CARIBBEAN
ENVIRONMENT OUTLOOK

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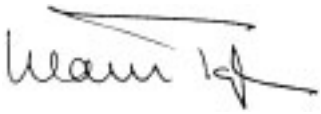

Klaus Toepfer
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In 1995, the United Nations Environment Programme (UNEP) launched the Global Environment Outlook (GEO) process for integrated environmental assessment and reporting at global and regional levels. GEO is based on cross-sectoral and participatory environmental assessment, facilitating dialogue between policy-makers and the scientific community.

Under the GEO framework, the first environment outlook report for the Small Island Developing States (SIDS) in the Caribbean was published in 1999 through UNEP's Regional Office for Latin America and the Caribbean (UNEP-ROLAC), and with the help of the European Commission and the University of the West Indies Centre for Environment and Development (UWICED). The report helped the region to identify the main environmental concerns and highlight appropriate policy priorities.

Small Island Developing States have been recognized as a special category of countries, with particularly vulnerable and delicate ecosystems due to their small size and other characteristics. The United Nations recognizes the unique situation of SIDS and actively supported the process of giving them an international political identity with the establishment in 1991 of the Alliance of Small Island States (AOSIS), which would provide a forum for small island states to have a collective voice in addressing their common problems. This recognition was reaffirmed by the United Nations Global Conference on the Sustainable Development of Small Island Developing States held in Barbados in 1994, and the resulting Barbados Programme of Action for the Sustainable Development of Small Island Developing States (BPOA).

In 2003, UNEP initiated the preparation of environment outlook reports for the Caribbean, Pacific and the Atlantic and Indian Oceans SIDS, as a contribution to the Mauritius International Meeting for the 10-year Review of the BPOA (Barbados +10) in 2005. The major objectives of these reports are to:

- Highlight the state of the environment in the SIDS showing the trends of national, regional and global significance;
- Provide policy guidance and early warning information on environmental threats;
- Provide a basis for regional consultations and for identifying the environmental issues and priorities in preparation for Barbados +10;
- Help to catalyse and promote international cooperation and action based on the best scientific and technical capabilities available; and
- Contribute to the development of a common strategy for sustainable development in SIDS.

There was considerable effort to ensure that the assessment and evaluation builds on the preparation initiatives for the Barbados +10, to ensure consistency of reporting.

The *Caribbean Environment Outlook* assesses the state of the environment in the Caribbean SIDS and Low-Lying Coastal States in terms of the environmental concerns identified in the BPOA and the driving forces of environmental change. It emphasizes the interdependence between the quality of the environment, human well-being and sustainable development. It is intended to be a resource document for civil servants, private and public sector policy-makers, professionals in development-related areas and funding institutions. It is our hope that this report will remind decision-makers in the Caribbean of the importance of a healthy environment and intact natural resource base for sustainable development.

The *Caribbean Environment Outlook* was prepared in collaboration with many experts from the region, the partners from the 1999 report including UWICED and the Caribbean Community Secretariat (CARICOM), as well as new partners such as the Caribbean Community Climate Change Centre (CCCCC) and the Mainstreaming Adaptation to Climate Change Project (MACC). UNEP considers such partnerships to be the key to the success of the GEO process.

It is my sincere hope that this report — *Caribbean Environment Outlook* — will be a useful resource during deliberations at the Barbados +10 Conference.

EXECUTIVE SUMMARY

Over the last three decades, environmental degradation and the unsustainable use of natural resources have reduced the availability of ecosystem goods and services, with negative consequences for sustainable social and economic growth in the Caribbean Small Island Developing States (SIDS) and Low-Lying Coastal States (LLCS). Environmental changes were found to be driven by socio-economic factors as well as by external forces over which these states have little or no control. Adverse environmental change in turn has negative consequences for social and economic development, and sustainable development overall.

Until now, social indicators in the majority of the Caribbean countries have overall displayed positive trends, with a child mortality rate at the lowest among all developing country groupings and with over 90 per cent of the population literate. More girls than boys are in secondary school in 10 of 16 independent states studied in this report. However, these desirable trends are tempered by uncertainty owing to the growing prevalence of HIV/AIDS, which stood at 2.15 per cent in 2002, and the influence of economic factors and, increasingly, environmental factors.

The close linkages between the state of the environment and development in the Caribbean SIDS and LLCS are a result of the unique conditions that exist there, including: a heavy dependence on their limited natural resource base; susceptibility to the vagaries of international trade; high transportation and communication costs; grave vulnerability to natural disasters; small domestic markets; and high import content and dependence on a narrow range of export products, among others.

The social and economic vulnerabilities of Caribbean states are the primary causal factors of environmental degradation at the national level. Sustainable economic development in SIDS must be approached through the reduction of economic, social and environmental vulnerabilities to maintain or increase the resilience of the social and natural systems and the flow of goods and services.

STATE OF THE ENVIRONMENT AND TRENDS

What is certainly limited in the Caribbean SIDS is land that is available for development activities. Even though the region is blessed with a lower proportion of land with severe agricultural restrictions — almost 4 per cent less than the Latin America and the Caribbean (LAC) average — poor land use and land management practices as well as heightened land use conflicts have led to degradation of a number of ecosystems. Current planning and policy practices result in the conversion of land from its natural state to other uses, with limited appreciation of the loss of the future value of the land as regards the natural goods and services it can provide.

The changes in land use witnessed in the region over centuries have had the most dramatic impact on forest ecosystems. Fuelled by the need for land for transportation infrastructure, agriculture, housing and industrial development, past and continuing deforestation has left the region with forest covering only 19 per cent of total land area. Expansion of road networks and improvement in road surfaces in general continue to allow improved access to more remote forest areas and timber resources, leading to further deforestation. Despite the critical condition of forest resources in the region, accurate data on the extent of these remaining forest types and their dominant species in the region are still unavailable. There are some localized conservation efforts to protect this valuable ecosystem — for example, in Cuba and Trinidad and Tobago — but they are far from sufficient to turn the current trend of decline around.

Natural disasters in the Caribbean in the last three decades have consisted of: geological events, such as the earthquakes in Antigua and Barbuda in 1975 and a volcanic eruption in Montserrat in 1995; and hydrometeorological events such as hurricanes and tropical storms which have been especially severe in 2004. Natural disasters, the occurrence of which appears to be increasing, have a far greater effect on people in the Caribbean SIDS and LLCS compared to other areas of LAC in terms of proportion of population affected (close to 50 per cent) and GDP (cumulative damages at 43.3 per cent of 1998 GDP). Renewed emphasis on planning and decision-making processes has led to the development of a Comprehensive Disaster Management framework which is implemented by the Caribbean Disaster Emergency Response Agency and other technical institutions.

In considering actions to improve environmental and social conditions, leading priorities are identified as: management and disposal of solid, toxic and hazardous wastes; water quality and supply; and disposal of wastewater. In many Caribbean countries domestic waste comprises the largest proportion of total solid waste generated, followed by commercial waste. Population growth, increased urbanization and improvements in the standard of living have led to an increase in the purchase of goods packaged in cheaper, non-biodegradable disposable material. As a result, the composition of solid waste generated in the Caribbean SIDS and LLCS continues to change from mostly organic to inorganic material. Albeit in small quantities, the amount of hazardous waste generated is also rising. The expansion of the tourism industry has also contributed to the increase in the quantity of waste. Landfilling, the most common method of solid waste disposal, is insufficient to deal with the increased waste, and countries are resorting to other methods such as incineration and recycling.

All of the environmental issues mentioned above reflect negatively on yet another vital but scarce resource in the region: freshwater. The available water supply in Antigua and Barbuda, Barbados, and St Kitts and Nevis is significantly below the international limit of 1 000 m^3 per capita per year, the level below which a country is classified as 'water scarce'. Increasing water demand to supply populations in cities as well as in areas for agricultural production has led to overextraction of water in many islands. Faced with the problems of chronic water shortage and the decline of the remaining water sources due to pollution and saltwater intrusion, some countries, such as The Bahamas, already import water.

The Caribbean region can claim high biological diversity per unit of land as well as a very high level of endemism (attributed to the diversity of microclimates and ecosystems found in tropical regions) and a high extinction rate. In the Caribbean, 54 per cent of vertebrates (excluding fishes) and 59 per cent of plants are thought to be endemic. This unique biodiversity, however, is being lost due to unsustainable natural resource exploitation, poorly managed tourism, mining, pollution, habitat destruction and conversion, natural events such as hurricanes, and the introduction of alien species. Though tourism has been one of the major sources of revenue for protected areas management, it has simultaneously become the greatest threat to protected areas in the insular Caribbean.

The region is a biogeographically distinct area of coral reef development within which the majority of corals and coral reef-associated species are endemic, making the entire region particularly important in terms of global biodiversity. Mainly due to pollution from increased suspended solids and chemical compounds, overexploitation and habitat conversion, corals in the region are becoming physically damaged or are overgrown by algae. Changes in reef fish communities throughout the Caribbean have also been reported, characterized by the reduced abundance of large-sized carnivorous reef fish such as snappers and groupers due to overharvesting. Mangrove forests, another important ecosystem, are also in decline because of coastal development and clearing linked to charcoal production. Of the 27 countries and territories studied in this report, 18 showed decreasing mangrove cover over the period 1990 to 2000.

These declines in the health of marine and coastal ecosystems, as well as overcapitalization and overfishing, unregulated and illegal fishing by local fleets and reflagging of vessels and migration of fleets, will all affect the long-term viability of the Caribbean

fisheries. While the fisheries of some countries appear to be in good condition, catches were reported to have levelled off in others, and were even in decline in Antigua and Barbuda and St Kitts and Nevis.

Affecting all aspects of the environment are local and regional meteorological changes associated with global climate change. Sea-level rise of 30–50 cm for the Caribbean over the next 50 years has been considered a reasonable projection. Although the severity of this threat will vary among the Caribbean SIDS and LLCS, the resulting effects will be coastal erosion, saltwater intrusion into coastal agricultural lands and aquifers, an escalation of the frequency and intensity of hurricanes and tropical storms, an increase in the frequency and severity of coastal inundation and flooding, and disruptions in precipitation and potable water supplies. Critical infrastructure and vital utilities will be at severe risk, and the countries will be required to consider costly adaptation measures to protect vulnerable populations.

POLICY RESPONSES

Over the three decades following the Earth Summit, the Caribbean SIDS and LLCS have been moving from being reactive to proactive in dealing with environmental issues at the national, regional and international levels. Environmental portfolios have gained status and have progressed from being on the periphery of conventional revenue-generating ministries to being ministries in their own right. For some of the countries the progress over the past 30 years has been significant, while others are still constrained by the traditional approach to development that is characterized by: a short-term development planning horizon defined by the five-year term of political office; a sectoral approach to economic planning and resource management; the low priority given to environmental issues in development and economic planning; and the low priority given to long-term land use and urban planning.

Governments in the region are attempting to address these constraints to sustainable development through the Barbados Programme of Action (BPOA), even though positive outcomes following implementation of the BPOA have fallen short of expectations. The regional plan, the Caribbean Action Plan (1981), as well as the sub-regional plan, the St George's Declaration (2000), are guiding countries in the region in their endeavour to achieve sustainable development.

NATIONAL ACTION PLANS, STRATEGIES AND LAWS

At the national level, the Caribbean SIDS and LLCS continue to prepare national action plans and strategies to address their development and environmental priorities. These national plans and strategies have been developed with varying degrees of linkage to international or regional agreements. Governments have invested in the development of Integrated Coastal Resource Management/Integrated Coastal Zone Management policies as well as the establishment of National Sustainable Development Councils. The concerns are that these tools are not fully utilized in developing national initiatives, and resource users are not being engaged sufficiently to drive the environmental agenda.

Environmental and sustainable development issues are also being addressed through: national planning legislation, such as Development Control and Planning legislation and Town and Country Planning legislation; the establishment of multisectoral bodies to implement the National Conservation Environment and Protection legislation; and the appointment of Sustainable Development Committees.

MULTILATERAL ENVIRONMENTAL AGREEMENTS AND REGIONAL INSTITUTIONS AND PROGRAMMES

More than 100 conventions are of some relevance to the Caribbean, 13 of which are of particular importance. Among them are the Cartagena Convention on the Protection and Development of the Marine Environment in the Wider Caribbean and its three protocols which are unique to the region. Despite a high commitment of the countries in the region to multilateral environmental agreements (MEAs) as witnessed by the high level of signing and ratification, many do not have the required financial and human resources to ensure compliance with the large number of conventions to which they subscribe. In order to tackle the problems associated with the cross-cutting nature of some MEAs, a number of countries have established national mechanisms to coordinate their implementation.

The regional bodies such as the Association of Caribbean States (ACS), the Caribbean Community and Common Market (CARICOM), the Caribbean Forum of African, Caribbean and Pacific States (CARIFORUM) and the Organization of Eastern Caribbean States (OECS) have established a number of specialized institutions and units, some of them related to the environment. Each regional body has a mechanism for coordinating its environmental programmes, and some routinely participate in the coordinating mechanisms of the others (for example, ACS with the Secretary Generals of the other bodies within the Meeting of Ministers; OECS Environment and Sustainable Development Unit [ESDU] reporting to the Council for Trade and Economic Development, which is responsible for CARICOM's Sustainable Development Work Programme). Due to the economic slow-down experienced in Latin America and the Caribbean, many of these regional bodies face financial constraints in meeting their objectives.

There are a number of environmental programmes and information networks in the region. The majority of these programmes focus on sustainable management of coastal and marine areas. In 2002, more than 40 information networks were identified. Several agencies in the Caribbean also have education and awareness programmes and related activities, including the Caribbean Conservation Association (CCA), UNEP-CEP (Caribbean Environment Programme), the Caribbean Marine Protected Area Managers (CaMPAM), as well as a regional arm of the global SIDSnet. Substantial work is needed to reduce duplication of effort, improve integration, and strengthen existing networks and programmes in the Caribbean SIDS and LLCS.

ECONOMIC INSTRUMENTS, SCIENCE AND TECHNOLOGIES

The use of economic instruments for environmental resource management is still in the early stages in the Caribbean, even though their potential for promoting sustainable development has been recognized. In the past, their use was limited and, in most cases, haphazard, with implementation taking the form of isolated initiatives rather than as a component of a coordinated strategy. However, Caribbean countries have begun to take a more coordinated and strategic approach, exemplified by environmental taxes in Belize, green funds in Trinidad and Tobago, debt-for-nature swaps in Jamaica, and economic valuations of natural resources in countries such as Antigua and Barbuda, Barbados, and Jamaica.

Caribbean countries are also turning to innovative measures and technologies either to develop alternative resources for development activities or to manage existing resources. Among such cases are the use of bagasse as an energy source in Cuba, production of freshwater using reverse osmosis in Barbados, and the use of geographic information systems (GIS) for integrated resource management and environmental monitoring. Useful technologies need not be complex, expensive or require major policy decisions for their adoption. Their value lies in the improved efficiency and/or reduced demand on scarce, human, financial, technical or material resources by generating multiple benefit streams. However, it should be noted that the Caribbean SIDS and LLCS often adopt technological options that represent sub-optimal contributions to development, or that are unsustainable, or environmentally detrimental. There is an urgent need for these countries to develop their capacity to select the technologies that are best suited to sustainable development.

THE WAY FORWARD

The ability of the Caribbean SIDS and LLCS to reverse the trends of increasing environmental vulnerability will determine whether or not economic development in these countries will be sustainable. Immediate action must be taken to: identify those social and economic goals that define the national and regional visions for sustainable economic development; identify the environmental conditions and natural resource systems on which the realization of these goals depends; and identify the areas where traditional approaches to development and lifestyles are preventing the achievement of the desired goals, and internalizing the costs of environmental degradation. The report recommends that the countries consider the following actions:

GOVERNANCE AND DECISION MAKING

- Invest in national and regional planning and decision-making governance structures to improve the availability of information on technologies and processes; promote interaction and integration among disciplines, sectors and geographic areas; encourage effective regional planning and development processes; support frameworks for technical cooperation among countries and for effective monitoring and evaluation of plans, policies and programmes; and involve civil society and external partners in the development process; and
- Reduce economic vulnerability by: diversifying economies; strengthening and empowering existing mechanisms and institutions; removing any undesirable structural bias and integrating environmental issues into national development policy, planning and management; promoting renewable energy; developing fiscal incentives to manage consumption and waste; reviewing land use policies and planning, and implementing integrated land use planning; developing means to reduce dependency on export markets and improve food security; developing capacity for integrated resource management; mainstreaming sustainable development thinking into the education curriculum; and identifying and developing technologies and strategies that provide multiple benefits and economic savings.

ALTERING LIFESTYLE CHOICES

Changes in people's living conditions and increasing affluence have given rise to lifestyles that contribute to environmental degradation, resource depletion and an increase in waste production. Reversing the trend of increasing environmental degradation requires a change in lifestyle practices that reflects the reality of Caribbean SIDS and LLCS, rather than that of industrialized nations. The Caribbean SIDS and LLCS must articulate national sustainable development visions based on welfare and the improvement of the human condition rather than on consumption.

REDUCING ENVIRONMENTAL VULNERABILITIES

- Define the characteristics and dynamics of natural resources and systems; the extent of environmental problems and their spatial and temporal parameters; environmental trends; and the nature and timing of interventions required;
- Strengthen technical and institutional capacity to deal with the environment by training specialists, developing functional interlinkages and multisectoral mechanisms, and employing appropriate MEAs;
- Reduce pollution loads by reviewing, revising and enforcing environmental legislation;

- Invest in the environmental monitoring, reporting and review mechanisms that are part of national and regional policy, planning and implementation processes; and
- Protect biodiversity by: promoting innovative bioregional planning approaches; strengthening national clearinghouse mechanisms linking them to regional and international decision-making processes and national environmental decision-making processes, using regional initiatives such as the Invasive Species Information Network and Inter-American Biodiversity Information Network, and focusing on system planning, management effectiveness, and network development of protected areas.

NATURAL DISASTER RISK REDUCTION AND PREPAREDNESS

- Apply integrated approaches to vulnerability reduction in key sectors; sustainable development planning at the local and national levels; increased use of financial instruments and incentives for risk reduction; development or review of legislation, planning and building and development standards and codes, and improving enforcement; and improving public education and awareness; and
- Strengthen regional networks for disaster preparedness, including emergency relief funds, GIS hazard mapping, up-to-date weather information, and early warning and emergency response systems.

FOOD, WATER AND ENERGY SECURITY

- Ensure that national agricultural policies address local projected food demand and encourage self-reliance in food areas critical to internal vulnerability, while reducing the sector's environmental impacts;
- Adopt a regional view of food security to maximize the advantages of Belize, Guyana and Suriname in agricultural production as well as to address some of the uncertainties that the likely impacts of global climate change will have on agricultural production;
- Improve the status of freshwater supply in the region by: urgently formulating and implementing national policies and frameworks for integrated water resource management; identifying and conserving strategically important watersheds as part of an integrated water resource management strategy; developing national inventories of water resources; implementing demand assessment studies to identify competing uses of water and water use patterns; developing strategies for water conservation, efficient use and recycling by making maximum use of economic instruments in conjunction with public education and awareness programmes; and developing regional and national climate change models to provide precipitation projections for water production models and information for vulnerability assessment studies; and
- Harness the abundant renewable energy resources, with the long-term effects of reducing foreign exchange expenditure on energy production and reducing the pressure on the natural resources of the Caribbean SIDS and LLCS.

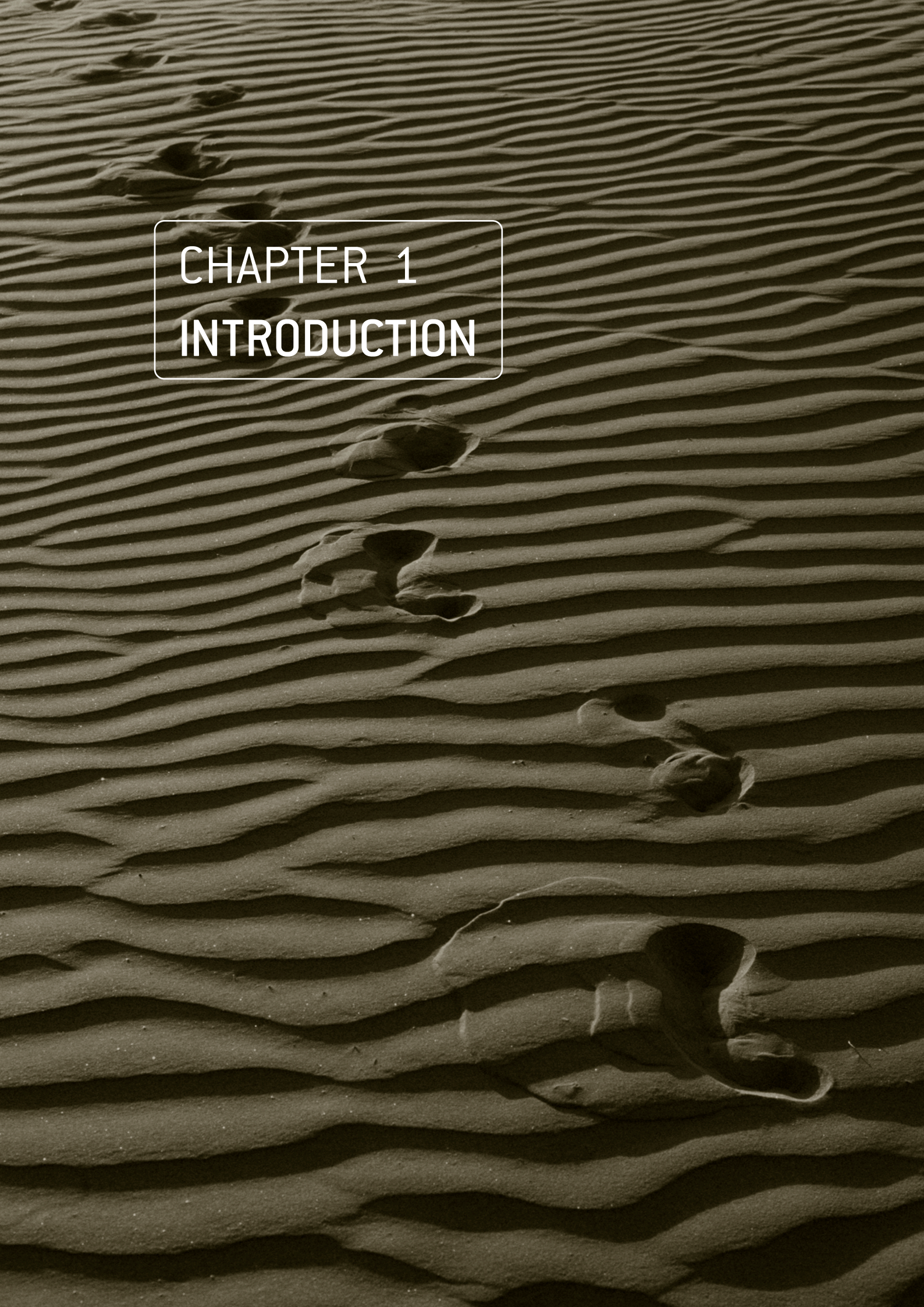
MANAGING HUMAN RESOURCES FOR THE ENVIRONMENT

- Strengthen the institutional capacity of the environmental institutions, making them more attractive employment options for skilled individuals;
- Increase and improve the quality of environmental education offered in the region with stronger links to the environmental skills needed in the region; and
- Enhance opportunities for professional development and career progression.

As the Caribbean SIDS and LLCS begin to take paths towards sustainable development, they face immense challenges ranging from fundamental assumptions about economies and lifestyles, a public that has a limited appreciation about the implications of environmental degradation and increasing environmental vulnerability on their lives, to heightened uncertainty about climate, natural productivity, human population and health, economic globalization, and security.

When possible futures are defined not by past trends but by anticipated events, new approaches to planning, decision making and governance must be considered. Strong commitment, informed decisions and innovative and visionary action are required at every level of society in the changing development paradigm. Public behaviour will not change unless individuals are made aware of the links between their behaviour and environmental degradation, and of the behavioural changes that they must adopt to mitigate the environmental degradation.

Sound environmental management will not be undertaken effectively unless there are clear economic and social benefits to justify the required investment of human, institutional, financial and material resources. The likely repercussions for poor environmental planning or inaction will be severe. The region must articulate a clear, long-term course and vision for sustainable development at the national and regional levels, looking beyond the immediate benefits and taking action that will lead to a sustainable future.



CHAPTER 1
INTRODUCTION

The environment of Small Island Developing States (SIDS) continues to receive increasing attention and recognition at national, regional and international levels. The special case of SIDS was recognized in 1992 at the United Nations Conference on Environment and Development (UNCED). This recognition was reaffirmed by the United Nations Global Conference on the Sustainable Development of Small Island Developing States held in Barbados in 1994, and the resulting Barbados Programme of Action (BPOA). The establishment of the Alliance of Small Island States (AOSIS) provided a forum for small island states to have a collective voice in addressing their common problems. More recently, in September 2002, the World Summit on Sustainable Development (WSSD) reaffirmed the special case of SIDS and highlighted a series of SIDS-specific issues and concerns in the Johannesburg Plan of Implementation (JPOI) that was adopted by the Summit. The WSSD also called for the ten-year review of implementation of the BPOA in 2005 (Barbados +10).

SIDS worldwide share a number of environmental and socio-economic challenges (Briguglio 2003), among which are:

- Heavy dependence on their natural resource base (for example, agriculture, forestry, fishing, tourism);
- Susceptibility to the vagaries of international trade;
- High transportation and communication costs;
- Grave vulnerability to natural disasters;
- Scarce land resources;
- Increasing pressures on coastal and marine environments and resources;
- Small domestic markets;
- Limited ability to develop economies of scale;
- Limited natural resources and high import content (especially of strategic imports such as food and fuel);
- Limited diversification possibilities;
- Limited extent to which domestic competition policy can be applied;
- Dependence on a narrow range of export products;
- Inability to influence international prices; and
- Uncertainties of supply due to remoteness or insularity.

These characteristics impose upon SIDS varying levels of environmental, economic and social vulnerability, which present particular challenges for sustainable development in these countries (Commonwealth Secretariat 2000; UNDP 2002; Briguglio 2003). The term 'vulnerability' refers to susceptibility to damage from external forces, and has become associated with SIDS because these countries tend to be very exposed to factors outside their control (UNDP 2002). Environmental vulnerability is related to the risk of damage to a country's natural capital. The suite of environmental vulnerabilities facing SIDS includes: natural hazards (such as hurricanes, earthquakes, tsunamis and volcanic eruptions); internal, anthropogenic hazards (such as deforestation), which over time reduce intrinsic resilience; externally driven, anthropogenic hazards (such as transport of toxic waste); and global climate change, the effects of which are particularly severe on SIDS.

The Caribbean environment displays various combinations of these vulnerabilities. Concern over the

Coastal and marine environments and resources are under increasing development pressure

Table 1 Examples of ecosystem services and their contribution to economic development

	BENEFIT/SERVICE
LAND	• Provision of a base for agricultural and industrial activities • Reserves of oil and minerals • Food security • Property rights/land tenure • Habitat • Biodiversity
FORESTS/ OTHER PLANT SPECIES	• Promotes infiltration of rainwater • Moderates local climate • Promotes rainfall • Timber products • Non-timber products (honey, handicraft materials, thatch, ornamental and household plants, spices, oils, medicinal plants, pharmaceutical products, seeds, tree seedlings, orchids, fruits)
MANGROVES	• Export of nutrients to other ecosystems such as coral reefs and sea grass beds through tides and currents • Provision of a variety of habitats for a wide array of terrestrial and aquatic species • Provision of feeding, nursery and breeding areas for fish and other species • Fish and shellfish stocks (support artisanal fisheries) • Stabilization of coastlines, acting as a buffer between the land and the sea • Protection of adjacent coral reefs from suspended solids and drastic changes in salinity due to inflow of freshwater • Removal of contaminants from surface inflows • Nutrient retention and removal
BEACHES	• Habitats and nesting sites for fauna such as sea turtles • Provision of a base for small-scale fisheries, tourism and recreational activities
CORAL REEFS	• Provision of a habitat for a large number of species • Provision of a hydrodynamic barrier to wave energy, thereby protecting the shoreline from erosion and facilitating the formation of sandy beaches and growth of sea grass beds • Fish and shellfish stocks (support artisanal fisheries) • Provision of sediment for the formation and maintenance of sandy beaches from the breakdown of carbonate skeleton • Ecotourism attraction • Source of seashells used in craft
SEA GRASS MEADOWS	• Habitat for a variety of animals • Provision of nursery and feeding areas and shelter for fish and crustaceans • Source of detritus to reef system and nutrient cycling • Settlement and binding of suspended sediments, and encouragement of accretion • Habitat for algae, including calcareous algae such as *Halimeda* sp. These algae have high concentrations of calcium carbonate and contribute to the sediment budget of beaches
OTHER MARINE SYSTEMS (CONTINENTAL SHELF, OPEN OCEAN)	• Fish and shellfish stocks (support artisanal, commercial and recreational fisheries)

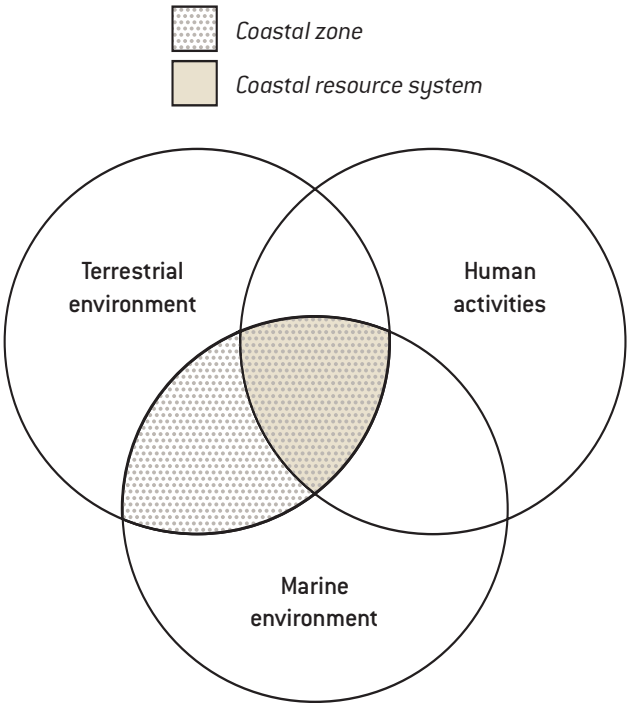
Source: Developed by the authors in consultation with experts in the Caribbean

vulnerability of the environment led to the development by the South Pacific Applied Geoscience Commission (SOPAC) of the Environmental Vulnerability Index (EVI), which reflects the vulnerability of a country's environment to damage and degradation. The first functional results show that SIDS are among the most vulnerable countries (Kaly and others 2003). The vulnerability of the environment has particular implications for sustainable development in SIDS since the environment and its ecosystems and their services (Table 1) are the life support of human systems. This is recognized in several Caribbean regional and sub-regional agreements. For instance, the Nassau Understanding (1984) acknowledges that the depletion of a major natural resource could erode the basis on which future structural adjustment strategies are supported. The Georgetown Accord (1973) recognizes the diversity of natural resources in the region, stressing their potential for providing the foundation for industrial production.

The national economies of the Caribbean are heavily dependent on a narrow range of natural resources for their major economic sectors of tourism, export agriculture and mineral extraction. In most of the countries, tourism contributes an average of 35 per cent of GDP and accounts for 20 to 86 per cent of earnings as a proportion of total exports (Commonwealth Secretariat 2000). Agriculture has been a major source of foreign exchange earnings, employment and socio-economic stability in the Caribbean countries and contributes up to 28 per cent of national GDP even though its share is in general decline (UNEP/DEWA/GRID-Geneva 2004). Marine fisheries production is also a significant source of food, employment and foreign exchange in the region, and contributes up to 8 per cent of GDP in some countries.

This reliance on the natural resource system creates the interrelationship between human socio-economic activities and natural systems, as illustrated for the coastal zone in Figure 1 (Cicin-Sain and Knecht 1998). Thus, degradation of one part of the mosaic is transmitted through various processes to other parts. Over the last three decades, environmental degradation and unsustainable use of natural resources have reduced the availability of ecosystem goods and services, with negative consequences for sustainable social and economic growth in the Caribbean. In addition, these countries are faced with the serious challenge of global climate change and sea-level rise, to which they are very vulnerable but over which they have little control. The Intergovernmental Panel on Climate Change (IPCC) noted that SIDS are likely to be among those countries most adversely affected by climate change as a result of their small size, economic dependence on a limited number of natural resource-based sectors, and limited human and financial capacities (IPCC 2001a). The Caribbean's elevated vulnerability to climate change is further compounded by its high economic and social vulnerability (Commonwealth Secretariat 2000). Impacts of global climate change are already being experienced in the region and are expected to increase.

Figure 1 Coastal resource system



Source: Cicin-Sain and Knecht 1998

SCOPE OF THE *CARIBBEAN ENVIRONMENT OUTLOOK*

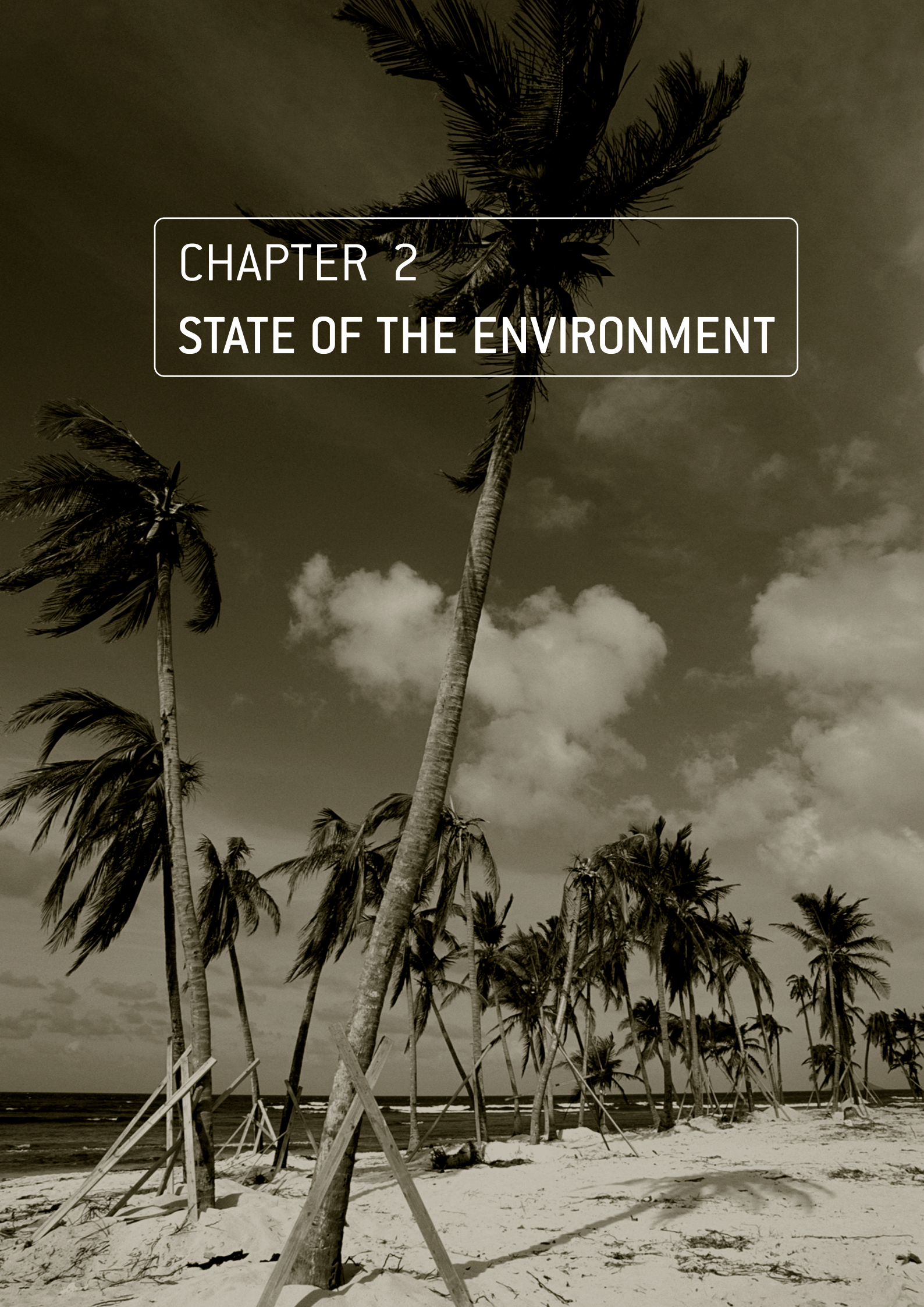
This assessment covers the 16 Caribbean SIDS that are included in the United Nations official list of SIDS as well as the Low-Lying Coastal States (LLCS) of Belize, Guyana and Suriname. These three countries share some of the same characteristics and challenges of SIDS; and Belize and Suriname also have strong historical, cultural and political links to the Caribbean SIDS and are member states of the Caribbean Community and Common Market (CARICOM). Also included in this assessment are seven territories bordering the Caribbean Sea and the Gulf of Mexico that are neither on the UN SIDS list, nor CARICOM members, but share similar environmental and socio-economic conditions (Table 2). It should be noted that 'the Caribbean' in this report refers to all these countries and territories, as also shown in the map opposite.

Table 2 States and dependent territories of the Caribbean covered in this report and their UN SIDS and CARICOM affiliation

INDEPENDENT COUNTRIES	DEPENDENT TERRITORIES
1. Antigua and Barbuda (SIDS, CARICOM)	**Dutch Overseas Departments**
2. Bahamas (SIDS, CARICOM)	1. Aruba (SIDS)
3. Barbados (SIDS, CARICOM)	2. Netherlands Antilles (SIDS)
4. Belize (CARICOM)	
5. Cuba (SIDS)	**French Overseas Departments**
6. Dominica (SIDS, CARICOM)	3. Guadeloupe
7. Dominican Republic (SIDS)	4. Martinique
8. Grenada (SIDS, CARICOM)	
9. Guyana (CARICOM)	**Territories of the United States of America (USA)**
10. Haiti (SIDS, CARICOM)	5. Puerto Rico
11. Jamaica (SIDS, CARICOM)	6. US Virgin Islands (SIDS)
12. St Kitts and Nevis (SIDS, CARICOM)	
13. St Lucia (SIDS, CARICOM)	**British Overseas Departments**
14. St Vincent and the Grenadines (SIDS, CARICOM)	7. Anguilla
15. Suriname (CARICOM)	8. British Virgin Islands
16. Trinidad and Tobago (SIDS, CARICOM)	9. Cayman Islands
	10. Montserrat (CARICOM)
	11. Turks and Caicos Islands

Note: Not all the dependent territories share the same status as their respective metropoles. For example, Puerto Rico and the US Virgin Islands have different status to the USA. The same is true for the relationship between The Netherlands and the departments of Aruba and the Netherlands Antilles.


0 200 400 600 800 km
Gulf of Mexico
ATLANTIC OCEAN
BAHAMAS
TURKS AND CAICOS ISLANDS
CUBA
CAYMAN ISLANDS
JAMAICA
HAITI
DOMINICAN REPUBLIC
PUERTO RICO
BRITISH VIRGIN ISLANDS
ANGUILLA
ST KITTS AND NEVIS
ANTIGUA AND BARBUDA
US VIRGIN ISLANDS
GUADELOUPE
MONTSERRAT
DOMINICA
MARTINIQUE
ST LUCIA
BARBADOS
ST VINCENT AND THE GRENADINES
GRENADA
BELIZE
Caribbean Sea
ARUBA
NETHERLANDS ANTILLES
TRINIDAD AND TOBAGO
GUYANA
SURINAME



CHAPTER 2
STATE OF THE ENVIRONMENT

The environment, natural and built, comprises our land, water, air, energy, and natural resources which these support, as well as the communal infrastructure for living, playing and working. It therefore provides the foundation, resource base, and framework for all global, regional or national socio-economic development.

(CARICOM 1989)

Over the last three decades environmental degradation has continued in the Caribbean, causing irreversible damage in these countries, as shown in the case of the Eastern Caribbean States (Box 1). Environmental changes are often driven by socio-economic factors as well as by external forces over which these states have little or no control. Adverse environmental change in turn has negative consequences for social and economic development. Any assessment of the state of the environment must take account of the socio-economic driving forces of environmental change in order for appropriate policies and strategies for sustainable development to be developed.

GEOPOLITICAL ARRANGEMENTS

The Caribbean has a history of European colonization, slavery and plantation economies. However, the countries exhibit substantial differences in governance, income, size (population, surface area and extent of coastline), and political affiliations and alliances. These political alliances are both with their respective metropoles and with regional and sub-regional bodies in the Caribbean, as shown in Table 3.

