

ENVIRONMENTAL PROBLEMS AFFECTING THE COASTAL AND MARINE ENVIRONMENT IN THE WIDER CARIBBEAN REGION



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ENVIRONMENTAL PROBLEMS AFFECTING THE MARINE AND COASTAL ENVIRONMENT IN THE WIDER CARIBBEAN REGION

BACKGROUND

The objective of the present document is to provide an assessment of the main environmental problems affecting the marine and coastal environment in the Wider Caribbean region, with some analysis of the emerging environmental problems and of the constraints on the environmentally sound sustainable development¹.

The geographic scope of the document is limited to the area covered by the activities of the UNEP-sponsored Caribbean Environment Programme in the 36 continental and island States and Territories² of the Wider Caribbean region (Figure 1).

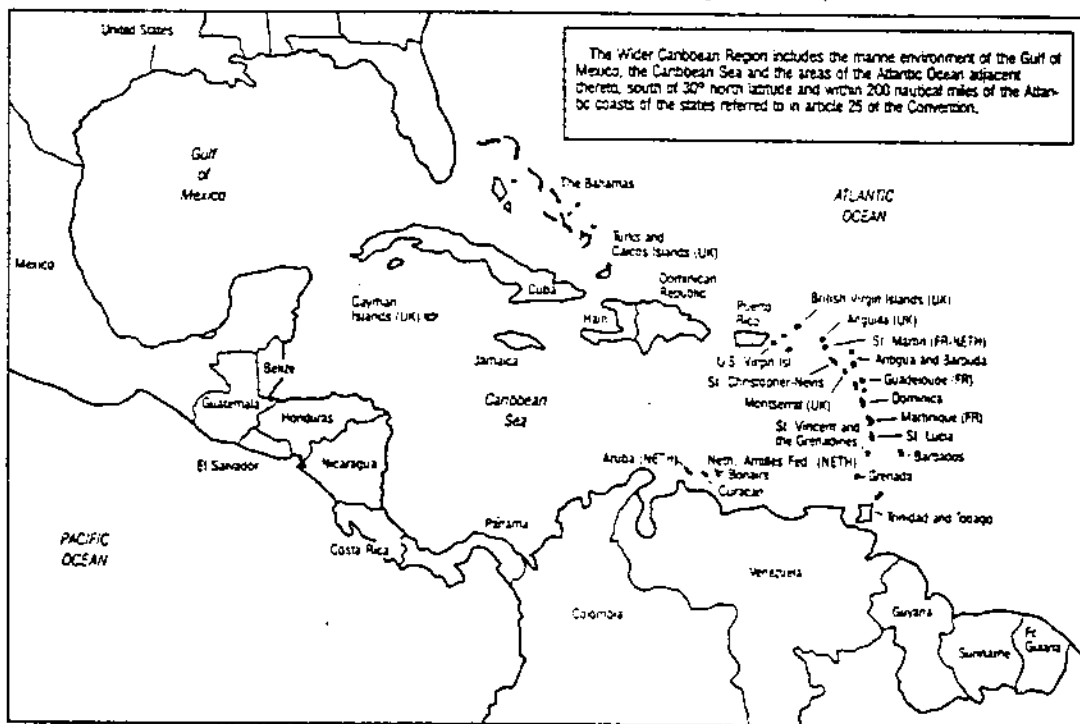


Figure 1.

- 1/ No attempt is made to provide in this document a precise definition of the term "sustainable development". The definition given by the World Commission on Environment and Development, i.e. "meeting present needs without compromising the ability of future generations to meet their own needs", was considered as adequate.
- 2/ In the text of this document these States and Territories are referred to as "countries" of the Wider Caribbean region.

The area comprises the *marine environment* of the Gulf of Mexico, the Caribbean Sea, the 200 mile zone of the Atlantic Ocean adjacent to the countries of the region, as well as their internal waters, and the *terrestrial environment* up to the limit of the watersheds.

While there is a large similarity in the nature of the environmental problems of this area, due to the considerable differences in the economic potentials of the countries in the region, the generalizations appearing in this document are mainly referring to the most common situations in developing countries of the region.

The document draws heavily on information available in previous regional studies prepared by UNEP and on material from other sources. The most important sources used in the preparation of the document are listed in the annex of the document.

I. INTRODUCTION

The nature of the problems affecting the marine and coastal terrestrial environment in the Wider Caribbean region has not altered greatly in the past decades. However, the incidence and extent of human activities in the coastal areas, as well as our perception of the main threats and corresponding solutions have changed markedly on the basis of knowledge and experience accumulated over the same period. Today the environmental problems are recognized as problems stemming from population pressure combined with inadequate or improper development whose ultimate solutions should be sought in resolving conflicting interests for space and resources in the framework of an environmentally sound economic development.

The physical and ecological degradation of coastal terrestrial areas, and the increase in pollution of the inland and near-shore waters from land-based sources, are accelerating in the Wider Caribbean region at an alarming pace. The often dramatic and irreversible alteration of natural coastal ecosystems and the extensive pollution of the sea and inland waters are primarily caused by the rapid growth of coastal population, the expansion of recreational areas, inappropriate agroforestry practices, and the concentration of industrial development in coastal zones, accompanied by inadequate environmental, technological and economic policies.

The expected impact of predicted climate changes will exacerbate the present problems of the Caribbean region and may, in areas such as low-lying islands and coastal zones, significantly influence or even imperil their future development and use.

**BOX 1 JAMAICA: AN ECONOMY UNDER PRESSURE FROM
OUTSIDE**

Originally established as a plantation based country, Jamaica's main crops and exports up to the 1950s included sugar, bananas, coffee, citrus and pimento. Mineral exploitation and tourism development flourished after the 1950s and between 1950 and 1986 the average annual rate of GDP growth was 6.7 per cent. Following the world recession and increases in energy costs, this growth rate fell by 4.1 per cent in the 1970s and continued to decline until 1980. A period of growth reemerged in the 1980s and 1990s with the exception of 1984 and 1988. Compared to performance of developing countries as a whole, which experienced an increase in real GDP of more than 80 per cent in the period 1973 to 1988, Jamaica registered a 10 per cent decline due chiefly to contraction in mineral exports and increased energy prices. The latter had adverse impacts on the country's balance of payments and foreign exchange reserves. The open and dependent nature of the economy meant that the latter factors restricted the import-dependent productive sector. The need to garner financial resources to alleviate these problems led to borrowing from major international lending institutions, including the International Monetary Fund. Whereas in 1970 external debt comprised 28.6 per cent of GDP, it climbed to 276.3 per cent in 1985 before declining to 177 per cent in 1990. In the period 1989 to 1991 transfers to the IMF, World Bank and IADB amounted to US\$ 631.07 million, 40 per cent of which was interest payments. As inflows during the same period was US\$ 312.1 million, net foreign exchange outflows for debt service was of the order of US\$ 319 million.

Source: National report of Jamaica to UNCED, 1992

The oceans and coastal areas are still not considered as finite economic assets which can be used on a sustainable basis only through prudent and rational exploitation. This is evident when development plans and environment protection confront conventional spending priorities of the Caribbean governments. Therefore relatively low priority is assigned in most national development plans to the protection of these areas and to rational use of their resources. The result is a scarcity of funds needed for measures which could prevent, reduce or eliminate the pollution of the environment, halt the physical degradation of coastal areas and protect their resources.

In reality, such an approach leads to seriously reduced capacities for social and economic development. The poorer Caribbean countries are particularly vulnerable to this vicious cycle.

The situation is particularly serious in economically disadvantaged countries burdened by depletion of natural resources, heavy indebtedness, unstable commodity prices and unfavourable trading systems. International assistance which would allow disadvantaged Caribbean countries to cope with their environmental problems, often originating from the industrialized world, is inadequate, frequently even misguided, and is not commensurate with the magnitude of the problem to be solved.

The capabilities of most Caribbean countries are still generally insufficient to cope adequately with the full complexity of the problems facing their marine and coastal environment and the rational management of their resources. In almost all countries the national institutional structures are too weak and lack the interdisciplinary expertise needed for effective action. This weakness of national structures also seriously hampers the effective participation of many Caribbean countries in international efforts, such as the Caribbean Environment Programme, designed to protect and develop the marine and coastal environment.

The protection of the marine and coastal environment is reflected in the legislation of most Caribbean countries. Some of this legislation is very comprehensive and quite sophisticated, but in most cases the provisions of the legislative acts are not applied efficiently to guarantee development without undermining the natural resource-base.

Public awareness about the nature, extent and implications of the problems of the marine and coastal environment needs to be considerably increased, although in some Caribbean countries it already plays an important and highly visible role in mobilizing support from broad segments of population for the necessary societal decision-making needed for the protection of this environment and a more rational utilization of its resources.

Poor management rather than limitations of science are the main reasons for the continued degradation of the Caribbean marine and coastal environment. The knowledge and insight accumulated over the past decades about the magnitude and the main causes of the environmental problems of the region is considerable and generally sufficient for meaningful action to be taken without delay. The technological solutions to most of these problems are also quite well known and are available, at a price.

However, the present databases and understanding of the processes shaping the natural conditions of oceans and coastal areas are generally inadequate for reliable predictions about the trends in these conditions. Consequently, forecasts for changes that may be expected contain a relatively high degree of uncertainty.

II. PRESENT MAJOR PROBLEMS AND THEIR POSSIBLE REMEDIES

To an outsider on his first visit to the Caribbean, the region seems a paradise. However, the reality is less idyllic and one does not need to be an observant scholar to realize that the environment of the region is the product of relatively recent but intense over-exploitation and abuse, mainly to satisfy external needs.

The present environmental problems of the Wider Caribbean region are most evident in coastal and near-shore areas under the direct onslaught of man's activities. Although seemingly local in nature, these problems are so widespread and are so evident even at sites far away from their origin that only regionally and globally applied strategies have a chance to achieve long-term solutions. However, the type and intensity of measures and policies, if they are to be effective, must be made in response to the actual situation, bearing in mind that a solution at one site should not create a nuisance elsewhere. Consequently, the most cost-effective remedies should be sought through action at the local and national levels, undertaken in the framework and as part of wider regional and global development strategies, including the transfer of the necessary resources, technology, knowledge and skills to the economically disadvantaged countries.

