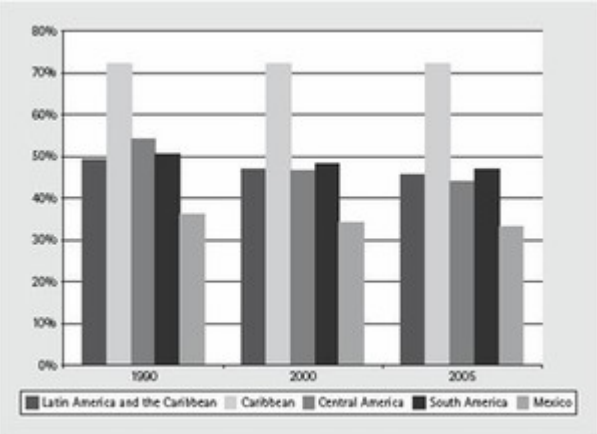

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figure 6.3 Latin America and the Caribbean: proportion of land areas covered by forest

Source: Based on the *Statistical Yearbook for Latin America and the Caribbean* (ECLAC 2008).

The countries of the region have made a notable effort to conserve their natural inheritance by organizing protected areas (the majority on land, although the number of marine reserves are growing). This force is principally funded from the national budget. The creation of the Meso-American Biological Corridor and the program for the conservation of the tropical humid forest in Brazil are some of the experiments that have encouraged a strong increase in the number of protected areas in the region. The government of Ecuador, for example, has developed the initiative Yasuni-ITT, which hopes (p. 139) to pay Ecuador to stop exploitation in perpetuity of untapped underground oil reserves in one of the most biologically diverse regions in the world. From 1990, depending on the subregion, protected areas have grown by between 50% and 100%, with South America showing the greatest increase. In 2007 Venezuela had 70% of its territory under protection, with Belize, Colombia, and Guatemala having around 30% and Brazil tripling its 1990 figure. There have been notable increases in protected areas since that date in Ecuador, Mexico, Nicaragua, and Surinam, with figures of around 7% to 15%.

Furthermore, changing land use is the main source of emissions of greenhouse gases in the region. The Latin American and Caribbean forests store an average of 138 tonnes of carbon per hectare from vegetation and another 128 tonnes from soils (ECLAC 2008a). The tropical forests hold most of the reserves. The 2007 report of the International Group of Experts on Climate Change ran simulations using the value of 109 tonnes per hectare as a base; assuming that the region would loose 68.7 million hectares of forest between 1990 and 2005, then almost 7,500 million tonnes of carbon, equivalent to 27,500 tonnes of CO_2, would have entered the atmosphere; with a conservative estimate of US$10 per tonne, this would have amounted to US$75,000 million over the period, or an annual loss of US$5,000 million— a substantial sum, which could amount to between 3% and 4% of agricultural value added. Further, one would have to assume that a good part of this forest cover would be replaced by cattle, with a consequent increase in methane emissions. The loss for the region is clear enough, even though the analysis did not consider the costs and benefits associated with projects or policies that affect deforestation.

About 25% of Latin American and Caribbean land is dry, and it is estimated that over 75% of the land area, like cultivated land, show evidence of soil degradation. The figures are few and divergent; nevertheless, all countries in the region face some sort of soil degradation, making numerous ecosystems highly vulnerable. In Central America, the pine and oak forests, the dry forests of the Pacific Coast, and the thorn forests in Guatemala are very vulnerable, principally because the poor live on and cultivate inadequate slopes, which become degraded, which obliges them to expand cultivation to even more vulnerable zones (ECLAC 2008a). In the Caribbean, the extreme meteorological events and marked seasonal variations of rainfall alternate with prolonged droughts and torrential rain, which aggravate soil degradation, particularly on islands of volcanic origin, and exhaust the coastal areas. The island of La Espanola, Haitian territory, is an example of extreme degradation. In South America, as well as the severe degradation of the high plateau (*altiplano*), there are the well-known cases of the Brazilian North East and the Chaco. According to different studies, the costs of degradation are very high, and can fluctuate between 3% and 13% of agricultural value added. Estimating the costs of biodiversity loss is very complicated, for while it is a fundamental asset that contributes to human welfare by providing various ecosystem goods and services, it also has an intrinsic value (Millennium Ecosystem Assessment 2005), without market values.

Other factors to consider in this balance are the contributions of fertilizers and pesticides to the intensification and extension of agricultural production, deforestation, and (p. 140) soil erosion; their abuse creates negative externalities for aquifers and biodiversity. Fertilizer consumption has been increasing at accelerating rates since 1980, to an average annual rate of 9% for the first five years of the 2000s; from then the rate appears to have moderated. Information about recent herbicides and pesticides use is limited, as the FAO has stopped updating this series. As both toxic and bio-accumulative substances, they can cause serious human and animal health problems.

6.3.2 The urban environment: atmospheric and hydraulic contamination, garbage, dangerous residues, and congestion

Latin America and the Caribbean is a highly urban region. Seventy-seven per cent of the 550 million population live in cities, which increases to almost 90% in the Southern Cone. Mega cities are commonplace—almost all capitals are in this category. Mexico City, São Paulo, Buenos Aires, and Lima have 20, 18, 3, and 9 million inhabitants respectively. The dominant paradigm is associated with a high level of industrial concentration and intense migrations from the countryside to the city, encouraged by greater opportunities. In fact, with the exceptions of Chile and Uruguay, the rate of poverty is always higher in rural than urban areas (ECLAC 2009a). Soil degradation and natural disasters are factors that contribute to this migration.

One regional priority must be to face the irrational growth of cities and the consequences of this for the environment. The lack of urban planning has been well documented (Jordán and Martínez 2009; Samaniego, Jordán, and Rehner 2009,) with multiple environmental consequences: increases in solid waste as well as liquid residues, atmospheric contamination,[1] access to clean water and sanitation, pressure on surrounding ecosystems, among others; but in turn, the loss of urban environmental quality directly affects the health and welfare of citizens. In addition, urban sprawl and the preference for automobiles over public transport has created congestion, more and longer journeys, and greater energy consumption that increases air contamination, so making urban transport another regional challenge. The automobile fleet continues to grow; between 1980 and 2000 the number of automobiles practically doubled, although the ratio per 100 inhabitants remains low at fewe4r than 20. The number of light vehicles is expected to double between 2000 and 2030, and by 2050 to be triple the 2000 number (Samaniego 2009). Some governments are making efforts to improve public transport; noteworthy are Bogota (*Transmilenio*), Curitiba, Mexico City (*Metrobús*), and Santiago, Chile (*TranSantiago, Chile*). However, most incentives encourage private transport, pedestrian infrastructure is deficient, and bicycle paths are nonexistent.

