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UNITED NATIONS ENVIRONMENT PROGRAMME

*Development and environment in the  
Wider Caribbean Region:  
A Synthesis*

*UNEP Regional Seas Reports and Studies No. 14*

*Prepared in co-operation with*



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## PREFACE

It is now almost ten years since the United Nations Conference on the Human Environment (Stockholm, 5-16 June 1972) adopted the Action Plan for the Human Environment, including the General Principles for Assessment and Control of Marine Pollution. In the light of the results of the Stockholm Conference, the United Nations General Assembly decided to establish the United Nations Environment Programme (UNEP) to "serve as a focal point for environmental action and co-ordination within the United Nations system" (General Assembly resolution (XXVII) of 15 December 1972). The organizations of the United Nations system were invited "to adopt the measures that may be required to undertake concerted and co-ordinated programmes with regard to international environmental problems", and the "intergovernmental and non-governmental organizations that have an interest in the field of the environment" were also invited "to lend their full support and collaboration to the United Nations with a view to achieving the largest possible degree of co-operation and co-ordination". Subsequently, the Governing Council of UNEP chose "Oceans" as one of the priority areas in which it would focus efforts to fulfil its catalytic and co-ordinating role.

The Regional Seas Programme was initiated by UNEP in 1974. Since then the Governing Council of UNEP has repeatedly endorsed a regional approach to the control of marine pollution and the management of marine and coastal resources and has requested the development of regional action plans.

The Regional Seas Programme at present includes ten regions\* and has over 120 coastal States participating in it. It is conceived as an action-oriented programme having concern not only for the consequences but also for the causes of environmental degradation and encompassing a comprehensive approach to combating environmental problems through the management of marine and coastal areas. Each regional action plan is formulated according to the needs of the region as perceived by the Governments concerned. It is designed to link assessment of the quality of the marine environment and the causes of its deterioration with activities for the management and development of the marine and coastal environment. The action plans promote the parallel development of regional legal agreements and of action-oriented programme activities.

By decision 8(II) of 29 March 1974, the Governing Council of UNEP decided that priority should be given, in the fields of oceans, to regional activities and stressed the importance of the Caribbean region.

After a preparatory process, which included a number of expert meetings, missions and preparation of sectorial studies on resources and environmental problems of the Caribbean region, the Intergovernmental Meeting on the Action Plan for the Caribbean Environment Programme (Montego Bay, Jamaica, 6 - 8 April 1981), attended by representatives of Governments from 22 States of the region, adopted the

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\* Mediterranean, Kuwait Action Plan Region, West and Central Africa, Wider Caribbean, East Asian Seas, South-East Pacific, South-West Pacific, Red Sea and Gulf of Aden, East Africa and South-West Atlantic.

(ii)

Action Plan for the Caribbean Environment Programme and three resolutions dealing with (a) programme implementation, (b) institutional arrangements, and (c) financial arrangements related to the implementation of the Action Plan (UNEP/CEPAL/IG.27/3).

The present document (issued as UNEP/CEPAL/WG.48/Inf.4) served as one of the documents prepared to facilitate the negotiations which led to the adoption of the Action Plan.

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## 1. INTRODUCTION

In accordance with resolution 2997 (XXVII) of the General Assembly, the United Nations Environment Programme (UNEP) was established "as a focal point for environmental action and co-ordination within the United Nations system". The Governing Council of UNEP defined this environmental action as encompassing a comprehensive, transectoral approach to environmental problems which should deal not only with the consequences but also with the causes of environmental degradation.

Although environmental problems are global in scope, a regional approach to solving them seemed more realistic. By adopting a regional approach, UNEP felt it could focus on specific problems of high priority to the States of a given region thereby more readily responding to the needs of the Governments and helping to mobilize more fully their own national resources. It was thought that undertaking activities of common interest to coastal States on a regional basis should, in due time, provide the basis for dealing effectively with broader environmental problems.

UNEP's regional approach is at present being applied to eight regional seas where action plans are operative or are under development: The Mediterranean (adopted in 1975), the Red Sea (adopted in 1976), the Kuwait Action Plan Region (adopted in 1978), the West African Region (under development, adoption expected in 1980), the East Asian Seas (under development, adoption expected in 1980), the South-East Pacific (under development, adoption expected in 1980), the South-West Pacific (under development, adoption expected in 1981) and the Wider Caribbean\*\*. Unless stated otherwise, the Wider Caribbean Region is defined as comprising the States and Territories of the insular Caribbean including the Bahamas, the north-eastern parts of South America from Colombia to French Guiana, Panama, the States of Central America, Mexico, the Gulf States of the United States, as well as the coastal and open waters of the Caribbean Sea proper, the Gulf of Mexico, and the waters of the Atlantic Ocean adjacent to the States and Territories mentioned above (figure 1).

Two elements are fundamental to UNEP's regional programme:

- (a) Co-operation with the Governments of the regions. Since any specific regional programme is aimed at benefiting the States of that region, Governments are encouraged to participate from the very beginning in the formulation and acceptance of the programme. After acceptance, the implementation of the adopted programme is carried out by national institutions which have been nominated by their Governments.
- (b) Co-ordination of the technical work through the United Nations system. Although the regional programmes are implemented predominantly by Government-nominated institutions, a large number of the United Nations specialized organizations are called upon to provide assistance to these

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\*\* Since the document was prepared, action plans have been adopted for West and Central Africa (1981), the East Asian Seas (1981), the South-East Pacific (1981), the Wider Caribbean (1981) and the South-West Pacific (1982).

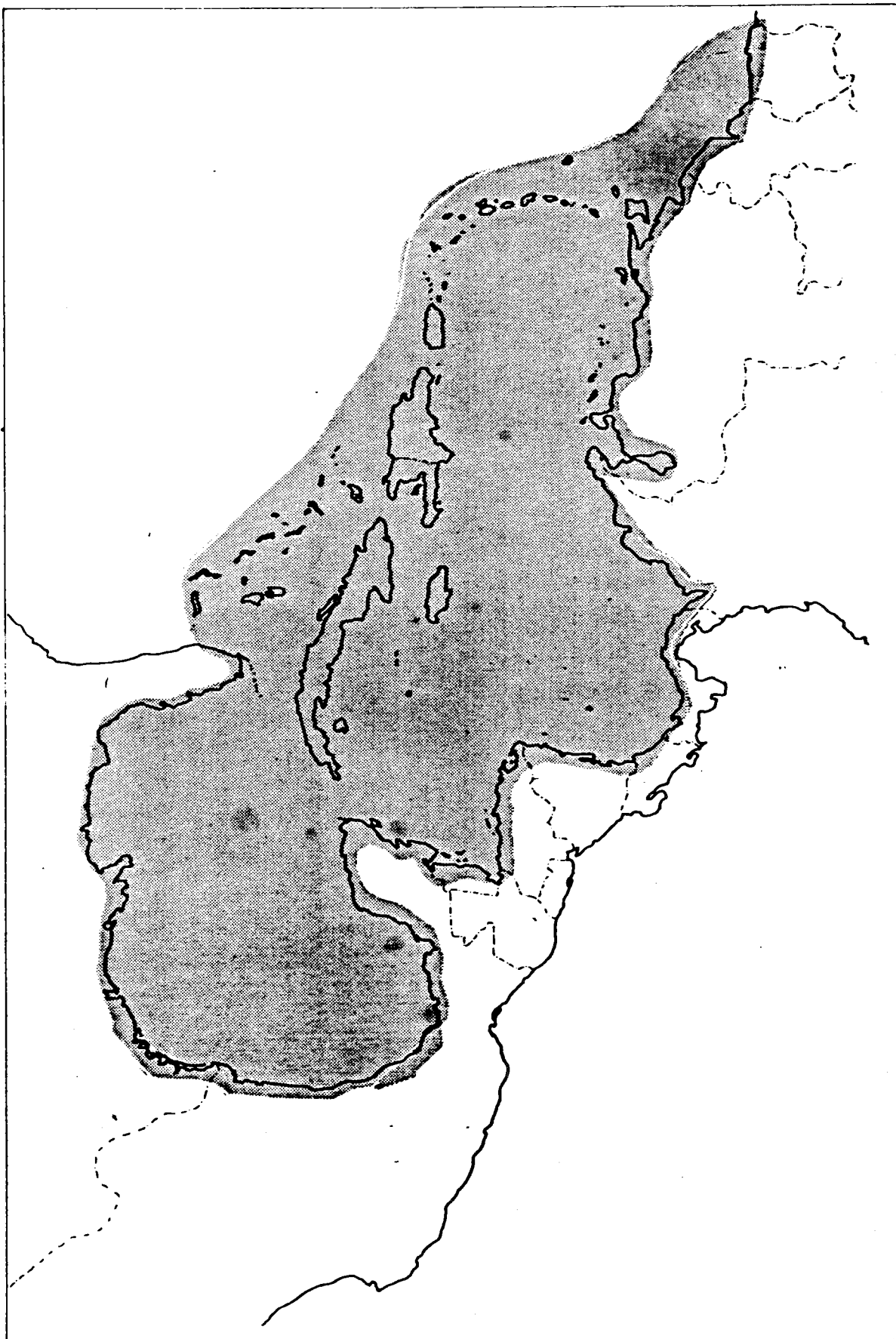


Figure 1 : The "Wider Caribbean Region", as defined in this document

national institutions. UNEP acts as an overall co-ordinator although in some cases this role is limited to the initial phase of the activities. Thus the support and experience of the whole United Nations system contributes to the programme.

The components of a regional programme are outlined in an "Action Plan" which is formally adopted by the Governments before the programme enters an operational phase.

Each action plan consists of three standard components as adopted by the United Nations Conference on Human Environment (Stockholm, 5 - 18 June 1972) and endorsed by subsequent meetings of UNEP's Governing Council. They are:

- (i) Environmental assessment. The assessment and evaluation of the causes, magnitude and consequences of environmental problems are essential activities providing the basis for assistance to national policy-makers to manage their natural resources in an effective and sustainable manner.
- (ii) Environmental management. A wider range of activities requiring regional co-operation falls under this component: rational exploitation of living resources, utilization of renewable sources of energy, management of freshwater resources, disaster preparedness and co-operation in cases of emergency, etc. Regional conventions, elaborated by specific technical protocols, usually provide the legal framework for the action plan and have in many regions proved to be an excellent tool in the hands of environmental managers.
- (iii) Supporting measures. The national institutions are the institutional basis for the implementation of the action plan. Large-scale technical assistance and training are provided to them where necessary to allow their full participation in the programme. Existing global or regional co-ordinating mechanisms are used when appropriate. However, specific regional mechanisms may be created if Governments feel they are necessary. Public awareness of environmental problems is stimulated as an essential supporting measure for the action plan. Financial support is initially provided by UNEP and other international and regional organizations, but, as the programme develops, it is expected that the Governments of the Region assume increasing financial responsibility.

In accordance with the regional approach, an early association was sought by UNEP with the Economic Commission for Latin America (ECLA) and a joint UNEP/ECLA project team was established to co-ordinate, under the overall guidance of UNEP and ECLA, the preparations for the development of an Action Plan for the Caribbean Environment Programme.