The causes of the present-day environmental problems, and their visible manifestations in the Wider Caribbean region, are very complex and can not be easily described in a sectorial way. Therefore in reading the analysis of these problems in the ensuing text, their intricate interrelationships and linkages should be kept in mind.

Coastal zone management

Due to numerous advantages offered by coastal and near-shore areas, they have always been among the most intensively used and abused parts of the planet. The Caribbean region is no exception. Aside from some large continental countries like Colombia, Mexico and the USA, and the Central American countries, most of the population of other countries bordering the Caribbean Sea and the

Gulf of Mexico live on the sea-shores or in their immediate proximity: the total coastal population of the Wider Caribbean region is estimated as 67 million persons. A variety of industries have developed on a large scale along the coast, the coastal zones became major recreational areas and the basis for expanding tourism, and harbours represent essential centres for national and international transport and trade. The near-shore maritime areas contain the largest part of commercially exploitable marine living and mineral resources of the region, and they are also the zones used for mariculture, whose full potential is yet to be developed.

As the result of human pressure on the Caribbean coastal zones, the gradual physical and ecological degradation of the coastal and near-shore areas, and the depletion of their resources, has accelerated during the last few decades at an alarming pace. The pressure on the coastal zone is mounting and has in many parts of the Caribbean region long ago surpassed the stage when the competing interests for space and resources could be resolved without careful planning and management.

In many areas of the Caribbean region inadequate coastal zone planning, development and management imperils the sustainable exploitation of natural resources and amenities. Inappropriate coastal zone management and land-use practices in the relevant drainage basins are also responsible for most of the problems associated with pollutants from land-based sources.

Drainage basins have a decisive influence not only on the economic development of coastal zones but also on their environmental quality. For instance, the Mississippi river drains about 75 per cent of the USA and carries about 50 per cent of the country's riverine wasteload into the Gulf of Mexico, mostly in particulate form.

BOX 2 COSTA RICA: A POISONED RIVER

Most of the rivers in the Tarcoles river watershed are in deplorable condition year-round. This watershed is home to nearly 40 per cent of Costa Rica's population, 75 per cent of the nation's industry, and 70 per cent of the coffee mills. All these activities dump their waste into the rivers, usually with no preliminary treatment. Beach areas adjacent to large outlets of these rivers are heavily contaminated by faecal bacteria.

Source: National report of Costa Rica to UNCED, 1992

Deforestation for farming and settlements is a common phenomenon throughout of the region. Jamaica lost approximately 70 per cent of its original forest coverage.

There is an estimated annual net loss of about 2 million hectares of tropical forests in the watersheds of the Caribbean basin. Because of the conditions under which the forests are removed, they can not be considered as a renewable resource, and the agricultural value of the "reclaimed" land usually declines quickly due to poor soil quality. The ensuing erosion further contributes to the degeneration of the soil, and through increased siltation creates environmental and developmental problems along the Caribbean shores. In 1986 about 21 per cent of the total land area of Honduras was considered as suffering from surface erosion, and according to the most recent estimates, approximately 63 per cent of Guatemala's soils are subject to various levels of erosion.

BOX 3 GUATEMALA: VANISHING FORESTS

In 1960, the forest covered areas of the country were 77 per cent, in 1970 they decreased to 47 per cent, and in 1980 to 42 per cent. The National Forest Institute (INAFOR) estimated 37 per cent for 1985 forest cover. In 1990 the Forest Plan of Action for Guatemala established, by means of LANDSAT satellite images, that the present cover is 23 per cent.

Source: National report of Guatemala to UNCED,
1992

Coastal wetlands are lost at an increasing pace all along the Caribbean due to "land development", agricultural uses and erosion. Louisiana is losing an estimated 50 - 60 square miles of coastal marshlands each year.

Intensive mining of beach sand, as well as inappropriate coastal engineering (e.g. construction of breakwaters, seawall) is significantly changing the shape and characteristics of the coastline and often leads to serious ecological impacts and coastal erosion in many Caribbean countries (e.g. the northern coasts of Puerto Rico and Jamaica, the east coast of Trinidad).

The rapid and unplanned growth of coastal urban centres around the Caribbean region, largely attributable to the migration of rural population to these centres, led to serious environmental problems.

BOX 4 USA: LOSS OF WETLANDS

The value of wetlands and their overall environmental importance have only recently been recognized. For most of U.S. history, wetlands were viewed as a hindrance to productive land use. Swamplands, bogs, sloughs and other wetland areas were considered wastelands to be drained, filled or manipulated to produce commercial, rather than natural, services or commodities. The Swamp Land Acts of 1849, 1850 and 1866 provide an early example; these acts gave federal lands in certain states to private parties on the condition that they be drained.

Since the 1970s, more than half of America's wetlands have been drained, dredged, or otherwise modified to provide what was thought to be more valuable lands and uses. It has been estimated that the land area that now comprises the United States originally contained almost 157 million hectares of wetlands.

A recent assessment of wetlands status and trends indicates that, over a nine-year period encompassing 1974 to 1983, the net area of wetlands declined by one million hectares.

Source: National report of USA to UNCED, 1992

Due to the economic situation of most countries, the development of infrastructures ensuring adequate sanitation (e.g. fresh-water supplies, sewerage systems) of swelling towns could not keep pace with the increasing number of inhabitants. These environmental problems, combined with shortage of affordable housing and job opportunities, largely contribute to the uncontrolled growth of squatter communities, breakdown of public safety and deteriorating quality of urban life in general. In an inner city district of Kingston (Jamaica) in 1990 the unemployment and underemployment rate was estimated as 60 per cent, with 77 per cent of households occupying only one room.

Responding to the demands of modern transport technologies, the harbours of most coastal cities of the region have been expanded, frequently at the expense of valuable urban waterfronts and hitherto undisturbed coastal ecosystems.

Such developments also contribute to the decreased quality of urban life and add to the problem of marine pollution, since practically none of the harbours have adequate facilities for receiving ship-generated waste.

By sacrificing the waterfront for the sake of harbour development, which in many cases was the historic centre of Caribbean coastal settlements, an important amenity essential for the economy and quality of urban life is usually irretrievably lost.

The explosive growth of tourism in most Caribbean countries became in the past decades an essential element of national economies, accounting for a considerable part of the national income. In Costa Rica, for instance, tourism was growing at a rate of 7.2 per cent in the period 1970-1988, and today it is the third most important source of foreign exchange (about 15 per cent of the total export earnings). Similar growth of tourism was experienced in a number of Caribbean countries. It is estimated that annually about 35 million tourists visit the Caribbean region.

The number of tourists visiting some of the countries and islands annually far outstrips the population of these countries and islands, e.g. 610,000 tourists per 30,000 inhabitants of Cayman Islands; 410,000 tourists per 80,000 inhabitants of Antigua and Barbuda; 700,000 tourists per 330,000 inhabitants of Martinique; 800,000 tourists per 250,000 inhabitants of Barbados; 1.6 million tourists per 100,000 inhabitants of US Virgin Islands; 1 million tourists per 30,000 inhabitants of St. Maarten.

BOX 5 BARBADOS: BRIGHT AND SHADY SIDES OF TOURISM

The tourism sector has played and will continue in the foreseeable future to play a vital role in the economic development of Barbados. The sector is the main employer of labour and major earner of foreign exchange (527.8 million US \$ were the total tourist expenditures in 1989). It currently contributes 12 per cent of GDP, over 20 per cent of total employment and 60 per cent of the export earnings.

The development of the tourist industry has not proceeded without its impacts on the environmental resource base. Presently, there is growing recognition of the importance of this resource base to the future viability and sustainability of the tourism sector. There is now little doubt that environmental parameters must be taken into account as an integral part of tourism development in Barbados.

Source: national report of Barbados to UNCED, 1992

However, the frequently ill-planned development of tourism created its own environmental problems, mainly due to the pattern in which tourist complexes and facilities are being developed. The intensive large-scale building of hotels, many of the largest on the very coastline, ruined some of the most precious scenic values, destroyed many important natural habitats, and "privatized" some of the best beaches for the benefit of foreign tourists and at the expense of the public at large. Such development most frequently disregarded the necessity of keeping at least some of the coastline in its natural state and even tried to "improve" it by construction of breakwaters, sea-walls, harbours for pleasure boats, navigation channels cut through the coral reefs, etc. In many cases significant changes in the circulation of coastal waters have been caused by such coastal engineering, which in turn led to considerable shifts in the sand deposition and to erosion of the hitherto stable coastline. The marine pollution often caused by the hotels' inadequate waste disposal practices further contributes to environmental degradation, undermining the very essence of the asset on which tourism is based.

The application of environmentally sound management practices in coastal and maritime activities, rather than narrowly defined "conservation" is now widely accepted as one key to safeguarding and developing the marine and coastal environment and their resources. The unplanned or poorly planned land and sea-use practices, the irrational exploitation of natural resources, and the pollution to which they incidentally give rise, can be avoided only by these means. Management implies use: rational use. Emphasis on the concept of integrated management reflects a critical change from earlier views of most environmentalists that the environment had to be preserved unchanged rather than used rationally.

The national policies and measures for the protection and development of coastal zones should be part of wider strategies ensuring sustainable social and economic development on local, national, regional and global levels. Moreover, since the oceans and coastal terrestrial areas, including river drainage basins, are linked in complex ecological and economic systems, their protection and development should be considered as inseparably interdependent.