The Association of Caribbean States (ACS), CARICOM and AOSIS have a comparative advantage in promoting the issues of small states. Much of the focus is directed at advocacy, policy advice and support for regional and national capacity building. The rise of globalization in recent years has further marginalized SIDS and increased their vulnerability. These three organizations are therefore devoting substantial resources towards facilitating the required adjustments to changes in global trading and environmental regimes.

Box 1 Environmental damage in the Eastern Caribbean States

The economic benefits of maintaining good environmental quality are among the highest of any component of the Organization of Eastern Caribbean States (OECS) economies, estimated to be in excess of US$1 614 million (about 25 per cent of the collective annual gross national product [GNP]) in 2000 for the OECS states collectively. Throughout the region, however, and in spite of ongoing efforts by all OECS, the quality of the environment continues to decline. The ability of some areas within the OECS to sustain the direct and indirect human stresses placed on them has already been exceeded; it is certain that in coming years the number and extent of such areas will increase if present trends continue. Notwithstanding a lack of baseline scientific data, itself a symptom of environmental management neglect, OECS experience some or all of the following within their jurisdictions:

- Near-shore marine areas and rivers polluted to the point of limiting and devaluing human activities;
- Continuing degradation of agricultural lands as a result of inappropriate agricultural practices, erosion and high levels of chemical use;
- Increased vulnerability to disasters as a result of inappropriate human activity;
- Declining wildlife populations as a result of human encroachment and loss of habitat.

Source: OECS ESDU 2002

Table 3 Regional and sub-regional bodies in the Caribbean

REGIONAL AND SUB-REGIONAL BODY	HISTORY AND OBJECTIVE	MEMBERSHIP
ASSOCIATION OF CARIBBEAN STATES (ACS)	The convention establishing the ACS was signed on 24 July 1994 in Cartagena de Indias, Colombia, with the aim of promoting consultation, cooperation and concerted action among all the countries of the Caribbean	**25 Full Members:** Antigua and Barbuda, Bahamas, Barbados, Belize, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Suriname, Trinidad and Tobago, and Venezuela **3 Associate Members:** Aruba, France (on behalf of French Guiana, Guadeloupe and Martinique) and the Netherlands Antilles *Note:* Eight other non-independent Caribbean countries are eligible for associate membership
CARIBBEAN COMMUNITY AND COMMON MARKET (CARICOM)	The treaty establishing CARICOM entered into force in August 1973. However, the current version of CARICOM is the latest evolutionary stage of the process of Caribbean integration that started with the establishment of the British West Indies Federation in 1958	**15 Full Members:** Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, St Lucia, St Kitts and Nevis, St Vincent and the Grenadines, Suriname, and Trinidad and Tobago **5 Associate Members:** Anguilla, Bermuda, British Virgin Islands, Cayman Islands, and the Turks and Caicos Islands **5 Observers:** Aruba, Cuba, Dominican Republic, the Netherlands Antilles and Puerto Rico *Note:* Of the 11 non-independent Caribbean countries, only Montserrat has full membership in CARICOM
CARIBBEAN FORUM (CARIFORUM)	The CARIFORUM convened its first session in 1993 and was specifically established to address the relationship of the African, Caribbean and Pacific States with the European Union	It consists of the CARICOM member states (see above) and Cuba
ORGANIZATION OF EASTERN CARIBBEAN STATES (OECS)	The OECS was established on 18 June 1981, when seven Eastern Caribbean countries signed a treaty to cooperate with each other and promote unity and solidarity among the members	**7 Full Members:** Antigua and Barbuda, Dominica, Grenada, Montserrat, St Kitts and Nevis, St Lucia, and St Vincent and the Grenadines **2 Associate Members:** Anguilla and the British Virgin Islands
ALLIANCE OF SMALL ISLANDS STATES (AOSIS)	AOSIS continues to be a major mechanism for dealing with island issues within the UN system. AOSIS was formed in 1992 as an outcome of the UNCED, and played a major role in the preparations for the 1994 UN Conference on the Sustainable Development of Small Island Developing States	**14 Full Members (in the Caribbean):** Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, St Kitts and Nevis, Grenada, St Lucia, St Vincent and the Grenadines, Guyana, Suriname, Haiti, Jamaica, and Trinidad and Tobago **2 Observers:** Netherlands Antilles and the US Virgin Islands

BIOPHYSICAL CHARACTERISTICS

Countries and territories of the Caribbean region exhibit substantial variation in size as measured by population, surface area and extent of coastline (Table 4). Size, however measured, has implications for sustainable development. For instance, high population densities imply high levels of natural resource exploitation and high rates of environmental change. Also, it is unlikely that the critical mass required for efficiently managing environmental resources and regional and international obligations will be available in the populations of individual small islands.

The ratio of coastline to land area is an indicator of 'islandness' or the proximity of the interior of the island to the coast: the larger the quotient, the more island-like the country. This quotient varies widely among the countries in the region and ranges from less than 1 to 30 (see Table 4). There is also great variation between countries in terms of surface area and the ratio of land area to Exclusive Economic Zone (EEZ) (Table 4). The EEZs of the Caribbean region form a mosaic that includes the entire region with the exception of two small areas of high seas in the Gulf of Mexico. Consequently, there are many transboundary resource management issues, even at relatively small spatial scales. These characteristics influence national and regional governance, and institutional arrangements for resource management, and the nature of regional initiatives for cooperation and collaboration to address transboundary environmental issues.

The elevation of the land determines the hydrology and terrestrial habitat diversity, with the variety of vegetative habitats increasing with elevation. Smaller, flatter islands and archipelagic systems such as The Bahamas and Turks and Caicos Islands tend to be dry with little or no surface water. The more elevated and bigger islands are characterized by the presence of surface water and forested hills and/or mountains.

The topography and hydrology determine the nature and extent of the land–sea interaction, which defines the coastal zone. 'Coastal zone' is defined here as the area between the landward limit of marine influence and the seaward limit of terrestrial influence. Because of their small physical size, the entire landmass of some of these small islands can be considered as coastal zone. The coastal zone concept has been expanded to become known as the 'island system'.

ECONOMIC PERFORMANCE

The speed of economic growth varies widely between the Caribbean SIDS and LLCS in terms of gross domestic product (GDP). The lowest growth rates were recorded for Haiti, the only country in the region that is placed in the low-income group by the World Bank, and the highest rates were for the high-income and the upper–middle-income groups (Figure 2). Real GDP decreased in Haiti from 4.43 per cent in 1995 to –1.7 per cent in 2001. A similar pattern was exhibited for the lower–middle-income countries (Jamaica, Belize, Cuba, Dominican Republic, Guyana, St Vincent and the Grenadines, and Suriname), although this downward trend was less dramatic, ranging from 3.78 per cent in 1995 to 2.71 per cent in 2001. The growth rates for the upper–middle-income group (Antigua, Barbados, Dominica, Grenada, St Kitts and Nevis, Puerto Rico, St Lucia, and Trinidad and Tobago) went up from 2.16 per cent in 1995 to 4.8 per cent in 1998, and thereafter declined in 2001. Finally, the growth rate for the upper-income group exhibited an overall upward trend from 0.3 per cent in 1995 to 4.9 per cent in 2001 (World Bank 2003).

The regional GDP growth exceeded population growth in the majority of years since 1970 with a few exceptions (Figure 3). In 2001, a significant economic downturn resulted in population growth rate exceeding that of GDP (World Bank 2003). Growth in GDP within the region can be attributed to investment

Table 4 Land and sea area in Caribbean countries and territories

	TOTAL AREA* (km^2)	LAND AREA** (km^2)	COASTLINE LENGTH (km)	COASTLINE TO LAND RATIO (coast km: land km^2)	EEZ (000s km^2)	EEZ TO LAND RATIO (land km^2: EEZ km^2)
ANTIGUA AND BARBUDA	440	440	289	1:1.5	110	1:250
ARUBA	190	190	na	na	na	na
BAHAMAS	13 880	10 010	11 238	less than 1:1	759	1:76
BARBADOS	430	430	97	1:4	167	1:388
BELIZE	22 960	22 800	1 996	1:2	28	1:12
BRITISH VIRGIN ISLANDS	150	150	na	na	na	na
CAYMAN ISLANDS	260	260	na	na	na	na
CUBA	110 860	109 820	14 519	1:8	363	1:3
DOMINICA	750	750	152	1:5	15	1:20
DOMINICAN REPUBLIC	48 730	48 380	1 612	1:30	269	1:6
GRENADA	340	340	252	1:1	27	1:79
GUADELOUPE	1 710	1 690	581	1:3	na	na
GUYANA	214 970	196 850	na	na	130	less than 1:1
HAITI	27 750	27 560	1 977	1:14	161	1:6
JAMAICA	10 990	10 830	895	1:12	298	1:27
MARTINIQUE	1 100	1 060	369	1:3	na	na
MONTSERRAT	100	100	na	na	na	na
NETHERLANDS ANTILLES	800	800	361	1:2	na	na
PUERTO RICO	8 950	8 870	1 094	1:8	na	na
ST KITTS AND NEVIS	360	360	na	na	11	1:30
ST LUCIA	620	610	166	1:4	16	1:26
ST VINCENT AND THE GRENADINES	390	390	264	1:1	33	1:84
SURINAME	163 270	156 000	na	na	na	na
TRINIDAD AND TOBAGO	5 130	5 130	704	1:7	77	1:15
TURKS AND CAICOS ISLAND	430	430	na	na	na	na
US VIRGIN ISLANDS	340	340	390	less than 1:1	na	na

Sources: FAO 2004a; WRI 2004a; UNEP-WCMC 2004

Note: The table includes selected Caribbean countries and territories with required data only. na = data not available

* Total area of the country, including area under inland water bodies. Data in this category are obtained mainly from the United Nations Statistical Division, New York. Possible variations in the data may be due to updating and revisions of the country data and not necessarily to any change of area.

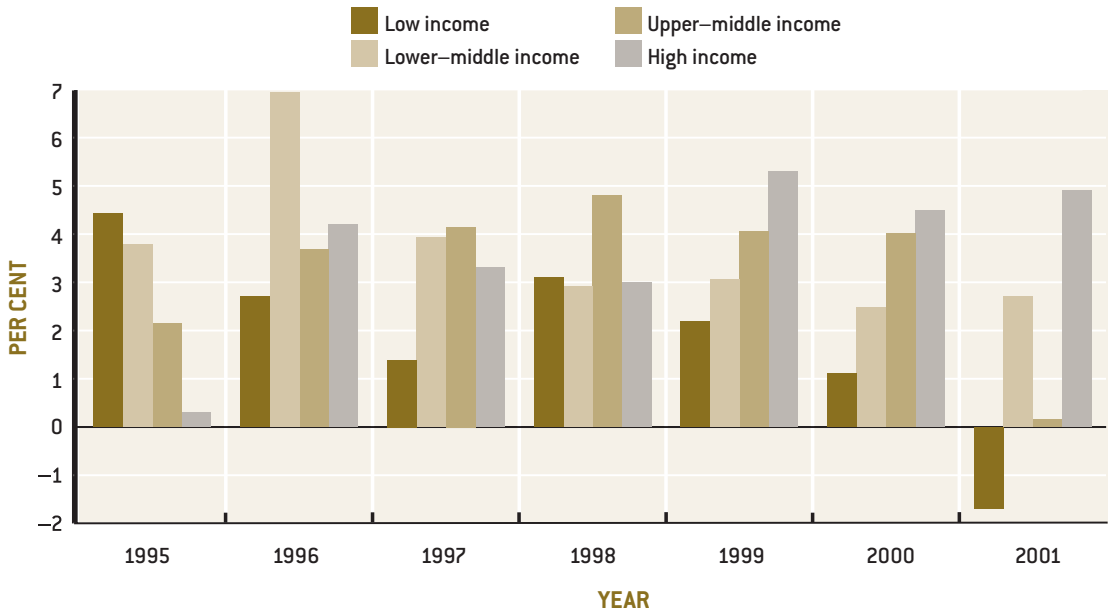
** Total area excluding area under inland water bodies. The definition of inland water bodies generally includes major rivers and lakes. Data in this category are obtained mainly from the United Nations Statistical Division, New York. Possible variations in the data may be due to updating and revisions of the country data and not necessarily to any change of area.

(gross capital formation), export of goods and services and government expenditure (Figure 4). Historically, the economies of the Caribbean specialized in the large-scale production and export of agricultural products and mineral raw materials. Agricultural activities within the region can be broadly categorized into five areas: export agriculture (traditional and non-traditional export), domestic agriculture, livestock, fisheries and forestry. Sugar remains the most important traditional export in Barbados, Jamaica, Guyana, and St Kitts and Nevis, followed by bananas in Jamaica. Other important traditional exports include citrus, coffee, cocoa and pimento. The economic downturn in 2001 was considered to be a direct result of the deceleration of the US economy and the effects of the terrorist attacks in the US in September 2001, the impact of which was manifested by a reduction in exports, investment and consumption (World Bank 2003).

With the exception of Dominica, Grenada, Guyana, St Kitts and Nevis, St Lucia, and St Vincent and the Grenadines, which still rely heavily on agriculture (FAO 2002), agricultural output in the region had continued to decline throughout the 1990s (Figure 5), and this has led to declining employment in the sector, high unemployment in rural areas, and increasing consumption of imported foods. This trend is likely to continue.

The contribution of the manufacturing sector has risen in recent years in Cuba and Trinidad and Tobago, but for the region as a whole it has remained constant at around 12 to 13 per cent of GDP. The construction sector, on the other hand, has expanded its contribution to GDP over the last decade, especially in St Kitts and Nevis where the sector's contribution grew from 11.59 per cent in 1991 to 17.65 per cent in 2001 (ECLAC 2004).

Figure 2 **Average growth performance by income category**

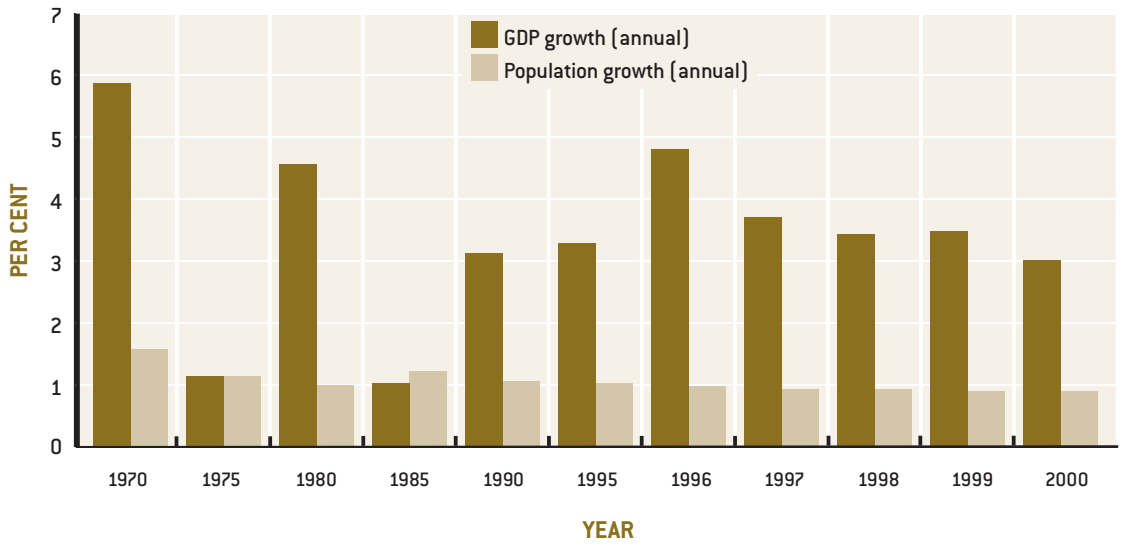


Source: World Bank 2003

Low income: Haiti; **lower–middle income:** Belize, Cuba, Dominican Republic, Guyana, Jamaica, St Vincent and the Grenadines, and Suriname; **upper–middle income:** Antigua and Barbuda, Barbados, Dominica, Grenada, Puerto Rico, St Kitts and Nevis, St Lucia, and Trinidad and Tobago; **upper income:** Bahamas

World Bank definition of GDP growth as annual percentage growth rate of GDP at market prices based on constant local currency; aggregates are based on constant 1995 US dollars

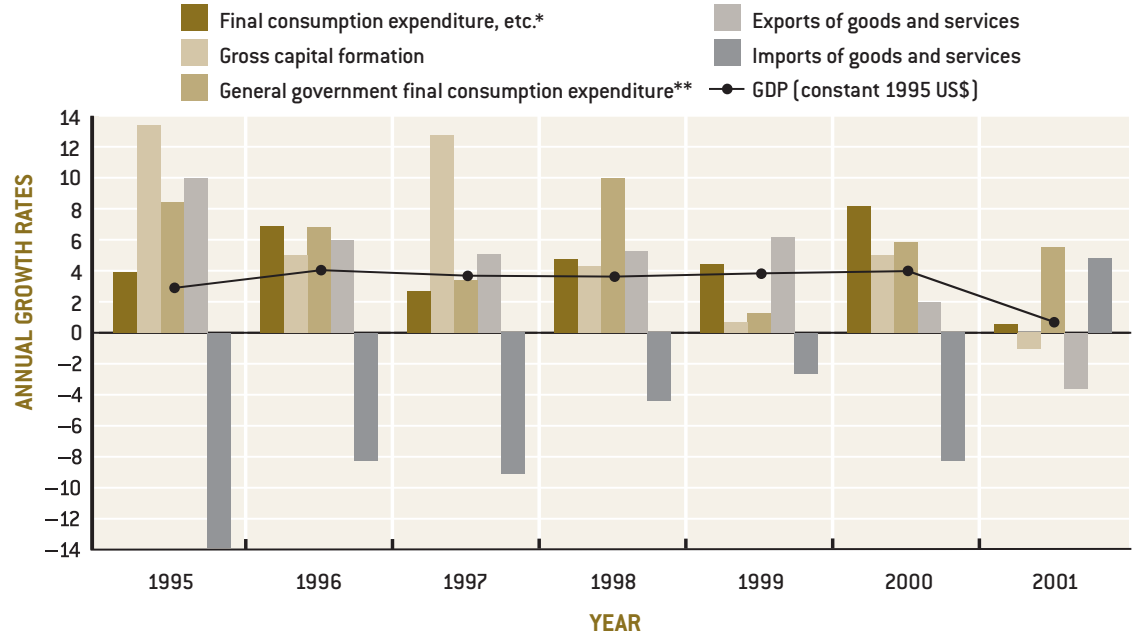
Figure 3 Average regional trends in population and GDP growth



Source: adapted from UNEP/DEWA/GRID-Geneva 2004 and CELADE 2004

Countries include: Netherlands Antilles, Bahamas, Barbados, Belize, Cuba, Dominica, Grenada, Guadeloupe, Guyana, Haiti, Jamaica, Martinique, Puerto Rico, Dominican Republic, St Lucia, Trinidad and Tobago

Figure 4 GDP growth by sector



Source: World Bank 2003

Countries include: Antigua, Barbados, Belize, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, and Trinidad and Tobago

* The sum of household final consumption expenditure and general government final consumption expenditure

** Includes all government current expenditures for purchases of goods and services (including compensation of employees)

Table 5 The importance of the tourism sector in the Caribbean region (2001 data)

	GDP PER CAPITA* (constant 1995 US$)	TOURIST ARRIVALS**	NUMBER OF TOURISTS RELATIVE TO RESIDENT POPULATION (%)	TOURIST RECEIPTS† AS PERCENTAGE OF GDP (constant 1995 US$)	TOURIST RECEIPTS AS PERCENTAGE OF EXPORTS	TOURISM INTENSITY PER km^2
ANTIGUA AND BARBUDA	9 015	237 000	346	43	63	5.38
BAHAMAS	13 836	1 439 000	464	60	64	1.44
BARBADOS	8 610	507 080	189	25	52	11.79
CUBA	2 900	1 736 000	15	10	na	0.16
DOMINICA	3 291	68 000	95	17	33	0.91
DOMINICAN REPUBLIC	2 077	2 777 800	33	9	32	0.57
GRENADA	3 579	123 350	123	18	30	3.63
HAITI	354	140 490	2	2	11	0.05
JAMAICA	2 171	1 277 000	49	18	37	1.18
ST KITTS AND NEVIS	6 535	69 000	153	17	38	1.92
ST LUCIA	3 771	250 130	160	35	72	4.10
ST VINCENT AND THE GRENADINES	2 737	70 790	61	20	44	1.82
TRINIDAD AND TOBAGO	5 553	398 560	30	4	7	0.78

Source: World Bank 2003; Central Statistical Offices, IBRD and CDB Reports

na = data not available

* GDP per capita (constant 1995 US$). GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant US dollars.

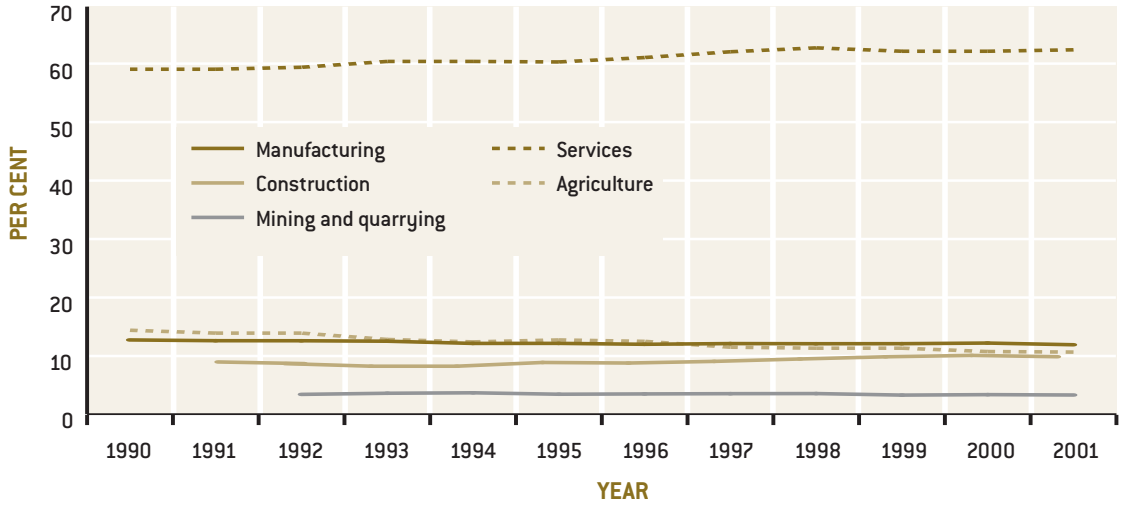
** International inbound tourists are the number of visitors who travel to a country other than that where they have their usual residence for a period not exceeding 12 months and whose main purpose in visiting is other than an activity remunerated from within the country visited.

† International tourism, receipts (percentage of total exports). International tourism receipts are expenditures by international inbound visitors, including payments to national carriers for international transport. These receipts should include any other prepayment made for goods or services received in the destination country. They may also include receipts from same-day visitors, except in cases where these are so important as to justify a separate classification. Their share in exports is calculated as a ratio to exports of goods and services.

The service sector, particularly tourism, continues to play the most prominent role in the economies of the Caribbean (Figures 5 and 6). While tourism is a vital income source for all countries in the region, Antigua and Barbuda, Bahamas, Barbados, Jamaica, St Kitts and Nevis, St Lucia, and St Vincent and the Grenadines depend on this sector more than the other countries (Table 5). During 2002, the service-based economies of the OECS and Barbados contracted, while the resource-based economies of Jamaica, Belize, and Trinidad and Tobago maintained the rate of GDP growth of the previous year (ECLAC 2002).

Mining is also an important sector especially in Guyana, Jamaica, and Trinidad and Tobago, where the sector contributed 19.3 per cent, 7.9 per cent and 10.6 per cent of GDP, respectively. Offshore banking is a fast-growing sector in the Caribbean. This sector is particularly significant in countries such as The

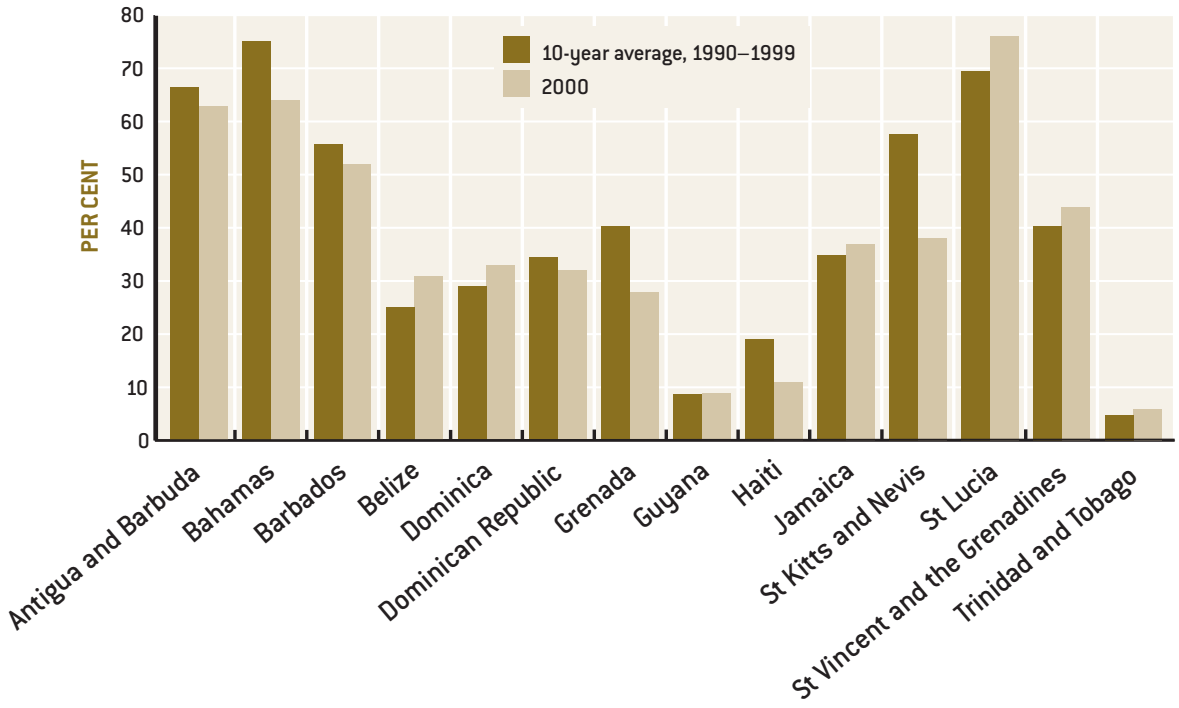
Figure 5 Sectoral value-added as a percentage of GDP



Source: ECLAC 2004

Countries include: Cuba, Haiti, Dominican Republic, Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St Kitts and Nevis, St Vincent and the Grenadines, St Lucia, and Trinidad and Tobago

Figure 6 Tourism contribution to total exports



Source: WTO 2002; World Bank 2002, 2003

Table 6 Vulnerability of food supplies for selected CARICOM countries

	ECONOMY OVERVIEW	AGRICULTURE SECTOR	PERCENTAGE OF LABOUR FORCE IN AGRICULTURE	AGRICULTURE AS PERCENTAGE OF GDP	INTERNAL VULNERABILITY
BARBADOS	Diversified; growing	Declining	10	4	Moderate
BELIZE	Diversifying	Key sector; expanding	38	18	Low
GUYANA	Expanding	Key sector; expanding	36	na	Low
JAMAICA	Diversifying; not stable	Declining	21	7	High
ST LUCIA	Recent expansion	Declining	10	43	High
TRINIDAD AND TOBAGO	Diversified; stable	Declining	2	10	Low

Source: Brklacich 2003
na = data not available

Bahamas, Barbados and Suriname. Finally, repatriated funds from the countries' population working overseas play an important role in providing foreign exchange for importation of goods and services, and in some cases these funds provide the largest share of foreign exchange flows.

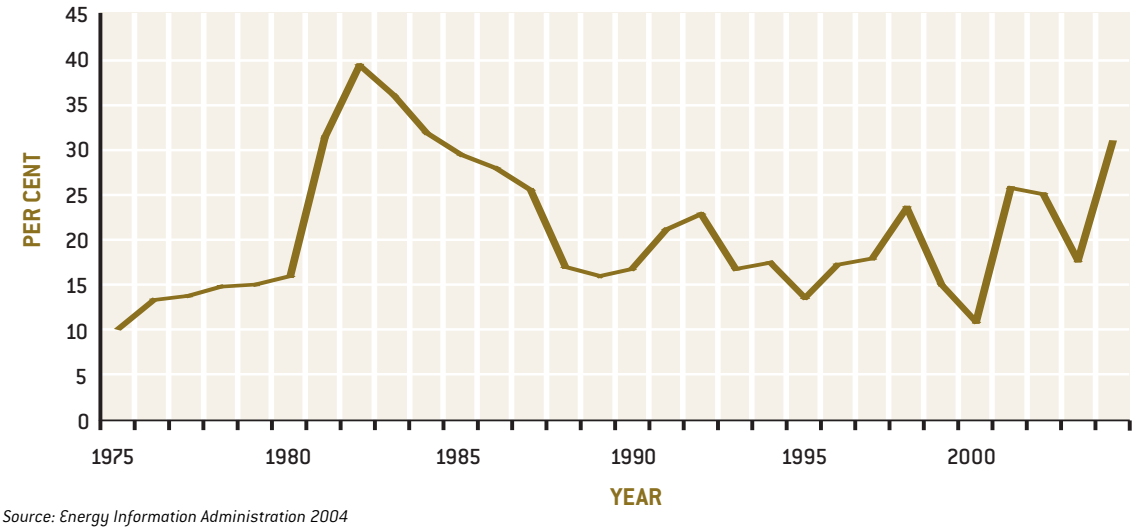
In the Caribbean, as in other SIDS regions, the high concentration of foreign exchange earnings in a small number of export industries, the small size and high degree of exposure of its economy (that is, the degree to which a national economy is dependent on external patronage, as indicated by the sum of exports of goods and services, including tourism, and imports as a proportion of GDP), and the high energy dependence as the share of imported energy in total energy consumption, have resulted in a high level of economic vulnerability, as defined by Whiter (2003) using the Index of Economic Vulnerability (IEV).

SIDS do not fall easily into the development categories, such as Less Developed Country, Developed Country and Industrialized Country, used by the Organization for Economic Cooperation and Development (OECD) countries and international agencies to define and describe the economic status of nations. The economies of SIDS frequently experience 'shocks' from external political, economic and social phenomena, sometimes leading to serious economic instability (Box 2).

Historically Caribbean SIDS, especially those of CARICOM, have been, and remain, committed to free trade and liberalization, with member states recognizing the benefits of free trade. Nevertheless, earnings and export earning capacity in all member states have been seriously affected by: (a) the erosion of preferential markets; (b) adverse commodity price shocks; and (c) stiff competition in tourism services (Nicholls and others 1999). The loss of tariff revenues from inter-participant trade that is associated with trade liberalization can exceed the net gains, resulting in overall welfare loss (Nicholls and others 1999). Indicators of national dependence on trade taxes include the ratio of tax receipts from international trade to total tax revenue, and the ratio of import duties to GDP. In the case of the former, the level of dependence is considered to be significant when the ratio is in excess of 15 per cent. For the OECS countries, this ratio is greater than 40 per cent, indicating a high level of dependence on tax receipts from international trade. The dependence on trade taxes is lower for the larger Caribbean states and higher for the smaller territories, which is the converse of the case with direct taxes (Peters 2002). In comparison, industrialized and industrializing countries depend more on sales or value-added taxes, with minimal or no dependence on trade taxes.

For the OECS, tariff removal under the proposed Free Trade Area of the Americas (FTAA) arrangement will

Figure 7 Refinery acquisition cost of imported crude oil



Source: Energy Information Administration 2004

Box 2 The economic vulnerability of a Caribbean SIDS

In 2002, Jamaica's real GDP experienced positive growth for the third consecutive year, but as the growth was insufficient to keep pace with population growth, in real terms, the overall economic performance represented a per capita decline. Following a rate of 0.7 per cent in 2000, GDP grew by 1.7 per cent in 2001 and 0.6 per cent in 2002. Several factors contributed to the slow growth in the economy in 2001–2002. The fiscal deficit limited the government's ability to spur demand. Floods in May 2002 and hurricane Michelle in November 2001 damaged numerous crops and the September 2001 terrorist attacks in the United States had a negative impact on tourism, the country's main foreign exchange earner (approximately US$1.4 billion in 2000). Jamaica was also beset by the three-month closure in October 2001 of the JAMALCO refinery, a joint venture between the Jamaican Government and ALCOA, following a strike at this aluminium processing plant.

Source: OECD 2004

result in a decline of revenues from trade taxes, at least in the short term. The loss in tax revenue combined with the erosion of preferential markets, adverse commodity price shocks and stiff competition in tourism services makes it difficult for the smaller CARICOM states to remain economically viable.

Further marginalization of Caribbean SIDS economies is expected because many countries find it increasingly difficult to engage themselves in several important international processes. The World Trade Organization (WTO) process has been identified as one of the most costly, complicated and time-consuming processes at the international level (UWICED 2002). Many SIDS have abandoned the WTO process because of the high level of financial, human and professional resources that must be dedicated to the process on a sustained basis. Of the 43 AOSIS members, 20 are full WTO members, but only a few participate on a regular basis. The issue that arises is whether or not the 'opportunity' that is available is actually within the grasp of all SIDS (UWICED 2002). The prescription (liberalization) and the mechanism (WTO) articulated by OECD countries as a development solution is of questionable benefit if SIDS cannot afford to represent their respective and collective interests. Global economic crises, combined with a loss in export earnings, have created a syndrome of indebtedness in

Table 7 Commercial energy consumption

	kg OF OIL EQUIVALENT PER CAPITA						
	1975	1980	1985	1990	1995	2000	2002
CUBA	1 409.7	1 535.5	1 436.0	1 555.2	1 016.8	1 180.0	1 216.0
DOMINICAN REPUBLIC	610.8	608.1	575.9	558.8	654.8	934.0	921.0
HAITI	350.2	392.1	323.6	244.9	239.5	256.0	257.0
JAMAICA	1 387.8	1 114.9	803.4	1 263.5	1 386.0	1 519.0	1 545.0
TRINIDAD AND TOBAGO	2 319.4	3 579.9	4 365.3	4 970.2	5 037.1	6 499.0	6 708.0
LATIN AMERICA AND CARIBBEAN	**921.51**	**1 070.4**	**1 039.9**	**1 050.3**	**1 097.5**	**1 171.0**	**1 151.0**

Source: World Bank 2004

the region (Box 2). The high levels of external debt in countries with small taxable populations will challenge their long-term economic viability.

Food and energy security represent additional areas of vulnerability for the Caribbean. Brklacich (2003) determined the internal vulnerability of food supplies of selected CARICOM countries to external stresses, based on an assessment of the production, supply and importation of major agricultural commodities (Table 6). Internal vulnerability takes account of the robustness and state of the national economy, the health and importance of the domestic agricultural sector, and reliance on imported agricultural commodities. Countries with moderate to high vulnerability were Barbados, Jamaica and St Lucia (Table 6).

Ninety per cent of all energy utilized in the Caribbean is derived from crude oil (UWICED 2002), most of which is imported at high cost to the countries. While energy consumption in the Latin America and the Caribbean region, and in some Caribbean countries, has increased over the years (Table 7), the cost of energy production in the Caribbean is increasing even more rapidly due to the recent rise in the world price of crude oil (Figure 7).

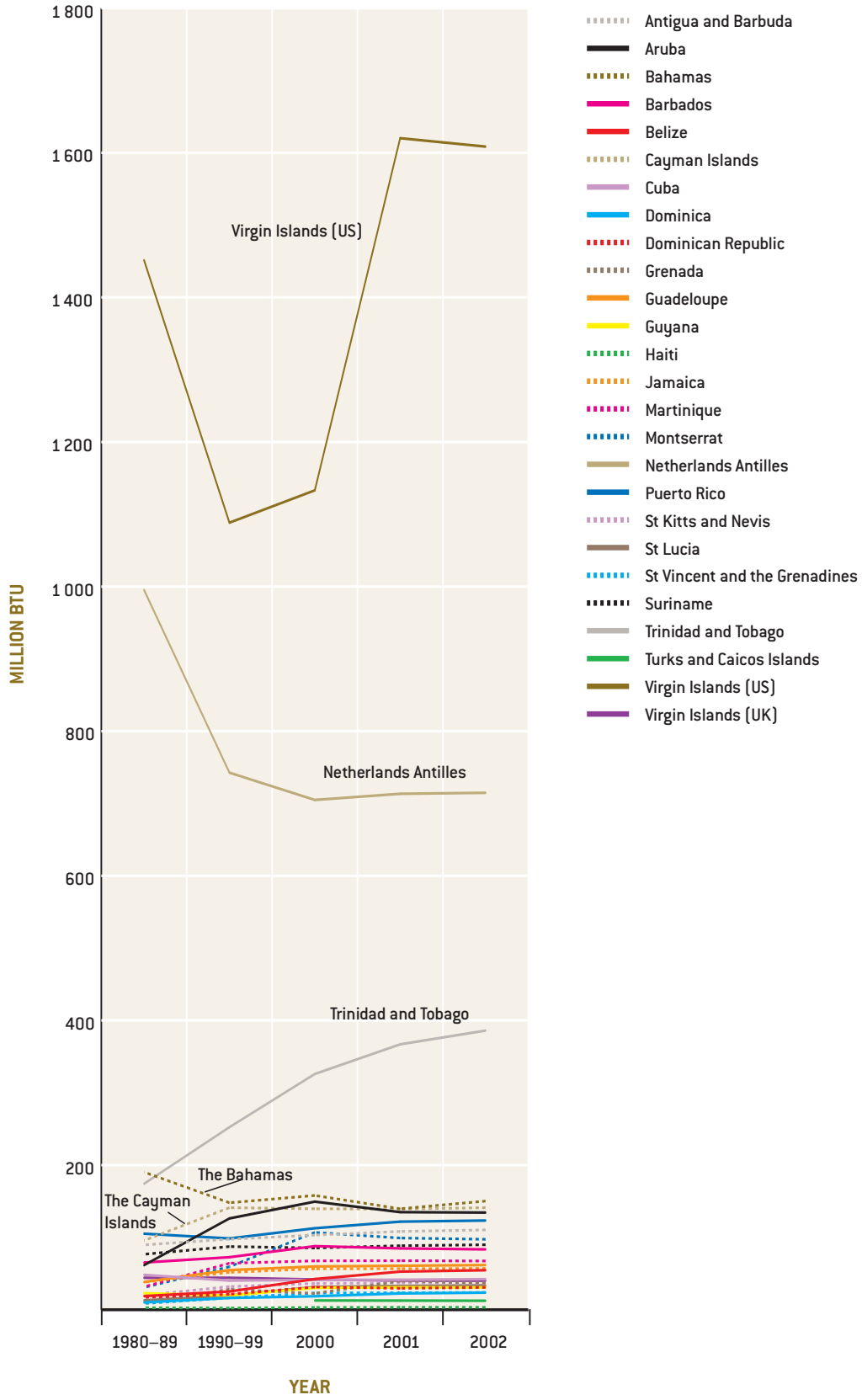
Per capita energy consumption in the Caribbean is elevated in general, but especially high in the US Virgin Islands, the Netherlands Antilles, and Trinidad and Tobago (Figure 8); the economies of these countries are considered energy-intensive (US Department of Energy 2004).

There are opportunities for investment in agriculture that would reduce energy dependence, and opportunities for investment in energy that would improve food security. Generating electricity from ethanol, which is produced from agricultural and biomass feedstocks, is an excellent example of such an agriculture–energy link. Bagasse is used to co-generate electricity in Cuba, and Jamaica has a good opportunity of implementing a bio-fuels programme to ban methyl tertiary-butyl ether (MTBE) and introduce ethanol as the replacement in gasoline (see Box 22 in Chapter 3).

To this end, there are many opportunities available for the sugar industry in the development of this programme. The US ethanol market has moved from an oversupply situation early in 2003 to a position of undersupply over the past months as a result of increased demand from California, New York and Connecticut, because of the MTBE bans in those states since 1 January 2004. The oversupply was due mainly to the construction of several new ethanol plants and the expansion of existing plants in 2001 and 2002 in response mainly to the California MTBE ban which was predicted to take effect in 2003 and which was expected to significantly increase the demand for ethanol (Petroleum Corporation of Jamaica 2004).

There is, however, a limitation on capacity to manage such options. The region has more renewable energy resources available than agricultural resources, and therefore needs to aggressively pursue the development of these abundant renewable energy resources.