(p. 141) More than 100 million people are exposed to atmospheric contamination that exceed WHO guidelines in the region, creating serious health problems (Cifuentes et al. 2005). Over 35, 000 deaths—principally the elderly, children, and asthmatics—are attributed to air contamination (PAHO 2002).

Table 6.3 Under-5 mortality

Countries and sub-regions	**Under 5 mortality (by 1,000 live births)**	**Deaths recorded as due to serious respiratory infection (%)**
Latin America and the Caribbean	40	9
Brazil	45	7
Mexico	34	10
Andean region	40	11
Southern Cone	23	6
Central America	45	21
Latin Caribbean	46	7

English Caribbean	28	6
Source: PAHO (2004).		

Table 6.4. PM10 emissions in select cities (%)

City	Mobile	Fixed	Area
Bogota	33.3	66.6	
Buenos Aires	63.6	4.0	32.4
Lima	66.3	33.0	0.7
Mexico city	61.4	32.7	5.9
Sao Paulo[a]	44.8	55.2	0.0
Santiago	56.4	31.4	12.2
Source: PAHO (2005).			

Notes: [a] For São Paulo the figures refer to total suspended solids.

Emissions of particulate matter, including its precursors such as sulfur dioxide and nitrogen oxides, have different origins. Transport is the main source of direct and indirect pollution drag and lift (Table 6.4). The paving of streets, reducing the sulfur content of fuels, and improved technical reviews and modernization of the automobile fleet are valuable steps, but need to be reinforced. For example, Brazil's diesel sulfur content is around 1,000 ppm, compared to 500 ppm in Mexico City, while in Santiago, Chile it has been reduced to 50 ppm. Most European countries insist of a maximum of 50 ppm, and for Scandinavian countries the limit is 15 ppm (Walsh 2005). Bus and truck ppm values (p. 142) are extremely high and fleets are poorly maintained, while automobile replacement is very low (many are 10 and even 20 years old). Growing congestion contributes to emission increases.

Fixed or industrial emissions are the second most important source of pollution, although most affected cities have imposed norms and standards for their control. The geographical location of some cities like Santiago, Chile and Mexico City have special climatic and topographical conditions, with inverted thermal episodes that reduce their natural dispersion and result in critical situations and greater population exposure.

Cifuentes et al. (2005) show that 26 Latin American cities, with a combined population of 81 million people, are exposed to particulates at a level far higher than the accepted international limits. A reduction to North American standards could avoid 10,500–13,500 premature deaths as well as the associated social costs. This number is the equivalent of between 2% and 2.6% of annual deaths in the cities studied.

The region's urban population face a dual challenge, with threats associated with access to safe water and garbage disposal and the recent and growing risks of contamination. While the region is providing more drinking water and better sanitation, especially in urban centers, more than 130 million people remain without these services, and a similar number live in slums. Only 14% of water supply is treated, which compares to 23% for garbage. Over the last 30 years, the quantity of residual solids has doubled in the region, and the share of organic and toxic wastes has increased. These conditions, in the context of poverty and poor hygiene behavior, have a strong impact on health. Intestinal illnesses are one of the principal causes of under-5 mortality, which is an indicator that varies directly and significantly with poverty levels and inversely with sanitation coverage and access to drinking water (ECLAC 2005). Countries where there has been an increase in sewage treatment show notable reductions in hepatitis, cholera, and typhoid fever.

It should not be forgotten that an important number of cities are located on or near the coast, with channels that discharge contaminated water into the sea. Half the region's population lives within 100 km of the coast. Thus, coastal degradation and the contamination of the sea are great environmental challenges to the region. The coastal and marine ecosystems have been strongly affected by population pressures, infrastructure development, and tourism. Aquaculture—principally for the development of shrimp farms—has caused losses to the mangrove swamp of 67% in Panama, 36% in Mexico, and 25% in Peru (UNEP 2007). Coral reefs are also threatened: in the Caribbean, around 61% of the reefs are under threat because of tourism and contamination, among other factors. In turn, the loss of these natural barriers increases the vulnerability of coastal human settlements to natural events. In general, the region's oceans are affected by water pollution, which stems from urban and rural inland activities increasing the nutrients that cause eutrophication problems, urban expansion, lack of sewage treatment (86% without treatment), lack of control of vessel discharges and oil spills, and minor water flows into rivers that increase the level of salinity.

(p. 143) 6.4 Toward sustainable development—opportunity or traumatic adjustment?

6.4.1 The basis of natural resources; sustainability and “artificialization”

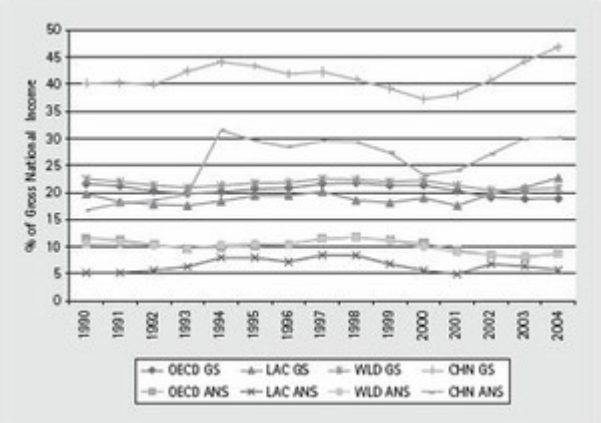

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figure 6.4 Gross Savings (GS) and Adjusted Net Savings (ANS)

Source: Authors' own construction from World Bank information.

Notes LAC: Latin America and the Caribbean; WLD: world; CHN: China.

