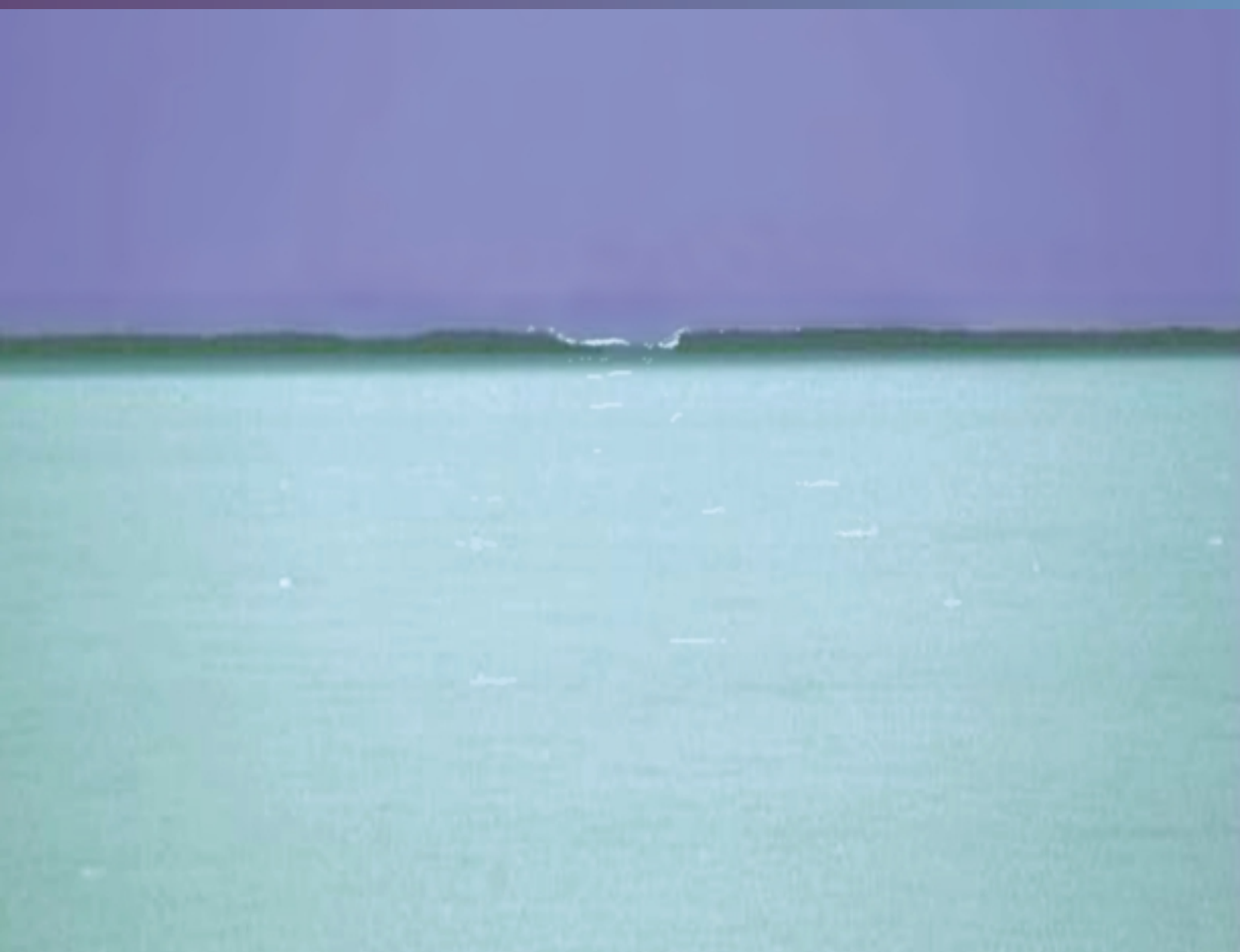


# CARIBBEAN ENVIRONMENT OUTLOOK



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# Caribbean Environment Outlook





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## Preface

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The *Caribbean Environment Outlook* (CEO) is part of a UNEP project to produce state of the environment assessments for the countries of the Caribbean, Western Indian Ocean and Pacific Islands. The objective of the CEO is to provide information on the state of the environment in the Caribbean, help identify regional environmental concerns and highlight policy priorities.

This report comes at a critical time for the island countries globally, as the international community reviews agreements reached at the Global Conference on Sustainable Development of Small Island Developing States (SIDS), held in Barbados in 1994. The CEO provides a forum for the promotion of issues of priority importance to the Caribbean at the UN General Assembly Special Session and subsequent fora. The analysis produced as a result of this project may also provide another opportunity for SIDS to revisit and refocus their national and regional priorities with regard to the programming of development assistance they receive from various donors. The report could also play a role in the consultations between SIDS and donors, for instance during the ongoing post-Lomé negotiations.

The report provides an overview of the state of the environment (SOE), followed by a review of current policy responses, including multilateral environmental agreements and regional and national policy initiatives already undertaken in the region. The concluding chapter focuses on emerging environmental issues that require further research, and proposes some alternative policy responses which could be considered in the future.

The production of the *Caribbean Environment Outlook* closely followed the process set up for the production of UNEP's *Global Environment Outlook* (GEO) publication

(Box 0.1), and the main partners in the process were the University of the West Indies and the Island Resources Foundation. The report is based on existing published reports, documents and data available for the sub-region, as well as inputs from institutions and professionals throughout the region. Additional input was provided through the circulation of a first draft of the report for comment, and the convening of a Regional Consultation in January 1999.

Although many national-level and some regional-level reports exist, very little has been published that examines the environmental issues affecting the countries of the sub-region in an integrated manner. It is therefore hoped that this study will make a valuable contribution to sustainable development planning in the sub-region.

### Box 0.1: The GEO process

The production of the Caribbean, Western Indian Ocean and Pacific Islands environment outlooks closely followed the process set up for the production of UNEP's *Global Environment Outlook* (GEO) publication. Both *GEO-1* (published in 1997) and *GEO-2000* (published in 1999) were produced using a regional and participatory process. This process was of crucial importance in ensuring that the assessment involved stakeholders and experts from all over the world and from every discipline relating to environmental and development issues. As with GEO, the Caribbean, Western Indian Ocean and Pacific Islands environment outlooks aim to incorporate regional views and perspectives and to build consensus on priority issues and actions through dialogue among policy-makers and scientists at both regional and global levels. The main components of the GEO process are:

- GEO Collaborating Centres
- Regional policy consultations
- International working groups
- UN System-wide Earthwatch

**GEO Collaborating Centres** are multi-disciplinary centres of excellence from all the regions which form a co-ordinated network for making policy-relevant assessments. The GEO 2000 network consists of some 25 such Collaborating Centres. The three Collaborating Centres chosen to help implement the UNEP/EC project were:

- the University of the West Indies, Centre for Environment and Development (UWI-CED), Kingston, Jamaica;
- the Indian Ocean Commission, Quatre-Bornes, Mauritius, and
- the South Pacific Regional Environmental Programme (SPREP), Apia, Western Samoa.

**Regional policy consultations** were held in each of the subregions to ensure the participation of all the stakeholders, especially policy-makers, regional organizations and NGOs. Regional consultations not only provide a forum in which governments are able to provide inputs into the GEO process, but also stimulate dialogue between scientists and policy-makers – a crucial step in ensuring that assessments are geared towards policy formulation and action planning.

The regional consultations provided advice and feedback from governments and scientists on the early drafts of the reports. As with the regional consultations for the GEO reports, the consultations for the Caribbean, Western Indian Ocean and Pacific Islands environment outlooks provided inputs that resulted in substantial improvement to the respective documents.

**International working groups** on modelling, scenarios, data and policy provided technical support to the GEO process by developing and recommending methodologies for achieving harmonized and integrated assessments.

**United Nations System-wide Earthwatch** ensures the participation of UN agencies in the GEO process.



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Numerous colleagues at UNEP also contributed to the report, including Marion Cheatle, Norberto Fernandez, Berna Bayinder and Kaveh Zahedi. Thanks also to Veerle Vandeweerd and Dan Claasen.

Finally, we owe special thanks to the participants in the Caribbean Regional Consultation, whose guidance enabled us to improve the document enormously.

A full list of these participants is included at the end of this report.



# Introduction



Ecological fragility, close interdependence of economy and environment and a vulnerability to natural hazards mean that the Caribbean countries (Figure 0.1) must be vigilant in maintaining their natural resource bases.

The environment in the Caribbean countries continues to come under great stress from competition by economic interests for a limited land resource base; expansion of export cash crops (sugar and banana); infrastructure developments (especially for tourism); inadequate waste disposal; increased use of cars, and increased frequency of natural disasters.

Environmental priorities for the Caribbean, as determined through the SIDS Programme of Action (SIDS POA, Box 0.2) and further focused at the regional consultation for the CEO, include:

- land use (including urbanization and fresh water);
- marine and coastal environments;
- waste management, and
- natural disasters.

A number of factors were identified by the CEO, and confirmed at the regional consultation, as critical cross-cutting issues and driving forces, including inadequate institutional and financial capacity and tourism.

The following are some of the highlights emerging from the CEO.

- Coastal zone management is assuming increasing importance in the Caribbean. Management systems

are being developed to deal with the growing problems of coastal deterioration caused by rapidly expanding levels of beach tourism, growing urbanization of coastal lands, and coastal sand-mining used to support the construction industry in coastal areas and elsewhere.

- Significant increases in the production of waste have resulted from the rapid development of tourism and the industrial sector, as well as from increased population, higher per capita incomes and altered patterns of consumption.
- Most of the islands of the Caribbean lie within the hurricane belt and suffer frequent damage from seasonally intense weather systems. The 1998 hurricane season was especially devastating: the impact of hurricanes George and Mitch will be felt for a long time.
- Tourism, accounting for 25 per cent of the region's foreign exchange earnings and providing one-fifth of all jobs, is seen as a principal driving force.

In terms of policy responses, the Caribbean region has made some progress towards the objective of sustainable development against a background of growing poverty, social tension and environmental degradation. Many Caribbean countries have achieved a better understanding of issues of sustainable development which has resulted in better identification of environmental and poverty concerns throughout the region. Some critical policy priorities identified by the

Figure 0.1: Countries and territories covered by the *Caribbean Environment Outlook*

Anguilla	Haiti
Antigua and Barbuda	Jamaica
Aruba	Martinique
Bahamas	Montserrat
Barbados	Netherlands Antilles
British Virgin Islands	Puerto Rico
Cayman Islands	St Kitts and Nevis
Cuba	St Lucia
Dominica	St Vincent and the Grenadines
Dominican Republic	Trinidad and Tobago
Grenada	Turks and Caicos
Guadeloupe	US Virgin Islands



### Box 0.2: SIDS Programme of Action

At the Global Conference on Sustainable Development of Small Island Developing States, held in Barbados in 1994, issues stemming from the 1992 United Nations Conference on Environment and Development (UNCED) were discussed. Building on the Rio Declaration on Environment and Development, and *Agenda 21*, representatives of governments of Small Island Developing States formulated the Barbados Declaration and Programme of Action. That document addressed the specific policies, actions and measures that needed to be taken at the national, regional and international levels to enable Small Island Developing States to achieve sustainable development.

Fifteen priority areas were identified and described, and the related actions that needed to be taken were documented. The priority action categories were:

- Climate Change and Sea Level Rise
- Biodiversity Resources
- Natural and Environmental Disasters
- National Institutions and Administrative Capacity
- Management of Wastes
- Regional Institutions and Technical Co-operation
- Coastal and Marine Resources
- Transportation and Communication
- Fresh Water Resources
- Science and Technology
- Land Resources
- Human Resource Development
- Energy Resources
- Implementation, Monitoring and Review
- Tourism Resources

A number of cross-sectoral issues were also identified under the category 'Implementation, Monitoring and Review'. These were Finance, Trade, Technology, Legislation, Institutional Development, Information and Participation, and Human Resources Development.

The *Caribbean Environment Outlook*, while cognizant of the SIDS POA priorities for action, seeks to further focus on the priority issues in the region through the provision of a comprehensive overview of the state of the environment in the region.

CEO process include the need for:

- improved land use planning and regulation (e.g. the establishment of policies on land sales and distribution to prevent speculation, high land costs and unsustainable economic and environmental practices);
- promotion of integrated waste management strategies;
- harmonization of sustainability indicators and monitoring parameters (especially as they relate to natural resource accounting);
- more harmonized regional programmes and policies;
- increased involvement of civil society in policy development and implementation;
- improved implementation and enforcement of existing laws;
- better evaluation of the environmental and social implications of policies and legislation prior to enactment, and
- better environmental information – including: indicators of change and sustainability (the policy relevance should be stated and the links to the regional inter-governmental process documented);

development of a core data set to be used as baseline data for future reports such as GEO/CEO, and the establishment of a technical and institutional network for updating information for future SOE reports.



# State of the Environment



## Introduction

The countries of the Caribbean share a common history of European colonization, slavery and plantation economies, but they also exhibit substantial variation in both geomorphological and socio-economic conditions. These characteristics, as well as cultural and political differences, affect the utilization and rate of exploitation of each island's natural resources.

The Caribbean islands represent a geographic grouping of islands comprising the northern and eastern boundaries of the Caribbean Sea and adjacent areas. In political terms the variety of jurisdictions encompassed by this list frustrates any attempt at joint action on environmental issues (see discussion in Chapter 2). The general classes of political jurisdiction include independent countries, British, US, French and Dutch dependencies with differing degrees of independence, and dependencies of dependencies (the small island dependencies of the French West Indies and Netherlands Antilles, such as St. Barthélemy, both sides of St. Martin/St. Maarten, St. Eustatius and Saba).

The Caribbean countries range in size from 91km<sup>2</sup> (Anguilla) to 110 860km<sup>2</sup> (Cuba), with varied topographies, geology, flora and fauna, high population densities, and even higher densities in the coastal areas. As can be seen from Table 1.1, average conditions in the Caribbean are dominated by the large islands: Cuba alone accounts for more than one-third of the population and almost half the land area. In comparison, the 'median'

**Table 1.1: Populations and land areas of the Caribbean countries**

Country	Population	Land area (km <sup>2</sup> )
Anguilla	8 000	91
Antigua and Barbuda	67 000	440
Aruba	71 000	19 000
Bahamas	296 000	13 942
Barbados	268 000	432
British Virgin Islands	20 000	150
Cayman Islands	36 000	264
Cuba	11 116 000	110 860
Dominica	71 000	750
Dominican Republic	8 232 000	48 443
Grenada	93 000	345
Guadeloupe	437 000	169 000
Haiti	7 952 000	27 000
Jamaica	2 538 000	11 424
Martinique	388 000	106 000
Montserrat	11 000	103
Netherlands Antilles	197 000	80 000
Puerto Rico	3 771 000	887 000
St Kitts and Nevis	39 000	269
St Lucia	150 000	616
St Vincent and the Grenadines	112 000	388
Trinidad and Tobago	1 283 000	5 128
Turks and Caicos	15 000	43 000
US Virgin Islands	106 000	34 000

Sources: FAO 1990–1998, from FAO website: <http://apps.fao.org/>

island in the region has a population of approximately 110 000 people and a land area of 45 000 hectares – about the size of Barbados.

Even between islands with similar land areas, there are great differences. In the Bahamas, for example, which have the same land area as Jamaica, 85 per cent of the population live on two islands, New Providence and Grand Bahama, leaving 40 000 people scattered over more than 80 other inhabited islands. Barbados and the Turks and Caicos Islands have the same land area, but differ so markedly that the development of a common sustainable development plan for the two areas would be extremely difficult. There is an even greater disparity in the marine resources under the control of each of these islands.

The problems of ecological fragility, close interdependence of economy and environment, and vulnerability to natural hazards require the Caribbean countries to exercise great care in maintaining their natural resource bases. Over-exploitation of near-shore fisheries, pollution, and conversion of wetlands and forests to other less productive uses are common, but these activities must be avoided if sustainable economic growth is to be achieved. Natural resource accounting must be factored into the planning of economic and social activities so that the true costs of development options can lead to selection of those activities that minimize negative impacts on vulnerable and productive ecosystems.

### Socio-economic overview

A variety of socio-economic pressures have the potential to affect the environment in the Caribbean. These include population growth rate, population density, uncontrolled urbanization, income inequality and poverty, and the unsustainable development of industry, agriculture and tourism.

The interdependence of economy and ecology is evident throughout the region. National economies are heavily dependent on tourism, export agriculture, mineral extraction and hydrocarbon exploration, fisheries exploitation by international fleets, or some combination of these activities. All involve direct exploitation of natural resources such as coastal environments, marine ecosystems, agricultural land and mineral resources. Degradation of these resources would greatly reduce the countries' prospects for social and economic growth and development.

While development pressures on coastal and marine resources are common to all countries, they are more acute in Small Island Developing States (SIDS). In these

territories, urban expansion and tourism development, coupled with inappropriate policies, have at times resulted in the destruction of coastal and marine environments and exacerbated problems of waste disposal and the maintenance of potable water supplies.

### Population growth, density and urbanization

According to the United Nations, the overall population of the Caribbean region is approximately 40 million (United Nations 1998 World Population Estimates and Projections, from FAOSTAT). The population of the Caribbean almost doubled between 1950 and 1995, despite the relatively high levels of emigration between 1960 and 1980. Over the same period, the proportion of the population below age 15 declined, while the 60 and over age group increased. This trend is projected to remain the same to the year 2005. Factors contributing to this trend include the marked increase in life expectancy at birth observed over the past 35 years, with women living on average four to six years longer than men.

Population growth in the Caribbean region over the last 20 years has tended to be stable. This is against the background of a demographic transition that has seen a gradual evolution from high birth rates to low ones, correlated with a fall in crude death rates and improvements in health conditions. Current health systems are not equipped for these changes in the age structure of the population. The need for health systems to adapt becomes increasingly important as family structures and traditional networks become less viable.

The reduction of the formerly relatively high levels of emigration, due to the imposition of more stringent immigration policies in the United States, Canada and the United Kingdom, as well as the effects of urbanization and the ageing of the population, has also contributed to changes in the population pattern. Although fertility rates in some of the countries, such as the Dominican Republic, are still high, in others such as the Bahamas, Jamaica and Barbados, general and urban specific rates are approaching replacement levels where deaths and births are almost equal.

Improvements in nutrition, sanitation, immunization and family planning have contributed to lower mortality rates and increased life expectancy so that the Caribbean countries, in comparison with other developing countries in other parts of the world, are not plagued by basic health problems. The Caribbean, with average levels of economic development and incomes, and generally good public health systems, manifests relatively good health status.



For example, Cuba's health rates are among the best in the Caribbean. Infant mortality per 1 000 live births has been less than 10 for several years, and was 7.1 in 1998. Life expectancy is 75 years, the numbers of patients per physician and per dentist are 183 and 1 148 respectively, and maternal mortality rate is 23.6 per 100 000 live births. Health care is free and covers 100 per cent of the Cuban population (Cuba, Government of 1998d). However, the health systems in most Caribbean countries are now showing signs of degradation and there is increasing recognition of the need to accelerate the process of health reform to address the problem.

While there are major differences in scale for the islands of the Caribbean, increased population densities and urbanization and the accompanying environmental stresses are phenomena occurring throughout the region. For the larger island nations of Cuba, the Dominican Republic, Haiti and Puerto Rico, both high density and urbanization are issues. The major urban centres create problems frequently characterized as 'brown pollution', from severe impacts of air and water pollution to other ills of modern urban life such as urban street congestion, toxic impacts from storm water runoff, and noise pollution.

For intermediate-size islands, such as Barbados, Jamaica and Trinidad, there is evidence of growing urban pollution problems (Natural Resources Conservation Authority 1996), with Bridgetown, Kingston and Port of Spain seemingly headed towards problems similar to those currently experienced in Havana, Santo Domingo and Port-au-Prince.

In the smaller islands, the notion of urbanization seems out of place, but the effects of overpopulation, over-crowded development in the coastal zone, and insufficient infrastructure still provide cause for concern about the degree of environmental stress. High housing and construction densities on the porous coralline marl which constitutes the surface of Grand Cayman Island result in ground water and coastal pollution stresses not unlike the pollution effects of urbanization and inadequate infrastructure in other urban centres.

In the smaller, rugged islands of the Eastern Caribbean, including St. Thomas, Dominica, Terre-Basse in Guadeloupe and much of St. Lucia, St. Vincent and Grenada, the hard volcanic substrata and steep slopes mean that even modest settlements can create concentrated pollutant 'hot spots' for both surface and groundwater discharge points, and for solid waste disposal sites and associated leachates, smoke and fumes.

Finally, from the standpoint of the state of the environment, urbanization may be a more desirable (or

less undesirable) effect than 'suburban' sprawl which is seen in many islands. Sprawl often distributes pollution and land cover impacts over a wider range of habitats, and tends to block more migration paths for local species than is the case with concentrated urban centres. In the Abaco Islands of the Bahamas, for example, the more dispersed settlements such as Marsh Harbour and Coopers Town seem to have greater coastal water quality problems than more compact villages such as New Plymouth, Man O'War Cay and Hopetown.

### **Economic development and poverty**

Over the past decade, the Caribbean countries have undertaken a number of economic reforms, with mixed results. For most countries, growth rates were positive during the 1990s with most economies rebounding in 1996 and 1997 due to the improved performance of exports in general, and tourism and free trade zones in particular.

Agriculture, mining, manufacturing and commercial services are the main components of Gross Domestic Product (GDP), with the services sector larger than the aggregate of all the other sectors (> 50 per cent), except in Haiti, Suriname and Guyana. In Guyana and Haiti, agriculture produces the greatest contribution to GDP (36 per cent and 46 per cent respectively). On average, exports from the region in 1995 were made up of: agriculture 15 per cent; mining 9 per cent; manufacturing 63 per cent and services 26 per cent. Most of the merchandise was exported to: North America (60.8 per cent); the European Union (EU) (22 per cent); Latin America (9.2 per cent) and the Caribbean Group for Co-operation in Economic Development countries (CGCED) (5.1 per cent). On average, imports for the same year were mainly from: North America (51.9 per cent); European Union (20 per cent); Latin America (18 per cent) and the CGCED countries (5.4 per cent).

The change from agriculture to tourism and other service industries has been a positive one for per capita incomes and wealth in the Caribbean. Increasing total and per capita incomes have been a feature of development in the Caribbean for the past twenty years (Table 1.2).

Those countries in which tourism and financial services are well developed have the highest per capita income (Caribbean Development Bank 1997). Thirteen are classified as middle income countries and nine have per capita incomes above the average for middle income countries. The Cayman Islands and the British Virgin Islands recorded per capita GDPs of US\$35 930 and

**Table 1.2: Per capita incomes in selected Caribbean countries: 1975 to 1995 (1987 US\$ per capita)**

	1975	1980	1985	1990	1995
Antigua and Barbuda	2 754	3 502	4 460	6 167	7 052
Bahamas	7 004	11 100	12 066	12 178	10 815
Barbados	4 877	6 024	5 671	6 655	6 456
Dominica	1 239	1 308	1 764	2 341	3 195
Dominican Republic	826	928	933	953	1 062
Grenada	1 252	1 566	1 895	2 452	2 628
Haiti	479	581	504	461	315
Jamaica	1 920	1 558	1 448	1 795	1 815
Puerto Rico	5 780	6 687	6 838	8 675	9 772
St Kitts and Nevis	1 427	2 160	2 597	3 738	4 720
St Lucia	1 022	1 465	2 075	2 999	3 954
St Vincent and the Grenadines	805	1 044	1 364	1 811	1 999
Trinidad and Tobago	4 138	5 692	4 816	4 100	4 157
Caribbean average	2 061	2 386	2 307	2 578	2 692

**Blue type:** Above Caribbean average

Source: RIVM, the Netherlands.

US\$26 957 respectively in 1996. However, dependence on preferential trading arrangements, tourism and official development assistance has made most states vulnerable to external developments.

External conditions have played a large part in the growth of the Caribbean countries over the past five years. Between 1994 and 1996, hurricanes and tropical storms retarded economic growth in St. Lucia, Dominica, St. Kitts and Nevis and Antigua and Barbuda (World Bank 1998). Continued growth in Europe and in the United States assisted increases in the tourism industry. Higher world mineral prices also helped exporters of oil (Trinidad), nickel (Dominican Republic) and bauxite (Guyana, Jamaica and Suriname). The region has benefited from preferential trade schemes adopted by the United States, Canada and the EU. In the case of the EU, the Lomé Convention has provided free access to the European market for some products and has also provided financial and technical assistance. Some Caribbean countries have had easier access to EU markets than lower-cost competitors elsewhere in the region.

Despite positive growth rates, approximately 38 per cent of the total population in the Caribbean can be classified as poor, with the highest incidence of poverty in Haiti (65 per cent), Jamaica (34 per cent) and Dominica (33 per cent). However, rates are higher than 20 per cent in the Dominican Republic, St Lucia, and Trinidad and Tobago (World Bank 1996). The chronically poor in the Caribbean include groups who are not active in the labour market – the elderly, children, individuals

with disabilities, and in some cases female-headed households. In addition, small-scale farmers, unskilled workers and indigenous populations (such as the Caribs in Dominica and St. Vincent; Amerindians in Guyana; Maroons in Jamaica, and Maroons and Amerindians in Suriname) have fallen into this group. On the whole, most of the poor in the Caribbean still live in rural areas.

Increasingly, rising rates of urbanization and high vulnerability of the urban poor to economic and social conditions make urban poverty a particular concern in the Caribbean. Economic growth has been at a rate that is below the minimum required to relieve the various pockets of poverty that exist in some islands. Haiti has the lowest per capita GDP in 1995: US\$315 (Table 1.3). In addition, economic growth has failed to keep pace with population growth in many countries, and with the urban population forecast to rise from 62 per cent in 1995 to 69 per cent by 2010 (UN Population Division 1997), urban poverty will become an increasing concern.

In general, Caribbean countries that have experienced positive growth rates and that have invested heavily in human resource development, such as Cuba, Barbados, the Bahamas, Antigua and Barbuda, and St. Kitts and Nevis, have low levels of poverty.

Another major concern is the high level of unemployment among young people, ranging between 25 per cent and 50 per cent for the region. Female unemployment is substantially higher than male unemployment, notably in Barbados and Jamaica where it is

Table 1.3: Socio-economic statistics for selected Caribbean countries, 1996, and urbanization rates 1975 and 1995

	Population density, 1996	Population in poverty, 1996	Per capita GDP, 1996	GDP growth, 1996	Urbanized population (%)	
	(per km <sup>2</sup> )	(%)	(US\$)	(%)	1975	1995
Anguilla	88	n.a.	7 397	3.4	10.0	11.0
Antigua and Barbuda	152	12	7 951	5.8	34.2	35.8
Bahamas	21	5	12 730	4.2	73.4	86.5
Barbados	620	8	7 538	5.2	38.6	47.3
British Virgin Islands	133	n.a.	26 957	n.a.	33.5	56.0
Cayman Islands	136	n.a.	35 930	n.a.	100.0	100.0
Cuba	100	n.a.	1 290*	7.8	64.2	75.8
Dominica	100	33	3 120	3.7	55.3	69.3
Dominican Republic	170	21	1 567	7.3	45.3	61.9
Grenada	269	20	2 985	3.1	32.6	35.8
Guadeloupe					82.9	99.4
Haiti	287	65	257	2.8	21.7	31.8
Jamaica	222	34	2 353	-1.7	44.1	53.7
Montserrat	106	n.a.	9 427	-17.7	11.8	16.3
Puerto Rico					62.8	73.3
St Kitts and Nevis	145	15	5 686	5.9	35.0	34.0
St Lucia	243	25	3 866	1.9	38.6	37.2
St Vincent and the Grenadines	289	17	2 415	0.9	20.6	48.1
Trinidad and Tobago	250	21	4 493	3.5	63.0	71.7

\* constant prices 1981                      n.a. not available

Source: Caribbean Development Bank (1997); World Bank (1996); World Bank Atlas (1997); World Bank (1998); United Nations (1998); Cuba Government of (1998d).  
Urbanization data from FAOSTAT; FAO website, December, 1998

twice as high. During 1997, the annual rate of unemployment in Barbados was 14.5 per cent. Unemployment among males was estimated at 11.3 per cent and that among females at 17.8 per cent (1997 Barbados Economic and Social Report). It is even more severe in some countries outside the Organization of Eastern Caribbean States, averaging about 15 per cent in the 1990s.

While increased income has produced many social benefits, it has also been coupled with increased generation of waste and consumption of potable water, both of which are major environmental problems throughout the Caribbean. On the other hand, increased wealth also implies that local populations are prepared to pay more for environmental amenities and essential services associated with environmental health.

For the near future, the economies of the countries of the Caribbean will most likely continue to be in a state of transition. Global economic changes in trade and capital markets are pressuring countries to become more competitive in export markets. Preferential market access

is being eroded by implementation of the North American Free Trade Agreement (NAFTA), by the revised policies of the European Union on bananas and sugar, and by the successful completion of the Uruguay Round of negotiations for GATT (General Agreement on Tariffs and Trade). Tourism, presently the major economic activity in the region, is also subject to fluctuations in the global economy and to competition from other destinations. Given these circumstances, the future presents a number of challenges for the Caribbean. Economic growth and social development is possible but will require sound macroeconomic management, adequate regulatory measures, effective mechanisms for the protection of the environment, improvements in the quality and accessibility of technical and vocational education, and investments in the health care system and physical infrastructure. The engines of future growth are likely to be in the areas of tourism and other service industries. To facilitate this growth, the Caribbean countries will have to pursue efforts to create demand through product development and new approaches to marketing.

## Tourism

Tourism was identified as one of the priority areas by the SIDS POA and as one of the main pressures on the environment by CEO and the regional consultation. The former dominance of agriculture is being displaced by mass tourism in the Caribbean, which accounts for between 25 and 35 per cent of the total economy of the region. Tourism is also the major foreign exchange earner in the region, accounting for one-quarter of foreign exchange earnings, and one-fifth of all jobs (ranging from direct dependence on tourism, such as working in hotels and on the beaches, to indirect involvement such as banking and farming) (McElroy and Albuquerque 1998). Agriculture is still a significant export earner and means of livelihood in several countries, with sugar and bananas being the most important agricultural products.

The data in Table 1.4 illustrate the sweeping impact and growth of tourism throughout the region (abetted by broad-based prosperity throughout the potential markets for Caribbean tourism during this period).

Tourism receipts in 1996 were in excess of US\$1 billion each for Jamaica, the Bahamas, Cayman Islands, Cuba and the Dominican Republic, within the range of US\$250–725 million for four of the other more popular tourism destinations in the region, and less than US\$81 million each for the rest (Finger, Ng and Soloaga 1998; Cuba, Government of, 1998d).