Figure 8 **Per capita energy demand in the Caribbean**



Source: US Department of Energy 2004

DEMOGRAPHICS AND SOCIAL PERFORMANCE

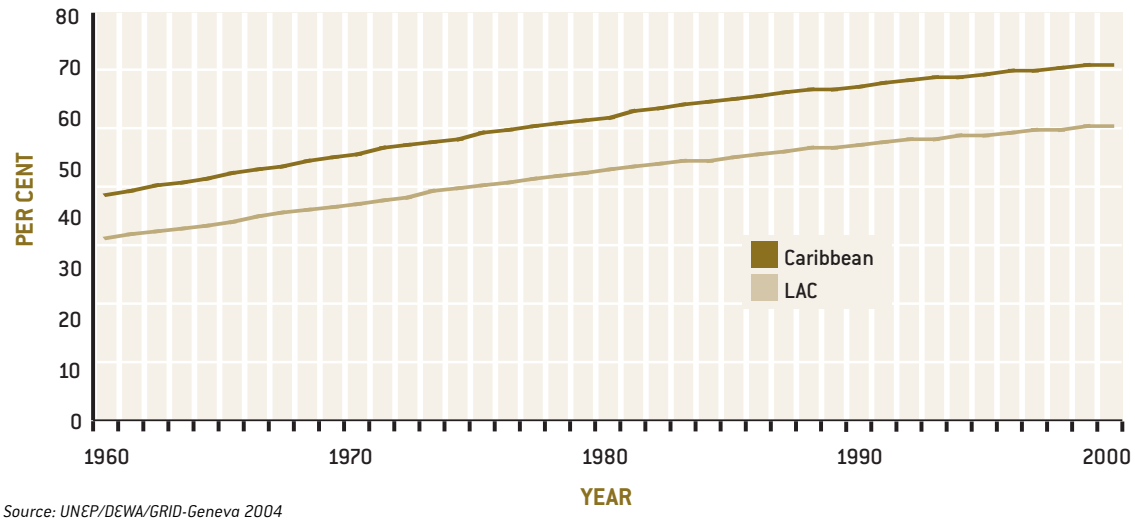
In addition to economic indicators, socio-demographic indicators must also be taken into consideration in analysing the driving forces of environmental change, since a worsening socio-economic climate can mean an increase in pressures on natural resources or fewer resources to devote to environmental management.

The annual average population growth in the region in 2003 was 0.79 for SIDS and 0.99 for LLCS, showing great reductions from the growth rates recorded three decades ago (Table 8). While national average population densities in the Caribbean LLCS and the archipelagic states such as The Bahamas, remain relatively low (2.4–17.0 per km^2 in 1970 and 2.8–31.0 per km^2 in 2002), population densities in other Caribbean SIDS continue to increase, with a few exceptions such as Grenada, Montserrat, and St Kitts and Nevis, which are more sparsely populated today than in 1970. The low average national population densities may mask the impact of high local population aggregations.

Also, over the last four decades the urban population as a percentage of total population steadily increased in the Caribbean SIDS and LLCS. Urbanization in the Caribbean is approximately 10 per cent above the average in Latin America and the Caribbean as a whole (Figure 9). At both the national and local levels, high population densities, when combined with high levels of urbanization, have the potential for creating substantial social and environmental changes. A common feature throughout the Caribbean is the location of population centres in the coastal zone, which is coming under increasing pressure from rising population and development pressures.

The majority of the Caribbean countries have maintained a positive trend in key health and social indicators. For example, the under-five mortality rate per 1 000 live births has been reduced from 39 to 30 for SIDS and 61 to 48 for LLCS (UNDP 2003a). The Caribbean SIDS are at the top of all developing-country groupings in the world and are only exceeded by high-income countries. However, among the Caribbean SIDS, Haiti still had an under-five mortality rate of 123 in 2001, the highest in the region. Cuba had the lowest

Figure 9 The urban population as a percentage of the total population in the Latin America and the Caribbean region (LAC) and the Caribbean sub-region



Source: UNEP/DEWA/GRID-Geneva 2004

figure of 9 for the same year, and is the only country in the region with an infant mortality rate comparable with the average of high-income countries (UNDP 2003a).

The major health-related threat to the socio-economic status of the Caribbean SIDS and LLCS is the HIV/AIDS epidemic. The average incidence of HIV/AIDS of 2.15 per cent of the population is significantly higher than the LAC regional average of 0.58 per cent. In addition, among the developing countries, HIV/AIDS incidence in the Caribbean SIDS and LLCS is surpassed only by that of Sub-Saharan Africa, at 8.38 per cent (World Bank 2002). Considered in the context of the small populations and hence small revenue bases that

Table 8 Demographic trends in the Caribbean: averages for SIDS and LLCS

	POPULATION DENSITY (persons/km²)	POPULATION (000s)					POPULATION GROWTH RATE (%)			
		1970	1980	1990	2000	2003	1970	1980	1990	2003
BAHAMAS	23	170	210	255	304	316	3.79	2.13	1.77	1.26
BARBADOS	628	239	249	257	267	270	0.3	0.28	0.35	0.35
CUBA	102	8 520	9 710	10 628	11 199	11 306	1.88	0.85	0.99	0.37
DOMINICA	105	70	74	71	71	70	1.16	0.34	–0.31	–0.09
DOMINICAN REPUBLIC	181	4 423	5 697	7 066	8 677	8 819	3	2.42	1.84	1.68
GRENADA	235	94	89	91	94	94	–0.59	–0.6	0.2	0.29
GUADELOUPE	257	320	327	391	428	438	1.27	–0.1	1.92	0.88
HAITI	318	4 520	5 454	6 942	8 357	8 827	1.74	2.06	2.47	1.83
JAMAICA	241	1 869	2 133	2 369	2 621	2 645	1.2	1.16	0.62	0.84
MARTINIQUE	357	325	326	360	388	390	0.89	-0.14	1.13	0.58
NETHERLANDS ANTILLES	276	159	174	188	215	221	1.67	0.88	0.64	0.87
PUERTO RICO	433	2 716	3 197	3 528	3 988	4 023	1.01	1.68	0.87	0.98
TRINIDAD AND TOBAGO	254	971	1 082	1 215	1 306	1 312	1.6	1.34	0.62	0.45
CARIBBEAN SIDS AVERAGE							**1.46**	**0.95**	**1.01**	**0.79**
GUYANA	4	709	761	731	761	767	1.9	0.72	–0.6	0.41
BELIZE	11	123	144	186	226	240	2.76	1.45	2.6	2.14
SURINAME	3	372	355	402	421	423	2.28	–0.51	0.91	0.43
CARIBBEAN LLCS AVERAGE							**2.31**	**0.55**	**0.97**	**0.99**

Source: CELADE 2004

Note: The table includes selected Caribbean countries and territories

characterize many of the Caribbean countries, HIV/AIDS poses a threat to the social and economic progress that has been achieved in the Caribbean SIDS and LLCS over the last 30 years. This threat emerges at a time when these countries are facing increasing pressures to improve economic performance despite changing trade arrangements.

Populations in the Caribbean SIDS and LLCS become sexually active at a young age, as shown by the overall high fertility rate per 1 000 women between the ages of 15 and 19 years. The highest fertility rate is 101.4 per 1 000 in the Dominican Republic and the lowest is 16.7 in Trinidad and Tobago (World Bank 2002).

The Caribbean continues to perform well as a region in education, which is displayed not only by high public spending on education but also by lower illiteracy rates than other developing regions. Public spending on education varies from 9.3 per cent of GDP in Guyana to 1.4 per cent of GDP in Haiti (World Bank 2002). In 2001, average adult literacy was 90.8 per cent in the region. Net primary enrolment ratio reached 100 per cent in 2000–2001 in Belize and St Lucia. The ratio of females to males in secondary education equalled or exceeded 1.0 in 11 of the 16 countries, with Antigua and Barbuda showing the highest ratio of 2.53 (Table 10). This high female enrolment may have contributed to the overall good status of women in the Caribbean, where female participation in the labour force ranges from 46.2 per cent in Jamaica to 24.0 per cent in Belize (World Bank 2002). The percentage of women employed in the non-agricultural sector ranges from 34 per cent in Suriname to 47 per cent in Barbados (World Bank 2002). Unemployment is high, although the educational quality of the labour force appears also to be high. The unemployment rate for LAC is 9 per cent, which is higher than the corresponding figure for East Asia and the Pacific (3.8 per cent), and lower than that for Europe and Central Asia, which is 11 per cent (World Bank 2002).

Another indicator of socio-economic performance is the Human Development Index (HDI) (UNDP 2003a). The HDI is a composite index that includes GDP, life expectancy and educational attainment. The Caribbean SIDS and LLCS show wide variation in the HDI, which ranges from 0.888 in Barbados to 0.467 in Haiti, corresponding to world rankings of 27th and 150th, respectively (Table 10). Haiti continues to be an outlier with respect to all the social indicators, demonstrating the strong link between economic performance and social well-being. There are also significant variations with respect to the percentage of the population below the national poverty line (the poverty line deemed appropriate for a country by its authorities). Haiti has the highest poverty rate of 53 per cent, which reflects the lower-than-average social indicators of its citizens. Meanwhile, Barbados has the lowest poverty rate of 13.9 per cent (World Bank 2002).

Urbanization is steadily increasing in SIDS and LLCS
Source: B. Potter

Table 9 Selected health indicators in the Caribbean

	UNDER-FIVE MORTALITY RATE (per 1 000 live births)		CHILDREN UNDERWEIGHT FOR AGE (percentage under age 5)	SUSTAINABLE ACCESS TO AFFORDABLE ESSENTIAL DRUGS
	1990	2001	1995–2001	1999
ANTIGUA AND BARBUDA	na	14	10	LOW
BAHAMAS	29	16	na	MEDIUM
BARBADOS	16	14	6	GOOD
BELIZE	49	40	6	MEDIUM
CUBA	13	9	4	GOOD
DOMINICA	23	15	5	MEDIUM
DOMINICAN REPUBLIC	65	47	5	LOW
GRENADA	37	25	na	GOOD
GUYANA	90	72	12	VERY LOW
HAITI	150	123	17	VERY LOW
JAMAICA	20	20	4	GOOD
ST KITTS AND NEVIS	36	24	na	LOW
ST LUCIA	24	19	14	LOW
ST VINCENT AND THE GRENADINES	26	25	na	MEDIUM
SURINAME	44	32	na	GOOD
TRINIDAD AND TOBAGO	24	20	7	LOW
CARIBBEAN SIDS	**39**	**30**	**na**	**na**
CARIBBEAN LLCS	**61**	**48**	**na**	**na**
CARIBBEAN	**43.07**	**32.19**	**8.18**	**na**
HIGH-INCOME COUNTRIES	**10**	**7**	**na**	**na**

Source: UNDP 2003a

0–49, very low access; 50–79, low; 80–94, medium; 95–100, good na = data not available

Table 10 Selected social indicators in the Caribbean

	EDUCATION			GENDER		ODA	TECHNOLOGY AND COMMUNICATION	HUMAN DEVELOPMENT INDEX
	Net primary enrolment ratio (%)		Adult literacy rate (% age 15 and above)	Ratio of girls to boys in secondary education	Seats in parliament held by women (as % of total)	ODA received (as % gross national income)	Personal computers in use (per 100 people)	Value (position in the global ranking)
	1990–1991	2000–2001	2001	2000–2001	2003	2001	2001	2001
ANTIGUA AND BARBUDA	na	na	86.6	2.53	5	1.3	na	0.798 (56)
BAHAMAS	96	83	95.5	0.95	20	na	na	0.812 (49)
BARBADOS	na	na	99.7	0.98	11	0.0	9.3	0.888 (27)
BELIZE	98	100	93.4	1.05	7	2.9	13.4	0.776 (67)
CUBA	92	97	96.8	1.00	36	n?a	2.0	0.806 (52)
DOMINICA	na	na	96.4	1.09	19	8.5	7.7	0.776 (68)
DOMINICAN REPUBLIC	na	93	84.0	1.21	17	0.5	na	0.737 (94)
GRENADA	na	84	94.4	0.47	27	3.1	13.0	0.738 (93)
GUYANA	93	98	98.6	0.97	20	16.0	2.6	0.740 (92)
HAITI	na	na	50.8	na	4	4.4	na	0.467 (150)
JAMAICA	96	95	87.3	1.02	12	0.7	5.0	0.757 (78)
ST KITTS AND NEVIS	na	na	97.8	1.08	13	3.4	17.5	0.808 (51)
ST LUCIA	na	100	90.2	1.33	11	2.6	14.6	0.775 (71)
ST VINCENT AND THE GRENADINES	na	na	88.9	1.18	23	2.6	11.3	0.755 (80)
SURINAME	na	92	94.0	1.13	18	3.4	4.5	0.762 (77)
TRINIDAD AND TOBAGO	91	92	98.4	1.05	19	0.0	6.9	0.802 (54)
CARIBBEAN	**na**	**na**	**90.8**	**na**	**16**	**na**	**na**	
AVERAGE OF HIGH-INCOME COUNTRIES IN THE WORLD	**97**	**97**	**na**	**na**	**na**	**0.1**	**43.3**	**0.927**

Source: UNDP 2003a

na = data not available

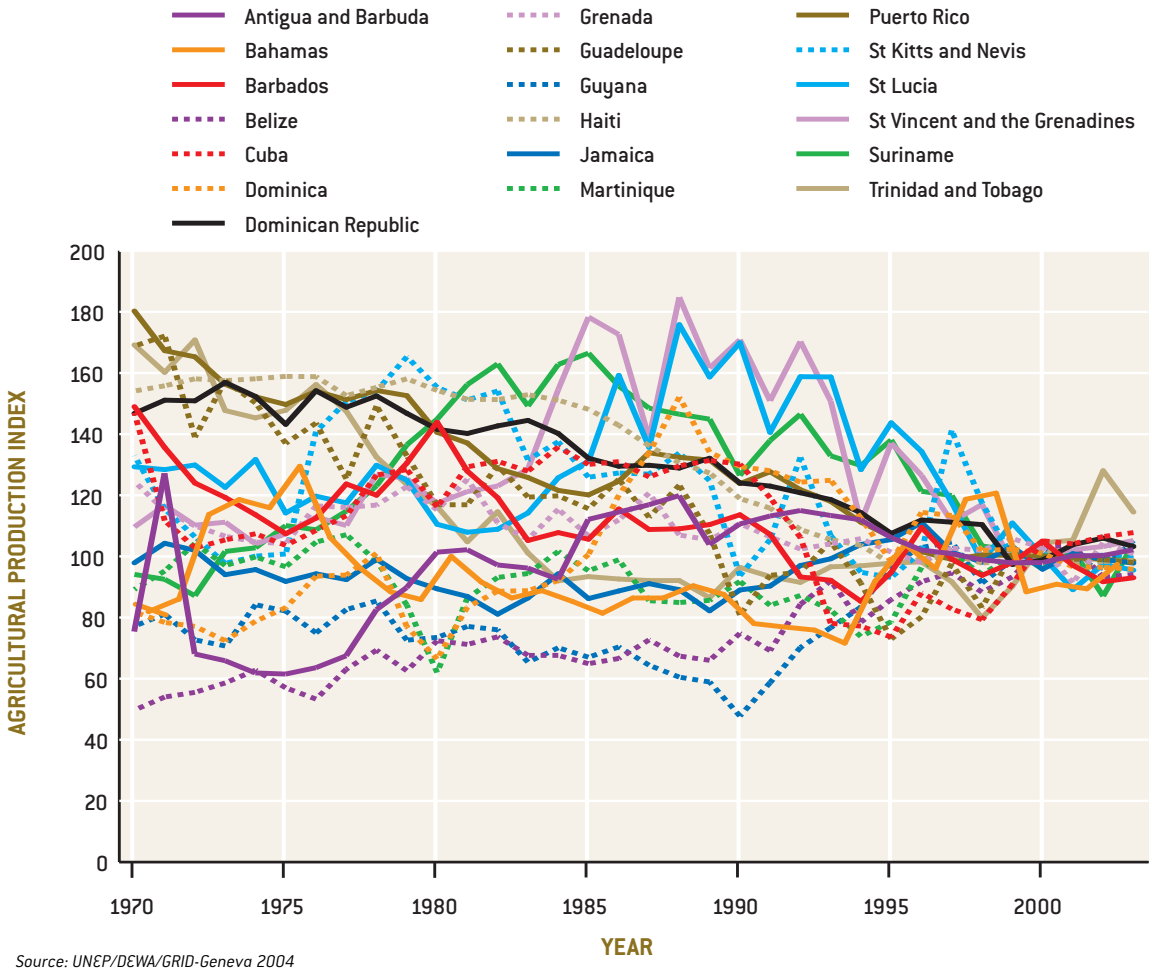
ENVIRONMENTAL TRENDS

LAND AND FOOD

The state of terrestrial resources is influenced by land use patterns. Poor land use and land management practices, as well as incompatible or conflicting land uses, cause serious environmental problems (FAO 2001). The absence of initiatives that ensure sustainable use of land resources results in the inefficient use of these resources and land use conflicts.

The conversion of lands from their natural state due to urbanization, industrialization or agricultural development is a major issue in the Caribbean. The lack of long-term planning as well as evaluation of the future value of the land and its goods and services, which may be lost in land use change (Ramcharan 2001), makes the conversion particularly problematic.

Figure 10 Per capita agricultural production index for the Caribbean



Source: UNEP/DEWA/GRID-Geneva 2004
Base: 1999–2001

Table 11 Area, population density and land use in the Caribbean for 1985 and 2000, with projections to 2015

	POPULATION DENSITY (Persons per 1 000 ha)			LAND AREA (000s ha)	ARABLE LAND (ha per person)		ARABLE LAND (% land area)	IRRIGATED LAND (% cropland)		PERMANENT CROPLAND (% land area)		OTHER (% land area)	
	1985	2000	2015	1997	1985	1997	1997	1985	1997	1985	1997	1985	1997
ANTIGUA AND BARBUDA	1 409	1 546	1 636	44	0.13	0.12	18.18	na	na	na	na	na	na
BAHAMAS	232	307	375	1 001	0.03	0.02	0.60	na	na	0.20	0.40	99.00	99.00
BARBADOS	5 884	6 279	6 698	43	0.06	0.06	37.21	5.88	5.88	2.33	2.33	60.47	60.47
BELIZE	73	106	139	2 280	0.26	0.28	2.81	3.77	3.37	0.44	1.10	97.68	96.10
CAYMAN ISLANDS	808	1 462	2 346	26	na	na	na	na	na	na	na	na	na
CUBA	921	1 020	1 060	10 982	0.28	0.33	33.69	24.13	20.45	6.54	6.83	67.51	59.48
DOMINICA	960	947	960	75	0.08	0.04	4	na	na	14.67	16.00	77.33	80.00
DOMINICAN REPUBLIC	1 318	1 756	2 119	4 838	0.17	0.13	21.08	13.85	17.27	7.34	9.92	70.44	69.00
GRENADA	2 647	2 765	2 941	34	0.03	0.02	5.88	na	na	29.41	26.47	61.76	67.65
GUYANA	40	44	49	19 685	0.61	0.57	2.44	25.66	26.21	0.08	0.08	97.49	97.48
HAITI	2 223	2 983	3 788	2 756	0.09	0.07	20.32	7.75	9.89	12.70	12.70	67.24	66.98
JAMAICA	2 121	2 385	2 719	1 083	0.05	0.07	16.07	15.00	12.04	9.70	9.23	79.69	74.70
NETHERLANDS ANTILLES	2 275	2 713	3 063	80	0.04	0.04	10.00	na	na	na	na	na	na
PUERTO RICO	3 808	4 362	4 824	887	0.01	0.01	3.72	39.00	51.28	5.64	5.07	88.73	91.21
ST KITTS AND NEVIS	1 222	1 056	1 000	36	0.19	0.15	16.67	na	na	11.11	2.78	66.67	80.56
ST LUCIA	2 049	2 525	3 049	61	0.04	0.02	4.92	5.88	17.65	19.67	22.95	72.13	72.13
ST VINCENT AND THE GRENADINES	2 615	2 923	3 205	39	0.04	0.04	10.26	10.00	9.09	15.38	17.95	74.36	71.79
SURINAME	25	27	31	15 600	0.14	0.14	0.37	88.71	89.55	0.06	0.06	99.60	99.57
TRINIDAD AND TOBAGO	2 296	2 524	2 768	513	0.06	0.06	14.62	18.64	18.03	8.97	9.16	77.00	76.22
US VIRGIN ISLANDS	2 971	3 206	3 588	34	0.05	0.04	14.71	na	na	5.88	5.88	79.41	79.41

Source: UNCHS-UN HABITAT 2002

na = data not available

In 2002, 32.5 per cent of the land in the Caribbean SIDS was classified as agricultural area, which is the sum of arable land and permanent crops, although the figures range widely at the national level among islands, from 76.4 per cent in the Dominican Republic to 2.3 per cent in the Turks and Caicos Islands. Among the Caribbean LLCS, Guyana has the highest proportion of land as agricultural area at 8.8 per cent, followed by Belize (6.7%) (UNEP/DEWA/GRID-Geneva 2004). In many of the countries, except Belize, Cuba, Dominica, the Dominican Republic, Guyana, St Vincent and the Grenadines, and Suriname, the percentage of land occupied by agricultural area has been decreasing over the last three decades, some more dramatically than others. Both total and per capita agricultural production decreased in most of the Caribbean countries and territories for most of the 1990s, with some exceptions, such as Antigua and Barbuda, The Bahamas, Belize, Dominica, the Dominican Republic, Guyana and Jamaica (UNEP/DEWA/GRID-Geneva 2004) (Figure 10).

According to FAO, the Caribbean SIDS have a lower proportion of land with severe agricultural restrictions (67 per cent) than in the LAC region overall (70.9 per cent), but have little capacity to accommodate often conflicting land use needs (FAO 2000). The present land use pattern in the Caribbean SIDS and LLCS (Table 11) has developed primarily as a result of historical demands in developed countries for tropical export crops rather than from the characteristics of the climate, soil, topography and natural vegetation (FAO 2002). Among the problems resulting from these demand-driven land use patterns is the issue of land tenure. As in many other parts of the world, land distribution in the region has been characterized by the inequitable distribution of property and the lack of titles to the land (UNEP 2003a).

Both large and small holdings are susceptible to degradation when the land is not suitably managed. Large-scale agriculture tends to degrade land due to its intensive, monoculture practices. Smallholdings, on the other hand, are often located in marginal lands that may be susceptible to erosion and desertification. Furthermore, traditional farming methods such as slash-and-burn have been used on these holdings. On both types of holdings there are few fallow periods and little crop rotation, leading to a gradual decline in soil fertility (UNEP 2003a).

The effects of climate change on freshwater resources and on crop susceptibility to certain diseases will have negative consequences for agriculture in the region. For example, in the case of banana cultivation, which is water-intensive (demanding 1 300–1 800 mm of water per year), adequate water supply is required to produce large fruit size and lack of water is associated with the onset of Black Sigatoka disease (Government of Jamaica 2000). Agriculture also suffers to varying degrees from tropical hurricanes, floods and droughts. The latter are extremely harsh on crops, and only a few deep-rooted and salt-tolerant species such as mango (*Mangifera indica*), coconut (*Cocos nucifera*) and acacias (*Acacia* sp.) are unaffected by drought. It is very likely that crop production in the Caribbean SIDS and LLCS would be affected by alterations in the patterns of these events brought about by climate change. A reduction in coastal arable land is also anticipated as a result of the projected sea-level rise and consequent saltwater intrusion. These impacts coupled with reduced rainfall and the anticipated reduction in yields of current crops will result in reduced food security in these countries.

FORESTS

In the Caribbean, forest covers only 19 per cent of the total land area, with the proportion of forested territory within individual countries ranging from 3.2 per cent in Haiti to over 90 per cent in Suriname (Table 12). Ten countries possess forest cover of over 40 per cent of the total land area (Table 12). The remaining natural forests are primarily rain, seasonal (evergreen, semi-evergreen and deciduous), dry, montane (low, high and elfin), mossy, swamp and mangrove forests. Accurate data on the extent of these remaining forest types and their dominant species in the region are unavailable.

Over the past 100 years various systems of classification have been proposed for the vegetation of some groups of Caribbean islands or for individual islands; the most important among the regional

Box 3 A community reforestation project in Trinidad and Tobago

Fondes Amandes is a hillside community that developed around a former cocoa estate in Trinidad. The growing community consists of over 160 residents. The community frequently suffered from damage caused by flooding, heavy siltation of river and water works, and forest fires, until a community-based reforestation and co-management project was initiated by dedicated members of the community in 1982. The Fondes Amandes Community Reforestation Project (FACRP) aims at protecting the Fondes Amandes watershed by preventing further deforestation through bush fires and other types of uncontrolled clearing and alleviating the threats posed by flooding. The project is designed to bring social benefits to the community, including employment, through the establishment of a tree nursery and corresponding cottage industries, and basic services and facilities (for example, piped water supply and a shelter for community activities).

This self-help project has succeeded in transforming a fire climax grassland into a viable, fruit-bearing agroforestry area. Over 1 500 trees have been planted, and more than two-thirds of them have survived severe forest fires in 1987 and 2003. Tree-planting and fire trace-cutting community gayaps*, successful and widely known outreach and educational events, are held annually. While assistance of external organizations, such as the Tropical Re-Leaf Foundation, has helped in sourcing equipment and other resources needed to continue with the project, FACRP continues to succeed mainly because of the spirit of self-reliance led by community champions and capacity building within the community.

Source: James 2003

* Gayap is the coming together of people, usually in a community, to volunteer their labour to get a job done. For example, if a house or a new road in the village needs to be built, people are mobilized to contribute their labour, while the ministry may provide the materials, so that the work can be done by the community itself. In St Lucia, a similar process of engagement is called 'Koudment', pronounced *koudma*.

systems is that developed by Beard (1944, 1945). More recently a region-wide standard vegetation classification system has been developed and a preliminary atlas of vegetation land-cover maps for the region has been prepared (USGS 2004a and b).

Except for Cuba, Grenada and Guadeloupe, percentage forest cover either remained unchanged or declined between 1990 and 2000, with St Lucia showing the greatest reduction. However, a wave of deforestation in the Caribbean SIDS had already occurred when colonial settlers first arrived in the region, often accompanied by the disappearance of many endemic terrestrial species. For instance, about 80 per cent of St Lucia's forests were cleared for agriculture within the first 30 years of colonization in the early 17th century (MPDE 2001). Haiti, currently with the lowest proportion of forested area, maintained 50 per cent of its forests until the beginning of the 20th century following the first wave of forest clearing by settlers, but lost most of them afterwards due to the demand for wood as an energy source (ANDAH 1999). More recently, deforestation in the region has been fuelled by the need for land for transportation infrastructure, agriculture, housing and industrial development. In addition, expansion of road networks and improvement

Forest covers only 19 per cent of the total land area in the Caribbean

Source: B. Potter

Table 12 Changes in forest cover in the Caribbean

	TOTAL FOREST (000s ha)	PERCENTAGE OF LAND AREA	AREA PER CAPITA (ha)	FOREST PLANTATIONS (000s ha)	FOREST COVER CHANGE 1990–2000 (%)
ANTIGUA AND BARBUDA	9	20.5	0.1	0	0.0
BAHAMAS	842	84.1	2.8	na	0.0
BARBADOS	2	4.7	0.7	0	0.0
BELIZE	1 348	59.1	5.7	3	0.0
BRITISH VIRGIN ISLANDS	3	20.0	0.1	na	0.0
CAYMAN ISLANDS	13	50.0	0.4	na	na
CUBA	2 348	21.4	0.2	482	2.5
DOMINICA	46	61.3	0.6	na	–5.4
DOMINICAN REPUBLIC	1 376	28.4	0.2	30	0.0
GRENADA	5	14.7	0.1	na	0.0
GUADELOUPE	82	48.5	0.2	4	8.9
GUYANA	16 879	85.7	19.7	na	–2.3
HAITI	88	3.2	1.0	20	–2.5
JAMAICA	325	30.0	0.1	9	–5.0
MARTINIQUE	47	44.3	0.1	2	0.0
MONTSERRAT	3	30.0	0.3	na	0.0
NETHERLANDS ANTILLES	1	1.3	0.5	na	na
PUERTO RICO	229	25.8	0.1	4	–0.6
ST KITTS AND NEVIS	4	11.1	0.1	0	0.0
ST LUCIA	9	14.8	0.1	1	–8.2
ST VINCENT AND THE GRENADINES	6	15.4	0.1	0	–2.5
SURINAME	14 113	90.5	34.0	na	0.0
TRINIDAD AND TOBAGO	259	50.5	0.2	15	–4.3
US VIRGIN ISLANDS	14	41.2	0.1	na	0.0

Sources: FAO 2003a; FAO 2004b; CELADE 2004; UNEP/DEWA/GRID-Geneva 2004

Note: The table includes selected Caribbean countries and territories with required data only.

na = data not available

Box 4 Family forestry area in Cuba

Cuba is the only independent country in the Caribbean that exhibits a positive forest growth rate. The country is carrying out an intensive programme aimed at increasing the forest coverage to 30 per cent of total land area by the year 2015.

The intensive reforestation programme has been focusing on the following areas:

- 42 000 ha of low-productivity sugar cane plantations;
- 50 000 ha in mountainous areas originally used for pasture and 18 000 ha of low-yielding coffee plantations;
- 100 000 ha in flat areas with soils of medium to low productivity covered by invasive species;
- 70 000 ha to be devoted to wood and fruits in the cooperative and private sectors;
- 11 000 ha in army farms;
- 22 000 ha to be planted in buffer areas surrounding dams and reservoirs; and
- 50 000 ha to be planted on the banks of rivers and streams.

The FAO considers the approach of the project, which integrates forestry with the sustainable development of the communities living in forest ecosystems, to be the most suitable for reforestation in Latin America and the Caribbean. The development of a system of forest farms since the mid-1990s has been a key element for the success of the programme that can be seen today. The state gives a generally unproductive area and a basic dwelling to a family who establishes tree plantations, mainly for wood and fruit production. The family also cultivates other crops and raises animals for their own needs and for sale at the free produce market.

The population nuclei inside agro-forestry systems receive revenues according to their productivity and have special incentives for the development and care of the forests. A notable increase in the survival of the forest plantations and a decrease of indiscriminate clearing and wild fires are among the most significant benefits of the forestry farm system. The survival of planted trees has increased from 50 per cent at the start of the programme in 1998 to 78 per cent. Cuba has established 1 100 forestry farms so far, ranging from 35 to 40 ha. Expansion of the system with around 1 000 new farms in suitable areas is planned.

It is estimated that this programme will need a further US$67.67 million to complete. A UNDP project amounting to US$1.22 million is also being implemented in the country. Its aim is to support the reforestation programme through the development of forestry farms in local communities of the eastern provinces of Cuba.

Source: CITMA 2002; UNDP CUBA 2004; Renda and Ponce 2004; Interpress Service 2004

in road surfaces in general increase access to more remote forest areas and timber resources, leading to further deforestation.

Caribbean LLCS, such as Belize, Guyana and Suriname, still retain much of their original forests (59.1, 85.7 and 90.5 per cent, respectively), mainly due to lower population densities and their policies for natural resource protection and utilization. While the forests in the majority of Caribbean SIDS are too limited to meet all national needs for energy and wood products, some produce a range of wood products (Table 13). Cuba produces the widest range of wood products, followed by Guyana where forests are the major income source. In 1995, Suriname's total timber export was estimated at about US$3.2 million, an increase of more than 400 per cent over the previous year. This timber production came from just over 16 per cent of its forested area (2 414 800 ha) (Government of Suriname 1997). Firewood and charcoal production was the highest in Cuba (2 810 tonnes), which has managed to increase forest cover at the same time, and in Haiti (1 978 tonnes), which had the highest deforestation rate

Dawn in Cuba
Source: B. Potter

among the Caribbean SIDS and LLCS (FAO 2004b). Decline in the coverage as well as the quality of the forests has removed their natural capacity to act as a buffer in case of extreme meteorological events, such as hurricanes. The lack of vegetation cover to retain excess water has led, to a great extent, to the increased severity of disasters: for example, in Haiti in September 2004 where over 1 000 people were killed by floods.

While the future of forests in the region is bleak as existing pressures on this resource are expected to increase, some encouraging results have emerged from localized forest conservation efforts (Boxes 3 and 4).

Table 13 Caribbean output of forest products (2002 data)

	FUELWOOD AND CHARCOAL	INDUSTRIAL ROUNDWOOD	SAWNWOOD	WOOD-BASED PANELS	PAPER AND PAPERBOARD
	1 000 cubic metres (m^3)				1 000 tonnes
BAHAMAS	na	17	1	na	na
BARBADOS	na	5	na	na	na
BELIZE	126	62	35	na	na
CUBA	2 810	808	190	149	57
DOMINICAN REPUBLIC	556	6	0	na	130
GUADELOUPE	15*	0	1	na	na
GUYANA	873	269	35	51	na
HAITI	1 978	239	14	na	na
JAMAICA	584	282	66	0	0
MARTINIQUE	10*	2	1	na	na
SURINAME	44	154	47	2	na
TRINIDAD AND TOBAGO	36	51	43	na	na

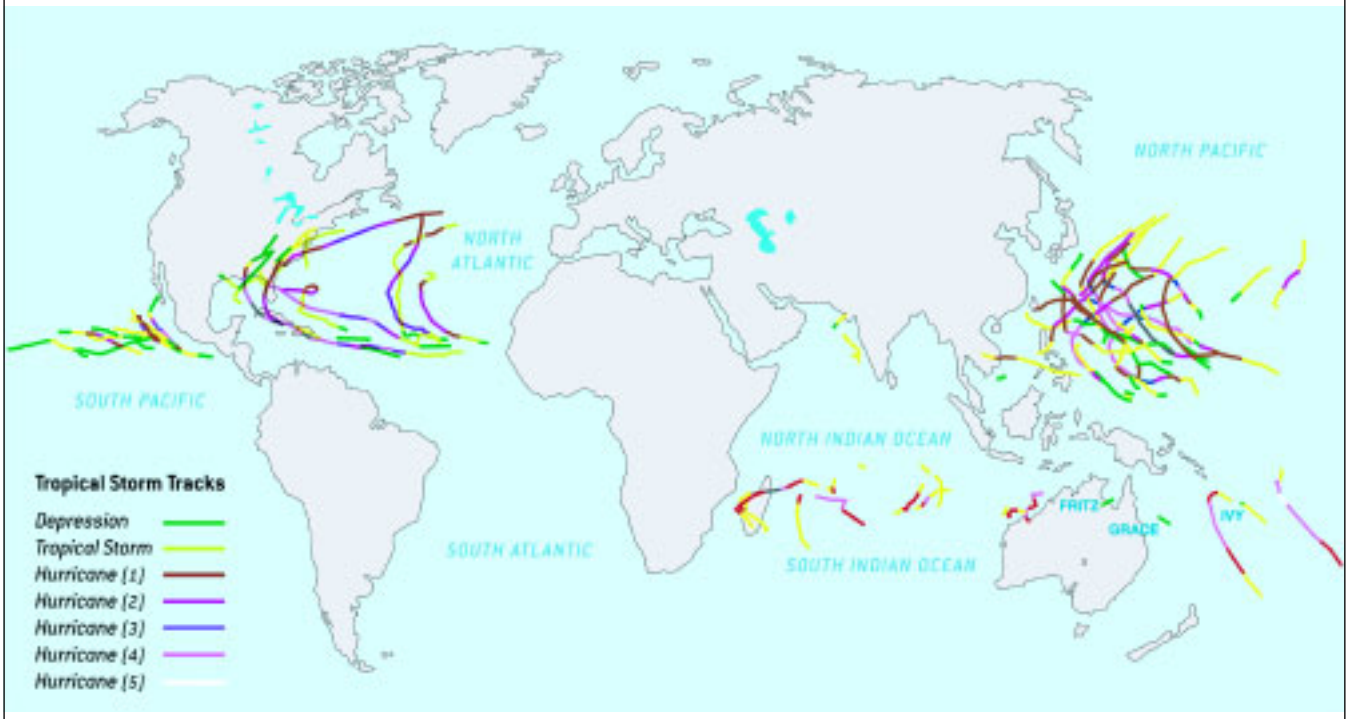
Source: FAO 2004b
* Data for wood fuel only na = data not available

NATURAL DISASTERS

Extreme natural events can significantly affect or alter the natural environment, physical infrastructure and human populations. Major disasters in the Caribbean in the last three decades have been mainly geological, such as earthquakes in Antigua and Barbuda in 1975 and a volcanic eruption in Montserrat in 1995, and hydrometeorological, such as hurricanes and tropical storms (Tables 14 and 15).

An overview of the risk posed by natural disasters showed that the LAC region ranks second after Asia in terms of total disaster occurrence over the 1970–1999 period, experiencing 16.3 per cent of the 5 970 natural

Table 14 Tropical storms and hurricanes in 2004



The colours of the lines indicate intensity (category based on Saffir–Simpson scale):

TYPE	CATEGORY	PRESSURE (mb)	WINDS (knots)	WINDS (kmh)	SURGE (m)	LINE COLOUR
Depression	TD	–	<34	<63		Green
Tropical Storm	TS	–	34–63	63–117		Yellow
Hurricane	1	>980	64–82	118–153	1.2–1.6	Red
Hurricane	2	965–980	83–95	154–177	1.7–2.5	Light red
Hurricane	3	945–965	96–112	178–209	2.6–3.8	Magenta
Hurricane	4	920–945	113–135	210–249	3.9–5.5	Light magenta
Hurricane	5	<920	>135	>249	>5.5	White

TD = Tropical Depression TS = Tropical Storm

Source: Unisys 2004 Map compiled by UNEP/DEWA, GRID Africa

Table 15 Some intense hurricanes in the Caribbean 1979–2004

YEAR	NAME	SUSTAINED WIND SPEED (kmh)/ category (Saffir–Simpson scale)	DAMAGE ESTIMATED (US$)	NUMBER OF PEOPLE AFFECTED IN SOME COUNTRIES
AUGUST–SEPTEMBER 1979	David and Frederic	David: 277/4 Frederic: 213/4		70 000 in Dominica, 1 200 000 in Dominican Republic, 1 110 in Haiti, 20 000 in Martinique, 4 500 in Puerto Rico
AUGUST 1980	Allen	302/5		330 000 in Haiti, 30 000 in Jamaica, 70 000 in St Lucia, 20 000 in St Vincent and the Grenadines
JUNE 1982	Alberto	139/1		105 000 in Cuba
OCTOBER–NOVEMBER 1984	Klaus	148/1	2 million in Dominica	10 000 in Dominica
NOVEMBER 1985	Kate	194/3		476 891 in Cuba, 770 in Turks and Caicos
SEPTEMBER 1987	Emily	203/3		
SEPTEMBER 1988	Gilbert	296/5	5 000 million	60 000 in Cuba, 870 000 in Haiti, 810 000 in Jamaica
SEPTEMBER 1988	Hélène	232/4		
OCTOBER 1988	Joan	232/4		
AUGUST–SEPTEMBER 1989	Gabrielle	232/4		
SEPTEMBER 1989	Hugo	259/5	3 000 million	
AUGUST 1990	Gustav	194/3		
OCTOBER 1990	Klaus	129/1		1 500 in Martinique
SEPTEMBER 1991	Claudette	212/4		
AUGUST 1992	Andrew	249/5	26 000 million	
JUNE 1995	Allison	120/1		160 in Cuba
AUGUST 1995	Felix	222/4		
SEPTEMBER 1995	Luis	241/4		65 000 in Antigua and Barbuda, 3 000 in Dominica, 40 000 in Netherlands Antilles, 98 000 in Puerto Rico, 1 800 in St Kitts and Nevis
SEPTEMBER 1995	Marilyn	185/3		
SEPTEMBER–OCTOBER 1995	Opal	241/4		
AUGUST– SEPTEMBER 1996	Edouard	232/4		
SEPTEMBER 1996	Hortense	222/ 4		25 000 in Dominican Republic, 7 864 in Puerto Rico

YEAR	NAME	SUSTAINED WIND SPEED (kmh)/ category (Saffir–Simpson scale)	DAMAGE ESTIMATED (US$)	NUMBER OF PEOPLE AFFECTED IN SOME COUNTRIES
OCTOBER 1996	Lili	2185/3		269 995 in Cuba
SEPTEMBER 1998	Georges	249/5	860 million	147 000 in Cuba; 855 000 in Dominican Republic; 12 000 in Haiti; 10 000 in St Kitts and Nevis
1998	Mitch	286/5	5 900 million	60 000 in Belize
1999	Bret	225/4		
1999	Cindy	225/4		
SEPTEMBER 1999	Floyd	248/4	500 million	
1999	Gert	241/4		
OCTOBER 1999	Irene	176/2		228 067 in Cuba
OCTOBER 1999	Jose	157/2		2 000 in Antigua and Barbuda
NOVEMBER 1999	Lenny	241/4	1 000 million	150 in Anguilla; 2 500 in Antigua and Barbuda; 400 in Dominica; 210 in Grenada; 450 in Guadeloupe; 400 in Martinique; 1 080 in St Kitts and Nevis; 100 in St Vincent and the Grenadines
SEPTEMBER 2000	Keith	222/4		62 000 affected in Belize
OCTOBER 2001	Iris	231/4		20 000 in Belize; 175 in Dominica
NOVEMBER 2001	Michelle	222/4		5 900 000 in Cuba
SEPTEMBER–OCTOBER 2002	Lili	231/4		300 in Cayman Islands; 281 470 in Cuba; 250 in Haiti; 1 500 in Jamaica
DECEMBER 2003	Odette	102/TS		10 000 in Dominican Republic; 100 homeless in Puerto Rico
JULY– AUGUST 2004	Alex	194/3		
AUGUST 2004	Charley	231/4	1 000 million in Cuba	41 500 homeless; 202 500 affected in Cuba
SEPTEMBER 2004	Jeanne	203/3	21 million in Haiti	1 000 in The Bahamas; 7 dead, 9 injured, 45 111 affected in Dominican Republic; 2 754 dead, 298 926 affected in Haiti
SEPTEMBER 2004	Karl	222/4		
SEPTEMBER 2004	Ivan		111 million in Jamaica	1 000 in Barbados; 3 245 in Cuba; 39 dead, 60 000 affected in Grenada; 2 500 homeless, 4 000 affected in Haiti; 15 dead, 350 000 affected in Jamaica; 1 000 in St Vincent and the Grenadines

Source: EM-DAT 2004

TS = Tropical Storm

Table 16 Disaster exposure indicators in Latin America and the Caribbean

	SHARE OF POPULATION KILLED PER MILLION INHABITANTS	SHARE OF POPULATION AFFECTED PER THOUSAND INHABITANTS	CUMULATIVE DAMAGE AS SHARE OF 1998 GDP (%)
SOUTH AMERICA	431.1	322.9	3.9
MESOAMERICA	555.1*	147.7	7.1**
CARIBBEAN	3.8	486.4	43.3

Source: Charvériat 2000

* 1.467 without Mexico ** 31.8% without Mexico

disasters recorded worldwide (Charvériat 2000). Over the period 1975 to 2002, more disasters have occurred and more people have been killed or affected by disasters in Latin America (nearly 105 million people) than in the Caribbean SIDS and LLCS (over 21 million people) (UNEP/DEWA/GRID-Geneva 2004); however, the proportion of the population affected by disasters is much higher in the latter (Table 16).