Integrated management of coastal zones and river basins, based on sound planning and responsible policies for management of the environment and its resources, could be achieved with wider application of environmental criteria in land- and sea-use zoning of coastal development, and by mandatory assessment (environmental impact assessment) of the likely environmental impact, related social and economic costs and benefits, and long-term effects of planned activities and projects which may affect the quality of the environment. An environmentally sound coastal zone management could benefit from:

- changes in the present patterns of national economic and social development (e.g. tourism, concentration of industries in coastal zones, demographic pressure on the coastline), taking into account viable alternatives;
- development and application of economic and fiscal policies and measures stimulating environmentally sound coastal zone development; and
- restrictions on coastal activities and development which may directly or indirectly affect the quality of the marine environment, its resources, and amenities.

Pollution from land-based sources

The environment has an undeniable capacity to absorb certain quantities and types of wastes without major effect on the integrity of its ecosystems, but this capacity is not limitless. The waste-receiving capacity of the environment, if wisely used, is a considerable renewable economic asset, but when the amount of waste surpasses this capacity, serious environmental degradation may occur. The response of ecosystems to pressure caused by pollution is not linear, and therefore whenever the pollution load is at the limit of the capacity, collapse of the system may be caused by small increments of pollution.

Aside from physical and ecological degradation of the coastal and marine environment, pollution from land-based sources is at present the single most important threat to the marine environment and impediment to the use and sustainable development of the coastal zones and their resources. It is estimated that land-based sources contribute about 77 per cent to the pollution load of the oceans: 44 per cent through run-off and land-based discharges; 33 per cent through the atmosphere.

Solutions to the problem may be costly, with estimates in billions of US\$ in the Caribbean region alone, but the benefits derived and the value of damaged ecosystems and resources at risk (including public health, fisheries, tourism, etc.) in most cases far outstrip these costs.

The most polluted "hot-spots" of coastal zones are in the vicinity of large urban and industrial centres, as well as estuaries, although poorly managed harbours and tourist complexes are lately emerging as additional major sources of pollution. Semi-enclosed bays which were traditionally selected as sites for urban industrial and transport development, are particularly vulnerable due to the limited exchange of their waters with those of the open seas.

Lake Maracaibo (Venezuela), Bay of Havana (Cuba), and harbours of Kingston (Jamaica), San Juan (Puerto Rico), Veracruz (Mexico), Cartagena (Colombia), Puerto Cabello (Venezuela) and Port-of-Spain (Trinidad) could be cited as examples of highly polluted areas.

From the standpoint of public health protection, in the Caribbean region sewage is the most common but also the most significant pollutant entering the marine environment and the freshwater courses. The average sewage production in the region is between 30 and 100 litres per day per person.

It consists mainly (about 99 per cent) of nutrient rich water which, however, carries a variety of pathogenic microorganisms (e.g. viruses, bacteria, helminthic eggs) excreted by the carriers of various diseases in the population.

The collection and conveyance of sewage by sewerage system into the nearest watercourse or sea is not new in the coastal cities of the Caribbean region. For instance, such systems have been built in Castries (St. Lucia), Roseau (Dominica) and St. George's (Grenada) during 1940s, and those in Port-of-Spain (Trinidad) and Kingston (Jamaica) have been installed even earlier. However, a UNEP/CARICOM/PAHO study carried out in 1981/82 estimated that only 9 per cent of the population in 11 CARICOM countries were served by centralized sewerage systems, predominantly constructed only for the central parts of the capital cities. For about 80 per cent of the population, the most common way of dealing with sewage was to contain it in septic tanks and privy pits before disposal on land, into streams, rivers and the sea, while about 11 per cent of the population had neither public nor private facilities for sewage disposal.

Efforts in the Caribbean region to increase the proportion of population served by communal sewerage systems are considerable, in spite of the high costs involved. For instance, in Trinidad and Tobago, where about 30 per cent of the population is already served by communal sewers, the estimated cost for their extension to cover an additional 480,000 inhabitants is about 1.1 billion US dollars.

The examples of sewerage systems quoted above, as well as systems built elsewhere, almost without exception do not include sewage treatment plants, and the construction and siting of their marine outfalls shows little if any concern for their impact on the ecosystems of receiving waters and on the health of the bathers. It is estimated that less than 2 per cent of the urban sewage is treated before its disposal, and the proportion of treated sewage from rural communities is probably even lower.

The outfalls of the sewerage systems are usually very short, although with longer outfalls, even without treatment of the sewage, and particularly with primary treatment, very considerable improvements could be achieved.

The prohibitively high costs of building and maintaining traditional sewage treatment plants are frequently given as a reason for not treating the sewage before its disposal. The possibility of using sewage not contaminated with wastes of industrial origin as agrofertilizer which could be safely used under certain conditions, is not sufficiently explored. Furthermore, for such sewage relatively cheap and highly efficient biological methods of treatment (e.g. stabilization ponds, artificial wetlands) are available and are eminently suitable to the tropical and sub-tropical character of the Caribbean region, provided that land is available for setting-up the treatment facility.

Unfortunately, in most instances, sewage does not contain only human excreta, but also various environmentally unfriendly compounds used in households (e.g. detergents). The problem is further exacerbated by the common practice of discharging untreated or inadequately treated industrial waste into communal sewerage systems. Therefore, most sewers contain a variety of toxic and nonbiodegradable substances which make their treatment less effective and more costly. Sewers contaminated by industrial wastes may pose various public health problems, and may even become a serious public danger, as demonstrated by the recent explosions of hexane contaminated sewers in Mexico (Guadalajara).

The industries along the shores and catchment basins of the Caribbean are the second major source of pollution. Industrial effluent are treated adequately only in exceptional cases before their release into the nearest water body. They may contain a variety of toxic, oxygen consuming and non-biodegradable substances. The major pollution loads in the region are created by chemicals (including petrochemicals and petroleum refining), food processing (particularly in sugar producing countries), metallurgical (iron and steel production, non-ferrous metal refining), textile, and pulp and paper industries. Petroleum exploration, exploitation, and transportation is the region's major permanent source of operational and accidental releases of industrial wastes. Petroleum refining produces an average of 380 litres of effluent per barrel of refined crude oil. On the USA Gulf coast alone, there are 57 refineries with an aggregate production of approximately 350 million tons a year. In the Coatzacoalcos region of Mexico is another large concentration of petrochemical plants: 65 plants with a productive capacity in excess of 15 million tons a year.

The other two large concentrations of various industries are in the Bay of Cartagena (Colombia) and in the Lake Maracaibo basin (Venezuela). The Bay of Cartagena carries approximately 90 per cent of all industrial and domestic wastes discharged along the Colombian Caribbean coastline. Iron and steel mills generate on average 25 m³ effluent per ton of production. Effluent of food processing industries (breweries, dairies, canneries, rum distilleries, fish processing plants, etc.) are rich in organic waste with high biological oxygen demand (usually from 1,200 to 2,000 mg per litre, but reaching even 70,000 mg per litre in the case of fish processing and fishmeal factories).

BOX 6 BELIZE: BITTER TASTE OF SUGAR

The sugar industry had been at the base of the Belizean agricultural economy for several decades. At its peak it provided more than 20 per cent of the gross domestic product, 50 per cent of export earnings and 70 per cent of agricultural export. Cane is processed in Belize at two plants, both border the New River.

Every hour of processing produces 2,520 gallons of liquid waste, which comes mainly from the cleaning of the evaporators and vacuum pans used to refine sugar cane, and from wash down operations in the factories. The waste has a high organic load and high quantities of spent lubricants from the machines. All of this waste is dumped into the New River without adequate treatment. It is thought that reported fish and turtle kills, as well as a general degradation of the New River ecosystem, can be attributed to the joint effluent from these plants, a rum distillery located along the same stretch of the river and non-point agricultural run-off.

Source: National report of Belize to UNCED. 1992

There are two nuclear power plants in the region (Turkey Point, Florida, USA and Laguna Verde, Veracruz, Mexico) but their wastes seem to be under adequate control. The shipments of spent nuclear fuel through the Panama Canal from Japanese reactors to reprocessing plants in Europe is causing concern in some quarters.

Treatment of industrial effluent intended for discharging into communal sewers must become a standard practice, as it would allow for the application of efficient sewage treatment by simple and cheap methods.

The increasing and frequently indiscriminate use of agrochemicals, particularly to boost the yield of export crops, is a growing source of aquatic pollution throughout of the Caribbean region.

Although still below the levels used in some developed countries, the consumption of fertilizers has almost doubled in the period between 1973 to 1985.

The use of various biocides (pesticides, herbicides) is also on the increase, with few restrictions enforced on their production, importation and use. On some cotton fields up to 80 kg of insecticides are used per hectare, one of the highest levels of use in the world.

During the 1980s in Costa Rica the average pesticide consumption was about 195 kg per km² of land, nearly double the average consumption for Central America as a whole, and almost 10 times the estimated 20 kg per km² for the land surface of the entire earth. Accidents from pesticide poisoning, mainly due to their inappropriate application by ill-informed users, are not rare and are probably considerably more frequent than shown in official statistics.

There is little information on the impact of agrochemicals on aquatic resources of the region, but by extrapolation of information from other regions it could be concluded that considerable damage was done by the extensive use of some slowly degradable biocides over the past 30 years (e.g. DDT, aldrin).

Solid waste is a growing problem in the Caribbean region, not only as an aesthetic nuisance but also as a mounting source of pollution. Its collection and disposal is poorly organized in most countries. Inappropriately selected sites for landfill are a permanent and dangerous source of various pollutants leaching and seeping into the surface and ground waters, and thus degrading the quality of these waters frequently to a dangerous level. Non-biodegradable or slowly degradable materials (plastics, metals) are a widespread nuisance for many recreational beaches of the region.

The progressive elimination of the most harmful substances and a considerable reduction of others should be considered as the ultimate goal in controlling pollution from land-based sources. A well co-ordinated stepwise approach on a national and regional level is the best avenue to the solution of the problem. It may include:

- preparation of inventories of land-based sources of pollution and databases on their effects through well co-ordinated national and regional efforts;
- assessment of the ecological, social and economic significance and impact of these sources, and determination of national, sub-regional and regional problems, policies, priorities and measures in controlling the sources;

BOX 7 TRINIDAD AND TOBAGO: MORE TRASH AROUND

The generation of solid wastes in Trinidad and Tobago is projected to virtually double between 1980 and 2000, from an estimated 239,000 tons (0.61 kg of waste per person per day) to 468,000 tons.