This document has been prepared by UNEP's Regional Seas Programme Activity Centre and the UNEP/ECLA project team, taking into account the comments and suggestions of an ad hoc group of experts and the meeting of the Advisory Panel on the Caribbean Environment Programme (Mexico City, 10 - 12 September 1979), as one of the basic background documents for the Meeting of Government-Nominated Experts (January 1980) which is being called to review the draft Action Plan for the Caribbean Environment Programme.

The document has been based on the nine sectoral overviews (1 - 9), prepared to highlight the economic, social, and environmental problems of the Wider Caribbean Region, as well as additional background information, reports, publications and communications available to the authors.

The document has three sections. The first briefly describes the scope and purpose of the document. The second examines some key issues relating to development and the environment in the Wider Caribbean. The third presents a suggested strategy for an action plan outlining the overall goals and objectives, the elements of the suggested substantive activities and the supporting measures necessary for the harmonious implementation of the action plan.



## 2. SCOPE AND PURPOSE OF THE DOCUMENT

Many of the environmental problems of developing countries, of the world in general and of the States and Territories of the Wider Caribbean in particular, result from underdevelopment. Other problems have resulted from the type of development process typified by the highly industrialized countries of the world and the more developed Caribbean ones. It is not development per se that has caused the environmental problems; rather, it is the type or pattern of development pursued. Although it would be unacceptable to suggest that development be suspended because of environmental concerns, the environmental dimension must be incorporated into the planning and implementation of development so that environmental degradation, with its attendant costs, may be minimized.

Sustainable development must be based on environmentally sound development policies, i.e. on policies that take account of the rational utilization of available resources and the natural capacity of a given ecosystem to support the utilization of those resources, non-renewable and renewable. Uneven distribution of natural resources and population, as well as variation of ecosystems, prevent most (and perhaps all) States and Territories from achieving sustainable development, without close mutual cooperation.

Ecosystems, which include man and his entire socio-economic system, are by definition complexes of mutually interacting plants and animals and their habitats. All ecosystems are characterized by their ability to adapt to changes and modifications. They are in a state of dynamic equilibrium as a result of continuous natural changes caused by forces from within and from without the systems. They have evolved a capability to withstand some man-induced stress before their structure and integrity are disrupted. Indeed, man's actions can enhance the useful productivity of some systems, but there is a limit to the interference they can tolerate. Man is in a position, therefore, to operate as manager of ecosystems for sustainable development, but only if he is aware of their complexity and their reaction to his interventions.

An understanding of the functioning of the local ecosystems is basic to obtaining optimum management of natural resources and to guiding development. There is therefore an obvious need for pertinent data. A large volume of information already exists, but much of it relates to temperate climate ecosystems. A careful search is required to identify information relevant to the ecosystems predominant in the Caribbean, so as to determine gaps in knowledge that need intensive investigation. Great care should be exercised in designing and maintaining data collection systems, since large data systems founded on the uncritical collection of irrelevant information, are very costly; do not necessarily lead to a better understanding of environmental characteristics, processes and problems; and do not necessarily help the decision-making process.

In addition it is necessary to study man's social and economic systems and their interactions with the ecosystems.

The identification of environmental and socio-economic characteristics that may influence development programmes or their impact is a difficult exercise. Too

often, relevant information is presented in a manner that is not readily understandable to planners, administrators and decision-makers, who are not trained in the mix of disciplines necessary for environmental management. There is, therefore, an important need for continuous dialogue among scientists (pure and applied), planners, sociologists, economists and decision-makers. Apart from the creation of such multidisciplinary teams, however, there is a clear need to incorporate the environmental sciences and basic ecology into the training programmes for planners.

As the experience of many highly industrialized countries demonstrates, the cost of corrective action in the medium to long term is many times greater than the initial cost of prevention; in some cases the damage is irreversible, and often the social costs have been found to be quite unacceptable.

The Region is a geographical entity made up of States and Territories with different economic and political structures, national resources, social systems, environmental and ecological characteristics, and potential capabilities. Nevertheless the peoples of the Region share many common development problems, are linked by a common body of water, and are exposed to many of the same natural and man-induced hazards.

Any environmental programme should take account of the lessons to be learned from the recent history of developing and developed countries throughout the world, and the international economic order within which they operate at present. It has been found that the indiscriminate transfer of technologies, life-styles, and development patterns from the more developed countries with a basically temperate climate to the less developed, and basically tropical ones, has been generally unsatisfactory.

It is against that background that a search is taking place for alternative patterns of development, consistent with the resources, social and cultural values, and hopes and needs of the people (endogenous development), together with a new international economic order.

The present document attempts to examine some key issues related to development and environment in the Wider Caribbean Region. The document also considers possible actions which could lead to environmentally sound, sustainable development of the Region, together with financial and institutional arrangements that may be necessary to fulfil the adopted strategies for action.

### 3. DEVELOPMENT AND ENVIRONMENT : SELECTED ISSUES

This section of the document attempts to synthesize the findings of a number of sectoral overviews which explore the interrelationships between developmental activities, policies, and the environment. Presenting a balanced synthesis is difficult because of the cultural, social, economic, and physical differences between these States and Territories (see annex), each with its own developmental priorities, social goals, and values assigned to environmental quality. Rather than emphasize the characteristics of each State and Territory, the overview attempts to identify concerns common to the Region, stressing those that require joint action on regional and subregional levels.

Because of the complex interrelationships within ecosystems, sound environmental management requires an integrated, resource-oriented perspective. This provides a sounder basis for action than does the traditional sectoral approach. Accordingly, the first six parts of this section describe key resources as components of the ecosystems of the Region : freshwater, agricultural, marine and fisheries, wildlife and genetic, energy, and mineral resources. Three important developmental activities that make significant demands on the Region's resources and environment are then described separately : human settlements, tourism, and transport. Industrialization, which makes demands on virtually every resource, is considered in conjunction with a description of each affected resource.

#### 3.1 Freshwater resources

Freshwater resources are unevenly distributed within the Region. Even in those States and Territories where overall resources are sufficient, there are problems of seasonal and spatial distribution.

The overwhelming majority of the fresh water discharged into the sea is carried by comparatively few large rivers, remote from locations which require water supplies. A few of the smaller rivers, whose waters are used, are suffering increasingly from sedimentation and pollution occasioned by upstream activities, mainly industrial. Many water courses are subject to competing demands - as sources of drinking water, for example - and as receptacles for industrial and domestic waste.

On many small islands, especially those with mountainous topography, the residence time of surplus precipitation is extremely short, thereby reducing percolation and accessibility.

The destruction of forest cover in the watershed areas has intensified the problem of water supply in many parts of the Region, since many streams and small rivers which used to maintain satisfactory year-round flows now virtually dry up in the dry season.

#### Water for agriculture:

Although the majority of the agricultural lands in the Region receive annual rainfall in excess of the total required by the crops for satisfactory growth, the seasonal distribution of the rainfall is a major constraint in using it efficiently for agricultural and other purposes.

Given the seasonal rainfall pattern, agricultural production can only be increased through supplementary irrigation during the dry seasons and by extensive drainage systems to avoid flooding and waterlogging in the wet seasons. The costs involved are quite considerable and increasing rapidly.

Because of the expenditure involved, irrigation schemes are often developed primarily for the more lucrative, large-scale, export-oriented agricultural sectors, with only marginal allocations for domestic food crops. This is a serious handicap for the expansion and development of local food production within the Region.

This situation does not necessarily arise from national agricultural policies; it is partly a result of the lack of domestic financial resources needed to implement drainage/irrigation schemes. The countries are forced to turn to the international finance market for loans, which naturally are granted only on the basis of returns on investment and ability to repay the debt in foreign exchange. Thus, countries whose foreign exchange earnings are almost totally dependent on agricultural exports, are in effect caught in a vicious circle.

#### Drinking water:

The goal of supplying adequate drinking water to urban areas appears to be attainable in the majority of the countries. However, the process of rapid urbanization will continue to make urban water supply a major problem in the Region. One of the unsolved problems in the urban areas is the high rate of loss due to leaks and wastage. The reported figures for some cities are as high as 55 to 60 per cent of the total water produced.

Water services to rural areas are less satisfactory than those to urban areas.

Providing for an adequate supply of potable water requires large capital expenditures. For example, a water supply project in Trinidad (population 1 million) for an additional 60 million gallons/day is costing more than 200 million dollars.

#### Water-related diseases:

Contamination of water resources with pathogens frequently leads to enteric infections and some parasitic diseases.

Available information indicates that diarrhoeal diseases are a major health problem in the Region, particularly among children under five years of age. Around 1975, enteritis and other diarrhoeal diseases stood among the five leading causes of death among those under five years of age in almost all the countries for which information was available.

The mortality rates for enteritis and other diarrhoeal diseases vary considerably. In 1975, very high rates per 100,000 inhabitants were reported in Guatemala (979.1) and Nicaragua (678.2), which represented respectively 26.0 per cent and 33.9 per cent of the total number of deaths for these countries. At the other extreme, Barbados (29.7), Cuba (44.0) and Puerto Rico (22.1) showed the lowest rate per 100,000 in the Region.

Typhoid fever is another enteric infection, mostly caused by polluted drinking water. The available information shows a very high average annual typhoid fever rate per 100,000 inhabitants for Haiti (56.7), Colombia (32.4), Honduras (24.1), Dominican Republic (19.0), and Dominica (21.7).

Malaria is reported to have disappeared or never existed in most of the States and Territories of the Region. Isolated cases, however, have been reported from Honduras, Nicaragua, Guatemala, Colombia and Haiti. Recent increases have been observed in several countries.

Schistosomiasis is endemic in Martinique, but is on the retreat from the few countries known to suffer from it (Puerto Rico, St. Lucia, Suriname).

Cases of hepatitis were consistently reported at high levels during the five-year period 1972-1976, as indicated by average annual rates of 74.9 per 100,000 population in Costa Rica and 167.8 in Cuba. However, mortality data indicate that the death rate from infectious hepatitis was low, below 1 per 100,000 in almost all the countries, with the exception of Belize which reported 2.3 (1973), 3.7 (1974), Costa Rica 1.0 (1973), Mexico 1.0 (1973) and Suriname 1.9 (1975).

Epidemics of dengue have occurred in the Region in different periods of this century. They continue to occur in many areas still infested with the Aedes aegypti mosquito, the dengue vector. A major dengue pandemic broke out in the Caribbean in 1977, although no cases of dengue haemorrhagic fever or dengue shock syndrome were confirmed.

Outbreaks of jungle yellow fever have occurred in recent years in Colombia, Panama, Guyana, Suriname, and Venezuela where the disease is endemic in monkeys living in forested areas. Available data seem to indicate a gradual shift of the disease towards the north and north-eastern part of Colombia and a wider geographic spread of the disease over the continent. Also, in 1979, a few cases occurred in Trinidad and Tobago where none had been reported over the previous decade.

Aedes aegypti eradication campaigns are proceeding in most countries, but progress has been slow.

### 3.2 Agricultural resources

The diverse soil resources of the Region include 517,525,000 hectares, of which 9.7 per cent are classified as arable and permanently cultivated, 22.7 per cent pasture, 50.3 per cent forest, and 17.3 per cent miscellaneous. There are four main problems relating to utilization of these resources : erosion, salinization, waterlogging, and chemical degradation.