Natural disasters, which appear to be on the increase (Table 17), also have a greater effect on GDP in the Caribbean SIDS and LLCS (Table 16). Political and economic decisions at the global, national and local levels that increase vulnerability have significant implications for the Caribbean SIDS and LLCS. Of particular importance is the effect of global warming, which is projected to increase the frequency and severity of tropical storms (IPCC 2001b). This is at the same time that global warming is also reducing the resistance of the coastal ecosystems (for example, through coral bleaching) to extreme climatic events.

Natural disasters will have severe consequences for tourism in the Caribbean SIDS and LLCS. The tendency for tourism infrastructure to be located on beachfronts has created a high demand for coastal real estate. Because of their increasing dependence on revenues generated by the tourism industry, Caribbean governments are reluctant to impose strict regulations on tourism development and its associated land use practices that could increase the vulnerability of property and infrastructure to extreme climatic events, including excessive rainfall and storm surges. The scarcity of prime coastal property in combination with increasing demand from a rapidly expanding tourism industry has created pressures to transform ecologically and economically important natural habitats to coastal real estate by clearing and filling. This has often led to removal of the natural protective function provided by coastal ecosystems.

Renewed emphasis on the planning and decision-making processes has led to the development of a Comprehensive Disaster Management (CDM) framework within the Caribbean (Bisek and others 2001). The articulation and implementation of this CDM framework is being supported by a number of international technical cooperation institutions, and led by the Caribbean Disaster Emergency Response Agency (CDERA), which was established by CARICOM to provide technical support to disaster management planning in member states. Many of these countries have established national disaster committees, strengthened national disaster organizations, and embarked on a series of capacity-building initiatives to integrate disaster management into the development planning and control processes.

Table 17 Fatalities and economic losses from disasters in the Caribbean

	NUMBER OF OCCURRENCES				TOTAL FATALITIES				ECONOMIC LOSSES (US$ 000s)			
	1970–79	1980–89	1990–99	2000–04	1970–79	1980–89	1990–99	2000–04	1970–79	1980–89	1990–99	2000–04
ANGUILLA	1	3	1	0	0	0	0	0	0	2 275	50	0
ANTIGUA AND BARBUDA	0	2	5	0	0	2	5	0	0	80 000	500	0
BAHAMAS	0	1	3	1	0	0	5	0	0	0	250 000	250 000
BARBADOS	1	3	1	1	3	0	0	0	500	101 500	0	0
BRITISH VIRGIN ISLANDS	0	1	2	0	0	0	0	0	0	135 000	12 000	0
BELIZE	3	0	4	0	5	0	0	44	10 000	0	4 950	315 612
CAYMAN ISLANDS	0	2	2	1	0	0	0	0	0	0	0	0
CUBA	4	13	21	8	34	66	96	10	0	145 000	1 345 968	87 000
DOMINICA	2	3	2	1	40	2	1	3	44 650	22 000	3 428	0
GRENADA	1	1	2	0	0	0	0	0	4 700	5 300	5 500	0
GUADELOUPE	3	2	2	0	0	5	4	0	100 000	0	0	0
GUYANA	1	2	2	1	0	0	0	10	200	0	29 000	0
HAITI	4	18	9	0	86	562	1378	200	959	131 286	80 000	0
JAMAICA	4	9	5	5	50	125	13	14	1 700	1 176 640	44 000	1 138 630
MARTINIQUE	2	2	3	0	45	0	10	0	81 000	68 000	0	0
MONTSERRAT	0	1	4	0	0	11	32	0	0	240 000	8 000	0
NETHERLANDS ANTILLES	0	1	3	1	0	0	2	0	0	0	15 151	0
PUERTO RICO	3	5	3	3	89	626	42	4	0	0	200 000	145 000
ST KITTS AND NEVIS	0	3	4	0	0	1	5	0	0	46 500	238 400	0
ST LUCIA	0	5	3	0	0	54	4	0	0	1 089 280	0	0
ST VINCENT AND THE GRENADINES	3	4	2	1	2	0	3	0	0	26 600	0	0
TRINIDAD AND TOBAGO	1	0	6	0	2	0	5	0	5 000	0	25 127	0
TURKS AND CAICOS ISLAND	0	1	1	0	0	0	0	0	0	5	0	0
US VIRGIN ISLANDS	0	0	2	0	0	0	11	0	0	0	1 531 500	0
TOTAL	**33**	**83**	**92**	**23**	**356**	**1 447**	**1 601**	**278**	**248 700**	**3 269 486**	**3 793 574**	**1 936 242**

Source: EM-DAT 2004, accessed May 2004

WASTE MANAGEMENT AND POLLUTION

In their country statements to the First CARICOM Ministerial Conference on the Environment (CARICOM 1989), the top priorities of CARICOM member states were solid waste management and disposal, water quality and supply, and disposal of domestic sewage, liquid waste, and toxic and hazardous waste. These issues were also targeted for priority action at the national level by the Environmental Health Strategy of 1978. At the time of the ministerial conference, it appeared that little action had been taken to address this problem in the preceding 11 years; action, if taken, had little effect (CARICOM 1989).

Many of the solid waste problems being experienced in the Caribbean stem from packaging materials, disposable food containers, aluminium beverage cans and plastic bags. Population growth, increased urbanization, increase in per capita income and improvements in the standard of living have led to an increase in the purchase of goods that, because of advances in materials science, are now packaged in cheaper, non-biodegradable disposable material. St Lucia, for example, recorded an increase of 12.5 per cent in the volume of waste generated between 1990 and 1996 (MPDE 2001). An expansion of the tourism industry and an increase in the number of stop-over and cruise ship tourist arrivals have also resulted in an increase in the quantity of waste generated by the tourism industry.

Solid waste collection coverage in major Caribbean cities varies from 60 per cent to over 90 per cent of the population, with the exception of Haiti where it is much lower. In many Caribbean SIDS and LLCS domestic waste comprises the largest proportion of total solid waste generated, followed by commercial waste (MPDE 2001; UNEP 2003a). While waste collection is still inadequate in some countries, the major problem is that current disposal methods are unable to cope with the increasing quantity or the changing composition of the waste. The most common method of waste disposal in the Caribbean SIDS and LLCS is landfilling, which is not recommended in the SIDS since land space is limited. Incineration of solid waste is undertaken on a much smaller scale. Existing incineration technologies can reduce up to 75 per cent of the weight and up to 90 per cent of the volume of waste to be disposed of into landfills (CEHI and UNEP 2003). Some Caribbean countries have implemented recycling programmes that significantly reduce the amount of waste deposited in landfills (Table 19).

The composition of the solid waste generated in the Caribbean SIDS and LLCS continues to change from mostly organic to inorganic material. This presents an additional challenge to solid waste management since these countries are already constrained by limited financial resources, spatial and geographical constraints, and insufficient technical personnel.

Table 18 Waste generation in selected Caribbean countries

	YEAR	WASTE GENERATED	HAZARDOUS WASTE
BELIZE	1999	563 000 tonnes	700 tonnes
GUYANA	2000	57 000 tonnes	na
JAMAICA	1999	945 000 tonnes	200 tonnes
ST LUCIA	2000	263 000 m^3	na
ST VINCENT AND THE GRENADINES	2000	27 000 tonnes	na

Source: CARICOM 2003 na = data not available

Table 19 Recovery and recycling initiatives in the Caribbean

MATERIAL	SOURCE(S)	PROCESSING METHOD	RECYCLING CENTRES
PAPER	Trinidad and Tobago	Baled or compacted in super sacks	Puerto Rico; continental USA
PLASTICS (HDPE)	Trinidad and Tobago	Ground and packaged in super sacks	Canada
CARDBOARD	Trinidad and Tobago, Barbados, Jamaica, Guyana	Baled	Guyana (limited); continental USA; Venezuela
GLASS	Trinidad and Tobago, Barbados, Grenada, Guyana	Collected in steel bins and ground	Trinidad and Tobago
WASTE OILS	Eastern Caribbean	Bulked in steel drums and re-refined	Trinidad and Tobago
VEHICLE BATTERIES	Trinidad and Tobago, Barbados, Antigua	Drained and shrink wrapped	Venezuela
SPENT CATALYSTS	Trinidad and Tobago	Packaged in super sacks	Continental USA
GREEN WASTES	Antigua and Barbuda, Barbados, Belize, Bermuda, Dominica, Grenada, Guyana, Jamaica, Montserrat, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Trinidad and Tobago	Composted	Local landfills, households

HDPE = high-density polyethylene

Source: CEHI and UNEP 2003

Although still in small quantities, the generation of hazardous waste (for example, household, agricultural, industrial, medical hazardous waste, used oil, batteries, asbestos and slaughterhouse waste) is rising. Several types of technologies are currently available in the region for treatment of industrial waste (Table 20).

Coastal and marine pollution caused by wastewater and solid waste is also a major environmental problem in the Caribbean SIDS and LLCS (Box 5). Most of the pollution in the coastal and marine environment comes from land-based sources such as industries, surface run-off from agricultural and urban areas, and garbage that has been dumped in rivers, streams, drainage gullies and wetlands. In addition, solid waste generated by shipping (cargo straps, dunnage), commercial fisheries (outboard-oil containers, mono-filament fishing line, floats, polyethylene line, cyalumes) and the offshore petroleum industry (hard hats, pipe thread protectors) is affecting the coastal areas (UNESCO 1994). Continuing coastal and marine pollution will have severe impacts on the tourism and fishing industries, with negative social and economic consequences for those countries with economies that are dependent on these industries.

Table 20 Industrial waste treatment and disposal methods in use in the Caribbean and some future possibilities

WASTE SOURCE BY INDUSTRY	WASTE MATERIAL	BEST DEMONSTRATED TREATMENT TECHNOLOGIES	WHERE SUCCESSFULLY USED
OIL AND GAS EXPLORATION AND PRODUCTION	Down-hole treatment chemicals and storage containers	• Incineration or bioremediation of chemical residues • Smelting or crushing of steel drums	• Trinidad • Outside Caribbean SIDS
	Oily sludges	• Oil recovery • Incineration or bioremediation	• Trinidad • Outside Caribbean SIDS
	Geological formation water (produced water)	• Oil recovery via gravity separation • Chemical constituent removal via reverse osmosis or chemical fixation on suitable adsorbent • Down-hole injection	• Trinidad • Outside Caribbean SIDS
	Drilling muds and fluids	• Bioremediation if oil-based • Secure burial in sanitary landfill if water-based • Used as common fill material for industrial sites if new formulation water-based muds are used	• Trinidad • Outside Caribbean SIDS
PETROLEUM REFINING	Tank bottoms (oily sludges)	• Bioremediation if unleaded • Chemical fixation if leaded	• Trinidad • Outside Caribbean SIDS
	Asphaltic and bituminous residues	Recycled as road paving material	• Trinidad • Outside Caribbean SIDS
	Oily wastewater	• Oil recovery • Chemical treatment • Biological treatment	• Trinidad • Outside Caribbean SIDS
	Treatment chemicals and storage containers	• Incineration or bioremediation of chemical residues • Crushing or smelting of steel containers	• Trinidad • Outside Caribbean SIDS
	Sulphurous gases	Sulphur recovery	• Trinidad • Outside Caribbean SIDS
	Spent catalysts	• Recharge of catalyst • Recovery of precious metals • Secure burial in sanitary landfill	• Trinidad • Outside Caribbean SIDS
PETROCHEMICALS	Spent catalysts	Precious metal recovery	Outside Caribbean SIDS
	Cooling water	Heat recovery units	
	Organic sludges	Chemical oxidation and stabilization	
	Inorganic sludges	Chemical encapsulation	
QUARRY INDUSTRY	Silts and quarry fines	Common fill	All Caribbean SIDS
	Overburden	Common fill	

WASTE SOURCE BY INDUSTRY	WASTE MATERIAL	BEST DEMONSTRATED TREATMENT TECHNOLOGIES	WHERE SUCCESSFULLY USED
QUARRY INDUSTRY (continued)	Fuels and chemicals and storage containers	Incineration or secure burial in sanitary landfill	Trinidad
METAL SMELTING AND FABRICATION	Slag	Chemical encapsulation	Outside Caribbean SIDS
	Cleaning chemical waste	Incineration or chemical encapsulation	
	Sheet metal scraps	Smelting	
ELECTROPLATING INDUSTRY	Spent anode and/or cathode rods	Secure burial in sanitary landfill or recycled in metal recovery plant	Outside Caribbean SIDS
	Electroplating sludges	Chemical stabilization and solidification	
WOOD PRESERVING INDUSTRY	Organic sludges	Chemical oxidation and stabilization	Outside Caribbean SIDS
	Metal wastes	Smelting	
PAINT AND COATINGS INDUSTRY	Organic sludges	Chemical oxidation and stabilization	Outside Caribbean SIDS
	Inorganic sludges	Stabilization and solidification	
	Waste solvents	Incineration	
CEMENT INDUSTRY	Clinker, limestone and cement dust	Neutralization and solidification	• Trinidad • Outside Caribbean SIDS
FERMENTED BEVERAGES INDUSTRY	Mixed sludge waste	Bioremediation	• Trinidad • Outside Caribbean SIDS
RUM DISTILLERIES	Biologically active sludges	Bioremediation	• Trinidad • Outside Caribbean SIDS
	Mixed wet wastes	Incineration	
POWER GENERATION	Oily sludges	Incineration or bioremediation	• Trinidad • Outside Caribbean SIDS
	Waste oils	Incineration, re-refining or bioremediation	
	Oily rags	Incineration	
SUGAR MANUFACTURING	Bagasse	Used as fuel for running boilers	All Caribbean SIDS
	Fly ash	Chemical fixation	Outside Caribbean SIDS

Source: CEHI and UNEP 2003

Box 5 Waste management in SIDS

Problems

The major problems in waste management in SIDS are:

- Pollution of groundwater, surface and marine pollution from land-based sources such as domestic sewage, industrial effluents and agricultural run-off. They carry risks for human health, and can degrade habitats and tourist attractions such as coral reefs and beaches; many SIDS receive bad publicity related to disease outbreaks and the destruction of fisheries, which can have major adverse economic impacts;
- Management of toxic substances such as pesticides, waste oil, heavy metals. Most SIDS do not have the systems or physical capacity to isolate and dispose of such substances;
- Sewage treatment facilities. In many SIDS, such facilities are inadequate and, as a result, poorly treated effluent is often discharged into the environment;
- Ineffective regulations. Some SIDS have spent a considerable amount of time and financial resources on developing regulations, which have often not been very effective because of inadequate institutional and human resources to enforce them;
- Lack of waste disposal sites. Gullies and the marine environment are still used as disposal sites by some SIDS because of the shortage of land and inadequate capacity to collect garbage; the inability to manage solid waste disposal facilities is a common problem for SIDS and disposal sites can easily become foci of disease transmission; and
- Lack of facilities for storage and disposal of hazardous wastes.

Constraints

In implementing waste management measures, institutions have been faced with a number of constraints, including:

- Many SIDS have not ratified the International Convention for the Prevention of Pollution from Ships (MARPOL 73/74) or the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal;
- Inadequate skilled manpower;
- Suitable financial planning for the entire cycle of waste management has not been well developed in most SIDS, resulting in severely underfunded operations. This is aggravated by the lack of financial autonomy since the generated revenue is often used for other purposes;
- The small land area in SIDS limits the use of conventional technologies requiring large areas of land; SIDS often do not have access to technologies that would meet their needs; and
- Most SIDS do not have environmentally sound waste management plans; for the few that do have them, the plans are not well integrated with other development concerns.

Source: UNEP 1999a

FRESHWATER

Water supply was identified as a priority by the 1978 Caribbean Environmental Health Strategy and the First CARICOM Ministerial Conference on the Environment (CARICOM 1989). The scarcity of water resources is a limiting factor for economic and social development in SIDS.

Available freshwater in the Caribbean SIDS is considerably less than that in oceanic islands. In 2002 freshwater resources (that is, internal renewable water resources) in the Caribbean (not including LLCS) were 2 532 m^3 per capita, compared with 17 607 m^3 in the Western Indian Ocean and 127 066 m^3 in the South Pacific (UNEP/DEWA/GRID-Geneva 2004). At current population levels, the available water supply in some of the Caribbean SIDS is significantly below the international limit of 1 000 m^3 per capita per year below which a country is classified as 'water scarce' (Government of Barbados 2000). This limit places Antigua and Barbuda (800 m^3 per capita), Barbados (301 m^3 per capita), and St Kitts and Nevis (621 m^3 per capita) in the category of water-scarce countries (Table 21) (FAO 2003b).

Many Caribbean islands rely almost entirely on a single source of water such as groundwater, imports,

Table 21 Renewable water resources in selected Caribbean SIDS in 1997

	INTERNAL RENEWABLE WATER RESOURCES (per capita m^3/yr)	MAJOR WATER SOURCES
ANTIGUA AND BARBUDA	800	Desalination, surface water (dams and small ponds), subterranean aquifers
BARBADOS	301	Subterranean aquifers, limited surface water, desalination
CUBA	3 404	Surface water, subterranean aquifers
DOMINICA	na	Surface water
GRENADA	na	Surface water
GUYANA	316 689	Surface water, subterranean aquifers
HAITI	1 598	Surface water, subterranean aquifers
JAMAICA	3 651	Surface water, subterranean aquifers
DOMINICAN REPUBLIC	2 593	Surface water, subterranean aquifers
ST KITTS AND NEVIS	621	Surface water, subterranean aquifers
ST LUCIA	na	Surface water
ST VINCENT AND THE GRENADINES	na	Surface water
SURINAME	211 031	Surface water, subterranean aquifers
TRINIDAD AND TOBAGO	2 968	Surface water, subterranean aquifers

Source: FAO 2003b
Note: The table includes selected Caribbean countries and territories na = data not available

rainwater, surface reservoirs, and rivers and other surface flows. The situation is critical in the low limestone islands of the Eastern Caribbean, where rainfall seasonality is very pronounced. In islands such as Anguilla, Antigua and Barbuda, Grenada, and Barbados, more than 65 per cent of total annual rainfall may be recorded in the wet season from June to December. In Barbados groundwater recharge is restricted to the three wettest months of the year, with only 15–30 per cent of annual rainfall reaching the aquifers (Jones and others 1998). Much of the rainfall in the region is strongly associated with the genesis and passage of easterly waves, tropical depressions and storms (Gray 1993; Nurse and others 1998). Thus, changes in the occurrence of these events will have an impact on the water supply of many Caribbean SIDS. In Dominica, for instance, within the last few decades an apparent tendency towards more extended periods of drought is well correlated with reduced flows in the Castle Comfort, Roseau, Layou and Geneva rivers (Government of the Commonwealth of Dominica 2000). Since rivers are the main source of potable and irrigation water on the island and are also harnessed for power generation, declining flows have become of serious national concern.

Groundwater recharge and water retention capacities of soils have been adversely affected by deforestation and inappropriate land use practices in watersheds in the region. Ineffective maintenance and replacement of infrastructure give rise to transmission losses as high as 50 per cent in some countries.

Water demand which has increased over the past 30 years as a result of population growth and rapid urbanization is exceeding the natural supply capacity. Agriculture is the largest consumer of water in the Caribbean, consuming over 90 per cent of the total water used in Guyana, Haiti and Suriname. Industrial consumption of total renewable water resources exceeds other uses in Barbados, while domestic consumption is the primary use in others such as Trinidad and Tobago (Table 22).

The demand for water in The Bahamas is met primarily by extraction from shallow freshwater lenses. Extraction of freshwater is very high on some islands in this archipelago as a result of the demands of the local population and the tourism industry. This is especially the case on New Providence, where inadequate freshwater resources necessitates the import of water from Andros Island. Nationally, the high water deficit has led to desalination of seawater by reverse osmosis

Table 22 Water use in selected Caribbean SIDS, 2002

	TOTAL USE (m^3)	AGRICULTURE (%)	INDUSTRY (%)	DOMESTIC (%)
BARBADOS	0.08	23	44	33
CUBA	8.20	69	12	19
DOMINICAN REPUBLIC	3.39	66	2	32
GUYANA	1.64	97	1	2
HAITI	0.98	94	1	5
JAMAICA	0.41	49	17	34
SURINAME	0.67	93	3	4
TRINIDAD AND TOBAGO	0.31	6	27	67

Source: UNEP/DEWA/GRID-Geneva 2004

Note: The table includes selected Caribbean countries and territories

(Government of the Commonwealth of The Bahamas 2001). It is projected that, on Andros Island, where the water table is only 30 cm below the surface, high evaporation and increasing brackishness will occur if sea-level rise continues (Martin and Bruce 1999). Saltwater intrusion into the freshwater lenses from overextraction is also threatening freshwater supplies in The Bahamas and Barbados. Singh (1997) has reported a recent increase in salinity levels for several coastal aquifers in Trinidad and Tobago, attributed mainly to rapid draw-down exacerbated by sea-level rise.

The impact of climate change on water supply is also a critical issue for sustainable development in the region. Shrivastava (1997) suggested that annual precipitation would increase by approximately 6 per cent in the Western Caribbean and decrease by 4 per cent in the Eastern Caribbean as a result of climate change. Wetter wet seasons and more severe and longer droughts during the dry seasons are also predicted. The vulnerability of water resources to climate change has been demonstrated in Grenada where the droughts of 1984 and 1992 caused freshwater losses of 20 per cent and 40 per cent, respectively. Recovery from these losses can take many years (Government of Grenada 2001). This situation is expected to become worse with the increase in freshwater demands due to population growth and the expansion of tourism. In several countries, the adverse implications of climate change on water resources will be compounded as growing populations move into marginal areas with very limited water supply. Insufficient quantity and quality of water, particularly potable water, is correlated with increases in water-borne diseases, particularly when people seek alternative sources, which may be of poor quality. Increases in the incidence of heat-related illnesses also occur during periods of drought and elevated temperatures (Government of Jamaica 2001).

One of the targets of the Millennium Development Goal 7 requires countries to 'halve, by 2015, the proportion of people without sustainable access to safe drinking water and sanitation'. It will be difficult for many Caribbean countries to meet this goal, considering their already high coverage rates (over 82 per cent for drinking water and up to 97 per cent for sanitation, with the exception of Haiti), as well as the deteriorating condition of remaining freshwater resources (UNDP 2004).

BIODIVERSITY

The Caribbean region has high biological diversity per unit of land area (Island Resources Foundation 1998), as well as a very high level of endemism and a high extinction rate (Table 23; Box 6). The high level of endemism is attributed to the insular conditions that impose an evolutionary pattern in isolation allowing

A trail in the Mahaut rainforest in St Lucia
Source: Institute of Marine Affairs, Trinidad and Tobago

speciation. In the Caribbean, 54 per cent of vertebrates (excluding fishes) and 59 per cent of plants are thought to be endemic (WCPA Caribbean 2003).

The biodiversity of Caribbean SIDS and LLCS is being lost due to unsustainable natural resource exploitation, poorly managed tourism, mining, pollution, habitat destruction and conversion, natural events such as hurricanes, and the introduction of alien species. In Belize the transformation of agriculture from subsistence cultivation to industrial-scale mono-crop cultivation of oranges and bananas, and the rearing of cattle, has had a significant impact on biodiversity. Fertile alluvial soils that supported species-rich ecosystems were cleared for agro-industrial farming, destroying valuable biodiversity in the process (Government of Belize 1998). The effluents generated by the agro-industry, especially of sugar, citrus and banana, also pose a significant threat to biodiversity. Fertilizers, pesticides and herbicides are transported in waterways, contaminating aquifers, and affecting the biology of sensitive riverine and coastal ecosystems.

Many species of aquatic animals are exploited for export, local consumption or recreational purposes. Coastal biodiversity has been under increasing threat from the development of tourism infrastructure. In Belize 22 threatened coastal and marine species are either unprotected or, if protected, the legislation lacks enforcement or protective measures are inadequate (Government of Belize 1998).

Urbanization has also contributed to biodiversity loss in the Caribbean SIDS and LLCS, through habitat destruction and conversion. Urbanization has been a major force for economic growth, modernization and improvements in human well-being in LAC (ECLAC

Box 6 Biodiversity features of the insular Caribbean

- The Caribbean is one of the two most important areas in the world for terrestrial molluscs. For example, in Cuba, more than 90 per cent of the species and 258 genera are endemic.
- Reptiles and amphibians show endemism rates among the highest in the world, with 99 per cent and 93 per cent, respectively, and 630 species.
- The insular Caribbean is home to 560 bird species, of which 40 genera and 180 species are endemic.
- There are 89 species of mammals, 48 of which are endemic.
- Caribbean biota exhibits some of the smallest and largest examples of their group.
- There are 188 endemic genera of flora.
- The coral reef system represents 11 per cent of the world's reefs, and is home to more than 600 species of fish and 60 species of coral.
- A number of threatened species have population or distribution centres in the Caribbean, including the West Indian manatee (*Trichechus manatus manatus*), the East Indian whistling duck (*Dendrocigna arborea*), the greater flamingo (*Phoenicopterus ruber ruber*), the rock iguana (*Cyclura* sp.), and four of the seven species of sea turtle.
- Most of the reproductive population of the humpback whale (*Megaptera novaengliae*) is found in the waters of the Dominican Republic.
- Two of the six major bird migratory routes from the North American continent cross the Caribbean.
- The endemic Cuban scorpion (*Microtityus fundorai*) is one of the smallest known scorpions (males attain a maximum length of only 10 mm).
- The frog, *Eleutherodactylus iberia*, is endemic to Cuba and is one of the two smallest tetrapods in the world.
- The world's smallest amniotes (16 mm long), *Sphaerodactylus araisae* and *Sphaerodactylus parthenopion*, are from the Dominican Republic and the British Virgin Islands, respectively.
- The largest butterfly in the Western Hemisphere, the giant swallowtail butterfly (*Papilio homerus*), is from Jamaica.
- The giant insectivorous mammal, *Solenodon cubanus*, is from Cuba.

Source: WCPA Caribbean 2003

Table 23 Caribbean biodiversity: numbers of threatened and extinct species and protected areas in 2003

	ANIMALS		PLANTS		PROTECTED AREAS		
	THREATENED*	EXTINCT*	THREATENED*	EXTINCT*	NUMBER**	ha**	PERCENTAGE OF TOTAL TERRITORY†
ANGUILLA	15	0	3	0	na	na	na
ANTIGUA AND BARBUDA	17	0	4	0	4	6 628	15.06
ARUBA	17	0	0	0	na	na	na
BAHAMAS	31	2	5	0	39	145 838	10.51
BARBADOS	15	1	2	0	3	248	0.57
BELIZE	29	0	30	0	72	1 041 689	45.37
BRITISH VIRGIN ISLANDS	19	0	11	0	29	2 093	13.95
CAYMAN ISLANDS	14	1	2	5	46	24 099	92.69
CUBA	62	7	163	0	60	1 436 490	12.94
DOMINICA	19	1	11	0	7	20 395	27.19
GRENADA	18	0	3	0	1	618	1.82
GUADELOUPE	23	7	7	0	na	na	na
GUYANA	35	0	23	0	3	486 000	2.26
HAITI	41	11	28	2	8	7 345	0.26
JAMAICA	46	4	208	0	142	915 892	83.34
MARTINIQUE	19	8	8	0	18	136 728	124.3
MONTSERRAT	17	0	8	0	18	1 067	10.67
NETHERLANDS ANTILLES	23	0	2	0	6	12 685	15.86
PUERTO RICO	31	1	53	0	20	18 510	2.07
ST KITTS AND NEVIS	16	0	2	0	1	15	0.06
ST LUCIA	23	1	6	0	38	6 241	10.06
ST VINCENT AND THE GRENADINES	19	0	4	0	25	8 284	21.24
SURINAME	31	0	27	0	16	2 406 620	14.74
TRINIDAD AND TOBAGO	22	0	1	0	18	30 715	5.99
TURKS AND CAICOS ISLANDS	18	0	2	0	32	71 713	166.77
US VIRGIN ISLANDS	18	1	10	0	6	17 261	50.76

*Sources: * IUCN 2003 ** UNEP-WCMC 2003*

† Includes marine protected areas

Table 24 Number of alien species in the Caribbean by broad habitat type

BROAD HABITAT TYPE	NUMBER OF ALIEN* SPECIES	NUMBER OF NATURALIZED** AND/OR INVASIVE† SPECIES
TERRESTRIAL	479	390
FRESHWATER	55	10
MARINE	18	16
TOTAL	**552**	**416**

Source: Kairo and others 2003b

* A species occurring in an area outside its historically known natural range as a result of intentional or accidental dispersal by human activities. Also known as introduced species; a species, subspecies, or lower taxon introduced outside its normal past or present distribution.

** An intentionally or unintentionally introduced species that has adapted to and reproduces successfully in its new environment; a concept by which, after some time or generations, immigrants or their descendants are considered to be native.

† Organisms (usually transported by humans) that successfully establish themselves in, and then overcome, otherwise intact, pre-existing native ecosystems; an alien species that becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity.

2001), but it often causes depletion of natural resources in surrounding areas.

A significant threat to the region's biodiversity is the insurgence of invasive alien species. Invasive alien species are considered to be the greatest threat to biodiversity in geographic and evolutionarily isolated systems such as the insular Caribbean (Kairo and others 2003b) (Box 7). An initial report indicates that there are 552 alien species (Table 24) in the insular Caribbean, 75 per cent of which are regarded as naturalized (established in the wild) and/or invasive (established and spreading or constituting a biological, environmental or socio-economic threat to the region). The remaining 25 per cent, though alien, were assessed to be neither established nor spreading (Kairo and others 2003b). The countries with the largest reported numbers of alien species are the Dominican Republic (186), Puerto Rico (182), The Bahamas (159) and Jamaica (102) (Kairo and others 2003b).

Biodiversity is a multisectoral issue with implications that extend far beyond the more obvious environmental considerations. In addition to the causes of biodiversity loss that have been mentioned already, a number of biodiversity strategies and action plans indicate that forces behind biodiversity loss themselves, or their causes are:

- Inadequate policies and regulations, and inadequate enforcement of existing laws;
- Absence of integrated development strategies;
- Absence of consideration of the non-market value of environmental goods and services;
- Displacement and loss of traditional, sustainable resource use practices; and
- Consumerism and inappropriate use of technology.

A mechanism to ensure the conservation of the Caribbean's rich terrestrial and marine biodiversity has been the creation of protected areas, as in other parts of the world. The momentum for the establishment of protected areas has increased significantly over the last 20 years, particularly after UNCED. The number of protected areas in the Caribbean SIDS and LLCS, depending on the sources and classification used, ranges from 400 to more than 600 and covers between 15.6 and 18.6 per cent of the region (Mittermeier and others 1999; UNEP 2002). In addition, there are over 200 proposed protected areas in these countries (CNAP 2002). At least 300 of these protected areas are marine and play a very important role in the conservation of coastal biodiversity resources both locally and regionally (WRI 2004b).

Box 7 Invasive alien species and biodiversity loss

Traditionally, invasive alien species (IAS) have been considered significant in terms of their potential threat to crops, livestock, and national and international agro-industries. It is only over the past few decades that the threat posed by IAS to the wider environment, including interference with ecosystem processes and services and loss of indigenous biodiversity, has been recognized. The vulnerability of the insular Caribbean countries to invasive species is due to several factors including:

- A paucity of indigenous species per unit area;
- The small size of indigenous populations;
- The evolution of island species in isolation;
- The wide range of pathways for species introduction;
- Inadequate capacity for implementing preventive measures;
- Close cultural ties; and
- Close and expanding economic and trade links.

Once established, IAS can be transmitted easily and rapidly among the countries because of their close cultural, trade and tourism links. Alien species affect biodiversity through a number of mechanisms. For example, the intentional introduction of the Indian mongoose (*Herpestes auropnctatus*) to Jamaica as a biological control agent is linked to the extinction of five endemic Jamaican species through predation. Other mechanisms include:

- Alterations in the availability of resources;
- Changes to ecosystem structure and function;
- Disease;
- Changes to natural processes;
- Changes to the gene pool;
- Selective loss of genotype; and
- Hybridization.

The region is only beginning to assess the nature of the IAS problem and the number of recorded alien species in the insular Caribbean is expected to double as more information is gathered. Globalization will increase trade and the movement of people. A direct correlation has been established between the increased incidence of invasive species and the increased trade in agricultural goods and movement of people. The demand for housing, commercial and recreational space will continue to fuel land use change and habitat destruction. Global climate change will also directly and indirectly affect biodiversity.

The economic impact of invasive species will extend beyond the direct damage and control costs, and could adversely affect trade, environmental quality and human health. The future prospects for the region's biodiversity appear to be grim.

Sources: CFCS 2003; Kairo and others 2003a and 2003b; Shannon 2003

Despite the progress made during the past decade, the current status of protected areas in the Caribbean is troubling. In many countries, protected areas are the last remaining areas that are not seriously degraded. Some sites that have been recommended for World Heritage designation have been under threat of having their sizes reduced or major tourism developments placed within their boundaries. Though tourism has been one of the major sources of revenues for protected areas management, it has also become the greatest threat to protected areas in the insular Caribbean. Networks of protected areas in the insular Caribbean are erratically distributed and incomplete in many areas (IUCN 2004). Only 30 per cent of the marine protected areas in the region are considered to be adequately managed (WRI 2004b). Ongoing assessments of biodiversity and its protection are producing more detailed plans for the creation and efficient management of protected areas to preserve interrelated suites of natural resources in the region (IUCN 2004).

MARINE AND COASTAL AREAS

The combined area of the Caribbean Sea and the Gulf of Mexico is approximately 5 326 000 km^2 and there is considerable spatial and seasonal heterogeneity in marine productivity throughout the region.
The Caribbean SIDS and LLCS possess many productive and biologically complex ecosystems including coral reefs, sea grass beds, mangroves, coastal lagoons, beaches and mud bottom habitats. The health of these diverse ecosystems has declined over the years, due mainly to pollution from increased suspended solids and chemical compounds, overexploitation and habitat conversion.

Caribbean SIDS possess many productive and biologically complex ecosystems
Source: Institute of Marine Affairs, Trinidad and Tobago

Box 8 CARICOMP: a regional clearinghouse for Caribbean coastal monitoring data

The Caribbean Coastal Marine Productivity (CARICOMP) Programme is a Wider Caribbean network that has successfully monitored and reported on the state of the region's three major coastal ecosystems (coral reefs, mangroves and sea grass beds) for the past ten years. Scientific monitoring of these ecosystems has been performed on a daily, weekly and twice-annual basis in 22 marine laboratories, parks and reserves in 14 islands and 8 mainland countries since 1993 using the same monitoring protocols.

The CARICOMP Programme is managed and coordinated by the Caribbean Coastal Data Centre (CCDC) at the Centre for Marine Sciences (CMS), University of the West Indies, Jamaica. The CCDC also serves as the repository of coral reef data collected under the regional climate change projects (Caribbean Planning for Adaptation to Climate Change, CPACC, and Mainstreaming Adaptation to Climate Change, MACC) as well as the Northern Caribbean Node for the Global Coral Reef Monitoring Network (GCRMN).

Source: UWI 2004

Coral reefs

The Caribbean Sea is a biogeographically distinct area of coral reef development within which the majority of corals and coral reef-associated species are endemic (AIMS 2002; Spalding and others 2001), making the entire region particularly important in terms of global biodiversity. Nevertheless, in general, assessments of

reef condition in the region appear to be based on a few well-studied locations; time series studies over extended periods are restricted to even fewer sites. Polunin and Williams (1999) noted that there was a scarcity of data from less-developed and less-populous areas where environmental stresses are presumed to be relatively low. The initial surveys of the Atlantic and Gulf Rapid Reef Assessment Programme (AGRRA) for over 20 countries in the region (AGRRA 2000), as well as the monitoring by the Caribbean Coastal Marine Productivity Programme, CARICOMP (Box 8), the Global Coral Reef Monitoring Network of the International Coral Reef Initiative (ICRI) and Reef Check, have filled some of these data gaps for the Caribbean (Lang 2003).

Recent studies have shown that the general trend in the health of Caribbean reefs has been one of serious and continuing long-term decline (Polunin and Williams 1999; AIMS 2002; Lang 2003). Healthy reefs are characterized by a high percentage of the reef being covered by living organisms — in particular, hard corals — and high species diversity. Dramatic changes in the community structure of coral reefs have taken place over the past two decades. Prior to the 1980s, scleractinian (stony) corals dominated Caribbean coral reefs and the abundance of macroalgae was low. Over the past two decades a combination of anthropogenic and natural stressors have caused a reduction in the abundance of hard corals and an increase in macroalgae cover to the point where some corals are overgrown by algae (Kramer 2003) (Box 9). This has been observed during the AGRRA programme on several reefs in the Caribbean, including in The Bahamas (Kramer and others 2003; Peckol and others 2003a), Belize (Peckol and others 2003b), St Vincent (Deschamps and others 2003), Cuba (Alcolado and others 2003) and the Virgin Islands (Nemeth and others 2003).

Changes in reef fish communities throughout the Caribbean have also been reported. One such notable change is the reduced abundance of large-sized carnivorous reef fish such as snappers and groupers in several locations surveyed during the AGRRA programme (Kramer 2003). Large-sized parrotfish were

Box 9 Offshore reefs of Jamaica Southern Island Shelf

It has now become accepted among the academic community that Jamaican reefs are an exemplar of 'bad' or 'damaged' reefs. In 1980, Hurricane Allen flattened much of the reefs and destroyed a significant amount of coral along the north coast. Normal recovery was prevented by algae that could not be controlled by herbivores, since overfishing had dramatically reduced Jamaican fish populations. In addition, populations of the other major herbivore, the sea urchin, *Diadema antillarum*, were wiped out by disease in 1983 and 1984, and have still not fully recovered.

Like all attempts to characterize the general health of an entire area, however, this picture is an oversimplification, and a result of the fact that reef studies tend to be confined to a few generally inshore areas close to human population centres. Much of the research on Jamaican reefs has been done at the Discovery Bay Marine Laboratory, on the north coast of Jamaica. Reefs in this area (a) are confined to a very narrow band parallel to the coastline, (b) were severely affected by Hurricane Allen in 1980, and (c) are generally subjected to intense anthropogenic pressures, particularly overfishing. In contrast, south-coast reefs are spread out over a much broader area, with numerous banks and shoals; the fishing and other pressures are less than on the north coast. Consequently, both coral cover and fish populations are on average significantly higher on the south coast offshore reefs than on the highly studied reefs in Discovery Bay. An ongoing study of south-coast reefs found live coral cover as high as 70 per cent on isolated reefs 8–20 km offshore on the south-coast shelf. Offshore banks show more than 30 per cent live coral cover, and larger, more diverse populations of fish. Generally, Jamaican offshore reefs on the south coast can be characterized as healthy, thriving ecosystems, while those on the north coast are damaged and heavily impacted.