The situation varies among the countries because of the contrasts in size and available human, financial and technical resources. The islands of the Greater Antilles – Cuba, Jamaica, Hispaniola and Puerto Rico – have extensive arable land and forest resources, while the

**Table 1.4: Growth of tourism, 1993-1997 (in thousands of overnight visitors per year), and tourism intensity**

	1993	1994	1995	1996	1997	Tourist intensity 1993–1997	
						per hectare	per resident
Anguilla	37.7	43.7	38.5	37.5	43.2	4.7	5.4
Antigua and Barbuda	249.4	262.9	220.0	228.2	240.4	5.5	3.6
Bahamas	1 488.7	1 516.0	1 598.1	1 633.1	1 617.6	1.6	5.6
Barbados	396.0	425.6	442.1	447.1	472.3	11.0	1.8
British Virgin Islands	200.2	238.7	219.5	243.7	244.3	16.3	12.2
Cayman Islands	278.6	314.4	361.4	373.2	381.2	14.7	11.6
Cuba <sup>1</sup>	544.1	617.3	762.7	1 004.3	1 170.1	0.1	0.1
Dominica	51.9	56.5	60.5	63.3	65.4	0.9	0.9
Dominican Republic	1 636.4	1 766.9	1 775.9	1 925.6	2 211.4	0.5	0.3
Grenada	93.9	109	108	108.2	110.7	3.3	1.2
Guadeloupe	452.7	555.6	640.0	625.0	660.0	3.9	1.5
Haiti	76.7	70.3	145.4	150.1	148.7	0.1	0.0
Jamaica	1 105.4	1 098.3	1 147.0	1 162.4	1 192.2	1.1	0.5
Martinique	366.4	419.0	457.2	477.0	513.2	4.8	1.3
Montserrat	21.0	21.3	17.7	8.7	5.1	0.5	0.5
Netherlands Antilles	1 377.3	1 474.5	1 400.6	1 302.9	1 376.0	9.1	3.7
Puerto Rico	2 923.2	3 112.7	3 053.9	3 127.7	3 378.5	3.8	0.9
St Lucia	194.1	218.6	232.3	235.7	248.4	4.1	1.7
St Kitts and Nevis	88.6	94.2	78.9	84.2	88.3	2.5	2.2
St Vincent and the Grenadines	56.7	55.0	60.2	57.9	65.1	1.7	0.6
Trinidad and Tobago	248.0	265.6	259.8	265.9	324.3	0.6	0.2
Turks & Caicos	66.8	70.9	77.8	86.5	92.1	2.1	6.1
US Virgin Islands	549.5	540.0	454.0	372.6	411.4	12.1	3.9
<b>Total Overnight Tourists</b>	<b>14 496.3</b>	<b>15 341</b>	<b>15 607</b>	<b>16 017</b>	<b>17 057</b>	<b>0.7</b>	<b>0.4</b>

Source: CTO (1998) (Overnight Stay Tourists); Tourism intensity data from FAOSTAT.

1. Note that the Cuban National Statistical Office estimates that tourists from all sources in 1998 totalled nearly 1.7 million visitors.

**Tourists per hectare** is an indicator of the likely effect of tourism on local infrastructure, such as lodging facilities, airports, highways, vehicular traffic and fresh water consumption for washing and irrigation of lawns and golf courses.

**Tourists per inhabitant** is obviously linked to the social pressures occasioned by tourism. But this measure also reflects impacts on the natural environment through heightened demonstration effects for consumption of imported foodstuffs, higher volume/lower cost freight for further imports, and life style choices for amenities such as swimming pools and lawns (again affecting demands for fresh water).

small islands of the Eastern Caribbean have limited land and forest resources. Those of Haiti and Puerto Rico have been severely depleted. Jamaica, Cuba, the Dominican Republic and Trinidad and Tobago have significant mineral deposits or petroleum reserves to develop but the smaller islands have few non-renewable resources available to them.

According to the February 1999 report of the World Travel and Tourism Council (World Travel and Tourism Council /WEFA 1999), the Caribbean is the most economically dependent on tourism of the thirteen world regions identified by the Council. For example, in 1999, on a global basis, the WTTC estimated that the combined effects of travel and tourism account for 11.7 per cent of world Gross Domestic Product (GDP); for the Caribbean, this figure is 20.6 per cent, and for some islands, such as Anguilla, it is over 65 per cent. (Estimates of total GDP and sectorial contributions to GDP in the smaller islands of the Caribbean are difficult to verify because of the historically large role of remittances in many islands, and because of the more recent distortions introduced by offshore purchasing of tourist packages and other services, such as financial services.)

McElroy and de Albuquerque (1998) cite some of the negative impacts of tourism as: 'filling-in of wetlands and mangrove destruction from resort construction, beach loss and lagoon pollution from sand mining, near-shore dredging and hotel sewage dumping, and reef damage from diving, yacht and cruise ship anchoring and marina development'. Also of significance is the physical transformation of coastal environments by hotel and marina construction, which reduces ecosystem productivity. Additional problems may arise as a consequence of 'the frequency of large recreational outings by tourists, often to offshore islands and caves, which disturb the wildlife and can destroy the fragile habitat of aquatic life'. Beach destruction can be further aggravated by the continuous use of motor vehicles on sand beaches, which destroys both sand stability and anchoring vegetation.

Sea pollution by faecal coliform and other pathogenic bacteria is another environmental concern as many hotels do not have adequate or properly maintained disposal facilities and consequently raw sewage is flushed into the sea. Finally, Caribbean tourism is dependent upon imports of goods and services ranging from construction material to furnishings, toiletries, food and staff. These imports directly affect the local balance of payments as well as stimulating a shift in local consumption patterns from domestic to imported goods

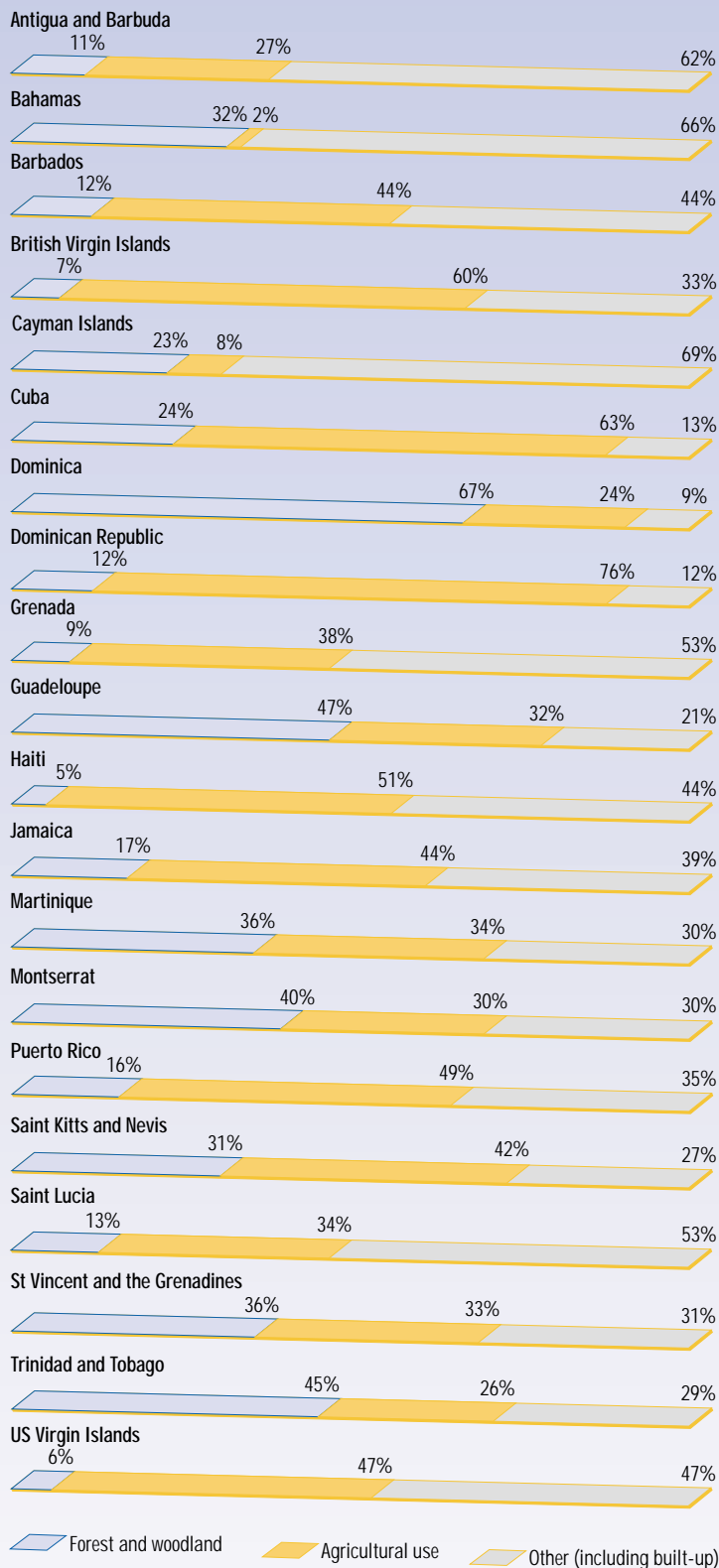
and services (the 'demonstration effect' of tourism).

One indicator of the environmental stress imposed by tourism is the intensity of tourist activity on each island. In Table 1.4 above, measures of the intensity of tourism activity are calculated both for the number of (overnight) tourists per hectare, and for the number of tourists per local inhabitant. These two measures demonstrate slightly different environmental effects.

Tourism in the Caribbean has developed from being merely a place of 'sun and fun', to include ecotourism (Boo 1990). Ecotourism is a marketing term that includes a range of activities from adventure tourism to visiting cultural and heritage sites. The positive developmental effect of ecotourism is that it serves to differentiate the tourist destination in terms related to both natural features and history and culture. An important secondary effect of ecotourism is that by marketing the special and unique characteristics of a place, local inhabitants develop more pride and interest in their own conditions and background. An example of this positive reinforcement working to produce both civic virtue and improved marketing opportunities is the recent discovery by local residents that ancestors of Thomas Jefferson lived on the small island of St. Kitts, whose sister island of Nevis is already known for its connection with other colonial-era leaders such as Alexander Hamilton and Admiral Horatio Nelson. The risk of these various expressions of ecotourism is that all have limits on their ability to absorb certain numbers of tourists without destroying precisely those features that serve to differentiate the site in the first place.

Despite these attempts to protect the environment through ecotourism, it is probably true that the increase in ecotourists has been equalled or exceeded by increased numbers of tourists staying in large resorts and all-inclusive hotels. In general, these larger facilities are felt to be more intrusive on the environment than bed and breakfasts, small inns and camping grounds. On a per-tourist basis, however, the economic and environmental costs and benefits of alternative forms and facilities supporting tourism are not known with sufficient confidence to guide public policy. In August 1998, the World Bank announced a new programme of support for tourism in the Caribbean. This is to be accompanied by studies of the costs and benefits of managed tourism in the region (statement of Maritta Koch-Wesser to the Caribbean Group for Co-operation in Economic Development, at the session on (Organization of Eastern Caribbean States (OECS) development presentations, Washington, August 1998).

Figure 1.1: Caribbean land use in 1995 (in thousands of hectares)



Source: FAO 1990–1998, Dec. 1998 (calculated)

## Land and food resources

A large portion of the Caribbean is recognizably and directly affected by human activities (Figure 1.1). The small size and rugged topography of most countries in the region create limits to the amount of land available for human settlements, agriculture, industry, tourism, mining, roads, ports and other infrastructure, grasslands and pastures, and forests – all of which compete for the limited space. Inappropriate land use has led to the ir retrievable loss of valuable land that would otherwise have had high economic or social value for agriculture, watershed protection or biodiversity conservation.

More than 70 per cent of the dry lands used for agriculture in Latin America and the Caribbean suffer from moderate to extreme degradation (UNEP 1997). For example, in the early twentieth century, cotton cultivation on the lower slopes of Montserrat and Nevis created major soil loss, while in Barbados pressure from small-scale farming, especially the grazing of numerous domesticated animals such as sheep and goats, resulted in loss of fertility and erosion on the steeper slopes of the Scotland District. Over the years, agricultural land degradation has continued as agricultural lands have been extended into marginal areas, as land has become degraded from over-use, and as informal squatter settlements have spread. In Jamaica, Haiti and the Dominican Republic, urban expansion of both housing and industrial estates has taken over prime agricultural land, which in turn has led to threats to forests and other natural areas not formerly used for agriculture.

## Landholding patterns

Landholding patterns in the Caribbean vary greatly from island to island due to differences in the natural environment and also to differences in the historic settlement processes. These different landholding patterns in turn lead to different conditions and threats to the environment.

One of the key differences among the islands of the Caribbean was the ability of natural conditions on an island (viz. topography, remaining soil fertility, rainfall and so on) to support large-scale plantation agriculture after the abolition of slavery. In those islands favourable to plantation agriculture, alienation of land ownership and maintenance of large landholdings producing products for world export markets continued. Where conditions would not support plantation agriculture, the tendency was for plantation lands to be abandoned, and

landholdings to revert to local residents who usually had smallholdings producing a variety of crops for local consumption. The contrasts between neighbouring small islands can be startling: St. Croix, for example, remained a plantation economy until the early 1960s, whereas St. Thomas and St. John were characterized by generally small plots (plus some commercial activity in St. Thomas); St. Kitts is still a major producer of sugar on large state-owned plantations, whereas most of the Great Houses on Nevis were abandoned until they were 're-cycled' as resorts, beginning in the 1960s.

On larger islands, both conditions could operate at the same time: agricultural land use would be characterized by scattered multi-crop smallholdings worked by small farm families, alongside vast plantations held by powerful interests such as wealthy landowners, the government and co-operatives. Inequality in land distribution between smallholders and wealthy landowners has contributed to this pattern of ownership and control. For example, in Jamaica and St. Kitts substantial areas of high-quality land are controlled by wealthy landowners, the government and co-operatives, while small farmers typically own 0.8–1.2 hectares of marginal land, often on steep slopes which are inherently prone to erosion.

This pattern of land ownership and control was entrenched in land distribution policies in the past, and even with reforms within the last 30 years inequalities in ownership and control still exist. Consequently, land conservation techniques among peasant farmers are not always exercised, and in most cases peasant holdings remain informal and tenuous. Ignorance about basic land conservation techniques also exists. Such inadequate land tenure policies contribute to increasing levels of squatting on state lands in Trinidad and Tobago, Jamaica, and St. Vincent and the Grenadines.

Food production by small and large holdings also differs as large farms typically focus on monocultures for export (such as sugar cane, coffee, bananas) while small peasant holdings produce a variety of crops, mainly for domestic consumption. By all indications, the agricultural sector in many countries in the Caribbean has failed to produce enough food to satisfy domestic demand and in some cases has had to be supplemented by imports. This situation has been compounded over the years by the movement of rural workers from rural areas to urban centres. On the other hand, poor agricultural policy initiatives undertaken by many governments in the region have created an imbalance that resulted in food production that did not match the level of domestic and external demand. With few exceptions, export food

production in the region has fallen short of market quotas. However, a recent study by the United Nations Food and Agriculture Organization Sub-regional Office for Latin America and the Caribbean (FAO/SLAC) in eight selected Caribbean Community (CARICOM) countries indicated the following:

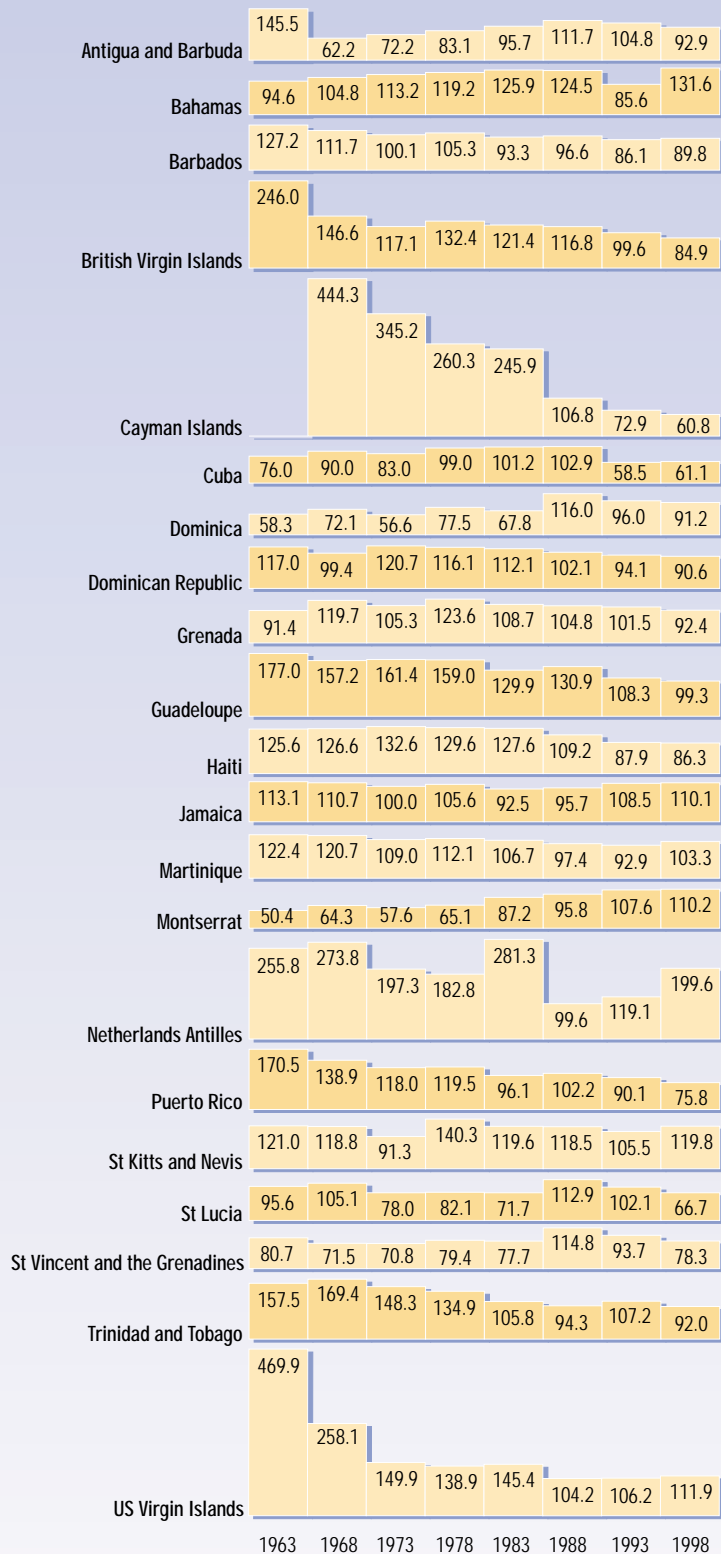
- Over the period 1986–1995, agricultural GDP increased in all countries of the Caribbean except Barbados and Grenada. In the case of Barbados, the food sub-sector's performance is directly linked to the decline of the sugar industry throughout the decade, while in Grenada, agricultural production showed variable performance for the decade. Traditional crops such as bananas, cocoa and nutmeg accounted for most of the decline in the Grenada agricultural sector's performance.
- Domestic food production is on the rise, in particular that of non-traditional crops, and a considerable share of the food security in the Caribbean is derived from domestic agricultural production.
- On the other hand, trade liberalization, increased transport services and stiffer competition from imported goods – in most cases cheaper than locally produced goods – will increase food imports. This situation is exacerbated by the increase in people's incomes, and the strong demonstration effects of the tourism and financial services sectors.

The dilemma faced by many islands in the region is that in order to maintain food self-sufficiency and expand export crops to earn much-needed foreign exchange, countries will need to farm more intensively and increase the amount of land under agriculture. The need to re-examine the trade policies of the majority of Caribbean territories will take on greater importance given the rise in competition for markets as a result of globalization and the simultaneous dismantling of preferential market access arrangements.

Agriculture in the Caribbean is diminishing in terms of both total and per capita agricultural production. Figure 1.2 shows Food and Agriculture Organization (FAO) calculations of per capita agricultural production, especially in the last ten years. Other indicators, such as gross agricultural production (in both dollar value and weight), exports and agricultural employment all show similar declines.

Other things being equal, reduced agricultural production may decrease environmental stresses from erosion, sedimentation, nitrification and pesticide use.

Figure 1.2: Changes in the index of per capita agricultural production: 1963–1998 (net per capita agricultural PIN 89–91)



Source: FAOSTAT, FAO website December 1998

## Forests

The Conservator of Forests in Trinidad in the 1930s stated: 'There will be no forest development, nor preservation of forests, without proper land-use management'. In May 1998, the Expert Meeting on Forest Policies in the Caribbean, held in Port of Spain, came to exactly the same conclusion – and land use management was identified as the key issue for forestry development in the region.

In recent years, tropical deforestation has stimulated interest and debate, stemming in part from the magnitude of the problem facing the region and the role that land-use changes play in biological diversity and climate stability. Caribbean forest cover continues to decline.

Annual deforestation rates in almost all island states vary between 0.8 per cent and 7.2 per cent (FAO 1997). In the fifteen years between 1980 and 1995 the region suffered moderate losses in its total forest cover (Figure 1.3) which is generally regarded as a slowing down of the rapid deforestation of the past. At the inter-regional level, South America and the Caribbean have lost significantly more tropical forest than their Asian, South Pacific and African counterparts, although at a rate slower than that of Asia and the South Pacific (WRI/UNEP/UNDP/WB 1994). At current levels, deforestation is destroying part of the region's biodiversity and soil fertility. On the other hand, the natural resources in some forest zones are not being fully utilized. (It should be noted that generally, when deforestation is analysed in Latin America and the Caribbean, the emphasis is on tropical and sub-tropical moist forests (closed forests) and that tropical and sub-tropical dry forests (open forests) are ignored.)

The main forestry issues for Caribbean island states are deforestation, land tenure, forest conservation and forest policies, and the provision of potable water. Forests play a major role in providing potable water, and continued deforestation will reduce the availability of drinking water. High population densities also lead to an increased need for agricultural land, and as the forests are regarded as land reserves they are often occupied by squatters. Uncertainty of land tenure then leads to unsustainable soil management practices, which lead in turn to an increased need to clear more of the forest. Land use practices and land tenure of agricultural lands are key issues that must be addressed in the preservation and conservation of forests.

Historically, in almost all the countries in the Caribbean, forests have been extensively logged to provide timber for ships, housing and furniture, and



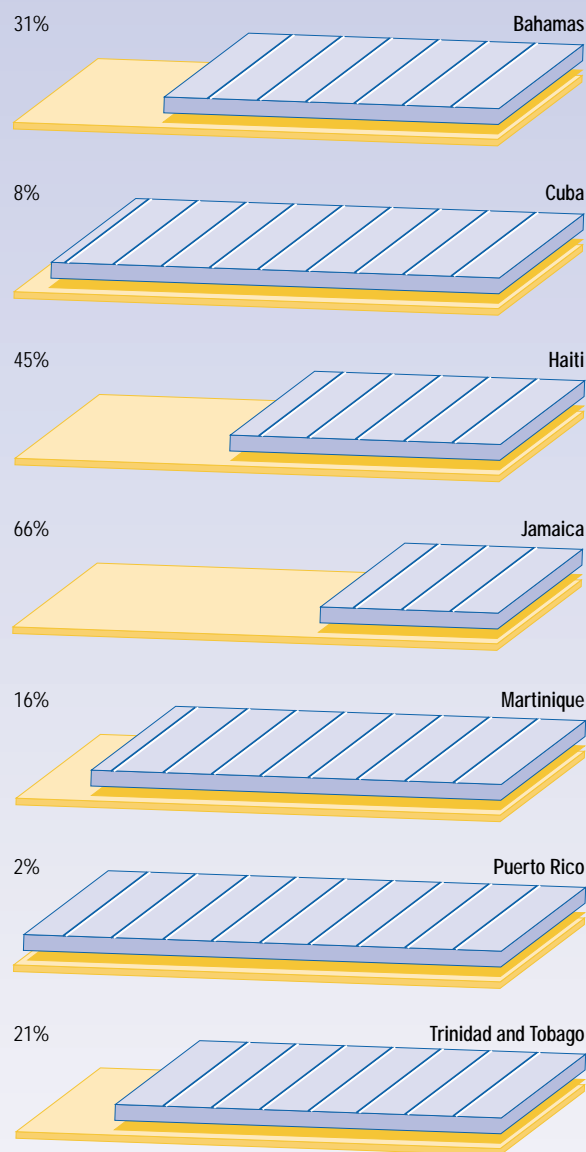
later cleared for sugar and banana plantations and other land-intensive economic development. This has left telltale traces on current forest structure and species composition as most of the forests in the region are secondary forests lacking the rich biological diversity that once existed. Fragmentation has also affected much of the few remaining natural forests (mostly in the Greater Antilles) as in the cases of Cuba, uplands areas of the Dominican Republic, and Dominica. Surviving tropical rain forests exist as fragments in inaccessible, mountainous interior locations. Continuing pressure on marginal forest areas from population growth and development, as well as the inexorable spread of exotic species, put these remaining patches at increasing risk.

There are three important points to bear in mind in examining the data on forest use and forest characteristics in the Caribbean.

- The forest baseline used nowadays has shifted radically from the natural forest cover in pre-colonial days. Most of the smaller and lower islands of the region were covered with a dry mahogany forest which was logged off by the eighteenth century, and which has not been restored anywhere in the region. Experience in reserves such as the Virgin Islands National Park indicate that regeneration of the natural dry mahogany forest may require many centuries.
- The destruction of lowland forest areas on most islands has created small 'islets' of upland forest which may not be sufficiently large to withstand major stresses such as hurricanes and accidental fires. These small upland reserves serve as aquifer recharge sites and habitat for a great diversity of endemic species. Even small reductions in overall forest cover may mask the destruction of key habitats.
- Official statistics on forest cover in the Caribbean are likely to understate the actual extent of deforestation and forest degradation by as much as one-half. This issue has been measured for estimates of forest change in the Amazon: similar conditions affect forest estimates in the Caribbean (Monastersky 1999). The problem arises because remote sensing techniques are not sensitive to indicators of degradation from selective cutting, forest fires and other encroachments on the natural forest.

Some data claim a less pronounced change in forest cover over the past 30 years. For example, the UN FAOSTAT Forest and Woodland database (December

Figure 1.3: Loss of natural forest and woodland in some Caribbean islands: 1980–1995



Sources: Food and Agriculture Organization of the United Nations (FAO), Forest Resources Division, State of the World's Forest 1997; International Tropical Timber Organization (ITTO), Annual Review and Assessment of the World Tropical Timber Situation, 1997.

1998) shows virtually constant forest cover for the period 1961 to 1994. It may be that by combining forests and woodlands in one data set the FAOSTAT data may mask severe degradation in the quality of woodland habitat, as areas move from closed woodlands to scrub through gradual harvesting of forest fringes.

## Biodiversity

Caribbean economies are still based on the extraction or use of renewable natural resources. Changes described at the beginning of this chapter illustrate that the region is moving from the production and sale of primary materials such as sugar, cotton and fruits to the sale of tourism services based on sun, sand and sea.

The small size of the Caribbean islands and their associated ecoregions creates substantial risks for local habitats and the species they feed and shelter. Details of the names, sizes and threat status of the Caribbean's 34 terrestrial ecoregions and 3 marine ecoregions are provided by Dinerstein *et al.* (1995) in *A Conservation Assessment of the Terrestrial Ecoregions of Latin American and the Caribbean*. (See also Table 1.5.)





The biological resources of the Caribbean and their related ecosystems are under great pressure from development activities, and although this situation is similar to that in other regions, there are a number of additional factors that increase the sensitivity of, and threat to, ecosystems in the Caribbean.

- Steep slopes and rapid changes in topography create small, scattered ecosystems.

- Small size of the ecosystems: for example the Windward Island dry forests represent an extremely small ecoregion, estimated at 431 km<sup>2</sup>. Even more remarkable, however, is that this area is actually divided among six or eight islands.
- The concentration of population and activities in small areas (relative to spatial orientation on continental landmasses) intensifies stress conditions.
- There is a high frequency and variety of natural disasters.
- Close coupling of terrestrial, coastal and marine systems results in fast-spreading communication among these systems. Clearing upland areas for farming can result in cloudy water over adjacent reefs within days.

Although relatively impoverished in terms of the absolute number of endemic species, the insular Caribbean displays high levels of biodiversity per unit of land area (Island Resources Foundation 1998). This high productivity in terms of current biodiversity is more remarkable given the high densities of human population in the region and the long history of settlement and resource-intensive development activity. It is undeniable that these pressures result in continuing ecosystem deterioration, such as the deforestation discussed above (FAO Internet site). Two-thirds of the coral reefs in the Caribbean are at risk, and one-third (Bryant *et al.* 1998) are at high risk.

**Table 1.5: Levels of endemism for selected Caribbean countries (for selected taxa)**

	Birds 	Mammals 	Amphibians & reptiles 	Higher plants 
Antigua and Barbuda		0	0	
Bahamas	3	4		
Barbados		0	0	
Cuba	22	15	43+91	3475
Dominica		1	0	
Eastern Caribbean	38	11		68
Guadeloupe/Marie Galante		2	2	
Hispaniola (Haiti/Dominican Republic)	34	3	47	1800
Jamaica	34	5	47	830
Martinique		0	0	
Montserrat		0	5	
Puerto Rico	26	1	42	234
St. Kitts, St. Eustatius and Nevis		0	1	
St. Lucia		0	2	
St. Martin, Anguilla and St. Bartholemy		0	0	
St Vincent and the Grenadines		0	2	

Source: Modified from UNECLAC/CARICOM (1993); Cuba, Govt. of (1998b).

## Fresh water

Fresh water resources available to the Caribbean islands are considerably less than those available to other oceanic island groups. Fresh water resources between 1970 and 1998 were 2 574 m<sup>3</sup> per capita, compared with 19 333 in the Indian Ocean and 149 505 in the South Pacific (World Resources 1998–99 database; data compiled from: Departement Hydrogeologie, Orléans, France; Institute of Geography, USSR National Academy of Sciences, 1997).

While all of the Caribbean islands are in the 'tropics', with respect to water resources the situation is as varied as the countries themselves. Several are very arid (Box 1.1) even though the region is generally considered to be relatively well endowed with precipitation. Aridity is usually present in specific regions or zones of the region's larger countries. The varied geology, topography and size of the islands also influence the availability of water and patterns of water resource development.