Prior to 1980 most of the solid waste was disposed of in open dumpsites or remained uncollected. Across the country the same scenes were repeated - refuse in the streets, litter on beaches and along roadsides, abandoned vehicles on isolated shoulders and in weeded grass grown lots, large number of open dump scarring the landscape and of course, although less visible, the contamination of the ocean and ground water and water resources.

Source: National Report of Trinidad and Tobago to UNCED, 1992

- establishment of adequate national and regional institutional mechanisms and financial support to ensure the implementation of the envisaged policies and measures.

Pollution from dumping³ and maritime transport

Dumping of waste from ships and aircraft contributes about 10 per cent of the pollution load of the oceans. It poses a problem for benthic marine ecosystems, may affect some commercially exploitable living resources, and certainly affects the quality of the beaches when it is washed ashore.

Quantitative information on the type and amount of waste dumped into the Caribbean region is insufficient to assess its potential significance, but the visible consequences of the dumping are sufficiently clear to be easily observed on practically all beaches throughout of the region. Reliable information on dumping is available only for the USA coastline. It reveals that, for instance, in 1982 about 4 million m³ of dredged material from the Mississippi river was dumped into the Gulf of Mexico, but it also indicates a decreasing trend in dumping of dredged spoils and of certain types of industrial waste during the last decade.

3/ "Dumping" in the context of this document refers only to deliberate disposal of wastes or other matter from ships or aircrafts.

The goal in controlling pollution from dumping should be a progressive reduction of harmful waste dumped into the sea, and elimination of waste which due to its nature (e.g. radioactive waste, waste with low degradation rate) may pose a long-term threat to the quality of the marine environment.

The release of tanker washing and oily residues from ships contributing to the heavy maritime traffic in the region are of special relevance to the region. Tar accumulated on some beaches, particularly on the windward exposed coasts of islands and other land masses, is ubiquitous and makes many of the beaches unsuitable for high quality tourism. The situation is particularly deplorable in cases, such as that of Grand Cayman, where the island does not benefit from the local petroleum industry but depends heavily on foreign tourists.

Solid waste (trash) thrown overboard regularly from the ships passing through the Caribbean region, and discarded fishing nets, are washed ashore and decrease the recreational value of litter-covered beaches. Marine debris along the coast of the Gulf of Mexico has averaged more than 1 ton per mile (2 tons on Texas beaches alone).

Although waste from maritime transport contributes only 12 per cent to the pollution load of the oceans, and is a minor problem when compared with the disposal of solid waste from land-based sources⁴, the lack of adequate harbour facilities for receiving waste from ships is a significant cause of pollution in the Caribbean region. In assessing the need for such facilities in 23 ports and harbours of the Wider Caribbean region, a recent study carried out by the International Maritime Organization (IMO) and the World Bank concluded that cruise ships generate on average about 4,200 kg of waste daily, compared with 60 kg per day produced by cargo ships and 10 kg per day by fishing vessels. About 30 per cent of the waste from cruise ships is deliberately dumped in the waters of the Caribbean due to lack of, or faulty, incineration units on the ships, or due to lack of adequate off loading to reception facilities in Caribbean ports.

4/ For instance, the total domestic waste in Trinidad is estimated as 438,000 tons annually, compared with 985 tons of waste arising at the main port which would have to be dealt with in accordance with Annex V of MARPOL 73/78 Convention starting from 4 April 1993, i.e. from the date when the Caribbean will be considered as a "special area" under the Convention.

Transboundary pollution

With the exception of pollution caused by maritime accidents, and pollution generated in the vicinity of political borders, the economic and ecological impact of pollutants is in general restricted to the country of the pollution's origin. Whenever transboundary pollution occurs in such instances, it is caused by the transfer of pollutants through natural oceanic processes which do not respect political boundaries.

Exception from this generalization is the deliberate transfer of wastes from one country to another, either as a result of an agreed procedure, or more often as the deliberate act of smuggling. With increasingly stringent restrictions posed on waste disposal and with the increasing cost of proper treatment of hazardous wastes in the industrialized countries, the export of waste became a lucrative business during the last decade, and some of the Caribbean countries became the favoured target of waste exporters.

A recent study noted at least fifty five incidence of attempted trade with hazardous waste in the Wider Caribbean region between 1980 and 1991, with at least twenty one in 1990 alone. The "products", often presented as raw materials suitable for landfill, recycling, fuel substitution or even as fertilizers, frequently contain toxic substances and can pose a public health and long-term environmental problems.

Management of fresh-water resources

With the increasing standard of life the demand for freshwater is on the increase throughout the Caribbean region to satisfy the public health requirements, as well as the needs of expanding industrial and agricultural use of water. The rapidly growing tourism industry is posing a specific pressure on water supplies in many Caribbean countries.

In some countries the freshwater resources are exploited at a higher rate than the natural replenishment could justify, leading to their exhaustion or degradation of their quality (e.g. intrusion of saline water in water tables close to the coast).

Higher priority is usually given to the development of the freshwater resources than to the problems inseparably linked with exploitation of these resources. The increased consumption is very frequently not followed by adequately expanded and improved system of wastewater treatment, collection and disposal.

This results in waste of scarce water which could be recycled and reused, as well as in increased pollution of watercourses, underground reservoirs and coastal marine waters, which in turn contributes to increased frequency of waterborne diseases and deterioration of the environmental quality of recipient waters and their exploitable biological resources.

According to an estimate about 52 per cent of the population in the Caribbean and Latin American countries is served by water through house connections (mostly in urban areas), 35 per cent has an easy access to water supplies, while 12 per cent is not served by water supplies. The situation is particularly difficult in rural areas.

The availability of adequate freshwater supplies, and the pollution caused by inadequate treatment and disposal of wastewater, are frequently the major constraints for a more vigorous development of tourism.

Protection of freshwater resources and their rational exploitation, including ultimate disposal, should be seen as a social investment in public health, as well as one of the bases for the protection of vital areas of the economy based on tourism, fisheries, and coastal zone management.

Public health

Public health is directly dependent on the quality of the environment. Environmental degradation, pollution of water, soil, air and foodstuff in particular, inevitably leads to conditions favouring the occurrence of specific diseases.

Cholera, typhoid fever, viral hepatitis, gastro enteritis and dysentery are among the most frequent illnesses associated with contaminated water resources in the Wider Caribbean region. They can be contracted through inadequate quality of drinking water (it was estimated that in 1985 about 50 per cent of the rural population was not served by protected sources of drinking water), bathing in water containing pathogens and through contaminated agricultural and fisheries products.

The number of recorded patients is high: 1,678 cases of gastro enteritis in Antigua and Barbuda in children under 5 year in 1980; 243 cases of typhoid fever in Guyana in 1985; 23,408 cases of gastro enteritis in Trinidad and Tobago in 1987; 438 cases of viral hepatitis in Dominica in 1987. The number of cases is most probably considerably higher because the available statistics are notoriously incomplete, and are in many instances deliberately misleading in order to protect the tourist industry.

Outside of the USA, there is practically no regular monitoring of the recreational quality of bathing waters, or the quality of shellfish growing waters.

Industrial wastes are responsible for elevated concentrations of pollutants in edible marine species from regions contaminated by industrial effluent (e.g. heavy metals in mangrove oysters off the coast of Campeche, Mexico; in products from Lake Maracaibo, Venezuela and Bay of Havana, Cuba). Due to the lack of epidemiological studies it is difficult to assess the full public health implications of contaminated food consumption.

Malaria, schistosomiasis and yellow fever are still common in many parts of the region due to poor environmental sanitation and/or lack of adequate integrated pest control management programmes.

Poisoning by indiscriminate use and improper application of agrochemicals, some of them highly toxic, is quite common throughout the region. A survey of 5 countries of the region revealed close to 20,000 cases of pesticide poisonings in a six year period (1971-1976). In Costa Rica alone, an average of 553 cases of pesticide poisoning is reported each year.

BOX 8 GUYANA: HOMICIDE BY PESTICIDES

Pesticides are the most readily available "over-the-counter" poisons in Guyana. Widespread use of these pesticides has led to intoxication, both intentional and unintentional. Between 1959 and 1964, 88 cases of insecticides poisoning were reported with 70 deaths, while in 1984 there were 26 deaths. Widespread alarm concerning thallium sulphate poisoning was reported in 1987. For the year 1988, over 123 cases of insecticides poisoning were seen at hospitals.

Source: National report of Guyana to UNCED. 1992

Management of living resources

The marine and terrestrial living resources of the Caribbean coastal zones are a valuable and important natural resource base for the sustainable development of the region.

The large scale destruction of forest areas in the drainage basins has already been mentioned as a serious problem in the section on coastal zone management. The once thriving coastal

forest have all but disappeared. Mangroves and coastal wetlands have also suffered from pollution, siltation, and in particular from large scale land reclamation schemes (e.g. the Portmore area of Metropolitan Kingston, Jamaica; the Carony swamp in Port-of-Spain, Trinidad), in spite of their critical importance as nursery grounds for commercially important fisheries and as habitats for many endangered species. About 65 per cent of mangrove swamps have been eliminated in Tabasco State (Mexico) by activities related to petroleum industries.

BOX 9 HONDURAS: A DOOMED RESOURCE

Seventy-one thousand hectares of swamp are disappearing from the shorelines of the Gulf of Fonseca in Honduras. This carries in its train the destruction of the mangrove forests and thousands of its animals which include at least 2 species of mammals and reptiles, 70 species of resident and migratory birds and hundreds of other species from wetlands. It also has implications for environmental degradation produced by the destruction of one of the few remaining forests in the south of the country and, further entails the destruction of a food source for thousands of households who depend on these resources for survival.

Source: National report of Honduras to UNCED. 1992

Sea-grass beds, important for development of juveniles of commercially exploited fish stocks and for the physical stability of the coast, are degraded in many places by sand extraction, pollution and siltation, thus weakening the coast to the onslaught of waves and storm surges.