The most serious problem affecting the soils of the Region is erosion due to specific soil characteristics, type of vegetation cover, intensity of rainfall, winds, topography, and inappropriate agricultural practices. The most vulnerable areas are the Greater Antilles and parts of Venezuela, Colombia, Guyana, and Trinidad and Tobago. Apart from soil degradation, an example of the costly effects of erosion is the Archicaya dam in Colombia: after only 21 months the reservoir was one-quarter full of erosion sediment, and after ten years silt took up three-quarters of its capacity. Desertification risk due to soil erosion is high in some parts of the Region (parts of Mexico, including the Yucatan peninsula).

It is estimated that Panama has 1 million hectares of eroded soil, Venezuela ten times more.

Salinization, mainly due to poor soil management practices, is in comparison a minor problem affecting an estimated 0.7 per cent of the total land surface of Central America, primarily Mexico. Saline intrusion is also an important cause of salinization in some islands.

Waterlogging is a minor agricultural problem for the Region, mainly associated with river deltas, plains, some savannahs, and coastal basins in Guyana, Suriname, French Guiana, and the Orinoco delta.

Chemical degradation is a specific but minor problem of some soils due to the toxicity or lack of some minerals.

#### Soil utilization:

Significant changes have been observed in soil resource utilization. For example, since 1969, arable and permanently cultivated land increased by 4 million hectares (8.6 per cent increase), while land for urban and industrial development, road construction and as waste land increased by 7.5 million hectares (9.1 per cent). Some of the agricultural problems relate to availability of arable land, which is under high pressure from urban and industrial developmental activities. The per capita arable land of the Lesser Antilles is 0.13 hectares, one-third of the average for the whole Region.

The agricultural output required for the population of the Region is inadequate since a significant proportion of arable land is under permanent export produce such as sugar-cane, bananas, coffee, cocoa, and cotton. The Region is increasingly dependent on imported edible oils, cereals and dairy products. Dependency on imported cereals increased from 6 per cent (1955-1960) to 46 per cent (1965-1970) and 60 per cent (1971-1975) of total food imports.

The large export-oriented systems, in addition to causing environmental degradation of the soil through monocultural practices, generally lead to increasing marginalization of a large section of the farming community, thus contributing to the flow of landless population into urban areas with all the environmental consequences of rapid, unplanned growth of such new areas.

Agricultural practices, especially in the continental subregions, have been constantly modifying the agricultural frontiers by removing the protective forest cover, possibly causing unwanted, negative, environmental changes in micro-climate, availability of water resources, soil erosion, etc.

The major environmental problems associated with agricultural activities stem from the utilization of unsuitable soils. The problem has arisen partly because of the land tenure situation in which the bulk of the farmers are forced on to marginal lands because the best lands are being occupied by comparatively few farms. However, it should be emphasized that mere redistribution of land cannot and does not solve the problems of misuse of the resource. For land reform to be truly effective, it must be carried out simultaneously with educational programmes, and mechanisms must be found for the farmers to have access to credit and technology. An additional related problem for the small farmer is the lack of adequate storage facilities, transport and access to markets.

In some cases, particularly in the smaller islands, there is insufficient suitable land even if the land tenure system is satisfactory. Also, large-scale farming is often characterized by under-utilization of the resource.

#### Pasture lands:

The pasture lands of the Region (117,457,239 hectares) are used for direct foraging of animals, mainly beef cattle and dairy cows. In the last ten years, there has been a reduction of the pasture lands by 105 million hectares, which have been turned over to other types of use.

Over-grazing is the main environmental problem associated with inappropriate utilization of pasture lands, leading to severe soil erosion (water and/or windborne) and soil degradation. In general this is a problem associated with small farms, particularly in Central America and the insular Caribbean. In the interior plains of Colombia, overgrazing plus seasonal burning created in 1979 massive attacks of insects and complete destruction of pasture.

#### Forest lands:

The total area under forest was estimated for 1975 as 221 million hectares. Since 1966, ten million hectares have been lost and, taking into account present forest management practices, the forest area is expected to shrink to 194 and 175 million hectares by 1980 and 2000, respectively. Many areas originally covered by forest could not be reforested, since centuries of man's activities have changed the basic characteristics of soils and the topography. Barbados, once completely forested, no longer has any forests; Colombia and Mexico are losing substantial forest lands. Development of commercial forests frequently led to serious environmental damage. Nevertheless, reallocation of forest land may be beneficial if its consequences are considered and found acceptable.

The most serious ecological consequences of deforestation are erosion and the disturbance of the hydrological equilibrium. Erosion leads to destruction of the soil characteristics and fertility and, in hilly or mountainous areas, encourages landslides. Disturbance of hydrological equilibrium affects the surface water supply of the river basins, leading to extremely exaggerated differences in river flow between seasons, reduction of underground aquifer recharge, sedimentation of rivers, estuaries, swamps and coastal areas, as well as to increased incidence of flash flooding. Also, because of changed surface-air moisture equilibria and the reduction in evapotranspiration, changes in micro-climates occur, and in severe cases of deforestation major large-scale climatic changes can occur, leading to serious drought or desertification.

The environmental effects of deforestation in the humid tropics are quite different from those in the temperate regions of the world. The humid tropics are, in general, subject to far higher annual rainfall, and this precipitation is also much more intense for longer periods. For example, hurricane Flora reportedly caused extensive damage in deforested areas of Cuba, yet relatively insignificant losses were reported in natural forest areas. A similar situation occurred in Honduras when hurricane Fifi struck that country.

Another significant problem associated with deforestation relates to the fact that, in the tropics in general and in the humid tropics in particular, the nutrient cycle is very rapid. Most nutrients are found in the first few centimetres of soil and in the vegetation itself. Consequently, total elimination of the forest biomass means that the majority of the nutrients are lost from the ecosystem and a poor soil is left. This can create serious obstacles to reafforestation efforts if the two activities are not undertaken at the same time.

One of the prime causes of deforestation in much of the Region is the migratory agricultural practice of clearing land using the "slash and burn" technology.

Much deforestation is carried out in order to extract mineral resources; to shift rapidly increasing, almost uncontrollable urban populations; and to increase agricultural land urgently needed to feed the growing populations.

#### Agricultural chemicals:

Although chemicals can be beneficial to agricultural production (fertilizers, pesticides) and in food-processing, there are frequent negative side effects such as occupational diseases, accumulation of pollutants in the ecosystem, and impairment of agricultural productivity. In Colombia, for example, the export-oriented cotton industry has suffered an economic crisis as the result of massive utilization of pesticides, which created genetic resistance and eliminated competition in the associated fauna without controlling it.

The widespread use of pesticides is resulting in frequent pesticide intoxications: in the period 1971-1976 more than 8,000 cases were reported from Guatemala.

High levels of pesticide residues have been found in meat and other food products, especially in the cotton-growing countries. It has been estimated that 85 per cent of the pesticide consumption is being used on cotton. Guatemala has reported the highest values in the world of DDT contamination in human milk.

An area of concern is lead and cadmium contamination of canned fruit products, probably due to the use of cans without resin protection. High levels of lead have also been found in cereals.

### 3.3 Marine and fisheries resources

Fish protein forms a significant part of the protein intake of the peoples of the Region, and fisheries figure prominently in the national economies. This is especially true of smaller islands, which lack facilities for livestock production. Although for mainly historical reasons, much of the fish requirement is currently imported, Caribbean fisheries are developing and expanding.

The total estimated potential of fisheries resources for the Region's continental platform ranges between 3 and 4.5 million tonnes per year. The theoretically sustainable exploitable potential is between 1.3 and 2.6 million tonnes per year.

Data on the amount of these resources actually extracted are incomplete. Data on fishing by countries from outside the Region are missing altogether. Incomplete data from countries of the Region indicate that their present fishing practices are unlikely to result in overexploitation of their resources over the continental platform, except possibly in localized areas.

The most significant fishery activities of the Region are to be found at the Campeche Bank in the Gulf of Mexico, at the Mosquito Bank in the Caribbean Sea off the coasts of Honduras and Nicaragua, in the Gulf of Paria between Venezuela and Trinidad and Tobago, and the coastal waters in the Guyana-Suriname area.

Because of a pronounced lack of upwellings and the existence of a stable thermocline in the Caribbean, nutrient-rich waters do not rise to the surface. This results in a generally low level of zooplankton in the food-chain and in significantly smaller populations of exploitable fish. As a consequence, coastal mangroves, estuaries, and coral reef communities play a proportionately large role in providing nutrients and breeding grounds for many species.

Coastal and inland fishing in the Region is mainly artisanal in nature.

Few or no statistics relating to inland fisheries or aquaculture in the Region are available. Inland fishing is generally carried out in a small, unorganized, private



capacity, with much of the catch being consumed by the fisherman and his family, and any remainder being sold outside the commercial market. Aquaculture is little developed in the Region.

Stresses: Natural environmental conditions in the Region impose a high stress on marine life, particularly in inshore areas, which often leads to natural fish kills. The superimposition of man-made stresses could lead to a reduction in the sustainably exploitable fisheries resources.

One major man-made stress is destruction of habitats through such activities as development of marinas, harbours, and coastal resorts. Inland activities, such as the construction of dams and canalization of rivers, may also influence migratory species and affect the quality of the marine environment.

Another major stress is pollution by industrial, agricultural, and urban wastes. The type and amount of pollutants affecting fisheries resources in the Region have not been quantified. With growing industrialization, urbanization, and coastal tourism, the problems associated with water pollution will increase considerably in the years to come if measures for control are not accelerated.

Less than 10 per cent of total domestic waste receives treatment before disposal. Much of this waste reaches rivers, inland waters, and coastal waters, causing severe local damage to fisheries.

Pollution from the sugar industries and distilleries, characterized by high BOD, suspended solids, and high pH values is familiar in most Caribbean countries. No figures are available, but visual evidence indicates that most of the streams and inland waters receiving effluents from these industries are putrefied due to the resulting anaerobic conditions.

Effluents from refineries are causing extensive damage to water courses and coastal waters.

Several harbours in the Region are experiencing accelerated eutrophication because of the disposal of inadequately treated domestic and industrial wastes.

Offshore oil drilling presents another danger to fisheries of the Region, in particular to the coastal shrimp industry. The recent IXTOC-1 blow-out off Ciudad del Carmen in the Gulf of Mexico has demonstrated the possible environmental consequences of accidental oil spills.

The transport of large amounts of toxic chemicals, oil in particular, is another potential source of pollution that may affect fisheries. Although the oil spill caused a few months ago by the collision of tankers off the Tobago coast does not yet appear to have caused significant damage to the fisheries resources of the Region, another accident of the same type might not end so fortunately.

### 3.4 Wildlife and genetic resources

Tropical ecosystems have the greatest diversity of species, and the Caribbean area follows this pattern.

Wildlife, at present, is mainly related to land areas commonly considered as marginal from the productive point of view, although they may cover nearly 40 to 50 per cent of the total surface of the Region. Enormous numbers of wild plant and animal species are currently used for food and feed; for traditional medicine; as

hides and skins, trophies and pets; and as raw material for cosmetics, drugs, local handicraft products, oil, building, and other purposes.