Source: Haley 2004

also rare on some of the reefs surveyed. The scarcity of large fishes is an indication that, regardless of location, legal designation or local fishing regulations, these species have been overharvested in the entire Western Atlantic region (Ginsberg and Lang 2003). Overfishing of reef fish communities has been one of the major causes of the deterioration of reef condition in the Caribbean in recent years.

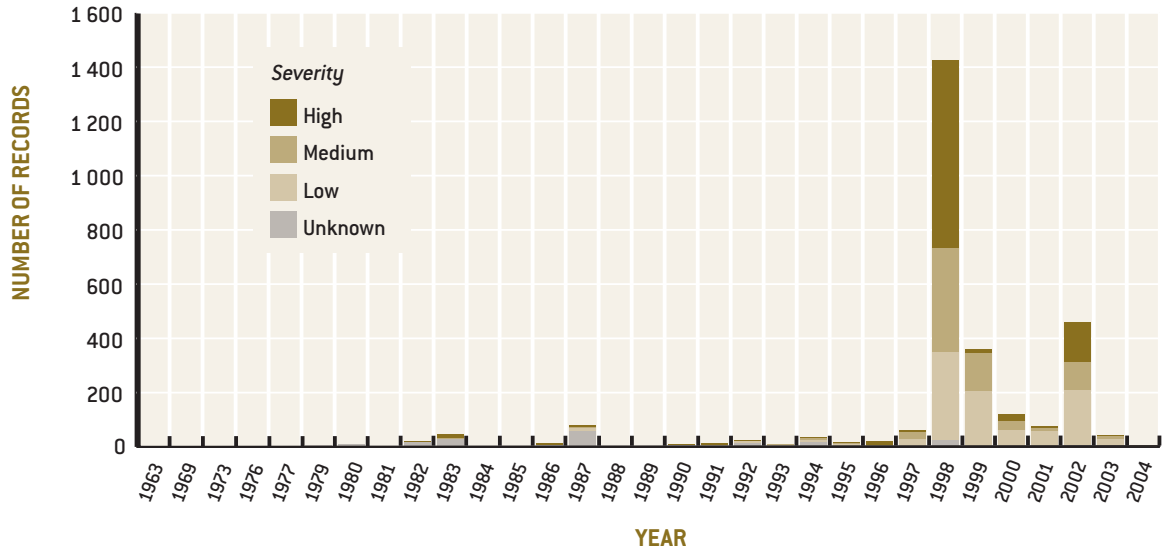
A study published recently shows that some Caribbean countries, including Cuba, Dominican Republic, Guyana, Haiti, Jamaica and Suriname host a range of cold-water coral species. Cold-water coral reefs are much slower-growing than their tropical counterparts with a growth rate of 4–25 mm/year. They are found globally at depths from 39 to over 1 000 m. Very little is known about their status in the region (Freiwald and others 2004).

The degradation of coral reefs has been particularly acute on narrow, coastal shelves accessible to low-income fishers, and on reefs that are relatively close to highly populated areas. The deterioration of coral reef ecosystems was greater in countries where economic development is heavily dependent on the marine environment, such as the Dominican Republic, Haiti and Jamaica (AIMS 2002). Earlier assessments found that reef condition tended to be relatively good in small, low-lying islands (for example, The Bahamas) and poor in near-shore areas in the high islands (AIMS 2002). The condition of Cuban reefs is reported to be among the best in the Caribbean, probably due to a combination of two main factors: the minimal coastal development on the north and south coasts, and the fact that many reefs are offshore and outside the influence of land-based sources of pollution (AIMS 2002).

The impact of diseases on marine organisms has become increasingly apparent since the early 1970s. A range of diseases has affected corals, starting with black band disease in the early 1970s followed by white band disease in the late 1970s. Most coral diseases affect only a few species, with the exception of black band disease and white plague, which affect multiple species. Evidence of diseased corals was found on several reefs in the region by the AGRRA programme (Kramer 2003). These diseases may have occurred on Caribbean reefs before the 1970s but remained undetected because of their low incidence and the state of knowledge at the time (Garrison and others 2003).

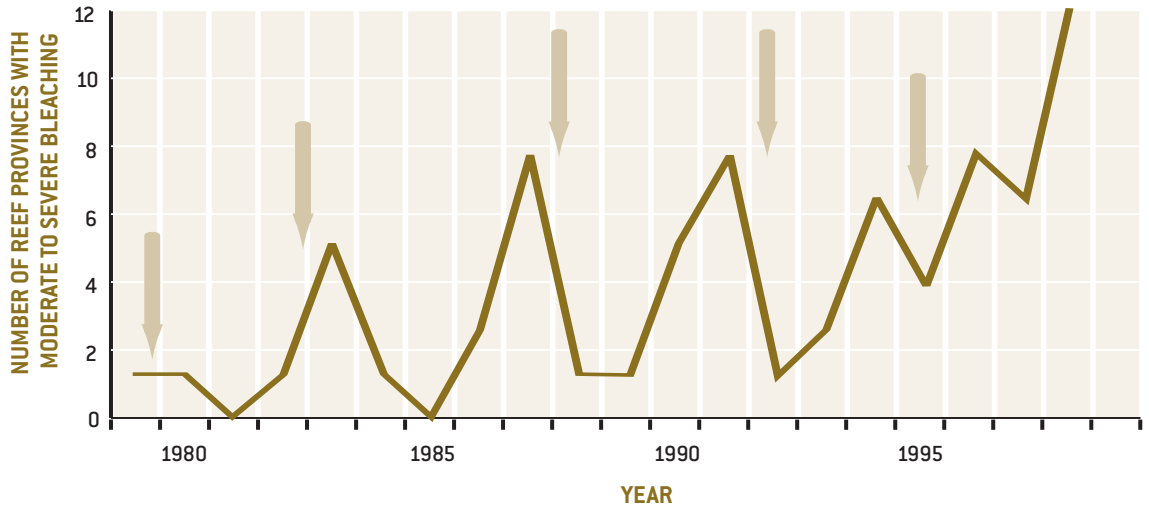
The mass coral bleaching events of 1997–1998

Figure 11 **The frequency of total annual bleaching reports submitted for Caribbean reefs**



Source: Reef Base 2004

Figure 12 Number of reef provinces (areas) showing bleaching since 1979



Source: Hoegh-Guldberg 1999
Note: arrows indicate strong El Niño years

affected coral reefs throughout the world. In the Caribbean, bleaching that began in June 1998 continued until early September 2003 (Figure 11) (Hoegh-Guldberg 1999). The impact of the bleaching events varied across the Wider Caribbean, with the Meso-American Barrier Reef sustaining severe damage; and the combined impacts of bleaching and Hurricane Mitch in 1998 reduced coral cover by up to 70 per cent in Belize (Wilkinson 2002). Bleaching was low to moderate in the Northern Caribbean with no major lasting effects, and moderate to severe in the Eastern Caribbean with low levels of mortality (Wilkinson 2002). Barbados experienced 65–90 per cent bleaching in 1998 with approximately 20 per cent mortality recorded at one site.

The frequency and extent of bleaching incidents have increased since the 1970s and are considered to be associated with an El Niño/Southern Oscillation (ENSO) disturbance (Figure 12). Some suspect that bleaching incidents may become an annual event by 2025–2050 (Hoegh-Guldberg 1999). Owing to their narrow temperature tolerances, some species of corals currently live at or near their thermal limits (Goreau 1992; IPCC 1998); and sea-surface temperature projections suggest that the thermal tolerance of reef-building corals will be exceeded within the next few decades. Moreover, the incidence of bleaching will rise rapidly, with the rate of increase highest in the Caribbean and lowest in the Central Pacific region (Hoegh-Guldberg 1999).

A preliminary biotic health index conducted through the AGRRA Assessment for 17 locations in the Western Atlantic region showed that islands with reefs in the 'better' health category included Bonaire and the Netherlands Antilles; reefs showing 'average' health included those in Turks and Caicos, Belize, Cayman Islands, Virgin Islands, St Vincent and the Grenadines, and Curaçao; and reefs in the 'worse' category were found in Cuba and The Bahamas (Kramer 2003). However, this categorization may be based on an incomplete picture of reef status (Box 9).

In the Caribbean, the economic sectors most affected by widespread bleaching and coral reef degradation are fisheries and tourism. The Caribbean, for instance, attracts about 57 per cent of the world's 10 million active scuba divers and it has been estimated that, by the year 2005, diving will generate about US$1 200 million annually (Cesar and others 2003). Since dive tourism is a function of the quality

of the region's coral reefs, permanent damage as a result of coral bleaching and other factors will have a direct economic impact on the region's tourism revenue.

Mangroves

Mangroves and littoral forests are considered to be the most biologically diverse habitats after coral reefs. For example, in Belize over 590 genera and more than 1 040 species of living organisms are known to inhabit the mangrove, littoral forests, lagoons and watersheds of coastal areas (Government of Belize 1998). The major threats to mangroves include coastal development and charcoal production. Of the 26 Caribbean countries covered in the FAO report on the state of the world's forests (FAO 2003a), 21 showed decreasing mangrove cover over the period 1990 to 2000, with annual rates of decline ranging from 0.3 per cent in The Bahamas to 3.8 per cent in Barbados (FAO 2003a). Only Aruba, Montserrat, St Lucia, the Turks and Caicos Islands, and the US Virgin Islands showed no significant change in mangrove cover over the period.

Fisheries resources

In the Caribbean, fish is the most important source of protein after poultry, especially in rural areas where the incidence of poverty may be high. Caribbean fisheries play an important social and economic role; national fisheries are an important source of food, employment and foreign exchange earnings (Table 25). In some countries the national fisheries serve as a default source of employment, providing livelihoods for individuals that might otherwise go unemployed. For instance, in Jamaica, approximately 130 000 persons are employed in the fisheries sector with estimated earnings of US$150 million per year; employment in this sector is growing. Fisheries contribute up to 8 per cent of GDP in some countries (for example, Guyana). The largest fish-exporting countries are The Bahamas (primarily lobster), Belize (mainly lobster and shrimp) and Guyana (primarily shrimp). Barbados, Dominican Republic, Jamaica, and Trinidad and Tobago are the largest importers of fishery commodities (Table 26).

There is a high level of uncertainty regarding the status of the fisheries resources in the region, due to high species diversity, complex overlapping stocks

Table 25 **CARICOM fisheries and aquaculture production and trade**

	1988	1992	1996	2000	2002
AQUACULTURE PRODUCTION					
Inland production (000s tonnes)	3	3	4	5	7
Marine production (000s tonnes)	0	0	1	4	5
FISHERIES PRODUCTION					
Inland production (000s tonnes)	2	2	2	2	2
Marine production (000s tonnes)	100	116	146	190	182
TRADE IN FISHERY COMMODITIES					
Total imports (US$ millions)	67	55	98	117	120
Percentage of world total	0.2	0.1	0.2	0.2	0.2
Total exports (US$ millions)	85	112	147	235	195

Source: FAO 2004c

Table 26 Total weight and value of fisheries imports to and from selected Caribbean countries, 1976–1998

	IMPORT QUANTITY (000s tonnes)	IMPORT VALUE (000s US$)	EXPORT QUANTITY (000s tonnes)	EXPORT VALUE (000s US$)	QUANTITY BALANCE (000s tonnes)	VALUE BALANCE (000s US$)
ANTIGUA AND BARBUDA	14 606	36 859	3 882	10 546	–10 724	–26 313
BAHAMAS	31 168	105 650	39 525	705 335	8 357	599 685
BARBADOS	45 415	112 198	2 004	8 665	–43 411	–103 533
BELIZE	4 783	13 998	21 002	196 756	16 219	182 758
DOMINICA	8 928	23 413	0	0	–8 928	–23 413
DOMINICAN REPUBLIC	345 780	537 642	18 135	27 651	–327 635	–509 991
GRENADA	10 483	27 546	3 086	16 257	–7 391	–11 289
GUYANA	2 427	7 289	93 420	481 985	90 993	474 696
HAITI	137 932	101 152	7 657	58 974	–130 275	–42 178
JAMAICA	351 708	601 978	20 419	113 305	–331 289	–488 673
ST KITTS AND NEVIS	6 073	16 882	1 868	3 214	–4 205	–13 668
ST LUCIA	16 212	53 373	188	640	–16 024	–52 733
ST VINCENT AND THE GRENADINES	5 999	14 966	30 575	71 470	24 576	56 484
SURINAME	17 295	29 580	38 870	104 745	21 575	75 165
TRINIDAD AND TOBAGO	91 660	193 885	45 460	92 785	–46 200	–101 100

Source: Hoggarth 2000

(Table 27), limited scientific information and inadequate management capacity. The fisheries of The Bahamas and Guyana appear to be in good condition, with catches still increasing, but catches were reported to have levelled off or even to be declining in others (Table 28). In his review of the trends in catch and fishing effort, Hoggarth (2000) concluded that fisheries resources are generally overexploited in the region.

The major issues and challenges facing the fisheries sector in the region include:

- Growing demand for fish and fish products associated with rapid human population growth;
- Overcapitalization and overfishing;
- Pollution and degradation of coastal and marine habitats;
- Unregulated and illegal fishing by local fleets;
- Illegal, unreported and unregulated fishing by re-flagging of vessels and flag of convenience practices used by vessels (re-flagging involves switching the registration of a vessel from one jurisdiction to another to overcome the cancellation or suspension of high-seas fishing rights in the first jurisdiction; flag of convenience practices involve registration of vessels in states that are either unwilling or unable to police the high-seas fishing rights that they grant); and
- Climate change and accompanying sea-level rise.

Table 27 Review of some important fisheries resources in the region of Western Central Atlantic Fishery Commission

RESOURCE TYPE	STATUS	IMPORTANCE	SHARED DISTRIBUTION
SPINY LOBSTER	Fully exploited or overexploited	High value for export and tourism	Throughout region (except the Guyanas–Brazil)
QUEEN CONCH	Fully exploited or overexploited. Highly vulnerable to overexploitation and stock collapse. Listed in CITES, Appendix 2	High value for export and tourism	Throughout region (except the Guyanas–Brazil and the Gulf of Mexico)
LARGE COASTAL PELAGICS (for example, dolphinfish, blackfin tuna, mackerels)	Unknown but fishery expanding rapidly	Domestic and tourism consumption, recreational	Broadly distributed and highly migratory
LARGE OCEANIC PELAGICS (yellowfin tuna, billfishes, swordfish)	Generally fully exploited to overexploited	High value for export, tourism, recreational	Broadly distributed and highly migratory
LARGER PELAGICS (coastal and ocean sharks)	Potential for severe overexploitation as by-catch. Biodiversity concern due to vulnerability	Food (domestic)	Broadly distributed and highly migratory
SOFT BOTTOM DEMERSALS (for example, drums, croakers, catfish)	Heavily exploited as by-catch and directed fishery	Domestic importance for food, export	Widely distributed on the continental shelves. Locally migratory
DEEP SLOPE DEMERSALS (for example, snappers, groupers)	Fully exploited to overexploited	High value for export, domestic and tourism consumption	Widely distributed on the continental and island shelf slopes. Locally migratory
SHALLOW REEF FISH (for example, snappers, groupers, parrotfish, grunts, surgeonfish)	Fully exploited to overexploited. Fishing is affecting reef ecosystem health and productivity. 13 species in 5 families on IUCN Red List	Domestically important food, high value for export, tourism aesthetics	Widely distributed in coral reef habitats. Some species migratory on shared shelves
FLYINGFISH	Unknown but fishery expanding slowly, after rapid expansion in 1980s	Domestically important food fish	Distributed and migratory throughout southeastern Caribbean
SHRIMP	Fully exploited to overexploited	High-value export	Widely distributed and migratory within sub-regions
OTHER (octopus, squid, seaweed, sea urchins, corals and so on)	Various	Locally important	Nationally to widely distributed
TURTLES AND MARINE MAMMALS	Some populations endangered	Of concern regarding biodiversity. Nationally important for tourism, aesthetic purposes	Nationally to widely distributed

Source: CRFM 2000

CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973 IUCN = The World Conservation Union

Table 28 Status of national fisheries

STATE	RECENT EFFORT LEVELS	RECENT CATCHES	COUNTRIES
Good	Increasing or stable	Still increasing	Bahamas, Guyana
Bad	Levelled off	Levelled off	Belize, Barbados, Dominican Republic, Grenada, Haiti, Jamaica, Trinidad and Tobago
Worse	Increasing	Levelled off	St Vincent and the Grenadines, Suriname
Worst	Declining	Declining/Senescent	Antigua and Barbuda, St Kitts and Nevis

Source: Hoggarth 2000

Impact of climate change

About 70 per cent of the Caribbean's population inhabit cities, towns and villages located in vulnerable low-lying coastal areas (UNEP 1999b). Coastal development throughout most of the region has been undertaken without consideration of climate change and sea-level projections. Based on global projections and studies in other regions, sea-level rise of 30–55 cm for the Caribbean over the next 50 years has been considered a reasonable projection. While the severity of the threat will vary regionally, sea-level rise of the magnitude projected is expected to have severe implications for the economic and social development of many Caribbean states (Granger 1997; IPCC 1998; IPCC 2001a). This will result from the associated coastal erosion and saltwater intrusion into coastal agricultural lands and aquifers, an escalation in the frequency and intensity of hurricanes and tropical storms, and disruptions in precipitation and potable water supply which might threaten the very existence of island nations and low-lying coastal states (IPCC 2001a). Critical infrastructure such as social services, airports, ports, telecommunication facilities, roads, coastal protection structures, tourism facilities and vital utilities will be at severe risk. It has been suggested that land loss from sea-level rise, especially on the low limestone islands, is likely to be of a magnitude that would disrupt virtually all economic and social sectors (Leatherman 1997). Climate change and sea-level rise would require costly adaptation measures to protect vulnerable populations (Government of Jamaica 2001).

Cocos Bay, Trinidad and Tobago

Source: Institute of Marine Affairs, Trinidad and Tobago

CONCLUSION

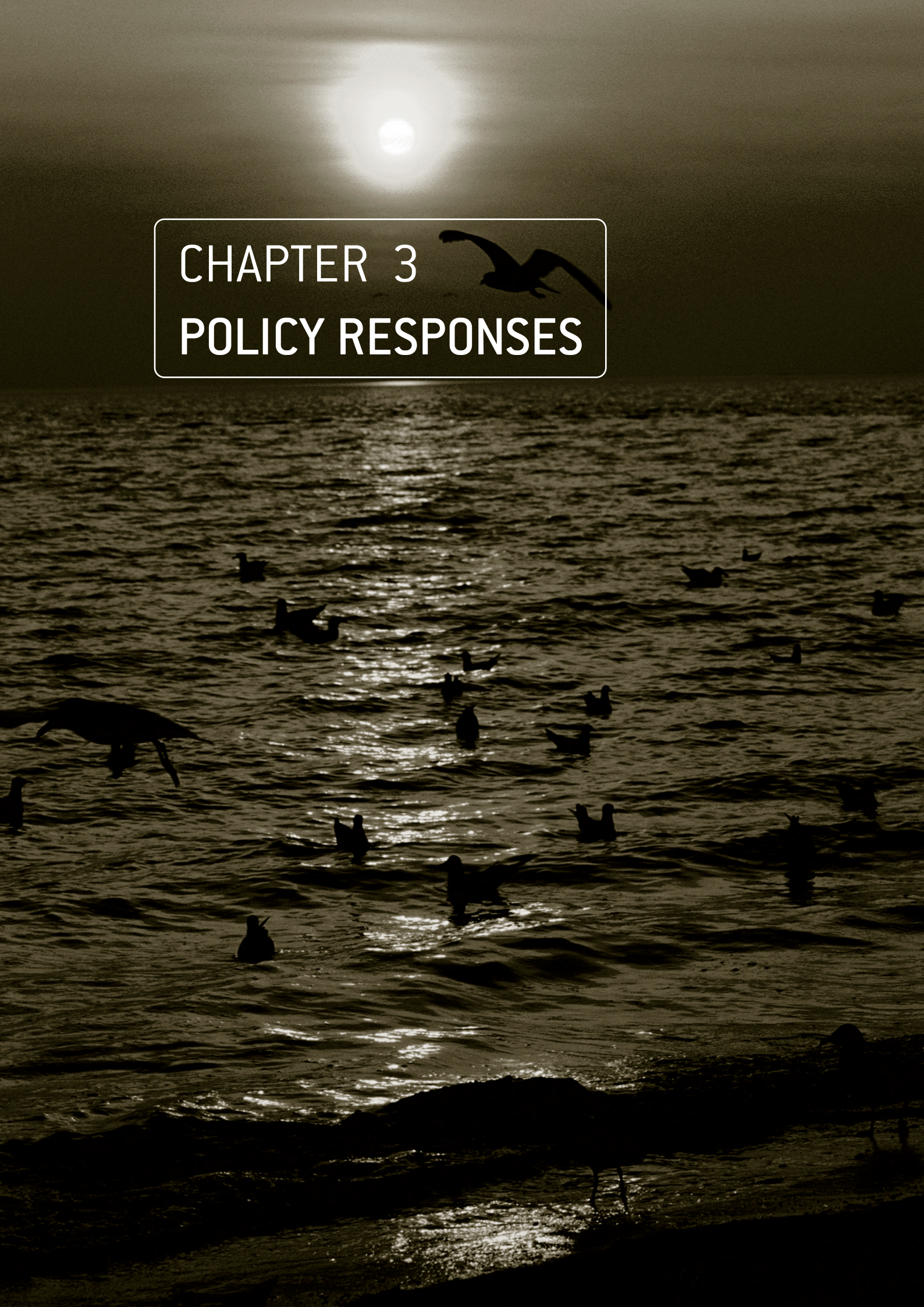
Social and economic development in the Caribbean SIDS and LLCS countries is dependent on a limited range of natural resources and a clean and healthy environment. Over the last three decades, the majority of these countries have maintained a positive trend in key health and social indicators. The rate of economic growth varies widely among the Caribbean SIDS and LLCS, with some countries showing an overall upward trend. Nevertheless, over the last three decades, environmental degradation and the unsustainable use of natural resources have continued in the Caribbean SIDS and LLCS, with negative consequences for social and economic development. The close linkage between the environment and development in the Caribbean SIDS and LLCS is a result of unique conditions — such as a heavy dependence on a limited natural resource base; susceptibility to the vagaries of international trade; high transportation and communication costs; grave vulnerability to natural disasters; small domestic markets; and high import content and dependence on a narrow range of export products. These make these countries environmentally, socially and economically vulnerable to external shocks. Food and energy security represent particular areas of vulnerability for the Caribbean because of dwindling natural resources and the high dependence on imported food and fossil fuel.

Driven by socio-economic factors, unsustainable exploitation of natural resources coupled with inadequate treatment and disposal of waste have resulted in continuing natural resource depletion and environmental degradation in the Caribbean SIDS and LLCS over the last three decades. Degradation of land and coastal ecosystems, and depleted fish stocks,

A quartet of hurricanes battered parts of the Caribbean in 2004
Source: C.Lee/Photodisc

freshwater, forests and other natural resources threaten human well-being and economic development in these countries. Natural disasters in the Caribbean in the last three decades have included hurricanes and tropical storms; these have been especially severe in 2004, with thousands of lives lost and damage totalling millions of dollars. Sustainable economic development in the Caribbean SIDS and LLCS must be approached through the reduction of economic, social and environmental vulnerabilities to maintain or increase the resilience of the social and natural systems and the flow of goods and services.

A gas station in Port of Prince, Haiti



CHAPTER 3
POLICY RESPONSES

It is well recognized that the Caribbean is faced with a number of complex and urgent environmental problems which pose a threat to the long term economic, social, and cultural viability of our society (CARICOM 1989).

Over the three decades following the Stockholm Conference, environmental awareness at the highest level of decision making in the Caribbean has increased greatly. For some of these countries progress in dealing with environmental issues at the national, regional and international levels has been significant. Environmental portfolios have gained status and have progressed from being on the periphery of conventional revenue-generating ministries to being ministries in their own right. An appreciation within the Caribbean of the impact of human activities on the natural environment and hence the well-being of future generations has been articulated for over 20 years. This is reflected in various agreements including the Georgetown Accord in 1975, the Nassau Understanding in 1984, the CARICOM Ministerial Conference on the Environment in 1989, the St George's Declaration in 2000, the OECS Environmental Management Strategy in 2001 and the OECS Development Charter in 2002. The 1994 UN Conference on Sustainable Development of SIDS (UN 1994) declared that:

Based on the principle of the right to development, small island developing states should, in accordance with their own priorities, endeavour to achieve the goals of sustainable development by, *inter alia*, formulating and implementing policies, strategies, and programmes that take into account:

- **development, health, and environment goals;**
- **strengthening national institutions; and**
- **mobilizing all available resources,**

all of which are aimed at improving the quality of life.

This affirmation strongly suggests that sustainable development in SIDS should be defined in terms of welfare, rather than consumption, capital and the processes of improvement of the human condition (ECLAC 2001). Sustainable development in SIDS must be approached through the reduction of economic, social and environmental vulnerabilities to maintain or increase the resilience of the social and natural systems and the flow of goods and services on which the socio-economic well-being of the Caribbean is based.

Governments are still constrained by the traditional approach to economic and social development, marked by:

- The short-term development planning horizon defined by the five-year term of political office;
- A sectoral approach to economic planning and resource management;
- The focus of development planning on economic gain accompanied by the dependence of national economies on foreign exchange earnings from one or two sectors;
- Adoption of reactive measures to environmental problems over proactive actions;
- The low priority given to environmental issues in development and economic planning; and
- The low priority given to long-term land use and urban planning.

The need for a mechanism that will move national and regional governments from the traditional 'short-term maximization of welfare' to the 'sustainable maximization of welfare' has been identified during the preparatory process for Barbados +10. Given the

characteristic high level of vulnerability of the Caribbean, it is imperative that the limited human and financial resources are not diverted to redressing the consequences of vulnerability if these can be avoided. Delegates at the 14th Meeting of the Forum of Ministers of Environment of Latin America and the Caribbean stressed the importance of the implementation of the Johannesburg Plan of Implementation (JPOI) and the Millennium Development Goals and of not losing sight of these vulnerabilities (UNEP 2003b).

Social responses to environmental challenges tend to be ad hoc and favoured over long-term planning. Actions tend not to be taken without a 'catalyst' or 'trigger' that dramatically indicates the seriousness of the threat. Thus, problems are sometimes not effectively addressed in a timely manner. For example, the Caribbean may be considered to be maladapted to current climate variability as demonstrated by recurrent vulnerability. Also, governments have traditionally taken a sectoral approach to development planning. More recent initiatives, however, suggest that the governments of the Caribbean show an increasing willingness to adopt integrated planning approaches.

National governments are usually not under public pressure to fulfil their environmental mandates. There are few environmental issues on the political agenda, as the public does not see the environment as a political issue. This is the result of the lack of widespread public appreciation of the linkage between environmental degradation and social and economic issues. In the absence of broad public awareness or concern over environmental issues, environmental NGOs play a critical role in holding governments accountable for the environmental consequences of their development policies.

ACTION PLANS AND NON-BINDING AGREEMENTS

GLOBAL AND REGIONAL ACTION PLANS

Among the most important global action plans for the Caribbean is the Barbados Programme of Action (BPOA) adopted in 1994 to facilitate the implementation of Agenda 21 in SIDS. In 1989, the first CARICOM Ministerial Conference on the Environment was held primarily to increase the appreciation of the significance of the issues and needs relevant to the management and protection of the Caribbean environment. This conference provided a comprehensive description of the Caribbean's environmental situation during the formulation of the Port of Spain Accord on the Management and Conservation of the Caribbean's Environment. At that time it was recognized that Caribbean countries were faced with a number of complex and urgent environmental problems that posed a threat to their long-term economic, social and cultural viability. The sustainable development priorities for the Caribbean SIDS have been articulated through the BPOA. These priorities are also embodied within the framework of other global, regional and sub-regional initiatives and agendas, including Barbados +5, the Millennium Development Goals, WTO agendas related to the Doha Round and the Monterrey Consensus, JPOI, various charters that deal with environmental issues that have been developed by CARICOM, and the St George's Declaration of Principles for Environmental Sustainability.

In a survey for the Caribbean Ministerial Meeting on the Implementation of the BPOA in November 1997, governments were asked to rate each of the 14 priority areas of the BPOA in terms of national and regional importance and assess key issues, including:

- Status of national initiatives;
- Specific initiatives under each priority area supported by government; and
- Major successes in implementation of the BPOA.

Box 10 The St George's Declaration of Principles for Environmental Sustainability in the OECS

- Foster sustainable improvement in the quality of life
- Integrate social, economic and environmental considerations into national development policies, plans and programmes
- Improve legal and institutional frameworks
- Ensure meaningful participation by civil society in decision making
- Ensure meaningful participation by the private sector
- Use economic instruments for sustainable environmental management
- Foster broad-based environmental education, training and awareness
- Address the cause and impact of climate change
- Prevent and manage the causes and impacts of disasters
- Prevent and control pollution and manage waste
- Ensure the sustainable use of natural resources
- Protect cultural and natural heritage
- Protect and conserve biological diversity
- Recognize relationships between trade and environment
- Promote cooperation in science and technology
- Manage and conserve energy
- Negotiate and implement multilateral agreements
- Coordinate assistance from the donor community in the organization of the Eastern Caribbean states region
- Implementation and monitoring (of the St George's Declaration)
- Obligations of member states (under the St George's Declaration)
- Review (of the St George's Declaration)

Source: OECS 2000

Of great concern was the discrepancy between ratings ascribed to some of the BPOA priority areas at both the regional and national levels and their strategic importance to the sustainable development of the Caribbean. For example, energy resources and science and technology were given low priority despite their importance in development.

Among the overall achievements of the BPOA are greater collaboration and information sharing among SIDS; greater understanding of the common problems; development, transfer and implementation of solutions among SIDS; and the establishment of the information and communications support network, SIDSnet, by the United Nations Department for Economic and Social Affairs (UNDESA).

The review of the BPOA held in Port of Spain, Trinidad and Tobago, in 2003 with the participation of 21 countries, showed several achievements in the Caribbean SIDS including the following:

- Caribbean SIDS have made progress in preparing for adaptation to the challenges of climate change and variability, and sea-level rise. Regional projects and national enabling activities have resulted in a better understanding of climate change impacts in the Caribbean. The CARICOM Climate Change Centre has been established;
- Most Caribbean SIDS now have draft disaster management policies and programmes and some have developed hazard mitigation policies that they have sought to integrate into their national development plans. There has been an improvement in the early warning system of the Caribbean, and a more coordinated regional approach to disaster management and recovery has been developed;
- A number of SIDS have improved their solid waste management capacities which have resulted in increased waste collection and sanitary landfills, and made progress in the implementation of MARPOL and other relevant conventions;
- Some SIDS have developed integrated coastal zone management policies and plans, and coastal zone units have been established. The marine resources

database developed by CARICOM is a successful venture. There are ongoing projects addressing marine issues such as the Meso-American Barrier Reef Project and the International Coral Reef Action Network;

- The implementation of watershed management policies has been successful in some of the Caribbean SIDS. Nevertheless, many of these SIDS still lack adequate water management, infrastructure and distribution systems;
- Most Caribbean SIDS have taken a more integrated development approach towards land use planning, but there is concern about the continuing loss of agricultural land;
- The use of solar energy for domestic and hotel water heating and for community-based projects,

Table 29 Major national plans and reports in the Caribbean

	NATIONAL REPORT FOR UNCED	NATIONAL REPORT FOR WSSD	STATE OF THE ENVIRONMENT REPORTS/ NATIONAL ENVIRONMENTAL PROFILES	NATIONAL BIODIVERSITY STRATEGY AND ACTION PLAN	NATIONAL CONSERVATION STRATEGY	NATIONAL SUSTAINABLE DEVELOPMENT POLICY/PLANS	ENVIRONMENTAL ACTION PLANS	UN CONVENTION ON DESERTIFICATION (ACTION PROGRAMMES)	UNFCCC NATIONAL COMMUNICATIONS	FORESTRY ACTION PLAN
ANTIGUA AND BARBUDA	1992	2002/ 2002*	1991	ip	na	na	na	na	2001	1993
BAHAMAS	1992	2002	na	1999	na	na	na	na	2001	na
BARBADOS	1992	2001	2001	2002	na	na	na	2001	2001	1993
BELIZE	na	2002	1995 (COAST)	1998	na	2004	1993/ 1996	na	2002	na
CUBA	na	2002	na	2002	na	1997	na	2003	2001	na
DOMINICA	na	2002*	1991	2001	na	na	1994	na	2001	1993
DOMINICAN REPUBLIC	1992	na	1981	na	na	na	na	na	2003	1993
GRENADA	na	2002/ 2002*	1991	1988/ 2000	na	na	1994	na	2000	1993
GUYANA	na	2002	na	1999	na	na	1994	na	2002	na
HAITI	1992	na	1985	na	na	na	1999	na	2002	na
JAMAICA	1992	2002	1987, 1995, 1996, 1997	2003	na	na	1994/ 1995	2002	2000	1990/ 2004
ST KITTS AND NEVIS	1992	2002*	1991	ip	na	na	1994	na	2001	1992
ST LUCIA	na	2001	1991	2000	na	na	1994	na	2001	1993
ST VINCENT AND THE GRENADINES	na	2002*	1991	1986	na	na	1994	na	2000	1993
SURINAME	na	2001	na	ip	na	na	na	na	na	na
TRINIDAD AND TOBAGO	1992	na	na	ip	na	na	na	na	2001	1993

na = information not available ip = in preparation * = OECS sub-regional report

and the use of wind and hydropower and biomass sources such as bagasse, have been successful in some SIDS. Niche industries for renewable energy have been developed in some of them;

- Regional organizations such as ACS, the University of the West Indies (UWI), the Caribbean Tourism Organization (CTO), and the Caribbean Alliance for Sustainable Tourism (CAST) have ongoing efforts to promote sustainable tourism development and ecotourism in member states.

Despite these positive outcomes, the review concluded that the implementation of the BPOA had fallen short of expectations and has yielded considerably fewer concrete results than were anticipated (ECLAC 2003). This was largely due to inadequate resources and institutional capability, including the required skilled manpower resources, external shocks related to trade liberalization and globalization, the slow-down of tourism, and the removal of preferential trade agreements.

Of greater concern also is the noted and continued discrepancy between ratings ascribed to some of the BPOA priority areas at both the regional and national levels and their strategic importance to the sustainable development of the region. According to ECLAC (1998), the importance of each of the BPOA priority areas varied considerably at the national level, possibly reflecting the differing national agendas. Only tourism resources, natural and environmental disasters, freshwater resources, and coastal and marine resources received relatively consistent, high ratings from representatives of the countries that participated in the review. When asked of their importance at the regional scale, all but a few issues were ranked as of relatively equal significance. Energy resources and science and technology have been given low priority at both levels, despite their critical role in shaping the development in the region.

The Caribbean Action Plan is another important plan in the Caribbean context that has been signed by more than 30 countries. It was adopted in 1981 at the first intergovernmental meeting held in Montego Bay, Jamaica, and covers the Wider Caribbean Region. The Caribbean Action Plan led to the creation of the Caribbean Environment Programme (CEP) and the Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region, also known as the Cartagena Convention (see the section on global and regional and multilateral environmental agreements in this chapter). The CEP is facilitated by the UNEP Caribbean Regional Coordinating Unit (CAR/RCU) in Kingston, Jamaica. The CAR/RCU continues to serve as Secretariat for CEP and the Cartagena Convention (UNEP-CEP 2004).

Also important in the region is the St George's Declaration (SGD) adopted by the OECS in 2000. The SGD, which has 21 principles for environmental sustainability (Table 29), resulted from a request from the Third Meeting of the OECS Ministers of the Environment Policy Committee in 1999 for guidance on environmentally sound approaches to economic development.

NATIONAL ACTION PLANS AND STRATEGIES

At the national level, the Caribbean SIDS and LLCS continue to prepare national action plans and strategies to address their development and environmental priorities (Box 11). These national plans and strategies are often developed without any linkages to the international or regional agreements previously mentioned. In some cases, however, these agreements have encouraged the development of national environmental policies and national environmental management strategies to define national initiatives and to promote the integration of efforts among key sectors (Table 29; Boxes 11 and 12).

Another good example of integrated management policies and a practical framework to implement policies is the development of integrated coastal resource management (ICRM)/integrated coastal zone management (ICZM) policies and plans. ICRM/ICZM provides the conceptual and operational framework within which integration can be achieved and has been identified as the vehicle for climate change adaptation by the United Nations Framework Convention on Climate Change (UNFCCC) and a number of other environmental initiatives (IPCC 2001a).

Box 11 Snapshots of national environmental strategies and plans in the Caribbean

St Lucia

St Lucia is preparing a National Environmental Policy (NEP) and a National Environmental Management Strategy (NEMS) in accordance with the terms of the St George's Declaration of Principles for Environmental Sustainability, with support from the Organization of Eastern Caribbean States Environment and Sustainable Development Unit (OECS ESDU). It is being undertaken by the Ministry of Physical Development, Environment and Housing, under the guidance of a Steering Committee comprising representatives of key national governmental agencies involved in environmental management.

Grenada

Grenada endorsed a National Environmental Action Plan during the 1980s. This plan, however, was never implemented as an objective-driven strategic plan of action. In 2000, Grenada published its National Physical Development Plan (NPDP) after an extended process of nationwide public consultations and endorsement by the Cabinet. The NPDP addresses a number of key issues, including forest, coastal and fisheries resources, sustainable tourism, and land use and management within the context of biodiversity conservation and management. This plan lacks a human resource strategy or capacity-building component.

St Kitts and Nevis

St Kitts and Nevis's National Environmental Action Plan (NEAP) was formulated in 1994. It identifies major environmental issues facing the community and ensures that appropriate policies and actions are formulated and implemented. The NEAP has ensured the Federation's involvement in regional and international projects related to sustainable development, assisted with the enhancement of environmental legislation, review of development policies, and the upgrade of existing institutions to address environmental concerns. The Development Control and Planning Act 2000 then followed to ensure the planned development of land in St Kitts and Nevis and the wise and efficient use of the country's scarce natural resources. A national physical development plan has yet to be formulated under the Act.

Jamaica

The National Environmental and Planning Agency (NEPA) of Jamaica is directly responsible for the management and protection of the country's environment and natural resources. NEPA has developed 15 policy papers, central among which is the Jamaica National Environmental Action Plan (JaNEAP). The policy document has been updated several times since the plan was issued in 1995. The present plan covers the period 1999–2002, and identifies 190 practical actions to which the government is committed, identifying the agencies and organizations responsible for their implementation.

Suriname

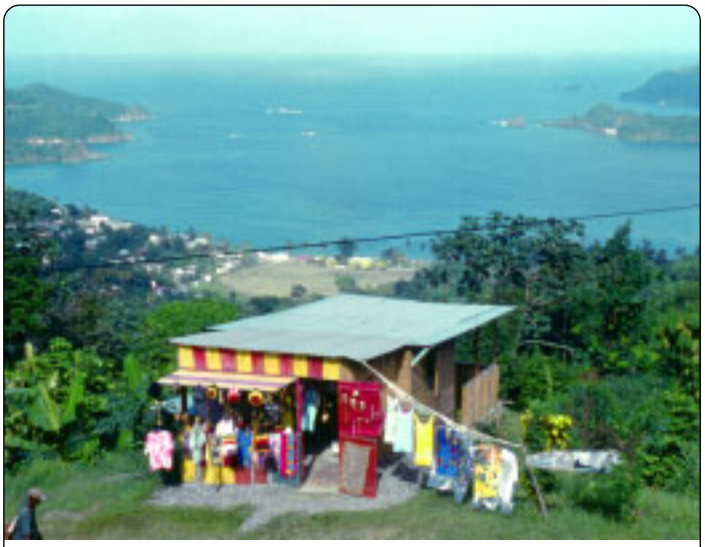
The Nationale Milieuraad, NMR (National Council for the Environment), in Suriname is a policy and advisory body in the Office of the President. The Nationaal Instituut voor Milieu en Ontwikkeling (National Institute for Environment and Development) in Suriname, known as NIMOS, is the executive and research arm of the Council. These bodies will work with the Inter-Ministerial Advisory Commission (IMAC) upon its establishment, which was unanimously endorsed in a special seminar titled *Op Weg naar een Duurzaam Milieubeleid* (*On the Way to a Sustainable Environmental Policy*) in November 1997.

Sources: UNEP 1999b; UNDP 2003b; NIMOS 2004

The UNCED and the 19th Special Session of the General Assembly (Earth Summit +5) called on governments to prepare national strategies for sustainable development. Caribbean SIDS and LLCS are increasingly looking towards national sustainable development strategies to harmonize the various sectoral economic, social and environmental policies and plans to ensure socially and environmentally responsible economic development.