Due to oceanographic conditions the marine fisheries resources are not distributed homogeneously throughout the Caribbean region: while they are quite abundant along the continental shelves of Central and South America, they are relatively scarce around the Antillean chain of islands. Some of the island countries are net importers of fish in order to satisfy domestic consumption.

The catches consist of bottom-dwelling (e.g. lobster, shrimp, conch) and free-swimming (e.g. sardines, tuna, marlin, anchovy) species. Major fisheries grounds are along the coast of Venezuela, Mexico and the USA, where the stocks are exploited on an industrial scale. Although there are no reliable statistics on total catch (roughly estimated as being between 0.5 and 5 million tons per year in the region), the artisanal fisheries probably provide a larger part of it.

There is need for increased monitoring of artisanal fisheries by assessing, for each fishery, fishing areas and efforts. Economics and trends is a fundamental contribution to the sustainable use of such an important economic and biological resource in the Caribbean.

Fish is an important source of food, and in some places it is the largest part of the protein diet of the poorer segments of population. The management and exploitation of fisheries resources is, however, beset with a number of environmental and social problems. The current rate of fisheries harvest in the Caribbean region, at least for some stocks, seems to be close to the estimated maximum sustainable yield. Aquaculture is practiced in many countries of the region, although its full potential is yet to be realized. The magnitude and extent of bycatches (unintentional harvest of any species) in fisheries (artisanal or otherwise) pose a serious threat to many populations of marine mammals. Sea birds and turtles will also require attention if effective conservation and management of protected species is to be achieved. Among others, programmes encouraging the proper selection of fishing gear in order to reduce bycatches should be considered.

Enhancement of marine living resources management in the Caribbean should also include sea turtles given that the survival of six species is a major concern. Sea Turtle Recovery Action Plans (STRAP) have been established in order to address the conservation and management problems along with solutions for sea turtles. Support to the implementation of such action plans should be among priorities for the region.

The conflict between the interests of artisanal and industrial fisheries is becoming an important social and environmental issue, which would have to be resolved with due respect for the traditional fishing rights and practices.

The enforcement of measures for environmentally sound management of marine and coastal living resources is inadequate, largely due to social constraints mitigating against stricter conservation policies.

Measures which may improve the management of the marine and coastal living resources include:

- integration of living resources management plans into larger scale integrated coastal zone management plans, and protection of ecosystems by removing the factors impinging on their integrity;

BOX 10 SURINAME: FISH BUT NOT WITHOUT PROBLEMS

The catch of shrimp is by far the largest and most productive activity within the fisheries sector. Of the 145 trawlers participating in this activity in the waters of Suriname, 120 (85 per cent) are foreign owned. The overall annual catch fluctuates between 2,400 and 3,400 tons. It is estimated that the industry's economic potential is reached with a catch and processing of approximately 3,000 tons per year.

Although production of finfish does occur in inland waters, the more important fishery occurs on the coast. Most of this catch is brought in by an estimated 1,500 small artisan fishermen whose overall production in the early 1980s was on the order of 3,000 tons. However, under the impact of restrictions on fish imports, such as saltfish and canned products, and because of the scarcity of meat products and their resulting high prices in Suriname, there has been a strong demand for fish products on the domestic market, which has resulted in profits for the fisheries sector.

Fisheries activities do create important clashes within the sector itself, as well as with other activities. Primary among these is the incidental killing of sea turtles during the capture of shrimp - a fact that has recently resulted in prohibitions for the importation of Surinamese shrimp in the United States. Shrimp fishing uses closely knit nets with a 5 cm mesh. However, these nets also bring up many fish. Owing to the scarce freezing space, however, only the more valuable shrimp are kept. At most about 1,500 tons of by catch are saved and brought to shore annually. The rest is thrown overboard. There is little monitoring of fishing activities in the exclusive economic zone, neither as regards for compliance with the licenses granted nor as regards illegal fishing by foreign fishing boats. Because of the low level of surveillance, fewer shrimp are brought to port than are caught - the difference being sold to passing ships to obtain extra private income.

Source: National report of Suriname to UNCED. 1992

- expansion of the exploitation of non-conventional fisheries resources and environmentally sound management of existing and expanding aquaculture; protection of artisanal fisheries and the access of indigenous people to the living resources traditionally exploited by them;
- application of environmentally sound administrative and legal measures, and technologies, for the exploitation of living resources on a sustainable level, including measures for

BOX 10 SURINAME: FISH BUT NOT WITHOUT PROBLEMS (CONT'D)

A less striking but no less important example is that the artisan fishermen who work the inland ponds and lakes come into contact with water that may contain bilharzia which is the cause of schistosomiasis, a debilitating infection that often occurs in human populations which have frequent contact with water.

Aquaculture, especially shrimp culture along the coast, is being studied and, in recent years, pilot projects have been executed. Although this subsector looks promising, the researchers are aware of recent experiences in other countries, as well as its potential for generating conflicts with other production sectors and within the fisheries sector itself. For example, a large increase in the area covered by shrimp pond could encroach on areas dedicated to agriculture but, more often, these ponds are built at the expense of wetland ecosystems. Because of the value of wetland ecosystems for the renewal of the wild fish and shrimp stock, any activity which reduces the size and quality of wetlands in Suriname would be potentially detrimental to the entire sector.

Source: National report of Suriname to UNCED. 1992

reduction of incidental capture on non-target species (e.g. marine mammals, turtles and birds), and limitations on the access to endangered stocks; adoption of economic measures and fiscal policies stimulating the protection and rational exploitation of living resources; and

- Enhancement of public involvement and education programmes attempting to obtain a local socio-economic perspective in order to develop and implement potential solutions to conflicting issues.

Maintenance of Biological Diversity

The Caribbean region contains a rich variety of complex ecosystems, with great abundance of animal and plant species, some of them endemic to the region. Along the coast of Belize is the second longest (220 km) barrier reef in the world, and the longest in the northern hemisphere. The ratios of endemic to total number of species are high: for instance in Jamaica they amount to 27:256 for breeding birds, 20:24 for lizards, 15:19 for frogs and toads, 82:579 for ferns, and 784:3000 for flowering plants.

Unfortunately many of these ecosystems are under heavy stress from human activities, and a number of unique ecosystems and habitats have been destroyed, and species exterminated. In the last 150 years at least eight species of vertebrates have become extinct in Jamaica alone. More than 100 plant species which are indigenous to Trinidad and Tobago may be threatened by extinction.

Habitat destruction due to aggressive coastal zone development, particularly the expansion of tourism, seems to be the main problem, although overexploitation of some species (e.g. scarlet ibis, turtles, flamingos) and predation by introduced species is also significantly contributing to the decline in the abundance of some species and biological diversity of some ecosystems.

In almost every Caribbean country a number of ecologically important areas have been formally designated by national legislation as marine parks and coastal protected areas. Costa Rica has even declared 27 per cent of the nation's land as protected area. However, in practice, due to weak management of these parks and areas, and lack of adequate control mechanisms, they are inadequately protected from mounting pressure on their space and resources.

For instance, in the Mayan Biosphere Reserve of Guatemala, approximately between 40,000 and 60,000 hectares of forested areas are deforested annually.

In addition to establishing new marine sanctuaries and parks, efforts and resources should focus on the management of those already established, so as to strengthen them and contribute to an overall improved system of protected areas, which will comply with recommendations of the Fourth World Congress on National Parks and Protected Areas convened in Caracas, during 10-21 February 1992.

In some Caribbean countries "debt-for-nature" swap programmes have been instituted. Through this innovative way of funding conservation efforts, Costa Rica alone in 1990 converted about 5 per cent of its 1.6 billion US dollars foreign debt (nearly 70 million US dollars) into "conservation bonds".

The marine environment is, in general, resilient to the loss of biological diversity, but some heavily exploited or stressed near-shore and coastal terrestrial ecosystems (coral reefs, sea-grass beds, lagoons, mangroves, wetlands, estuaries) and certain species of large marine mammals (e.g. the West Indian manatee) are clearly threatened in the Caribbean region. Coral reefs and mangroves which are highly productive and diverse ecosystems suffer intense pressure, threatening biological diversity in the region. Mining, sedimentation, industrial pollution, exploitation for

ornamentation and damaging fishing practices are the main factors contributing to the destruction of reefs in the Caribbean. Similar practices also affect mangroves, sea-grass beds and wetlands comprising critical processes such as filtration of waste and protection from coastal erosion.

**BOX 11 TRINIDAD AND TOBAGO: RICHNESS IN
DIVERSITY**

In relation to its size Trinidad and Tobago is one of the more biologically diverse countries in the Western Hemisphere and reflects the transition from the South American landmass to an Antillean flora and fauna. There are over 100 mammalian species, almost 50 per cent of which are bats, 420 species of birds, of which approximately 160 are migratory species which visit annually to feed during North American and South American winters, 70 species of reptiles, 76 species of freshwater and euryhaline fishes, and 26 species of amphibians. The number of insect species is not known, but at least 600 species of butterflies have been identified.

In respect of the fauna there are 280 species of ferns, over 2200 species of native flowering plants, which include 200 species of orchids, 58 bromeliads and 34 aroids. Over 110 of these species of flowering plants are endemic to the islands. In addition, 800 species of flowering plants have been introduced to the islands. There is limited information on lower plants and new species of insects and plants are being discovered each year.

In terms of its marine biodiversity, Trinidad and Tobago, being in the Caribbean Sea, shares along with the other Caribbean islands, a healthy repository for some of the most productive and biologically complex ecosystems in the world. There are at least 300 marine fish species, numerous species of crabs, shrimps and lobsters, and up to 200 species of molluscs. Five type of sea turtles nest on the north and east coast beaches of Trinidad, while the leatherback, green and hawksbill turtles also nest on Tobago.