Any human activity brings associated impacts, but the problem occurs when the limits of the natural environment is exceeded according to their assimilation capacity and their ability to restore balance. The growing process of artificial transformation[2] (Sunkel 1980) should be channeled into a sustainable style of development, for it is necessary to account for natural capital (natural resources and environmental services).[3] Unfortunately the balance in the region is not encouraging; apart from the meager savings and investment rates (necessary to increase physical capital) and the performance in education (necessary to increase human capital), which have room for improvement, natural capital seems doomed to continuous decline. There is little regional information, as countries do not undertake integrated economic and environmental accounts. What is available is a calculation of the ecological net domestic product (PINE)[4] in Mexico, or an adjusted saving measure calculated by the World Bank.[5] For Mexico, the total cost of the exhaustion of natural resources and environmental degradation is around 10% of GDP/GNI, equivalent to that of fixed capital consumption, although there is a steady and slight downward trend in these costs. On the other hand, in Latin America and the Caribbean, gross saving has recently increased from 20% of GDP in 1990 to around 23%, while adjusted savings have scarcely varied from values a little above 5% of GDP, showing that there has been less and less saving owing to the exhaustion of natural and environmental resources (adjustments from 13% to 17%). In China, with higher savings rates, the “environmental adjustment” is similar, although it has been decreasing over time, while that of the OECD is much lower—around 10%, but stable over time (see Figure 6.4). In the Latin American and Caribbean region, many countries have negative net adjusted savings rates, which show their strong dependence on natural resources—for example Bolivia, Chile, Ecuador, Venezuela, and Peru. On the contrary, Honduras, Costa Rica, and Panama experienced positive (p. 144) adjustments. This regional assessment shows that when these adjustments are taken into account, saving rates are much less substantial.

States have the power to charge royalties to recover for their citizens the extraordinary Ricardian rents obtained by exploiting natural assets, and to compensate for loss. Indeed, the tax revenue in the region from fees and royalties for the extraction and export of

natural resources account for 28% of tax collected, much higher than OECD countries (15%). There are substantial variations between countries; in Argentina, Brazil, the Dominican Republic, Guatemala, Peru, and Uruguay, they do not reach 15%, while in Bolivia, Colombia, Panama, and Venezuela they are more than 40% (OECD 2008). However, its allocation for the maintenance of the stock of capital, understood in its broadest sense, is doubtful. The region can report only few examples of this approach such as Chile, which legislated for an Innovation Fund for competitiveness as the recipient for the collected funds.

6.4.2 Institutionality and environmental policies

Latin America and the Caribbean's environmental management has evolved in recent years. Environmental issues have come to the forefront as responses to the United Nations Conference on Human Environment (Stockholm, 1972) and especially after the (p. 145) Earth Summit (Rio, 1992), which formulated Agenda 21, the Framework Convention on Climate Change, the Convention on Biological Diversity, and Convention to Combat Desertification (see Annex 6.1). Gradually, and with differences, the region has achieved a modern institutionality, with the creation of ministries as the highest environmental authorities (Bárcena et al. 2002), the consolidation of the standards that make up framework laws for the environment, and the inclusion of environmental rights and obligations as part of constitutions. Environmental regulations and market instruments have come to complement each other in environmental management, together with examples of the successful use of tax instruments to resolve environmental problems (Acquatella and Bárcena 2005).

As well as the large conferences that have stimulated environmental institutionality and standards, there are endogenous factors—the magnitude of the problems, their impact on the health and welfare of citizens—together with exogenous pressures, particularly opening up regional trade with partners that insist on environmental standards which otherwise would have been delayed.

Over the last few years, however, this positive trend appears to have lost its impetus, as the marginal cost of additional policies has increased and the opportunity costs in terms of resources for effective environmental policy have risen. There are many reasons for this change, in particular:

(i) The small environmental budget contrasts with the level of the problems and the overall costs of their resolution. Environmental expenditures hardly exceed 1 of GDP and rarely more than 3% of total public expenditure. In addition, environmental budgets are subject to strong volatility that vitiates stable and continuous environmental policies, with major cuts during periods of economic recession (Bárcena and de Miguel 2003). International funding for the environment is elusive and, in a region of middle-income countries, will probably decrease over time.

(ii) While legislative development is important, monitoring implementation and performance is poor. The assigned financial and human resources are in contrast to the magnitude of the challenges, and have resulted in a progressive increase in environmental conflicts. So too the preparation of legal personnel, conversant with these issues, is in its infancy.

(iii) There are many serious failures of coordination, coherence, and integration among different public policies that directly and indirectly impact environmental issues (Lerda, Acquatella, and Gómez 2003); this causes contradictory actions, thus making efficient and effective policymaking more difficult. So too the so-called implicit policies—i.e. sectoral and economic policies with environmental implications—often reduce the effectiveness of explicit environmental policies, leading to complete annulment (Gligo 2006).

(iv) Environmental policies are allowed only a peripheral role, and little effective power is granted to environmental authorities, which are often obliged to negotiate with economic authorities in a disadvantageous situation (Ocampo 1999).

(p. 146) **(v)** The other environmental protagonists—civil society and business—tend to be reactive. Apart from the exception of some environmental NGOs, firms associated with business councils for sustainable development, signatories of the Global Pact, or other socially responsible business initiatives, as well as citizen reactions to big environmental conflicts, environmental issues constitute little more than anecdotes for ordinary mortals. The lack of environmental education and information, and obstacles to greater participation, limit changes to environmental consciousness.

Nevertheless, it is important to reiterate that environmental policy is totally justified and should be central to government actions. Environmental issues reflect the differences between private and public interests (or between private and social costs). The presence of externalities and the nature of public goods exhibited by many environmental goods and services require governments to act, and make the state responsible for its lack of action.

Among the most urgent activities are: integration between ecosystem and land use managements; encouraging policies to supply drinking water and sanitation; combining environmental policies with urban and land use planning; and developing policies to improve energy efficiency (ECLAC 2005). To these one might add: the need to strengthen policies that protect biodiversity and ecosystems, without forgetting marine and coastal zones; encouraging science and technology, where the region appears to be very backward, to support sustainable development; and better use of the natural heritage and any existing ancestral knowledge.

Neither do implicit policies help. Take energy as an example. The great regional potential for renewable energy is not being taken advantage of because environmental benefits, which would justify altering relative prices by subsidies or taxes on polluting alternatives, have not been considered. So too it is necessary seriously to examine alternative sources of renewable and non-conventional energy that might significantly replace hydrocarbons.