The degradation of the wildlife resources is considerable. Forty per cent of the global vertebrate extinction has occurred in the Caribbean. Compared to 40,000 marine turtles hatching on the Gulf of Mexico in 1974, only 700 were found in 1976 and 450 a year later. The white-tailed deer, the wild rabbit, and the spider monkey have disappeared from El Salvador. They were formerly used as important protein sources by local farmers.

Habitat destruction and overexploitation are the main causes of this sad state of affairs. In the absence of appropriate research and statistical data, it is difficult to assess the magnitude of the ecological and economic damage brought about by such extensive loss of wildlife, but perhaps the most serious consequences are in terms of lost or endangered genetic resources.

The recent extinction or replacement of indigenous species by imports has greatly eroded the genetic resource base of the Region. The irreplaceable value of the indigenous species stems from their excellent adaptability to local conditions and their higher resistance to pests and diseases indigenous to the Region. They thus constitute a valuable reserve as potential genetic resources to be used in cross-breeding and in implanting resistance in other species or breeds that are more vulnerable to some diseases or less adapted to local environmental conditions.

### 3.5 Energy resources

The energy resources of the Region are unevenly distributed. As developmental potential is to a large extent dependent on energy resources, the future rate of development of each Caribbean State and Territory will depend on the use it will make of its own energy resources and on co-operative arrangements with other States in the field of energy.

At present oil and gas provide most of the energy required for development. Petroleum accounted for nearly 55 per cent of regional energy consumption in 1977, natural gas for 12 per cent, solid fuels 20 per cent, hydro 13 per cent, and nuclear less than 1 per cent.

Operational and accidental losses of crude oil are only part of the environmental problems associated with the exploration, exploitation, and utilization of oil and gas. Waste products of oil and gas combustion in industry, in internal combustion engines, and in domestic installations, are causing heavy air pollution. The formation of heavy smogs over densely populated urban areas is causing serious health problems requiring urgent solutions.

Although the Region is highly dependent on petroleum as its major commercial source of energy, firewood still plays a significant role. Gathering of firewood remains a significant cause of deforestation, with all its negative environmental consequences. Firewood and charcoal are estimated to supply 80 per cent of the domestic energy used in rural areas. It is likely that several countries will increasingly turn their attention towards their forests to seek at least a partial solution to their deficiency in alternative indigenous sources of energy. Adequate forest management could raise present yields, providing a continuous supply for domestic consumption and for export.

Biomass other than firewood, based on agricultural products and residues, may have a significant future as a renewable source of energy in the Region. It could be a

supplementary supply for some States and Territories that have limited prospects of being self-sufficient in terms of energy supplies from more conventional sources. Direct combustion of agricultural residues is just one, perhaps not the most important, use of biomass. Aerobic fermentation of sugar- or starch-bearing crops (sugar cane, cassava) for production of alcohol as fuel, or anaerobic digestion of vegetal and animal wastes for the generation of biogas, are promising and environmentally-sound technologies which could, on various scales, replace the currently used energy resources. The former is of particular importance as it could produce a partial substitute for fuels used in internal combustion engines (automobiles), while the latter could easily meet many of the local energy needs of farms and small communities.

Only a few States exploit coal reserves to an appreciable degree, although recent prospecting shows that coal could represent an alternative solution to the energy problems of some of the countries. Combustion of coal, even more than oil, can lead to serious pollution problems.

Hydrological energy reserves are mainly concentrated on the mainland, with a few minor exceptions. Hydroelectricity, compared with conventional thermal generation of power, seems to be a non-polluting and renewable source of energy. However, hydropower can also have an indirect negative impact on the environment, in particular when its generation is linked to dam construction. The large reservoirs created by damming river valleys can contribute to the spread of certain tropical diseases by providing habitats for disease vectors, to climatic and ecosystem changes, and to changes in the socio-economic structure of the communities affected by the construction of artificial lakes in places which have been traditionally used for other purposes.

Geothermal energy is used as an alternative energy resource in some countries of the Region. If no precautions are taken, air pollution (heavy metals, sulphuric acid, ammonia and others) in the vicinity of the geothermal power plants can sometimes be considerable and can affect human health, livestock, and the natural composition of the adjacent ecosystems.

The Region, due to its location on the globe, is suitable for the exploitation of solar energy. While large-scale applications of sophisticated technology (solar cells) may not now compete economically with other types of energy generation, small-scale use of solar energy for water heating, crop drying, and solar pumps could in many instances be considered as economically and environmentally sound alternatives.

### 3.6 Mineral resources

#### Oil:

The production, conversion, and transportation of petroleum and petroleum products are the most significant economic activities of the Region as a whole. The location of the area, with respect to the major petroleum producing areas in the Middle East and the major consuming areas of the north-eastern United States and Canada, has made petroleum products even more dominant within the Region.

The total crude oil production of Venezuela, Mexico, Trinidad and Tobago, Colombia, and Barbados was 3.6 million barrels per day in 1977. Since then the production figures have increased considerably, largely due to the increase in Mexican production.

Petroleum refining is fast developing in most of the oil producing countries. The refining capacity of the Region has increased in the 1973-1980 period by 27 per cent (Dominican Republic 190, Mexico 121, Bahamas 100, Virgin Islands 87 per cent) and exceeded 6 million barrels per day in 1978.

No region-wide figures can be given for refinery pollution in the Caribbean. However, when compared to the volume of petroleum hydrocarbons (PHCs) entering the ocean from exploration and production, coastal refineries account for almost twice the PHC volume from exploration and production activity. Refined products are also much more persistent and long-lived in the marine environment than crude oil, so they may pose a more serious long-term threat.

Losses of PHCs occurring from marine transport account for up to one-third of the total volume of PHCs entering the oceans. On the basis of the limited evidence available for the Caribbean, it appears that much of the pollution originates from losses and dumpings from tankers.

#### Mining:

At the end of 1977, no fewer than 56 large-scale mining operations were in production in the Region : 30 in the Central American subregion, 10 in the South American subregion, and 16 in the Greater Antilles. The most important minerals mined over the ten-year period 1967-1976 included gold, silver, copper, lead and zinc, iron, bauxite, manganese and nickel.

Over the ten-year period, the Region produced on average, 16.7 per cent of the world's gold output, with a peak of 30.9 per cent in 1976. None of the gold mines and mills in the Central and South American subregions were located on the coast, save an underground mine in Santa Barbara, Honduras, about 80 km from the Caribbean coast. In the Dominican Republic, the Pueblo Viejo gold mine and cyanide plant at Sanchez are very near the north-eastern coast. Plans are under way to expand operations here, following discovery of a deposit at Los Cacaos. Mercury is also being recovered at Pueblo Viejo.

Regional bauxite production has been impressive in the past. Over the ten-year period 1967-1976, the Region averaged 37.4 per cent of the world output. Production came from five countries : three islands and two countries in South America. In all cases, the environmental impact of mining activities on the coast has been considerable. In Guyana and Suriname, the deposits are near rivers, a little over 80 km from the coast, and the interaction may not be as severe as in the case of the island countries.

Bauxite processing is concentrated in the developed countries, not in the ore-producing countries. The Region accounted for over 37 per cent of the total ore production of the market economies in 1976, but for only 19 per cent of the world's production of aluminium. A considerable proportion of the benefits from bauxite extraction are therefore lost to the Region. In response to this, a number of initiatives have been taken within the Region, particularly with regard to increasing regional refining and smelting capacities.

Available information suggests that management of waste resulting from bauxite mining and processing (red mud) may be a problem in some areas, e.g. in Jamaica, and that very little treatment of wastes takes place in general. The production of over 2.5 million tonnes of alumina in Jamaica, in 1976, resulted in the production of about half a million tonnes of waste. From bauxite processing in Suriname, over 2.5 million tonnes of waste were produced, while in Guyana the figure was only about half a million tonnes. With respect to the continental countries, these figures may

not be significant, but on the islands, given the smaller surface area, they may have a greater impact.

Regional production of silver has not been as impressive as that of gold, even though most of the silver produced is in association with gold production. Production, mainly from Mexico and Honduras, has been 14.9 per cent of world production over the 1967-1976 period.

Iron ore is produced on a large scale within the Region. At least 11 large-scale operations exist in Venezuela, Mexico, and Colombia. Given the deposits discovered but not yet exploited, iron ore will play a major role in the Region in the future. None of the major operations are located within the coastal area save those at Puerto Ordaz and San Felix on the Orinoco River in Venezuela.

Regional nickel ore production amounts to an average of 7.4 per cent of world output. Cuba and the Dominican Republic are the major producers in the Region.

Small-scale mining in the Region accounted for the production of about 6 per cent of the world's annual output of antimony during the period 1967-1976. A considerable amount of lead and zinc were also produced as by-products in silver and gold extraction. Small amounts of magnesite, manganese, mercury, molybdenum, and tungsten : phosphate rock in the Bahamas, Cuba and the Netherlands Antilles; and a variety of other industrial minerals including salt, sand and gravel, kaolin, asbestos, and gypsum were also obtained.

The Region is a net exporter of salt. For some of the island countries, this commodity is a significant foreign exchange earner. In the Turks and Caicos Islands, for example, salt is the only known mineral wealth.

A potentially important mineral in the island States and Territories is the iron-bearing magnetite and titanium-bearing ilmenite. Commonly referred to as beach sands, these metalliferous sands, when processed, yield titanium dioxide, the most important component of titanium.

Another mineral product of increasing importance in some of the islands is aggregate. Fine aggregate in particular, is obtained from mining beach sands in almost all the islands. These activities, although they represent a significant economic benefit, are the single most destructive human activity in terms of beach erosion in many of the islands.

Beach mining operations have seriously disturbed coastal and marine ecosystems. Where nursery or spawning grounds are present, losses in fish stock may occur. In addition, several island countries in the Region, in seeking to establish or increase tourism, rely upon the natural attributes of unspoiled beaches, clear waters, and coral reefs. Sand and silt disturbed by the mining operations may not only cause temporary increases in turbidity of the water, but may blanket benthic communities and smother coral reef communities.

The generation of waste and waste products and their management in the mineral industry, especially with regard to the coastal areas, is of great environmental concern, although the simple fact that wastes are present in the environment does not per se indicate pollution.

Apart from the environmental consequences of inadequate protective measures in the exploitation of mineral resources, a large number of occupational diseases have been recorded in many States and Territories of the Region. The most serious include silicosis, lead and arsenic poisoning, and asbestosis. In Colombia, 13.6 per cent

of the mining population is affected by silicosis. Among the industrial workers, rates of 5.2 per cent for silicosis, 23 per cent for asbestosis, and 10.3 per cent for lead poisoning are reported.

### 3.7 Human settlements

The Region is characterized by the uneven spatial distribution of its population. Data on population density per country frequently do not show this clearly because they do not reflect the often very uneven distribution of population within a given country. This has to be taken into account when considering the apparently low density of the Region as a whole.

The islands of the Antillean Arc have reached such a high population density that any significant further increase in their population would endanger their carrying capacity. (All these islands have more than 100 inhabitants per km<sup>2</sup>, with the exception of Cuba and the Dominican Republic, which have less; Barbados has over 550/km<sup>2</sup>.) As most of these islands (with the exception of Cuba and the Dominican Republic) have few flatlands, the high population density results in a very intensive land use of hills and mountain slopes causing serious environmental degradation.

In contrast to the islands, the continental countries of the Region have a population density of slightly more than 25 inhabitants per km<sup>2</sup>. Almost all these countries have therefore relatively large territorial reserves to accommodate an expansion of their populations. El Salvador is an exception. Its limited territorial extension, coupled with rugged topography and a markedly high population density (169.5/km<sup>2</sup>), makes it very similar to the highly populated islands of the Caribbean.

Historically, the populations of tropical Latin America settled in the valleys, plateaux, and watersheds of the highlands, i.e. in the less humid lands where the ecological conditions favoured human life. In Central America these lands are either near the Pacific Coast or are hinterlands far away from the coasts and separated by topographic barriers.

In recent times, the population of the coastal areas of the Region has experienced a marked increase, showing a continuous trend towards the occupation of these areas. As the population pressure will probably further increase, if adequate administrative measures are not taken, it could easily lead to unacceptable environmental and social consequences.

Venezuela and Colombia are the only countries with trends of population increase in the hinterlands. On the Caribbean coasts of these two countries, high increases in population densities occur only in very specific areas, influenced principally by the expansion of existing cities. Due to the very low population densities existing at present in the interior plains of these countries and expected growth rates of lower magnitude, the foreseen stress is different from that of the Central American subregion.

The population settled in cities and towns of over 20,000 inhabitants showed a marked growth, particularly in the 1950-1960 decade. The number of cities increased by a factor of 2.5, whereas the population of these cities practically tripled during the 1950-1970 period.

The annual growth rates for urban population were exceedingly high in comparison with total population growth for the whole Region except for the Bahamas and Belize,

in the period 1960-1970, and Suriname throughout the two last decades. Nevertheless, rural population in the Region was still preponderant in 1970.

The lowest urban growth rates and urbanization levels correspond to the insular countries of which more than 45 per cent, in 1970, did not have urban centres of 20,000 inhabitants or more. On the other hand, the highest urban levels were found in the north and north-west region of South America.

The largest percentage increases, both in numbers of cities and in population, occurred in cities having populations between 500,000 and 1 million inhabitants; up to 1950, these were almost non-existent. However, if absolute numbers are considered, it becomes evident that there was a greater proliferation of the smaller-sized cities than those with populations between 20,000 and 50,000, whereas the largest increases in population occurred in medium-sized cities, i.e. those with populations between 100,000 and 500,000. These data suggest that if the observed trend continues, the number of large-sized cities, i.e. those with populations ranging between 500,000 and 1 million, will increase significantly by 1980.

Density of occupancy figures, taken as an indication of housing needs and the percentage of the population covered by basic services, show serious deficits for most, if not all, of the countries of the Region. Between 1960 and 1970, no country had been identified as having produced sufficient dwellings to keep up with demographic growth. At the beginning of the decade, Venezuela was one country whose annual housing production most closely corresponded to demand (75 per cent of the required number). Mexico, however, produced annually 30 per cent of the required number during the decade. The equivalent figures for Costa Rica and Guatemala were 27 and 9 per cent respectively. It is assumed that these figures refer largely to urban areas, since very few of the countries mentioned had rural housing programmes.

In urban areas the results of this situation are slums and squatter settlements, the latter being more typical of the continental countries and the former of the islands, although both types are present in all countries. These "precarious settlements" have received considerable attention over recent years, both as objects of study and policy. This is so because of the high proportion of the urban population they house and their rapid growth rates, frequently greater than overall urban growth rates. In many cases, the uses of these areas have changed with time, tending towards increased density as spaces originally utilized as one-family dwellings are progressively subdivided. This represents a deterioration in the service/inhabitants ratio, which is accelerated to the extent that the maintenance of existing services is neglected.

Rapid growth of metropolitan areas has implied in many countries the absorption of agricultural land by settlements. The only settlement reserves left to Mexico City, for example, are agricultural lands. It is calculated that currently 40 per cent of the population is settled illegally on such lands, while by 1980, 26.5 per cent of the agricultural land around the city will have been absorbed by settlements. Similar encroachment is also reported for San José, Kingston, and Bogota.

Urbanization can also increase problems of flooding, when deforestation and large earth movements are not accompanied by adequate drainage. This occurs, for example, in Venezuela where it is estimated that 25 per cent of settlements of more than 2,000 inhabitants have a high flood potential.

Inadequate coverage of piped waste and sewerage systems determine, on the one hand, that an important part of the urban population resorts to polluted surface waters for their needs, and, on the other, that sewerage is dumped directly into the nearest water courses and often finds its way into the underground water layers.

Large metropolitan areas make enormous demands on water resources, and sometimes sources in the nearby surrounding areas do not suffice. Wastage due to bad maintenance aggravates the problem. Increased infrastructure using more distant sources not only affects costs but can also prejudice activities such as agriculture.

The availability of urban sewerage services has failed to keep up with the extension and improvement in water supplies, and there is little, if any, sewerage service outside the urban areas. The situation appears more critical in the insular Caribbean where 60 per cent of the islands reported few or no services. The available statistics indicate that the percentage of population connected to sewerage systems remained static between 1970 and 1975.

Air pollution is becoming more and more important in urban areas in the Region, mainly as a consequence of the effluents from industrial plants and of increased motorized transport.

Natural disasters constitute an additional constraint on human settlements. The most common disasters affecting the Region are earthquakes, volcanic eruptions, hurricanes, and tropical storms. Their frequency and the extent of damage they cause (in terms of lost lives, destroyed property and disrupted fabric of the society) require that a strategy for their mitigation be adopted. This strategy, although national in principle, requires a great deal of inter-country co-operation, as it can be based only on adequate disaster preparedness, which is most frequently beyond the economic capability of the smaller States and Territories.

### 3.8 Tourism

Tourism in the Region is most closely linked to the coastal environment, although in countries such as Mexico and Venezuela coastal tourism and recreation may be relatively secondary in economic terms.

While Mexico dominates the Region's tourist industry in terms of "tourist arrivals", the economic and environmental significance of tourism is much greater for some of the small States and Territories of the insular Caribbean. In the Bahamas, for instance, tourism contributes 77 per cent of the country's gross domestic product. The figures for Antigua are 40 to 50 per cent, for Barbados 20 per cent, for Jamaica 6 per cent, indicating the importance of tourism to these countries, but also their vulnerability to the fluctuations in the tourist market.

Benefits from tourism are frequently questionable, as development of tourism can have unpleasant economic, ecological, social, and cultural side-effects. It often results in inflated land values. High wages in tourist industries often lure labourers out of menial, but essential jobs, and result in alienation of agricultural land when small farmers leave their land to work in urban tourist areas. Governments must spend significant amounts on infrastructure, such as power, roads, and sanitation for tourist complexes; this is often counted as a social cost, but it can also permit extension of these services to the local population, by virtue of economies of scale, and therefore there is a social benefit in this category of expenditure. High import bills for construction material, food and beverages, and furniture are endemic to the Caribbean tourist industry, and reflect the inability to create and exploit significant links with the national economy.

Tourism stimulates contacts and exchange of ideas among people of different cultures, but it can, and frequently does, lead to resentment and erosion of local values and customs essential to the social structure of the indigenous population.



The effects on coastal resources, which provide the basis for shore-based tourism, are usually on water quality. Local pollution occurs when tourist influxes cause waste loadings to exceed seasonal maxima; occasionally shellfish beds are affected. A particularly important problem in the Caribbean is the partial destruction of coral reefs through visitor-related damage; Bucco Reef in Tobago is a classic example.

### 3.9 Transport

Maritime transport is the major transport activity of regional relevance, and because of the strong dependence of the Region on imports and exports, ports and harbours play an important role in the economics of the Region.

Ports and harbours are large direct consumers of coastal space, including areas for infrastructure. The risk of spills, discharge of noxious fumes, explosions, or fire requires the use of safety exclusion areas. Ports act as magnets, attracting the working population, who wish to minimize their transport costs to work; this, in turn, attracts commercial enterprise, particularly services, which have a ready market.

Petroleum plays a particularly large part in the transport economy of those island States that are near continental oil and gas resources, or that are sufficiently close to ultimate markets to be utilized as trans-shipment and intermediate processing points for crude being imported into North America; Trinidad and Tobago, the Netherlands Antilles, and the Bahamas are cases in point. Additionally, many of the island States and Territories operate refineries for their own needs, so there is a twofold need for oil terminals throughout the Region.

The concept of the "Free Trade Zone" or "Free Port" has induced extensive industrial development in some areas of the Caribbean. In Colombia, for example, the Port of Barranquilla, a free zone which started as a commercial centre in 1964, has become an industrial and manufacturing complex of 70 companies with 16,000 employees. In Panama, the Colon Free Zone, first established in 1948, now employs more than 5,500 regular workers and 1,000 "occasional" workers. This distribution and light manufacturing area now has a business volume of 1.5 billion dollars per year.

Coastal area land use varies significantly depending on the type of ports. Certain categories of facilities require large exclusion areas or remote siting because of potential hazards associated with the commodities handled (e.g. LNG, and LPG). In other cases facilities may be land-intensive because of storage requirements. This holds true for tank farms used for the storage of crude oil or refined products. It is also true of storage areas associated with container terminals, though not to as great an extent as for petroleum.

During the second half of the 1970s, there has been a marked increase in the development of container terminals in the Region.

The environmental constraints related to the fast-expanding maritime transport include pollution of coastal waters as a result of operational losses during loading and unloading operations (crude oil, bulk chemicals, ores) and of accidents involving loss of substances that could affect the marine ecosystems.

The development of trans-shipment terminals in the Region is a cause for special concern. At these terminals, which are designed to cater for vessels of deeper draft, smaller tankers destined for the north-eastern coast of North America are filled with crude oil from very large crude carriers. They themselves are not

likely to increase the present pattern of accident risks, but the density of the smaller tankers most probably will. This is especially the case when they pass through waters such as the Mona Passage.

#### 4. SUGGESTED STRATEGY FOR ACTION

Development is being increasingly understood to be the use of natural resources in such a manner as to improve the quality of life of the majority of the population, especially the disadvantaged. Implicit in this, there is a need for increased popular participation, more equitable distribution of benefits, increased access to resources and sustainability of the development process over the long term.

It has been widely established that the achievement of meaningful (and sustainable) development involves the application of sound environmental management.

Sound environmental management requires integration of the environmental dimension into the development process. This integration is suggested as the basic objective of the Action Plan for the Caribbean Environment Programme.

##### 4.1 Goals and objectives

The Action Plan should provide a framework for activities requiring regional co-operation in order to strengthen the capability of each country to implement sound environmental management and thus to achieve sustainable development for the people of the Region. In order to achieve these goals and objectives, the co-operation should specifically include:

- (a) assistance to the smaller (island) States and Territories;
- (b) use of the Region's (scarce) human, financial and natural resources through technical co-operation between developing countries (TCDC);
- (c) regional self-reliance through the sharing of experience on common problems;
- (d) co-operation on problems of transnational or international nature, including natural and man-induced disasters;
- (e) stimulation and co-ordination of international assistance activities;
- (f) strengthening of the existing national and subregional institutions;
- (g) demonstration of the Region's appreciation of the importance of the environment/development process;
- (h) increasing public interest in, and awareness of the environment/development process.