On Trinidad the north coast has the greatest coral development with progressive enrichment of community composition from the Bocas Islands in the west, eastward to Toco in the north-east. Tobago has richer and more diverse coral communities. The Bucco reef, a marine park, is the largest and best known of the reefs, but there are other, smaller important reefs particularly at Kilgwyn, Speyside and Man-O-War Bay.

Source: National report of Trinidad and Tobago to
UNCED. 1992

Their destruction not only increase the loss of biological diversity but also causes negative impacts on social and economic regional development.

The enforcement of legislation protecting habitat and species is in general ineffective. The reasons for this are manifold: pressure from industrial interests, and poverty of people living in the vicinity of the protected areas, (which frequently are their main if not the only natural resource base) being among the more important.

BOX 12 USA: YIELDING TO PRESSURE

Administration officials say the effort to open natural resources has been aided by President George Bush's four-month-old regulatory moratorium in which existing environmental rules are under review and others are being rewritten to reduce their cost to business.

Last week, in the clearest signs yet that Mr. Bush is taking account of industrial interests in weighing environmental protections, a cabinet-level committee voted to exempt the government from the Endangered Species Act and allow the cutting of 1,700 acres of forest in Oregon that provide habitat for the threatened northern spotted owl.

Source: International Herald Tribune, 21 May 1992

The safest way to maintain the biological diversity of the region is through maintenance of the integrity of the region's coastal and marine ecosystems. This could be achieved by:

- protection of habitats and ecosystems critical for the maintenance of biodiversity and survival of endangered species, taking into account the viable alternatives;
- restriction on the commercial exploitation, including trade, of species considered endangered or threatened; and
- stricter control on the genetic manipulation of species which may be exploited in mariculture, and on deliberate and accidental introduction of alien species which may impoverish the biodiversity.

The measures suggested above could bear fruits only by enlisting the support of local communities, and by involving them in the management of species and habitats intended for special protection.

The recently adopted Protocol concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region (1990), and the subsequently adopted Annexes of the Protocol (1991), if applied, could provide a rational framework for the protection of the most endangered and threatened ecosystems and species of the region, and for the maintenance of its biodiversity.

Exploitation of non-living resources

Most of the mineral resources (e.g. oil, gas, sand) now exploited in the Caribbean region, can not be considered as renewable on the time scale on which their exploitation is taking place. The exploitation of non-renewable resources irreversibly depletes the wealth of a country and, therefore, their exploitation should be used to provide the economic basis for build-up of activities and conditions which will ensure or contribute to a long-term and sustainable socio-economic development, once the resource is exhausted.

Careless exploration and exploitation of mineral resources may lead to serious environmental damage through habitat destruction and pollution described in other sections of this document. Therefore, measures and technologies in the exploration, extraction, processing and transportation of mineral resources should be designed and operated so that they do not cause environmental damage.

Environmental emergencies and accidents

Environmental emergencies pose a serious and ever-present threat to the economy and the ecology of most countries in the Caribbean region. The most common emergencies are caused by earthquakes, floods, volcanic eruptions, landslides, hurricanes, storm surges and droughts.

Volcanic eruptions and earthquakes are among the most damaging natural disasters. Due to the geology of the Caribbean region they are quite frequent and the scale of destruction and the loss of life caused by them can be of catastrophic dimensions. For instance: in 1692 an earthquake and the associated tidal wave completely destroyed the two thousand inhabitants and the city of Port Royal, the unofficial Jamaican headquarters of many ruthless pirates, including the notorious Henry Morgan; in 1902 an avalanche of incandescent material, caused by the eruption of Mt. Pelée in Martinique, descended on St. Pierre and within a few seconds wiped out its entire population of 30,000 people; the relatively recent (1985) volcanic eruption in Colombia claimed more than 20,000 victims.

Due to its geographic location the Caribbean region is exposed to frequent and violent tropical cyclones, known in the region as hurricanes. They are characterized by strong wind velocities, high waves, temporary but considerable elevation of sea level (storm surge) and high precipitation. The extent of damage caused by hurricanes (including loss of life and injuries), and the disruption of social and economic activities caused by them, is next only to the ravages of volcanic eruptions and earthquakes. Belize, after a long history of devastating encounters with hurricanes, which in the present century alone have killed thousands of people and left many more homeless, moved, in 1971, its capital to Belmopan, 80 km inland, because of Belize City's vulnerability to hurricanes. A well documented study on the impact of the 1988 hurricane Gilbert estimated that, in addition to lost lives (45 in Jamaica, 54 in Haiti and about 300 in Mexico) and injuries, the damage to the coastal and marine resources of Jamaica was about 200 million US dollars.

The natural systems which could mitigate the impact of some natural disasters are frequently weakened by their irrational destruction and removal. For instance: mangroves, coastal wetlands, sea-grass beds and coral reefs constitute natural barriers protecting the exposed coastal locations from the action of waves and mitigating the impact of storm surges and hurricanes.

The preparedness for natural disasters, and the individual response capabilities of Caribbean countries, particularly the smaller ones, are too weak to cope alone with any mayor emergency. Therefore, aside from a reliable early warning system, a stronger regional co-operation on the organization of disaster preparedness, response and post-disaster relief, would be desirable.

Accidents resulting in damage to the coastal and near-shore environment, such as pollution caused by tanker accidents, blow-outs of oil wells, or accidents at coastal industrial installations, can not be completely avoided. Of special importance for the region are accidents caused by heavy maritime transport of hazardous goods and by petroleum exploration and exploitation. Tanker traffic alone moves daily about 5 million barrels of petroleum through the region.

Within the relatively small Gulf of Paria (Trinidad and Tobago) there are some 42 marine platforms and 161 km of pipelines serving the petroleum industry. In the 1986-1988 three year period 609 accidental spills were reported from exploration, drilling, refining and transportation. A total of 65,610 barrels of oil was spilled, of which 46,910 barrels were recovered during the cleanup operations. About US\$ 400,000 were paid out to the affected parties as compensation for the damage.

In 1980 one of the largest ever oil spills was caused in the region by the blow-out of an offshore oil rig (Ixtoc II). An estimated 475,000 tons of oil spread into the Gulf of Mexico, contaminating an area of about 15,000 km² and hundreds of kilometres of coastline.

Accidental or intentional releases of domestic and industrial pollutants may cause considerable ecological damage to the marine environment. Fish kills resulting from such releases are common throughout the region. Some of them can be quite dramatic: a massive fish kill was attributed in 1988 in the Gulf of Paria (Trinidad) to oxygen depletion associated with algal blooms caused by excessive release of organic material; repeated fish kills occur in the vicinity of Belize City (Belize) due to effluent from a galvanizing industrial plant.

The damage caused by accidents associated with industrial waste could be even more catastrophic. The recent explosions of hexane contaminated sewers in Guadalajara (Mexico) claimed more than 200 lives, injured close to 1,400 people, left about 15,000 inhabitants without shelter, deprived about 70,000 citizens of basic sanitation (drinking water, sewerage), and caused an estimated 66 million US\$ material damage.

As revealed by some recent large scale accidents, even when they occur in the most developed countries, it is difficult to contain their damaging effect on the environment. International co-operative arrangements seem to be the best mechanisms through which the impact of the accidents could be mitigated, particularly when they occur in smaller countries.

The impact of the accidents, although sometimes quite dramatic and leading to massive environmental damage, is mainly local and does not usually leave permanent and long-term consequences. Nevertheless, with measures aiming at improved safety of navigation, with improved design of ships, and with the formulation and adequate implementation of contingency and emergency plans, the number of accidents could be reduced and their environmental impact could be considerably mitigated.

Two main avenues should be followed to minimize the frequency and size of the accidents, and to cope efficiently with their consequences:

- improved safety of navigation, activities related to the exploration and exploitation of mineral resources, and operation of coastal industrial plants; and

- elaboration and adoption of national, sub-regional and regional contingency plans for emergencies caused by accidents, combined with the development of national and regional response capabilities (institutions, expertise, manpower, material, equipment and financial resources).

Education and public awareness

In most of the Caribbean countries the general public still lacks an adequate understanding of the linkages between development and environmental protection, and of the short- and long-term benefits and disadvantages of economic (including fiscal) and environmental protection measures. This lack seriously weakens the societal decision-making process needed for the sustainable development of the marine and coastal environment and their resources.

The investment in education and public awareness building is relatively small when compared with investment in development, and is the most cost-effective contribution to sustainable development.

The concern of citizens about environmental and developmental issues is frequently expressed through non-governmental pressure groups which are unfortunately too often treated by governments, business, financial and trade communities as certain adversaries, rather than potential allies. While it is relatively safe for such groups to advocate the establishment of nature reserves and parks, when they decide to investigate pesticide abuse, dubious land transactions or the inefficiency of a public agency, they frequently become a target of attacks by the government and certain vested interests.

Measures which could contribute to a better education and public awareness related to environmental issues may include:

- addressing parents, women in particular, with systematic educational programmes suitable for transfer of environmental awareness to their families, children in particular;
- raising the interest of the general public, including the non-governmental environmental organizations, in environmental and developmental matters by keeping it well informed about major developmental projects and their environmental, economic and social implications, and by involving it in the planning and decision-making process;

- training of educators and teachers in introducing materials on developmental issues and associated environmental problems into school curricula on all levels of formal education; and
- intensive and more frequent use of all standard channels of communication with public at large (e.g. newspapers, radio, television) for transmission of information on the inseparable link between the socio-economic development and protection of the environment.

Business and trade communities, financial institutions

The business and trade communities, and financial institutions, both in public and private sector, have a critical role in shaping the countries' developmental policies, and hence have a potentially significant role in steering these policies in an environmentally acceptable way. Although they are primarily interested in development activities which frequently do not take sufficiently into account either the environmental consequences or the long-term economic costs and benefits of these activities for society or a country as a whole, their co-operation on environmental matters is of utmost importance.

The economic interests are the most powerful, if not the only incentives for the healthy functioning of business and trade, and financial institutions. By the very nature of these interests, they are in most cases of short-term nature, particularly in the private sector. The control over the public sector, which in principle should cater to the long-term interests of a nation, although theoretically exercised by the general public through its representation in government structures, is in too many Caribbean countries in the hands of powerful interest groups which do not necessarily pursue the long-term interests of that public.