The lack of policy priorities for energy efficiency, although encouraged by rising hydrocarbon prices, impedes the utilization of one of the region's greatest potential source of emission reduction. To alter one of the bases of the transnational development style— dependence on hydrocarbons—requires a reduction in their use or at least a decoupling between energy use and economic production for which price signals are essential. However, these are going in the opposite direction. The price of diesel in all OECD countries was US $1.10 per liter in 2006, and US $1.40 per liter among European countries, while the average for Latin America it was US $ 0.60 cents, lower than the US price of US $ 0.70 cents, although in petroleum exporter countries the price was even lower. Faced with the continuous increase of the international price of petroleum and fuel, the general response has been to reduce the tax rate. In the OECD, the tax on premium petroleum, used mainly for personal vehicles, was reduced by 5 points (from 59% to 54% of the price); in Latin America and the Caribbean it was reduced by 13 points, from 47% to 34%. The tax proportion for diesel is lower, but it was also reduced like petroleum, and these reductions were overall greater in the Central American isthmus.

(p. 147) What could have been a great opportunity for technological innovation, for policies which promote energy efficiency, for changing production patterns based almost exclusively on petroleum and consumption that mirrors the ‘American style of life’, was regarded as a risk to development and an attack on citizens' purchasing power; thus the response is to maintain prices at the expense of tax receipts. When prices become more tolerable, oil taxes will not be recouped, leading to a new change of relative prices in their favor and a smaller tax take to cover the large social and environmental needs facing countries in the region.

In any case, greater changes require substantial transformations to development styles that countries are apparently unwilling to make, and which public policies are unlikely to achieve unless all of society is involved. Restrictions or outside pressure can force countries to create the appearance of solutions, but maybe only the shock of a global economic or climatic crisis could generate the necessary environment for a drastic change.

6.4.3 The new global green pact

In mid-2008 the world and the region were preparing themselves for a new petroleum crisis—which fortunately, as a consequence, reignited interest in energy efficiency and security (many countries in the region began or intensified policies), and in renewable and alternative energy. By the end of 2008 all these concerns had given way to the threat of a new world economic crisis, but now energy had a lower priority because of more reasonable prices. However, the situation continued, and when the world began to organize itself to face the crisis with stimulus policies, the idea of the ‘Global Green New Deal’ was born (Barbier 2009). The Initiative for a Green Economy was launched by the United Nations in support of smart investment. In the short term this might help

reactivate the world economy and in the medium term reduce carbon footprints and help achieve the Millennium Development Goals—in other words, help to move to a more sustainable development model.

The range of policies adopted by the countries of the American continent can be analyzed as a function of environmental effects using the action-impact matrix (Munasinghe et al. 2006). Tax and sector policies have the most direct impact on changes in patterns of production and consumption. Most countries in the region use expansive fiscal policies to stimulate infrastructure and housing construction. But these policies have not brought about sustainable architecture, energy efficient construction, improved urban public transport infrastructure, or alternatives to road transport. However, there are some positive features: paving streets in a city saturated with air pollution permits reduction of particulate airborne matter (Chile); the improvement of urban road infrastructure improves transport efficiency and thereby reduces CO_2 emissions; and potable water supply, sewerage, and sanitation (Argentina, Colombia, Nicaragua) have health benefits and improve the quality of water resources.

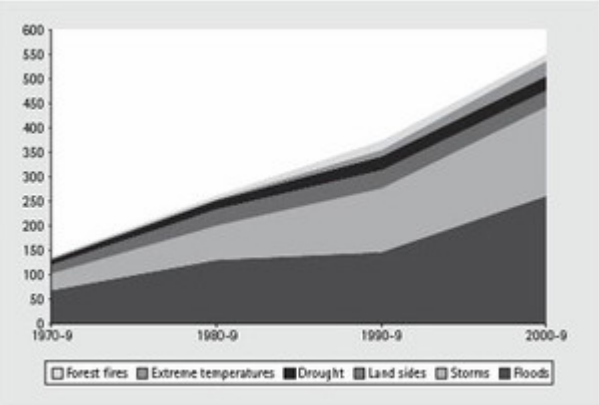
(p. 148) Tax stimuli in the energy sector—supply as well as demand—have been notably negative as incentives to encourage low carbon intensity economies. To favor fuel, electricity, water, etc. by not incorporating environmental externalities may have short-term benefits by reducing consumer costs, but inefficient incentives can be more expensive in the medium term. Many countries have reduced taxes, granted subsidies, set maximum prices, or applied other measures to fuels without considering their environmental implications. There are alternatives, for example the targeting of subsidies to buy fuel for collective urban transport (Nicaragua), supporting mass use of this type of transport (El Salvador), or tariff revisions to ensure that a reduction in petroleum prices is quickly transferred to help reduce public transport prices (Costa Rica). Uruguay's support for the production of renewable energy equipment and science and technology is another example that should be promoted in the region, together with the consolidation and development of efficiency energy measures. Additionally, traditional policies to reactivate the automobile industry allow environmental benefits when focusing on more fuel-efficient and less polluting fleet renewal instead of its expansion.

Methods of financing the stimuli package have not taken the opportunity to implement environmental taxation, i.e. to tax bads. Furthermore, transfers and subsidies conditionality, commonly used in social policies, could inspire fiscal and sectoral policies according to their environmental implications.

6.4.4 Climate change

The global climate is a public good, and therefore climate change, from the economist's point of view, represents its greatest negative externality (Stern 2007). Given its magnitude, climate change will principally determine the characteristics and conditions of economic development in this century. On the one hand, the impacts and adaptation

processes will be, without question, impressive and increasing throughout the century in various economic activities, such as agriculture, hydrology, land use, biodiversity, tourism, the infrastructure, and public health. On the other hand, the development of new technological options that promote lower carbon intensities and the economic costs of mitigation will certainly be significant in areas like, energy, transportation, or forest conservation, and will alter current patterns of economic development (Galindo 2009).



Click to view larger

figure 6.5 Latin America and the Caribbean: frequency of hydro-meteorological events, 1970–2009

Source: ECLAC, based on "EM-DAT: Emergency Events Database", at: www.em-datnet

The undeniable warming of the climate, reported by the IPCC, is already affecting Latin America and the Caribbean's climate. Temperatures have increased by 1 C during the 20th century, while sea levels have risen by 2–3 mm annually since the 1980s and there have been changes to precipitation patterns (de la Torre et al. 2009). Extreme hydro-meteorological events have become more common and intense (Figure 6.5), causing damages valued at US $ 2,100 million annually. Climate change is having an increasing impact on various countries and regions; this region's vulnerability is one of its principal environmental, social, and economic challenges (UNEP 2007; de la Torre et al. 2009; Samaniego 2009).

(p. 149) The key issues, in terms of the impact of climate change on ecosystems (likely to increase during this century), are:

(i) warming and eventual deterioration of the Andean mountain ecosystems including the retreat of Andean glaciers;
(ii) bleaching of coral reefs and the possible ecological collapse of the Caribbean Basin;
(iii) damage to large tracts of wetlands and associated coastal systems in the Gulf of Mexico; and
(iv) the risk of continuing death of forest in the Amazon basin.

If global measures are not taken to reduce emissions, then the socioeconomic damage will be very serious and adaptation will require considerable effort. As yet there are few studies that quantify costs for the region, which cover the loss of agricultural productivity and water scarcity, together with hydro-meteorological phenomena, discussed above, as well as increases in sea levels, the increasing possibility of plagues and illnesses, and the loss of biodiversity and ecosystems (which are difficult to cost). It has been estimated

using a time horizon to 2100, annual losses which amount to between 0.23% and 0.56% of GDP, depending on the scenario (Tol 2002). Medvedev and van der Mensbrugghe (2010) project a loss of 1% of GDP by 2050 if the temperatures increase by two degrees (at present value an impact of 18% of GDP, using a 5.5% discount rate). The exhaustive (p. 150) 'Stern' type study undertaken in Mexico[6] shows that the costs of the impacts are greater than those associated with an international mitigation agreement for the country. The total costs of climate change will reach by 2100 around 6.2% of GDP, using a 4% discount rate, excluding livestock activities, extreme events, increasing sea levels, and non-market costs associated with biodiversity loss and human lives. Mitigation costs associated with a 50% reduction in emissions by 2100 from 2002 would range between 0.7% and 2.2% of GDP depending on the value of a tonne of carbon (Galindo 2009). A similar study for Chile on climate change suggests an annual loss of approximately 1.1% until 2100 (ECLAC 2009b). In both studies poverty levels increase.

While Latin America and the Caribbean is being and will be seriously impacted by climate change, the region contributes no more than 12% of global emissions of greenhouse gases, 70% of which are concentrated in Mexico, Brazil, Argentina, Venezuela, and Colombia. Average per capita emissions of these gases are 9.9 tCO_2e (tonnes of CO_2 equivalent), which could be reduced to 5.4tCO_2e if emissions coming from changes in land use are not taken into account (Samaniego 2009).

The regional average CO_2 emissions per capita hides large differences between countries. In Trinidad and Tobago the number is around 25, and the regional average is duplicated by Venezuela and exceeded by Mexico, Argentina, and Chile.

The main emitters of greenhouse gases are agriculture and forestry, together with changes in land use, transport, and energy. Industry and wastes contribute much less in relative terms.

In general the region is a low emitter and an important carbon sink (given its large forest areas). However, the downshift trend of emissions from land use change has been steadily countered by increasing energy use. The major challenge is to decouple GDP from energy consumption, and to decouple both from CO_2 emissions (Figure 6.6). As shown, while trends in Mexico appear positive, those in the Caribbean and Central America are distinctly negative.

The region does have important mitigation opportunities which bring important economic benefits, as reflected by the curves of marginal abatement costs calculated for several countries. In the case of Chile, for example, this corresponds to profiting from the high potential for energy efficiency in specific activities such as transport, industry, mining, and the sector of public, household, and commercial services. In most cases their application costs are very low (promotion, regulation, certification, small-scale improved technologies, etc.) and the benefits from fuel savings are high. Furthermore, these measures are the most effective way to reduce greenhouse gases. There are also

opportunities in the transport sector and hydropower options that should not be dismissed (O' Ryan, Díaz, and Clerc 2009).

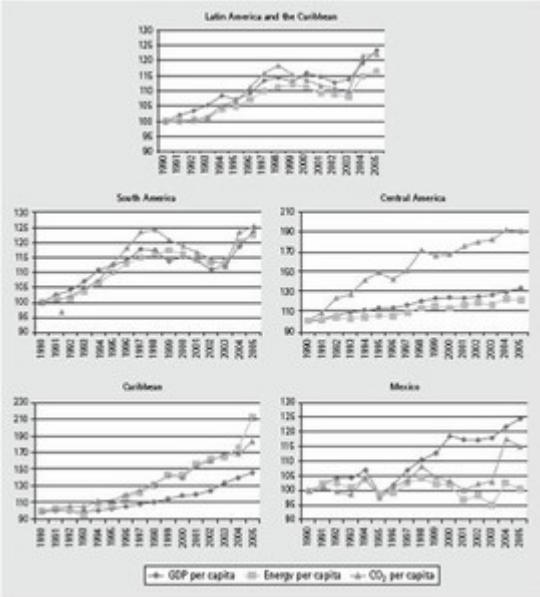


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figure 6.6 Latin America and the Caribbean: coupling among GDP, energy, and CO_2 emissions

Source: Based on statistics and economic indicators (BADECON), Annual Statistical Yearbook for Latin America and the Caribbean, (2008) and Population Estimates and Projections (CELADE), ECLAC/CEPAL.

On the other hand, the international community has implemented financial mechanisms to support both mitigation and adaptation in a region that for now has (p. 151) no obligation to reduce emissions but does have numerous adaptation costs. However, these are small in relation to needs. Official development assistance received by the region is 8.6% of the world total, and of this figure only 5.3% is for general environmental protection and for the objectives of the conventions agreed at the World Summit. The region has received $ 544 million from the Global Environment Facility, primarily for mitigation actions. In addition, the CDM's funds are slight when compared to mitigation needs. The Adaptation Fund, agreed as part of the Kyoto Protocol, is a potential source of funding.

(p. 152) International support for the region has been scarce. However, the costs related to competitivity due to expected requirements applied by developed countries (e.g. carbon taxes or similar measures in terms of the carbon footprint), coupled with the costs of adaptation of a highly vulnerable region, require the region's governments as a matter of urgency to face the issue of climate change.[7] In addition, the negotiations of the second commitment period of the Kyoto Protocol would require emission reduction across a growing number of countries, especially middle-income, and surely some in this region, with different outcomes to their economies. The region's eventual participation in the world carbon market should allow a reduction in the global costs of mitigation (de Miguel, Ludena, and Schuschny 2009).

6.5 Conclusions and an agenda for action

Latin America and the Caribbean continue to have advantages in terms of natural capital and the quality of the environment. However, the region's pattern of integration into the world economy combine with the aspirations of its citizens to join and be assimilated into the existing style of development without questioning its production and consumption patterns. The region today can be described as having a relatively competitive export structure, dependent on industries that make intensive use of energy and natural resources and generate high pollution.

The natural resource base affects the production structure and the pattern of specialization, but that structure is no less the result of the efforts of each country to build its model of development. Natural resources are not in themselves a gift or a curse —it depends on how and for what reason they are used. It will be difficult to switch to an alternative development model, environmentally more sustainable, from the present one, especially since the benefits will accrue to future generations.

While the reliance on natural assets is a competitive opportunity, the region faces enormous environmental challenges: the loss of ecosystems and biodiversity, uncontrolled urban expansion, vulnerability in terms of climate change, etc. which requires a rejuvenated State to play a role. The management of externalities and public goods urgently require that states take the lead in many areas, if not to change the development style, at least to make it sustainable in the medium term. The first step is to strengthen institutional capacities, including greater efforts in education, participation, and environmental justice for citizens. Greater financial resources are needed for sustainability, but it should be a joint action between the region and developed countries, especially in those areas that encompass global public goods or bads. That is, the principle of common but differentiated responsibilities should be applied both in financing and in technology (p. 153) transfer. On the other hand, the region can take its own actions to reduce environmental pressures—in areas such as energy efficiency, materials use, and water resources—while generating economic benefits.

The challenge of climate change cannot be avoided. The region is highly vulnerable to natural disasters, which will only intensify. The costs of adaptation will be high; therefore, an active role in pursuing a global agreement to mitigate emissions, taking into account the different degrees of development of participants, can be beneficial for the region. To reduce global CO_2 emissions to levels that avoid a climate crisis of unknown consequences for human life and ecosystems will require radical changes to production, transportation, consumption, energy use, land use, and urban planning patterns. Rapid action can generate long-term comparative advantage; if not, it will be the future requirements of developed countries, linked to the concept of the carbon footprint, that will impose more costly and reactive measures. Current actions to exit the global economic crisis offer a clear opportunity to adopt a long-term view and push the region towards a more dynamic and non-traumatic sustainable development model. For Latin American and Caribbean countries, we are talking about applying the old idea of

sustainable development—no more, no less than growth with equity and environmental protection.

Annex 6.1 Multilateral environmental agreements

Year of signature and year that the country became party to the agreement (through ratification, acceptance, approval or adhesion). P: party; F: signature; EV: entry into force.

Table 6. A1. Multilateral environmental agreements

Country	**Ramsar[ap]**	**Heritage[bp]**	**CITES[cq]**	**CMS[dr]**	**Law of the Sea[e]**	
	P	P	P	EV	F	P
Argentina	1992	1978	1981	1992	1984	1995
Belize	1998	1990	1986	-	1982	1983
Bolivia	1990	1976	1979	2003	1984	1995
Brazil	1993	1977	1975	-	1982	1988
Chile	1981	1980	1975	1983	1982	1997
Colombia	1998	1983	1981	-	1982	-
Costa Rica	1991	1977	1975	2007	1982	1992
Cuba	2001	1981	1990	2008	1982	1984
Ecuador	1990	1975	1975	2004	-	-
El Salvador	1999	1991	1987	-	1984	-
Guatemala	1990	1979	1979	-	1983	1997

Guyana	-	1977	1976	-	1982	1993
Haiti	-	1980	-	-	1982	1996
Honduras	1993	1979	1985	2007	1982	1993
Mexico	1986	1984	1991	-	1982	1983
Nicaragua	1997	1979	1977	-	1984	2000
Panama	1990	1978	1978	1989	1982	1996
Paraguay	1995	1988	1976	1999	1982	1986
Peru	1992	1982	1975	1997	-	-
Dominican Republic	2002	1985	1986	-	1982	-
Suriname	1985	1997	1980	-	1982	1998
Uruguay	1984	1989	1975	1990	1982	1992
Venezuela (Bolivarian Republic of	1988	1990	1977	-	-	-

Venezuela (Bolivarian Republic of)						

(a) The Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat, 1971.

(b) The Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972.

(c) The Convention on the International Trade in Endangered Species of Wild Fauna and Flora, 1973.

(d) The Convention on the Conservation of Migratory Species of Wild Animals, 1979.

(e) The United Nations Convention on the Law of the Sea, 1982.

(p) The year that the countries signed the agreement is not available.

(q) All the countries that are party to this convention signed it between 1973 and 1974, the period in which the convention was open for signature.

(r) Year that the convention went into force in the country.

(p. 154) Year of signature and year that the country became party to the agreement (through ratification, acceptance, approval or adhesion) P: party, F: signature, EV: entry into force.

Table 6. A2. Multilateral environmental agreements(%)

Country	**Vienna[f]**		**Montreal[g]**		**Basel[h]**		**Diversity[i]**		**UNFCCC[j]**	
	F	P	F	P	F	P	F	P	F	P
Argentina	1985	1990	1988	1990	1989	1991	1992	1994	1992	1994
Belize	-	1997	-	1998	-	1997	1992	1993	1992	1994
Bolivia	-	1994	-	1994	1989	1996	1992	1994	1992	1994
Brazil	-	1990	-	1990	-	1992	1992	1994	1992	1994
Chile	1985	1990	1988	1990	1990	1992	1992	1994	1992	1994
Colombia	-	1990	-	1993	1989	1996	1992	1994	1992	1995
Costa Rica	-	1991 1992	-	1991	-	1995	1992	1994	1992	1994
Cuba	-	1992	-	1992	-	1994	1992	1994	1992	1994
Ecuador	-	1990	-	1990	1989	1993	1992	1993	1992	1993

El Salvador	-	1992	-	1992	1990	1991	1992	1994	1992	1995
Guatemala	-	1987	-	1989	1989	1995	1992	1995	1992	1995
Guyana	-	1993	-	1993	-	2001	1992	1994	1992	1994
Haiti	-	2000	-	2000	1989	-	1992	1996	1992	1996
Honduras	-	1993	-	1993	-	1995	1992	1995	1992	1995
Mexico	1985	1987	1987	1988	1989	1991	1992	1993	1992	1993
Nicaragua	-	1993	-	1993	-	1997	1992	1995	1992	1995
Panama	-	1989	1987	1989	1989	1991	1992	1995	1993	1995
Paraguay	-	1992	-	1992	-	1995	1992	1994	1992	1994
Peru	1985	1989	-	1993	-	1993	1992	1993	1992	1993

Dominican	-	1993	-	1993	-	1999	1992	1996	1992	1998
Suriname	-	1997	-	1997	-	-	1992	1996	1992	1997
Uruguay	-	1989	-	1991	-	1991	1992	1993	1992	1994
Venezuela (Bolivarian Republic of)	-	1988	1987	1989	1989	1998	1992	1994	1992	1994

(f) The Vienna Convention for the Protection of the Ozone Layer, 1985.

(g) The Montreal Protocol on Substances that Deplete the Ozone Layer, 1987.

(h) The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989.

(i) The United Nations Convention on Biological Diversity, 1992.

(j) The United Nations Framework Convention on Climate Change, 1992.

(p. 155) Year of signature and year that the country became party to the agreement (through ratification, acceptance, approval or adhesion) P: party, F: signature, EV: entry intoforce …

Table 6. A3 Multilateral environmental agreements

Country	**UNCCD[k]**		**Kyoto[l]**		**Rotterdam[m]**		**Cartagena[n]**		**Stockholm[o]**	
	F	P	F	P	F	P	F	P	F	P
Argentina	1994	1997	1998	2001	1998	2004	2000	-	2001	2005
Belize	-	1998	-	2003	-	2005	-	2004	2002	-
Bolivia	1994	1996	1998	1999	-	2003	2000	2002	2001	2003
Brazil	1994	1997	1998	2002	1998	2004	-	2003	2001	2004
Chile	1995	1997	1998	2002	1998	2005	2000	-	2001	2005
Colombia	1994	1999	-	2001	1998	-	2000	2003	2001	2008
Costa Rica	1994	1998	1998	2002	1999	-	2000	2007	2002	2007
Cuba	1994	1997	1999	2002	1998	2008	2000	2002	2001	2007
Ecuador	1995	1995	1999	2000	1998	2004	2000	2003	2001	2004

El Salvador	-	1997	1998	1998	1999	1999	2000	2003	2001	2008
Guatemala	-	1998	1998	1999	-	-	-	2004	2002	2008
Guyana	-	1997	-	2003	-	2007	-	2008	-	2007
Haiti	1994	1996	-	2005	-	-	2000	-	2001	-
Honduras	1995	1997	1999	2000	-	-	2000	-	2002	2005
Mexico	1994	1995	1998	2000	-	2005	2000	2002	2001	2003
Nicaragua	1994	1998	1998	1999	-	2008	2000	2002	2001	2005
Panama	1995	1996	1998	1999	1998	2000	2001	2002	2001	2003
Paraguay	1994	1997	1998	1999	1998	2003	2001	2004	2001	2004
Peru	1994	1995	1998	2002	1998	2005	2000	2004	2001	2005

Dominican Republic	-	1997	-	2002	-	2006	-	2006	2001	2007
Suriname	-	2000	-	2006	-	2000	-	2008	2002	-
Uruguay	-	1999	1998	2001	1998	2003	2001	-	2001	
Venezuela (Bolivarian Republic of)	-	1998	-	2005	-	2005	2000	2002	2001	2005

Source: Statistical Yearbook 2008, ECLAC.

(k) The United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, 1994.

(l) The Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1997.

(m) The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, 1998.

(n) The Cartagena Protocol on Biosafety to the Convention on Biological Diversity, 2000.

(o) The Stockholm Convention on Persistent Organic Pollutants, 2001.

References

A**CQUATELLA**, J. (2008). *Energía y cambio climático: oportunidades para una política energética integrada en América Latina y el Caribe*, Santiago, Chile: ECLAC.

—— and B**ÁRCENA**, A. (eds) (2005). *Política fiscal y medio ambiente: bases para una agenda común*, Santiago, Chile: ECLAC.

(p. 157) A**LTOMONTE**, H. (ed.) (2008). 'América Latina y el Caribe frente a la coyuntura energética internacional: oportunidades para una nueva agenda de polí ticas', presented at the Seminario Crisis Alimentaria y Energética, Santiago, Chile: ASDI and GTZ, September.

B**ARBIER**, E. (2009). 'A Global Green New Deal', report prepared for the Green Economy Initiative, UNEP.

B**ÁRCENA**, A., and **DE** M**IGUEL**, C. (eds) (2003). *Financing for Sustainable Development: Visions and Proposals for Action from a Latin American and Caribbean Perspective*, Santiago, Chile: United Nations.

—— et al. (2002). 'Financing for Sustainable Development in Latin America and the Caribbean: From Monterrey to Johannesburg', Santiago, Chile: ECLAC.

C**IFUENTES**, L., K**RUPNICK**, A., O'R**YAN**, R., and T**OMAN**, M. (2005). *Urban Air Quality and Human Health in Latin America and the Caribbean*, Washington, DC: IDB.

DE LA T**ORRE**, A., F**AJNZYLBER**, P., and N**ASH**, J. (2009). *Low Carbon, High Growth: Latin American Responses to Climate Change*, Washington, DC: World Bank.

DE M**IGUEL**, C., L**UDENA**, C., and S**CHUSCHNY**, A. (2009). 'Climate Change and Reduction of CO2 Emissions: The Role of Developing Countries in Carbon Trade Markets', presented at the 12th Annual GTAP Conference on Global Economic Analysis, Santiago, Chile, June. Serie medio ambiente y desarrollo, forthcoming, CEPAL, Santiago, Chile.

ECLAC (UN Economic Commission for Latin America and the Caribbean) (2005). *The Millennium Development Goals: A Latin American and Caribbean Perspective*, Santiago, Chile.

—— (2008a). 'Agricultura, desarrollo rural, tierra, sequía y desertificación: resultados, tendencias y desafíos para el desarrollo sostenible de América Latina y el Caribe', project document from the Regional Implementation Forum on Sustainable Development, Santiago, Chile, November 2007.

—— (2008b). *Latin America and the Caribbean in the World Economy 2007: 2008 Trends*, Santiago, Chile.

—— (2009a). *Social Panorama of Latin America, 2008*, Santiago, Chile.

—— (2009b). *La economía del cambio climático en Chile: síntesis*, Santiago, Chile.

—— (2009c). *Statistical Yearbook for Latin America and the Caribbean, 2008*, Santiago, Chile. ECLAC/UNEP (UN Environment Programme) (2002). *The Sustainability of Development in Latin America and the Caribbean: Challenges and Opportunities*, Santiago, Chile.

FAO (Food and Agriculture Organization) (2006). *FAO Statistical Yearbook, 2005–2006 1*, Rome.

—— (2007). *State of the World's Forests 2007*, Rome.

F**ERRAZ**, C., and S**EROA DA** M**OTTA**, R. (2001). 'Regulação, mercado ou pressão social? Os determinantes do investimento ambiental na industria', Rio de Janeiro, Instituto de Investigación Económica Aplicada.

G**ALINDO**, L. M. (ed.) (2009). *La economía del cambio climático en México: síntesis*, Mexico City: SEMARNAT.

G**LIGO**, N. (1995). 'The present state and future prospects of the environment in Latin America and the Caribbean', *CEPAL Review* 55.

—— (2006). *Estilos de desarrollo y medio ambiente en América Latina, un cuarto de siglo después* (Serie medioambiente y desarrollo), Santiago, Chile: ECLAC.

J**ORDÁN**, R., and M**ARTINEZ**, R. (2009). *Pobreza y precariedad urbana en América Latina y el Caribe: situación actual y financiamiento de políticas y programas*, Santiago, Chile: ECLAC.

L**ERDA**, J. C., A**CQUATELLA**, J., and G**ÓMEZ**, J. J. (2003). *Integración, coherencia y coordinación de políticas públicas sectoriales: reflexiones para el caso de las políticas fiscal y ambiental* (Serie medioambiente y desarrollo), Santiago, Chile: ECLAC.

(p. 158) M**EDVEDEV**, D., and **VAN DER** M**ENSBRUGGHE**, D. (2010). 'Climate Change in Latin America: Impacts and Mitigation Policy Options', in de Miguel et al. (eds), in *Modeling Public Policies in Latin America and the Caribbean*, Santiago, Chile Libros de la CEPAL 109.

M**ILLENNIUM** E**COSYSTEM** A**SSESSMENT** (2005). *Ecosystems and Human Well-Being: Synthesis*, Washington, DC: Island Press.

M**UNASINGHE**, M., et al. (eds) (2006). *Macroeconomic Policies for Sustainable Growth: Analytical Framework and Policy Studies of Brazil and Chile*, Cheltenham: Elgar.

O**CAMPO**, J. A. (1999). *Políticas e instituciones para el desarrollo sostenible en América Latina y el Caribe* (Serie medio ambiente y desarrollo), Santiago, Chile: ECLAC.

—— and M**ARTIN**, J. (eds) (2004). *América Latina y el Caribe en la era global*, Bogotá: Alfaomega and ECLAC.

OECD (Organisation for Economic Cooperation and Development) (2008). *Latin American Economic Outlook 2009*, Paris.

O'R**YAN**, R., D**ÍAZ**, M., and C**LERC**, J. (2009). *Consumo de energía y emisiones de gases de efecto invernadero en Chile 2007–2030 y opciones de mitigación*, PROGEA, Universidad de Chile.

PAHO (Pan American Health Organization) (2002). *Health Situation in the Americas: Basic Indicators 2002*, Washington, DC.

—— (2004). *Health Situation in the Americas: Basic Indicators 2004*, Washington, DC.

—— (2005). *An Assessment of Health Effects of Ambient Air Pollution in Latin America and the Caribbean*, Washington, DC.

P**REBISCH**, R. (1980). 'Biosphere and development', *CEPAL Review* 12.

Q**UEZADA**, F. (2007). *Status and Potential of Commercial Bioprospecting Activities in Latin America and the Caribbean* (Serie medio ambiente y desarrollo), Santiago, Chile, ECLAC.

R**OMO** M**URILLO**, D. (2007). *La competitividad exportadora de los sectores ambientalmente sensibles y la construcción de un patrón exportador sostenible en América Latina y el Caribe*, Santiago, Chile: ECLAC.

S**AMANIEGO**, J. (ed.) (2009). *Economics of Climate Change and Development in Latin America and the Caribbean, Summary 2009*, Santiago, Chile: ECLAC.

—— J**ORDÁN**, R., and R**EHNER**, J. (2009). *Metropolitan Cities Sustainability: Regional Panorama, Latin America*, Santiago, Chile: ECLAC.

S**TERN**, N. (2007). *The Economics of Climate Change: The Stern Review*, Cambridge: Cambridge University Press.

S**UNKEL**, O. (1980). 'The Interaction between Styles of Development and the Environment in Latin America', *CEPAL Review* 12.

T**OL**, R. S. J. (2002). 'Estimates of the Damage Cost of Climate Change', *Environmental and Resource Economics, European Association of Environmental and Resource Economists* 21.1.

UNEP (United Nations Environmental Programme) (2007). *Global Environmental Outlook: Environment for Development (GEO-4)*, Valletta: Progress Press.

Walsh, M. P. (2005). ‘Status Report: Low Sulfur Diesel Fuel Trends Worldwide’, memo, June 13.

Notes:

(1) Intra-household pollution is an important factor for morbidity and mortality from respiratory diseases in the region, but it also occurs in rural areas and is associated with burning biomass for heating and cooking food. In the region, its impact on health is higher than pollution from particulates and other gases in the cities themselves, but this often goes unnoticed. The countries most affected are in the Andes (Bolivia, Ecuador, and Peru), part of Central America, and Haiti.

(2) Constructed or artificial environment.

(3) There are two ways to view sustainability: weak sustainability, which assumes that different forms of capital are substitutable, so that a reduction in natural capital could be compensated by an increase in other kinds of capital in such a way as to maintain the balance; and strong sustainability, which sees capital as complementary, so that it is necessary to ensure that natural capital itself is sustainable.

(4) PINE: Net Domestic Product—Total Exhaustion and Environmental Degradation Cost.

(5) Net adjusted savings discounts from gross national savings fixed capital consumption, the exhaustion of mineral, energy and forest resources, damage caused by CO_2 and PM10 and increases according to educational expenditures, to provide an idea of long-term savings.

(6) ECLAC/CEPAL is leading this type of study for the nations of Central America, the Caribbean. and in Argentina, Bolivia, Chile, Colombia, Ecuador, Paraguay, Peru, and Uruguay.

(7) There are already impacts and behaviors originating with climate change that lead to different adaptation and mitigation processes which are not always efficient from an economic perspective and less so for sustainable development (Galindo 2009).

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