### Box 1.1: Barbados among the ten most arid countries of the world

Barbados has been classified by the World Health Organization as being in the top ten most arid countries in the world. As a consequence of this and other factors, including the 1993 and 1994 droughts, the Barbados Water Authority is pursuing the development of a Reverse Osmosis Desalination Plant to provide an additional four million gallons per day of potable water for distribution.

In addition to this, the Water Authority is conducting other measures to address the water problems in the island – including replacement of mains, some of which are over 100 years old, public awareness and education programmes, and the provision of water-saving devices free of charge to customers not in arrears. The structure of the Water Authority is being reviewed with a view to separating the operational and regulatory functions.

National water availabilities have been estimated by the World Resources Institute for a number of countries in the Caribbean (Figure 1.4).

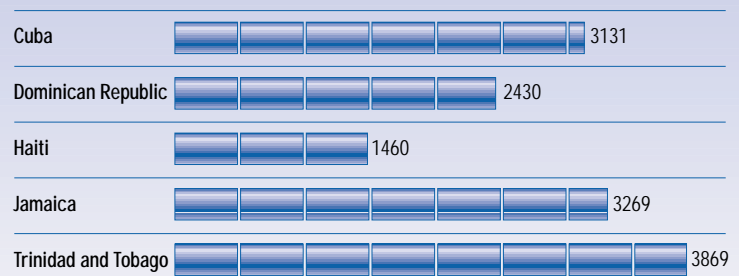
Some of the region's water supply systems date back to the nineteenth century. In Trinidad, the first public water supply system, the Maraval Waterworks, date from the 1850s, utilizing surface water, while Jamaica's first system, utilizing groundwater, dates from 1854, and in Barbados the date is 1850 and the source was a spring. In Cuba, the Albear Aqueduct, built in 1892, still serves some Havana City zones. The first water infrastructure, whether for domestic or agricultural use, was constructed on agricultural plantations, which were very large in some cases. Sugar plantations would also have been the first non-domestic consumers in the region and the forerunners of an industrial water supply. Later industrial fresh water systems were also used for home consumption around the mining, refining and oil and gas production centres, for example in Trinidad.

The growth of the tourism industry in the Caribbean has placed huge demands on the islands' water resources. However, a workshop on 'Water Resources Management in Small Island States', held in Barbados in August 1995, concluded that there were insufficient data to evaluate water resources for most of the Caribbean islands. Only the larger states (Cuba, Trinidad, Barbados and Jamaica) had the equivalent of a functioning Water Resources Agency.

The known facts about fresh water management in the Caribbean highlight a highly stressed environment.

- Many small islands have virtually no fresh water ecosystems (Virgin Islands, Netherlands Antilles, Barbados, etc.).
- Fresh ground water resources in many islands, especially the smaller islands, are being exhausted,

Figure 1.4: Fresh water availability for selected Caribbean countries (m<sup>3</sup> per capita)



Sources: 1970–1998 World Resources Institute; 1980–1998 World Bank.

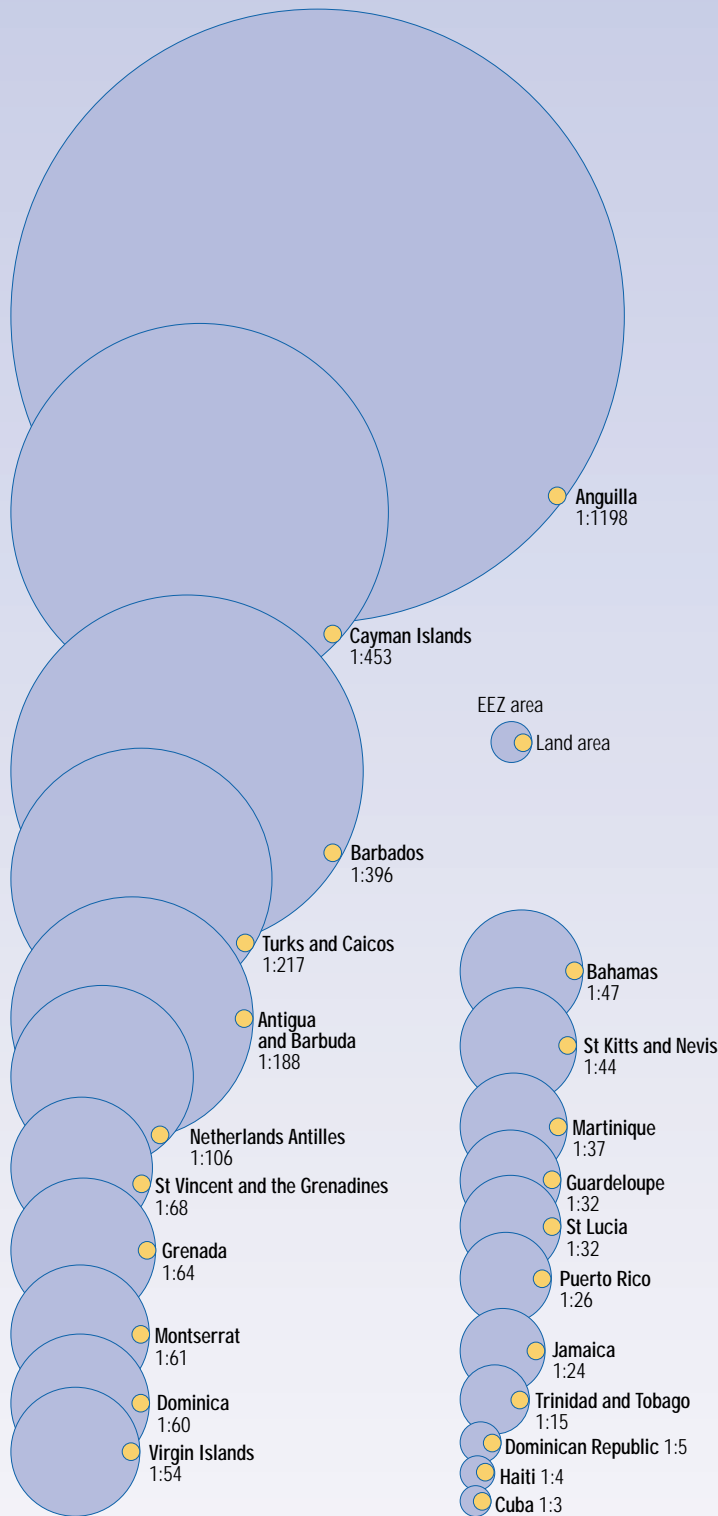
polluted or displaced by salt water intrusions.

- Polluted surface and ground water are major causes of degradation of coastal and near-shore marine ecosystems, including critical salt-pond, mangrove, estuary, sea grass and coral reef systems.
- Due to the lack of investment in the sector, in particular investment in maintenance, most water utilities in the region are unable to account for up to 50 per cent of total production.
- Increasing rates of deforestation are thought to be contributing to severe drought-and-flood cycles in most of the insular Caribbean during the annual dry and wet seasons.
- Tourism is a major consumer of water, with many resorts showing water consumption five or ten times higher than other residential areas.
- Expensive infrastructure such as the Roseau Dam in St. Lucia and a proliferation of desalination plants have been developed to provide fresh water to meet the increasing demands of agriculture, urbanization and tourism.
- Some attempts at agricultural diversification such as fruit and vegetable production require irrigation.
- Water recycling (such as the commercial use of grey water for irrigation) is uncommon.

## Marine and coastal areas

The marine and coastal environments in the Caribbean represent an important natural resource: they provide the region with food and materials for new medicines, protect coastal settlements from storm damage, and generate income from tourism. This coastal ecosystem with its high level of biodiversity is extremely fragile, and therefore vulnerable to human interventions.

Figure 1.5: Water to land area ratios in the Caribbean



Based on a proprietary geographic information system (GIS) calculation of EEZ and island land areas developed by CAPMap for the Island Resources Foundation. Actual EEZ boundaries or areas claimed or being negotiated by any Caribbean island may not bear any relationship to this calculation: land areas are approximate and conditioned by the accuracy of islands depicted by the Digital Chart of the World.

### Marine resources

Figure 1.5 illustrates the importance of the marine environment to the smaller islands of the Caribbean, where the ratio of water to land area exceeds 30:1, and which averages over 200:1 for the quartile of smallest islands of the region. This illustration does not automatically mean that countries at the top of the list should count on marine and coastal environments for over 90 per cent of their GDP, but it should answer the question of why marine issues should be near the top of the development planning agenda.

Stresses in the Caribbean may be occurring at a regional scale in addition to site-specific coastal and marine pollution from nearby watersheds. For example, the 1979 satellite image presented in Figure 1.6 shows regional-level impacts of sediment from Venezuela. While conclusive studies relating these levels of increased opacity to impaired coral growth have not been concluded, it is prudent to assume that such effects are likely, given our knowledge of the light dependence of coral growth and the additional stresses being put on coral as a result of increased temperatures. (See also in the section ‘Climate Change’ below.) This picture of continental-scale sediment movement makes it clear that all the Caribbean countries have a direct and immediate interest in issues such as deforestation, agricultural practices, soil loss and fertilizer and pesticides use occurring hundreds or even thousands of kilometres away.

Figure 1.6: Large-scale sediment flows into the Caribbean



An analysis of chlorophyll in the water column (used as an indicator of sediment load and increased opacity), as seen from a satellite in 1979, shows a large plume of material flowing into the Caribbean from waters adjacent to the South American coast. Although most of this material might be assumed to be from the Orinoco watershed, other analyses have shown apparent sediment movements along the South American coast all the way from the mouth of the Amazon River.

Source: University of South Florida (USF) <http://usfweb.usf.edu/>

### Box 1.2: Integrated coastal zone management and legislation in the anglophone Caribbean

Coastal zone management is assuming increasing importance in the Caribbean. Management systems are being developed to deal with the growing problems of coastal deterioration caused by rapidly expanding levels of beach tourism, urbanization of coastal lands, and coastal sand mining to support the construction industry. Exposure of coastal areas to the risk of maritime oil pollution has also stimulated pollution control legislation.

Traditionally, Caribbean coastal zone management was carried out under a fragmented administrative and legal system. However, in the last ten years there have been significant improvements in management approaches, and today Caribbean countries present multiple management frameworks:

- Independent stand-alone coastal management units, authorized by coastal zone legislation.
- Coastal zone divisions of larger, comprehensive environmental management agencies, established by umbrella legislation regulating coastal resources as a component within an overall environmental strategy.
- Fragmented management systems reflecting piecemeal coastal zone regulation and legislation, arising on an ad hoc basis in response to specific problems.

In every instance, recognition of the vulnerability of the coastal zone to sea level rise, and the requirement for regulation of pollutants that cause climate change, tends to be implied and not expressed.

The existence of improved coastal management practices in some Caribbean countries provides important lessons for the regional management of coastal resources.

*Source:* Caribbean Law Institute Center 1998

In addition to looking ahead to improved, integrated management of the coastal zone, the Caribbean must also address two critical issues:

- 1) the protection and restoration of shallow-water ecosystems, including reefs; and
- 2) the improvement of fisheries management, including that of virtually all harvested species.

The functions of shoreline stabilization, fish nurseries, recreation and flood control provided by the coastal zone are being drastically curtailed by degradation of coastal and near-shore environments. A number of sectors (agriculture, aquaculture, fisheries, forestry, energy, transportation, urbanization, industry and tourism) have operations with potentially high impacts on the coastal and marine environment. Caribbean shorelines provide a logistically convenient location for industrial and commercial activities, and are critical for successful tourism. Coastal environments are subject to the pressures of high population and multiple economic activities across several sectors. Additionally, conflicts among competing user groups are intense in the coastal zone.

#### Shallow-water ecosystems

The Caribbean has 20 000 km<sup>2</sup> of reefs (Figure 1.7), and probably ten times that area in shallow-water systems such as sand banks, sea grass beds and sponge beds at depths of less than 100 metres. A combination of near-shore pollution and offshore over-harvesting places the whole of this vast ecosystem at risk of collapsing. The WRI/ICLARM/WCMC/WB report *Reefs at Risk* (Bryant *et al.* 1998) estimates that two-thirds of the reefs in the region are at medium or high risk. The unexamined side of that conclusion, however, is how much of the adjacent non-coral-reef areas are equally damaged. Harvesting technologies for both fish and

shellfish are in danger of depopulating vast areas of the Caribbean as more fishers use subsidized vessels and equipment to pursue shrinking fisheries resources.

While pollution from outside the Caribbean plays a part, the reality is that most of the pollution problems faced by the Caribbean can be ascribed to local impacts. Satellite images have revealed large amounts of sediment along the southern coast of the island of Cuba, probably as a result of forest removal and agricultural practices, possibly combined with severe rains. Similar pictures could be developed for the coastal areas of most islands in the region if imagery of sufficiently fine resolution was available. Such data, which would permit near real-time monitoring of many elements of coastal pollution for Caribbean islands, may become available when products from the new generations of 1m and 3m resolution satellite sensors become widely available.

The coastal zone contains some of the Caribbean's most productive ecosystems, including seagrass meadows, mangrove swamps and wetlands, all of which have rich biodiversity reserves. The coast also supports the majority of the region's human population and, as elsewhere, is integral to the region's social and economic life. Major population centres, agricultural areas, ports and other major sites for industrial and commercial activity are located in the coastal zone. In addition, tourism is to a great extent concentrated in the coastal areas. Combined, these activities and uses have

Figure 1.7: The reef areas of the Caribbean



Source: Bryant *et al.* (1998)

contributed towards the deteriorating quality of many coastal habitats in the Caribbean.

The costs of rapid population growth, the human disturbance of coastal areas and overexploitation of

marine resources are becoming more and more evident. According to a WRI/ICLARM/WCMC/WB report (Bryant *et al.* 1998), 29 per cent of the region's reefs are considered to be at high risk from human development, 32 per cent are considered to be at medium risk and 37 per cent at low risk. Most reefs off Haiti, the Dominican Republic, Puerto Rico, Dominica and Barbados are under high potential threat. Virtually all the reefs of the Lesser Antilles are at risk. These figures are a matter of concern, especially when combined with the documented degradation of coral reefs throughout the Caribbean.

The *Reefs at Risk* report (Bryant *et al.* 1998) identifies four major threats to reefs:

- sediment and land-based pollution;
- exploitation;
- marine sources of pollution, and
- coastal development.

The progressive degradation of reefs throughout the Caribbean is due to a combination of human and natural causes (Table 1.6), which often compound each other. The massive die-off of the grazing long-spined sea urchin

### Box 1.3: Jamaica's reefs

Jamaica is completely surrounded by reefs, although those of the north coast once contained the most extensive coral cover and are the most diverse. Reefs are an integral part of the Jamaican economy, supporting fishing and tourism, the country's most important industries.

Virtually all reef communities here have been affected by human and natural impacts. Overfishing in particular, and pollution from sewage disposal, industrial effluents and agricultural runoff, siltation due to poor land use practices, and tourism-related activities, have seriously degraded Jamaica's reefs. Storm damage from hurricanes, coral reef bleaching (see also Box 1.6) due to periodic high sea water temperatures, and – with the decline of sea urchins and other algae grazers – the unchecked algal overgrowth of corals, have all compounded the problem. The reefs surrounding Montego Bay are perhaps the most seriously degraded, even though they are protected, in part, by a marine park. The original park, established in 1966, was too small and was completely unmanaged. Although re-established and expanded in 1990, with a financial base and a staff that works closely with town authorities, reefs in the park continue to be affected by poaching, pollution for the nearby city and airport, and runoff from inland agricultural activity.

Source: Bryant *et al.* (1998)

Table 1.6: Summary of threats to coral reefs in the eastern Caribbean states

	Sediments	Exploitation	Marine pollution	Coastal development	Composite threat
Antigua and Barbuda		●		●	●
Barbados	●	●		●	●
Dominica		●			●
Grenada	●	●			●
St. Kitts and Nevis		●		●	●
St. Lucia	●	●	●	●	●
St. Vincent and the Grenadines	●	●		●	●
Trinidad and Tobago	●	●	●	●	●

● = high threat   ● = medium threat

*Diadema antillarum* in 1983 has resulted in dramatic increases in macroalgae, which are smothering coral colonies and reducing coral recruitment and survival. In many areas the sea urchin populations have still not recovered to their pre-1983 levels. The effects of the urchin die-off have, in many locations, been made more severe by added stress from nutrient pollution and overfishing, contributing to a decrease in coral cover (Woodley *et al.* 1998).

Islands with fewer people and little fishing pressure (Bonaire, Cayman, Turks and Caicos, and parts of the Bahamas, for example) have reefs that are in good shape. In these and several other areas the growing economic importance of diving tourism has helped promote awareness of reef conservation. Other areas, such as the north coast of Jamaica, have reefs that show a large amount of damage. Steep-sided islands with reefs on narrow shelves are particularly vulnerable to the heavy runoff of sediments and nutrients that result from the clearing of hillsides due to increased population pressure. Where shelf and reef areas are larger (the south coast of Jamaica, Cayman Islands), reef fish are larger and more abundant, and help prevent algal overgrowth of corals.

Hurricanes are the main source of natural impacts on coral reefs, and their effect is especially severe on shallow and exposed reefs. For example, hurricanes Allen and David (1980), Hugo (1989), Luis and Marilyn (1995) and Georges (1998) had major impacts in the Lesser Antilles, in addition to Hurricane Gilbert (1988) – probably the largest hurricane in the Caribbean in the twentieth century – in Jamaica. Hurricanes often trigger major changes in coral reef ecosystems because chronic human disturbances have altered the natural conditions and prevent normal recovery.

Diseases are another important, apparently natural

factor. White band disease (affecting especially the branching corals such as *Acropora* spp.) has reduced live coral cover on many reefs during the last two decades. Diseases, together with storms, boat groundings, and the direct and indirect effects of pollution have contributed to severe losses in the abundance of the three species of *Acropora* (*Acropora palmata*, *Acropora cervicornis* and the rare *Acropora proliferata*). Dead colonies have been found in locations ranging from relatively pristine reefs in the central-eastern Bahamas, Turks and Caicos Islands and Cuba, to impacted reefs in the Dominican Republic and Jamaica. *Acropora palmata*, once luxuriant, has disappeared from the reefs flats of Barbados since the start of intensive sugar cane cultivation over a century ago, while on the US Virgin Islands reefs, the same species – previously the primary reef builder on many shallow reefs – has been severely affected by white band disease and shows little sign of recovery. New colonies have been destroyed by major storms, along with the other major reef builder, *Montastrea annularis* (Lang *et al.* 1988; Smith, Rogers and Bouchon 1988; Woodley *et al.* 1998).

Several episodes of coral bleaching (see Box 1.6) in the Caribbean have resulted in partial mortality. The most recent event took place during the summer and autumn of 1998. Prior to this, the most notable coral bleaching events occurred in 1983 and 1995. Mass bleaching can happen when sea surface temperatures rise well above the average summer temperatures in an area, stressing the corals. Frequently corals recover from bleaching, but death may result if the stress is extreme or prolonged (Wilkinson 1998).

There are few long-term studies that would help determine the status and trends of coral reef community dynamics in the Caribbean. However,

monitoring programmes for coral reefs and other marine resources have now been put in place in most countries. Some standardized regional or global efforts include ReefCheck, the Caribbean Coastal Marine Productivity Programme (CARICOMP) and the Atlantic and Gulf Rapid Reef Assessment (AGRRA). These programmes – some using volunteers, some trained personnel – monitor the status and health of reef areas and promote sustainable management. CARICOMP is an environmental monitoring programme that includes reefs, seagrass beds and mangroves, as well as some physical measurements, and is implemented at participating stations throughout the Caribbean using common methodology. AGRRA was launched by scientists at the University of Miami in Florida in 1998, to map reef health. ReefCheck is a global monitoring programme with many Caribbean participants, using volunteers to monitor reefs, and has a major goal in raising awareness among the public and governments about the need for coral reef conservation. ReefCheck is sometimes portrayed as a step towards community-based management.

### Fisheries resources

Table 1.7 shows the rise and fall of marine fisheries in the Caribbean between 1975 and 1995. Marine fish harvests peaked at around 280 million tonnes for the region in 1985, and have since dropped to a little over half that level. Detailed figures by type of fishery or type of fish show that this trend is not limited to specific areas or species, but in fact is a general collapse throughout the region.

It should be understood that these fishery data are not presented for their economic and development implications, which are themselves significant, but as indicators of potentially catastrophic damage occurring to the marine and coastal environments of the Caribbean as a result of stress and overfishing.

Knowledge of the status of the stocks being harvested is generally poor, and sustainable levels of fishing harvests are essentially unknown for most species in most areas. There is a prevalent assumption that many stocks are being fully or over-exploited and there is concern for the status of species such as the Nassau grouper (*Epinephelus striatus*) and jewfish (*Epinephelus itajara*), the spiny lobster (*Panulirus argus*) in some regions, and the queen conch (*Strombus gigas*). The greatest need in the region is for improved knowledge of the status and potential productivity of the stocks and of the fisheries harvesting them, in order to put in place

appropriate management action (FAO 1997a).

Depletion of reef fish stocks ranges from relatively small (for example, parts of the Bahamas, Turks and Caicos) to severe (for example Haiti and many areas of the eastern Caribbean). Manatee (*Trichechus manatus*) and jewfish are commercially extinct throughout the Caribbean. The main crustacean fisheries are those for spiny lobster and penaeid shrimps. The spiny lobster fishery is dominated by Cuba and the Bahamas (FAO 1997a). Populations of spiny lobster as well as queen conch, the most important commercially exploited mollusc, are greatly reduced in some areas. Fishing pressure has been so intense in Haiti that many of the edible fish and invertebrates caught by artisanal fisheries are below sexual maturity (Lang *et al.* 1998). Marine turtles are still taken in many countries, both for their meat and for their shells which are used in crafting jewellery and ornaments.

The pelagic fishery includes such large internationally distributed oceanic species as billfishes, tunas and swordfish. Most of these species are assessed by the International Commission for the Conservation of Atlantic Tunas (ICCAT) and are considered to be either fully exploited or over-exploited (FAO 1997a). Using catch per unit effort (CPUE) as a measure of relative abundance, declines in Atlantic yellowfin tuna in the Caribbean were recorded by the Japanese longline fleet around the mid-1960s. These observations have been reinforced by recent stock assessments which indicate an overall decline in Atlantic yellowfin tuna (Singh-Renton 1997).

The status of the stocks of the more common locally distributed large pelagics, such as mackerel (*Scomberomorus* spp.), blackfin tuna and common dolphinfish is unknown. The round sardinella and Atlantic thread herring are generally caught close to the continental mainland, and large islands such as Trinidad and Jamaica. Fisheries for small pelagics on the smaller islands of the Lesser Antilles generally make use of beach seine nets. These fisheries are locally important providers of employment and food. They tend to be based on jacks and scads, such as *Selar crumenophthalmus*, *Decaotyrys* spp. and halfbeaks (*Hemiramphus* spp.). The flying fish (*Hirundichthys affinis*) makes up only a small portion of landings of small pelagics, but is important in the south-eastern Caribbean states (FAO 1997a).

### Marine and coastal summary

In addition to overfishing, the loss of important coastal



**Table 1.7: Caribbean marine fish catch by country (thousand tonnes per year)**

	1975	1980	1985	1990	1995
Antigua and Barbuda	1 601	1 171	2 407	2 200	2 400
Bahamas	2 772	4 997	7 589	7 492	9 636
Barbados	4 412	3 735	3 915	2 967	3 284
British Virgin Islands	318	670	1 148	1 377	1 300
Cayman Islands		1 391	396	837	625
Dominica	1 001	1 445	640	448	797
Dominican Republic	5 243	8 032	15 721	18 240	16 542
Grenada	1 700	1 419	1 731	1 784	2 093
Guadeloupe	4 740	8 000	8 421	8 642	7 990
Haiti	3 700	4 700	6 100	4 800	5 000
Jamaica	10 100	9 000	9 438	7 912	9 847
Martinique	3 631	4 842	4 559	3 474	5 292
Montserrat	89	109	110	150	110
Netherlands Antilles	887	1 090	030	1 200	1 200
Puerto Rico	2 264	2 557	1 496	1 949	2 516
Saint Kitts and Nevis	1 218	1 935	1 595	1 720	1 700
Saint Lucia	2 000	969	1 052	927	1 114
Trinidad and Tobago	4 417	4 461	5 509	8419	13 000
Turks and Caicos Islands	1 132	1 190	1 349	941	1 459
United States Virgin Islands	503	669	607	684	890

Sources: Food and Agriculture Organization of the United Nations (FAO); FISHSTAT 97.

nursery areas such as mangroves and seagrass beds may have contributed to the decline in stocks. The status of the region's seagrasses is not well known. Mangrove swamps are often regarded as marginal land and are being systematically degraded and destroyed as land is cleared for human settlements, or for the creation of beaches for tourism purposes. Mangroves and coastal wetlands are also frequently used as sites for landfills and the dumping of garbage, further degrading these important habitats. The decline of coral reefs, detailed above, has implications for reef fisheries. The successful management of marine and coastal resources of the Caribbean requires a solid understanding of how ecosystems function. Incorporated in this understanding is knowledge of the distribution of habitats and of the species that inhabit them. The interaction of species and their responses to the activities of man are of great importance for coastal resource management. The conservation of a particular resource requires a comprehensive, integrated framework for policy, planning and management.

The current state and importance of the marine and coastal environment demands action, and because of the dynamism of much of that environment, action will require international agreement and co-operation.

Tentative beginnings of such activities are seen in regional investigations of stocks such as conch and lobster, and in the growing pressure to do something about the disappearing pelagic and wide-ranging species which are important for commercial, recreational and tourist fishers. In order for these regional efforts to be successful, however, Caribbean governments themselves must be empowered and encouraged to design, monitor and assess progress in coastal and marine activities.

## Atmosphere

Caribbean countries are mainly small islands with limited mineral resources and small populations. This combination limits industrial development, energy use and the size of urban centres – all major sources of air pollution. Exceptions are mineral extraction in the Dominican Republic (ferromanganese, gold, silver, nickel and gypsum); Jamaica (bauxite, limestone and gypsum); Trinidad and Tobago (oil and gas); and Cuba (nickel, copper, limestone, oil and gas, among others).

Air quality is not generally the highest environmental concern in the Caribbean but increased urban growth and industrialization particularly in the

Dominican Republic, Cuba, Jamaica and Trinidad will demand increased attention be paid to air quality (Figure 1.8). Infrastructure for monitoring is lacking, as are regulations, although plans are in place to remedy this in the three countries with the most serious air pollution concerns. Failure to curb emissions from mobile sources in urban areas (including the elimination of lead from gasoline) and also from industrial sources will add to health-related costs as adverse health effects from air pollution take their toll. Measures such as the elimination of leaded gasoline, introduction of motor vehicle emission standards and inspection and maintenance programmes, and industrial emission control programmes are required in these countries.

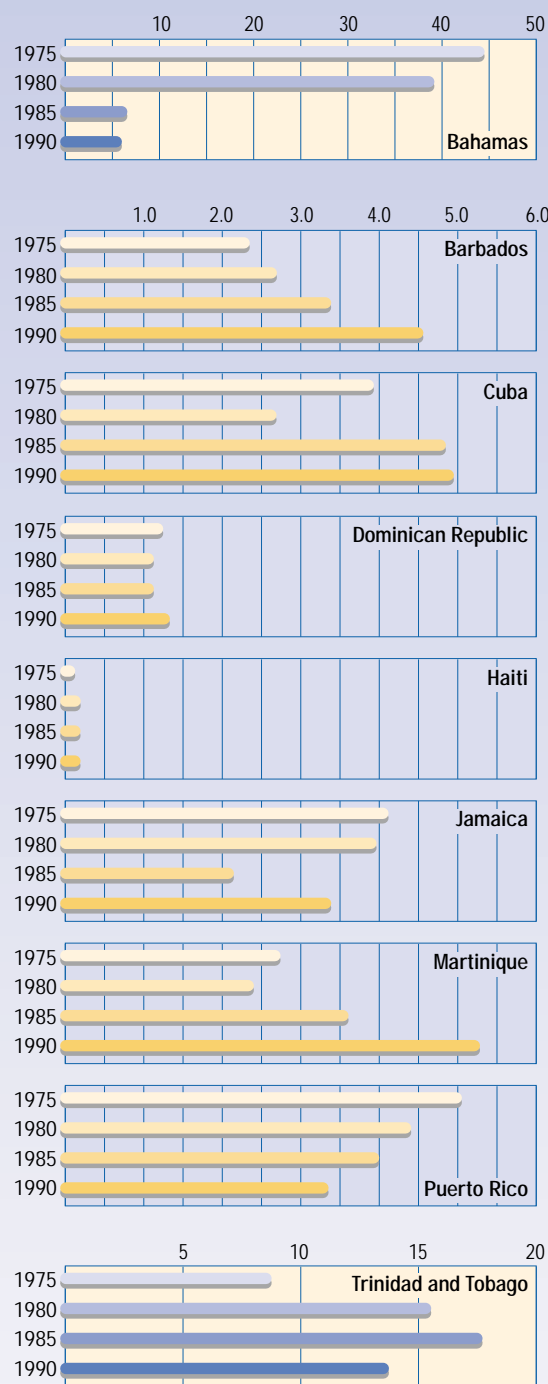
The following are the main contributors to poor air quality in the Caribbean:

- inadequate vehicle emissions controls, exacerbated by a recent influx of foreign used vehicles with inadequate emission devices;
- industrial activity;
- inefficient energy use;
- high density settlements and urban areas;
- pesticide residues from spraying in rural agricultural communities, and
- particulates from soil erosion and sugar cane burning.

Motor vehicles are a major contributor to air pollutant emissions in the region, and the number of vehicles is likely to increase with rising incomes. The contribution of motor vehicle emissions to air pollution in urban areas is evident in Jamaica, where the fleet has doubled in the past five years (PJC 1998) and where topographic features exacerbate the problem, and in Port of Spain, Trinidad, where there has been an increase of roughly 18 per cent in the vehicle fleet since 1993. The large populations in Santo Domingo and Havana, the continued use of leaded gasoline, and an apparently older motor vehicle fleet can be expected to result in higher than desired airborne emissions from mobile sources in these Caribbean cities.

Since the mid-1990s the mining industry (for nickel, gold and silver) in the Dominican Republic has increased production in response to world prices and new technology. Emissions from mining operations are due primarily to fuel combustion for electrical power generation and process energy requirements. Environmental management in the mining sector is

Figure 1.8: CO<sub>2</sub> emissions per capita (in tonnes) for selected countries



Source: Carbon Dioxide Information Analysis Center (CDIAC), Environmental Sciences Division, Oak Ridge National Laboratory, '1995 Estimates of CO<sub>2</sub> Emissions from Fossil Fuel Burning and Cement Manufacturing based on the United Nations Energy Statistics and the US Geological Survey Cement Manufacturing Data'.