A number of CARICOM countries have operational national Sustainable Development Councils (SDCs). The establishment of SDCs was supported by the United Nations Development Programme (UNDP) Capacity 21 programme, which was initially conducted in Barbados, the British Virgin Islands, Dominica, Grenada, Jamaica and St Lucia from November 1994 to March 1998. The programme evaluation (Impact Consultancy Services 1998) found that national sustainable development strategies based on inter-sectoral linkages and multisectoral consultation (especially the participation of the private sector, NGOs and communities) and considerations were absent. The evaluation also identified the lack of national environmental action plans that clearly describe ways to manage natural resources sustainably, as well as the lack of environmental quality criteria. Other constraints linked to national sustainable development strategies include:

- A multiplicity of governmental agencies with responsibility for the environment, and absence of institutional mechanisms to coordinate their policies and programmes;
- A proliferation of outdated environmental laws often weakly enforced by disparate government agencies;
- Limited capacity in national development planning, environmental economics, natural resource management, project cycle management, environmental engineering, coastal zone management, collaborative management, conflict resolution, environmental impact assessment, and policy analysis and design; and



Socially and environmentally responsible development is an important aim in SIDS

Source: Institute of Marine Affairs, Trinidad and Tobago

- Weak governance systems at national and community levels, as reflected by ineffective local government and public administration systems.

Lessons learned from the Capacity 21 programme included:

- Interest and commitment at the highest political level is critical to the success of the management process;
- Having committed persons leading and supporting the process is more important than the physical location of the SDC within a central coordinating government agency;
- The most effective SDCs were those that addressed issues of direct relevance to people;
- The design of new institutions should be based on the results of a detailed analysis of the previous and current situation, to avoid duplication of efforts. Local experience on successes and failures should be applied; and
- To be effective, SDCs and other similar bodies should be given detailed terms of reference, clearly

Box 12 The OECS waste management project

Objective: To reduce public health risks and protect the environmental integrity of the islands of its membership and their coastal and marine systems, by improving domestic solid waste management facilities and facilitating compliance with the 'Special Area' designation of the Caribbean Sea for MARPOL 73/78 Annex V wastes.

Aims:

National

- Establish autonomous or semi-autonomous solid waste management entities in the beneficiary states;
- Improve waste collection and disposal practices; and
- Provide ship waste reception facilities at major ports and marinas and treat biomedical waste in three of the countries.

Sub-regional

- Develop harmonized policies and legislation for both shore and ship-generated waste management;
- Investigate the feasibility of the 4 Rs (recycling, reduction, recovery and re-use) in these small island states;
- Provide relevant training as well as public awareness and education; and
- Introduce cost recovery measures.

Before:

- A significant proportion of the population was not served by any type of waste collection system;
- There was little public understanding of the public health, environmental, tourism or economic implications of inadequate waste management systems;
- The capacity to improve the waste management system was severely constrained by the existing institutional framework, most particularly at the technical and financial levels;
- Existing infrastructure was under-capitalized and poorly maintained and operated; and
- Controls on the management of international wastes entering the country were either non-existent or totally ineffective.

After:

- The project has provided an avenue to address solid waste management issues in the region; and
- Harmonized policies and legislation for both shore and ship-generated waste management developed at a regional level were amended to suit local conditions.

St Lucia: measures achieved since the project began in 1997

- Establishing a semi-autonomous solid waste management entity;
- Improving waste collection and disposal practices;
- Improving ship waste reception at major ports and marinas and better managing biomedical waste;
- Providing the harmonized policies and legislation for shore and ship-generated waste management, amended to suit local conditions;
- Cabinet-approved policies for the management of shore and ship-generated wastes, which will form the basis for new waste management legislation;
- Small advances were made in the areas of recycling, reduction, recovery and re-use;
- Public awareness and education were an integral part of project implementation;
- Cost recovery measures were introduced; and
- Deficiencies in the management of the sector were identified, and recommendations on the way forward were proposed.

Source: CEHI 2003

stipulating their mandates, structures and modes of operation, and the required resources to facilitate their work should be made available (Ecotech Inc. Limited 2000).

While national action plans and strategies can provide new approaches to addressing environmental issues, Caribbean countries still do not make full use of these tools when designing and implementing national initiatives. A major concern at the national level is that natural resource users are not driving the environmental agenda. Driven by self-interest and short-term gain, natural resource users do not lobby enough for action to protect the crucial resource base.

It should be noted, however, that there have been some efforts to make sectors such as tourism more sustainable. For example, the Commonwealth Secretariat has sponsored a series of workshops on Green Management and Ecotourism Product Development Strategic Planning for officials from English-speaking Caribbean countries. The Government of The Bahamas has twice received the World Travel and Tourism Council's Green Globe Environmental Achievement Award for its contribution to these workshops.

GLOBAL AND REGIONAL MULTILATERAL ENVIRONMENTAL AGREEMENTS

More than 100 conventions are of some relevance to the Caribbean; those that are of particular importance to the Caribbean are listed in Tables 30 and 31. In general, Caribbean SIDS and LLCS have demonstrated a high level of commitment to the MEAs, which place certain obligations on the signatories as well as on non-party states (Box 13).

Unique to the region is the Cartagena Convention on the Protection and Development of the Marine Environment in the Wider Caribbean and its three protocols: Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region (SPAW), Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean Region (Oil Spills), and Protocol Concerning Pollution from Land-based Sources and Activities (LBS). They constitute the first regional framework convention for the protection of the marine and coastal resources (UNEP-CEP 2004). The Convention was adopted in Cartagena, Colombia, in March 1983 and entered into force in October 1986. All Caribbean countries, except The Bahamas, Guyana, Haiti, St Kitts and Nevis, and Suriname, have ratified this convention and its protocol on oil spills. The SPAW protocol that entered into force in 2000 has been ratified or acceded to by nine countries in the region,

Box 13 Country-level tasks related to MEA compliance

- Participation in regional management organizations
- COP representation
- Attending expert meetings
- Reporting on implementation
- Provision of statistical and other information
- Record keeping
- Research, data collection, analysis
- Administration (for example, export and import restrictions)
- Dispute resolution and the defence of regulatory measures
- Institutional strengthening
- Capacity building and training
- Establishment of legal and administrative frameworks
- Development of national implementation plans
- Public education and outreach
- Appropriate conservation measures

Source: based on Anderson 2000

Box 14 International environmental conventions and national law: the case of the queen conch in Jamaica

The need for national legislation was illustrated recently in the case of *Natural Resources Conservation Authority* v. *Seafood and Ting International Ltd* in Jamaica. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) requires contracting states to prohibit the export of the queen conch without an export permit. The permit could be granted only if the scientific authority of the exporting state advises that the export would not be detrimental to the survival of the conch and the management authority is satisfied that it had been legally harvested. Jamaica, the world's largest producer and exporter of queen conch, acceded to CITES in 1997 and its management authority, the Natural Resources Conservation Authority (NRCA), adopted the Jamaican Conch Fishery Management Plan, which was developed by the Fisheries Division of the Ministry of Agriculture. The plan includes a quota for the harvest and export of queen conch, which was accepted by the NRCA and the scientific authority appointed by it.

In upholding the challenge by exporters to the requirement for a permit, the Jamaica Court of Appeal ruled that the absence of national legislation incorporating CITES robbed the permit system of all validity. The Court said that it was imperative that the convention be made a part of the domestic law of Jamaica as early as possible — if the protection of the environment is a serious national objective.

Source: UNEP 2002

and by the United States and France. The LBS Protocol has been ratified by Trinidad and Tobago and acceded to by Panama (UNEP-CEP 2004). Implementation of these protocols has not been without challenge. For example, the Caribbean SIDS and LLCS have difficulty in implementing Annex 3 standards under the LBS Protocol, since proper treatment and disposal systems are very costly (UNDESA 2004).

Often due to the small human resource pool and small income and tax bases typical in the region, the governments of many of the Caribbean SIDS and LLCS do not have the required financial and human resources to ensure compliance with the large number of conventions to which they subscribe.

MEAs, such as the London Convention and MARPOL, have been instrumental in elevating the status of the Caribbean as an area that requires special protection as well as to restrict or prohibit certain harmful activities. However, the usefulness of MEAs has been difficult to assess for two reasons. Firstly, environmental initiatives at the national level in the Caribbean SIDS and LLCS are largely driven by country environmental profiles (CEPs) and/or NEAPs often prepared with the encouragement of funding institutions. Secondly, there is no accepted methodology or agreed set of indicators, and few data, for determining the impacts of global MEAs on the country's environment (UNEP 1999b).

A possible indicator of the effectiveness of MEAs for environmental management could be the extent to which enabling legislation has been enacted to facilitate the implementation of the respective conventions. MEAs have very limited applicability within the policy and legal framework of Caribbean jurisdictions. As a result, Caribbean courts based in British law can refuse to recognize treaties as rules of national law unless they have been incorporated into national legislation (UNEP 2002). Enactment of national laws to facilitate compliance with the obligations of global MEAs is still limited but increasing in the Caribbean, recognizing national needs as seen in the case of CITES and national legislation on queen conch exports in Jamaica (Box 14). Progress in enacting national legislation is also being made with respect to the UNFCCC, the Montreal Protocol and the CBD.

As for compliance regarding the obligation for public education and outreach (Box 13), the general public in the region is well informed about only a few MEAs, such as UNFCCC, Montreal Protocol, CBD and CITES, which have implemented awareness-raising campaigns through both public and non-governmental organizations.

Table 30 Status of MEA implementation among Caribbean states

	GLOBAL MEAs										REGIONAL MEAs			
	CBD	CITES	Basel	Ozone	UNFCC	CCD	Ramsar	Heritage	UNCLOS	MARPOL	Cartagena	Oil spills	SPAW	LBS
ANGUILLA (UK)	CP	CP	CP	A	A	A	A	A	CP	AN5	SR	SR	SR	
ANTIGUA AND BARBUDA	CP	CP	CP	A	A	A		A	CP	AN5	SR	R	S	
ARUBA (THE NETHERLANDS)	CP	CP	CP	A	A	A	A	A	CP	AN4	SR	SR	SR	
BAHAMAS	CP	CP	CP	A	A	A	A		CP	AN4				
BARBADOS	CP	CP	CP	A	A	A		A	CP	AN4	SR	SR	R	
BELIZE	CP	CP	CP	A	A	A	A	A	CP	AN5	R	R	R	
BRITISH VIRGIN ISLANDS (UK)	CP	CP	CP	A	A	A	A	A	CP	AN5	SR	SR	SR	
CAYMAN ISLANDS (UK)	CP	CP	CP	A	A	A	A	A	CP	AN5	SR	SR	SR	
CUBA	CP	CP	CP	A	A	A	A	A	CP	AN2	R	R	SR	
DOMINICA	CP	CP	CP	A	A	A		A	CP		R	R		
DOMINICAN REPUBLIC	CP	CP		A	A	A	A	A	S	AN5	R	R	R	
GRENADA	CP	CP		A	A	A		A	CP		SR	SR		
GUADELOUPE (FRANCE)	CP	CP	CP	A	A	A	A	A	CP	AN5	SR	SR	SR	
GUYANA	CP	CP		A	A	A	A	A	CP	AN5				
HAITI	CP		S	A	A	A	A	A	CP					
JAMAICA	CP	CP		A	A	A	A	A	CP	AN5	SR	SR	S	
MARTINIQUE (FRANCE)	CP	CP	CP	A	A	A	A	A	CP	AN5	SR	SR	SR	
MONTSERRAT (UK)	CP	CP	CP	A	A	A	A	A	CP	AN5	SR	SR	SR	
NETHERLANDS ANTILLES (THE NETHERLANDS)	CP	CP	CP	A	A	A	A	A	CP	AN4	SR	SR	SR	
PUERTO RICO (US)		CP	CP	A	A	A	A	A		AN4	SR	SR	SR	
ST KITTS AND NEVIS	CP	CP	CP	A	A	A		A	CP	AN5				
ST LUCIA	CP	CP	CP	A	A	A		A	CP		SR	SR	SR	
ST VINCENT AND THE GRENADINES	CP	CP	CP	A	A	A			CP	AN5	R	R	SR	
SURINAME	CP	CP		A	A	A	A	A	CP	AN5				
TRINIDAD AND TOBAGO	CP	CP	CP	A	A	A	A		CP		R	R	SR	R
TURKS AND CAICOS (UK)	CP	CP	CP	A	A	A	A	A	CP	AN5	SR	SR	SR	
US VIRGIN ISLANDS		CP	CP	A	A	A	A	A	_	AN4	SR	SR	SR	

Legend: A: acceptance (ratification or accession) of the convention; S: signed; R: ratified; CP: contracting party; AN: the number of the annexes accepted by the state or overseas territory

Conventions

- **CBD** = United Nations Convention on Biological Diversity, 1992, http://www.biodiv.org/world/parties.asp
- **CITES** = Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973, http://www.cites.org/eng/disc/parties/index.shtml
- **Basel** = Convention on the Transboundary Movements of Hazardous Wastes and their Disposal, 1989, http://www.basel.int/ratif/ratif.html
- **Ozone** = Convention for the Protection of the Ozone Layer, 1985, and Protocol on Substances that Deplete the Ozone Layer, 1987, http://www.unep.org/ozone/spanish/ratif-sp.shtml
- **UNFCCC** = United Nations (UN) Framework Convention on Climate Change, 1992, http://unfccc.int/resource/conv/ratlist.pdf
- **CCD** = UN Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, 1994, http://www.unccd.int/convention/ratif/doeif.php
- **Ramsar** = Convention on Wetlands of International Importance especially as Waterfowl Habitat, 1971, http://www.ramsar.org/key_cp_e.htm
- **Heritage** = UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972, http://whc.unesco.org/nwldrat.htm
- **UNCLOS** = United Nations Convention on the Law of the Sea, 1982, http://www.un.org/Depts/los/reference_files/chronological_lists_of_ratifications.htm
- **MARPOL** = International Convention for the Prevention of Pollution from Ships, 1973, 1978, http://www.imo.org/home.asp?topic_id=161
- **Cartagena** = Convention on the Protection and Development of the Marine Environment in the Wider Caribbean
- **Oil Spills** = Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean Region
- **SPAW** = Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region
- **LBS** = Protocol Concerning Pollution from Land-Based Sources and Activities

Downtown Havana, Cuba
Source: B. Potter

The cross-cutting nature of some MEAs also continues to be a challenge. Countries are required to adopt sectorally integrated, socially inclusive implementation strategies and to create multisectoral awareness about their purpose. A number of countries have established national mechanisms to coordinate implementation of MEAs (Box 15).

Governments of the Caribbean are becoming more aware of the measures necessary to ensure compliance with MEAs. Greater efforts have been made by the conventions to enable needs assessment and capacity building for more effective implementation of MEAs, and there has been increased advocacy for measures that specifically support technology transfer and financial assistance in order to promote the implementation of MEAs further.

Box 15 Coordinating mechanisms for implementation of MEAs

- The Cabinet of Antigua and Barbuda established the National Coordinating Mechanism (NCM) in 1999 which coordinates MEA focal points hosted in different governmental agencies. Meeting a minimum of three times a year, this group reviews implementation and issues concerning all conventions and recommends future national actions directly to the policy-makers. Each focal point has access to technical expertise and other resources available within the NCM and divides the responsibilities of maintaining the NCM.
- In Dominica, the Environmental Coordinating Unit has been designated as the implementing agency for the CBD, UNFCCC, CCD, Montreal Protocol, POPs (Persistent Organic Pollutants), and Biosafety Conventions and Protocols. The Unit also serves as Dominica's focal point for regional and international environmental agreements and programmes.
- In addition to the responsibility for the overall management of environmental issues in Grenada, the Ministry of Health and Environment is also responsible for coordinating initiatives at the sub-regional and international levels. Grenada's Ministry of Agriculture, Forestry, Lands and Fisheries serves as the focal point for several MEAs including the CCD, the Ramsar Convention, the SPAW Protocol, and CITES. The Ministry of Finance serves as the focal point in the coordination of environmental programmes related to the UNFCCC and the CBD. Both Ministries coordinate on issues concerning the CCD.
- The Environmental Services Coordination Unit (ESCU) of the Minister of Health and Environment in St Vincent and the Grenadines serves as the focal point for most of the country's MEAs, and as the clearinghouse for those MEAs not directly under its control (e.g. CITES, UNCLOS and MARPOL).

Source: UNEP 2003a

Table 31 Parties to Caribbean conventions limiting discharge of ship-generated waste

	IMO Convention 1948	IMO amendments 1991	IMO amendments 1993	MARPOL 1973/1978 (Annex I/II)	MARPOL 1973/1978 (Annex III)	MARPOL 1973/1978 (Annex IV)	MARPOL 1973/1978 (Annex V)	MARPOL Protocol 1997 (Annex VI)	London Convention 1972	London Convention Protocol 1996
ANTIGUA AND BARBUDA	✓	✓	✓	✓	✓	✓	✓		✓	
BAHAMAS	✓	✓	✓	✓	✓		✓	✓		
BARBADOS	✓	✓	✓	✓	✓	✓	✓		✓	
BELIZE	✓		✓	✓	✓	✓	✓			
CUBA	✓	✓	✓	✓			✓		✓	
DOMINICA	✓		✓	✓	✓		✓			
DOMINICAN REPUBLIC	✓			✓	✓	✓	✓		✓	
ECUADOR	✓		✓	✓	✓	✓	✓			
GRENADA	✓		✓							
GUYANA	✓		✓	✓	✓	✓	✓			
HAITI	✓								✓	
HONDURAS	✓	✓	✓	✓			✓		✓	
JAMAICA	✓		✓	✓	✓	✓	✓		✓	
MEXICO	✓	✓	✓	✓			✓		✓	
NETHERLANDS	✓	✓	✓	✓	✓		✓		✓	
NICARAGUA	✓			✓	✓	✓	✓			
PANAMA	✓	✓	✓	✓	✓	✓	✓	✓	✓	
ST KITTS AND NEVIS	✓	✓	✓	✓	✓	✓	✓			
ST LUCIA	✓		✓	✓	✓	✓	✓		✓	
ST VINCENT AND THE GRENADINES	✓	✓	✓	✓	✓	✓	✓		✓	
SURINAME	✓			✓	✓	✓	✓		✓	
TRINIDAD AND TOBAGO	✓	✓	✓	✓	✓	✓	✓			✓
UNITED KINGDOM	✓	✓	✓	✓	✓	✓	✓		✓	✓
UNITED STATES	✓	✓	✓	✓	✓		✓		✓	
VENEZUELA	✓		✓	✓	✓	✓	✓			

Source: London Convention 1972; IMO 2004

NATIONAL LAWS

Environmental and sustainable development issues are being addressed in a more strategic manner through national planning legislation. For example:

- The St Kitts and Nevis's Development Control and Planning Act addresses issues, including:
  - Mitigation of natural and man-made disasters;
  - Reduction of increasing pressures on the environment and limited land area through the adoption of appropriate management strategies;
  - Preparation of the National Physical Development Plan;
  - Creation of environmental, infrastructure and building standards to inform the preparation and evaluation of projects; and
  - Development of environmental skills to undertake and review environmental impact assessments (UNDP 2003b);
- St Kitts and Nevis's National Conservation Commission (NCC) is a multisectoral body established to implement the National Conservation Environment and Protection Act 1987. The Act provides the legal framework to protect the national environment, to provide for the establishment of marine and terrestrial protected areas, and to generally encourage sustainable development of the country's natural resources;
- The Town and Country Planning Act 1992 of St Lucia makes provisions for the orderly and progressive development of land and the proper planning of town and country areas, as well as for the enforcement of the plan. Under this Act, the Physical Planning and Development Board is required to give consideration to the planned or anticipated demand and availability of land for natural reserves, agricultural use, national parks and public open spaces;
- Dominica has appointed a Sustainable Development Committee of representatives of the National Development Cooperation, private sector, NGOs, and public and other government agencies to review national strategies for socio-economic development and to advise the Minister for Finance, Industry and Planning on the national sustainable development strategy (UNDP 2003b);
- Grenada's Ministry of Health and the Environment has responsibility for the overall management of environmental issues (including policy development, coordination and monitoring of various environmental initiatives executed by various agencies). However, it is the Ministry of Agriculture, Forestry, Lands and Fisheries that is responsible for the development of policies, programmes and projects to promote the sustainable use of Grenada's natural resources (UNDP 2003b).

Red mangrove
Source: Institute of Marine Affairs, Trinidad and Tobago

Effective application of environmental legislation is possible within a functioning regulatory, institutional, administrative and public participatory framework such as national sustainable conservation or development committees, commissions and/or councils.

REGIONAL INSTITUTIONS AND PROGRAMMES

The main regional and sub-regional bodies in the Caribbean are listed at the beginning of Chapter 2. In addition, the secretariat of each of the regional bodies has established a number of specialized institutions and units, some of them related to the environment (Box 16).

As for their programmes concerning the environment, the ACS has adopted a Social Partnership Programme, which focuses on involving regional NGOs in the inter-governmental process. The environmental programme of CARIFORUM, the Caribbean Regional Environmental Programme (CREP), is a four-year project currently being implemented by the Government of Barbados. Development blocks such as CARICOM and the OECS continue their efforts to integrate environmental considerations in national and regional development agendas.

A number of regional NGOs also participate in the environmental programmes and in the inter-governmental decision-making process. Regional NGOs play an important role in shaping and facilitating the implementation of environmental and sustainable development policy. The main regional environmental NGOs are the Caribbean Conservation Association (CCA), Island Resources Foundation (IRF) and the Caribbean Natural Resources Institute (CANARI). Both the CCA and the IRF have a long history of implementing a range of environmental programmes in the Caribbean. While the CCA specializes in environmental awareness, regional environmental networking and amenity area/protected area demonstration activities, IRF activities include environmental assessments, capacity development for NGOs and preparation of environmental profiles for the OECS countries. CANARI's main focus over the past ten years has been on providing training in sustainable forestry, concept development and collaborative management of natural resources.

A number of regional environmental information networks are also active and, in 2002, more than 40 such networks or environmental information providers were identified (Caribbean Media Consultants 2002). These networks involve a range of private, public, national, regional and international institutions, and are both conventional and internet-based in nature. A substantial amount of work is required to reduce duplication of effort, improve network integration and strengthen existing networks.

Each regional and sub-regional body has a mechanism to coordinate its environmental programmes, and some routinely participate in the coordinating mechanism of the others. For example, the ACS works through its Meetings of Ministers, in which the secretary generals of the other bodies participate. The OECS ESDU works with a Technical Advisory Committee comprising member countries and a number of regional NGOs. It reports to an Environmental Policy Committee, the OECS Council of Ministers for the Environment, as well as to the Council for Trade and Economic Development (COTED), which is responsible for CARICOM's Sustainable Development Work Programme, and makes recommendations regarding policy and future initiatives.

It should be mentioned that many of these bodies face financial constraints in meeting their objectives, due to the economic slow-down experienced in Latin America and the Caribbean.

Other key environmental programmes in the Caribbean include the following (see also Box 17 for a list of web addresses):

CARIBBEAN ENVIRONMENT PROGRAMME

The Caribbean Environment Programme (CEP) was developed in 1981 by 33 governments of the Wider Caribbean Region to promote the integration of environmental considerations into development planning. The programme is based on the Cartagena Convention (see p. 75). The CEP currently consists of four sub-programmes:

- Assessment and Management of Environmental Pollution (AMEP);
- Specially Protected Areas and Wildlife (SPAW);

Box 16 Specialized institutions under the regional economic bodies

During the 1990s the Caribbean witnessed a surge of specialized institutions that were created by the regional organizations such as CARICOM and the OECS, whose principal objective is to integrate the economies of the member states and coordinate the development of their socio-economic policies. Often established at the request of their members, the work of these specialized institutions ranges widely from agriculture and food production to environmental health, disaster mitigation and meteorology. Such institutions under the CARICOM Secretariat include:

- Caribbean Disaster Emergency Response Agency (CDERA);
- Caribbean Meteorological Institute (CMI);
- Caribbean Meteorological Organization (CMO);
- Caribbean Food Corporation (CFC);
- Caribbean Environment Health Institute (CEHI);
- Caribbean Agriculture Research and Development Institute (CARDI);
- Caribbean Regional Centre for the Education and Training of Animal Health and Veterinary Public Health Assistants (REPAHA);
- Assembly of Caribbean Community Parliamentarians (ACCP);
- Caribbean Centre for Development Administration (CARICAD); and
- Caribbean Food and Nutrition Institute (CFNI).

The OECS has the following institutions under its wing:

- Eastern Caribbean Telecommunication Authority (ECTEL);
- The Directorate of Civil Aviation (DCA);
- Eastern Caribbean Central Bank (ECCB); and
- The Eastern Caribbean Supreme Court.

The OECS is an associate institution of CARICOM. The Environment and Sustainable Development Unit of the OECS (ESDU) was established in 1981, when seven Eastern Caribbean countries signed the Treaty of Basseterre, agreeing to cooperate with each other and promote unity and solidarity among its members. The ESDU coordinates environmental policy development within the OECS sub-region and provides technical assistance to the relevant departments of its member countries. The ESDU coordinates regional environmental programmes for the OECS sub-region, including responsibility for the OECS regional environmental strategy, and is responsible for monitoring the adherence of the member states to the St George's Declaration. It has also been mandated to negotiate with international funding institutions for regional environmental projects. The ESDU has spearheaded the development of an Environmental Charter.

Source: CARICOM 2004; OECS 2004.

- Information Systems for the Management of Marine and Coastal Resources (CEPNET); and
- Education, Training and Awareness (ETA).

Its decision-making bodies are: Meeting of the Member States of the Caribbean Environment Programme; Contracting Parties to the Cartagena Convention; the Monitoring Committee; the Bureau of the Parties; the Scientific and Technical Advisory Committee of the SPAW Protocol (STAC/SPAW); and the Interim Scientific and Technical Advisory Committee of the LBS Protocol (ISTAC/LBS). All groups report to the Conference of Parties to the Cartagena Convention. International and regional NGOs and non-member countries to SPAW participate as observers and in programme implementation. The Caribbean Regional Coordinating Unit (CAR/RCU) located in Kingston, Jamaica, which is a sub-programme of UNEP's Regional Seas Programme, serves as Secretariat to CEP.

INTERNATIONAL CORAL REEF ACTION NETWORK PROJECT

The International Coral Reef Action Network (ICRAN) focuses on the implementation of the strategies identified under the International Coral Reef Initiative. In the Caribbean, ICRAN is coordinated by the CEP Regional Coordinating Unit.

INTEGRATING WATERSHED AND COASTAL AREA MANAGEMENT IN SMALL ISLAND DEVELOPING STATES OF THE CARIBBEAN (IWCAM)

The IWCAM Project was developed under the Global Environment Facility (GEF) by UNEP in collaboration with UNDP. UNEP-CAR/RCU and CEHI are co-executing agencies of this project on behalf of the 13 SIDS of the Wider Caribbean Region. The main focus of IWCAM is the demonstration of integrated watershed and coastal area management systems. Issues to be addressed include the requirements for institutional and infrastructural realignment; adoption of modalities for sectoral participation; capacity building; linkages to social and economic root causes of environmental degradation; and the overall need for sustainability. In May 2004, the project was approved by the GEF and received US$12 million as well as over US$13 million in co-funding from national governments, international organizations and the private sector, among others.

CARIBBEAN BLUE FLAG PROGRAMME

Blue Flag is a voluntary certification scheme for beaches and marinas which has been operating in Europe since the mid-1980s. The scheme has proved to be an effective environmental tool, particularly in assisting and facilitating the implementation of the European Union Directive on Bathing Water Quality Standards. In addition, the Blue Flag includes criteria on safety, management and environmental awareness for beaches and marinas. In 1995, UNEP, the Foundation for Environmental Education in Europe and the World Tourism Organization joined forces to investigate the possibility of extending this scheme to non-European countries. The feasibility assessment for the Caribbean was conducted in 2000, and the Caribbean Blue Flag Programme pilot phase implemented. The programme, which is being jointly coordinated by the CCA, the CTO and the Caribbean Alliance for Sustainable Tourism (CAST), is being implemented in Antigua and Barbuda, The Bahamas, Dominican Republic, Jamaica, Martinique, Puerto Rico and Venezuela.

CARIBBEAN GLOBAL WATER PARTNERSHIP

The Caribbean Water Partnership (CWP) was developed in response to the priorities established by the BPOA, and motivated by the Global Water Partnership. The objectives of the CWP are to establish a framework for collaboration in integrated water resources management (IWRM), within the context of a network of institutions, agencies and stakeholders, that will promote IWRM and assist in: technology transfer; best practice replication; institutional strengthening; information dissemination and sharing; public awareness programmes; and policy formulation. The Interim Secretariat (the Caribbean Council for Science and Technology) and Steering Committee of the CWP have been established, and the CWP was launched in June 2004.

DESIGNATING THE CARIBBEAN SEA AS A SPECIAL AREA

In 1991, the Marine Environment Protection Committee (MECP) of the International Maritime Organization (IMO) designated the Gulf of Mexico and the Wider Caribbean Region as a Special Area under the MARPOL Convention Annex V. The designation entered into force in 1993. Annex V concerns the disposal of solid waste by ships in near-shore coastal areas, and requires that ships travelling in these waters abide by discharge regulations, and that party nations provide proper waste reception facilities.

A wider initiative to have the Caribbean Sea internationally recognized as a special area in the context of sustainable development arose from the BPOA. Opposition by major maritime states led to the adoption of a negotiated version of the draft resolution. In February 2001 at the 55th Session of UNGA (UN General Assembly) resolution 55/203 — Promoting an integrated management approach to the Caribbean Sea area in the context of sustainable development — was adopted. This resolution did not substantively advance the region's agenda for establishing the Caribbean Sea as a special area. Subsequently, resolution 57/261 with the same title was adopted by UNGA in December 2003. The process of securing a declaration of the Caribbean Sea as a special area with respect to all potentially threatening activities will continue at the Barbados +10 Conference in Mauritius in 2005.

CARIBBEAN PLANNING FOR ADAPTATION TO CLIMATE CHANGE PROJECT (CPACC)

CPACC is one of the regional projects that have been developed to assist countries in implementing activities linked to global MEAs. From July 1997 to December 2001, 12 CARICOM countries that are parties to the UNFCCC collaborated in the successful implementation of this project. The CPACC project involved a combination of national pilot/demonstration activities and regional training and technology transfer, designed to prepare the CARICOM states for the adverse effects of global climate change and particularly sea-level rise. The CPACC project has successfully addressed a number of the problematic issues that have hampered effective environmental management by successfully incorporating strategies for sectoral integration and social inclusion into its implementation.

A major achievement of the CPACC project was the adoption of a participatory approach that led to the development of National Climate Change Adaptation Policy and Implementation Plans and Strategies. The process led to the approval by cabinet of a national adaptation policy in St Lucia, Dominica, Guyana, Barbados, The Bahamas, Antigua and Barbuda, Belize, and Trinidad and Tobago. The goals of the comprehensive policy include the avoidance and reduction of, and adaptation to, negative climate change impacts on a range of sectoral interests and natural resources. Policy directives regarding coastal and marine resources address the issues of monitoring, resource assessment, coastal protection, enhancement of ecosystem resilience, ecosystem restoration, the development of a national land use and management plan, the promotion of different fishery and resource use activities, and the fostering of increased public

Box 17 Regional institutions and programmes

- **Caribbean Environment Programme**
  http://www.cep.unep.org
- **International Coral Reef Action Network Project**
  http://www.cep.unep.org/programmes/spaw/icran/icran.htm
- **Integrating Watershed and Coastal Area Management in Small Island Developing States of the Caribbean (IWCAM)**
  http://www.cep.unep.org/programmes/amep/GEF-IWCAM/GEF-IWCAM.htm
- **Caribbean Blue Flag Programme**
  http://ccanet.net
- **Caribbean Global Water Partnership**
  http://www.ccst-caribbean.org/tmplpg.asp?pgid=6&id=47
- **Caribbean Planning for Adaptation to Climate Change Project (CPACC)**
  www.cpacc.org
- **The Caribbean Regional Fisheries Mechanism (CRFM)**
  http://www.caricom-fisheries.com

awareness of climate change impacts. The National Climate Change Strategy is a derivative of the Climate Change Adaptation Policy. Each sub-component of the strategy corresponds to a subject area under the directives provided in the Climate Change Policy. The CPACC project has also provided a forum and mechanism for the development of regional positions on climate change negotiations prior to participation in international negotiations. The outcomes of the CPACC project have been consolidated into the Mainstreaming of Adaptation to Climate Change (MACC) Project, which runs from April 2003 to December 2006.

THE CARIBBEAN REGIONAL FISHERIES MECHANISM (CRFM)

In February 2002, the Heads of Government of CARICOM countries signed the Inter-Governmental Agreement that established the Caribbean Regional Fisheries Mechanism (CRFM). The formation of the CRFM resulted from the CARICOM Fisheries Resource Assessment and Management Programme (CFRAMP), which was funded jointly by the Canadian Government, through the Canadian International Development Agency (CIDA), and participating CARICOM countries, and executed by the CARICOM Fisheries Unit in Belize until 2001. The CRFM has a mission 'to promote and facilitate the responsible utilization of the region's fisheries and other aquatic resources for the economic and social benefits of the current and future population of the region'.

The CRFM is the core of a complex interactive network of a wide variety of stakeholders in fisheries, and composed of three bodies: the Ministerial Body, the Caribbean Fisheries Forum and the Caribbean Fisheries Technical Unit (CFTU). The CRFM Secretariat serves as secretariat to the Forum and Ministerial Body (CRFM 2000).

The shoreline of Matelot, Trinidad and Tobago
Source: Institute of Marine Affairs, Trinidad and Tobago

ECONOMIC INSTRUMENTS

The potential of economic instruments to protect the environment and to promote sustainable development has been recognized by decision-makers in the Caribbean. For instance, under Principle 6 of the St George's Declaration of Principles for Environmental Sustainability, OECS members agreed to pursue and promote sound environmental practices, in part through the establishment of innovative means of generating public and private financial resources by means of fiscal incentives and market-based instruments and to provide economic incentives to encourage the adoption of sound environmental technologies and practices. The declaration also promotes the application of the polluter pays principle.

Notable success with an economic instrument in the Caribbean was achieved in promoting the use of solar water heating technology by Barbadian households. The Government of Barbados used a combination of policy, legislation, fiscal incentives and advertisements to stimulate the solar water heating industry in the country (Box 18).

St Lucia has embarked on the reformation of its water resources sector. This involves the development of a national water policy and a new legal framework, and the privatization of the water sector. The reform process will include use of economic incentives, public education and outreach, and community-level management (Geoghegan and others 2003). Planned and current measures in support of sustainable watershed management in the Caribbean include internalization of all water production and watershed management costs into water rates; development of a water-pricing structure that rewards conservation and eliminates cross-subsidies; establishment of a surcharge on water rates to finance the purchase of critical upper watershed areas for conservation; and metering for agricultural users to encourage conservation and efficiency (Geoghegan and others 2003).

These measures are more effective when accompanied by incentives to reward appropriate uses and behaviours, such as incentives for private landowners to grow tree crops that improve water retention; tax incentives to hotels that install water-saving devices and storage facilities; or incentives for farmers who utilize cropping systems that do not degrade watersheds, or convert to tree crops and other land uses that are compatible with clean water production. These measures are necessary to address and rectify systemic problems, which, among other constraints, limit the potential for development in strategic economic sectors (Geoghegan and others 2003).

In 2001, the Government of Belize enacted the Environmental Tax (Amendment) Act that imposes an environmental tax of one per cent on certain imported goods. Belize faces increasing amounts of waste, especially plastics. The environmental tax is placed in a special fund for use in the development of a national solid waste management programme. The government also plans to impose an environmental tax on plastic containers in an attempt to reduce the volume of garbage being generated. A charge of five per cent is also placed on all imports of plastic containers and on the value of goods packaged in such containers.

In 2000, the Government of Trinidad and Tobago introduced a Green Fund, which is financed through a levy on all registered companies. This initially consisted of a tax of 0.1 per cent of gross earnings, and was subsequently reduced to 0.074 per cent in 2002. The fund was established to assist communities in undertaking reforestation and environmental remediation in watersheds and other ecologically important areas.

Another approach to funding environmental management is the debt-for-nature swap mechanism. The Jamaica Conservation Development Trust (JCDT) established the Jamaica National Park Trust Fund (JNPTF) with the proceeds of the Anglophone Caribbean countries' first debt-for-nature swap on Earth Day 1992. The Bank of Jamaica allocated the JCDT a quota of US$600 000 of debt. The Conservation Trust of Puerto Rico and the Smithsonian Institute contributed an additional US$100 000 and US$60 000, respectively, to support the debt swap. The JNPTF was established as

Box 18 Solar water heaters: incentive-driven adoption of renewable energy technology

Fiscal incentives may be essential to stimulate the adoption of renewable energy technology (RET) by the public. By 1997, approximately 2 800 solar water heaters had been installed in Jamaica, a country with a population of 2.5 million. In contrast, Barbados, a smaller island with a population of 250 000, had installed 26 000 solar water heaters by 1997. This difference was ascribed to a combination of policy, legislation, fiscal incentives and promotion to stimulate the national solar water heating industry and popular demand for this energy-saving technology.

In 1974 the Government of Barbados enacted the Fiscal Incentive Act, allowing solar water heating businesses to benefit from tax import preferences and tax holidays. These incentives were accompanied by a fiscal disincentive in the form of a 30 per cent consumption tax on electric water heaters, which made solar water systems more competitive. In addition, the government has allowed all water heater installation costs to be deductible from personal income tax. By ensuring that developers and architects were stakeholders in this RET initiative, the government ensured that householders were informed of the various advantages of solar water heaters. Currently more than one-third of the households are served by solar water heaters, representing a total savings to the country of US$3 million per year.

In 2000, more than 5 000 solar water heaters were installed in Jamaica. This increase was attributed to a demand-side management/World Bank-funded programme under which special financing arrangements were made available to purchasers. The Government of Jamaica facilitated the expansion of this industry by reducing the import duties from 30 per cent to 5 per cent on all renewable energy equipment. It is now proposed that a zero-rating for general consumption tax be applied to renewable energy equipment to boost installation even more.

Sources: Write 1997; Ince 2000; Government of Jamaica 2004

an endowment, capitalized with the funds from the swap to support the running costs of the national park system. According to Jamaica's National Parks System Plan, the JNPTF serves as the major vehicle for channelling funds to the park system. The Fund allows contributions to be tied to specific projects, parks or geographical areas. As part of the debt-swap agreement, the Government of Jamaica will make annual contributions to the Fund as well as help to develop proposals to funding sources. The parks are also expected to generate funds from user fees, leases and other mechanisms to cover operational and some recurrent expenses, with a portion being repaid to the JNPTF.

The Caribbean has often conducted economic valuation studies to determine the value of a resource. For example, economic valuations of marine and terrestrial protected area services have been conducted in Jamaica (Walling 1997) and Barbados (Yee Sang 1996). Also, a study of sand and beach resources in Antigua and Barbuda was undertaken as part of the CPACC pilot activity (Parker 2002). Sand mining was considered a potential threat to long-term coastal integrity and to the availability of sand, an essentially non-renewable natural resource. As a result of the valuation and cost–benefit analysis, it was proposed that the buyers of locally sourced sand be charged a sand mining tax in combination with legislation and enforcement of laws restricting illegal sand mining. This ensured that the appropriate economic valuation of sand was applied at the demand side. The subsequent increase in the price of sand created an incentive to find substitutes for beach sand. In construction, the substitutes included stone aggregates that were previously under-utilized.

The use of economic instruments in environmental management is in the early stages in the Caribbean. In the past, their use was limited and, in most cases, haphazard, with implementation taking the form of isolated initiatives, rather than components of a coordinated strategy. However, Caribbean countries have begun to take a more coordinated and strategic approach to the use of economic instruments. Application of economic instruments is not without difficulty, since Caribbean countries, especially those of

the OECS and possibly Jamaica, often do not have the necessary financial resources to implement these measures. In addition, in many of these countries, funds from environmental levies go into the consolidated fund and are not specifically allocated to environmental programmes. Furthermore, increases in taxes are often unpopular and controversial. In the absence of nationally generated funds for environmental management, Caribbean SIDS and LLCS continue to depend on grant aid for environmental initiatives.

SCIENCE AND TECHNOLOGIES

The combination of changing global markets, increasing economic pressures and environmental degradation, and growing awareness of the linkages between the environment and economic development creates incentives for the adoption of innovative technologies. This is particularly the case with information technologies such as geographic information systems (GIS), which can improve the efficiency with which information can be stored, retrieved, analysed and presented to support the decision-making process (Box 19).

Useful technologies need not be complex, expensive or require major policy decisions for their adoption. The use of digital video technology in the CPACC project to

Box 19 GIS support tools: an integrated approach to land and water resources management in the Caribbean

Decision support systems, which include geographic information systems (GIS) and soil erosion/hydrologic/water quality models, are useful in the selection of best management practices for watersheds.