##### 4.2 Substantive activities

Environmental assessment:

Assessment of the environmental processes of the Region is incomplete. Because sound action requires an understanding of the intricate links between development

and the environment, there exists a need for continuing systematic assessment of the main factors influencing environmental quality. Among the tasks that should be performed are the following :

- (a) Assessment of national and subregional capabilities to investigate and manage environmental processes, including scientific and administrative institutions, manpower, research facilities, and equipment;
- (b) Identification of institutions with a potential to serve as "centres of excellence" in particular disciplines and as (sub)regional activity centres co-ordinating specific inter-country projects;
- (c) Collection and analysis of data on the quality of the environment and on the process influencing this quality;
- (d) Assessment of characteristics of natural and man-induced disasters and of opportunities to mitigate and respond to their consequences;
- (e) Collection and analysis of data on resource potential of the Region;
- (f) Analysis of data on competing demands for resource utilization;
- (g) Assessment management practices to enable States and Territories to make effective use of data obtained on environmental characteristics.

Groups of States and Territories within the Region have distinctive assessment needs, that should receive special attention within the framework of the Action Plan. This is particularly so in the case of the islands, the entire area of which can be considered a coastal zone.

Data collected through the various assessment activities, in particular those on research and management practices, should be disseminated throughout the Region.

#### Environmental management:

The key to sustainable, environmentally-sound development is the management of the resource base. Such management should take into account the carrying capacity of the environment, the goals of development as defined by relevant national authorities, and the economic feasibility of their implementation.

Most of the Region's environmental needs can best be satisfied, and will continue to be principally dealt with, by individual States and Territories. Regional and subregional co-operative action, however, can strengthen and supplement national efforts, particularly in attending to joint concerns which by their nature lie outside the control of any single country. Sands that nourish a country's beaches, for example, larvae essential for its fishing industry, an oil spill, a natural disaster, may all cross international boundaries. In addition, co-operative regional and subregional action can be especially beneficial to the States and Territories, which have a limited capability to deal with environmental problems.

Possible types of regional and subregional action are numerous, including international consultations, co-operative research, networking of national institutions, and many others. Although specific actions can only be chosen by the participating Governments, the following appear to present important opportunities for regional or subregional co-operation:

- (a) Strengthening or expanding the relevant ongoing national, regional or internationally supported development activities which demonstrate sound environmental management practices;
- (b) Co-ordination of national research and development activities for improving the quality and quantity of agricultural products needed primarily for local consumption, including soil management and biological pest control techniques;
- (c) Co-operation in the exploration and utilization of fisheries and forest resources to achieve the most rational utilization on a sustainable basis;
- (d) Co-operation on preparedness for natural disasters and measures to mitigate their consequences;
- (e) Research on, and development of, locally applicable low waste and pollution control technologies;
- (f) Studies on the environmental, social and cultural effects of tourism and the development of alternative strategies for tourism development;
- (g) Harmonization of policies on the management of wildlife, genetic resources, and natural habitats;
- (h) Co-operation on devising alternative development patterns appropriate for conditions in the Region;
- (i) Co-operation on improving the national capability to assess the environmental impact of development proposals;
- (j) Consultations on incorporating the environmental dimension in the planning and implementation of development programmes.

There is a need to develop management techniques tailored to the special requirements of groups of States and Territories within the Region. Distinctive techniques are especially needed by islands because of the fragility of their ecosystems and their particularly limited carrying capacities.

#### Environmental legislation:

Environmental legislation is an important management tool in the hands of national policy-makers and planners. In order to facilitate the harmonization of national legislation related to environmental issues, in particular legislation regulating national activities that may affect territories beyond the control of national jurisdiction:

- (a) Assistance should be provided, to States and Territories requesting it, in analysing their needs for new or revised environmental legislation;
- (b) Assistance should be provided, as appropriate, to aid States and Territories in exchanging information on national environmental legislation.

For the implementation of the Action Plan for the Caribbean Environment Programme, a formal regional legal agreement is desirable in order to:

- (a) provide a legal framework for implementing the Action Plan;

- (b) create a legal basis for financing the Action Plan and the institutions participating in it on the regional, subregional, and national levels.

A formal legal agreement, if established for the above purposes, might also help in accomplishing a number of other objectives such as:

- (a) Providing a framework for harmonizing national legislations and creating, as necessary, new legislations, relating to environmental problems;
- (b) Providing a forum for regular (periodic) high-level consultation among participating Governments on implementation of the Action Plan;
- (c) Establishing guidelines for co-ordinating environmental programmes and institutions at the regional and subregional levels;
- (d) Stimulating accession by more Governments within the Region to existing global and regional conventions relevant to the environmental issues of the Region.

Various options are available for the form of such a regional legal agreement: convention, declaration of principles, etc. (10).

#### 4.3 Supporting measures

A host of measures would be required to ensure the full support for and the harmonious development of the substantive components of the Action Plan.

##### Public awareness:

Notwithstanding the need for sound legislation, adequate care and management of the environment can only be achieved with the help of the entire population. Clearly, therefore, there is need for a high level of awareness of the environment and its problems, particularly those caused by the actions of human beings. To accomplish this end, the Action Plan should include an extensive programme of environmental education to offer the population correct information and dispel prejudices and change attitudes and habits which at present have a negative impact on the environment.

The awareness component of the Action Plan should include at least the following:

- (a) Educational programme, at all levels, closely related to local socio-economic and ecological characteristics;
- (b) Inclusion of an environmental education component in primary, secondary and higher education;
- (c) Special environmental training programmes for professionals, technicians, decision-makers, teachers, mass media professionals, engineers, etc.;
- (d) Special material on environment prepared for and used by schools, mass media, and non-governmental organizations.

The appropriate infrastructure should be developed to provide logistic and financial support for this component of the Action Plan.

#### Institutional arrangements:

The concrete results of the Action Plan depend on action at regional, subregional, and national levels. It is therefore important to identify and develop appropriate institutional capabilities and co-ordinating mechanisms at each of these levels. The following components seem essential for this task.

##### (A) Regional Co-ordinating Unit (RCU)

A central regional co-ordinating unit (RCU) will be necessary to ensure the timely and harmonious implementation of the Action Plan.

The RCU should operate under the authority of the organization to which the Governments of the States and Territories participating in the Action Plan will assign the overall task of co-ordinating its implementation. Some of the options available to the Governments in selecting this organization: UNEP, ECLA, an existing or newly-created regional organization.

The principal function of RCU should be technical, i.e. the development and co-ordination of the work of national, subregional and regional institutions.

The RCU should not itself conduct research. However, it should serve as a referral system for the dissemination of information on results obtained through the Action Plan and as a centre which could organize aid to participants in the Action Plan in solving their specific environmental problems.

The staff of the RCU should be recruited from the nationals of the States and Territories participating in the Action Plan.

The suggested links of the RCU with the other structures participating in the implementation of the Action Plan are shown in figures 2 and 3.

The RCU should be physically located in the Wider Caribbean Region. In siting the RCU the following should be specifically kept in mind:

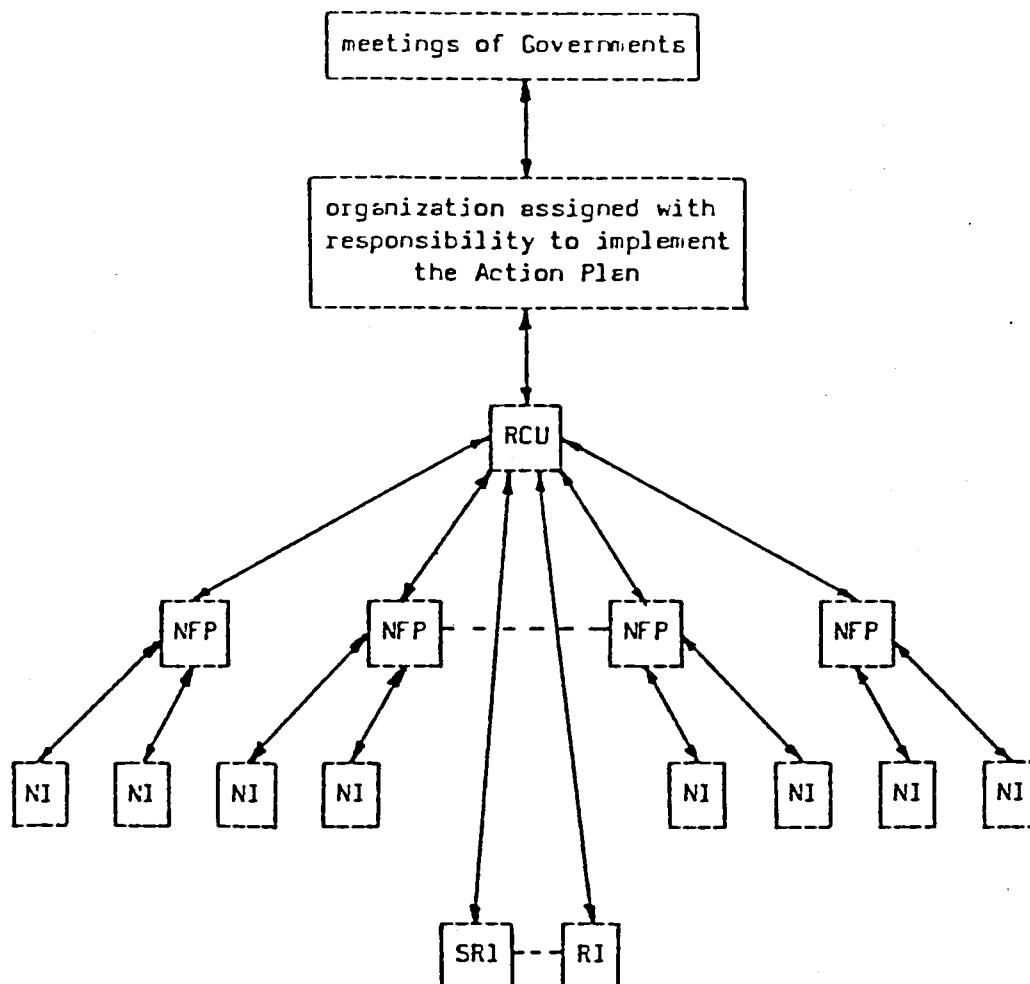
- locally available support from the organization under whose authority RCU operates;
- suitable telecommunication and travel conditions;
- other factors bearing on the costs of RCU's functioning.

##### (B) National Focal Point (NFP)

The active participation and co-operation of the States and Territories is the basic prerequisite for the success of the Action Plan. In order to achieve an efficient and well-co-ordinated co-operation, a national focal point (NFP) to deal with all matters relevant to the Action Plan, should be established (or an existing structure should be assigned this task) at a high level in each of the participating States and Territories.

The role of the national focal points should be:

- to co-ordinate the input of their national institutions into the Action Plan;
- to maintain links with the central co-ordinating unit of the Action Plan.



RCU : Regional Co-ordinating Unit

NFP : National Focal Point

NI : National Institution

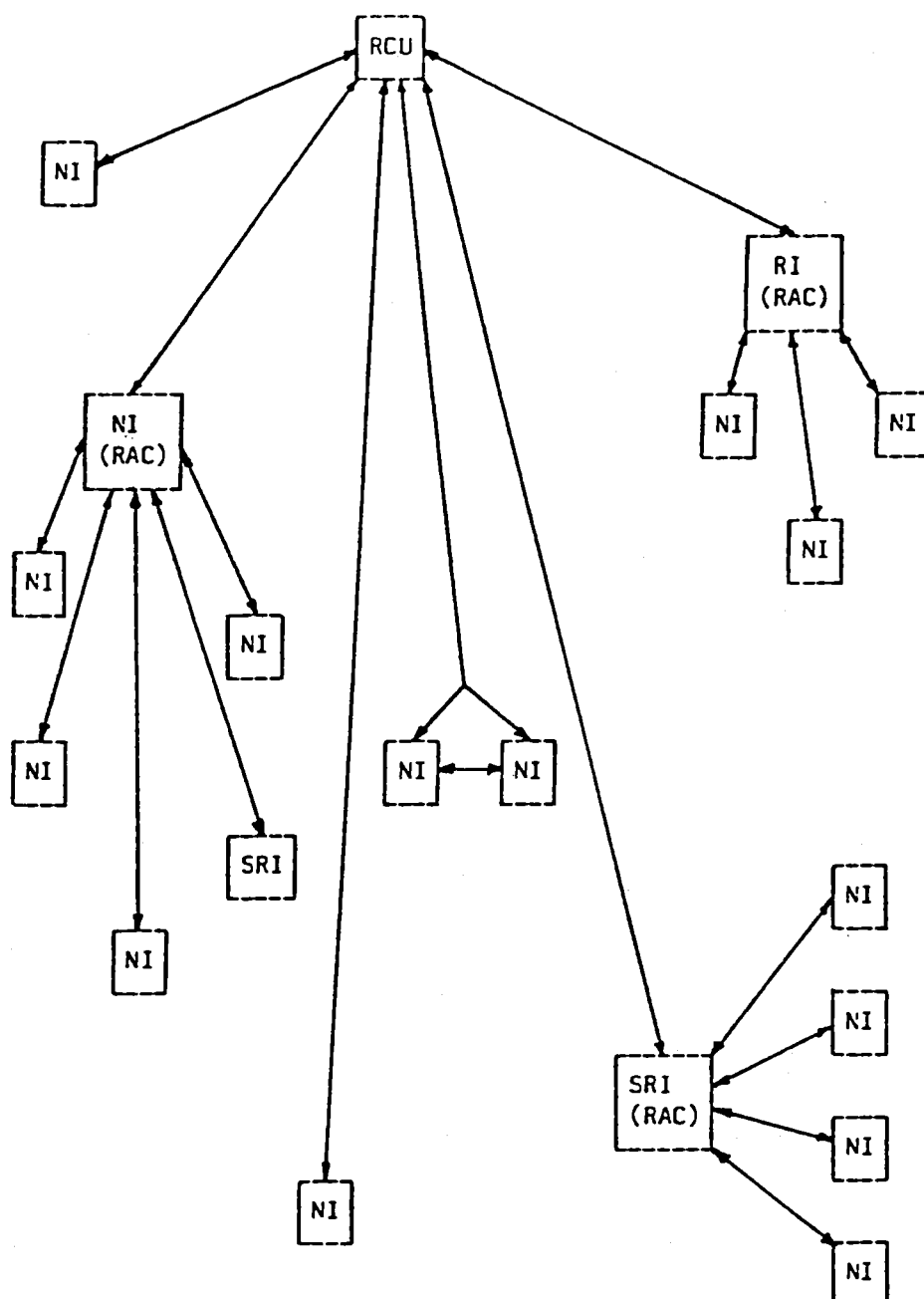
RI : Regional Institution (organization)

SR1 : Subregional Institution (organization)

Note : links with international organization not indicated in this simplified scheme

Figure 2 : Communication links on policy matters





RCU : Regional Co-ordinating unit  
NI : National Institution  
RI : Regional Institution (organization)  
SRI : Subregional Institution (organization)  
RAC : Regional Activity Centre

Note : links with international organizations not indicated in this simplified scheme

Figure 3 : Communication links on technical matters  
(implementation of specific activities through networks)

(C) National Institutions (NI)

National institutions (NI) designated by their Governments should provide the institutional basis for the activities agreed upon between the Governments as components of the Action Plan. They should be the principal executants of specific activities within the Action Plan.

In order to allow for their full participation in agreed activities, technical and managerial assistance (equipment, training, etc.) should be provided through the Action Plan to those national institutions requiring it.

(D) Subregional and Regional Institutions (Organizations)

The existing subregional (covering only parts of the Wider Caribbean Region) and regional institutions should be used to the maximum possible extent for the implementation of specific activities or for the co-ordination of their implementation.

Whenever necessary, a national institution could also assume a subregional or regional role.

Technical and managerial assistance should be provided through the Action Plan to the subregional and regional institutions participating in it.

(E) Networking

In principle, each of the activities agreed as part of the Action Plan should be carried out by several national institutions (NI) located in the various States and Territories of the Region. They should be linked in networks of co-operating institutions.

The regional (RI) and subregional institutions (SRI) participating in specific activities should be also considered as members of the networks.

One member of each network should assume the role of the regional activity centre (RAC) for that network and co-ordinate the activity for which the network was established.

Several options could be identified for the type of operative links between the participants in the implementation of the Action Plan (figure 3):

- a regionwide option would establish direct links between the regional (central) co-ordinating unit and each national, regional and subregional institution;
- a subregional option would establish links between the regional (central) co-ordinating unit and several regional and subregional institutions, each of which would in turn establish linkages with institutions in a specified geographical area;
- a third option relies on identification of national institutions which could assume the role of regional activity centre (RAC), each having special expertise or facilities qualifying it to deal with a particular subject area. For each activity within the Action Plan, the regional co-ordinating unit would establish linkage principally with the RAC, which would in turn co-ordinate the activities of other institutions pursuing that activity.

(F) International Organizations

The assistance of the international organizations, in particular those belonging to the United Nations system, is essential for the implementation of the Action Plan and therefore, their technical and managerial support for specific projects should be solicited.

Financial arrangements:

Financial support for the activities identified as part of the Action Plan, should come from participating Governments, international and regional organizations, and non-governmental organizations.

The creation of a Regional Trust Fund should be considered in order to provide a suitable financial basis for the implementation of the Action Plan in the long term. The Trust Fund could be controlled by a Council of Ministers drawn from the Region on the basis of a predetermined formula ensuring equitable geographical distribution. Funds would be disbursed directly from the Trust Fund to the participants in the various projects. The Trust Fund should be administered by the organization to which the Governments of the Caribbean States and Territories will assign the overall task of co-ordinating the implementation of the Action Plan according to the terms of reference (financial rules) adopted by those contributing to the Trust Fund.

Although the ultimate aim is that the Action Plan should be financially self-supporting, the United Nations System should initially provide a substantial financial contribution, progressively decreasing as the Governments of the Region, through a Trust Fund or other mechanism, assume fuller financial responsibility.

Table 1 : Selected statistical data on States and Territories of the Wider Caribbean Region: Size, population and general indicators. Source: Adapted from United Nations Statistical Yearbook, 1977 (11)

Size km <sup>2</sup>	Population in thousands	% annual increase in population	Disposable Income (per person US\$) (1975)	GDP per 10 <sup>3</sup> US \$ capita (US\$) (1974)
442	66	1.4		
Antigua				
13 935	175	3.6		
Bahamas				
431	238	0.7		1 297
Barbados				
22 965	121	3.1	664	311
Belize				93
British Virgin Islands	10	3.1		
153	10	3.1		
Cayman Islands	259	5.0		
1 138 914	21 070	2.9	515	12 142
Colombia				
50 700	1 872	2.6	915	1 660
Costa Rica				
114 524	8 569	1.7		
Cuba				
751	71	1.1		
Dominica				
48 734	4 006	3.0		2 923
Dominican Republic				
21 041	3 555		434	1 577
91 000	55	3.5		
Grenada				
1 779	325	1.6		
Guadeloupe				
108 889	5 160	2.9		3 161
Guatemala				
214 969	702	1.8	579	424
Guyana				
27 750	4 330	1.6		733
Haiti				
112 088	2 657			997
Honduras				
10 991	1 849	1.6	1 283	2 807
Jamaica				
1 102	325	1.5		
Martinique				
1 972 547	48 225	3.5	1 205	65 096
Mexico				
98	12	1.3		
Montserrat				
961	218	1.4		
Netherlands Antilles				
130 000	1 878	3.3	684	1 506
Nicaragua				
75 650	1 428	3.1	1 034	1 835
Panama				
8 897	2 712	2.8	2 777	8 208
Puerto Rico				
357	64	0.5		
St. Kitts-Nevis-Anguilla				
616	101	1.5		
St. Lucia				
388	87			
St. Vincent				
163 265	385	2.7	1 046	445
Suriname				
5 128	941	1.1		1 927
Trinidad and Tobago				
430	6	1.3		
Turks and Caicos Islands				
9 363 123	203 235	0.8	6 262	1 406 777
United States of America				
344	62			
United States Virgin Islands				
912 050	10 722	3.1	2 115	25 982
Venezuela				
				2 234

Table 2 : Agricultural and fisheries production in 1976 (in thousand metric tonnes).  
Source: United Nations Statistical Yearbook, 1977 (11)

	Cocoa (beans)	Coffee	Cotton	Maize	Milk	Potatoes	Rice	Tobacco	Wheat	Fish Catch
Antigua										2.8
Bahamas										4.0
Barbados										1.9
Belize				11			6			
British Virgin Islands										
Cayman Islands										
Colombia	26.0	510.0	145	810	2 200	1 126	1 560	38.6	59	75.1
Costa Rica	5.6	86.8	1	89	267	25	150	3.2		12.7
Cuba	2.0	24.9	1	125	637	119	420	45.8		204.0
Dominica	0.2									
Dominican Republic	32.2	42	1	35	293	29	258	46.0		7.1
El Salvador	0.4	159.0	62	342	294	16	36	2.2		9.1
French Guiana										1.1
Grenada	2.5									1.0
Guadeloupe	0.1									5.0
Guatemala	0.8	148.9	99	686	320	30	24	7.7	48	3.7
Guyana										20.1
Haiti	4.0	36.0	1	250	66	8	131	0.1		2.5
Honduras	0.3	45.4	7	289	187	5	26	2.5		3.3
Jamaica	1.7			11	54	8	2	1.2	1	10.1
Martinique	0.1									3.7
Mexico	32.0	242.2	211	8 393	4 164	695	460	68.0	3 363	572.3
Montserrat										
Netherlands Antilles										
Nicaragua	0.6	59.1	99	201	263	2	61	3.0		1.0
Panama	0.9	4.7		64	74	11	144	1.1		17.9
Puerto Rico		12.0			408		2	1.9		171.6
St. Kitts-Nevis-Anguilla										80.9
St. Lucia	0.4									
St. Vincent	0.1									2.2
Suriname	0.1									
Trinidad and Tobago	3.2	2.7								4.5
Turks and Caicos Islands								0.1		4.3
United States of America										
United States Virgin Islands			2 304	159 173	54 592	16 228	5 246	968.9	58 307	3 003.9
Venezuela	16.6	49.6	23	532	1 193	135	277	15.0	1	145.7

Table 3 : Energy production and consumption in 1976. Source: United Nations Statistical Yearbook, 1977 (11)

	Electric Energy production 10 <sup>6</sup> kWh	Energy Production (10 <sup>6</sup> metric tons equivalent of coal)	Energy Consumption (Kgs/person)
Antigua	47	0.17	2 438
Bahamas	600	1.54	7 286
Barbados	228	0.24	974
Belize	43	0.09	602
British Virgin Islands	12	.01	1 027
Cayman Islands	37	.04	2 558
Colombia	15 292	18.7	685
Costa Rica	1 646	0.18	448
Cuba	7 198	0.25	1 225
Dominica	15	.02	207
Dominican Republic	2 690	0.02	653
El Salvador	1 199	0.09	260
French Guiana	65	0.13	2 155
Grenada	28	.02	211
Guadeloupe	190	0.25	685
Guatemala	1 250	1.61	257
Guyana	398	0.84	1 072
Haiti	209	0.02	28
Honduras	590	.06	264
Jamaica	2 378	.02	1 937
Martinique	194	0.36	984
Mexico	46 612	76.4	1 227
Montserrat	9	.01	1 078
Netherlands Antilles	1 500	5.5	22 836
Nicaragua	1 040	1.07	478
Panama	1 508	1.52	885
Puerto Rico	17 150	0.04	3 591
St. Kitts-Nevis-Anguilla	23	.02	282
St. Lucia	45	.04	366
St. Vincent	17	.02	200
Suriname	1 335	0.15	2 406
Trinidad and Tobago	1 367	18.4	4 272
Turks and Caicos Islands			
United States of America	2 123 406	2 049.7	11 554
United States Virgin Islands	720	5.16	54 283
Venezuela	23 276	199.0	2 838

Table 4 : Mining in 1976 (in thousand metric tonnes). Source: United Nations Statistical Yearbook, 1977 (11)

	Coal	Crude Petroleum	Natural Gas (tera calories)	Bauxite
Antigua				
Bahamas				
Barbados				
Belize		20	37	
British Virgin Islands				
Cayman Islands				
Colombia	3 620	7 553	16 645	
Costa Rica				
Cuba		144	196	
Dominica				
Dominican Republic				621
El Salvador				
French Guiana				
Grenada				
Guadeloupe				
Guatemala		7		
Guyana				3 203
Haiti				739
Honduras				
Jamaica				10 309
Martinique				
Mexico	5 650	41 336	120 286	
Montserrat				
Netherlands Antilles				
Nicaragua				
Panama				
Puerto Rico				
St. Kitts-Nevis-Anguilla				
St. Lucia				
St. Vincent				
Suriname				
Trinidad and Tobago		10 990	15 774	4 587
Turks and Caicos Islands				
United States of America	585 684	401 211	4 996 843	2 420
United States Virgin Islands				
Venezuela	89	120 153	118 270	

Table 5 : Manufacturing in 1976 (in thousand metric tonnes). Source: United Nations Statistical Yearbook, 1977 (11)

	Total Meat	Sugar ( <sup>1</sup> 000 metric tons)	Nitrogenous Fertilizers	Total Wood ( <sup>1</sup> 000 m <sup>3</sup> )	Cement ( <sup>1</sup> 000 metric tons)
Antigua		0			
Bahamas		0			271
Barbados		106			
Belize		68		21	
British Virgin Islands					
Cayman Islands					
Colombia	625	935	66.4	950	3 612
Costa Rica	72	200	30.8	450	362
Cuba	237	6 150	68	50	2 501
Dominica					
Dominican Republic	63	1 287			582
El Salvador	49	261	4.5	32	322
French Guiana				10	
Grenada					
Guadeloupe					130
Guatemala	82	517		267	341
Guyana		342		82	
Haiti	48	60		12	232
Honduras	57	81		534	234
Jamaica	22	368			365
Martinique		14			
Mexico	988	2 710	650	1 850	12 691
Montserrat					
Netherlands Antilles			2.5		
Nicaragua	79	242		400	209
Panama	53	161		53	311
Puerto Rico	40	275			1 390
St. Kitts-Nevis-Anguilla		36			
St. Lucia					
St. Vincent					
Suriname		10		58	51
Trinidad and Tobago		205	46.3	32	242
Turks and Caicos Islands					
United States of America	17 965	6 163	9 790	88 809	60 311
United States Virgin Islands					
Venezuela	390	510	74.7	349	3 838



Table 6 : Consumption of selected commodities in 1976 (in thousand metric tonnes).  
Source: United Nations Statistical Yearbook, 1977 (11)

	Sugar ( '000 metric tons)	Cotton ( '000 metric tons) Industrial consumption	Steel (kg/person)	Nitrogen Fertilizer ( '000 metric tons)
Antigua				
Bahamas				0.5
Barbados				0.7
Belize				0.3
British Virgin Islands				
Cayman Islands				
Colombia	844	70.5	30	142.7
Costa Rica	114	1.7	79	28.5
Cuba	532	27.1	107	187.0
Dominica				
Dominican Republic	167		26	35.0
El Salvador	123	17.3	13	77.1
French Guiana				
Grenada				
Guadeloupe				3.4
Guatemala	204	13.0	26	41.0
Guyana				8.1
Haiti		0.7	7	0.1
Honduras			22	11.0
Jamaica	104	1.1	30	7.3
Martinique				4.0
Mexico	2 675	164.8	96	891.0
Montserrat				
Netherlands Antilles				
Nicaragua	100	5.6	25	22.8
Panama			31	11.0
Puerto Rico				
St. Kitts-Nevis-Anguilla				0.3
St. Lucia				1.6
St. Vincent				2.1
Suriname				5.8
Trinidad and Tobago			121	6.0
Turks and Caicos Islands				
United States of America	9 843	1 453.1	604	9 654.3
United States Virgin Islands				0.7
Venezuela	540	34.7	229	74.3

Table 7 : Communications in 1976. Source: United Nations Statistical Yearbook, 1977 (11)

	Radio Receivers (per '000 persons) (1974/5)	TV Receivers	No. Telephones per 100 persons	Newsprint (kg/person)
Antigua	214	214	4.3	
Bahamas	466		27.1	4.8
Barbados	554	163	18.1	2.0
Belize	588		4.0	1.4
British Virgin Islands			21.7	
Cayman Islands	318		36.6	
Colombia	119	51	7.0	1.7
Costa Rica	74	79	6.2	5.5
Cuba	224	64	3.2	2.5
Dominica			4.6	
Dominican Republic	40	34	2.6	0.5
El Salvador	349	34	1.4	2.8
French Guiana	48	52	14.9	
Grenada	229		1.4	
Guadeloupe	59	37		1.7
Guatemala	45	19		1.2
Guyana	354		2.8	2.2
Haiti	20	2.8	0.4	0.2
Honduras	53	15	0.7	0.7
Jamaica		54	5.4	4.2
Martinique	88	55	9.0	
Mexico	301	84	5.4	3.9
Montserrat			14.0	
Netherlands Antilles	545	143	19.5	2.0
Nicaragua	60	36	2.5	1.7
Panama	159	111	9.0	2.0
Puerto Rico	570	204	14.4	
St. Kitts-Nevis-Anguilla			4.1	
St. Lucia	759	16	6.0	
St. Vincent	300	7	4.8	
Suriname	261	81	4.2	1.4
Trinidad and Tobago	235	94	6.5	6.2
Turks and Caicos Islands	500			
United States of America	1 882	571	72.1	41.5
United States Virgin Islands	815	326	33.5	
Venezuela	171	107	6.0	7.9

#### REFERENCES

- (1) Overview on Environmental Health in the Wider Caribbean Region, PAHO/WHO, May 1979. E/CEPAL/PROY.3/L.INF.11.
- (2) Overview on Natural Resources for Food and Agriculture in the Wider Caribbean Region, FAO, 1979. E/CEPAL/PROY.3/L.INF.10.
- (3) Natural Disasters in the Wider Caribbean Area : An overview, UNEP/ECLA, 1979. E/CEPAL/PROY.3/L.INF.12.
- (4) Overview on Energy and Environment in the Caribbean Area, UNIDO, 1979. E/CEPAL/PROY.3/L.INF.9.
- (5) Human Settlements in the Wider Caribbean Area : An overview, UNEP/ECLA, 1979. E/CEPAL/PROY.3/L.INF.14.
- (6) Marine and Coastal Area Development in the Wider Caribbean Area : Overview Study, UNDIESA, 1979. E/CEPAL/PROY.3/L.INF.13.
- (7) The State of Marine Pollution in the Wider Caribbean Region, UNEP/ECLA, August 1979. E/CEPAL/PROY.3/L.INF.4.
- (8) The Status of Oil Pollution and Oil Pollution Control in the Wider Caribbean Region, IMCO 1979. E/CEPAL/PROY.3/L.INF.5.
- (9) Review of International Conventions relevant to the Environmental Protection of the Wider Caribbean Region, UNEP 1979. E/CEPAL/PROY.3/L.INF.15.
- (10) Principles and Guidelines which may be Used for a Regional Legal Agreement, UNEP/ECLA 1979. E/CEPAL/PROY.3/L.5.
- (11) United Nations Statistical Yearbook 1977, United Nations 1978.

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- No. 24 UNEP: Action Plan for the protection and development of the marine and coastal areas of the East Asian region. (1983)
- No. 25 UNEP: Marine pollution. (1983)
- No. 26 UNEP: Action Plan for the Caribbean environment programme. (1983)
- No. 27 UNEP: Action Plan for the protection and development of the marine environment and coastal areas of the West and Central African region. (1983)
- No. 28 UNEP: Long-term programme for pollution monitoring and research in the Mediterranean (MED POL) - Phase II. (1983)
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- No. 48/ Appendices SPC/SPEC/ESCAP/UNEP: Hazardous waste storage and disposal in the South Pacific. (1984)
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- No. 63 IUCN/UNEP: Management and conservation of renewable marine resources in the Kuwait Action Plan region. (1985)
- No. 64 IUCN/UNEP: Management and conservation of renewable marine resources in the Red Sea and Gulf of Aden region. (1985)
- No. 65 IUCN/UNEP: Management and conservation of renewable marine resources in the East Asian Seas region. (1985)
- No. 66 IUCN/UNEP: Management and conservation of renewable marine resources in the Eastern African region. (1985)
- No. 67 UN/UNEP: Coastal erosion in West and Central Africa. (1985)
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- No. 69 UNEP: Environment and resources in the Pacific. (1985)
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- No. 71 IUCN/ROPME/UNEP: An ecological study of the rocky shores on the southern coast of Oman. (1985)
- No. 72 IUCN/ROPME/UNEP: An ecological study of sites on the coast of Bahrain. (1985)
- No. 73 SPC/SPEC/ESCAP/UNEP: Ecological interactions between tropical coastal ecosystems. (1985)
- No. 74 UNEP: Environmental problems of the marine and coastal area of Sri Lanka; National Report (1986)

- No. 75 UNEP: Environmental problems of the marine and coastal area of Bangladesh; National Report (1986)
- No. 76 UNEP: Environmental problems of the marine and coastal area of Maldives; National Report (1986)
- No. 77 UNEP: Environmental problems of the marine and coastal area of Pakistan; National Report (1986)