Note: Based on petroleum consumption, these data are driven largely by the operation of oil refineries in the region: note the precipitous decline in Bahamas emissions between 1980 and 1985, corresponding to the closure of the distillation refineries on Grand Bahama Island.

limited to ongoing implementation of ISO 14000-based environmental management systems. There is rudimentary ambient air quality monitoring (sulphation plates) in the vicinity of the nickel facility, but there are no national ambient air quality standards.

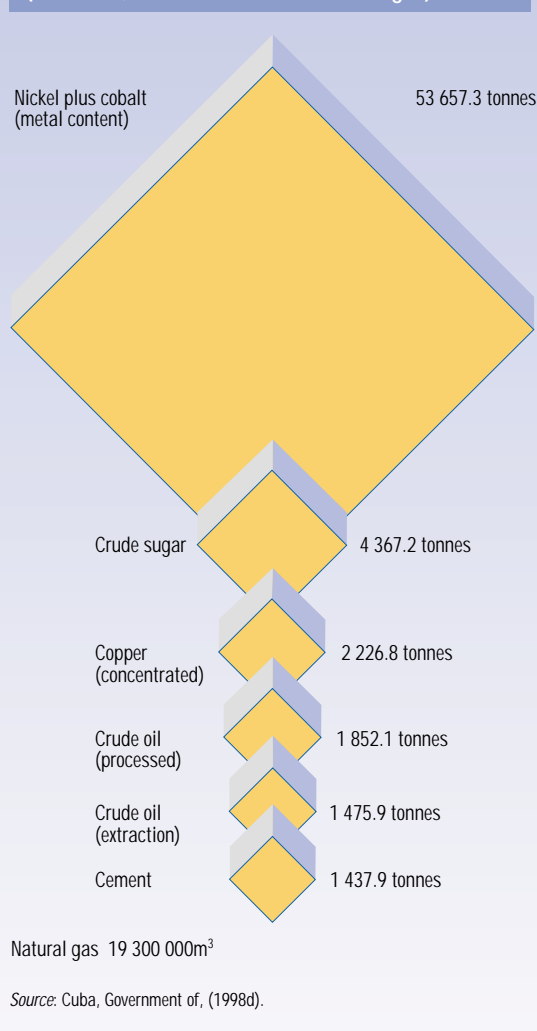
Cuba's industrial sector shows a relatively high development of those industries most often associated with air pollution. Figure 1.9 lists several of the main indicators of such activity.

Jamaica's industrial air pollution derives mainly from the country's mineral industries (bauxite–alumina, lime, gypsum, cement and glass manufacture); petroleum refining; sulphuric acid manufacture and oil-fired electricity generation. The bauxite–alumina industry started in the 1950s and five plants were built by the 1960s. Expansions of the bauxite industrial plant in the late 1990s and further planned plant expansions and construction of a new plant will increase production over the next decade. The main industrial airborne emissions in Jamaica are sulphur and nitrogen oxides from fuel combustion and particulate matter from kiln operations and from mining and shipping operations. In advance of air quality regulations, which are currently being developed, several companies are at varying stages of implementing ISO14000-based environmental management systems and some facilities have been conducting ambient air quality monitoring.

Electrical generation in the larger islands is based on burning heavy fuel oil, with the exception of Trinidad, which uses natural gas, and the OECS, which relies mainly on diesel. Generating capacity has remained relatively flat in the past decade in keeping with the general lack of industrial growth and significant improvements in the operating efficiency of major energy systems. The electricity-generating sector is a significant source of airborne emissions in most Caribbean countries. There are planned increases in electricity generating capacity in most countries of the region to meet increased demand. Cuba, with 9 989.6 gigawatt hours in 1980 grew to 13 235.8 GWh in 1996 (Cuba, Government of, 1998d).

Ambient air quality monitoring in the Caribbean has been limited. The US dependencies have well-established ambient air monitoring programmes for particulate matter, sulphur dioxide and carbon monoxide, and recently also for nitrogen oxides and ozone in Puerto Rico and for particulate matter and sulphur dioxide in the US Virgin Islands. Cuba also has its own national programme. Routine monitoring in other islands is

Figure 1.9: Major industrial outputs in Cuba (in tonnes, and million m<sup>3</sup> for natural gas)



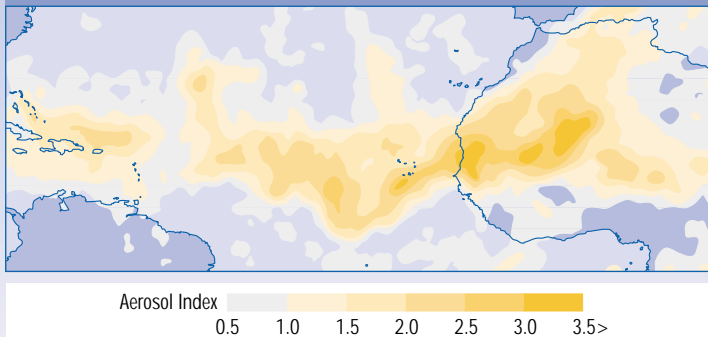
limited to stations near industrial sources such as:

- some alumina plants and power stations in Jamaica;
- some industrial facilities in the Dominican Republic, and
- some industrial facilities in Trinidad.

There is also periodic monitoring in support of environmental impact assessments (EIAs) in Jamaica and Trinidad.

Air pollutant emission inventories have been compiled only in Puerto Rico and the US Virgin Islands, while preliminary compilations of emissions have been made in Trinidad. Improvement to the process of emissions monitoring and control is receiving support through the implementation of GEF-funded UN Framework Convention on Climate Change National

Figure 1.10: Aerosol plume stretching from the Sahel to the Caribbean (based on a TOMS satellite image, taken on 1 July 1998)



On four successive days in 1998, a United States National Oceanic and Atmospheric Administration analysis of high-altitude aerosols captured a sequence of images showing dust from the Sahara being lofted across the southern North Atlantic to arrive in the Caribbean and beyond. The presence of North African sand in Caribbean sediments has been noted since the 1880s, and in recent years it has been suggested as a possible mechanism for the direct dispersal of pesticide pollution, fertilization and possibly disease from Africa to the Caribbean.

Communications Strategies. Eleven countries to date have accessed approximately US\$2.2 million.

Per-capita energy use in Caribbean countries is low in comparison to that in developed countries, and the low population also means low emissions of greenhouse gases. Further industrial development will lead to increased energy use and emissions unless extraordinary efforts are made to employ the best available emissions control technologies or non-emitting renewable energy technologies. Further implementation of energy efficiency programmes and development of renewable energy sources will slow the rate at which Caribbean countries contribute to toxic and greenhouse gas emissions.

On a regional scale, there is also evidence of transcontinental dispersal of particulates from Africa to the Caribbean, which can impair visibility and result in substantial deposits of dust in some seasons (Figure 1.10). In 1997, large numbers of locusts rained down on the Eastern Caribbean, provoking much comment but no other known effect.

### The urban environment

In 1950 only 35.4 per cent of the population of the Caribbean lived in urban areas. In 1970 the figure had risen to 47.4 per cent, and the portion classified as urban in 1995 had increased further to 62.4 per cent. There are, however, marked regional variations in the level of urbanization, with Antigua and Barbuda, Haiti and Montserrat having less than 40 per cent of their populations so classified, while more than 80 per cent of the populations of the Bahamas, Cayman Islands,

Guadeloupe and Martinique fell within this category in 1995. Data on national urbanization rates are presented in Table 1.3. In 2010 it is expected that 69 per cent of the overall population of the region will reside in urban areas, while Cuba will have joined the ranks of countries having more than 80 per cent of its population urbanized.

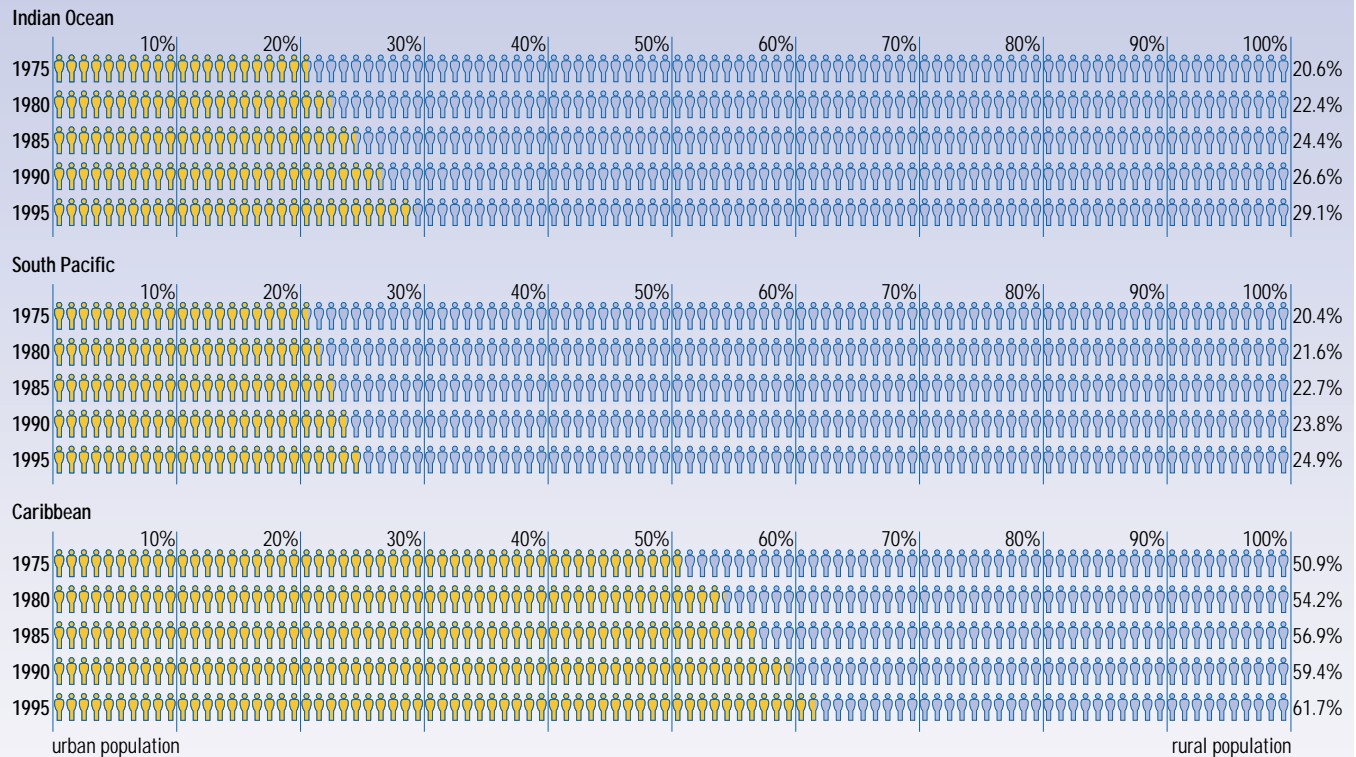
Urban growth rates were highest during the 1960s when overall population growth rates were also at their highest for the post World War II period. Since 1970 there has been an attenuation of overall growth – estimated rates being 1.31 per cent between 1990 and 1995, compared with 1.84 per cent from 1965 to 1970. The region's population is projected to grow at the rate of 1.21 per cent between 1995 and 2000, and at 1.12 per cent between 2005 and 2010. Similarly, although the rate of growth of the urban population has been decreasing and is projected to continue in this trend, it has grown and is expected to continue to grow at a faster rate than overall population.

The Caribbean is distinctive among global island groups because of the high rate of urbanization (Figure 1.11). As discussed above, urbanization can cause major pressures on the environment, with the potential of adding to general environmental problems of land use, marine and coastal deterioration, air quality, water use and pollution, and solid and hazardous waste management. On the other hand, except in the largest cities of the Greater Antilles the urban environments of the Caribbean are not perceived to represent severe environmental degradation: the urban environment is not demonstrably deteriorating in general, and is noticeably improving in specific instances such as San Juan.

Because urbanization and urban planning are not seen as critical issues, the result has been inefficient utilization of urban lands culminating in the unnecessary loss of valuable lands which could be used for other high priority environmental and social values, ranging from watershed protection and the preservation of biodiversity to preferred sites for recreational opportunities. Land areas that could be easily developed have long since been built upon, and the continued growth of population has meant that environmentally unsuitable and hazard-prone areas such as mountainsides and flood plains are increasingly being used for settlements.

Throughout the Caribbean, wetlands have been reclaimed for, or indirectly impacted by, residential, industrial, tourism and other forms of urban or built development. The coastal and marine environment is further stressed by runoff of pollutants from

Figure 1.11: Urbanization rates in global island groups



Source: United Nations Population Division, Annual Population 1950-2050, Median Estimate; FAOSTAT; FAO (1996 Revision)

impermeable surfaces in built-up areas, while heavy pollutant loads of industrial effluent are carried in urban waste water. Development pressures can be expected to intensify with the growth of urban areas, as housing developments continue to be sited in sensitive areas such as steep hill slopes, and on groundwater aquifers.

Lack of planning and lax enforcement of planning controls also result in a potentially dangerous juxtaposition of industrial and residential activity. This places residents at risk from discharges of harmful emissions and effluents. Throughout the Caribbean, small motor vehicle garages ('shade tree mechanics') proliferate within residential areas, undertaking a variety of operations (even including spray painting) that release heavy loads of waste oils, fuel, solvents and other toxic substances into the atmosphere, and often into groundwater and surface water runoff, on a regular and recurrent basis. Cast-off parts and auto chassis litter the landscape. Other manufacturing activities undertaken in the region include the bauxite and alumina industries of Guyana and Jamaica and the heavy petrochemical and steel industries located in Trinidad and Tobago (see also Box 1.4).

Another effect of lax enforcement of laws and regulations is the unsatisfactory quality of the built environment in many areas. The squatter settlements that proliferate in many urban areas are characterized by substandard housing and inadequate infrastructure. Many are situated in close proximity to noxious industrial operations and solid waste dumps, exposing residents to potentially dangerous substances. Residents subsist in unhealthy conditions without basic water, waste and sewage disposal services, increasing the susceptibility of large portions of the urban population to debilitating diseases.

The potential for air quality degradation is heightened since all countries in the region continue to utilize high-impact fossil fuels, including petroleum, for transportation and for electricity generation.

The conclusion is that within the diversity of the Caribbean, there are at least three different environmental management strategies that need to be developed, depending on local conditions:

- urban and regional planning and redevelopment strategies for the larger cities on the larger islands of the region;

**Box 1.4: Urban Trinidad: a typical case**

In Trinidad and Tobago, almost all of the wetlands in the heavily populated north-west of Trinidad have been lost to housing and industrial development over the past two decades

- Environmental 'hot spots' on the Gulf Coast of Trinidad are due in the main to chronic pollution from industrial sources.
- Hydrocarbon pollution 'hot spots' are related to the discharge of contaminated effluents from several major industrial and manufacturing plants as well as from (non-urban) sugar factories.
- The waters in the Gulf Coast are also affected by thermal pollution caused by the discharge of waste heat from plants at Point Lisas and Port of Spain.
- Sewage effluents and waste from cesspools and improperly operated septic systems result in high faecal coliform rates, and contribute to human health problems and fish mortalities.
- The combined effects of these chronic pollutants has led to the destruction of mangrove stands, seagrass beds and fish nurseries.
- Built development in areas such as Diego Martin and Maraval have resulted in reduced rates of groundwater recharge.
- Aquifers along the foothills of the Northern Range have been almost completely built out. Thus, while the demand for water has been continuously increasing, sources of the commodity have been shrinking, and this continues to impact the ability of the authorities to provide potable water and water for sanitation.
- Residents in proximity to the Point Lisas Industrial Estate in Trinidad live in continuous fear of major accidental releases of toxic substances or explosions from the petrochemical industries on the estate.
- According to the EMA (1996) it is estimated that 20 per cent of the population of Trinidad and Tobago lived in irregular settlements in 1985, and that this had increased to 25 per cent in 1990.
- High car ownership rates (approximately one vehicle for every six persons) and intense industrial activity have resulted in high levels of toxic chemicals in the air, exacerbated by the continued use of leaded fuel.
- Studies conducted at busy intersections and roadways in Trinidad and Tobago reveal that the recommended long-term exposure limits for CO and SO<sub>2</sub> are exceeded during rush hours. The residents of densely populated areas within the impact range of heavily trafficked arterial roads are considered to be at some risk (EMA 1996).

A study conducted in Trinidad and Tobago (Rajkumar 1995) showed manufacturing and transportation (mostly in urban areas) to be major sources of pollution, together accounting for around 71 per cent of the total air pollution load. Manufacturing generated extremely high loads of CO, total suspended solids (TSP), SO<sub>2</sub>, ammonia and chlorine. Transportation yielded high loads of nitrogen oxides, CO, volatile organic carbons (VOCs), lead (from combustion of leaded gasoline), black smoke, and SO<sub>2</sub> emissions. Forest fires and burning of sugar cane also made significant contributions to the TSP, CO and VOC loading. Lead smelting and battery manufacturing were found to be responsible for harmful levels of lead emissions.

Industrial activity is undertaken largely without air emission control mechanisms. There are no systematic programmes for monitoring and regulating either the transportation sector or the industrial sector, and no effective on-going inspection and maintenance programmes (Rajkumar).

- waterfront and coastal redevelopment (especially in association with ports projects) to preserve and restore both natural and amenity values of urban areas in intermediate size islands; and
- a range of policies and practices, including financial incentives, to promote concentration or clustering of habitation patterns for settlements and new developments.

**Table 1.8: Commercial energy consumption (gigajoules per capita)**

(Gigajoules per Capita)	1975	1980	1985	1990	1995
Bahamas	243.76	161.47	-32.69	105.88	86.02
Barbados	30.74	37.01	40.22	50.58	49.81
Cuba	37.07	41.25	40.07	40.74	34.48
Dominican Republic	15.76	14.34	12.29	17.72	20.71
Haiti	1.23	1.78	1.72	2.01	1.26
Jamaica	54.54	53.09	29.62	43.96	50.24
Martinique	0.00	29.53	46.10	63.89	63.16
Puerto Rico	0.00	82.18	75.87	70.01	77.28
Trinidad and Tobago	105.15	190.75	197.02	199.03	219.89
<b>Caribbean</b>	<b>26.94</b>	<b>40.31</b>	<b>35.58</b>	<b>38.25</b>	<b>38.00</b>

Sources: World Resources Institute (World Resources 1998-99 database); (United Nations Energy Statistics Yearbook (of the United Nations Statistical Division). Energy data are compiled by UNSTAT, primarily from responses to questionnaires sent to national governments, supplemented by official national statistical publications and by data from intergovernmental organizations.

**Energy**

Energy resources are among the issues highlighted as especially significant in the Programme of Action of the Small Island Developing States (Barbados, 1994), within the context of sustainable development.

Per capita commercial energy consumption in the Caribbean is three or four times greater than in the island states of the Indian Ocean or the South Pacific. Reasons for this difference are not altogether clear, but three possibilities are suggested as first-order hypotheses for further investigation:

- higher median incomes, and higher numbers of upper income residents, substantially increase

**Table 1.9: Solar applications in the Caribbean (number of installations)**

(number of installations)	
Solar dryers	114
Solar units	120
Solar water heaters	45 000
Photovoltaics	Widespread – used primarily in communications and security lighting

residential and commercial energy consumption for air conditioning;

- the Caribbean has many large oil refineries, which are extremely energy-intensive, and
- energy-intensive physical infrastructure (including generating equipment) in the Caribbean may be older and less efficient than similar equipment in the other two regions.

A major barrier to increasing the use of renewable energy resources in the Caribbean is the large investment that has already been made in the various fossil fuels, in their processing, and in the equipment installed to use them. Thus, a shift from current patterns of energy provision and use will have to overcome the barriers and inertia that exist from these patterns of prior use (Table 1.8).

Renewable energy technologies that are most likely to be feasible in the islands of the Caribbean include hydropower in some of the larger and wetter islands; modern biomass conversion technologies; wind energy systems; active (thermal and photovoltaic) and passive (low energy architecture) solar energy systems (Table 1.9); ocean thermal energy conversion (OTEC); wave energy and geothermal energy. Some of these technologies, such as large hydropower and modern biomass energy systems, can have adverse environmental impacts. Biomass conversion, for example, is a potential threat to biodiversity because it replaces natural forests by monoculture energy forests. Also, there is risk of competing for agricultural land and the need for maintaining and improving soil quality in biomass production. Also many renewable active solar and wind energy systems are land-intensive, which may raise costs to unacceptable levels in tourism-intensive islands.

Coal, oil and gas are still the cheapest fuels. Wind power is now close in cost to oil, but it is site specific and requires a certain critical mass of installations for

affordable maintenance. Active solar power systems now make economic sense only in remote areas where extending the electricity grid would be expensive.

## Management of wastes

The management of wastes throughout the Caribbean is largely unsatisfactory, notwithstanding significant strides made over the past two decades to improve the situation. Systems for the storage, collection, transportation, processing, recovery and disposal of wastes have not kept pace with the increasing demand for these services. The impacts on the terrestrial, coastal and marine environment, biodiversity and human health, have been severe. Inadequate institutional arrangements, ineffective legislation, lack of monitoring of effluents and emissions, and failure of enforcement mechanisms relating to the management of waste characterize almost all countries in the region.

### Solid waste

Factors that are responsible for significant increases in the production of urban solid waste include:

- increased population;
- increased per capita incomes;
- changing patterns of personal and household consumption, and
- rapid development of the tourism and industrial sectors.

Three decades ago, the daily per capita generation of waste in the Caribbean was approximately 500 grams per person. In 1996 it was estimated to be between 500 and 1 000 grams (PAHO/WHO 1996). In 1994 the volume of waste disposed of at the major landfills in Trinidad and Tobago was 44 per cent above the 1979 figure whereas population increased by 30 per cent over the same period (Goddard 1997). In addition to locally generated waste, the increasing popularity of the Caribbean as a destination for cruise ships and yachts has led to an increase in the volume of waste at ports.

Most environmental observers believe solid waste management is among the highest priority environmental problems facing the smaller islands of the Caribbean (Towle 1991). Although studies have been done on solid waste management in several Caribbean countries, such reports have seldom addressed the problem in a comprehensive or financially realistic manner, lacking implementation

schedules or funding strategies (except the World Bank-funded OECS ship-generated waste project).

Solid waste management is a problem because it is a moving target: the quality and composition of the waste stream has altered significantly over the past two decades while at the same time quantities have nearly doubled. Solid waste has changed from the dense and almost completely organic waste associated with agricultural economies to the less biodegradable waste produced in industrialized economies. Larger proportions of plastics, aluminium, paper and cardboard packing cases are being utilized and disposed of by households and businesses. In Trinidad and Tobago the level of organic waste fell from 44 per cent in 1980 to 27 per cent in 1994, while plastic waste increased from 4 per cent to 20 per cent over the same period (Goddard 1997). There is, in addition, a growing percentage of toxic and hazardous material in the waste stream of all countries.

The lack of recycling and re-use initiatives (many of which are not feasible because of transportation and scale problems) and the failure to minimize waste generation have meant that increasingly larger volumes of waste need to be collected and disposed of throughout the region.

Anti-litter campaigns undertaken in almost all states have been largely ineffective because of lack of enforcement of Litter Acts. The littering of streets and other public places is therefore a common phenomenon in the Caribbean, and directly impacts tourism marketing.

Among the most common items collected during beach clean-up exercises throughout the Caribbean are plastic materials that end up in the marine environment with devastating effect on marine life. The deficiencies in collection services contribute to the breeding of vectors, produce offensive odours, and result in an unaesthetic landscape. Refuse burning was a traditional solution to the solid waste disposal problem, but it is now precluded by the density at which development has taken place, the change in the composition of the waste, and concerns for atmospheric pollution.

Even where solid waste collection services have been improved, less attention has been given to the questions of waste disposal, including the following issues:

- the predominant method of disposal in the region is crude dumping and unsanitary landfilling;
- most of the existing dumps and landfills were sited without the necessary prior hydro-geological investigations;
- drains, rivers, streams, wetlands, alleys and land depressions are all used as waste depositories;
- many informal dump sites are unauthorized and were created in response to excess demand for waste disposal facilities;
- the absence of toxic waste disposal facilities in the region encourages the dumping of such wastes in dumps and landfills, and
- lower-income areas and squatter settlements whose residents are unable to pay for collection services are particularly affected.

Consequently, a heavy toll is exacted upon surface and groundwater sources, rivers, and the marine environment, particularly where the distance from receiving water is inadequate to attenuate contaminants. Public health, especially of low income urban residents, is compromised. Valuable mangroves, salt ponds and marine and fresh water wetlands are among the ecosystems that have been especially degraded as a result of these practices.

Environmentally sound disposal methods such as sanitary landfilling and composting are not practised on any significant scale in the region. Incineration is limited to a small number of general sites, and to hazardous medical waste in several islands. The insular Caribbean, and in particular the smaller units such as the Bahamian Family Islands, the Virgin Islands and the Grenadines, are plagued with the difficulty of locating suitable landfill sites. In densely populated areas it is extremely difficult to locate sites that are environmentally, socially and politically acceptable.

The management of biotic waste from the agricultural sector (including poultry and livestock operations) such as agricultural chemicals, manure and carcasses is much neglected. Problems are also experienced with the collection and disposal of large items such as derelict vehicles, household appliances and furniture, which commonly end up in watercourses and wetlands.

While improvements have taken place in solid waste management throughout the insular Caribbean over the past two decades, in spite of the major increases in the total volume of waste generated by modern society, there still is not enough consistent reporting and monitoring to document the changes that are occurring.

### Liquid waste

Disposal of domestic sewage is a serious problem throughout the Caribbean. Raw or partially treated human and animal waste is routinely deposited into watercourses in many areas. In Aruba, the pollution of groundwater by sewage effluent is one of the factors that has necessitated



the use of expensive desalinated water (Archer 1988).

In 1991, only 10 per cent of the population of the Caribbean was served by a centralized sewer system (Vlugman 1992). This statistic will have increased in the more recent past with the implementation or extension of municipal sewerage systems in the major urban areas of a number of countries. Pit latrines were the main faecal waste disposal system utilized in the Caribbean up to the 1980s, and they are still the main method in use along with pail closets in rural areas, particularly where running water is not available. Individual septic tanks and soakaways serve much of the remainder of the population.

Packaged sewerage treatment plants accompanied the advent of planned residential developments, resorts and industrial estates in the 1960s, but because the systems are usually poorly maintained they tend to malfunction or become altogether non-operational and consequently deliver raw sewage into ground and surface water. Hotel plants are known to discharge untreated sewage into inshore waters throughout the region (often from inoperative treatment plants), with destructive effects on coastal wetlands, coral reefs and seagrass beds. In 1991, approximately 13 per cent of 138 plants surveyed in the eastern Caribbean were found to be non-functional. Twenty-five per cent were considered to be efficiently operated, while 36 per cent were operated only moderately and 22 per cent were operated poorly (Vlugman 1992). Adopted effluent quality criteria were not being met by 75 per cent of the plants surveyed by Vlugman in 1992.

Pollution of land and water by sewage is a major public health hazard in several Caribbean islands, where low absorbability sub-soil conditions and high groundwater conditions prevail. In densely developed coastal areas such as Kingstown in St. Vincent and Basseterre in St. Kitts, the height of the water table limits the absorptive capacity of the soil and heightens the risk of sewage pollution of coastal waters during large-volume discharges. In a number of islands, outfall pipes have been damaged or destroyed by hurricanes and rough seas, and as a consequence pipes discharge raw sewage onto beaches and inshore marine areas (Archer 1988).

The problem of faecal contamination from land-based sources is compounded when yachts discharge raw sewage into the water. This is a particular concern where coral reef systems are involved. Reef and beach ecosystems in southern St. Vincent and south-western Tobago are under stress from the discharge of liquid waste from the adjacent land areas and from yachts.

Some have even been destroyed. In some locations the degradation of protective reef systems by sewage-induced eutrophication is contributing to coastal erosion and the destruction of beaches. There are few sewage pump-out stations for yachts in the Caribbean.

The past two decades have seen the increasing industrialization of some states. Paint manufacturers, food processors, metal works, petrochemical industries and battery manufacturers all generate toxic and hazardous solid and liquid wastes in increasing quantities. Facilities for the safe treatment and disposal of these wastes are severely limited. Waste is frequently stored on factory sites or vacant lots, disposed of in municipal dumps, or discharged into rivers with little or no treatment. Inappropriate handling of lead wastes has caused the contamination of numerous sites and resulted in cases of acute lead poisoning in children in Jamaica and in Trinidad and Tobago.

Surface waters are routinely utilized as receptors of untreated process waste effluent. Only 39 per cent of 140 small industries surveyed in 1995 (UNDP/CARICOM Regional Sewage Disposal Project) undertook some degree of wastewater treatment. Approximately 64 per cent of the total wastewater was discharged into the coastal zone, sea, or surface water; 25 per cent was discharged into the ground (including soakaway systems); 6 per cent was released into public sewers, and 4 per cent was utilized for crop irrigation (Sammy *et al.* 1995). These disposal practices were linked to unpleasant smells, water discoloration and reduced fish catches, and imposed health risks on users.

Many proposals for solutions have been adopted by Caribbean governments, but have not then been implemented. One example is the Policies and Strategies for Port Reception Facilities for waste generated by small ships and vessels adopted in Port of Spain by Caribbean governments in 1996.

### Natural and man-made disasters

The distinctive geological feature of the Caribbean is the Caribbean Plate, which underlies most of the Caribbean Sea (Figure 1.12). The movement of this plate relative to the surrounding crustal plates creates a halo of earthquakes and other tectonic activities which reveal the shape of the plate and the geological processes occurring around its periphery. Stresses along the eastern part of the northern boundary of the Caribbean Plate have caused uplift and subsidence,

Figure 1.12: Caribbean tectonic plate



Source: from Dillon *et al.* (1998)

including the sediment blocks seen at Mona Island between Hispaniola and Puerto Rico and the karst formations along the north coast of Puerto Rico. The volcanic activity of the islands of the eastern Caribbean is caused by subducting Caribbean Plate material melting to form magma which then folds back on itself and wells up through the volcanic islands of the zone (Dillon *et al.* 1988). The environmental effect of all of this seismic and tectonic activity is to create a relatively high risk of earthquake, volcanic and tsunamic activity throughout the insular Caribbean, on top of the already abundant risk of hurricanes and floods.

Disasters are so frequent and so all-encompassing that they are one of the main causes of environmental degradation in the region. The typical pattern of environmental breakdown in the Caribbean is not a steady, even progression: it is the gradual accumulation of small injuries and changes which increasingly compromises the ability of natural systems to respond, but which result in no immediate deterioration in system functioning until the area is hammered by a major disaster. Then, the host systems are unable to recover, and the previous condition is rapidly succeeded by a new regime or ecosystem that is less resilient, less diverse, and less able to provide environmental services such as water purification or sediment trapping.

Most of the islands of the Caribbean lie within the hurricane belt and are vulnerable to frequent damage from seasonally intense weather systems. The distribution of natural hazards such as earthquakes, volcanic eruptions, floods and landslides in the region is a result of the islands' common geologic-tectonic-geophysical framework, and their geographic location within the plate boundary zones of the Caribbean. In

the last decade a considerable amount of attention has been given to disaster preparedness, assessment and mitigation in the insular Caribbean, as it is realized that lack of forward planning and failure to address disaster preparedness and mitigation have resulted in massive economic, social and ecological costs.

Since 1983 there have been many major natural disasters in the region – including a succession of major hurricanes (see section 'Shallow-water ecosystems', Box 1.5 and below); the eruption of the Soufriere Hills Volcano in Montserrat (1997), the Piparo Mud Volcano eruption in Trinidad in 1997, and severe drought conditions in Cuba and Jamaica attributed to El Niño (1997–1998).

Hurricane Georges is estimated to have reached a peak intensity of 250 km/h (Category 4) and a minimum central pressure of 937 mb while located about 675 kilometres east of Guadeloupe in the Lesser Antilles. Georges' first of many landfalls occurred at Antigua in the Leeward Islands after moving near or over several other islands including the US Virgin Islands. It then hit Puerto Rico with estimated maximum winds of 185 km/h. Georges weakened very little while over Puerto Rico and was even stronger when it made landfall in the Dominican Republic with estimated maximum winds of 190 km/h. Georges weakened after crossing the mountainous terrain of Hispaniola and made landfall in eastern Cuba with estimated maximum winds of 120 km/h. Georges caused one death and damage estimated at US\$5.1 billion.

Hurricane Mitch, the strongest October hurricane ever recorded, formed as a revolving storm in the south-west Caribbean Sea about 580 kilometres south of Kingston, Jamaica, late on 21 October. Three days later it had developed into a major hurricane which began to intensify rapidly. In about 24 hours its central pressure dropped 52 mb – to 924 mb by the afternoon of 25 October. Further strengthening took place and the central pressure reached a minimum of 905 mb about 65 kilometres south-east of Swan Island on the afternoon of 26 October. This is the fourth-lowest atmospheric pressure recorded in an Atlantic hurricane this century (tied with hurricane Camille in 1969), and is the lowest pressure ever observed in an October hurricane in the Atlantic basin. At its peak, the maximum winds were estimated to be 290 km/h – a strong Category Five hurricane. The estimated death toll from Mitch could be as high as 11 000.

The environmental effects of natural and man-made disasters are multiple and complex. Some of the major

### Box 1.5: The 1998 hurricane season

The 1998 hurricane season will be remembered as being one of the deadliest in the region's history, and for having the strongest October hurricane on record. It was a very active season with 14 named tropical storms, of which 10 became hurricanes. Three of these were major hurricanes – Category Three, Four or Five on the Saffir/Simpson Hurricane scale. The four-year period 1995–1998 had a total of 33 hurricanes – an all-time record.

Tropical cyclones claimed an estimated 11 629 lives in 1998 – 11 000 of them claimed by Hurricane Mitch in Central America and the Caribbean. Damage runs to many billions of US dollars.

On 25 September 1998 there were four Atlantic hurricanes in progress at once – the first time such an event was observed since 1893.

#### Summary table

Name	Class	Dates	Maximum wind (km/h)	Minimum pressure (mb)	Damage (US\$ millions)	Deaths
Alex	Tropical storm	27 July–2 August	96	1000		
Bonnie	Hurricane	19 August–30 August	185	954	720	3
Charley	Tropical storm	21 August–24 August	113	1000	50	20
Danielle	Hurricane	24 August–3 September	169	960		
Earl	Hurricane	31 August–3 September	161	985	79	3
Frances	Tropical storm	8 September–13 September	105	990	500	1
Georges	Hurricane	15 September–1 October	249	937	5100	602
Hermione	Tropical storm	17 September–20 September	72	999		
Ivan	Hurricane	19 September–27 September	145	975		
Jeanne	Hurricane	21 September–1 October	169	969		
Karl	Hurricane	23 September–28 September	169	970		
Lisa	Hurricane	5 October–9 October	121	995		
Mitch	Hurricane	22 October–5 November	290	905		11 000 <sup>(1)</sup>
Nicole	Hurricane	24 November– 1 December	137	979		

(1) Preliminary estimate

Source: National Weather Service, Miami, Florida

problems experienced in the Caribbean (Potter, Towle and Brower 1995) are:

- physical destruction of resources which are unable to recover because of anthropogenic-induced stresses: principal sources of this destruction include fire, landslides, landslide flooding and flooding from coastal waves;
- destruction of habitats by emergency response operations in the immediate aftermath of a major disaster: coastal areas of small islands are most susceptible here as emergency responses require access to the land, which may have been interrupted by coastal roads being cut off;
- poisoning of resources by pollutants released by the disaster: oil spills, sewage releases, and chemical spills from warehouse and port areas are the major sources of problems here;
- enormous quantities of waste generated by post-disaster clean-up and reconstruction, usually at a time when on-island transportation is slow and difficult: solid and hazardous waste disposal facilities

throughout the region are in a precarious condition, and the consequences include illegal dumping, overwhelming of existing dumps, introduction of toxics to dumps, rupture of existing sealing mechanisms in dumps, and frequently the use of refuse to infill damaged natural areas, especially coastal wetlands such as mangroves and salt ponds.

There are at least three different levels at which disasters threaten the environmental systems of Caribbean islands, and the smaller the island, the more acutely these effects are felt. They are:

- the disaster event itself;
- the impacts of the detritus of the disaster (and its disposal), and
- the acceleration of human impact trends, such as encouraging the in-filling of temporarily damaged natural areas, the replacement of indigenous species and systems with exotic species, and the hardening of shorelines and steep hillsides during reconstruction.

To a great degree, the damage that results from natural disasters is a function of decisions made, activities undertaken and technologies utilized during the process of development. A number of key issues have been identified which illustrate the range of priority concerns.

- lack of disaster preparedness, including zoning of susceptibility in development planning;
- poor mitigation mechanisms for dealing with oil spills and other environmental disasters;
- lack of, or inadequate, building code legislation;
- limited use or knowledge of appropriate building codes and guidelines;
- inadequate administrative arrangements and human resources for the enforcement of building codes;
- unavailability of suitable insurance policies for low-income households, and
- inadequate support systems for affected communities.

At the national level, early warning systems for hurricanes and tropical storms are effective, and the media publicize, well in advance, information on precautionary measures. A number of countries have national disaster response co-ordinating agencies that have mandates to provide precise assessments of damage, and to provide the necessary assistance. There are also disaster-specific institutions such as the Seismic Unit at the University of the West Indies, which monitors earthquakes in the region, and the Montserrat Volcano Observatory (MVO) which monitors the Soufriere Hills Volcano.

### Climate change

Climate change represents a threat to the Caribbean region because of the vulnerability of small island ecological and socio-economic systems to climate change, including the impact of sea-level rise. Although climate change is of global concern, there are a number of issues that need to be addressed for the Caribbean. These include:

- the magnitude and rate of climate change in the Caribbean Basin;
- the relative sensitivities of and impacts on ecological and socio-economic systems;
- identification and implementation of viable response options, and

- an effective role for countries of the Caribbean in carrying out regional and international actions.

The majority of capital cities, towns and settlements in the Caribbean have developed in the coastal zone and are susceptible to sea-level rise and its associated impact on living conditions, infrastructure and the economy. Also important are the levels of emission of greenhouse gases in the Caribbean Basin and the comparison of climate trends with model projections of what should have happened with greenhouse gas and aerosol changes to date. It was noted in the International Panel on Climate Change Second Assessment Report that there has been a regional increase in the frequency of some severe events. The report also concluded that there were inadequate data to determine whether consistent global changes in extreme events have occurred over the last century. However, climate models continue to predict more severe climate-related disasters such as storms and floods. It is clear that environmental effects of climate change could include:

- destruction of coral reefs by a combination of inhibited growth from heat stress, over-washing from sea level rise, and increased wave energy from storms. This in turn will expose many coastlines to direct wave action, never before experienced.
- inundation of coastal settlements with multiple impacts on natural systems, including multiple pollution incidents, stemming from sea level rise, increased storm precipitation, and frequency.
- loss of fertile coastal nursery areas in the few remaining fringing mangroves as these are drowned by sea level rise compounded by hardened shorelines immediately inland of these fringes.
- loss of the few remaining salt ponds.
- loss of soft shorelines (especially beaches and mangroves) to construction activities designed to harden other portions of the coast.

Climate change in the Caribbean region will affect the agriculture and water resource sectors, and ecosystems in tidal zones, and fisheries. There are also potential health impacts related to higher temperatures and resultant heat-stress morbidity and mortality, as well as the potential for spread of tropical disease vectors that are temperature limited. Caribbean public health programmes therefore need to be on guard against diseases such as malaria, schistosomiasis, river blindness, dengue, yellow fever and cholera.

### Box 1.6: Coral bleaching

The year 1998 was a difficult time for the world's coral reefs due to abnormally high sea surface temperatures. These warm water temperatures caused widespread coral bleaching. The coral animals, polyps, have tiny symbiotic algae called zooxanthellae living inside their tissues. High water temperatures, and sometimes other environmental conditions such as pollution, cause the zooxanthellae to leave the coral. Because the brownish or yellowish colour exhibited by a coral colony is due to the presence of algae in the animal tissues, a bleached coral, devoid of algae, appears white. Bleached coral is still alive, but because it is not receiving the energy it normally would from the tight symbiotic association with the algae, it is not as healthy. Bleached corals do not grow very much, if at all, and usually do not reproduce. If the sea water temperature returns to normal before too much time has passed, the algae will re-colonize the coral animal and the colony will probably recover. However, some coral colonies may die due to bleaching events.

Severe and widely reported coral bleaching took place in the Caribbean region between June and November of 1998. This period was one of higher than average sea surface temperatures. The figure below is a sea surface temperature anomaly, or 'hot spot' map derived from NOAA AVHRR (Advanced Very High Resolution Radiometer) satellite data on 29 September 1998. The coloured areas indicate regions where sea surface temperatures were higher than normal. It has been speculated that coral bleaching is a response to global climate change. There are still not enough data available to assess whether this is the case: however, recent widespread bleaching events world-wide are a cause of concern to reef scientists.



Source: NOAA/NESDIS



# Policy Responses



## Policy background

Sustainable development issues present a difficult challenge to conventional government structures. They are typically complex problems with political, social, economic, environmental, intergenerational and international implications, and it is difficult for any one government department or agency to address such complex issues as some dimensions will inevitably fall outside the department's normal remit. The solution lies in better planning, co-operation and co-ordination, and thereby improving integration – both horizontally (between departments at the same level) and vertically (between departments at different levels).

There are a number of reasons why some Caribbean governments are not yet fully able to address sustainable development issues. The main reasons are – inadequate funding, or lack of resources; insufficient human resources, coupled with inadequate training; and technical considerations relating, for example, to the absence of an integrated approach to the issues at national level (ECLAC 1999). Often, these impediments are compounded by the existence of weak government infrastructure and non-compliance with the law – even when laws are in existence.

These institutional issues, in conjunction with a lack of agreement on the long-term goal of the national development strategy, and with the very real technical and political difficulties of operationalizing elusive concepts such as sustainability, make it difficult for

Caribbean governments to deliver a long-term strategy for sustainable development without extensive and fundamental changes in the system of government, existing institutional arrangements and the prevailing political culture.

## MEAs and non-binding agreements

### Global MEAs

A review of multilateral environmental agreements (MEAs) has shown that more than 100 conventions hold some relevance to the Caribbean, of which 13 are of particular importance (Caribbean Law Institute 1998a; Box 2.1). However, determining the extent to which many of these global MEAs have impacted Caribbean regional or national environmental programming and the environment in the region is difficult to assess, for two reasons. First, environmental initiatives at the national level are largely driven by Country Environmental Profiles (CEPs) and/or National Environmental Action Plans (NEAPs) prepared by Caribbean governments, often with the encouragement of bilateral and multilateral funding institutions. Second, there is no accepted methodology or agreed set of indicators, and few data, for determining the impacts of international MEAs on the environment at the national level.

Global conventions, much as regional ones, place obligations on the signatories and many have implications even for states that have not ratified the particular convention. Table 2.1 shows the level of ratification of

### Box 2.1: Global MEAs of particular importance to the Caribbean

**Basel:** Convention on the Transboundary Movements of Hazardous Wastes and their Disposal. Basel, 22 March 1989.

**CBD:** Convention on Biological Diversity. Nairobi, 22 May 1992.

**CITES:** Convention on International Trade in Endangered Species of Wild Fauna and Flora. Washington, 3 March 1973.

**CLOPOL:** International Convention on Civil Liability for Oil Pollution Damage. Brussels, 29 November 1969 (as amended in 1976 and 1984).

**Heritage:** UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage. 23 November 1972.

**OILPOL:** International Convention for the Prevention of Pollution of the Sea by Oil. London, 12 May 1954 (as amended in 1962 and 1969).

**London Dumping Convention:** Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. London, Mexico City, Moscow, Washington D.C., 29 December 1972 (and its 1996 Protocol).

**MARPO:** International Convention for the Prevention of Pollution from Ships. London, 2 November 1973 (as amended by the Protocol of 1978).

**Ozone:** Convention for the Protection of the Ozone Layer. Vienna, 22 March 1985; and Protocol on Substances that Deplete the Ozone Layer. Montreal, 16 September 1987.

**Ramsar:** Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention). Ramsar, 2 February 1971.

**SOLAS:** International Convention for the Safety of Life at Sea. 1 November 1974.

**UNCLOS:** Convention on the Law of the Sea. Montego Bay, 10 December 1982.

**UNFCCC:** Framework Convention on Climate Change. New York, 9 May 1992.

Other global MEAs of lower priority to the region include:

**CMS:** Convention on the Conservation of Migratory Species of Wild Animals. Bonn, 23 June 1979.

**CCD:** Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa. Paris, 17 June 1994.

*Note:* dates are dates of adoption, not entry into force.

global MEAs by Caribbean states. The table indicates that of the 13 conventions identified as particularly important, eight (UNCLOS, Ozone Layer, UNFCCC, SOLAS, Biodiversity, CITES, Basel and Heritage) have been ratified by more than 50 per cent of the states.

One anomalous feature of note is the low level of ratification of pollution-related conventions. The

existence of a regional oil spill response mechanism (supported by the Cartagena Convention) indicates governmental interest, and the public outcry against shipments of waste (especially hazardous wastes) through the region suggests that there is public support. Yet this is not reflected in the ratification of related global MEAs, such as the International Convention on Civil Liability for Oil Pollution Damage.

Significant levels of involvement in international MEAs may be related to the perception of immediate benefit versus potential problem in Caribbean states (UNFCCC, Ozone Layer, Biodiversity) and the level of involvement of the convention's secretariat in working with individual states (UNCLOS, CITES).

Governments of the region are usually aware of the measures necessary to ensure compliance with global MEAs. However, that awareness is often restricted to one or two agencies, and in many cases widespread support is absent. Additionally, the general public is well informed about only a few MEAs, such as the Ozone Layer, Biodiversity and CITES, which have implemented awareness-raising campaigns through both public and non-governmental organizations.

Few new national institutions have been created specifically for the implementation of global MEAs, either at the national level or at regional level. Inter-agency co-ordinating mechanisms have been established in a few countries, based on the regulatory and scientific focus/requirements of CITES. More than ten Caribbean Community (CARICOM) countries that are parties to the UNFCCC are currently collaborating to implement the Caribbean Planning for Adaptation to Global Climate Change project. This project involves a combination of national pilot/demonstration activities, regional training and technology transfer.

Given that the environmental programmes in Caribbean countries are driven more by bilateral and multilateral funding arrangements than by MEA obligations, it is difficult to determine the impact or effectiveness of global MEAs in promoting national legislation to protect the environment. In general, there is very limited enactment of national laws to facilitate compliance with the obligations of global MEAs. For the international treaties adopted by Caribbean Countries, most have not been supported by legislation at the national level. In the few cases where such laws exist, such as those dealing with protected species, the laws were often enacted prior to ratification of the related MEA. Regulatory measures and mechanisms were developed primarily to address national environmental



Table 2.1: Caribbean signatories to relevant international environmental conventions

(actual numbers in brackets)	CBD 174 parties	CITES 145 parties	CMS 56 parties	Basel 121 parties	Ozone 168 parties	UNFCCC 176 parties	CCD 144 parties	Ramsar 144 parties	Heritage 156 parties	UNCLOS 130 parties
Latin America & Caribbean (33)	100 (33)	94 (31)	18 (6)	82 (27)	97 (32)	97 (32)	88 (29)	67 (22)	88 (29)	82 (27)
Caribbean (13)	100 (13)	85 (11)	0 (0)	69 (9)	92 (12)	92 (12)	85 (11)	23 (3)	69 (9)	100 (13)
Antigua and Barmuda	●	●		●	●	●	●		●	●
Bahamas	●	●		●	●	●		●		●
Barbados	●	●		●	●	●	●			●
Cuba	●	●		●	●	●	●		●	●
Dominica	●	●		●	●	●	●		●	●
Dominican Rep	●	●			●		●		●	●
Grenada	●				●	●	●		●	●
Haiti	●					●	●		●	●
Jamaica	●	●			●	●	●	●	●	●
St Kitts and Nevis	●	●		●	●	●	●		●	●
St Lucia	●	●		●	●	●	●		●	●
St Vincent and the Grenadines	●	●		●	●	●	●			●
Trinidad and Tobago	●	●		●	●	●		●		●

● = parties to environmentally related conventions

Source: Compiled from the websites of the various conventions.

### Box 2.2: Biodiversity policy

Initiatives in biodiversity conservation occur at both the national and regional levels, and involve many and varied actors. Unfortunately, these activities appear to be sporadic and project-driven, rather than resulting from any systematic planning process. At the national level, ten countries are now embarked on the preparation of national biodiversity strategies and action plans (NBSAP) funded with GEF resources (ECLAC 1997). An increasing number of countries are also undertaking activities (involving both government agencies and NGOs) under related international conventions such as Ramsar and CITES.

Data on investments in biodiversity conservation are sparse, but those available for funding from government sources and NGOs based in the United States show that the Caribbean received a very small percentage of total US funding: 2 per cent in 1987 (US\$ 918 465) and 4 per cent (US\$ 2 826 613) in 1989. Areas of focus included research, site/species management, policy planning/analysis, education, and institutional strengthening. Nevertheless, a number of actions have been initiated at the regional level, including:

- the establishment of the Inter-American Biodiversity Information Network (IABIN);
- maintenance of an Internet mailing list on biodiversity by the Island Resources Foundation;
- preparation of a Caribbean Action Plan as supporting activity under the International Coral Reef Initiative, and
- increasing the capacity of communities to manage biodiversity, facilitated by the Caribbean Natural Resources Institute (CANARI).

Given the existing levels of resources, information and popular support, no immediate change is expected in the status of, and pressures on, biological resources in the Caribbean. Future directions for biodiversity action in the Caribbean should include:

- implementation of biodiversity strategies at the national level;
- development of protected areas to protect valuable ecosystems, especially those of regional importance;
- greater use of information networks, such as IABIN, BIONET and BCIS;
- incorporation of biodiversity impact assessment in policy analysis, sustainable development/physical planning, and development control activity;
- incorporation of biodiversity conservation measures in sectoral projects (tourism, watersheds, etc.);
- incorporation of biodiversity impact assessment as part of the project assessment procedures of donor institutions;
- increased attention to the issues of bioengineering, biosafety and agricultural production;
- improved research, monitoring and evaluation, including harmonization of methods and guidelines;
- restoration of degraded areas, and
- improvement in the collection, manipulation, storage, retrieval and dissemination of information.

problems, and not as a response to the obligations assumed by ratification of the global MEAs.

However, some areas of potential progress exist. It is anticipated that with nine countries now preparing national biodiversity strategies, national implementation of the Biodiversity Convention will be supported by legislation, clear institutional mechanisms and adequate resources (Box 2.2).

Issues relating to the United Nations Framework Convention on Climate Change (UNFCCC) and Ozone Layer conventions are also being addressed in varying degrees throughout the region. Although only Aruba and Cuba have developed or upgraded national legislation to address these issues, almost all of the other states have ratified or acceded to relevant international conventions, including the UNFCCC, and are participating in the Caribbean Plan for Adaptation to Climate Change project. A few countries have undertaken enabling activities and measures to address greenhouse sinks and resources. Some, including Barbados, Cuba, Dominica, Jamaica and St. Lucia, promote the use of alternative and renewable sources of energy, including solar, hydroelectric, biomass and biogas. Jamaica has attempted the use of wind energy, and biomass has been utilized in the sugar cane industry in Cuba. Barbados, Guyana and Jamaica have attempted to promote efficient renewable energy technologies through the application of economic incentives and policies. Most governments have been actively promoting the efficient use of non-renewable energy sources. However, with few exceptions consumers have not been offered sufficient inducements to make the switch. Lack of progress in adopting alternative energy sources is attributed in part to costs – which are currently higher than traditional sources – and in part to the lack of public information about energy-efficient technologies and renewable energy options, although this is being addressed in some instances through public awareness programmes.

There are other notable exceptions: Barbados has placed an environmental levy on non-recyclable goods entering the country, and Jamaica has revised its import policy and guidelines to prevent the entry of motor vehicles and other goods containing products that contribute to the greenhouse effect.

### Regional MEAs

The limitations on assessing the impact and effectiveness of global MEAs also hold true for regional MEAs. However, the effects of regional MEAs are more tangible at the level of regional programming.

The only environmental convention covering the

**Table 2.2: Status of the Cartagena Convention**

	Cartagena <sup>1</sup> Convention	Oil Spills <sup>2</sup> Protocol	SPAW <sup>3</sup> Protocol
Anguilla			
Antigua and Barbuda	●	●	●
Bahamas			
Barbados	● ●	● ●	
British Virgin Islands	● ●	● ●	●
Cuba	● ●	● ●	● ●
Dominica	●	●	
Dominican Republic			
Grenada	● ●	● ●	
Haiti			
Jamaica	● ●	● ●	●
Montserrat			
St. Kitts & Nevis			
St. Lucia	● ●	● ●	●
St. Vincent and the Grenadines	●	●	● ●
Trinidad and Tobago	●	●	●
Turks and Caicos	● ●	● ●	●

Source: Modified from UNEP CEP Website: <http://www.cep.unep.org/>

● = Signed ● = Ratified or acceded

1 Entered into force on 11 October 1986

2 Entered into force simultaneously with the Convention on 11 October 1986

3 Awaits ratification by five more signatories before its entry into force.

whole of the Caribbean region is the Cartagena Convention (Table 2.2) and its protocols on oil spills, specially protected areas and wildlife, and pollution from land-based activities (under development). However, most Caribbean countries have also signed a number of other conventions and protocols that are relevant to regional and national environmental initiatives.

Over the next decade, the Caribbean countries would be expected to use these agreements and associated programmes to move their countries and the region towards a position of strength with respect to environmental management and long-term development of the region's resources. To this end governments, supported by regional efforts, will continue to promote and implement policies and programmes in support of integrated coastal area management, require more science and data-based decision-making in national planning and development efforts, and demand more cost-effective use of technical human resource pools in the region.

In support of the national and regional efforts to make the Caribbean Sea an environmentally sustainable zone, the governments of the region continue to seek

### Box 2.3: Barriers to implementation of global and regional MEAs

A number of barriers hinder treaty adoption and national implementation of treaty commitments. Case studies from four Caribbean countries have identified the following constraints:

- limited financial, technical and human resources;
- lack of political priority for environmental protection and sustainable development;
- lack of information and understanding of treaty benefits and costs, and
- lack of national focal points responsible for treaty acceptance.

Constraints on national implementation of treaty commitments were identified as:

- lack of expertise and inadequate financial/human resources in relevant departments to 'champion' legislative follow-up and enforcement;
- a tendency on the part of international financial institutions to support projects rather than long-term institutional capacity-building;
- other political priorities, and
- the lack of comprehensive framework environmental legislation.

Source: Caribbean Law Institute (1998b)

Note: dates are dates of adoption, not entry into force.

international recognition of the Caribbean Sea as a 'Special Area'. A formal proposal to this effect will be presented to the United Nations General Assembly Special Session on SIDS in September 1999. The preparation of this proposal would entail defining the concept of 'Special Area' in detail, seeking political support for its acceptance and implementation, and making an analysis of the international and regional conventions within the context of which the 'Special Area' status could be established.

Recognizing the weaknesses that exist in the implementation of MEAs in the region, Caribbean governments have begun to identify possible remedies, including the need for a much stronger regional approach to treaty negotiation and implementation. Interviews with selected countries of the Organization of Eastern Caribbean States (OECS) sub-region (Caribbean Law Institute 1998b) provided a number of suggestions, including the following:

- that a regional treaty guide be prepared to assist countries in understanding treaty obligations and benefits, and
- that a regional workshop be held to explore ways of overcoming national treaty implementation constraints.

In addition, representatives of Caribbean governments attending the Caribbean Sea Forum (Port of Spain, 3–6 June 1998) agreed that the trends and required actions mentioned above were relevant to all Caribbean states. Based on this, the Forum proposed the following actions:

- development of a strategy to encourage Caribbean countries to ratify relevant treaties (and the identification and implementation of treaties that can be adequately implemented);
- support and encouragement for the ratification of treaties and the inclusion of treaty provisions in national legislation. Model legislation on integrated coastal zone management could be included in the recommended strategy for governments to consider;
- establishment of a permanent regional mechanism to consider, review and provide guidance to governments on the provisions of international treaties. This will assist in effective and harmonized treaty implementation and enforcement;
- identification of resources for the training of negotiators at international fora, and the establishment of post-graduate programmes in law, and multidisciplinary programmes in environmental sciences, at the University of the West Indies.

### Action plans and non-binding instruments

In addition to the major conventions and protocols, a number of regional, hemispheric and global non-binding agreements and programmes help to guide regional environmental programming. These include:

- *Agenda 21* (Rio), 1992
- The Summit of the Americas Plan of Action, 1994/1998
- The Programme of Action for the Sustainable Development of Small Island Developing States (SIDS), 1994
- The Plan of Action for the Sustainable Development of the Americas (Bolivia), 1996

- The Caribbean/United States Summit (Bridgetown, Barbados), 1997

Of these, both *Agenda 21* and the SIDS-POA have had a profound impact on the promotion of sustainable development in the region. Both have helped to set the framework for a number of National Environmental Action Plans (NEAPs) (Table 2.3) which measure progress, establish priorities, and identify actions to guide national policies, programme planning, investment decisions and budget preparation towards sustainable development.

*Agenda 21* has also led to the setting up of numerous Sustainable Development Councils. For example, the Government of Jamaica has established a Sustainable Development Council to officially link all stakeholders in national development through a multi-stakeholder approach to sustainable development. Its mandate is to:

- sensitize key players and decision-makers at all levels of society by facilitating dialogue on the importance of sustainable development, the responsibility it imposes on government and all other sectors and interests, and the need for all to work in an integrated and co-ordinated manner;
- monitor national progress towards sustainable development measured against the dictates of both *Agenda 21* and the SIDS POA;
- identify policy gaps, influence policy-makers and promote research, policy reform, programmes and legislation for sustainable development;
- advise the government on international co-operation issues regarding the promotion of sustainable development;
- promote and facilitate capacity-building and awareness programmes on sustainable development, and
- co-ordinate and harmonize sustainable development activities nationally.

For the Caribbean, the formulation of the Programme of Action for Small Island Developing States (SIDS POA) in 1994 is beginning to influence regional and national environmental action. The greatest concerns with respect to the implementation of the SIDS POA revolve around priority areas such as 'Coastal and Marine Resources', 'Natural and Environmental Disasters' and 'Tourism', among the substantive elements of that Programme, and 'National Institutions and Administrative Capacity' among the cross-sectoral

areas. However, in this region, all the Priority Areas embodied in the SIDS POA are deemed to be of direct importance and relevance to its sustainable development, and significant progress has been made by many regional SIDS in their implementation.

According to a recent report by the Economic Commission for Latin America and the Caribbean (ECLAC 1999), what is needed to maintain and enhance the contribution of activities in these areas to national and regional development is a focused and sustained effort, once certain constraints are overcome. This would involve, *inter alia*, more rigorous adoption of sustainable development approaches, the explicit integration of the SIDS POA into the national planning and decision-making process and the provision of much-needed financial resources.

Among the lasting achievements in the implementation of the SIDS POA in the Caribbean is an enhanced understanding of sustainable issues to which this process has given rise. This is already evidenced by, *inter alia*, the improved identification of environmental as well as socio-economic concerns and projects throughout the region. Further, governments and society have reacted to the needs of the SIDS POA by forging innovative partnerships for collaboration at unprecedented levels, in terms of both intensity and scope. The role of society, including the private sector, in identifying and achieving the objectives of the SIDS POA has been recognized and encouraged in a novel and intense system of co-management of natural resources, in setting standards and in preparing environmental policies and action plans. Another significant area in which lasting gains have been recorded relates to the appreciation of the critical importance of institutional strengthening, through capacity-building, enactment of environmental legislation, the application of management tools such as environmental impact assessments, and the adoption and implementation of environment action plans. These, plus environmental authorities and ministries, are among the mechanisms through which Caribbean SIDS have given explicit recognition to the need for an adequate institutional framework for the promotion and advancement of their sustainable development endeavours (ECLAC 1999).

However, it should be noted that many activities relevant to the SIDS POA were neither conceived nor implemented in direct response to the adoption of the SIDS POA. Rather, the commencement of many such activities pre-dated the adoption of the SIDS POA and these activities continue to be pursued in the context of the respective national sustainable development plans.

Table 2.3: National environmental strategies and plans

	National Report for UNCED	State of the Environment Report	National Environmental Profile	National Biodiversity Strategy	National Conservation Strategy	Environmental Action Plan	Forestry Action Plan
Anguilla	n.a.		1993				
Antigua and Barbuda	1992		1991	i.p.			1993
Bahamas	1992						
Barbados	1992						1993
Belize	n.a.			i.p.		1996	n.a.
British Virgin Islands	n.a.	n.a.	n.a.	n.a.			n.a.
Dominica	n.a.		1991	i.p.		1994	1993
Dominican Republic	1992		1981			n.a.	1990
Grenada	n.a.		1991	1988		1994	1993
Guyana	n.a.	n.a.	n.a.	i.p.		1994	n.a.
Haiti	1992		1985			i.p.	
Jamaica	1992	1995/96/97	1987	i.p.		1994/95	1990
Montserrat	n.a.		1993	1993		1994	1993
St. Kitts and Nevis	1992		1991	i.p.		1994	1992
St. Lucia	n.a.		1991	i.p.		1994	1993
St. Vincent and the Grenadines	n.a.		1991	1986		1994	1993
Suriname	n.a.	n.a.	n.a.	i.p.		n.a.	n.a.
Trinidad and Tobago	1992			i.p.	i.p.	n.a.	1993
Turks and Caicos	n.a.	n.a.	n.a.	n.a.			n.a.

n.a. = Information not available      i.p. = in preparation

Source: Updated from UNEP (1997).

#### Box 2.4: Forestry policy

Regional and national policy decisions and past donor strategies in the region have sent conflicting signals to landowners and natural resource users. Incentives for competing land uses, mainly in agriculture and ranching, have promoted deforestation in the region. In many instances also, land titling and timber concession policies have been skewed in favour of those that have removed forest cover and intensified deforestation. For many governments in the region, the main thrust of policy action has been to enhance timber production, although forestry units of these governments have also generally been charged with responsibilities ranging from the conservation and management of natural resources to the sustainable management of national parks and other protected areas.

However, in the past few years, with the changing perspectives being adopted by international organizations on the link between public timber pricing policies and the sustainable management of forests, a number of regional governments have taken steps to rehabilitate public policy and institutional frameworks. Policy initiatives such as the FAO's 1985 Tropical Forestry Action Plan (TFAP) represented recent attempts to incorporate 'sustainable' timber production with natural forest management on a much wider scale than previously existed. Belize, Jamaica and Guyana took steps to adopt TFAP, but with moderate success as constraints – including difficulties with donor funding and TFAP's failure to address the root causes of deforestation – have diminished its effectiveness on the ground. Other policy initiatives arising from UNCED/*Agenda 21*, and commercial and economic instruments (such as bans on the importation of forest products not carrying an environmental label), are now being developed and implemented by some countries in the region. Another encouraging phenomenon is the paradigm shift from donor dependency to the adoption of local initiatives in sustainable forest management as is evident in Saint Lucia and Dominica.

On the other hand, while official attention has increasingly concentrated on the establishment and maintenance of forest reserves to prevent exploitation, not much is being done to manage the marginal forests on the peripheries of these reserves. Consequently, these outlying forest areas suffer encroachment by an informal sector which extracts charcoal, firewood, fodder for goats and sheep, traditional medicines, and wild food and other resources to fuel economic activities. In addition, forestry and conservation policies in the region concentrate almost exclusively on tropical moist forests, not accounting for other zones with high deterioration and forest loss levels. As for reforestation, the policy challenge is tremendous since for each hectare cultivated, 8.5 hectares of natural growth are deforested (Windgrad n.d.).

In many cases the solution to these problems does not relate directly to forestry, but rather to public policies towards alternative energy, appropriate soil conservation and agro-forestry practices. Although no comprehensive internationally binding policy exists, it is the general consensus that the region would benefit from a cross-sectoral policy framework for sustainable forestry management.

### Box 2.5: Marine and coastal areas policies

During the last ten years, Caribbean coastal zone management issues have moved into the mainstream of policy and planning, albeit at a comparatively low level of priority. Steps have been taken to amend the traditional reactive, *ad hoc* approach to coastal zone management. However, despite the growing awareness of the pivotal role of coastal resources in national development, sustainable management practices and sound environmental stewardship are not common.

A number of international and regional organizations have co-ordinated programmes, which include:

- strengthening institutional capacity;
- monitoring coral reefs, beaches, sea-level and coastal water quality;
- economic valuation of coastal resources;
- improving natural resource data bases through stock assessments and resource inventories;
- producing coastal zone management plans;
- upgrading marine protected area management capability;
- assessing land-based pollution of the marine environment;
- sharing technical information;
- formulating coastal set-back guidelines, and
- developing and harmonizing regulations and legislation.

While the SIDS POA has resulted in improved understanding of sustainable development, including the need to prioritize marine and coastal areas, with few exceptions these gains must be viewed in the context of national political mechanisms in which the lack of an integrated planning framework has resulted in the creation of isolated and often conflicting policy and regulatory measures.

In the last ten years there has been a significant improvement in the management approach. A variety of management frameworks have been employed, ranging from stand-alone coastal zone legislation, and umbrella legislation regulating coastal resources, to fragmented legislative systems employed in the reactive, case-by-case management of sectors within the coastal zone (see Box 2.6).

However, several key issues continue to challenge governments within the region:

- inadequate enforcement of coastal resource protection legislation;
- uncontrolled development in key watersheds, wetlands and active beach zones;
- unsustainable near-shore fishing practice by trawlers;
- illegal fishing in territorial waters;
- degradation of coral reefs and sea grass beds from insensitive recreational and commercial activity;
- inadequate management of coastal resources, and
- inadequate co-ordination of activities at the regional level among key agencies.

### Box 2.6: Marine protected areas

The concept of protected areas is not new to the Caribbean. The very first protected areas in the region were established over 200 years ago out of concern for watershed protection. This was the reason behind the establishment of the Main Ridge Reserve of Tobago in 1776, as 'woods for protection of the rain' (Cross 1991), and the Kings Hill Reserve in St Vincent in 1791, for the purpose of 'attracting the clouds and the rain for the benefit and advantage of the owners and possessors of lands in the neighbourhood thereof' (Birdsey, Weaver and Nichols 1986). Two examples of successful marine protected areas in the Caribbean are the Bonaire Marine Park on the Dutch Antilles island of Bonaire and the Soufriere Marine Management Area in St. Lucia.

**The Bonaire Marine Park**, which was established in 1979, is one of the few actively managed protected marine areas in the world. The marine park includes the waters around Bonaire from the high-water mark to the 60m depth contour.

Bonaire's abundant coral reefs and clear waters have long made it one of the most popular diving destinations in the world.

The marine park was established with grant funding from the World Wide Fund for Nature, together with funds from the Island and Dutch Governments. Comprehensive legislation is in place, and the park has 37 public moorings, research and monitoring programmes and interpretative information centres. The park is completely self-financing, obtaining its funds from admission fees charged to divers (De Meyer 1997).

The coastal and marine areas of St. Lucia have recently been under increasing pressure from human activities, and have witnessed the advent of conflicts between resource users.

**The Soufriere Marine Management Area (SMMA) in St Lucia** was created in 1994 to resolve conflicts of use and to ensure that all economic activities would be able to prosper without damage to the people and their environment.

The SMMA extends for 11km from Anse Jambon in the north to Anse l'Ivrogne in the south, and is divided into five zones. One of the primary reasons for the establishment of the SMMA was to rehabilitate Soufriere's fishing industry, which was at an all-time low. Since the creation of the SMMA there has been a marked increase in fish stocks, which in the future will translate into greater catches.

The SIDS POA has nevertheless been able to impact these activities, imparting greater focus and renewed emphasis, and thereby contributing to a more holistic approach to their management and to the development of new projects and programmes (ECLAC 1999).

## Laws and institutions

Caribbean islands are now giving increased attention to addressing the issue of sustainable development by updating their legal and institutional frameworks. Since the 1990s, governments of the region, having embraced the concept of 'environmentally sustainable development', have increased their commitment to improving environmental management, and are cognizant of the importance of including environmental content in development plans and public investment programmes. To a large extent, the need to establish programmes, initiatives and strategies for sustainable development has been a response to the UN Conference on Environment and Development (UNCED) in 1992, and the UN Conference on Sustainable Development of Small Island Developing States (Barbados, May 1994).

To this end there have been moves to establish institutions charged with environmental responsibilities and to enact legislation with modern resources management and environmental protection authorities. These authorities include the Environment Management Agency in Trinidad and Tobago, the Natural Resources Conservation Authority of Jamaica and, at the regional level, the Natural Resources Management Unit of the Organization of Eastern Caribbean States (OECS-NRMU). These institutions have on the whole been given the power to provide for the effective management of the physical environment in order to ensure the conservation, protection and proper use of natural resources. For example, the NRCA in Jamaica has powers to develop, implement and monitor programmes relating to the management of the environment and to formulate standards and codes of practice to be observed by different sectors or interest groups for the improvement and maintenance of the environment. The Authority has emerged as a credible and effective national lead agency on the environment and sustainable development.

While concrete action in the implementation of environmental law is limited, political will does seem to be present. As a demonstration of this, at the Caribbean Ministerial meeting on the Implementation of the Programme of Action for the Sustainable Development of

Small Island Developing States (November 1997), the following recommendations were made for legislation, rationalization and institutional reform for the Caribbean:

- that countries incorporate the principle of sustainable development into their legal statutes and enhance the awareness and technical skills of the judiciary with regard to sustainable development issues;
- that the Caribbean Region be viewed as an entire eco-system;
- that the Island System Management Approach being promoted by OECS-NRMU be given further study as a primary vehicle for integrating the legislative framework for the sustainable development of Caribbean SIDS.

A number of consultations have been held in the region to discuss issues related to legislation and sustainable development. The consultation held in Barbados in September 1997 on Policy and Legal Considerations for Sustainable Development agreed that law and the translation of law was critical when looking at sustainable development and the distribution of benefits. The issue of good governance was also discussed, and it was noted that in the Caribbean there is a large gap between the law as it exists and the actual practice of law or its implementation.

The crucial issues for the Caribbean are the development and harmonization of standards of legal regulations; the importance of being involved in the process of international treaty-making, and the building of awareness, which should include not only the judiciary but also enforcement officers and the NGO community. There is also need for institutional capacity-building especially in terms of learning from the experiences of the NRCA, EMA and OECS-NRMU and forging co-operation between institutions in the region.

In Jamaica, the NRCA has formulated a range of regulations, policies, standards and guidelines, and has also developed a system of National Protected Areas that will ensure that 25 per cent of the national land area is protected by the end of the century. Two national parks have been established and seven other protected areas are under study. An environmental permit and licence system has also been established to monitor, and minimize, the negative effects of development on the environment through a process of environmental audits and impact assessments. Society's capacity to address environmental problems through a process of full

### Box 2.7: Regional institutions

Large institutions have the potential to implement a wide range of projects, but this potential is dependent mainly on the institutional arrangements used by the institutions. By working through their member organizations, participating states, national focal points, and/or large core groups of associates, they are able to draw on a pool of resources much larger than that contained within the institution itself.

Such regional bodies existent in the Caribbean include:

- Caribbean Natural Resources Institute (CANARI)
- Caribbean Centre for Development Administration (CARICAD)
- Caribbean Conservation Association (CCA)
- Caribbean Disaster Emergency Response Agency (CDERA)
- Island Resources Foundation (IRF)
- Organization of Eastern Caribbean States/Natural Resources Management Unit (OECS/NRMU)
- CARICOM
- Caribbean Fisheries Management Programme (CFRAMP)
- Caribbean Coral Reef Monitoring Programme (CARICOMP)
- Caribbean Environmental Health Institute (CEHI)

Based on their experience in project management, institutional mandates, and access to large groups of associates, members, and/or participating agencies, a number of the above institutions have been targeted for institution-strengthening support. Assistance ranges from improvement of management systems to provision of furniture and physical space.

disclosure using environmental impact assessments and public pollution registers has also been established. New legislation and policies have also been developed in the fields of water resource management, pesticide regulation, forestry management, fisheries management, energy conservation and use, industrial development and land management and use.

### Economic instruments

Most Caribbean governments over the last five years have recognized the need to use environmental economic instruments. This is due in part to concern about the implications of these instruments for the achievement of sustainable development and in part to the need to mobilize additional funding sources. However, these instruments have been used rather sparingly in Caribbean countries, and in most cases where they have been used, cost recovery has been the principal objective.

Even though deposit refund schemes and resources charges have been the most popular route chosen for applying economic instruments in the region, these schemes have enjoyed only limited success in terms of their environmental effectiveness due to the continued

existence of policy and market distortions. The same is true for resource user fees and user fees for tourism-related activities. Future policy must therefore ensure that there is completeness in the development and application of appropriate instruments and the elimination of market distortions.

Faced with increasing threats to the environment, some Caribbean governments have begun to use economic policy measures to encourage environmentally sustainable and responsible decision-making by investors, consumers and other actors, and to guide their economies towards sustainable development. In particular, many governments are now using these instruments to mobilize additional revenue/funding for environmental protection, monitoring, enforcement and investment. As a result, many Caribbean governments are now seeking to incorporate environmental economic instruments into their overall environmental policy.

At the regional level, the Commonwealth Secretariat has sponsored a programme on the Application of Environmental Economic Policy Instruments in the Caribbean Region. The Planning Institute of Jamaica, the national planning agency of the Government of Jamaica, initiated comprehensive research, training and analysis in environmental policy with assistance from the Commonwealth Secretariat. This is the first Commonwealth Secretariat sponsored programme on environmental economic policy in the region, and one of its main objectives is to integrate environmental economic policy into macro-economic and sectoral policies. The programme also seeks to achieve capacity-building in the application of environmental economic policy (including training and research in Jamaica and the region as a whole).

Deposit refund systems (DRSs) – notably for the return and re-use of glass bottles – have been a major feature of the application of environmental economic instruments in the Caribbean, and have met with some degree of success. In Jamaica the manufacturers of sodas and beer now charge a deposit on glass beverage containers which is refunded to the consumer upon return of the bottle at designated collection points. The current charge levied by the island's largest producer, Desnoes and Geddes, is JA\$5 per bottle. The success of the DRS scheme has been moderately good, with 50 per cent and 80 per cent recovery rates for beer and soda bottles respectively.

However, with the increased influx of polyethylene terephthalate (PET) bottles into the local market, DRSs



for drinks containers are becoming less successful due to the lack of incentives for packaging and recycling PET bottles. A further constraint is that in most countries the informal collection of recyclable materials represents an important occupation for poor, unskilled labourers. However, there is scope for the expansion of DRSs to include such products as batteries, tyres and lubricating oil.

Resource user charges, especially for water, exist in virtually all countries in the region. Their effectiveness, however, has been minimal due to the large number of households that are not metered. Water is still provided free of charge through public standpipes, and this has served to discourage water use efficiency among domestic consumers. In Jamaica, for example, a volume-based pricing structure is used, which allows for a fairly full recovery of operational costs. However, capital costs are not captured in the pricing structure. In Barbados, water charges are subsidized, with domestic charges substantially lower than the total supply cost. Cuba has a similar price differentiation between domestic and industrial users, but prices are lower.

The application of the 'user pays' principle for tourism-related activities and the management of national parks is widespread throughout the region, with success in some cases. The establishment of visitor fee system for the Bonaire Marine Park has raised enough money to cover operating costs and capital depreciation (see also Box 2.6). The Park also receives income from the sale of souvenirs. In St. Kitts, the introduction of user fees for the Brimstone Hill Fortress (a major heritage attraction) has increased revenues to the extent that the cost of managing the attraction is no longer the sole responsibility of the government.

The use of incentives and subsidies is not widespread although it has been proposed in some countries. Barbados appears to have gone farthest in applying this technique, with one particularly successful case being the use of incentives to promote solar technology. The Barbados experience with incentives for the use of solar water heaters has demonstrated that the widespread use of proven and reliable technologies could go a long way towards reducing petroleum consumption. In 1974, the Barbados Government introduced tax benefits for homeowners who invested in solar energy. Since then the results have proved to be beneficial. Between 1974 and 1997, an estimated U\$66 million has been saved as a direct result of the installation of more than 30 000 solar water systems. In addition, the tax breaks have facilitated economic growth in the country by stimulating the

development of the solar industry in Barbados.

Despite these efforts at applying economic instruments, a structured approach to the matter does not exist, and issues such as the feasibility, appropriateness and applicability of economic instruments to environmental management have not been addressed. In this regard the Economic Commission for Latin America and the Caribbean (ECLAC) has proposed a programme for the two-year period 1997–1999 that includes the establishment of a regional focal point for economic instruments; regional and national training programmes; country reviews of existing environmental actions designed to establish clarity in policy objectives; exchange of relevant information, and regional project development for implementation at national level.

The ECLAC proposal could be complemented by a more consistent collective effort by the region's governments, with future environmental economic policy considerations including the following:

- Continued efforts to remove subsidies that encourage unsustainable use of natural resources. This policy action is needed to discourage the wasteful use of scarce resources on the one hand, and to reduce environmental problems on the other. Particular attention needs to be paid to water, timber and energy resources, all of which currently attract significant subsidies from governments.
- Development of adequate legislative measures to allow for the easy introduction of environmental economic policy instruments.
- Continued and comprehensive training to instil skills formation and awareness creation in environmental economic policy development among decision-makers at various levels. This will provide local personnel with the working knowledge of relevant economic instruments and the steps needed to effectively implement and administer such instruments.
- Measures to enhance the awareness and knowledge of policy-makers in the use of economic instruments

### Industry and new technologies

While there has been a marked increase in the development of clean technologies in the industrial world, the Caribbean countries still do not possess the advanced technologies required for effective use of their resources, nor can they access them easily. A number of obstacles hinder the transfer of clean

technologies from industrialized countries to developing ones, including – in many Caribbean states – lack of adaptation to local conditions; inadequate scientific and technological background; the reluctance of industrial firms in the North to release state-of-the-art technologies for fear of competition, and lack of funds in the South.

In addition, policy inadequacies and the slow pace of economic growth and investment in the region have further hindered the adoption of cleaner solutions. Nevertheless, emerging clean technologies in the Caribbean came about in the early 1990s, primarily as a result of the formation of a number of government environmental agencies, rising environmental standards and regulations, ISO standards, and public scrutiny. As a result, several islands, including Cuba, Jamaica, and Trinidad and Tobago, have undertaken some clean technology initiatives.

It is predicted that over the next two decades there will be an almost two-fold increase in world-wide energy consumption by developing countries, which will require significant increases in investment to expand existing energy systems and technologies (UNEP 1999). A number of regional initiatives have taken place in the agriculture, mining and tourism industries, utilizing several types and sources of cleaner technologies (some already commercialized) primarily in the areas of renewable energy and waste management.

Wind Energy Conversion Systems (WECS) have been successfully advanced in Curacao, Jamaica and Barbados, despite the variability of the wind and continuing high turbine costs. Curacao has been operating a wind farm since 1993, and Jamaica plans to install one by 2000. The first Ocean Thermal Energy Conversion (OTEC) plant, which used heat energy from the warm surface areas of the ocean to generate power, was constructed in Cuba, followed by the development of a demonstration OTEC plant in Jamaica. Other renewable energy technologies include hydropower, low energy architecture, wave energy, geothermal, solar technologies such as photovoltaics, solar thermal, solar drying and biomass.

In the case of waste management, there are common problems throughout the region, but the most critical is the need for hazardous waste management as most islands lack such technology or are unprepared to manage hazardous waste in the event of a disaster. The lack of legislation for waste management is also a region-wide issue.

Jamaica has also made strides in the management of waste from its bauxite operations. JAMALCO, a fifty-fifty joint venture between the Government of Jamaica and Alcoa Minerals of Jamaica Ltd., has pioneered two types of bauxite residue disposal technology. JAMALCO is a 'zero-discharge' facility, and all water collected from the plant site or the residue system is impounded within the disposal area for re-use in the process. Other environmentally sound technologies being used in the mining sector include reclamation activities, and use of filters and sprinklers in order to control dust in mining operations.

It has been estimated that the daily per capita generation of waste in the Caribbean is between 500 and 1 000 grams per person (PAHO/WHO 1996). The quality and composition of the waste matter has altered significantly over the past 20 years, with solid waste changing from the dense and almost completely organic waste associated with agricultural economies to the less biodegradable waste produced in industrialized economies. Industrial waste from sugar factories and rum distilleries, which has a significantly higher pollution load than sewage, is a common problem for sugar and rum producing islands attempting to find suitable treatment systems for wastes such as dunder. A number of studies on treatment of wastes have been undertaken in Jamaica, Trinidad and other countries in the region, on disposal methods and treatments for food processing industries: however, none have been implemented, due to costs and reluctance on the part of the public and private sectors. Environmentally desirable methods such as sanitary landfilling and composting are not practised on any significant scale, and incineration is limited to the British Virgin Islands, to port waste in Barbados, and to hospital waste in a number of jurisdictions.

Technical development alone might not be sufficient to promote the adoption of cleaner technologies (Clayton *et al.* 1995). Some measures that could be adopted to promote wider development include greater regional collaboration; institution of incentives, regulatory mechanisms and standards; public debate and information dissemination; and aid from technologically advanced countries. The challenge for the Caribbean is to find ways of achieving greater use of cleaner technologies that would lead to sustainable development in the region.

## Financing environmental action

External financing has historically been the principal plank for the allocation of resources in the Caribbean countries. Trends and patterns in external financing have changed since the early sixties and late seventies, with greater emphasis being placed on sustainable development in recent years. Two principal constraints which have affected the effectiveness of external financing are the lack of adequate and appropriate institutional capacity and the inability on the part of both donors and recipient countries to effectively coordinate and focus on the implementation of policies and projects that are sustainable.

There have been dramatic changes in the sources of external finance available to Caribbean countries over the past decade. Net capital flows from bilateral and multilateral sources have declined significantly, from an average of US\$611.8 million and US\$482.4 million respectively in the period 1980–84, to US\$131.2 million and US\$79.9 million in the period 1985–90, and to US\$98.4 million and US\$91.4 million in the period 1991–96 (Table 2.4). These declines are due in part to high debt service obligations, world-wide decreases in aid flows, and the reorientation of many organizations in the donor community to address fundamental changes in the global economy. It is anticipated that these downward trends in bilateral and multilateral assistance to the region will continue.

Nonetheless, in the 1990s there have been increasing private capital flows to the region, from an average US\$317.9 million in 1985–90 to US\$3 987.7 in 1991–96 (Table 2.4). For many Caribbean countries, the keys to accessing scarce official resources are the achievement and maintenance of viable macro-economic frameworks, improvement of incentive frameworks for private sector development, and the ability to collectively and/or individually liberalize their economies and implement policies that alleviate poverty and enhance the environment. Should Caribbean countries consolidate their economic policies, there is the increased likelihood of the international financial markets playing a larger role in the provision of significant portions of the region's external financing requirements. To what extent the subsequent development will be sustainable remains to be seen.

**Table 2.4: Net external capital flows to Caribbean countries 1980–1996 (US\$ millions)**

	1980-84	1985-90 <sup>1</sup>	1991-96 <sup>2</sup>
Total Net Resources Flows	1 336.0	1 015.0	1 719.0
Total Net Long-term Resources Flows	786.2	968 <sup>2</sup>	1595 <sup>2</sup>
Official Development Finance	1,590.7	650.2	774.7
Grants	724.2	439.2	781.7
Loans	866.5	211.0	(7.0)
Bilateral	611.8	131.2	(98.4)
Non-concessional	n.a.	(23.7)	(125.3)
Concessional	n.a.	154.8	26.9
Multilateral	482.4	79.9	91.4
Non-concessional	n.a.	(15.1)	26.9
Concessional	n.a.	95.0	83.3
Total Private Flows	356.7	317.9	3 987.7
Debt Flows	n.a.	40.7	(139.0)
Commercial bank loans	n.a.	(48.6)	(108.3)
Bonds	n.a.	30.4	50.7
Other	n.a.	59.0	(81.4)
Foreign Direct Investment	266.4	277.2	958.9
Short-term Debt Net Flows	-	47.1	158.3
Memorandum items:			
Total Net Transfers	-	(57.2)	568.2
Workers' remittances, received	-	539.6	1 040.7

Notes: 1 Excluding Antigua and Barbuda, Bahamas and Suriname. 2 Includes IMF transactions

Source: World Bank; IMF International Financial Statistics (various publications).

## Public participation

The trend towards decentralization of government functions to provinces and municipalities identified by UNEP (1997) continues. The growth in recent years in the number of environmentally active NGOs, community-based organizations (CBOs), financial and technical support from international aid agencies, and enabling legislation, have allowed some Caribbean governments to divest or share environmental management responsibilities with groups at the 'grass roots' level.

The contribution of NGOs is crucial in the creation and management of protected areas as evident in the Kingshill Forest Reserve in St. Vincent and the Grenadines, the Montego Bay Marine Park in Jamaica, and in Trinidad and Tobago where concerned individuals and NGOs, with government support, introduced an 'eco-management' arrangement that vested responsibility for the management of the turtle nesting beaches in local villagers. The St. Lucia National Trust, along with the Caribbean Natural Resources Institute (CANARI),

spearheaded a nation-wide participation in protected area management (PANOS/CANARI 1994). Public participation is also being institutionalized through legislative requirements as in the case of St. Lucia, which included special provisions for public participation in amendments to its National Trust Act. Projects funded by international aid agencies continue to support initiatives that seek to incorporate public participation. The UNDP/CDB/CARICAD Capacity 21 Project, for example, gave financial and technical support for the establishment of Sustainable Development Councils (SDCs) to facilitate government and civil society partnerships in Barbados, Dominica, Grenada, Jamaica, and St. Lucia.

Local participation for some countries in the Caribbean is facilitated by public education and awareness rather than by active programme planning and implementation. NGOs and CBOs in small island states including those in St. Lucia, Barbados and Dominica have implemented capacity-building programmes to prepare them for effective management of protected areas. However, a number of

constraints have affected public participation, including weaknesses in the institutional capacity of NGOs and CBOs (finance, human resources, infrastructure); loopholes in legislation which result in uncertainty regarding roles and responsibilities in a partnership arrangement; absence of relevant policies; limited flow of information between governments, NGOs, CBOs and individuals at the grassroots level; little integration of sustainable development concerns in economic and policy planning; and the inability of Caribbean countries to implement international agreements due to lack of finances, lack of capacity or lack of will.

Despite some success in the regional adoption of public participation approaches in protected area management (Table 2.5), there is still need for further action by government and society in general to encourage and promote public participation. More education programmes; greater national budget allocations to education and human resources; and acceleration, strengthening or initiation of existing government

Table 2.5: Territories that have adopted public participation strategies in sectors identified by SIDS/POA and SOE

	Land	Water	Atmosphere (Climatic change)	Bio-diversity	Marine and coastal environment	National and environmental disasters	Management of waste	Tourism resources	National institutional and administrative capacity	Human resources development	Transportation and communication	Energy resources
Anguilla					●		●					
Antigua and Barbuda	●	●		●		●	●		●			
Aruba				●	●		●			●		
Bahamas												
Barbados		●		●	●	●	●	●				
Belize												
British Virgin Islands												
Cuba	●	●	●	●	●	●	●	●	●	●	●	●
Dominica		●				●	●		●			
Dominican Republic		●				●	●	●	●	●	●	●
Grenada												
Guyana												
Haiti												
Jamaica				●	●	●	●	●	●	●		
Montserrat												
St. Kitts and Nevis				●			●	●	●			
St. Lucia				●		●		●	●	●	●	
St. Vincent and the Grenadines			●		●	●	●	●	●	●	●	
Suriname												
Trinidad and Tobago				●	●	●	●	●				
Turks and Caicos												

Sources: ECLAC/ENEP/IDRC/UNDP (1997); data on Cuba from Cuba, Government of (1998a).

collaboration and co-management efforts to manage critical natural resources are some recommendations offered to facilitate increased public participation in the region.

## Environmental information and education

A growing number of Caribbean states have encouraged, promoted or implemented environmental information and education programmes in the management of land resources, bio-diversity and the marine and coastal environments. Many governments have also supported environmental information and education programmes in waste management and sustainable tourism. Nevertheless, there is a need for greater collaboration among SIDS and between SIDS regions, especially in the exchange of experiences and information and in the development of common approaches to solving problems. Governments need to allocate more resources for the development of public awareness activities related to UNCED *Agenda 21* and the SIDS/POA to catalyse discussion among various target groups including policy-makers, technocrats and the wider public.

### Environmental information

Some government policy initiatives in the region now make allowances for the establishment of environmental management institutions with responsibility for information management. For example, three regional governments – Jamaica, Trinidad and Tobago, and Guyana – have established institutions that will also be responsible for the development of National Environmental Information Systems (NEIS). In addition, nearly half the projects undertaken by SIDS up to November 1996 had an information component (ECLAC-CDCC/IDRC/UNEP 1997) and the trend has continued since then.

The establishment of institutions with information responsibility demonstrates the growing awareness among governments of the value of information in environmental management. Awareness is most acute at the technical level in the public and private sectors and NGOs. A positive development in the region is the growing involvement of NGOs in data collection, public education and capacity-building. The Caribbean Conservation Association (CCA) in Barbados is focused on implementing an information management programme, information dissemination, and public education. The Guyana Environmental Management

Conservation Organization (GEMCO) conducts ecological research, and in St. Lucia, the National Trust is working on progressing from the collection of scientific data to the incorporation of these data into a management system for its national parks.

Except for the activities of a few entrepreneurs, the private sector is not a major player in environmental information collection and dissemination. There appears to be a mixed reaction from the public sector to private sector initiatives in data management. A wide variety of regional networks are also involved, with some networks exchanging information via newsletters, for example, CARICOM's *Fisheries Newsnet* or the *Sea Grant* in the Caribbean newsletter. Others focus on creation and maintenance of regional databases on socio-economic and environmental data and information, for example AMBIONET, CARISPLAN, CEIS, INFONET and UNEPNet.

Geographic Information Systems (GIS) and Satellite Remote Sensing (SRS) technologies are used mainly by government agencies, although universities and the private sector also use them. There is, however, a tendency for entities funded by different donors to establish independent GIS systems. The result is a lack of co-ordination among owners/users of GIS, duplication of data collection effort and coverage, a lack of consistency in map scaling, and a lack of standards for spatial data quality. The Caribbean is increasingly using Internet technology but the level of use differs across regions, within countries and within organizations. Access to the Internet by Caribbean countries is a recent phenomenon (not many had access prior to 1997). Consequently, a World Wide Web presence is not fully capitalized by the environmental NGO community although there is some indication that a few have started to maintain a presence.

Although the potential for the use of information technology exists, the few Caribbean states that use GIS and SRS technologies continue to experience low financial resources and a shortage of relevant skills which militate against the successful adoption of these technologies. Other constraints on effective data management include the poor success of national focus point systems, lack of response from the focal points, and the difficulties experienced in obtaining country information. However, a Caribbean environmental information strategy was approved at the Caribbean Ministerial Meeting on the Implementation of the POA for the Sustainable Development of SIDS. As yet, however, little concrete action has resulted from this. In addition, the Caribbean CEPNET project has attempted

### Box 2.8: The CEPNET/IDB project: facilitating decision-making in coastal zone management

With its growing popularity, the Internet has become a powerful tool for information dissemination and management. In an effort to use this tool to help countries in the Wider Caribbean region to better manage their coastal and marine environmental resources, UNEP together with the Inter-American Development Bank (IDB) conceived the CEPNET/IDB project. The project sought to build and strengthen the capacity of the governments of the region, and the UNEP Caribbean Environment Programme, for documenting and disseminating their data holdings, thereby promoting the sharing of information and expertise in the subjects of coastal and marine resource management. This capacity was strengthened by the provision of training and the initial investment in the necessary equipment to establish and maintain Internet-based clearinghouses of coastal and marine data and information. The project was developed in six IDB member countries: Barbados, Dominican Republic, Jamaica, Nicaragua, Trinidad and Tobago and Venezuela. It is currently under development in the Bahamas.

While making use of the Internet as the medium of communication, the project was designed around the concept of disseminating metadata, or data about data. The participating agencies created Web sites with environmental information, as well as metadata for their key marine and coastal datasets. Metadata form the backbone of the clearinghouse system, where searches for metadata on coastal and marine data and information from the Wider Caribbean region can be executed on the Internet.

The participants also produced Internet-based 'State of the Coasts' reports for their countries. These reports use the Internet as a means of publishing information about the country's coastal zones, and Web-GIS to demonstrate coastal zone management case studies of relevance to the country itself and to the Wider Caribbean Region. The information content varies depending on the amount of existing data and information available in the country, as the collection of new data was not a part of the project. The main criterion for choosing an environmental problem or management application for display in the 'State of the Coasts' report was that it be of interest not only to the country producing the report, but also provide an opportunity for other Wider Caribbean Region countries to benefit from the shared experience.

to further environmental information for decision-making in the region (Box 2.8).

The Caribbean is increasingly making use of environmental information in decision-making for sustainable development and a number of technological opportunities are available to facilitate improved efficiency and effectiveness in data management and dissemination. A number of needs have been identified as critical to the development of successful information management systems in the region:

- the need for baseline data;
- the need to locate existing data/information;
- the need for quality data;
- the need for linkages between environmental and socio-economic data;
- the need for human resource development, and
- the need for inter-agency collaboration.

### Environmental education

It has been observed that 'traditional approaches to formal education in the Caribbean have not achieved a sufficiently high level of sensitivity towards the

environment' (Howell 1994). Caribbean governments have been slow to integrate environmental education into the formal education system because political support has been lacking. A growing number of NGOs, however, have spearheaded a new emphasis on environmental education, and although for the most part their approach has been non-traditional they have managed to achieve positive results.

Environmental education in Caribbean countries is also becoming more widespread and is slowly finding a place in the formal education system at the secondary and tertiary levels. Since 1993, Guyana has embarked on a programme of teaching and research in Environmental Studies at the University of Guyana, and Jamaica's UWI Centre for Environment and Development (UWICED) has plans to establish a teaching programme.

Voluntary NGOs, CBOs, and the print and electronic media have implemented non-formal and creative environmental education programmes in the Caribbean. Indeed, programmes carried out by the CCA for over ten years have assisted in the establishment of Environmental Awareness Committees and programmes in Anguilla, Antigua and Barbuda, Nevis and other countries in the region. International and regional bodies have continued to initiate regional workshops and training seminars on environmental education. A number of Caribbean countries have participated in regional training activities developed by the UNESCO/UNEP International Environmental Education Programme (IEEP), as well as other initiatives sponsored by regional tertiary institutions and NGOs (Howell 1994).

Whereas it is encouraging to see the growing number of NGOs and other bodies actively involved in environmental education, the barriers faced in integrating environmental education into the formal education system appear formidable. Decision-makers, as a first step, should put a higher priority on environmental education and devote more resources accordingly.

In spite of the many environmental education initiatives that have been undertaken across the region, the effectiveness of environmental education is being compromised by a number of constraints:

- a lack of appropriate curricula;
- inadequate materials and methodologies;
- inadequate funding for programmes;
- insufficient emphasis on specialized teacher-training in environmental issues;
- negative impacts of structural adjustment programmes (Howell 1994).

**Table 2.6: Territories that have used environmental information and education in sectors identified by SIDS/POA and SOE**

	Land	Atmosphere (climatic change)	Biodiversity	Marine and coastal environment	Management of waste	Tourism resources	National institutional and administrative capacity	Human resources development	Science and technology	Energy resources
Anguilla	●			●	●					
Antigua and Barbuda	●	●	●	●	●	●		●		
Aruba			●		●	●				●
Bahamas										
Barbados	●		●	●	●	●				
Belize										
British Virgin Islands										
Cuba	●	●	●	●	●	●	●	●	●	●
Dominica	●	●		●	●	●		●		●
Dominican Republic		●	●	●	●					●
Grenada										
Guyana										
Haiti										
Jamaica			●	●	●	●	●		●	●
Montserrat										
St. Kitts and Nevis	●		●		●	●	●			
St. Lucia	●		●	●	●	●				●
St. Vincent and the Grenadines	●			●	●	●	●			
Suriname										
Trinidad and Tobago	●		●	●	●	●	●	●	●	
Turks and Caicos										

Sources: ECLAC/ENEP/IDRC/UNDP (1997); data from Cuba from Cuba, Government of (1998a).

Few Caribbean governments have managed to implement a comprehensive environmental education programme owing to the reduced funding created by structural adjustment, and the tendency for policy-makers in most sectors to categorize environmental education as a low priority item.

## Social Policies

Social policies have had a significant impact on the environment in many countries. Programmes devised to fight poverty have often been unrelated to environmental policies. Projects that damage the environment have nevertheless been considered valuable because of the employment they have generated (UNEP 1999).

Population growth continues to put pressure on the limited resources of the islands. Although fertility rates in the region have generally fallen in recent years, they remained high in Haiti and the Dominican Republic.

The Caribbean population is still very young, but life expectancy in the region has improved significantly. For example, more than 50 per cent of the population is under the age of 25, although the age cohort 0–14 has declined. Simultaneously the age cohort 65 and over has grown from 4 to 10 per cent between 1950–1990 and is expected to reach 14 per cent (UN ECLAC/CDCC 1994).

Improving health, education and living conditions remains the top policy imperative for many countries, many of which see the eradication of poverty, or at least its reduction, as a prerequisite to environmentally sustainable development. Indeed, during the 1980s, recession, high interest rates, poor terms of trade and fluctuating currency exchange rates all contributed to the downward plunge of the economies of many countries in the region. The World Bank estimated that in 1990 about ten million people in five countries in the Caribbean lived below the poverty line, although the scarcity of relevant data and lack of uniformity in data measurement

techniques make the extent of poverty in the region difficult to determine. Haiti and the Dominican Republic account for approximately two-thirds of this number although Jamaica, Guyana and Trinidad and Tobago also had significant numbers of impoverished people, including the unemployed, women, young people, the aged, and rural dwellers. Unemployment rates in the region are generally high, with female unemployment significantly higher than male (World Bank 1996).

Economic conditions and the adjustment policies pursued by many Caribbean governments over the past decade have reduced the number of workers in the public and private sectors, resulting in a larger number of workers who, unless retrained for employment

elsewhere, could remain unemployed and therefore vulnerable to poverty. The consequence of any rise in poverty levels would be an increase in the pressure on natural resources as people would be forced to exploit vulnerable and fragile environments in order to subsist.

Migration from countries with relatively stagnant economies or political instability (Guyana and Haiti) to those with vibrant economies and labour shortages (Bahamas, British Virgin Islands and St. Maarten), and migration of skilled workers to North America, are longstanding characteristics of population movement in the region. Migration to urban areas is also on the rise as rural agricultural land is exhausted.

Although many macro-economic indicators show a

### Box 2.9: Small Island Developing States (SIDS) and the Lomé Convention

#### Lomé Convention

The Lomé Convention, which for the past 25 years has been the framework for the European Community and its African, Caribbean and Pacific (ACP) development co-operation partners, has from the very beginning taken into consideration the obstacles particularly hampering SIDS (Article 335, Lomé IV Convention). Out of the 71 ACP countries, 26 are independent island states<sup>1</sup> and 17 of them<sup>2</sup> fall into the category of least-developed ACP states, which entitles them to special treatment under Article 329 of the Convention (Lomé IV bis). When compared with other ACP regions, the island states have derived considerable benefits per capita from European Development Fund (EDF) allocations. (Total funds provided by the EC to island developing states for the period 1976–1995 were €4 447 million. For the period 1996–2000 (Lomé IV bis) the package foreseen for the National and Regional Programmes amounted to €1 024 million.) In addition, for several island ACP countries the trade protocols of the Lomé Convention on sugar, bananas, rum and rice have provided privileged access to the European market, and also indirect price support for these products. In order to assist some SIDS to diversify their mono-producer economies, the EC is supporting some banana and mineral producers with EDF and budget line assistance. Good examples of this are Jamaica and the Windward Islands.

#### Lomé and the environment

Lomé IV embodied for the first time in 1991 environmental agreements between the EU and ACP states stating that 'development shall be based on a sustainable balance between its economic objectives, the rational management of the environment and the enhancement of natural and human resources' (Art. 4), and a new Title I on Environment spelled out the principles, priorities and procedures for integrating an 'environmental reflex' into all other Lomé operations. It did not, however, set any quantitative targets, and as EDF 7 was programmed just prior to the Rio Conference, it is unreasonable to expect the Rio commitments to be fully reflected in the EDF national indicative programmes for 1992–96. The integration of the environment dimension into EC development co-operation takes place at three different levels: direct financing of projects and programmes with specific environmental objectives; environmental concerns in the overall dialogue with the partner countries; and through efforts to ensure that overall development and economic co-operation activities integrate

environmental issues, in particular through further development of the Environmental Impact Assessment (EIA) tool.

In 1996, the EC initiated a comprehensive independent evaluation of the environmental performance of its programmes in the developing countries. It was concluded that the overall environmental performance was relatively low in the period 1990–1995, in view of the extensive policy objectives which existed. Only a few of the National and Regional Indicative Programmes included sustainable development as a cross-sectoral issue at the strategic level, although almost all rural development programmes incorporated environmental factors. However, it was also indicated that improvements have been set in motion since 1990 through the design of specific strategies and through a more systematic use of Environmental Impact Assessment and the integrated Project Cycle Management. In the early 1990s the Commission introduced formal procedures for assessing the environmental implications of project proposals and for integrating environmental factors during the project cycle. Nevertheless, over the period 1990–1995, Environment Impact Assessment (EIA) procedures were rarely applied, although those actually undertaken were of a high quality. In 1998, a project was set in motion to update and harmonize the EIA procedures and guidance of the various departments of the Commission involved in development co-operation. This work will place attention on a more strategic use of the EIA instrument, as well as greater involvement of the developing country counterparts in the EIA process. However, since the Lomé Convention is a partnership agreement, the success of environmental policies depends only in part on incorporation of priority objectives into the design of EC programmes. More importantly, it depends on the commitment of ACP governments to these objectives in their respective national and regional indicative programmes.

#### Post-Lomé

The current Lomé IV Convention expires on 29 February 2000, and negotiations with a view to concluding a new development partnership agreement were started in September 1998. In 1996 the European Commission published its Green Paper on the future of ACP-EU relations, launching a debate on a thorough review of the present Convention. The paper observes that the relationship between the EU and the ACP countries will enter a new phase, that this renewed relationship will have to be based in the new global reality and that the



rebound from the crisis of the 1980s in recent years, other indicators related to quality of life and the condition of natural resources do not. For example, in some countries, malnutrition is a leading cause of death among children of poor households, and there are a growing number of street children and juvenile delinquents especially in Haiti, the Dominican Republic, Jamaica, and Trinidad and Tobago. While in recent years several Caribbean countries have significantly improved their level of access to safe drinking water, sanitation and quality housing, pipe-borne water is still not readily available in many households.

The Caribbean region has made some progress towards the goal of sustainable development but this

has been against the background of growing poverty, social tension, and environmental degradation. Many Caribbean countries have achieved a better understanding of the issues of sustainable development which has resulted in a better identification of environmental and poverty concerns throughout the region. In many countries the changed perception of the role of society in social development has resulted in the adoption of the principles of co-management and in a closer collaboration between governments, NGOs, community organizations and the private sector in setting standards, and in the preparation of environmental policies or action plans. In some countries this collaboration is formalized in the initial

innovations introduced will have to increase the efficiency of the co-operation programme. It also identifies some special aspects of importance to the SIDS: the challenges of further regional integration and transition to a competitive economic environment; problems such as political transitions, heterogeneous economies within the region, lack of human resources, migration and drugs (Green Paper, page 21); and stresses the attention to be given to problems relating to transport, communications, environment and preservation of natural resources.

On the surface the EU and ACP agree on the principles and objectives of future co-operation: strengthened partnership through deeper political dialogue – a partnership geared towards poverty reduction, sustainable development and further integration of the ACP into the international economy. Both mandates recognize the need for 'differentiation' between ACP countries (e.g. by providing special treatment to least-developed countries and vulnerable land-locked and island countries).

However, the aspirations of designing a simpler, leaner and user-friendly agreement are not necessarily focused on the same priorities. The Commission's mandate translates the commitment of radical review of the existing Convention into four main priorities. First, to rationalize and simplify existing instruments by grouping all resources for long-term development into a single facility (including structural adjustment, Stabex, Sysmin, decentralized co-operation etc.). Second, to restore the centrality of programming while linking resource allocation to performance. Third, to move away from projects towards support for sectoral reforms and, if conditions allow, direct budget aid. Fourth, to introduce the concept of differentiation in resource management. The ACP reform agenda looks quite different. There is much insistence on reducing delays; improving transparency; simplifying aid instruments; clarifying the division of roles, and reducing the adverse effects of aid on local institutions and capacities. The focus is on improving day-to-day management; less on changing the rules of the game. The three main proposals of the ACP group differing from the EU mandate are: to allow more time before making changes; to retain as much as possible of the current agreement; and to create a fairer deal. The ACP call for existing access for agricultural goods to be improved, whereas the EU makes no firm proposal, is not prepared to settle the case before negotiations on the future of trade arrangements (REPA), and will maintain the current access provisions until the new agreement is concluded.

Generally, the ACP seem more 'conservative' than the EU. The principles that the ACP promote are: local ownership of reforms; predictability and security of resources; partnership with more explicit allocation of responsibilities; simplification and rationalization of instruments, and flexibility in programming. As for the actors in partnership, in its negotiating mandate the ACP Group is rather vague about the nature and modalities of private sector involvement whereas for the EU extending partnership to a wide range of actors seems to be a political priority.

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1 Western Coast of Africa: Cape Verde and Sao Tomé & Príncipe; the Caribbean: Antigua and Barbuda, Bahamas, Barbados, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, St. Christopher & Nevis, St. Vincent & the Grenadines, St. Lucia and Trinidad & Tobago; Indian Ocean: Comoros, Madagascar, Mauritius and Seychelles; South Pacific: Fiji, Kiribati, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

2 Antigua and Barbuda, Cape Verde, Comoros, Dominica, Grenada, Haiti, Kiribati, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sao Tome and Príncipe, Seychelles, Solomon Islands, Tonga, Tuvalu, Vanuatu and Samoa.

movements for decentralization of governance to the community level. In most instances the region has also followed up on global conferences (Poverty, Women and Development and Population) by adopting and implementing Caribbean specific action plans.

Studies have determined that vigorous and sustained economic growth is an essential precondition for poverty reduction. Economic stagnation and problems of adjustment during the 1980s and early 1990s appear to have contributed to poverty in a number of countries. A related policy concern is the need to expand productive employment which calls for policies and measures to bring about vibrant economic growth as well as more direct approaches to employment generation. Social

integration to incorporate marginalized and disadvantaged groups as equals in society is also a concern for some countries in the region.

Social policy responses in the region have been manifested mainly in the form of poverty reduction and alleviation initiatives, employment generation, social services and social integration measures. In Jamaica, for example, legislation to provide old age, death and invalidity benefits have been enacted since 1965. Other countries in the region – Barbados (1966), Guyana (1969), and Trinidad and Tobago (1971) – have enacted similar legislation.

Various forms of food subsidy have been implemented in a number of countries, especially in

### Box 2.10: Lomé and the Caribbean Region

#### *Regional co-operation*

Regional co-operation under the Lomé Conventions will promote long-term collective, self-reliant, self-sustained and integrated social, cultural and economic development and greater regional self-sufficiency. In recognition of regional co-operation as a special feature of the four Lomé Conventions, over 10 per cent of the Lomé funds have been set aside for projects dealing with issues of interest to groups of ACP states on a regional basis. This funding is in addition to national allocations. In the Caribbean, regional co-operation involves Antigua and Barbuda, the Bahamas, Barbados, Belize, Dominica, the Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname and Trinidad and Tobago. These countries have in 1991 established CARIFORUM and nominated a Regional Authorising Officer (RAO). He is assisted by a Programming Unit which co-ordinates Caribbean regional co-operation with the European Union and assists in the preparation of project proposals. The implementation of this co-operation is decentralized, and each project is managed by a Deputy Regional Authorising Officer (DRAO), supported by the corresponding delegation of the European Commission in the CARIFORUM region.

In the Caribbean, regional co-operation covers the region's fifteen ACP countries and has benefited from more than €340 million in the form of allocations since 1976. The Regional Indicative Programme covering the first financial protocol of Lomé IV (7th European Development Fund) signed in 1992, involves €105 million. Its main objective was *the promotion and support of regional co-operation and integration*. This process is based on liberalizing the intra-regional movement of production factors, a closer co-ordination of strategies and sectoral policies at regional level, and the reinforcement of functional co-operation in the region. Programmes under these themes cover trade, tourism, agriculture, telecommunications and transport, human resources development and environmental protection.

The Regional Indicative Programme covering the second financial protocol of Lomé IV (8th EDF), which was signed in 1997, allocated €90 million for the promotion and support of *regional economic integration and co-operation* (including private sector development in trade and tourism) and *human development and capacity building* as the two focal sectors of Community support. Outside the focal points, priority programmes are planned in the areas of decentralized co-operation with non-state actors and within the framework of the Caribbean action plan for drug control.

#### *Co-operation at national level*

The main sectors to receive support in the Caribbean, however, have been *transport and communications*. In 1990 an exceptionally high commitment was made for tourism which accounted for more than 26 per cent of all aid to the Caribbean in that year because of commitments made to the Netherlands Antilles. In 1993 commitments to the Dominican Republic and Guyana increased the share of *industry* projects to an exceptional €54 million, which was 20 per cent of all aid in that year. The Dominican Republic also received significant aid flows in the *energy* sector in 1994 and 1995.

The high proportion of aid to the *social sectors* (12%) is mainly accounted for by big water and sanitation projects in Jamaica and Guyana in 1993 and 1995 respectively. *Health* issues have become more prominent in commitments to the Caribbean since 1992 and accounted for an exceptional high 6 per cent in 1994, mainly thanks to €9 million commitments to the Dominican Republic. *Rural development* appears as 5 per cent of all aid to the Caribbean between 1986 and 1995, but this is mainly due to two years, 1988 and 1992, in which €21 million and €38 million were allocated to this sector. Only Jamaica and Guyana received substantial commitments in support of rural development. The agricultural sector, which received €40 million between 1986 and 1995, was prominent only in Suriname and Grenada. In 1992 and 1995 some commitments were made for good governance and civil society: in 1995 all of this was allocated to Haiti.

#### *Environment*

The approach of the EC in the CARIFORUM Caribbean with respect to *environmental policy* has been linked mainly to policy reform and capacity development. Environment has not been a focal area but an integral part of National and Regional Indicative Programmes. Projects have been implemented in the areas of biodiversity and coastal zone management (Jamaica, Belize, Guyana), eco-tourism and environmental management (Dominica), sustainable agriculture (Dominican Republic), sustainable forestry (regional, Belize, Jamaica, Suriname).

Under preparation at the regional level is a four-year *Caribbean Regional Environment Programme* which aims to strengthen regional co-operation and build capacity in conservation management and sustainable development of amenity areas. The main activities include development and strengthening of an effective regional environmental information network, promotion of education and awareness on

Guyana and Jamaica. Public employment schemes – mainly in the form of short-term jobs for unskilled and manual workers – have also been adopted in many countries while many governments have introduced income enhancement policies to help the poor through credit, training and technical support. Guyana's Social Impact Amelioration Programme (SIMAP) to finance small, short-term technically feasible projects is an example of this type of programme. Programmes targeting youth, women, the disabled, and other marginalized and disadvantaged groups have been developed and implemented by some Caribbean states. An example of this is Trinidad and Tobago's SERVOL programme which sought to re-integrate disadvantaged

youth into society.

The success of poverty reduction and other social policies in the Caribbean has been severely affected by a number of constraints and shortcomings, some being the direct result of economic recession in the region. In most Caribbean countries there is also an absence of a system-wide monitoring mechanism to evaluate the effectiveness of social programmes. It is also apparent that some social problems have not been adequately addressed by relevant agencies. Reports found that sufficient resources are not being invested in education and human resource development as most countries in the region still show high levels of illiteracy.

environment issues, improvement of the skills and capacity of the regional institutions and development and enhanced management of amenity areas (marine, terrestrial, and watershed). The project will cover all CARIFORUM member states except Haiti and the Dominican Republic. These two countries will benefit from a specific programme financed from the resources of the 8th EDF.

**Specific instruments (Stabex, Structural Adjustment, Humanitarian Assistance...)**

Stabex transfers during the past few years have been relatively low but peaked in 1991, 1994 and 1995 when they accounted for 14 per cent, 12 per cent and 24 per cent of Caribbean aid respectively. St. Lucia and St. Vincent received particularly high payouts in the last two years – as compensation for the *banana crisis* – whereas most of the 1991 transfer went to Haiti. The main recipients of support for structural adjustment were Haiti, the Dominican Republic and Jamaica, which account for 70 per cent of the total support to the Caribbean through this instrument. Haiti received €58 million in food aid and €38 million in humanitarian assistance, which accounted for most of that aid to the Caribbean.

**Post-Lomé and trade**

In November 1998, the European Commission released studies on the impact on ACP countries of its proposed Regional Economic Partnership Agreements (REPAs). General conclusions of the studies were:

1. In most cases, LDCs have little to gain from REPAs. They can keep non-reciprocal trade preferences in any case.
2. The loss of non-reciprocal preferences would hardly affect the export performance of many ACP countries.
3. By contrast, the direct or indirect effects of not renewing the protocols could dramatically affect the exports of some ACP countries. However, the studies did not estimate these effects as this would have required separate studies.
4. The negative impact on customs revenues varies considerably, but could be substantial for some.

In the Caribbean, the study included CARICOM<sup>1</sup> (the Caribbean Community) and the Dominican Republic. CARICOM is the most integrated of the ACP sub-regions, and has institutional mechanisms capable of negotiating with the EU. It is currently at an advanced stage of negotiating an FTA with the Dominican Republic. This could soon be

an entity with which the EU could sign a REPA. If CARICOM granted preferential treatment to the EU, it would have to extend it also to the US and Canada, with whom it has trade agreements. CARICOM has also entered, or has plans to enter, trade negotiations with Mexico and several Latin American countries, and would take part in the wider Free Trade Agreement of the Americas (FTAA). The main recommendation of the study was therefore that any negotiation of a REPA should be co-ordinated with those activities, and thus should not necessarily fit the 2005–2015 timetable proposed by the EU.

As for the impact of a REPA, results indicate that trade creation would substantially exceed trade diversion, although the former was estimated at only 10 per cent of CARICOM/DR imports. The analysis indicated that there would be significant losses in terms of revenue from import taxes, on which CARICOM/DR countries, especially the smaller Caribbean states, are heavily reliant. Since a REPA would probably be introduced along with hemispheric trade liberalization, the induced adjustment cost will be very high, and thus require special attention by aid donors, including the EU. It was also recommended that sensitive, mainly agricultural, sub-sectors be excluded from the agreement on the grounds of maintaining employment in socially desirable areas.

1. Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, St Kitts & Nevis, St Vincent and the Grenadines, Suriname, Trinidad and Tobago. (The Bahamas are members of the Community, but not the common market.)

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# Future Perspectives



## Introduction

For most of history, the capacity of human beings to affect the environment was limited and local. Today, human activities have grown to the point where they not only affect many of the large-scale physical systems of the planet, but also have consequences that reach far into the future. The impact of present policies, for example on energy and infrastructure, will extend well beyond the lifetimes of those who initiated and implemented these projects. The future impacts of today's decisions are becoming more and more prominent in current policy-making (UNEP 1999).

This chapter deals with some of the environmental issues in the Caribbean that will require priority attention in the coming years. Many are old problems that are rapidly becoming worse or for which solutions are becoming more and more difficult, while others are issues that are at present not high on the policy agendas of the region's governments. In addition, the chapter identifies one key issue for the future, namely energy, through an alternative policy study.

According to *GEO-2000* (UNEP 1999), the environmental issues that may become priorities in the twenty-first century fall into the following categories:

- unforeseen events and scientific discoveries;
- sudden, unexpected transformations of old issues;
- well-known issues that currently do not receive

enough policy attention – although their long-term environmental consequences are well known.

The huge increase in environmental research over the past two decades has made the possibility of sudden and unexpected scientific discoveries about the environment less probable. Scientific discoveries such as stratospheric ozone depletion and acid rain, or rather the bringing to light of their consequences in a sudden and unexpected way, is less likely.

Unexpected transformations of old issues are more likely. Many of the issues that will require priority attention in the next century will be aggravated forms of today's issues – many of which continue to evolve and broaden in response to changing socio-economic, cultural and environmental conditions. An example is the current surge in number and severity of natural disasters. A further example with heavy impacts on the Caribbean is coral bleaching. In the mid-1980s, this phenomenon was more severe than ever before and occurred in at least 60 countries around the world (ISRS 1999; ITMEMS 1998). Although the links between global climate change, the El Niño phenomenon and extensive coral bleaching are still subject to debate (ISRS), it has been suggested that only global warming could have induced such extensive bleaching simultaneously throughout the disparate reef regions of the world (Pomerance 1999, from UNEP 1999).

Most issues that will require policy attention in the next century are ones that are well known. As time goes on they will become more severe and pose major local

and global challenges. If these challenges are not addressed, they will give rise to major environmental crises in the twenty-first century (UNEP 1999). They are emerging primarily due to lack of action. There are numerous examples from the past which affect the Caribbean region. Increased and accelerated emissions of carbon dioxide have led to climate change issues; the increased intensification of fishing activities has led to the collapse of fisheries in many seas, and the relentless pace of urbanization, especially in coastal areas, has created problems for governments (UNEP 1999). Many of the emerging issues for the Caribbean region fall within this category of 'neglected issues'.

### Issues for the Caribbean in the twenty-first century

Addressing the policy nexus between emerging environmental concerns and future economic development trends is an urgent task for ensuring the sustainable development of the Caribbean. Currently, the small states of the Caribbean are hard pressed to respond effectively to global environmental problems such as climate change because of their ecological fragility and their economic vulnerability within the context of a globalized world economy.

From a regional perspective, the key issues that will need to be addressed in the coming millennium include the following (see also Box 3.1):

- global climate change and the impacts of climate variability;
- linkages between globalization and environmental management;
- coastal, marine and fresh water resources;
- waste management and pollution practices, particularly in the tourism industry;
- capacity development, and
- energy.

The interlocking nature of economic factors and ecological conditions is very evident in the Caribbean region where economies are heavily dependent on tourism, mono-crop export-led agricultural practices, mineral hydrocarbon exploration and escalated use of marine resources. These economic activities all involve direct exploitation of natural resources, such as coastal environments, marine ecosystems, agricultural land and mineral resources. Rapid and irreversible degradation of these resources greatly

reduces these countries' prospects for socio-economic growth and development. While development pressures on coastal and marine resources are common to all countries, they are more acute in the small island states. In these countries, careful attention needs to be paid to the problems of urbanization and tourism development with a view to formulating policies and instituting capacity that will prevent coastal and marine environment degradation and reduce problems of waste disposal.

To ensure the effective implementation of sustainable development within the region, priority will have to be given to the development of economically sound and environmentally beneficial technologies and practices, particularly in the areas of transportation (less polluting, higher efficiency vehicles), waste and pollution management, toxic chemical disposal, and land and natural resource management. Clearly one of

#### Box 3.1: Emerging problems in the Caribbean – an alternative perspective

A number of emerging problems were identified (either explicitly or by inference) by the responses to a questionnaire prepared by the ECLAC Sub-regional Office for the Caribbean. These emerging problems, for the most part, occur unevenly across the region, and relate to the following:

- continuing degradation of the Caribbean marine environment;
- problems relating to fresh water resources, regarding both the quantity required to meet increasing demand and the quality of the water supplied;
- frequent absence of measures to ensure ownership and protection of intellectual property rights in the area of bio-diversity;
- the low priority attached to the commercial development of energy based on renewable sources;
- sparse arrangements for the reintroduction of bio-genetic resources following disasters;
- limited capability in, and attention to, the generation and use of such modalities as economic instruments and indices of sustainable development in policy development and planning;
- sparse efforts at the compilation of biodiversity resources;
- concerns related to land resources involving intensified land-use conflicts;
- inadequate attempts at the co-management of major economic sectors such as tourism, and wider conservation and sustainable development activities involving all economic and social sectors, as well as local communities;
- unavailability of resources for GIS and mapping;
- the apparent de-emphasizing of sustainable development criteria in some cases, and the emphasis on economic goals in a context of a tightening financial situation, and
- difficulties encountered in managing the implementation of projects where the collaboration of a number of agencies is required.

Source: ECLAC (1999).

the most critical issues in the region's ability to respond to these issues is the development of effective technical and institutional capacity. It is also important to note that many of the emerging issues identified by the region are influenced by factors and concerns that are externally induced or global in nature.

### Global climate change and the impacts of climate variability

Combating the adverse effects of global climate change is a particularly serious concern for the Caribbean. Comprising predominantly small island and low-lying states, the region is gravely affected by global changes such as sea-level rise, coastal zone inundation, and the increasing frequency and intensity of hurricanes and typhoons.

Although these small Caribbean states are not significant emitters of greenhouse gases, their very existence is threatened by the adverse impacts caused by increases in anthropogenic emissions of greenhouse gases in other regions of the world. The principal challenge for the region is to develop adequate adaptation strategies that will allow states to respond to and cope with the adverse impacts of global climate change.

The Caribbean region is prone to extremely damaging natural disasters, primarily in the form of cyclones, volcanic eruptions and earthquakes, and are subject to effects of climate variability. The 1997–1998, El Niño phenomenon had its strongest impact on record on the region, and the 1998 hurricane season was especially devastating: the impacts of hurricanes Georges and Mitch will be felt for a long time. The region will have to work to improve scientific understanding of severe weather events, such as those associated with the El Niño Southern Oscillation, and develop long-term capabilities for natural disaster mitigation and early warning systems.

### Globalization and environmental management

Given the small size of their economies, Caribbean states are extremely vulnerable to impacts of global trade and global financial flows. For small countries, the increased flow of information and the growth of information technology as a consequence of globalization also produces new challenges in the management of information. Constraints to the sustainable development of the Caribbean region include:

- fragile and small natural resource bases which do not allow states to benefit from economies of scale;

- small domestic markets and a heavy dependence on a few external markets;
- costly energy imports;
- frequent exposure and vulnerability to climate-related natural disasters;
- rising populations;
- high volatility of economic growth;
- limited opportunities for the private sector, and
- dependence on public sector investments.

The pace of globalization and liberalization has heightened the economic problems faced by small island developing states and presented new challenges and opportunities for them. As a result of globalization, national policy frameworks and external factors, including trade impacts, have become crucial in determining the success or failure of national policy efforts. At the regional and national level, Caribbean states will need to focus attention on policy practices that integrate economic, social and environmental approaches in order to maximize opportunities available to them and to minimize the constraints they face.

Ecological fragility, close interdependence of economy and environment, and vulnerability to natural hazards mean that the Caribbean countries must be vigilant in maintaining their natural resource base. Over-exploitation of near-shore fisheries, conversion of wetlands and forests for other less productive uses, and pollution, are common problems which must be avoided in pursuing sustainable economic growth. Natural resource accounting must be factored into the planning of economic and social activities so that the true costs of development options can lead to selection of activities that minimize negative impacts on vulnerable and productive ecosystems.

### Coastal, marine and fresh water resources:

Heavily dependent on the revenues from tourism, many small island nations have sought to rapidly develop their fragile coastal areas. But this aggressive coastal development, along with overfishing, pollution and the introduction of exotic species, are factors that play a major role in the destruction of valuable coastal and marine ecosystems.

The health, protection and preservation of coastal and marine resources are fundamental to the sustainable development of the Caribbean region. Improved coastal and ocean management, sustainable use of coastal and marine resources and the reduction of land- and sea-based pollution are critical issues in the

maintenance of the oceans as a source of food and equally critical in the development of tourism. Coastal zone management is assuming increasing importance in the Caribbean. Management systems are being developed to deal with the growing problems of coastal deterioration caused by rapidly expanding levels of beach tourism, growing urbanization of coastal lands, and coastal sand-mining to support the construction industry in coastal areas and elsewhere.

The development of sound policies and practices that facilitate the integrated management and sustainable development of coastal zone ecosystems and marine resources, including wetlands and coral reefs, is an urgent task. To ensure marine and coastal food supplies for the region, increased attention will need to be paid to the promotion of sustainable fisheries and environmentally sound aqua-culture practices. Building on the work of the International Coral Reefs Initiative (see, for example, Bryant *et al.* 1998), action will also be needed to sustain healthy reefs. Such actions could include the development of integrated national and regional community-based reef conservation and management programmes and the promotion of sustainable tourism practices.

In much of the Caribbean, small watershed and aquifer-recharge areas limit surface water and groundwater resources, and urbanization has placed additional stresses on the availability and quality of water resources. The geophysical characteristics of many small islands leave them vulnerable to periods of drought, and to slow recharge rates. Adverse environmental impacts, including pollution, saline intrusion and soil erosion, reduce the quality of fresh water resources. Consequently, careful attention will need to be paid to integrated water resources management, and to practices and systems that take into consideration land-use patterns, soil erosion, watershed management and waste disposal.

### **Management and disposal of wastes**

Significant increases in the production of waste have resulted from the rapid development of tourism and industry, as well as from urbanization, demographic changes and altered patterns of consumption. The quality and composition of the waste generated within the Caribbean has also altered significantly over the past two decades. Solid waste composition has changed from the dense and almost completely organic waste associated with agricultural economies to the less biodegradable wastes of consumer societies, including toxic materials. Ineffective waste disposal systems have had significant

adverse impacts on the terrestrial, coastal and marine environment. Inadequate institutional arrangements, ineffective legislation, lack of monitoring of effluents and emissions, and failure of enforcement mechanisms relating to the management of waste are prevalent in almost all countries in the region.

Pollution of land and water by sewage is a major public health hazard in several Caribbean islands, where low absorbability sub-soil conditions and high groundwater conditions prevail. In densely developed coastal areas, the height of the groundwater table limits the absorptive capacity of the soil and heighten the risk of sewage pollution of coastal waters during large-volume discharges. In a number of islands, out-fall pipes have been damaged or destroyed by hurricanes and rough seas and as a consequence pipes discharge raw sewage onto beaches and into inshore marine areas. The problem of faecal contamination from land-based sources is compounded when yachts discharge raw sewage into the water. The increasing popularity of the Caribbean as a destination for cruise ships has led to an increase in the volume of waste discharged at ports, where reception facilities for ship-generated solid waste are generally inadequate. This is a particular concern where coral reef systems are involved. In some locations the degradation of protective reef systems by sewage-induced eutrophication is contributing to coastal erosion and the destruction of beaches.

The problems associated with toxic wastes are not confined to industrialization. In agricultural areas farm run-off, containing chemicals, is adversely impacting the aquatic environment. There has also been an increase in the trans-boundary movement of toxic and hazardous waste, including chemicals and radioactive materials, through the Caribbean Sea. Attempts have also been made to establish disposal/incineration facilities for foreign waste. Although a number of states have ratified the Basel Convention, there is no united response to this problem – Cuba and Dominica being among the few countries to have formulated laws banning the importation of hazardous wastes.

Very high priority has been accorded to the sustainable management of waste by most countries, and efforts are being made to improve management structures. In this regard, most have ratified relevant international conventions, and legislative deficiencies are being addressed in those countries that have functioning environmental management agencies. Environmental monitoring and management systems as well as emission and effluent standards are being developed and will need



to be continually strengthened. Nevertheless, these activities will need to be implemented more completely and more quickly if the issue of waste management is not to become a major problem in the coming years.

### Capacity development

Despite the convening of numerous global environmental conferences, very little attention has been paid to understanding and supporting the technical and institutional processes by which Caribbean island nations respond to the problems of environmental degradation. Consequently, the difficult issue of building economic and institutional capacity within such nations still remains to be addressed. The UN Secretary General's Report on progress on the implementation of the Barbados Programme of Action for SIDS indicates that the two key constraints related to institutional capacity-building are the limited availability of human resources and a lack of financial resources for developing and strengthening institutions and mechanisms (UN ECOSOC 1999a, 1999b). The constraints imposed by the inadequacy of technical capacity at the national level as well as at the level of regional institutions impairs the ability of small island Caribbean nations to meet the challenges of sustainable development because many of these nations depend on regional mechanisms and institutions for responding to environmental problems.

The central challenge is therefore to build regional capacity that will not only develop data and monitoring networks for weather, climate and sea-level rise, and strengthen the legal and institutional protection of valuable natural resources, but also engender more effective systems to manage wastes and reduce sewage contamination, promote tourism practices geared to biodiversity conservation and protection, minimize dependence on destructive agricultural and land-use patterns and promote the use of sustainable energy.

### Energy

Use of renewable energy sources and increased energy efficiency offer scope for tapping what are considered to be sizeable domestic resources in the Caribbean and thus of reducing exposure to risk. In some Caribbean countries where the national electricity grid does not extend to remote rural areas, renewable energy technologies such as photo-voltaics are seen as a cost-effective option. While there are many ways to approach renewable energy issues, they should be reviewed in the context of competitive energy markets, and fiscal, legislative and regulatory barriers.

## Scenarios for the future

The priorities identified in the first two chapters of this report, and discussions at the regional consultation, indicate that a number of issues warrant further scenario study. These issues include land use (land-based activities and their impacts), fresh water and energy. For this first *Caribbean Environment Outlook*, energy has been chosen as the policy study. The reason for this choice is that energy was identified as a priority not only by the SIDS POA, but also by the CEO process. In addition, energy use has profound impacts on the Caribbean, both in terms of environmental pollution and in terms of its impact on the economies of the region. An underlying commonality among Caribbean nations is the reliance on crude oil as the main fuel for energy production. This consumption of petroleum results in high foreign exchange bills, and increasing exports to maintain purchases of the commodity. This study draws extensively on information available in two ongoing studies being undertaken by the University of the West Indies Centre for Environment and Development (UWI-CED): 'Barriers to Renewable Energy Use' and 'Social and Environmental Costs of Petroleum'.

The adoption of alternative energy policies is something that can be undertaken fairly easily by the governments of the region. Indeed, there have already been examples of such shifts, albeit on a small scale, with Jamaica and Barbados providing case studies for wind and solar power respectively. A project established at the Munro College in St. Elizabeth, Jamaica, generates one million kilowatt-hours of electricity each year using wind-driven turbines. This electricity is currently being sold to the national utility company, the Jamaica Public Service Company (JPSCo.), and is incorporated into its grid (CEIS). Barbados has also embarked on a massive exercise to introduce solar power to meet its energy demands for water heating in domestic and commercial enterprises. Both exercises are exploiting natural weather patterns of the respective countries. It would therefore not be unreasonable to adopt similar strategies throughout the region as comparable conditions exist right across the Caribbean.

Distinct from the provision of energy from the 'formal' energy sector, a vibrant 'informal' energy sector is in existence around the Caribbean, in the form of unregulated production of charcoal or wood fuel. This practice is mainly carried out by people from the lower socio-economic stratum of society who either have had little or no education, or who regard this enterprise as a

viable source of income in the face of poor employment prospects. One of the main consequences of this 'industry' is the removal of vegetation from ecologically sensitive areas. Trees are removed from designated watershed zones, and no effort is made to replenish the stock. The implications of this become more apparent in the more water-stressed scenario which affects a number of the islands in the Caribbean.

### Scope of the study

The questions that this section attempts to address are: 'What policy changes can be implemented to enhance cleaner energy technologies while delivering reliable power supplies at manageable costs?' and 'How will this impact on the priority issues of climate change and those associated with the coastal and marine environment?'

### REFERENCE SCENARIO ('BUSINESS AS USUAL')

This scenario assumes continued oil dependence in each of three countries – Jamaica, Barbados and St. Lucia. It also assumes that there will be no new investments in renewable energy or energy efficiency and that the policies in place, such as current laws, will remain unchanged. The projections of forecasting studies of the Latin American Energy Organization (OLADE) indicate that the overall electric power demand of Caribbean countries will grow by 3.2 per cent to 6.7 per cent per year during the period 1998–2010. In order to meet this growth without implementing any alternative policies, additional capacity of 400 MW will have to be provided, at a cost of US\$25 million per year over the same period of time.

Table 3.1 summarizes assumptions regarding future electricity production in three island states. This scenario represents developments in the electricity sector that can be expected given the continuation of trends in electricity use and fuel prices. In this 'business as usual' scenario for Barbados, current high growth rates of roughly 5 per cent per year between 1993 and

1998 continue in the near term and gradually taper off to 3 per cent per year by 2015, resulting in an average annual growth rate of about 4 per cent. St. Lucia has experienced very high demand growth rates of around 10 per cent per year in recent years. A recent study suggests these rates may decline to about 8 per cent in 2005 and then decline further to 5 per cent per year in 2015, resulting in an average annual growth rate of nearly 7 per cent per year (OLADE studies).

### Impacts of the reference scenario on selected environmental issues

A combination of rising energy use, expanding populations and a 'business as usual' scenario (Box 3.2) will have a severe impact on the sub-region's socio-economic development and living conditions. If current trends continue, the region may encounter not only increasing environmental problems, but also balance of payments problems due to rising energy costs.

Historically, the Caribbean countries have had to rely on external sources of fuel to meet their energy requirements. Trinidad and Tobago is the only country in the region with oil reserves of its own. The use of crude oil and petroleum-based products extends throughout the islands' economies, from transportation to the generation of electrical power.

Of the environmental issues that present themselves in the energy sector, climate change, deforestation and watershed deterioration are of most concern, along with the increasing incidence of air pollution. Informal sector pressures are also having a severe impact on forest resources.

One of the main environmental impacts of energy production is the gaseous and particulate emissions that are discharged. The gases include carbon dioxide, methane, sulphur dioxide and nitrous oxides, which result from the combustion of fossil fuels. The low quality fuels and technologies typically used in the region (high sulphur content fuels and negligible emission controls) emit a variety of pollutants that contribute to public health effects. Caribbean countries along with most of the world's nations have committed themselves to the United Nations Framework Convention on Climatic Change (1994) which recognizes this change in global climate.

Also related to the evolution of these gases is the damage done to the ozone layer and their contribution to the greenhouse effect. Emissions from fuel-consuming enterprises are made up mainly of carbon dioxide and methane which are discharged into the atmosphere and subsequently attack the earth's protective ozone layer.

**Table 3.1: Electricity production forecast**

	System generation (GWh)		Growth rate
	1995	2015	
Jamaica	5 811	10 883	3.2%/yr
Barbados	644	1 388	3.9%/yr
St Lucia	191	510	6.7%/yr

Source: OLADE

Note: For Jamaica, system generation assumptions are based on data obtained from JPSCo as well as from OLADE.

While the Caribbean is not a major contributor to greenhouse gas emissions, the region will be adversely affected by climate change. As such, leading the way with alternative non-polluting energies will set an example for higher polluters.

For these reasons, revision of existing energy policies and formulation of new policy frameworks that impact the environment less than current practices do need to be carried out. Promoting the transition to different energy forms, for example through aggressive conservation and emissions regulation, is an important step.

### Alternative policies

As previously stated, there is a great dependence in the Caribbean region on energy generated from fossil fuel sources. One alternative that must be explored and indeed implemented in Caribbean states is a shift to new,

renewable forms of energy, for example wind, solar power and natural gas. An obvious advantage of adopting these forms of energy is the reduction in the quantities and related costs of crude oil imports. Secondly, the emissions associated with the refining of crude oil and actual use of the refined product will be abated. Also, the incidence of oil spills – which are likely with the frequent transport of the commodity through the region's oceans from oil-producing areas in North and South America – will be dramatically reduced.

The following is a selective overview of policy options available for promoting a transition to the use of renewable energy and improved energy efficiency in the Caribbean. It is important to note that the effectiveness of any particular option has to be considered within the overall planning context in which it is introduced. Indeed, the solutions for encouraging the use of renewable energy

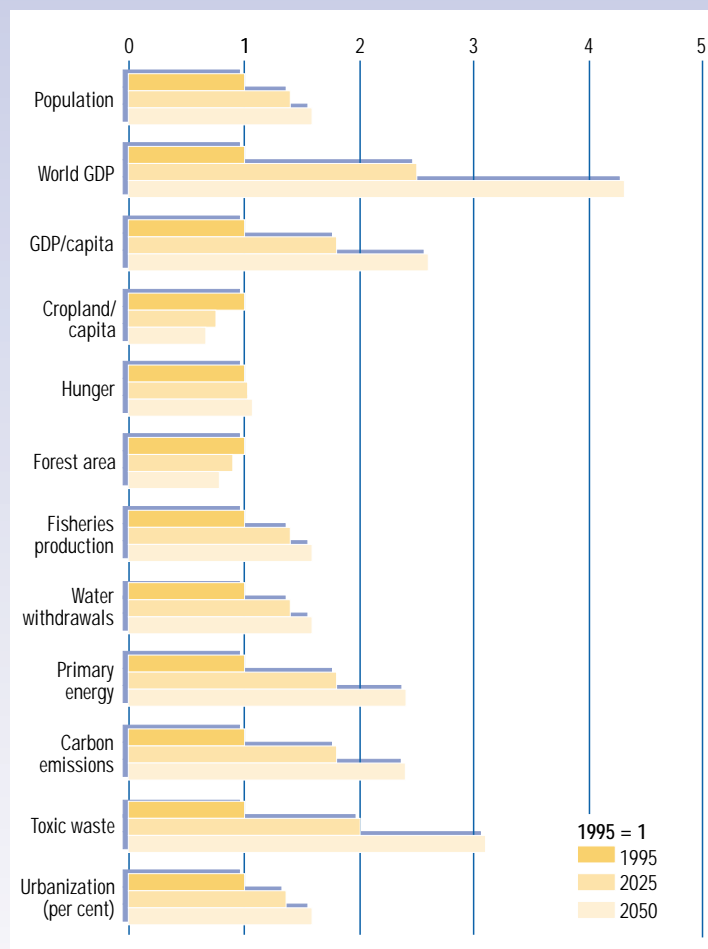
#### Box 3.2: 'Business as usual' scenario – the global picture

The conventional development or 'business-as-usual' scenario provides the framework for many projection studies (SEI/UNEP 1999). Under this scenario, world population increases 65 per cent and economic output more than quadruples by 2050. At the same time, income per capita, expressed in purchasing power parity, would grow 2.6 times. Under these conditions, energy and water requirements are expected to increase by factors of 2.4 and 1.6 respectively, and food requirements to almost double, driven by growth in population and income. Despite rising average incomes, the number of people still in poverty and unable to feed themselves adequately would rise slightly rather than decline over the next 50 years as populations grow and traditional sources of material support are eroded.

With such a continuation of present trends in population growth, economic growth and consumption patterns, the natural environment would be increasingly stressed. Many environmental gains and improvements would be offset by the pace and scale of global economic growth, increased global environmental pollution and accelerated degradation of the renewable resource base.

Widespread policy reform could make a significant difference to these outcomes (SEI/UNEP 1999).

Source: UNEP (1999)



are inherently regional and even system-specific. Issues such as a country's implementation record (if any), its stage of development, the degree of privatization of the electricity supply sector, and informational requirements of the policy, will determine the relative advantages and disadvantages of the various options available.

For the shift to new forms of fuel and/or energy to happen, a favourable environment has to be in place. This will be facilitated by economic and legislative instruments, which favour the development and use of renewable forms of energy over the current energy systems present across the region. The case studies for Jamaica and Barbados show that this is indeed possible and can be extended to other Caribbean nations. However, the task needs to be expanded to incorporate more forms of energy, for example natural gas to make use of raw materials, which are common to the region.

The shift towards more renewable forms of energy will also require mechanisms by which tariffs are levied on fuel imports so as to encourage the implementation of renewable energy technologies. There should also be a regulatory framework by which air emissions are controlled, i.e. a permit system that dictates the quantities and constituents of air emissions derived from energy-related processes. This measure would force energy producers and some consumers to adapt their operations to adhere to the new standards, and simultaneously institute efficient processes. Moreover, the permit system will reduce the impact that these emissions have on the environment.

The trend towards the unmonitored and uncontrolled importation of motor vehicles with little regard for fuel efficiency has to be arrested. At present, cars and other vehicles are brought into the region indiscriminately – and a fair number of these are 'gas guzzlers'. Also, there are no real regulations to safeguard against the emissions from these engines. The shift towards non-leaded gasoline and reduced use of diesel fuel needs to be intensified so that the air pollution hazard can be drastically reduced.

A remedial and eventually sustainable measure is recommended with respect to the production of wood fuel. This would entail the re-planting of trees specifically meant for the production of charcoal. Other options include plant oil commodity control to meet household needs and produce a product that has growth potential as a natural raw material for energy, chemicals and pharmaceuticals. Not only would this activity reduce the stress on the vegetation resource, but it would also maintain and restore the integrity of the watershed catchment areas and reduce surface run-off which can

prove critical during tropical storms. Another benefit to be gained by preserving these areas is that the sinks for carbon dioxide, a major greenhouse gas, will remain intact – so helping to offset the negative effects of global warming.

In addition, the legislative and economic frameworks of the Caribbean have to be tailored to bring existing energy delivery systems into line with environmental air emission standards. This will include the setting up and enforcement of limits on the amounts and types of emissions that are allowable for energy-producing entities and a penalty, usually monetary, on entities that do not adhere to these limits. Further to these measures, economic incentives should be given to industries that attempt to transform either their process machinery or the process itself to bring about greater energy efficiency and reduced environmental impact.

Other specific policy measures could include:

#### **INTEGRATED RESOURCE PLANNING**

Integrated resource planning (IRP) is an approach that systematically evaluates potential electricity supply-side and demand-side resources with the aim of developing a plan that provides energy services to customers at the lowest societal cost under a given set of objectives. To promote renewables, an IRP could be developed that enhances energy security, minimizes the environmental impacts of electricity supply, maximizes the use of local resources (e.g. renewable energy potential), provides local economic benefits (e.g. demand-side management industries), and minimizes foreign exchange costs.

Using externality adders in an IRP can increase the comparative benefit of demand-side management (DSM) and renewables, thus making them more attractive to electricity utilities. However, this policy on its own would not necessarily increase the amount of DSM resources unless there was also some institution that had the responsibility and the incentives to implement DSM programmes. External costs can be quantified in terms of local currency, and added directly to the traditional costs of constructing and operating electricity resources. To date, externality costs have only been applied in selecting new resources in North America: they are not applied to existing facilities.

#### **RESOURCE PORTFOLIO STANDARDS**

The target percentages of different resource types could be set by individual national governments by legislation.

The target could be based on an IRP-type assessment of the resource potential, as well as the costs and benefits of obtaining those resources. For renewables, the target would require that utilities develop renewable resources as a certain percentage of their overall generation. For DSM, utilities would be required to acquire DSM resources up to a certain fraction of their customer demand. A resource portfolio requirement demands a pre-determined percentage of renewables and DSM be included in the overall resource portfolio. It is also worth mentioning one other type of portfolio requirement. A fossil plant efficiency portfolio standard would require utilities to maintain a specified maximum system-wide average combustion efficiency (i.e. heat rate) for their fossil plants. A key element to making such portfolio requirements practical would be implementation at the regional level.

### EMISSION TAXES

Pollution taxes, applied as a charge per tonne of selected pollutants, could readily correct for many market failures in allocating the costs of pollution from electricity generation. There are a variety of approaches to the setting of emissions taxes. First, a tax could be set to represent the societal cost of pollutants. An emissions tax would be set at a level equal to the marginal societal cost of environmental damage. Second, a tax could be set to achieve a particular level of environmental protection. In this case, a particular environmental objective is set (e.g. 50 per cent reduction in particulate emission relative to some previous year), and then the emissions tax is set at a level designed to achieve that objective. Third, a tax could be set to raise funds for preventing or mitigating environmental damage (i.e. a trust fund). Tax revenues could then be used to develop DSM or renewable resources.

### QUANTITY CONTROLS

Quantity controls aim to limit the total amount of pollutants that can be emitted from all sources owned by a utility or within a geographical region. Quantity controls are the opposite of taxes since they specify the upper threshold for total emissions that must be met collectively. Taxes, on the other hand, address the issue of pollution prevention from the other direction, by specifying the monetary penalty for pollutant emissions on the basis of some ultimate desired level of quantity control.

Within this approach, emission caps could be specified to place a ceiling on emissions in a country or

region. Utilities could be allocated a certain number of pollution permits, on a pro-rated basis according to historical emission levels, each of which allows them to emit a fixed quantity of the pollutant.

### GREEN ELECTRICITY PRICING

New approaches to electricity pricing may offer limited opportunities to encourage consumers to purchase cleaner sources or invest in conservation. However, these 'green pricing' schemes generally rely on the customer's willingness, voluntarily, to pay higher prices for cleaner resources, and they have not as yet been shown to be effective in North American contexts where they have been attempted. The operational premise is that there are certain customers who want to use electricity produced by 'clean' technologies, and that they will undertake to pay the expense necessary to secure it. Electricity utilities could use funds raised from environmentally oriented customers to acquire renewable resources that would not otherwise be developed, either because they are above market costs or because they are hindered by market barriers. One advantage of green pricing is that it can protect customers from fuel price fluctuations. Prior to implementation, market research and pilot programmes would have to be conducted to determine if there is general interest in green pricing options.

### Changes in impacts caused by alternative policies

The economic and regulatory measures proposed for making the energy sector more efficient are expected to make alternate sources of energy more attractive relative to those that are currently being tapped. They would also provide a combined incentive-penalty scheme that would encourage efforts to incorporate energy efficiency and a wide-scale transition to renewable sources.

Implementation of the components of the alternative policy package would alter the impacts of energy production and consumption. Additional sources of energy would be made available and the environmental impact of these sources would be significantly less by virtue of the nature and quantities of the emissions they produce. The use of solar, wind and natural gas would be more environmentally friendly. The emissions from natural gas would be relatively harmless when compared to the sulphur- and nitrogen-based gases associated with the use of crude oil and fossil fuels. The decline in crude oil use would also lead to a decrease in the air emissions that arise from using this fuel. The anticipated reduction in these discharges would auger well for global warming

and ozone-layer depletion phenomena which can only worsen if remedial measures are not taken.

The development of renewable energy sources would also permit a gradual reduction in the importation of crude oil and in the expenditure of the foreign exchange reserves currently spent on purchasing the commodity and refining it for use.

The rehabilitation of forest areas, which are currently being exploited for making charcoal, would lead to the preservation of the natural vegetation cover and the protection of watershed areas. This is also directly linked to the air emissions previously outlined. Maintenance of the vegetation cover ensures that there are viable sinks for the main greenhouse gas, carbon dioxide. When the gas is utilized in the photosynthetic process, provided there are sufficient forestry reserves in existence the amount available to contribute to the greenhouse effect is significantly reduced.

Finally, the additional sources of energy production would also translate into improved energy delivery which would be better able to keep pace with the demands of the region's growing population. Renewable or alternative forms of energy are also more viable in rural areas where interconnection is too expensive or politically difficult. Consequently, new energy sources would facilitate the expansion of energy-related services such as transportation, electricity generation, domestic heating etc. into rural areas, which in some Caribbean countries are still without these services.

## Conclusions

The key environmental issues in the Caribbean in the twenty-first century are likely to be unexpected transformations of old issues and well-known issues that currently do not receive enough policy attention, rather than unforeseen events and new scientific discoveries. As such, the issues that need to be addressed in the region are well known.

Clearly, to carry on with business as usual will exert immense pressures on the environment and natural resource base of the Caribbean. Widespread policy reform could make a significant difference.

Implementation of alternative policies, such as those outlined above for the energy sector, could dramatically improve the environmental situation and could shift the Caribbean towards a more sustainable production and consumption pattern.

These policies are often fairly easy to implement, and in many instances may have unexpected benefits for the

economy the long term. Initial finance, however, remains a major obstacle to successful policy implementation. Another obstacle is the low priority afforded to the environment: other issues, such as poverty, housing, education and health care take priority.

Nevertheless, the economy and ecology of the Caribbean are interdependent, and economies are heavily dependent on tourism, mono-crop export-led agricultural practices, mineral hydrocarbon exploration, and escalated use of marine resources. Rapid and irreversible degradation of these resources greatly reduces these countries' prospects for socio-economic growth and development.

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Acronyms

Participants in the Regional Consultation

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## Acronyms

ACP	African, Caribbean and Pacific	ICCAT	International Commission for the Conservation of Atlantic Tunas
AGRRA	Atlantic and Gulf Rapid Reef Assessment	ICLARM	International Centre for Living Aquatic Resources Management
BCIS	Biodiversity Conservation Information System	IDB	Inter-American Development bank
BIONET	Biodiversity Action Network	IOC-REP	Indian Ocean Commission, Regional Environment Programme
CANARI	Caribbean Natural Resources Institute	IRF	Island Resources Foundation
CARICAD	Caribbean Centre for Development Administration	MARPOL	International Convention for the Prevention of Pollution from Ships
CARICOM	Caribbean Community	MEA	Multilateral Environmental Agreement
CARICOMP	Caribbean Coastal Marine Productivity Programme	NAFTA	North American Free Trade Agreement
CARISPLAN	Caribbean Information System for Economic and Social Planning	NBSAP	National Biodiversity Strategy and Action Plan
CBD	Convention on Biological Diversity	NEAP	National Environmental Action Plan
CBO	Community-Based Organization	NEIS	National Environmental Information System
CCA	Caribbean Conservation Association	NGO	Non-Governmental Organization
CCD	Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa	OECS	Organization of Eastern Caribbean States
CDERA	Caribbean Disaster Emergency Response Agency	OECS/NRMU	Organization of Eastern Caribbean States/Natural Resources Management Unit
CEHI	Caribbean Environmental Health Institute	OILPOL	International Convention for the Prevention of Pollution of the Sea by Oil
CEIS	Caribbean Environmental Information System	OLADE	Latin American Energy Organization
CEO	Caribbean Environment Outlook	SDCs	Sustainable Development Councils
CEP	Country Environmental Profile	SIDA	Swedish International Development Agency
CEP-RCU	Caribbean Environment Programme – Regional Co-ordinating Unit	SOLAS	International Convention for the Safety of Life at Sea
CEPNET	Caribbean Environment Programme Network – Information Systems for the Management of Marine and Coastal Resources at the UNEP Caribbean Environment Programme Regional Co-ordinating Unit, Jamaica	SPAW	Specially Protected Areas and Wildlife Protocol
CFRAMP	Caribbean Fisheries Management Programme	SPREP	South Pacific Regional Environment Programme
CGCED	Caribbean Group for Co-operation in Economic Development	UNCED	United Nations Conference on Environment and Development
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora	UNCLOS	United Nations Convention on the Law of the Sea
CLOPD	International Convention on Civil Liability for Oil Pollution Damage	UNECLAC	United Nations Economic Commission for Latin America and the Caribbean
CMS	Convention on the Conservation of Migratory Species of Wild Animals	UNEPNet	The UNEP Internet site dedicated to environmental information services
CPUE	catch per unit effort	UNFCCC	United Nations Framework Convention on Climate Change
ECLAC	Economic Commission for Latin America and the Caribbean	UWI-CED	University of the West Indies, Centre for Environment and Development
FAO/SLAC	Food and Agriculture Organization / Subregional Office for Latin America and the Caribbean	WCMC	World Conservation Monitoring Centre
GATT	General Agreement on Tariffs and Trade	WTTC	World Travel and Tourism Council
GEMCO	Guyana Environmental Management Conservation Organization		
GEO	Global Environment Outlook		
IABIN	Inter-American Biodiversity Information Network		

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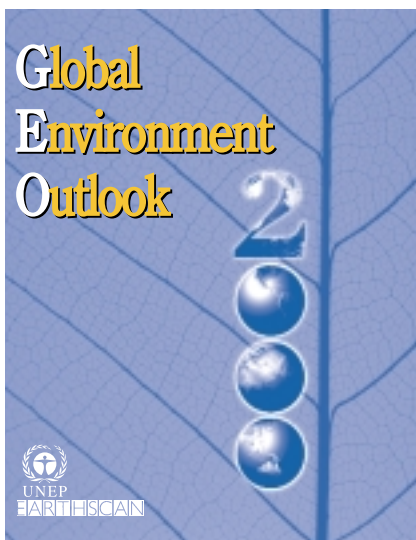
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