The Grenada Land Information System (GLIS), for example, is a powerful tool for integrated watershed management. The GLIS operates under PC ARCINFO, and contains digital databases on hydrology, climate, soils, infrastructure, parishes, terrain elevation, land use, protected areas, forest reserves and geology. The GLIS has been used to create different agro-ecologic zones in the country based on factors such as the length of the growing period, mean annual temperature, mean annual rainfall, mean temperature during the growing season, length of the dry season, and so on. The agro-ecologic zone information is combined with data on soil types and land slopes to establish the most appropriate cropping systems for the entire country. Market prices for the crops are also considered in the simulations. The GLIS allows the most economic cropping systems for various soil types and land slopes to be selected, while minimizing soil erosion. An added feature of the GLIS is that areas within watersheds that are suitable for different land uses could be delineated.

In St Lucia, GIS is linked to a soil loss model (Universal Soil Loss Equation) to estimate soil loss from two watersheds. Based on these estimates, conservation practices that reduce loss were identified.

GIS also allows watershed data to be easily entered into hydrologic models, and is being coupled to water quality models such as AGNPS and ANSWERS. Using GIS in this way, phosphorus loads in watersheds can be predicted and best management practices to reduce agrochemical pollution can then be determined. With this advancement, strategies for controlling run-off, peak flows, soil erosion and pollutant loads could be evaluated for various storm recurrence intervals.

Other potential applications of advanced technologies lie in the use of remote sensing for assessing land use changes with time, and the use of radar measured rainfall for real-time flood forecasting and run-off predictions.

Source: Madramootoo 2000

monitor coral reefs for climate change impacts was intended to address a number of problems, including limited resources that are commonly faced in the region. This technology reduces the time and the cost of fieldwork while allowing surveyors to collect permanent records of coral reef condition. Digital images could then be processed by persons with basic computer skills using a computer routine that permitted manual or automated image capture. Under time constraints or in the absence of staff with taxonomic skills, the images could be electronically transferred to the Caribbean Coastal Data Centre (CCDC) in Jamaica for processing and analysis. The CCDC served as the sub-regional technical support node for the three countries involved in the pilot study (The Bahamas, Belize and Jamaica) demonstrating the principle of utilizing centrally located regional expertise to meet the needs of individual countries. In 2004 the monitoring network was expanded to include eight countries in the Eastern Caribbean as part of the MACC project. A technical support node will be established in the Eastern Caribbean to coordinate the pooled expertise in the sub-region in the establishment of the monitoring network. A similar technology is used by Coral Reef Watch, a programme of the United States National Oceanographic and Atmospheric Administration (NOAA) (Box 20).

Some technologies, such as desalination of water by reverse osmosis, are adopted to address existing environmental or development problems. In the islands of Tortola and Virgin Gorda, 100 per cent and 90 per cent, respectively, of the public water supply is provided through desalination. In Barbados the use of reverse osmosis was part of a strategy to address water scarcity (Box 21).

The need to adopt technologies to address future demands for water is not unique to islands in the Caribbean. A common feature is the adoption of technologies that allow value to be added though reduced energy consumption, and the integration with other technologies with economic, social and/or environmental benefits.

The potential for obtaining multiple benefits is also demonstrated by ocean thermal energy conversion (OTEC) technology. OTEC harnesses the temperature difference of 20°C or more between the ocean's deep cool waters and the warm surface waters in tropical and subtropical regions to generate electricity. The technology can generate multiple goods such as water for potable and agricultural use, aquaculture products and cooling agents for air conditioning and refrigeration, in the process of producing electricity.

Box 20 Coral reef monitoring technology

Coral Reef Watch, a new programme of the United States National Oceanographic and Atmospheric Administration (NOAA), has developed a new early warning monitoring system to alert them of episodes of coral reef bleaching. The Coral Reef Watch is developing a long-term coral reef monitoring network with the ability to predict coral bleaching episodes in all major coral reef areas throughout the Caribbean. Originally focused on US island territories in the Caribbean, the network now includes stations in Jamaica and Belize. Scientists will be using an artificial intelligence technique known as the Coral Reef Early Warning System (CREWS) to inspect data obtained from meteorological and oceanographic monitoring stations. CREWS will then analyse the combined effect of environmental conditions such as sea temperature, salinity, tides and ultraviolet light. Data from the CREWS stations will be used in conjunction with NOAA's satellite-monitored high sea temperature ('HotSpot') data and biological monitoring data to help assess regional and global trends in coral reef condition, and also to gauge the effect of human influence on coral reefs. When stressful conditions are detected, an alert will be automatically sent to researchers and sanctuary managers, and posted on its website. CREWS successfully predicted coral bleaching episodes in the Florida Keys National Marine Sanctuary in 1998 and on the Great Barrier Reef in January 2000.

Source: SPG Media Limited 2004

Box 21 A brackish water reverse osmosis desalination plant, Barbados

Barbados is a 'water-scarce' country. Rain-fed groundwater has always been the main source of supply, providing nearly 90 per cent of the domestic water supply. Any change in the seasonal precipitation pattern can have a potentially devastating impact. As a result Barbados is particularly vulnerable to the effects of droughts, such as that which occurred in 1994–95, when the country experienced severe water shortages. In order to address the social and economic vulnerability that the dependence on rain-fed groundwater creates, the growing evidence of deteriorating groundwater quality, and the competing demands on existing resources, the Government of Barbados invested in a US$37.5 million brackish water reverse osmosis (BWRO) plant. With a capacity of 30 000 m^3/day, this plant is claimed to be the largest of its kind in the Caribbean, and supplies potable water to 44 000 people among a population of 276 000. The plant has been specifically designed to reduce the overall energy requirements and provide high-quality potable water.

Source: SPG Media Limited, a subsidiary of SPG Media Group PLC 2004

Some Caribbean countries are also turning to innovative measures to develop alternative resources, such as generating electricity from bagasse (Box 22).

Appropriate technologies can serve to address some of the social, economic and environmental problems that constrain development in the Caribbean SIDS and LLCS. Ideally, technologies should provide other advantages or benefits in addition to their primary purpose. These may include foreign exchange savings, reduced energy consumption and minimal or reduced adverse social and environmental impacts. The adoption of more market-based technologies such as those associated with renewable energy has been less systematic in the region despite the economic and social benefits.

Often the Caribbean SIDS and LLCS adopt technological options that represent sub-optimal contributions to development, or that are unsustainable, or environmentally detrimental. In addition, the Caribbean is frequently regarded as a soft target by technology developers. These countries need to develop the capacity to deal with these issues.

Box 22 Co-generation: generating electricity from bagasse in SIDS

The case of Mauritius

The sugar industry is the primary earner of foreign exchange in Mauritius, which has a long history of electricity generation using a sugar cane by-product, bagasse. The industry has exported surplus electricity intermittently to the national grid since 1957. By the late 1970s electricity exports reached 25 GWh from the processing of 6 million tonnes of sugar cane. However, at this time pricing and supply conditions were not attractive enough to encourage heavy investment. Sugar production grew steadily until 1975, benefiting from rising demands in the guaranteed market under the Sugar Protocol of the Lomé Convention, and rapid price increases. After 1975, a combination of factors, which included unfavourable government policies, sugar price stagnation, price cuts, rising production costs and extreme climatic events, caused industry profits to fall. While Mauritius had a guaranteed export quota under the Sugar Protocol, prices paid by the EU fluctuated with developments in the EC Common Agricultural Policy. Prices declined steadily from 1988, and it became difficult to predict future declines.

The declining viability of this major economic sector coincided with a sharp increase in energy consumption associated with high levels of growth in the export and tourism sectors and increasing domestic demand. Average annual increases in electricity consumption and maximum demand were 11 per cent and 9.5 per cent, respectively, between 1985 and 1990. Growth in tourism and export production exceeded the national average of 6 per cent, necessitating a revision of energy consumption forecast. With increasing attention to efficiency, product diversification and cost recovery, the electricity surpluses increased and the export of surplus electricity became a production objective.

By 1989 the sugar industry was exporting 97.3 GWh of electricity to the public grid, or 15 per cent of the island's demand. Eight per cent of this was generated from bagasse. By 2002, this figure had increased fourfold. Forty-three per cent of Mauritius's electricity needs is generated from the sugar industry power plants, and 18 per cent is from bagasse, which displaces 60 000 tonnes of fuel oil. The resulting foreign exchange savings were estimated to be US$7.8 million.

The case of Cuba

The Cuban sugar cane industry constituted the principal source of national income from the early 16th century to the mid-1990s. Annual sugar production amounted to 7.3 per cent of world production, with exports averaging 6.8 million tonnes, representing 24 per cent of total world sugar exports. The 155 sugar factories were served by various types of infrastructure including electricity co-generation facilities with a total installed capacity of 800 MW.

In 1992, following the disintegration of the Soviet Union, Cuba's principal commercial partner, and the reinforcement of the North American blockade, serious restrictions on the flow of raw materials and fuel to the country had an impact on all of its socio-economic activities. Annual sugar production declined to about 4 million tonnes throughout the 1990s. This situation, combined with the decline in the world price of sugar, led to a programme of sectoral adjustment during which about 70 sugar factories were closed. An Energy Development Programme was approved in 1992 with the initial objective of achieving self-sufficiency in energy in the sugar sector, based on sugar cane biomass, and in the longer term of becoming a net exporter of energy to the national grid.

In 2004, the co-generation facility (615 MWe) is supplying 2 kWh per tonne of milled cane to the national grid for 90–100 days/year. To achieve the long-term target of the Energy Development Programme, medium-term investments in new co-generation projects are planned with additional capacity of approximately 130 MWe. With these new investments the sugar sector could supply its own demand and approximately 1 200 GWh/year to the national grid.

The case of Jamaica

Petrojam Ethanol Limited is a wholly owned subsidiary of Petrojam Limited which is a subsidiary of the Petroleum Corporation of Jamaica (PCJ), a statutory body of the Government of Jamaica. In 1985, Petrojam Ethanol Limited decided

to establish an ethanol plant on its Kingston refinery site, which began operation in 1987. The company's primary involvement is in the procurement of ethanol feedstock (hydrous alcohol), which is sourced mainly in the Caribbean, Europe and Brazil, the dehydration process to fuel ethanol (anhydrous alcohol) and the marketing of fuel ethanol in the United States or other markets.

To ensure an adequate supply of Caribbean-sourced feedstock, two initiatives were taken. In 1985, Petrojam's parent corporation, PCJ, acquired the Bernard Lodge sugar factory, which was slated for closure, and also identified a recently closed sugar factory at Libertad in Belize, with a capacity similar to that at Bernard Lodge, to ensure access to abundant sugar cane production capacity. In Jamaica, several pre-conditions exist to encourage the production of ethanol. Sugar cane, one of the crops from which ethanol can be produced, is widely grown in Jamaica and other Caribbean territories. The technology and skilled manpower are available in the region as well.

Some potential benefits are as follows:

1. The opportunity to rehabilitate the Bernard Lodge alcohol distillery to produce hydrous alcohol from sugar cane for further dehydration at the Petrojam Ethanol plant for use in the domestic market or for export;
2. The opportunity to upgrade other local sugar factories to produce hydrous alcohol either from molasses or directly from sugar cane; and
3. The opportunity to expand local sugar cane production to meet the requirements of the ethanol plants. This will open the door to increased investment in the sugar industry which should in turn improve employment prospects.

The ethanol feedstock requirement for its introduction into motor gasoline is estimated at 15 million US gallons per annum. Based on this demand, it is understood that for Jamaica to produce all of the feedstock it will require a minimum of 9 000 hectares of sugar cane farmland. The primary supply of the feedstock could, therefore, be sourced from the local sugar industry and, if there is a shortfall, this can be supplemented with imports from countries such as Brazil.

Source: Programa de Desarrollo Energético Sostenible, MINAZ 2004

ENVIRONMENTAL INFORMATION, EDUCATION AND OUTREACH

There is a need to harmonize and coordinate the environmental public education and outreach initiatives in the Caribbean. An integrated approach, as recommended for development, must also be applied to the public education and awareness programmes to:

- Minimize duplication of effort and the wastage of limited human resources and technical capacity;
- Avoid overloading the public with disparate environmental information; and
- Create awareness of the impacts of human activities on the environment.

Several agencies in the Caribbean have education and awareness programmes and related activities. For example, the CCA implements activities in environmental awareness, information management, communications and international conventions compliance. UNEP-CEP is working through its Information Systems for the Management of Marine and Coastal Resources (CEPNET) to promote information and data networks and national-level capacity building. CEPNET maintains a database on the Caribbean Marine Protected Area Managers (CaMPAM), and also provides information on the conservation and sustainable development of the coastal marine resources of the Wider Caribbean Region (Box 23).

SIDSnet is a global network that provides information on sustainable development issues in SIDS, and was launched in 1998 through UNDP's Sustainable Development Networking Programme (SDNP) and AOSIS. SIDSnet serves 43 SIDS in the Pacific, Atlantic and Indian Oceans, and the Caribbean and Mediterranean Seas. Its main goal is to utilize information and communication technologies (ICTs) to support the implementation of the BPOA. Information officers have been appointed in all the SIDS regions. SIDSnet Caribbean is building a database on the organizations and experts working on sustainable development themes in the Caribbean, and provides the website with relevant news from the region.

Box 23 Caribbean Marine Protected Areas Managers Network (CaMPAM)

CaMPAM is a very active network developed for Marine and Coastal Protected Areas (MPA) of the Wider Caribbean. It is assisted by the UNEP-CAR/RCU and Biscayne National Park. The main beneficiaries of CaMPAM are the managers of MPAs. Membership is flexible in order to respond to national circumstances and may include existing networking efforts (such as those of IUCN, CCA, CARICOMP and FAO), local institutions and partners. Consideration is given to the scope of the membership and organization of CaMPAM to encourage full participation of the management community's partners in the region. CaMPAM, in coordination with the International Coral Reef Action Network, has carried out three training courses for trainers in MPA management. These trainers develop training programmes in their respective countries, and have trained over 200 MPA professionals in the Caribbean.

Sources: WWF, UNDP, UNEP, IUCN 2003

The GEO Capacity Building in Haiti

INSTITUTIONAL AND INDIVIDUAL CAPACITY FOR ENVIRONMENTAL MANAGEMENT

The Declaration of Barbados from the SIDS Conference in 1994 clearly affirmed at the very beginning that the survival of Small Island Developing States is firmly rooted in their human resources and cultural heritage, which are their most significant assets (UN 1994). In the Caribbean those assets are under severe stress, and the environmental sector is no exception.

As seen in Chapter 2, most Caribbean countries have small populations of less than half a million. Considering the consequent small scale of the skilled labour force, national budget, as well as job market, it is not difficult to imagine the lack of institutional and individual capacity that exists in the region. Particularly in sectors such as the environment, which are often marginalized, the situation is more acute. It is clear that the size of environmental departments, in terms of manpower and financial resources allocated to them, is not enough to effectively manage environmental issues in the Caribbean; and the numbers of skilled individuals available to undertake roles in the fields of environmental management, conservation and policy development are similarly constrained by population size. Competition among a relatively small number of skilled individuals is high, resulting in their often being overburdened. At the same time, others are under-utilized, due to insufficient capacity in implementing institutions. Limited employment opportunities in the region as well as the failure of environmental institutions to build on the capacity of skilled personnel has led, to a certain extent, to a loss of skilled individuals to metropolitan countries in the region and, even worse, outside the region.

The need for capacity building and public cooperation were among the main issues that came out of the 7th Meeting of the OECS Ministers of Environment Policy Committee which took place in St Vincent and the Grenadines in 2003. It was noted that there is a need for capacity building within the ministries of environment around the region in order to help in the conservation and protection of the environment.

Some Caribbean governments have taken national action to develop human resources to address the lack of capacity that has hampered them from dealing with domestic environmental issues and fully engaging in international and regional environmental discussions. Barbados has introduced environment and development concerns into teacher-training programmes, while environmental education is an integrated part of primary- and secondary-level school curricula in The Bahamas (CSD 1998). These initiatives will, in the long run, increase the proportion of the population with environmental awareness and interest, leading to an increase in the overall pool of individuals with skills required for environmental management.

Antigua and Barbuda have strengthened institutional arrangements and administrative capacity in integrating environmental policy into national planning (Government of Antigua and Barbuda 2004). Both national governments and international, regional and sub-regional entities have endeavoured to strengthen or improve institutional arrangements in order to achieve more efficient implementation of environmental and sustainable development initiatives, especially in the areas of elimination of ozone-depleting substances, biodiversity conservation, waste management, integrated watershed management, and climate change and disaster mitigation.

However, it will not be an easy task to maintain the built capacity in these areas and to obtain capacity to deal with emerging concerns, such as employment of new technologies (e.g. biotechnology) and industries, environment and energy, and environment and trade. As for cross-cutting skills, those that have been recently identified as being in need of further strengthening are: capacity for project development and management, data and information management, and implementation of nationally and regionally relevant studies and researches (Government of Antigua and Barbuda 2004; Government of Belize 2004).

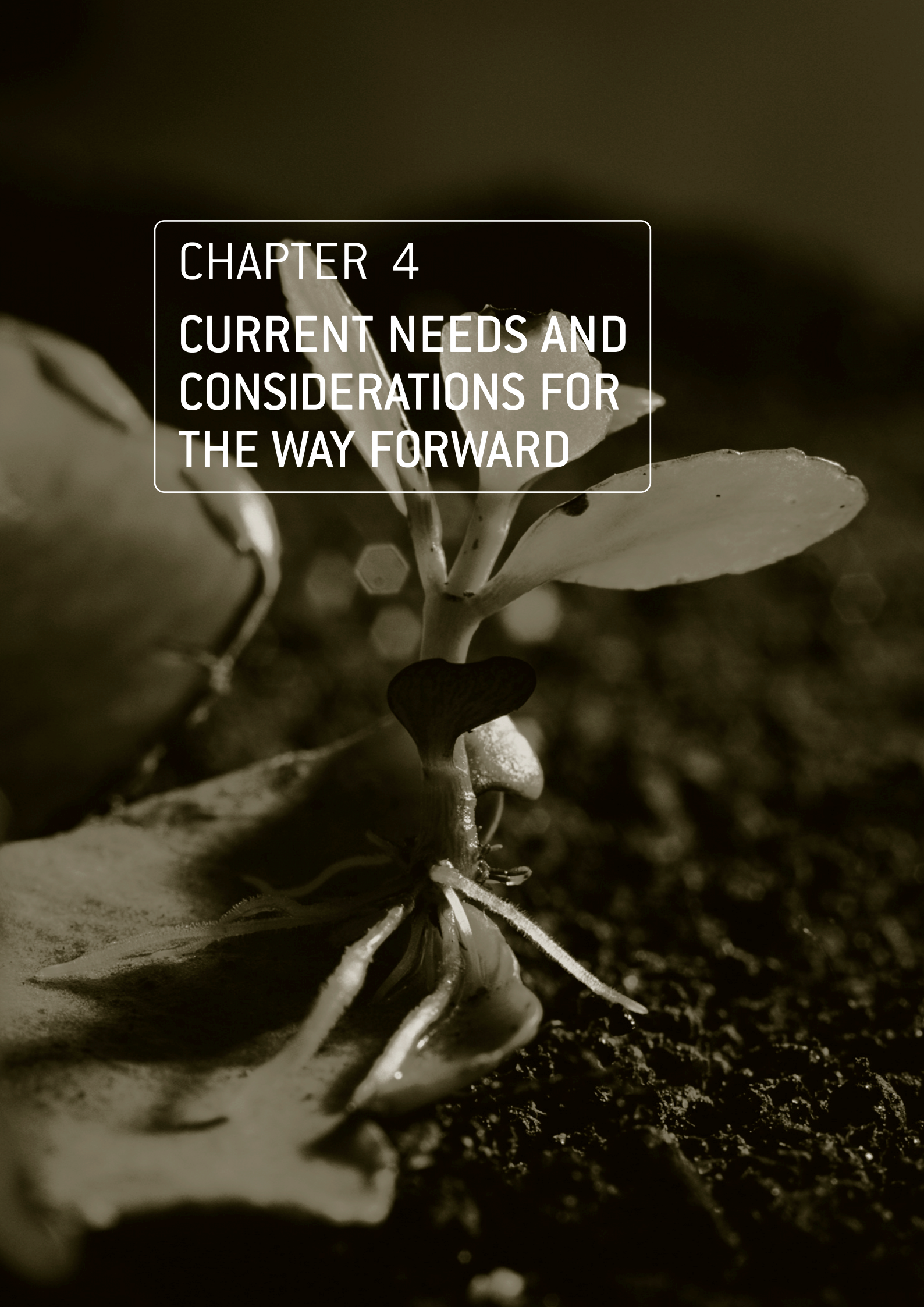
CONCLUSION

Barbados from the air
Source: B. Potter

Over the three decades following the Earth Summit, the Caribbean SIDS and LLCS have been moving from being reactive to proactive in dealing with environmental issues at the national, regional and international levels. For some of the countries the progress over the past 30 years has been significant: for instance, some countries are party to various regional and global, binding and non-binding policy instruments and are actively implementing them at the national level. Environmental and sustainable development issues are also being addressed through national and regional programmes. The countries have also made progress in improving human and institutional capacity for environmental management, increasing education and awareness, and introducing new technologies such as renewable energy. The wide range of existing environmental and sustainable development policy responses in the Caribbean indicates that these countries have begun to acknowledge the linkages between the environment and development. In fact, there are increasing attempts at integrating the environment into development planning. By better defining these linkages, responses to environmental issues could result in greater socio-economic benefits for the Caribbean. Despite these achievements, however, they continue to be faced with obstacles and constraints in the effective implementation of some of the existing policy instruments. These include:

- Inadequate funding or resources;
- Lack of coordination;
- Lack of a regional vision;
- Duplication of efforts;
- Inadequate human and institutional capacity;
- Competition for scarce human and financial resources;
- Inadequate access to information on projects and studies undertaken in the region;
- Lack of commitment by governments; and
- Apathy in civil society.

Governments in the region are attempting to address some of these constraints through the BPOA, even though positive outcomes following its implementation have fallen short of expectations. In the following chapter some available environmental policy responses are presented for consideration in the way forward to a sustainable future.



CHAPTER 4

CURRENT NEEDS AND CONSIDERATIONS FOR THE WAY FORWARD

As previously discussed, Caribbean countries share a number of characteristics that make them socially, economically and environmentally vulnerable. However, as the small island state of Singapore has demonstrated, these vulnerabilities do not necessarily constrain economic performance (Whiter 2003).

The future well-being of the environment in the Caribbean SIDS and LLCS will depend on the ability of their governments and other stakeholders to reduce and prevent further degradation of the natural resource base on which their social and economic development depends. The effectiveness with which Caribbean SIDS and LLCS can prevent further overexploitation of the natural resource base and degradation of ecological integrity also depends, for a significant part, on the level and type of economic productivity that will be achieved and sustained, and the extent to which governments invest in human resource development and poverty alleviation.

The Caribbean collectively and as individual states should urgently consider the following in the pursuit of sustainable economic development:

- Define development in terms of desired changes and the social and economic goals that are to be pursued in a Caribbean context. A primary objective of the new approach to development in the Caribbean must be the reduction of social, environmental and economic vulnerability;
- Revisit the fundamental assumptions that underlie the economies and lifestyles of these countries;
- Identify the areas in which traditional approaches to development and lifestyles represent departures from the social and economic goals that are to be pursued; and
- Internalize the costs of environmental degradation by those individuals and entities that cause the damage.

GOVERNANCE AND DECISION MAKING FOR SUSTAINABLE DEVELOPMENT

The Caribbean Regional Workshop on National Sustainable Development Strategies and Indicators of Sustainable Development, held in St Lucia in January 2004, found, as one of its conclusions, that, in many countries, the level of commitment of the political directorate to sustainable development issues is lacking, and as such, these issues often do not receive high priority in government work programmes and budgets (OECS/UNDESA 2004).

The successful initiatives in natural resource management and use of environmentally sound technology reviewed in this report have been characterized by strong government vision and leadership, transparency and participation of all stakeholders in planning, information exchange and dissemination, and the distribution of the resulting benefits at the national level in some countries in the region. By showing long-term political commitment to the objectives of sustainable development, ensuring that they transcend successive administrations, the governments of the Caribbean SIDS and LLCS would guarantee the continuity of national strategies for sustainable development (ECLAC 2000).

Efforts should be made to establish and/or strengthen governance structures in the Caribbean SIDS and LLCS that emphasize the following (Binger and others 2002):

- Availability of information on conventional and emerging technologies and processes;
- A culture of interaction and integration among disciplines, sectors and geographic areas;
- An effective regional planning and development process that is driven by a clear consensus on the strategic approaches that are most relevant to the countries;
- A framework that facilitates ongoing technical cooperation among the countries;

The northwest coast of the Archipelago of San Andres, Old Providence and Santa Catalina
Source: B. Potter

- A framework that permits effective monitoring and evaluation of approved plans, policies and programmes at the local, national and regional levels; and
- A mechanism that facilitates the involvement of local civil society and external partners in the development process.

Governance structures, in the form of COTED, CARICAD and the CARICOM Sustainable Development Unit, have been instrumental in coordinating disparate development goals of the various sectoral interests and regional institutions. The capacities of these institutions could be strengthened to support and facilitate implementation, supervision, monitoring and control of the commitments made in national strategies for sustainable development, including access of the public to information and to decision making (ECLAC 2000).

Due to limited size and natural resource endowment, innovative technologies will be a key determinant of the region's future. It is therefore critical that regional leadership initiates processes for the development of innovative technologies that will efficiently utilize the region's resource endowment in a sustainable manner to meet future social and economic needs.

In order to reduce economic vulnerability and make their economies more sustainable, the governments of the Caribbean could consider the following actions:

- Diversify national economies;
- Strengthen and empower existing mechanisms and institutions;
- Remove any structural bias towards increasing vulnerability in national development planning;
- Integrate environment issues into development policy, planning and management, and manage ecosystems to enhance their resilience and maintain productivity;
- Reduce dependence and expenditure on energy imports by promoting renewable energy technology (RET) and co-generation technology (CT);
- Develop fiscal incentives to implement demand-side management strategies to reduce consumption and waste;
- Review current land use policies to reduce vulnerability of human settlements and infrastructure and to ensure sustainable land utilization through rationalized planning;
- Implement integrated land use planning based on vulnerability assessments, hazard mapping and disaster mitigation;
- Evaluate the current levels of food security and develop means of improvement, with particular emphasis on the influence of climate change;
- Restructure the national and regional production base to satisfy national and regional demands and reduce dependence on export markets, for example in agricultural products;
- Develop the national capacity in integrated resource management;
- Mainstream environmental management, sustainable economic development and management of cultural resources into the education curriculum; and
- Identify and develop technologies and strategies that provide multiple benefits and economic savings.

In implementing these measures, social fragmentation or marginalization arising from political rivalries and gender discrimination should be avoided. The process should include innovative frameworks and mechanisms for facilitating civil society participation in planning and decision making. Civil society participation can:

- Facilitate feedback;
- Be genuinely participatory;
- Be promoted within relevant gender-sensitive and culture-sensitive forums;
- Allow for the outcomes of civil society participation in the decision-making process to be continuously monitored and evaluated;
- Build capacity of all actors (including through umbrella organizations where appropriate); and
- Be based on the implementation of charters on civil society, for example the CARICOM Charter on Civil Society.

It is essential to acknowledge that civil society is diverse, and will ideally accommodate views of both formal and informal partners. It is important that attention is also given to building inter-generational equity and resilience, by ensuring that the youth are engaged in the national development process from the start.

ALTERING LIFESTYLE CHOICES

The growing demographic trend towards urbanization, concentration of human populations in coastal zones and rural to urban migration are often driven by people's desire to improve their standard of living. Changes in people's living conditions and increasing affluence have given rise to changes in lifestyle that have contributed to environmental degradation, resource depletion and an increase in the volume and rate of waste production. Improvements in standards of living have provided individuals with discretionary time and income.

Within contemporary society, the natural feedback mechanisms that limit resource wastage have broken down or ceased to be applicable as environmental impacts have become externalized. Improved infrastructure and increased income have reduced or eliminated many of the traditional disincentives to resource wastage. As a result, resource wastage and environmental degradation have become mere development trade-offs.

Individuals may be aware of the relationship between their actions (pressure) and the condition of the environment (state). However, the effect of the changing environmental state on human well-being and economic prospects (impact) are seldom understood or fully appreciated. Unless these relationships are acknowledged, the true costs of lifestyle choices cannot be determined and appropriate responses cannot be formulated.

The adoption of economic and regulatory instruments represents an attempt to reconstruct the once-lost feedback mechanisms. For instance, a tax on the purchase of a specific type of good with higher environmental cost, such as water in plastic bottles, encourages consumers to internalize the impacts of their behaviour and provides an opportunity to choose not to incur that cost.

Reversing the trend of increasing environmental degradation requires a change in lifestyles that reflects the reality of Caribbean SIDS and LLCS, rather than that of industrialized nations. The Caribbean SIDS and LLCS will have to articulate national sustainable development visions based on welfare and the improvement of the human condition rather than on consumption. The populations of these countries need to understand that the sustainable lifestyle practices of individual members of society are the building blocks of sustainable national economic development.

REDUCING ENVIRONMENTAL VULNERABILITY

Box 24 Capacity building in coastal ecosystem assessment in Barbados

When the Government of Barbados was faced with potential environmental consequences associated with the discharge of hyper-saline water from a reverse osmosis desalination technology plant, it utilized existing data and additional data generated by an ocean discharge design that would function effectively under a range of meteorological and oceanographic scenarios. The ability of the government to independently characterize, assess and mitigate the risks associated with the desalination plant discharge was mainly due to its commitment to data collection and capacity building related to coastal ecosystem assessment over the past 20 years. In collaboration with the University of the West Indies the government has systematically developed institutional capacity of its Coastal Zone Unit to conduct oceanographic surveys and analyse and assess the resulting data.

The ability of the Caribbean to reverse the trends of increasing environmental vulnerability is one of the key factors that determine whether or not development in these countries will be sustainable. Reducing environmental vulnerability will require the governments' unequivocal material commitment to the strategic management of this issue. Maintaining or improving the resilience of ecosystems can be achieved through the determination of ecosystem carrying capacity and sustainable yields; reduction of pollution loading; maintenance of biodiversity; and strengthening technical and institutional capacity to manage dynamic environmental systems. Governments could consider the following immediate actions:

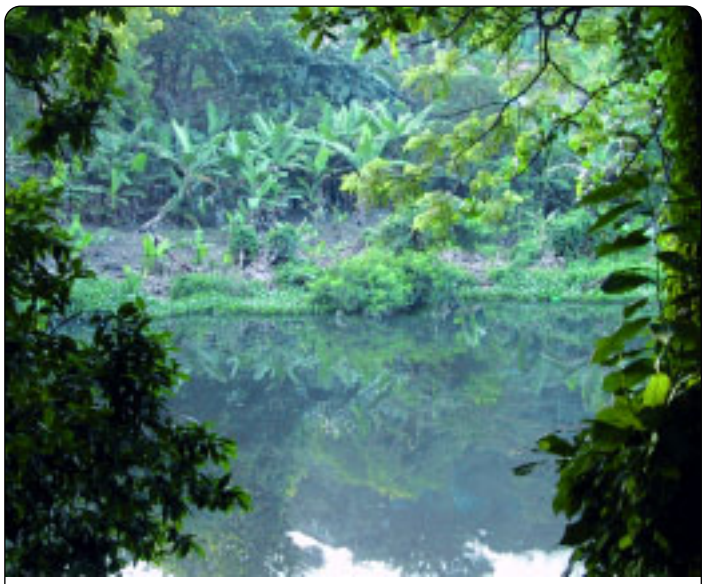
- Invest in environmental monitoring, reporting and review mechanisms that are incorporated into the national and regional policy, planning and implementation processes. A good monitoring, reporting and review mechanism will assist the governments in defining:
  - The characteristics and intrinsic dynamics of natural resources and systems;
  - The extent of environmental problems, and their spatial and temporal parameters;
  - Likely future trends in the status of natural resources systems; and
  - The nature and timing of the interventions required to improve the robustness and resilience of natural resource systems;
- Review, rationalize, revise and enforce existing environmental and planning legislation, especially to reduce pollution loading;
- Strengthen technical and institutional capacity to manage dynamic environmental systems by:
  - Training of specialists in relevant disciplines;
  - Development of functional institutional interlinkages, and strengthening, expansion or replication of the multisectoral mechanisms that have been developed such as the Sustainable Development Councils;
  - Employing appropriate MEAs to catalyse or overhaul their internal management systems, through access to critical financial and technical resources (Nurse 2003).

PROTECTING BIODIVERSITY

As mentioned in the previous section, maintenance of biodiversity is essential in reducing environmental vulnerability. The high rate of loss of biodiversity in the Caribbean is attributed primarily to human behaviour, specifically unsustainable practices in natural resource exploitation and development pressures, and alien invasive species. It is vital that the limited implementation of national biodiversity strategies and action plans in a number of Caribbean countries is addressed. Resources need to be allocated to support more strategies that utilize bioregional planning approaches instead of the current inflexible and narrow approaches to land use planning and development. Innovative bioregional planning approaches such as the Environmental Policy Framework developed by Jamaica and the Island System Management approach developed by the OECS could be translated from theoretical constructs to integrated development plans. At the national level, the clearinghouse mechanisms should be strengthened and linked to regional and international decision-making processes, especially those associated with MEAs. Strengthening regional initiatives, such as the Invasive Species Information Network Pilot Project, being conducted in 13 countries by the Inter-American Biodiversity Information Network, is important to enable them to be utilized in national environmental decision-making processes.

One of the most important mechanisms for conservation of biodiversity is the establishment and management of protected areas. In the Caribbean, protected areas are being increasingly used to support a number of creative development strategies, such as democratization of natural resource management through the devolution of management authority to local and community organizations, rural development and poverty alleviation through focus on provision of benefits to adjacent communities, and focus on community development through capacity building and support to civil society.

Based on the existing situation, the future directions for protected areas in the Caribbean will involve more focus on system planning, greater emphasis on management effectiveness, measurement of benefits to local communities and integration of protected areas management with other sectors.



Almendares River, Cuba
Source: B. Potter

At the regional level, there is an increasing focus on the need to develop a network of protected areas and strengthen the networks of protected areas managers. Both areas of need are supported by a number of regional organizations, primarily the Caribbean Conservation Association, the Gulf and Caribbean Fisheries Institute and the Regional Coordinating Unit of the Caribbean Environment Programme.

NATURAL DISASTER RISK REDUCTION AND PREPAREDNESS

Although the level of the region's preparedness and capacity to cope with natural disasters has increased significantly over the past 30 years, the risk associated with natural disasters has not decreased (Charvériat 2000).

Reducing vulnerability to natural disasters can be achieved through:

- Development and implementation of an integrated approach to vulnerability reduction in key sectors, particularly agriculture, tourism and fisheries;
- Sustainable development planning, including physical planning at the local and national levels, and utilizing tools such as geographic information systems (GIS);
- Increased use of financial instruments and incentives for risk reduction;
- Developing or reviewing legislation, planning, and building and development standards and codes, and improving enforcement; and
- Improving public education and awareness.

It is crucial that the Caribbean continues to strengthen regional networks for disaster preparedness, including emergency relief funds, GIS hazard mapping, up-to-date weather information, and early warning and emergency response systems. Regional support mechanisms for local preparedness should be strengthened, such as the Pan American Disaster Response Unit (PADRU), which trains national intervention teams to deal with natural disasters and to improve donor coordination in order to improve effectiveness and minimize duplication in case of disasters (International Federation of Red Cross and Red Crescent Societies 2002). Promoting inter-regional information exchange initiatives such as the CDERA would also be extremely valuable. Efforts should be made to develop the appropriate indicators to help measure and assess SIDS' vulnerability to hazards.

Hurricane damage in Grenada

FOOD, WATER AND ENERGY SECURITY

The ability of the Caribbean SIDS and LLCS to secure fuel for development — that is, food, water and energy — is an important requirement for sustainable development. Sustainable investment choice in any of these sectors would increase sustainability of the other two sectors (for example, electricity co-generation from sugar production, biogas production), as they are intertwined and almost impossible to separate. National agricultural policies need to address local projected food demand and encourage self-reliance in food areas critical to internal vulnerability, while reducing the sector's environmental impacts. Adopting a regional view of food security would assist in maximizing the advantages of Belize, Guyana and Suriname in agricultural production. A regional approach to food security would also help to address some of the uncertainties of the probable impacts of global climate change on agricultural production. Notwithstanding the continued declining trend in agricultural output, especially in the Caribbean SIDS, this sector still remains the backbone of national economies and continues to offer the best potential to make sustained contributions to the livelihood and well-being of the people in the region by contributing to food security, poverty alleviation, employment, foreign trade, foreign exchange earnings and the development of rural and coastal communities (Creary in press). In order for this vision to be realized, the region's resources must be administered in such a way as to provide optimal benefits in both the short and the long term. Strategies are needed to assist rural farmers, women in agriculture and extension officers through targeted training aimed at increased farm productivity and sustainability.

Inadequate water supply is a constraint for the development of agriculture and industry, and has serious implications for hygiene and human health. The Caribbean should consider:

- Urgently formulating and implementing national policies and frameworks for integrated water resources management where they do not exist;
- Identifying and conserving strategically important watersheds as part of an integrated water resources management strategy;
- Developing national inventories of water resources;
- Implementing demand assessment studies to identify competing uses of water and water use patterns;
- Developing strategies for water conservation, efficient use and recycling by making maximum use of economic instruments in conjunction with public education and awareness programmes; and
- Developing regional and national climate change models to provide precipitation projections for water availability/provision models and information for vulnerability assessment studies.

Harnessing the abundant indigenous renewable energy resources would reduce foreign exchange expenditure on energy production over the long term. In addition, the utilization of renewable energy resources may provide more local employment than is currently provided by fossil fuel-based systems. Reducing the importation of energy resources and hence foreign exchange outflows would reduce the region's vulnerability to the vagaries of the global economy. Furthermore, the potential to reduce environmental impacts would help to maintain or improve ecosystem condition and its capacity to continue to provide the goods and services needed for economic development. This would also increase ecosystem resistance to the likely impacts of climate change, within certain limits, and to continue to provide those services such as storm protection that would reduce the vulnerability of human settlements and infrastructure to global climate change.

MANAGING HUMAN RESOURCES FOR THE ENVIRONMENT

As reviewed in the section on *institutional and individual capacity for environmental management* in Chapter 3, inadequate human capital is a major constraint in the environmental sector. The need for capacity building, institutional strengthening, public education and outreach, and civil society participation has been identified in the implementation of practically every area of the BPOA. The lack of capacity at the national level with respect to the commitments arising from MEAs has also been recognized.

Skilled individuals will continue to be attracted by better professional opportunities that are offered in metropolitan areas and outside the region. Instead of viewing the situation as a crisis the region must consider the opportunities and benefits that the situation presents. This will involve the implementation of sound long-range human resources planning to:

- Strengthen the institutional capacity of the environmental institutions, making them more attractive employment options for skilled individuals;
- Increase and improve the quality of environmental education offered in the region, linking programmes more closely to the environmental skills that are and will be needed in the region; and
- Enhance opportunities for professional development and career progression.

In addition, the Caribbean SIDS and LLCS could consider greater participation in existing initiatives that address the small pools of expertise and capacity by encouraging pooling and sharing human resources capacity.

CONCLUSION

Agenda 21, the major outcome of the UNCED, called on countries to adopt national sustainable development strategies designed to build upon and harmonize the various sectoral economic, social and environmental policies and strategies operating within each country. The Caribbean SIDS and LLCS have begun to take action towards achieving sustainable development in the face of numerous social, economic and environmental challenges which require them to revisit the fundamental assumptions that underlie the economies and lifestyles of the region developed over the past 50 years.

The people of these countries rely on national governments, regional and sub-regional institutions, and the international community to implement the measures necessary to bring about the changes required for sustainable development. This will require strong commitment, informed decisions and action that is both innovative and visionary, at all levels of society, in the face of the changing development paradigm. Not only must the governments understand the integrated nature of environmental, social and economic challenges they face; they must also address these challenges within a framework of radically changing future scenarios of climate, natural productivity, human population and health, economic globalization and security. In this context, governments are being asked to chart courses that maximize social and economic benefits, maintain or improve environmental quality and ecosystem resilience, and

minimize social, economic and environmental vulnerability in the face of serious uncertainties about the future.

The global climate will change more over the next century than it has in previous millennia. An examination of the likely impacts of climate change on agriculture and tourism in the Caribbean illustrates some of the issues that governments may have to face. The assumptions on which projections of agricultural productivity and availability of water resources are based will probably not remain valid. Pests and diseases, rainfall variability and climatic conditions may combine to make particular crops no longer economically viable. Although several countries in the region are attempting to diversify their respective economies by moving away from a dependence on traditional agri-export crops, agriculture remains an important economic sector.