The recently established US-based Caribbean Environment and Development Institute (CEDI) is an example of an interesting and potentially useful initiative which may successfully promote the partnership between the public and private sector in the search of solutions to specific environmental problems affecting the Wider Caribbean region. The Institute is planned to be funded by contributions from the private and public sectors and will be operated as a non-profit organization.

The promotion of the following strategies may seem appropriate in the Caribbean countries:

- increased public sector investments in environmentally sound developmental projects and environment protection measures, such as application of clean technologies;
- stronger partnership between the public and private sectors, particularly in fields where the private sector does not have enough economic incentives to provide funds for research, development and initial capital investment;
- wider application of economic and fiscal measures (e.g. subsidies, tax incentives) linked with environmental accounting, and lending policies stimulating environmentally sound developmental activities;
- increased public pressure on the business communities for "environment-friendly products" (e.g. paper instead of plastic bags, returnable and recyclable bottles), or products manufactured through "environment-friendly technologies" (e.g. recycled paper);
- taking into account national security considerations in their broadest sense, e.g. the advantages offered by the conservation of non-renewable resources and exploitation of renewable resources on a sustainable basis, and reduction of imports if they can be economically replaced by domestic products; and
- involvement of the private sector in the formulation of national economic and environmental goals and policies, particularly in countries where the private sector operates relatively free from the administrative control of the government.

Research, observations, monitoring, forecasting

Rational long-term policies and management decisions for the protection and development of the environment can be based only on facts collected, analyzed and interpreted according to strict scientific criteria. Systematic research and observations in fields of natural, social, economic and political sciences is the right path to a correct diagnosis of the present environmental problems; to an understanding of the processes underlying and determining the present conditions and foreseeable changes; and to the appreciation of the social, economic and political factors which may have to be taken into account in defining the long term developmental goals.

The information base needed for critical assessments of the environmental and developmental problems of the Caribbean region is today very fragmented and incomplete. The data from natural, technical, social and political sciences, even when available, is frequently presented in a form which is of little use to managers and policy-makers. Yet without access to vital information and well founded analyses, the decision-makers cannot gain sufficient insight into the complex interaction among the forces undermining sustainable development.

Damage to oceanic resources, or problems arising from the use of polluted resources, has usually taken place unpredictably. Surprises, such as the bleaching of corals or outbreaks of algal blooms in eutrophicated coastal waters of the Caribbean region, were beyond the predictive capabilities of environmental scientists. Future events can best be judged by what has taken place in the past. Consequently, forecasting also critically depends on the quality of data resulting from research, observations and monitoring, and on their meaningful interpretation.

Although the understanding of the present causes of the environmental problems of the region, and of the possible remedies to these problems, are in many instances sufficient for immediate action, fields which seem in particular deficient include target oriented research and studies whose results could be locally applicable under the conditions prevailing in the Caribbean region, such as:

- development of less wasteful production technologies, i.e. technologies with high energy efficiency and low amount of waste;
- improvement of existing and development of new technologies for treatment and reuse of industrial and domestic waste;
- effectiveness of economic measures, and in particular fiscal incentives which are or may be used in controlling environmental degradation or contribute to the restoration of damaged systems;
- societal response to short-term disadvantages of measures designed to ensure environment protection and sustainable development in the interest of long-term benefits, and how to overcome the eventual negative responses; and
- development, testing and application of methodologies related to planning and managing sustainable development suitable for the Caribbean region (environmental impact assessment

procedures with good predictive capabilities, environmental accounting, cost-benefit analysis of environmental protection measures, comparative analysis of alternative development options, risk assessment and management, management techniques for coastal areas, such as zoning of uses and different type of use or protection regulations).

National Institutions

The existence of national institutions with clear mandates and capabilities to deal with environmental problems is the essential prerequisite for a country's successful attempt to deal with these problems. Although considerable progress has been achieved during the last decades in some of the Caribbean countries, the national institutions in charge of environmental protection are still weak in most countries of the region. Their influence on national development plans is frequently only of marginal importance. Without creating strong national infrastructures, equipped with interdisciplinary expertise, and without giving them access to the circles where decisions relevant to the protection of environment are made, no effective protection of the Caribbean marine and coastal environment could be expected.

The existing institutions and structures charged with the co-ordination of national environmental policies and programmes are in many of the Caribbean countries too fragmented and deal with the problems as sectorial issues, rather than as parts of coherent national policy. They usually lack adequate authority and means to regulate and enforce environmental policies, or to influence national economic strategies on which ultimately rest the protection and development of the marine and coastal environment.

The protection and development of coastal zones require a variety of expertise, and above all a good grasp of the cross-sectorial nature of environmental protection. The scarcity of trained personnel, particularly in interdisciplinary skills, is one of the major impediments in most countries of the region.

Countries without such expertise have to rely on foreign advice on matters which require deep understanding of national social and economic development aspirations, and traditional cultural and social values. Consequently, the advice, even when theoretically and technologically sound, may frequently result in unsuitable solutions which, if applied, could cause considerable harm.

Without underestimating the importance of nation-wide institutions in solving environmental problems of a country, more emphasis should be given to the community-based institutions in management of environmental affairs. Such institutions are fully aware of the specific environmental problems facing the community daily, and consequently they are in the best position to find suitable solutions.

National policies and practices

The declared goal and national policy of the Caribbean countries is the protection and development of the marine and coastal environment in order to ensure their sustainable use without jeopardizing their ecological integrity. The national legislation of practically all Caribbean countries clearly enunciates this goal and policy.

In practice, however, the implementation of the declared national goal and policy is confronted with a large number of constraints, some of them seemingly insurmountable under the present economic conditions of some Caribbean countries. The established prevailing global production and consumption patterns a root cause of unsustainable development are difficult to change swiftly, and by attending only to the ecological and technological causes and symptoms of the environmental problems, without addressing the economic and social plight of populations, these problems can not be solved successfully. Consequently, the sometimes poor environmental record of many Caribbean countries is resulting less from lack of commitment to the protection of the environment, than simply from the countries lack of financial and technical capabilities.

Financial constraints

The difficult economic situation of the heavily indebted Caribbean countries is forcing them to reduce public expenditures. This affects particularly investments in environmental protection which are not perceived as urgent and absolutely necessary. For the same reason, higher priority is accorded to curative actions applied to problems which could have been avoided, at relatively low cost, had the proper action been taken in time. Preventive action with emphasis on resource conservation as a long-term protection against future economic stagnation resulting from irreversible resource depletion, although economically much more cost-effective, for objective reasons can not be applied too frequently.

BOX 13 GUATEMALA: CONSTRAINTS ON USE OF WEALTH

Great problems exist in the country that directly or indirectly affect it internally, and the quality of life. Also, the quality of life of its inhabitants, which is mainly of a low standard caused by lack of opportunities, causes a large part of the population to destroy their environment in order to satisfy their basic needs. The lack of environmental consciousness in almost all of the sectors of our society, combined with general corruption and an overwhelming external debt, restrains our economic growth. These diverse factors of external debt, and many others, paradoxically causes a country that generally has the resources to be very wealthy to find itself submerged in poverty.

Source: National report of Guatemala to UNCED.
1992

The presently prevailing distorted and biased pricing policies, as well as taxing and trading policies on both national and global levels, most often dictated by factors beyond the control of individual Caribbean countries, are a serious obstacle for sustainable development, and thus adversely affect the quality of the environment and its resources. The effects of low, frequently heavily subsidized prices for energy, water and many industrial products and commodities negatively influence the development and protection of the marine and coastal environment. Such practices encourage excessive use (e.g. water, fertilizers, pesticides), and provide little incentives for resource recovery (e.g. treatment and reuse of wastewater), or for the application of alternative, environmentally more friendly solutions.

International co-operation

On the threshold of the 21st century all countries of the globe became inextricably linked into an interdependent web of economic, political, economic and environmental interests, forcing them to work together to meet the "inner limits" of basic human needs for all the world's people and doing it without violating the "outer limits" of the planet's resources and environment⁵. Starting from the 1972 United Nations Conference on Human Environment (Stockholm) and through the process leading to the 1992 United

5/ The quote is from the Cocoyoc Declaration

Nations Conference on Environment and Development (Rio de Janeiro) it was recognized, on the highest international political level, that it is no longer possible to protect the Earth and its resources on a country by country basis.

There are several aspects and mechanisms through which the Caribbean countries actively participate in international collaboration. In this chapter the emphasis will be on collaboration related to the protection of marine and coastal environment, with particular reference to the collaboration within the framework of the Caribbean Environment Programme.

International agreements, most often in the form of legally binding conventions, are policy instruments serving as the legal framework for a set of internationally agreed actions.

The Cartagena Convention, now ratified or acceded to by 19 States, embodies the political commitment of these States to cooperate on the protection and development of the marine environment in the Wider Caribbean region. By not acceding to the Convention, several Caribbean countries signified their reluctance to surrender their individual right to accept or reject regionally binding policy commitments, and to enter into potentially open-ended financial obligations. The major weakness of the Convention is that it is imposing financial and technical demands on nations which can not possibly meet them, without linking commitments to environmentally sound practices with concrete and credible reassurances that international assistance will be part of the deal for needy countries.

The parties to the Convention are implementing its provisions only partially and with considerable delay. The reasons for that are: insufficient financial and technical resources, absence of sanctions to deter violations, and national sensitivities about intervention in internal affairs.

Multilateral and bilateral programmes of co-operation are the basis for concrete co-operation among the parties to such programmes.

The Caribbean Environment Programme is the specific instrument of multilateral regional co-operation on environmental matters, open to all 36 States and Territories of the Wider Caribbean region and the European Economic Community. In spite of its successes, it suffers from chronic lack of adequate funds which would allow it to assist the Caribbean countries to refocus their national developmental policies and programmes on the root causes of environmental degradation.

The numerous bilateral co-operative programmes between various Caribbean countries and donor/funding countries/institutions/agencies, while undeniably useful in many instances, tend to pursue primarily the economic and political interests of the donors and frequently do not reflect the priorities for financial and technical assistance as seen by the recipients of this assistance. Another frequent weakness of the bilateral programmes is that they do not sufficiently take into account the capabilities of the recipient countries to absorb, maintain and operate the results of some programmes.

Assistance provided to many Caribbean countries by funding or lending institutions, or donor governments, too frequently suffer from lack of co-ordination. Countries are likely to receive contradictory policy advice from different sources. Structural readjustment programmes have been launched without heed to environment and social consequences. Distortions in national development plans also occur when too many donors work on the same sector or issue, even though the individual projects may make sense. However logically compelling the case, both donors and recipients of the assistance have resisted the co-ordination of donor assistance, hoping to preserve their autonomy and fearing that they may have to sacrifice sectoral, political and economic interests.

The requirements of the multiple appraisal procedures for loan and grant projects is another problem. No special efforts are made by the donors through such projects to build national capabilities for environmental assessment and monitoring, or to ensure that these capabilities are maintained. The procedures prescribed by the donors did not capture the economic and social factors that may undermine sustainable development. Impacts that occur are not monitored and recipient countries can not evaluate the projects' long-term benefits or costs. Countries trying to comply with the different donors' requirements can not easily establish a single viable national procedure for environmental impact assessment.

The weakness of national institutions is a serious impediment for a more effective participation of many Caribbean countries in international programmes designed to protect the marine and coastal environment. The strengthening of presently inadequate indigenous national capabilities of many disadvantaged countries is a long and arduous process requiring massive international assistance. Such assistance should not be seen only as a mandatory part of foreign aid packages but also as in the best self-interest of donors of the aid. Unfortunately, the training of skilled technicians and financing the technical and institutional support have not been high priorities in development cooperation.

III. EMERGING ENVIRONMENTAL PROBLEMS

In the long-term, the climate changes, predicted due to the atmospheric accumulation of "greenhouse gases", especially the various direct and indirect effects of expected temperature and sea level rises (2 - 5° C and 65 ± 35 cm by the end of the next century), as well as the increased frequency and severity of episodic events (e.g. tropical storms, droughts, floods), may prove to be among the major social, developmental and environmental problems facing the low-lying coastal areas and islands of the Caribbean region.

Effects on terrestrial ecosystems and socio-economic activities are expected to be considerable and probably painful for a number of Caribbean countries with unfavourable geographic configuration, pattern of settlements and distribution of land used for agriculture and forestry. Thousands of hectares of land may be lost to the sea in deltaic and estuarine areas, and in low-lying coastal plains; mangroves and wetlands would have to retreat from their present sites; crops adapted to the present climatic conditions may be affected in various ways; coastal cities, tourist complexes, harbours and transport infrastructures built close to the shores and almost at present sea-level (e.g. roads, airports) may have to be relocated or protected by costly engineering work. Some countries of the region may be particularly vulnerable: the largest part of the 16-64 km wide coastal plain of Guyana, occupied by over 90 per cent of the country's population, already lies below sea level.

The predicted climate changes will certainly also affect the marine living resources in many ways. Large scale changes in total marine fisheries production are not expected, although individual stocks may suffer. Mariculture will probably be more affected. Tropical upwelling zones, which produce large amount of fish resources may shift polewards by hundreds of kilometres. The year to year variability of the resources they support may increase and the increased plankton productivity may reduce oxygen levels and lead to anoxic situation. The increased ultraviolet radiation related to ozone layer depletion may lead, according to some estimates, to detrimental effects on some shallow water ecosystems such as coral reefs, and may affect plankton growth.

The picture given above may, however, not be so bad after all for everyone. There is a realistic expectation that climate change will also have some positive effects and benefits. A recent study carried out for the Caribbean region lists the change in precipitation associated with a temperature rise which may allow the introduction of valuable new crops, and the change in the wind pattern which could increase the upwelling and thus increase

fishery yield, as two examples of potentially positive consequences for the Caribbean region.

Although there are claims that the climate changes have already caused the first observable ecological effects (increased incidence and extent of coral "bleaching") in the Caribbean region, the effects of predicted climate changes may not be felt in the near future. However, in the long-term their implications for the socio-economic life of coastal zones may be considerable and particularly serious for low-lying countries and small islands. Adaptation to the changing conditions will require a long lead-time. Therefore the full complexity of the potential problems which may be associated with predicted climate changes should be analyzed without delay and the particularly vulnerable resources, developmental activities, species, ecosystems and geographic areas identified. In the light of such analysis the possible policy options and measures which may be used as suitable response to the expected impacts should be examined and reflected in the national integrated coastal zone management plans.

The information and data collected through the present monitoring and observation systems operating in the Caribbean region is insufficient to meet all the demands posed by the protection and development of the marine and coastal environment, and rational management of their resources. The available information is particularly inadequate in providing clarification and answers to the questions raised in connection with forecasting environmental degradation and impact of climate changes.

IV. CONCLUSIONS

The degradation of the marine and coastal environment of the Caribbean is today clearly recognized as a problem for the whole region. It is deeply rooted in the complex political, social and economic circumstances of our planet. Therefore, it can not be solved by individual countries without effective international co-operation, although solutions should be sought primarily through concrete national actions taken within a globally and regionally agreed framework.

Four main factors, none of them specific to the Wider Caribbean region or to the marine and coastal environment, seem to be at the root of the present environmental problems hampering sustainable development of the region:

- inappropriate national and international economic policies and forms of development which do not adequately take into account the environmental consequences of these policies;

- weak regulatory mechanisms and administrative systems dealing with environmental issues;
- insufficient public awareness about the real causes and magnitude of environmental problems, and about the available remedial measures; and
- inadequate forecasting of emerging environmental problems.

Sustaining human life and well-being requires development and a healthy environment. Development can become difficult to achieve if natural resources are depleted or the environment degraded. Therefore, the ultimate goal of all strategies for the development and protection of the marine and coastal environment in the Wider Caribbean region, as well as elsewhere, should be to ensure their rational use. In case of renewable resources, rational use must imply indefinite sustainable use. The use of non-renewable resources, obviously can not be sustained indefinitely, but must provide the economic basis for the build-up of activities and conditions that will ensure or contribute to a long-term and sustainable socio-economic development, once the non-renewable resources are exhausted. Consequently, all remedies for the present and anticipated environmental and developmental problems should be designed with that goal in mind, and their appropriateness should be judged by the degree to which they succeeded in achieving that goal.

The policies, measures and arrangements for the protection and use of the marine and coastal environment, if they are to be rational and thus effective in the long-term, should be based on improved understanding of the marine and coastal ecology, including ecosystem dynamics; of the relevant ocean and shore processes; and of their interaction with the terrestrial and atmospheric systems. Long-term systematic research and observation programmes are the basis for improving the knowledge needed for improved management.

The widest possible participation of the populace in the protection of the marine and coastal environment is essential. Such participation necessitates involvement of those who may be affected by changing environmental conditions in decision-making debates about development schemes which may cause such changes. It also requires broad educational and public awareness programmes, including introduction of environmental subjects in school curricula on all levels, as well as the provision of information on a regular basis to the general public through mass media and specific publicity campaigns about environmental and developmental issues. Such publicity campaigns should emphasize the importance of the potential contribution from each individual to maintain a healthy environment as a basic precondition for sustainable socio-economic development.

The lack of funds, particularly in developing countries, is the most crucial impediment to forceful and dynamic environmental protection action. The remedy, without which all measures and decisions will remain only at the level of declarations, is in the provision of financial resources additional to those currently available, enabling the disadvantaged countries to become equal partners in dealing with global economic and environmental issues. The financial resources required are of unprecedented magnitude, unlikely to be met from regular government budgets. They could only come from increased flow of assistance through international agreements, from radical expansion of the present bilateral agreements between developing countries and lending/funding/donor/aid countries and agencies, or from new multilateral funds through which such resources would be channelled to disadvantaged countries.

Inequality and disparity of a number of factors required for sustainable development within and among Caribbean countries, constitute the main problem affecting the management of marine and coastal resources in the region.

Consequently, it is apparent that no combination of policies, technologies and resources, can by themselves, significantly ameliorate the present situation in the Caribbean region or elsewhere, unless the non-technological roots of the problem are resolved: population pressure on limited resources and space; competitive nationalism; the global maldistribution of wealth and opportunity; patterns of over-consumption and enthusiasm for unrestrained growth; the notion that economic growth and human well-being are directly proportional; and, last but not least, the illusion that supposes civilizations to be self-supporting without help from natural ecosystems.

Obviously, in order to achieve sustainable development of marine and coastal resources in the Wider Caribbean region, the non-technological roots of the problem must be addressed and a new attitude, based on global solidarity, embraced by all.

BOX 14 OCTAVIO PAZ: SOS FOR THE EARTH

In Mexico, my own country, will we finally enjoy that true progress which is not just political democracy, economic prosperity and social justice but also reconciliation with our traditions and with ourselves? The recent past has shown us that no one holds the key to history. As this century draws to close there are still many questions. We can be certain, however, of one thing: life on our planet is in danger. Our rash veneration for progress and our efforts to exploit nature to the extreme have turned into suicidal race. And just as we are beginning to understand the mysteries of the galaxies and of atomic particles, just as we are delving into the secrets of molecular biology and the origins of life, here we are hitting out at nature's integrity. But aside from the political, social and economic problems the most urgent thing we have to do today is to save the environment. At the end of this century we have discovered that we are part of a vast system in which plants and animals but also cells and molecules and atoms exist, and we are only a link in the "great chain of living beings," as the great philosophers of the past used to call the universe. One of the man's most common and spontaneous actions is to raise his eyes and gaze at the marvel of the starry sky. This act of contemplation often gives us a feeling of solidarity with nature. We must defend life if we want to go on enjoying this feeling.

Source: Ulisse 2000. May 1992

ANNEX: I

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