Tourism has a significant role in many national economies, but will milder winters and hotter tropical conditions reduce tourist arrivals in the region? Will disruption of food chains and life cycles due to changing seasonal patterns reduce the productivity and viability of tropical ecosystems? What are the implications for tourism of the products that are being considered as alternatives to the sun-sea-and-sand packages? Will the geographic range of vector-borne diseases expand with increasing global temperatures? What will be the implications for the tourism industry of changes in the availability of potable water and increases in the prevalence of vector-borne diseases?

Any attempt to predict the future of two major sectors in the Caribbean leads to more questions than answers. In view of the complexity of the challenges that governments face and the required changes to lifestyles and development paths, decision making should involve all partners and stakeholders in an institutionalized, legal and financially enabled manner. In a climate of uncertainty, where information on plausible futures is limited, risks are complex and the resources required to prepare for these futures are scarce, the prudent approach to planning and development is to incorporate the precautionary approach of environmental resource management. It would also incorporate the strategic reduction of environmental vulnerability. This measure should address the need to maintain the flow of environmental goods and services to the social and economic sectors, and to maintain the resilience and viability of the natural systems. These approaches would ensure that the environmental pillar of sustainable development is not compromised in developing the social and economic pillars, and that options for sustainable development are not foreclosed.

In a developmental climate in which plausible futures are defined not by past trends but by anticipated events, new approaches to planning, decision making and governance must be considered. National and regional planning processes should incorporate more fully the formulation and comparison of development scenarios and the assessment of associated risks based on information from a wide range of disciplines. Employing environmental information and accounting in these scenarios will provide a better understanding and facilitate the evaluation of the environmental risks and trade-offs that will be implicit in any given portfolio of development scenarios.

The developing trend of formulating multisectoral committees for planning and policy development should be formally expanded, institutionalized and rationalized, to maximize collaboration, coordination and information exchange, to reduce resource wastage and effort duplication, and to mitigate unnecessary or unintentional damage to environmental resources and systems. These forums can be mandated to periodically review and revise plans, policies and decisions in the light of new information, changing assumptions and revised risk assessments.

At the national and regional levels, it is desirable that decisions are based on the best available information, and actions and mandates that affect the management of environmental resources are driven by national and regional sustainable development priorities, and not by extra-regional funding streams and agendas. Apolitical mechanisms for rationalizing and coordinating the mandates and activities of implementing institutions must be strengthened.

Sound environmental management will not be effectively undertaken unless there are clear economic

and social benefits to justify the investment of human, institutional, financial and material resources. In the Caribbean SIDS and LLCS, environmental issues are currently handled in an apolitical wilderness. The average Caribbean citizen does not appreciate the implications of environmental degradation and increasing environmental vulnerability on their quality of life and livelihoods. Thus, development issues that affect the environment are not part of local and national election agendas and, in the absence of local and national constituencies with environmental interests, effective environmental management remains far from the mainstream of the development agenda. Public behaviour will not change unless people are made aware of the links between their individual and collective behaviours and lifestyle choices and environmental degradation and future development opportunities.

The likely repercussions for poor planning or no action will be severe. The region must articulate a clear, long-term course and vision for sustainable development at the national and regional scales, in a world where the fundamental global assumptions that underpin development planning are constantly changing; where the resources required to influence the direction of global change are insufficient; and those responsible for implementing change are unwilling to do so or face several constraints. The Caribbean and its people must look beyond the immediate situation and take actions that will lead to a sustainable future.

Urban transport in Havana, Cuba
Source: B. Potter

REFERENCES

AGRRA (2000). *Status of Coral Reefs in the Western Atlantic: Results of Initial Surveys*. Atlantic and Gulf Rapid Reef Assessment Program, Miami, USA

AIMS (2002). *Status of Coral Reefs of the World: 2002* (ed. C. Wilkinson). Australian Institute of Marine Sciences, Townsville, Queensland

Alcolado, P. M., Martinez-Daransas, B., Menendez-Macia, G., del Valle, R., Hernandez, M., and Garcia, T. (2003). Rapid assessment of coral communities of Maria La Gorda, Southeast Ensenada de Corrientes Cuba (Part 1: Stony corals and algae). In *Status of Coral Reefs in the Western Atlantic. Results of Initial Surveys, Atlantic and Gulf Rapid Reef Assessment (AGRRA) Programme* (ed. J. C. Lang) Atoll Research Bulletin no. 496, pp. 268–77. National Museum of Natural History, Smithsonian Institute, Washington, DC

ANDAH (1999). *Dégradation de l'environnement haïtien*. Association Nationale des Agro-professionnels haïtiens, Port-au-Prince, Haiti

Anderson, W. (2000). *Multi-lateral Environmental Agreements (MEA) Implementation in the Caribbean: Report and Guidelines*. Prepared for UNEP-ROLAC, Mexico

Beard, J. S. (1944). Climax vegetation in tropical America. *Ecology* 25, 127–58

Beard, J. S. (1945). Some ecological work in the Caribbean. *Empire For. J.* 24, 40–46

Binger, A. and others (2002). Vulnerability and Small Island Developing States. Prepared for the *Alliance of Small Island States Meeting of Experts on Capacity Development for Sustainable Development Through Training, Education, and Public Awareness, Suva, Fiji, 3–8 December 2003*, pp. 49–81

Bisek, P., Jones, E. and Ornstein, C. (2001). *A Strategy and Results Framework for Comprehensive Disaster Management in the Caribbean*. Caribbean Disaster Emergency Response Agency, St Michael, Barbados

Briguglio, L. (2003). The Vulnerability Index and Small Island Developing States: A Review of Conceptual and Methodological Issues. Prepared for the *Regional Meeting of the Caribbean SIDS, Port of Spain, Trinidad and Tobago, October 2003*.

Brklacich, M. (2003). Climatic Change Impacts on Agriculture and Food Security in the Caribbean: A Food Importation Perspective. Prepared for the *Adaptation to Climate Change in the Caribbean (ACCC) Project: Component: Climatic Change Impacts on Agriculture And Food Security in the Caribbean*

Caribbean Media Consultants (2002). *Assessment of Regional Environmental Information Networks (REIN) and Development of a REIN Implementation Plan*. Final Report. Caribbean Regional Environmental Programme, Caribbean Conservation Association, St Michael, Barbados

Caribbean Tourism Organization (2003). Total tourist arrivals to the Caribbean 1991–2001, http://www.onecaribbean.org

CARICOM (1989). *Proceedings of the First CARICOM Ministerial Conference on the Environment. 31 May to 2 June 1989, Port of Spain, Trinidad and Tobago*

CARICOM (2003). *Caribbean Economic Performance Report 2003*. CARICOM Secretariat, Georgetown, Guyana

CARICOM (2004). The Caribbean Community. http://www.caricom.org

CEHI (2003). Case Study: Evolution and Implementation of a Solid Waste Strategy, St Lucia. Presented at the UNDP Capacity 2015 sponsored Waste Management Experts Meeting, 27 October–1 November, 2003, Havana, Cuba

CEHI and UNEP (2003). *A Directory of Environmentally Sound Technologies for the Integrated Management of Solid, Liquid, and Hazardous Waste for Small Island Developing States (SIDS) in the Caribbean Region, December 2003*. The Caribbean Environmental Health Institute, St Lucia

CELADE (2004). *Demographic Bulletin: Latin America and Caribbean: Populations Estimates and Projections*. CELADE, Santiago, Chile

Cesar, H., Burke, L. and Pet-Soede, L. (2003). *The Economics of Worldwide Coral Reef Degradation*. Cesar Environmental Economics Consulting, Amsterdam, the Netherlands

CFCS (2003). Invasive species policy recommendations. *Proceedings of the Caribbean Food Crops Society* 39(1), 128–30

Charvériat, C. (2000). *Natural Disasters in Latin America and the Caribbean: An Overview of Risk*. IADB Research Department Working Papers Series, no. 434, p. 104. IADB, Washington, DC

Cicin-Sain, B. and Knecht, R. W. (1998). *Integrated Coastal and Ocean Management: Concepts and Practices.* University of Delaware, Center for the Study of Marine Policy, and Island Press, Washington, DC

CITMA (Ministeria de Ciencia, Tecnologia y Media Ambiente, Cuba) (2002). II Informe Nacional Comité de Revision Implementación de la Convención de las Naciones Unidas de Lucha contra la Desertificación y la Sequia, http://www.medioambiente.cu/deselac/downloads/segundo%20informe%20PAN.pdf, April 2002

CNAP (2002). *Sistema Nacional de Áreas Protegidas. Cuba. Plan 2003–2008*. CNAP, Habana, Cuba

Commonwealth Secretariat (2000). *Small States: Meeting Challenges in the Global Economy*. Report of the Commonwealth Secretariat/World Bank Joint Task Force on Small States, London

Creary, M. (in press). Agriculture and fisheries in the Caribbean. In *Report on Climate Change in the Caribbean: Agriculture and Food Security*. Chapter 3. Adapting to Climate Change in the Caribbean Project. CARICOM

CRFM (2000). Proposal for the Establishment of the Caribbean Regional Fisheries Mechanism (CRFM). A Report for the Working Group of the Caribbean Regional Fisheries Mechanism, CARICOM Fisheries Unit, Belize City

CSD (1998). Human Resource Development in Small Island Developing States, Progress in the Implementation of the Programme of Action for the Sustainable Development of Small Island Developing States, Commission on Sustainable Development, Sixth session, 20 April–1 May 1998.

Deschamps, A., Desrochers, A. and Klomp K. D. (2003). A rapid assessment of the Horseshoe Reef, Tobago Cays Marine Park, St Vincent, West Indies (Stony corals, algae and fish). In *Status of Coral Reefs in the Western Atlantic. Results of Initial Surveys, Atlantic and Gulf Rapid Reef Assessment (AGRRA) Programme* (ed. J. C. Lang) pp. 438–59, Atoll Research Bulletin no. 496. National Museum of Natural History, Smithsonian Institute, Washington, DC

ECLAC (1998). *National Implementation of the SIDS POA: A Caribbean Perspective*. United Nations Economic Commission for Latin America and the Caribbean (LC/CAR/G.520), Santiago, Chile

ECLAC (2000). Sustainable development Latin American and Caribbean perspectives. Based on the *Regional Consultative Meeting on Sustainable Development 19–21 January 2000, Santiago, Chile*

ECLAC (2001). *Science and Technology, Sustainability and Sustainable Development*. Prepared by Gilberto Gallopin for the Environment and Human Settlement Division of ECLAC (LC/R.2081), p. 30. Santiago, Chile

ECLAC (2002). *Preliminary Overview of Caribbean Economies*, p. 24. United Nations Economic Commission for Latin America and the Caribbean (LC/CAR/G.714), Santiago, Chile

ECLAC (2003). *Statistical Year Book 2002 for Latin America and the Caribbean*. United Nations Economic Commission for Latin America and the Caribbean, Santiago, Chile

ECLAC (2004). Economic Survey of Latin America and the Caribbean, 2003–2004. LC/G.2255-P/I, Santiago, Chile

Ecotech Inc. Limited (2000). *Framework for a National Parks Commission*, Final Report. Caribbean Tourism Organization, St Michael, Barbados

EM-DAT (2004). The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium, http://www.em-dat.net/disasters/list.php, 6 June 2004

Energy Information Administration (2004). World Oil Market and Oil Price Chronologies: 1970–2003, March 2004, http://www.eia.doe.gov/emeu/cabs/chron.html

FAO (2000). Climate, soil and terrain constraints to rain-fed crop production, FAO, Rome. In *GEO Latin America and the Caribbean: Environment Outlook 2003*. UNEP Regional Office for Latin America and the Caribbean, Mexico

FAO (2001). Land Resources Information Systems in the Caribbean: Proceedings of a Subregional Workshop. *World Soil Resources Reports* 95.

FAO (2002). *Commodity Market Review*. FAO of the United Nations, Rome

FAO (2003a). State of the World's Forests, p. 151, www.fao.org/docrep/005/y7581e/y7581e00.htm, September 2003

FAO (2003b). Water Reports #23. Review of the World's Water Resources by Country. Food and Agriculture Organization, Rome, Italy.

FAO (2004a). FAOSTAT Land Use Database, http://faostat.fao.org/faostat/agricult/landuse-e.htm, consulted in May 2004

FAO (2004b). FAOSTAT Forestry Data, http://faostat.fao.org/faostat/, consulted in May 2004

FAO (2004c). Database and Statistics. Fishstat Plus, FAOFisheries, http://www.fao.org/fi/statist/FIOFT/FISHPLUS.ASP, consulted in May 2004

Freiwald, A., Fosså, J. H., Grehan, A., Koslow, T. and Roberts, J. M. (2004). *Cold-water Coral Reefs*. UNEP-WCMC, Cambridge, UK

Garrison, V. H., Shin, E. A., Foreman, W. T., Griffin, D. W., Holmes, C. W., Kellogg, C. A., Majewski, M. S., Richardson, L. L., Ritchie, K. B. and Smith, G. W. (2003). African and Asian dust: from desert soils to coral reefs. *BioScience* 53(5), 469–80

Geoghegan, T., Krishnarayan, V., Pantin, D. and Bass, S. (2003). *Incentives for watershed management in the Caribbean: Diagnostic studies in Grenada, Jamaica, St Lucia, and Trinidad and Tobago*. The Caribbean Natural Resources Institute, Lavantille, Trinidad, and the International Institute for Environment and Development, London

Ginsberg, R. N. and Lang, J. C. (2003). Foreword. In *Status of Coral Reefs in the Western Atlantic. Results of Initial Surveys, Atlantic and Gulf Rapid Reef Assessment (AGRRA) Programme* (ed. J. C. Lang) pp. xv–xiv, Atoll Research Bulletin no. 496. National Museum of Natural History, Smithsonian Institute, Washington, DC

Goreau, T. J. (1992). Bleaching and reef community change in Jamaica: 1951–1991. *American Zoology* 32, 683–95

Government of Antigua and Barbuda (2004). Antigua and Barbuda's National Assessment Report for the Ten-year Review of the Barbados Programme of Action. The Environment Division of The Ministry of Agriculture, Land, Marine Resources, Environment and Food Production

Government of Barbados (2000). *State of the Environment Report 2000*. GEO Barbados

Government of Belize (1998). The Belize Biodiversity Strategy. In (eds. N. D. Jacobs and A. Casteneda) p. 137. National Biodiversity Committee, Ministry of Natural Resources and the Environment, Belmopan, Belize, Central America

Government of Belize (2004). National Assessment Report for Barbados +10, The Government of Belize. September.

Government of the Commonwealth of The Bahamas (2001). *First National Communication on Climate Change Report 2001*. Government of the Commonwealth of The Bahamas, Bridgetown

Government of the Commonwealth of Dominica (2000). *Biodiversity Strategy and Action Plan: 2001–2005*, p. 72. Ministry of Agriculture and the Environment, Roseau

Government of Grenada (2001). *First National Communication Report 2001*. Government of Grenada, St George's

Government of Jamaica (2000). National Statement of Vulnerability and Adaptation to Climate Change and Sea Level Rise: Agricultural Sector. UNDP Project JAM/G#1/A/1G/99, p. 67

Government of Jamaica (2001) *First National Communication Report 2001*. Government of Jamaica, Kingston

Government of Jamaica (2004). Ministry of Commerce, Science and Technology website, www.mct.gov.jm

Government of Suriname (1997). Republic of Suriname: Country Profile. Implementation of Agenda 21. Review of progress made since the United Nations Conference on Environment and Development, 1992. Information provided by the Government of Suriname to the *United Nations Commission on Sustainable Development Fifth Session 7–25 April 1997, New York*

Granger, O. E. (1997). Caribbean island states: perils and prospects in a changing global environment. *Journal of Coastal Research* 24, 71–94. In IPCC (2001). *Climate Change 2001: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, UK

Gray, C. R. (1993). Regional meteorology and hurricanes. In *Climatic Change in the Intra-Americas Sea* (ed. G.A. Maul) pp. 87–99. Edward Arnold, London

Haley, M. (2004). personal communication

Hoegh-Guldberg, O. (1999). *Climate Change, Coral Bleaching and the Future of the World's Coral Reefs*. Greenpeace International, Sydney, New South Wales

Hoggarth, D. (2000). Regional Overview of Fish Catch and Effort in CARICOM and CARIFORUM Countries. Draft Report to the CARICOM Fisheries Unit. Presented at the *Fisheries Management Data System Terminal Workshop, St Lucia, 27 November 2000*

IMO (2004). Conventions, International Maritime Organization, http://www.imo.org/home.asp?topic_id=161

Impact Consultancy Services (1998). *A Review and Forward Evaluation of the Capacity 21 Pilot Programme in the Caribbean*. United Nations Development Programme, New York

Ince, D. (2000). *Development of Solar Water Heating and other Renewable Energy Technologies in Barbados*. Government of Barbados, Energy and Natural Resources Division, Bridgetown

International Federation of Red Cross and Red Crescent Societies (2002). *The World Disasters Report 2002*. International Federation of Red Cross and Red Crescent Societies, Geneva, Switzerland

Interpress Service (2004). Cuba a la Mano: Bosques acelerados, http://www.ipsenespanol.net/cubaalamano/sitio/muestra_especial.asp?art=5411, 9 November 2004

IPCC (1998). *The Regional Impacts of Climate Change: An Assessment of Vulnerability. A Special Report of IPCC Working Group II* (eds. R. T. Watson, M. C. Zinyowera and R. H. Moss). Cambridge University Press, Cambridge, UK

IPCC (2001a). *Climate Change 2001: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK

IPCC (2001b). *Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change* (eds. J. T. Houghton, Y. Ding, D. J. Griggs, M. Noguer, P. J. van der Linden, X. Dai, K. Maskell and C. A. Johnson). Cambridge University Press, Cambridge, UK

Island Resources Foundation (1998). *Biodiversity Assessment of the Eastern Caribbean*. St John's, Antigua

IUCN (2003). Red List of Threatened Species, World Conservation Union, www.redlist.org

IUCN (2004). WCPA Caribbean, http://www.iucn.org/themes/wcpa/region/caribbean/caribbean.html

James, C. (2003). Case Study: Civil Society Responses to Land Management Dilemmas in a Caribbean Small Island State, Fondes Amandes Community Reforestation Project, Trinidad. *Alliance of Small Island States (AOSIS) Experts' Meeting on Vulnerability and Resilience in Small Island Developing States, Roseau, Dominica, 29 September–03 October 2003*

Jones, I. C., Banner, J. L. and Mwansa, B. J. (1998). Geochemical constraints on recharge and groundwater evolution: the Pleistocene Aquifer of Barbados. In *Proceedings of the Third Annual Symposium, American Water Resources Association, and Fifth Caribbean Islands Water Resources Congress, San Juan, Puerto Rico, 12–16 July 1998*

Kairo, M. T. K. and others (2003a). Dangerous invasive species threatening or with a foothold in the Caribbean. *Proceedings of the Caribbean Food Crop Society* 39(1), 12–22

Kairo, M. T. K., Ali, B., Cheesman, O., Haysom, K. and Murphy, S. (2003b). Invasive Species Threats in the Caribbean Region. Report to the Nature Conservancy, Arlington, Virginia

Kaly, U. L., Pratt, C. R., Mitchell, J. and Howorth, R. (2003) The demonstration Environmental Vulnerability Index (EVI). SOPAC Technical Report 356. South Pacific Applied Geoscience Commission (SOPAC), Suva, Fiji

Kramer, P. (2003). Synthesis of coral reef health indicators for the Western Atlantic: Results of the AGRRA Programme (1997–2000). In *Status of Coral Reefs in the Western Atlantic: Results of Initial Surveys, Atlantic and Gulf Rapid Reef Assessment (AGRRA) Programme* (ed. J. C. Lang) pp. 1–57, Atoll Research Bulletin 496. National Museum of Natural History, Smithsonian Institute, Washington, DC

Kramer, P., Kramer, P. R. and Ginsberg, R. N. (2003). Assessment of the Andros Island Reef System, Bahamas (Part 1: stony corals and algae). In *Status of Coral Reefs in the Western Atlantic: Results of Initial Surveys, Atlantic and Gulf Rapid Reef Assessment (AGRRA) Programme* (ed. J. C. Lang) pp. 76–99, Atoll Research Bulletin 496. National Museum of Natural History, Smithsonian Institute, Washington, DC

Lang, J. C. (2003). Caveats for the AGRRA 'Initial Results' Volume. In *Status of Coral Reefs in the Western Atlantic. Results of Initial Surveys, Atlantic and Gulf Rapid Reef Assessment (AGRRA) Programme* (ed. J. C. Lang) pp. xv–xx, Atoll Research Bulletin no. 496. National Museum of Natural History, Smithsonian Institute, Washington, DC

Leatherman, S. P. (1997). Beach ratings: a methodological approach. *Journal of Coastal Research* 13, 1 050–63

London Convention (1972). Conventions: Profiles of Selected International Conventions, Guidelines and Regional Agreements, http://www.londonconvention.org/main.htm

Madramootoo, C. A. (2000). An integrated approach to land and water resources management in the Caribbean. *Keynote Address at the First Technical Meeting Caribbean Land and Water Resources Network (CLAWRENET). Bridgetown, Barbados, 1 October 2000*, http://www.fao.org/landandwater/swlwpnr/reports/y_cm/cm.htm

Martin, H. and Bruce, J.P. (1999). *Effects of Climate Change: Hydrometeorological and Land-based Effects in The Bahamas*. Global Change Strategies International, Inc., Ottawa, Canada

Mittermeier, R. A., Meyers, N. and Mittermeier, C. G. (1999). *Hotspots: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions*. CEMEX, Mexico

MPDE (2001). *Barbados State of the Environment Report 2000*. Ministry of Physical Development and Environment, Barbados

Mueller, J. (2000). Singapore reaches for the sea. *Asian Water* 16(9), October 2000.

Nemeth, R., Quandt, A., Requa, L., Paige Rothenberger, J. and Taylor, M. (2003). A rapid assessment of coral reefs in the Virgin Islands (Part 1: Stony corals and algae). In *Status of Coral Reefs in the Western Atlantic. Results of Initial Surveys, Atlantic and Gulf Rapid Reef Assessment (AGRRA) Programme* (ed. J. C. Lang) pp. 544–65, Atoll Research Bulletin no. 496. National Museum of Natural History, Smithsonian Institute, Washington, DC

Nicholls, S., Christopher-Nicholls, J. and Colthrust, P. (1999). *Evaluating the Fiscal Impact of a Potential Regional Economic Partnership Agreement (REPA) between the European Union and the Small Island Economies of CARICOM*. University of the West Indies Department of Economics, Mona, Jamaica

NIMOS (2004). Introduction. National Institute for Environment and Development in Suriname, http://www.cybermango.biz/nimos/en/introduction.html, 12 May 2004

Nurse, L. A. (2003). Exploring the Concept of Environmental Vulnerability: Critical Considerations. *Presentation to the Alliance of Small Island States Meeting of Experts on the vulnerability of Small Island Developing States: enhancing resilience, the role of the private sector, civil society and trade in the sustainable development of SIDS. Fort Young, Roseau, Dominica, 29 September–3 October 2003*

Nurse, L. A., McLean, R. F. and Suarez, A. G. (1998). Small island states. In *The Regional Impacts of Climate Change: An Assessment of Vulnerability. A Special Report of IPCC Working Group II* (eds. R. T. Watson, M. C. Zinyowera and R. H. Moss) pp. 331–54. Cambridge University Press, Cambridge, UK

OECD (2004). *OECD Investment Policy Reviews. Caribbean Rim: Costa Rica, Dominican Republic, and Jamaica*. OECD, Paris

OECS (2000). *The St George's Declaration of Principles for Environmental Sustainability in the Organization of Eastern Caribbean States*

OECS (2004). Institutions in the OECS. The Organization of Eastern Caribbean States. http://www.oecs.org/inst.htm

OECS ESDU (2002). *OECS Environmental Management Strategy*. p. 30

OECS/UNDESA (2004). *Final Report, Regional Caribbean Workshop on National Sustainable Development Strategies and Indicators of Sustainable Development*. Castries, St Lucia

Parker, H. (2002). *Formulation of Economic and Regulatory Mechanism. Antigua and Barbuda Country Report*. Prepared for the Caribbean Planning for Adaptation to Global Climate Change Project

Peckol, P. M., Curran, H. A., Greenstein, B. J., Floyd, E. Y., Robbart, M. L. (2003a). Assessment of coral reefs off San Salvador Island, Bahamas (stony corals, algae, and fish populations). In *Status of Coral Reefs in the Western Atlantic. Results of Initial Surveys, Atlantic and Gulf Rapid Reef Assessment (AGRRA) Programme* (ed. J. C. Lang) pp. 124–45, Atoll Research Bulletin no. 496. National Museum of Natural History, Smithsonian Institute, Washington, DC

Peckol, P. M., Curran, H. A., Floyd, E. Y., Robbart, M. L., Greenstein, B. J. and Buckman, K. L. (2003b). Assessment of selected reef sites in north and south-central Belize, including recovery from bleaching and hurricane disturbance (stony corals, algae, and fish). In *Status of Coral Reefs in the Western Atlantic. Results of Initial Surveys, Atlantic and Gulf Rapid Reef Assessment (AGRRA) Programme* (ed. J. C. Lang) pp. 146–71, Atoll Research Bulletin no. 496. National Museum of Natural History, Smithsonian Institute, Washington, DC

Peters, A. (2002). *The Fiscal Effects of Tariff Reduction in the Caribbean Community*, p. 37. Prepared by the Economic Intelligence and Policy Unit of the CARICOM Secretariat for the IADB, Washington, DC

Petroleum Corporation of Jamaica (2004). Petrojam Ethanol Limited. http://www.pcj.com/petrojam

Polunin, N.V.C. and Williams, I.D. (1999). *Reef Condition and Recovery in the Caribbean*. Marine Systems Research Group Technical Report 6. A Subject Review for the Department for International Development (DFID) NRSP LWI Project R6783. Government of the United Kingdom

Programa de Desarrollo Energético Sostenible, MINAZ (el Ministerio del Azúcar), Cuba (2004). Personal communication; Petroleum Corporation of Jamaica

Ramcharan, E. (2001). *Land Use Planning. Coastal Zone/Island Systems Management*. CDCM Professional Development Programme, University of the West Indies, Cave Hill, Barbados

Reef Base (2004). ReefBase Home Page, http://www.reefbase.org/threats/thr_bleaching.asp

Renda, A. and Ponce, D. (2004). 'Fincas Forestales Integrales para la recuperación ambiental de las cuencas hidrograficas', Online version at York University website: http://www.yorku.ca/hdrnet/images/uploaded/Brochureesp.pdf

Seshagiri, G.V. (2001). Singapore's engineering marvel: the deep tunnel sewerage system. *Asian Water* 17(8), September 2001.

Shannon, M. J. (2003). Challenges in safeguarding the Greater Caribbean Basin against invasive pests, diseases, weeds, and other agents: a Florida perspective. *Proceedings of the Caribbean Food Crop Society* 39(1), 1–5

Shrivastava (1997). Impacts of climate change on water resources in the Commonwealth Caribbean. In *Proceedings of the Seminar on Integrated Waters Management, Institutional and Policy Reform. Trinidad and Tobago, 24–27 June 1997*

Singh, B. (1997). Climate changes in the greater and southern Caribbean. *International Journal of Climatology* 17(10), 1 093–114

Singh, S. (2003). Singapore make new water from waste water. *Asian Water* 19(9), November 2003.

Spalding, M. D., Ravilious, C. and Green, E. P. (2001). *World Atlas of Coral Reefs*, pp. 92–177. UNEP World Conservation Monitoring Centre. University of California Press, Berkeley, California

SPG Media Limited, a subsidiary of SPG Media Group PLC (2004). St.Michael BWRO Desalination Plant, Barbados. Water-technology.net. http://www.water-technology.net/projects/barbados

UN (1994). Report of Global Conference on the Sustainable Development of Small Island Developing States, Bridgetown, Barbados, 25 April–6 May 1994. United Nations, October.

UNCHS-UN HABITAT (2002). Global Urban Observatory Databases. *Global Report on Human Settlements*. Statistical Annexes to the Global Report on Human Settlements 2001 (April 2004)

UNDESA (2004). Report of the Caribbean Regional Preparatory Meeting to Review the Programme of Action for the Sustainable Development of Small Island Developing States in October 2003 in Trinidad and Tobago. Division for Sustainable Development, Department of Economic and Social Affairs, New York. http://www.un.org/esa/sustdev/sids/sids.htm

UNDP (2002). *Vulnerability and Small Island Developing States*. UNDP Capacity 21 Programme, United Nations Development Programme, New York

UNDP (2003a). *Human Development Report — Millennium Development Goals: A Compact Among Nations to End Human Poverty 2003*. United Nations Development Programme, Oxford University Press, New York

UNDP (2003b). *Environmental Country Profiles for Barbados and the OECS*. United Nations Development Programme, New York

UNDP (2004). *Human Development Report 2004*. United Nations Development Programme, Oxford University Press, New York

UNDP Cuba (2004). Apoyo a la reforestación mediante el desarrollo de fincas forestales, www.undp.org.cu/proyectos/fincas.html

UNEP (1999a). *Waste Management in Small Island Developing States*. United Nations Commission on Sustainable Development Seventh Session 1999. Report of the Secretary General. http://islands.unep.ch/d99-6a2.htm

UNEP (1999b). *Caribbean Environment Outlook*, UNEP, Nairobi

UNEP (2002). *Global Environment Outlook 2002*. Earthscan, London

UNEP (2003a). *GEO Latin America and the Caribbean: Environment Outlook 2003*. UNEP Regional Office for Latin America and the Caribbean, Mexico, DF, Mexico

UNEP (2003b). *Final Report of the Fourteenth Meeting of the Forum of Ministers of the Environment of Latin America and the Caribbean, Panama City, Panama, 20–25 November 2003*. UNEP/LAC-IG.XIV/4.

UNEP-CEP (United Nations Environment Programme; Caribbean Environment Programme) (2004). Convention and Protocols Status Page, UNEP and CEP, Kingston, Jamaica, http://www.cep.unep.org/law/cartstatus.php

UNEP/DEWA/GRID-Geneva (2004). GEO Data Portal, http://geodata.grid.unep.ch/, 20 May 2004

UNEP-WCMC (2003). GEO3 Protected Areas Snapshot, United Nations Environment Programme–World Conservation Monitoring Centre

UNEP-WCMC (2004). Marine Database, United Nations Environment Programme–World Conservation Monitoring Centre, May 2004

UNESCO (1994). *Marine Debris: Solid Waste Management Action Plan for the Wider Caribbean*. Inter-governmental Oceanographic Commission Technical Series No. 41.

Unisys (2004). *Unisys Weather: Hurricane: Hurricane/Tropical Data*.http://www.weather.unisys.com/hurricane

US Department of Energy (2004) International Energy Annual, http://www.eia.doe.gov/pub/international/iealf/tablee1c.xls, 25 June 2004

US National Renewable Energy Laboratory in Ocean Energy Conversion (2004). A Survey of Energy Resources, World Energy Council, http://www.worldenergy.org/wec-geis/publications/reports/ser/ocean/ocean.asp, April 2004

USGS (2004a). Caribbean Vegetation and Landcover Mapping Initiative, USGS International Program, US Geological Survey, http://edcintl.cr.usgs.gov/tnc/project/project.html

USGS (2004b). Caribbean Vegetation Mapping Project. USGS International Program, US Geological Survey, http://edcintl.cr.usgs.gov/tnc/products/atlas.html

UWI (2004). The Caribbean Coastal Marine Productivity Program (CARICOMP), The University of the West Indies. http://www.uwimona.edu.jm/cms/caricomp.htm

UWICED (2002). The Impact of Privatisation on Public Utility Performance in the Caribbean Region: A Case Study of Electric Utility Privatisation in Dominica, Grenada, Jamaica, St Lucia and Trinidad p. 59. UWICED, Mona, Jamaica

Walling, L. (1997). A Total Economic Assessment of the Conservation Benefits of the Montego Bay Marine Park, Montego Bay, Jamaica. MSc thesis, Marine Resources and Environmental Management Programme, University of the West Indies, Cave Hill Campus, Barbados

WCPA Caribbean (2003). *Insular Caribbean WCPA Report to the World Parks Congress, Durban 2003*.

Whiter, M. (2003). The vulnerability of SIDS: enhancing resilience — the role of the private sector, civil society and trade — in the sustainable development of SIDS. Background document to the meeting, *Building Resilience in SIDS on the Barbados/SIDS Programme of Action: Convened by UWICED/UNDP, Dominica, 29 September 2003–3 October 2003*

Wilkinson, C. (2002). Coral bleaching and mortality: the 1998 event four years later and bleaching to 2002. In *Status of Coral Reefs of the World 2002* (ed. C.R. Wilkinson) Chapter 1, pp. 34–44. GCRMN Report, Australian Institute of Marine Science, Townsville, Queensland

World Bank (2002). *Caribbean Economic Overview 2002: Macroeconomic Volatility, Household Vulnerability, and Institutional and Policy Responses*, Report No. 24165-LAC. Caribbean Group for Cooperation in Economic Development. Caribbean Country Management Unit, Poverty Reduction and Economic Management Unit, Latin America and the Caribbean Region, World Bank, Washington, DC

World Bank (2003). *World Bank Development Indicators 2003*. World Bank, Washington, DC

World Bank (2004). Data Query, http://www.worldbank.org/data/dataquery.html

WRI (2004a). Earth Trends Database, May 2004

WRI (2004b). Reefs at Risk in the Caribbean. World Resources Institute, Washington, DC

Write, R. (1997). Financing sustainable energy in developing countries such as Jamaica. Inter-American Programme for Environmental Technology Cooperation in Key Industry Sectors. *Round Table on Energy Efficiency: Tourism Sector. Kingston, Jamaica, 9–11 December 1997*

WTO (2002). *Yearbook of Tourism Statistics*. World Tourism Organization, Madrid, Spain

WWF, UNDP, UNEP, IUCN (2003). Insular Caribbean WCPA Report to the World Parks Congress, Durban 2003. CNAP, Environmental Defense, WWF, UNDP, UNEP, IUCN, http://www.cep.unep.org/programmes/spaw/MPA/mpa.htm

Yee Sang, F.M. (1996). An Assessment of the Tourism and Recreational Use and Value of the Proposed Barbados National Park. MSc thesis, Marine Resources and Environmental Management Programme. University of the West Indies, Cave Hill Campus, Barbados

ACRONYMS AND ABBREVIATIONS

ACCP	Assembly of Caribbean Community Parliamentarians
ACP	African, Caribbean and Pacific States
ACS	Association of Caribbean States
AGRRA	Atlantic and Gulf Rapid Reef Assessment Programme
AIDS	acquired immuno-deficiency syndrome
AMEP	Assessment and Management of Environmental Pollution
AOSIS	Alliance of Small Island States
BPOA	Barbados Programme of Action for Sustainable Development of Small Island Developing States
BWRO	brackish water reverse osmosis
BTU	British Thermal Unit
CaMPAM	Caribbean Marine Protected Areas Managers Network
CANARI	Caribbean Natural Resources Institute
CAR/RCU	Caribbean Regional Coordinating Unit
CARDI	Caribbean Agriculture Research and Development Institute
CARICAD	Caribbean Centre for Development Administration
CARICOM	Caribbean Community and Common Market
CARICOMP	Caribbean Coastal Marine Productivity Programme
CARIFORUM	Caribbean Forum of African, Caribbean and Pacific States
CAST	Caribbean Alliance for Sustainable Tourism
CBD	United Nations Convention on Biological Diversity
CCA	Caribbean Conservation Association
CCCCC	Caribbean Community Climate Change Centre
CCD	United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa
CCDC	Caribbean Coastal Data Centre
CDERA	Caribbean Disaster Emergency Response Agency
CDM	comprehensive disaster management
CEHI	Caribbean Environmental Health Institute
CEO	Caribbean Environment Outlook
CEP	country environmental profile
CEP	Caribbean Environment Programme
CEPNET	CEP's Information Systems for the Management of Marine and Coastal Resources
CFC	Caribbean Food Corporation
CFNI	Caribbean Food and Nutrition Institute
CFRAMP	CARICOM Fisheries Resource Assessment and Management Programme
CFTU	Caribbean Fisheries Technical Unit
CIDA	Canadian International Development Agency
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMI	Caribbean Meteorological Institute
CMO	Caribbean Meteorological Organization
CMS	Centre for Marine Sciences (University of the West Indies)
CO_2	carbon dioxide
COP	Conference of the Parties to the United Nations Framework Convention on Climate Change
COTED	Council for Trade and Economic Development
CPACC	Caribbean Planning for Adaptation to Climate Change
CREP	Caribbean Regional Environmental Programme
CREWS	Coral Reef Early Warning System
CRFM	Caribbean Regional Fisheries Mechanism
CT	co-generation technology
CTO	Caribbean Tourism Organization
CWP	Caribbean Water Partnership
DCA	Directorate of Civil Aviation
EC	European Commission
ECCB	Eastern Caribbean Central Bank
ECLAC	Economic Commission for Latin America and the Caribbean
ECTEL	Eastern Caribbean Telecommunication Authority
EEZ	Exclusive Economic Zone
ENSO	El Niño/Southern Oscillation
ESCU	Environmental Services Coordination Unit (St Vincent and the Grenadines)
ESDU	Environment and Sustainable Development Unit (OECS)
ETA	Education, Training and Awareness
EU	European Union
EVI	Environmental Vulnerability Index
FACRP	Fondes Amandes Community Reforestation Project (Trinidad)
FAO	Food and Agriculture Organization of the United Nations
FTAA	Free Trade Area of the Americas
GCRMN	Global Coral Reef Monitoring Network
GDP	gross domestic product
GEF	Global Environment Facility

GEO	Global Environment Outlook
GIS	geographic information system
GLIS	Grenada Land Information System
GNI	gross national income
GNP	gross national product
HDI	Human Development Index
HDPE	high-density polyethylene
HIV	human immunodeficiency virus
IAS	invasive alien species
ICRAN	International Coral Reef Action Network
ICRI	International Coral Reef Initiative
ICRM	integrated coastal resource management
ICT	information and communication technology
ICZM	integrated coastal zone management
IEV	Index of Economic Vulnerability
IMAC	Inter-Ministerial Advisory Commission (Suriname)
IMO	International Maritime Organization
IPCC	Inter-Governmental Panel on Climate Change
IRF	Island Resources Foundation
ISATC	Interim Scientific and Technical Advisory Committee of the LBS Protocol
IUCN	The World Conservation Union
IWCAM	Integrating Watershed and Coastal Area Management in Small Island Developing States of the Caribbean
IWRM	integrated water resources management
JaNEAP	Jamaica National Environmental Action Plan
JCDT	Jamaica Conservation Development Trust
JNPTF	Jamaica National Park Trust Fund
JPOI	Johannesburg Plan of Implementation
LAC	Latin America and the Caribbean
LBS	Protocol Concerning Pollution from Land-based Sources and Activities
LLCS	Low-Lying Coastal States
MACC	Mainstreaming of Adaptation to Climate Change
MARPOL	International Convention for the Prevention of Pollution from Ships
MEA	multilateral environmental agreement
MECP	Marine Environment Protection Committee
MPA	Marine and Coastal Protected Areas
MTBE	methyl tertiary-butyl ether
NCC	National Conservation Commission (St Kitts and Nevis)
NCM	National Coordinating Mechanism (Antigua and Barbuda)
NEAP	National Environmental Action Plan
NEMS	National Environmental Management Strategy (St Lucia)
NEP	National Environmental Policy (St Lucia)
NEPA	National Environmental and Planning Agency (Jamaica)
NGO	non-governmental organization
NIMOS	Nationaal Instituut voor Milieu en Ontwikkeling (Suriname)
NMR	Nationale Milieuraad (Suriname)
NOAA	National Oceanographic and Atmospheric Administration (USA)
NPDP	National Physical Development Plan (Grenada)
NRCA	Natural Resources Conservation Authority
ODA	overseas development assistance
OECD	Organization for Economic Cooperation and Development
OECS	Organization of Eastern Caribbean States
OTEC	ocean thermal energy conversion
PADRU	Pan American Disaster Response Unit
POP	persistent organic pollutant
Ramsar	Convention on Wetlands of International Importance Especially as Waterfowl Habitat
REPAHA	Caribbean Regional Centre for the Education and Training of Animal Health and Veterinary Public Health Assistants
RET	renewable energy technology
SDC	Sustainable Development Council
SDNP	Sustainable Development Networking Programme (UNDP)
SGD	St George's Declaration
SIDS	Small Island Developing State(s)
SOPAC	South Pacific Applied Geoscience Commission
SPAW	Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region
STAC	Scientific and Technical Advisory Committee (SPAW)
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP-ROLAC	UNEP Regional Office for Latin America and the Caribbean
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UWI	University of the West Indies
UWICED	University of the West Indies Centre for Environment and Development
WCMC	World Conservation Monitoring Centre
WCPA	World Commission on Protected Areas
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization