



REPUBLIQUE D'HAÏTI

**" INTEGRATING THE MANAGEMENT OF  
WATERSHEDS AND COSTAL AREAS IN HAÏTI "**

**HAITI NATIONAL REPORT**



MDE



GEF



CARICOM

**MINISTERE DE L'ENVIRONNEMENT**  
**UNITE DE MISE EN OEUVRE DU PLAN D'ACTION**  
**POUR L'ENVIRONNEMENT ( UMO-PAE)**

**" INTEGRATING THE MANAGEMENT OF  
WATERSHEDS AND COSTAL AREAS IN HAÏTI "**

**HAÏTI NATIONAL REPORT**

**SEPTEMBER 2001**

**MDE**

**UNEP**

**GEF**

**UNDP**

**CEHI**

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**- Outline for National Reports**

## ABREVIATIONS

ANGRE	Agence Nationale pour la Gestion des Ressources en Eau
ANP	Association Nationale des Pêcheurs
ASSODLO	Association Haïtienne pour la Maîtrise de l'Eau
BME	Bureau des Mines et de l'Energie
CAMEP	Centrale Autonome Métropolitaine d'Eau Potable
CARE	Cooperative American Relief Everywhere
CEHI	Caribbean Environment Health Institute
CFAIM	Centre de Formation en Aménagement Intégré des Mornes
CIDA	Canadian International Development Agency
CMC	Center for Marine Conservation
CNRA	Commission Nationale pour la Réforme Administrative
DR	Dominican Republic
FIDA	Fonds International pour le Développement Agricole
GEF	Global Environment Facility
GIS	Geographic Information System
IDB	Inter-American Development Bank
IMWACA	Integrated Management of Watershed and Coastal Area
IUCN	World Conservation Union
MAI	Moisture Availability Index
MARNDR	Ministère de l'Agriculture, des Ressources naturelles et du Développement Rural
MARPOL	International Convention for Prevention of Pollution from Ships
MOE or MDE	Ministry of Environment
MPA	Marine Protected Area
MSP	Ministère de la Santé Publique et de la Population
MTPTC	Ministère des Travaux Publics Transport et Communication
NEAP	National Environmental Action Plan
NGO	Non Governmental Organization
OPDES	Office pour la Protection des Désastres et Secours
ORE	Organisation pour la Réhabilitation de l'Environnement
OSAMH	Organisme de Surveillance pour l'Aménagement du Morne Hôpital
PADF	Pan-American Development Foundation
PDF B	Project Development Facility Block B
PHO	Pan-American Health Organization
SEMANAH	Service Maritime et de la navigation en Haïti
SIDS	Small Island Development States
SNEP	Service National d' Eau Potable
SPAW	Protocol Concerning Specially Protected Areas and Wildlife
UN	United Nations



UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Program
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention to Climate Change
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization
WWF	World Wildlife Fund

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## EXECUTIVE SUMMARY

### Presentation

This paper represents the Haiti National Report prepared in the context of the Global Environment Facility (GEF) approved Project Development Facility Block B (PDF B) entitled *Integrating Watershed and Coastal Areas Management in Small Island Developing States in the Caribbean* whose major objective is to identify common problems and specific recommendations to be included in a future full-scale project intended to improve watershed and coastal zone policy and practices in support of sustainable development in the region. The PDF –B was implemented under the United Nations Environmental Program (UNEP) and United Nations Development Program (UNDP) with the Caribbean Environmental Health Institute (CEHI) designated as the Executing Agency.

### Key Water/Watersheds and Coastal Areas issues in Haiti

Haiti is being experienced major alterations of its watersheds and coastal areas as a result of intensifying and unregulated human pressure due to increasing population. The latter associated with poverty create several stresses on the environment as the demand for natural resources rises. The ability of the environment to provide fundamental ecological services, goods for the benefit of current and future generations is seriously compromised. Lands are extremely eroded and poverty reduction strategy is being undermined by the continuing degradation of soils, the loss of forest cover, the loss of biological diversity at the genetic, species and ecosystem level and the increasing scarcity of freshwater. In fact, population's needs for safe water supply and sanitation waste disposal system are being expanded. Hydrologic regime of the most part of Haiti's rivers has been severely disturbed. Most part of the Haitian population live in environmentally vulnerable areas such as steep slopes, flood plains and valleys etc. As a result, they are at greater risk from natural disasters and severe weather.

Mangrove forests and coral reefs are being cleared and destroyed. Many forms of coastal disturbance stem from physical developments associated with urban developments and maritime activities. Coastal environments are under pressure from human activities leading to pollution. Continental drainage carries effluents of the sea from urban sewage and some industrial activities. Plastic containers, faecal bacteria and heavy metals affect the quality of many coastal ecosystems. Transboundary threats associated with watersheds and coastal zones are a great concern.

## **Response to the key issues**

Given the issues mentioned above, actions to be considered in the Integrated Management of Watersheds and Coastal Areas National Action Plan have been grouped in four Strategic areas of interventions:

### *Strategic Area I : Restoration of critical coastal ecosystems and watersheds associated*

Actions identified are intended to:

- Maximize the sustainable benefits to local communities from using resources within watersheds and coastal zones to generate food, employment and income, supply safe water and conserve biodiversity resources for the benefit of local and global communities;

### *Strategic Area II: A new Institutional and Legal Framework to address Integrated Management of Watersheds and Coastal Areas*

Actions to be considered will:

- Put in place innovative legal and institutional mechanisms and instruments to overcome obstacles, facilitate the planning and improve the overall governance of the sector related to the Integrated Management of Watersheds and Coastal Areas;

### *Strategic Area III : Reduction of Communities' Vulnerability to Natural Disasters*

Actions in this field will provide assistance to:

- Prepare communities for and respond to natural and human-induced disasters such as floods, droughts, fires and non human –induced disasters like hurricanes;

### *Strategic Area IV : Transboundary Cooperation in Integrated management of Watersheds and Coastal Areas with Dominican Republic*

Actions to be implemented will aim to:

- Facilitate border integration with Dominican Republic (DR), foster environmental management in the areas of Watersheds and Coastal Zones Management and strengthen national Agencies of both countries concerned with environmental planning and natural resources use and promote creation of mechanisms for joint interagency activities in support of sustainable development of border populations of Haiti and DR.

## SECTION ONE. INTRODUCTION

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### **1.1 CONTEXT, PURPOSE, METHODOLOGY AND ORGANIZATION OF THE HAITI NATIONAL REPORT**

The adoption of an integrated approach in the process of planning and management of watersheds and coastal areas is fundamental to achieve the goal of sustainable development of Haiti, a Caribbean mountainous country with 33 watersheds and a coastline of 1771 km.

Watersheds and Coastal areas form interlinked large ecosystems that provide the basis of resources for the well-being of Haitian population and they are essential to key economic sectors such as agriculture (food supply) and tourism.

Although their great importance, these ecosystems are very vulnerable and under serious threats. It is, therefore, extremely important to define a framework for comprehensive, integrated and coordinated actions for the management, development and restoration of these areas.

In consideration of this situation, Haiti has been involved, since March 2000, with fourteen small island states in the Global Environment Facility (GEF) approved Project Development Facility Block B (PDF B) entitled ***Integrating Watershed and Coastal Areas Management in Small Island Developing States in the Caribbean*** whose major objective is to identify common problems and specific recommendations to be included in a future full-scale project intended to improve watershed and coastal zone policy and practices in support of sustainable development in the region.

The PDF –B was implemented under the United Nations Environmental Program (UNEP) and United Nations Development Program (UNDP) with the Caribbean Environmental Health Institute (CEHI) designated as the Executing Agency. Key issues targeted by the PDF B include the following:

- *Current Watershed/Water Resources Management and Coastal Areas Management Assessment* placing the emphasis on aspects such as Freshwater habitats and Ecosystems, Supply and Demand, Ground water vis a vis Surface water, Land-use, Coastal habitats and Ecosystems, Living and non living marine resources exploitation, Climate change and Natural disaster, Transboundary threats, Pollution, Tourism and health, Data/Information/Management and Research, Stakeholder participation/ Awareness and Education, Institutional framework;
- *The need to integrate Watershed and Coastal Area Management* by addressing Legal and Policy, Institutional and Financial issues;

- *A National Action Programme* to improve Integrated Management of Watersheds and Coastal Areas.

Under the PDF B, every participating country is supposed to prepare a National Report. This paper represents the Haiti National Report on ***Integrating Watershed and Coastal Areas Management*** in the context of this initiative.

The report provides an overview of the current Management of Haiti's Watershed/Water and Coastal Area Resources. It also highlights actions that have been carried out to respond to threats on natural resource systems associated to watersheds and coastal zones and puts some recommendations to be part of a Regional Action Programme.

The preparation of this report was a joint effort of a multidisciplinary team from the Ministry of Environment (MOE) composed of:

- Joseph Ronald Toussaint Msc, Natural Resources Management Specialist/ Coordinator of the National Environmental Action Plan Secretariat/MOE, Team leader;
- Dr Eliot Hamilcar, Geology specialist and Coordinator of the Pilot Coastal and Marine Management Programme/MOE, Member;
- Dimitri Noris Msc, Environmental specialist from the Technical Direction of the MOE, Member;
- Dr Marie Alice Limage, Specialist in Health and Environment, Member.

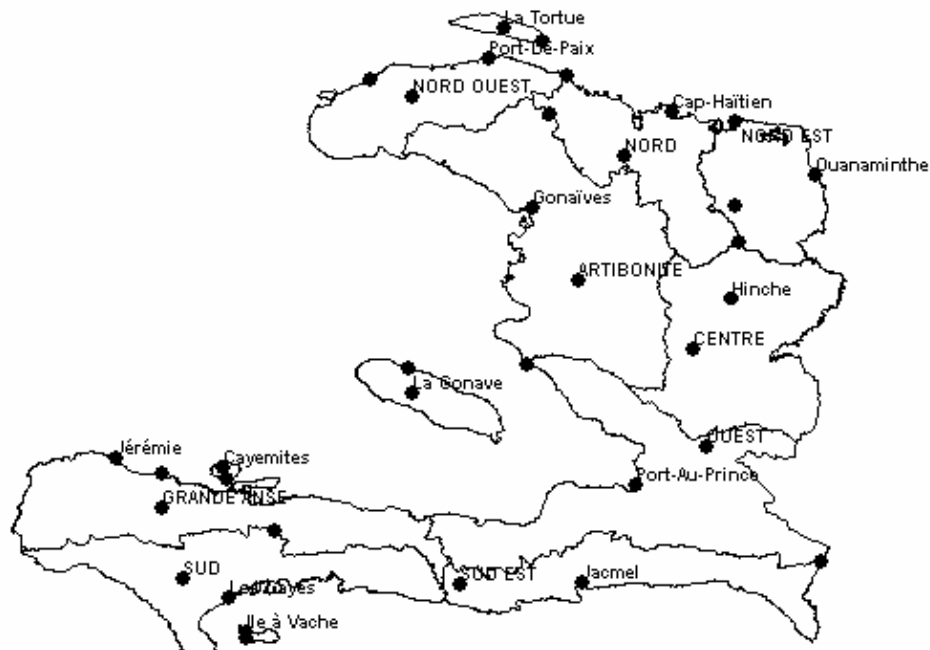
The Team has used different kind of reference materials ( national and international documents) to develop the report. An intersectoral workshop jointly organized with the Ministry of Agriculture, the Ministry of Planning, the Ministry of Public Works - partly supported by the funds from UNEP/GEF and entitled *Atelier de Concertation Interministérielle pour la Gestion des Bassins Versants en Haiti* – was also carried out and provided interesting inputs to improve the quality of the report.

The organization of the Haiti National Report follows the guidelines provided by UNEP AND CEHI stated in " Outline for National Reports" (Annex I).

## **1.2 BACKGROUND**

### **A - GEOGRAPHY**

The Republic of Haïti shares with the Dominican Republic the second largest island of the Caribbean also known under the name of Hispaniola. Haïti occupies one third ( 27750 km<sup>2</sup>) of the territory on the Western side of the island. It is located between 18° and 20° north of latitude and between 71° 30 and 74° 30 west of longitude. It is surrounded by the Atlantic Ocean to the North, the Caribbean Sea to the West and South and by the Dominican Republic ( DR) to the East ( Fig I: Haïti in the Caribbean). The Haitian coastline covers 1535 km before giving a way to a relatively narrow continental shelf of 5000 km<sup>2</sup>. Its also comprises five satellite islands: La Gonave ( 670 km<sup>2</sup>), La Tortue ( 180 km<sup>2</sup>), Ile-à-vache (52km<sup>2</sup>), Cayémites (45km<sup>2</sup>) and La Navase ( Navassa island : 7 km<sup>2</sup>).



**Fig 2 – Principal Departments and townships of Haïti**

## **B - POPULATION**

Historically, it has been estimated that as many as one million Tainos inhabited the island prior to the arrival of Christopher Columbus. The 16<sup>th</sup> century witnessed a complete collapse of the Amerindian population, mostly due to the introduction of diseases and intolerance to slavery conditions. This was followed by a gradual increase in population as the Amerindian population was replaced with ethnic groups originating in Africa and Europe. Haiti was considered the most productive of the French colonies during the Napoleon era. The sugar cane plantation economic system required a large number of slaves, resulting in Haiti's headstart on the acceleration of its population.

Today, the country is one of the most densely inhabited regions in the Caribbean. The current overall density population is 286 inhabitants per km<sup>2</sup> with existence of peaks in some places: 560 inhabitants per km<sup>2</sup>. Haiti's population is estimated to be 8 millions with a 2,08 % annual growth rate ( IHSI, 2000). Lower estimates of 6,0-7.0 millions and annual growth rates are also cited ( CIA,2000; SEP 2000). Eight million is the high projection of the 1982 calculations by the *Institut Haïtien de Statistique et d'Information (IHSI)*. At this rate of annual growth, the doubling time of the population is approximately 36 years. The population is heavily skewed toward the younger age groups: 40 % of the population is younger than 15 years of age and the median age is 20 years.

## **C – CLIMATE**

Haiti lies in the Low Subtropical Region ( 18 – 20 degrees North Latitude), not truly tropical but rather that portion of the Tropical and Warm Temperate Regions which is free of frost at low elevations above sea level and in which the temperature range is significantly wider than in the deep tropics.

Haiti's climate is a result of the country's position in the Caribbean and its mountain terrain. Hurricanes, Tropical storms, natural fire are largely influenced by Caribbean climate factors. These have shaped the natural ecosystems of the country.

Haiti is an Amerindian word that means *Mountainous land*. Mountains occupy 75% of the country and their orientation greatly influences local rainfall and insolation regimes. The climate of the plains and lower montane regions is primarily tropical monsoonal, while that of the montane area is sub-tropical. The dominant winds are from the northeast and the northerly directions. As a result, the moist ecosystems generally occur on the windward mountain slopes and the sub-humid ecosystems occur in the rain shadow of the leeward exposure. Most precipitation is brought by the NorthEast Trade Winds and to a lesser extent by winds from the east. Site specific rainfall pattern are influenced mostly by orographic factors (related to topography). For example, high land masses such as mountains intercept precipitation so that the highest rainfall areas are in the mountains of the northcoast ( near Cap Haitien) and in the southwest peninsula.

Rainfall patterns range from less than 400 mm in the northwest to more than 3000 mm in the mountains of the southwest. The arid and semi-arid coastal zones receive the least amount of rainfall. Two ranges in the southern part of the country - the Massif de



la Hotte and the Massif de la Selle including Pic la Selle ( the country's highest peak at 2,684 meters above sea level) – constitute the wettest spot of Haiti.

### **D – GEOLOGY AND SOILS**

According to some theory, the island of Hispaniola was created by the uplifting of three major land masses and their subsequent collision over geologic time. These land masses were derived from oceanic crust, uplifted and influenced by the level of sea. Most marine terraces were exposed during the Pleistocene era. There have been no major sea level changes in the last 10,000 years.

In Haïti, exposed rock formations are igneous, metamorphic and sedimentary origin. The latter formations are the most abundant ( 80%) and are represented by limestone deposits from the middle and upper Eocene era.

Accordingly, the parent material of soils in Haïti is primarily limestone. These soils are moderately young and fertile, exhibiting neutral to alkaline pH properties and with a tendency toward salinization where exposed to high evapotranspiration rates from irrigation or salt water intrusion. Pockets of basalt soils (mostly igneous rock) are found throughout the country, giving rise to soils that are less fertile and more highly eroded. More highly weathered oxisols and beauxitic soils ( *sols ferralitiques et sols ferrugineux*) are a feature of several montane areas of the country.

### **E – HYDROLOGY**

In general, precipitation increases and evapotranspiration decreases as a function of elevation in Haïti. The major portion of the rainfall that occurs on the island is orographic, or the result of warm moist air rising rapidly as a result of the mountainous topography. The humid and wet montane systems are the source of major rivers and streams in the country, as well as the aquifers of the highly porous limestone substratum.

Dissected by numerous mountain ridges and flowing across two relatively narrow peninsulas, Haïti's rivers are mostly short and swift flowing. The exception is the Artibonite river which originates along the border with the Dominican Republic and flows for approximately 290 km. Along this river is found the country's major hydroelectric power generating facility ( *Le Barrage hydro-électrique de Peligre*).

Surface water is used by the great majority of people in Haïti for domestic purposes ( drinking water and irrigation). In fact, four large irrigated plains constitute the country's most important agricultural areas: the *Plaine du Nord*, *Fort Liberté* area in the North, the Lower Artibonite and Estere Valleys in the Artibonite Department, the *Cul de Sac* plain in the West and the *Les Cayes* plain in the South. Groundwater represents the second most important source of water.

Erosion has resulted in heavy siltation and the deposit of talus in many of the riverine systems with drainage becoming subterranean in many cases. This has resulted in a dramatic increase in peak hydrological response that, in turn, has caused a great probability of flooding and destruction to downstream communities.

### **F – BIODIVERSITY**

The Caribbean is an internationally recognized biodiversity hotspot, ranking fourth in the world for major diversity indices ( Meyers et al 2000) and perhaps containing the highest concentration of endemic species on a land area basis. Haiti is one of the richest countries in the Caribbean in terms of biological diversity.

The geologic history of Hispaniola characterized by repeated changes in level sea and the highly varied geomorphology provides a wide range of abiotic factors that favor habitat diversity and had given rise to significant local endemism.

Haiti in spite of severe environmental degradation problems has , together with the Dominican Republic, the second most diverse flora in the Caribbean, after Cuba. Floristic studies among the vascular plants invariably reveal new species to science, particularly in biological rich areas. According to a floristic study conducted by the University of Florida in the 1980s and 1990s, an inventory of orchids of Macaya National Park ( in the Southern Peninsula) revealed that a third of 134 species were undescribed at the time of their collection. The total orchid flora, occupying less than 10 km<sup>2</sup>, represent roughly 40 % of the three hundred fifty orchid species known to exist on Hispaniola ( Dod 1993; Hespeneheide & Dod, 1993).

The Haitian flora consists of over 5,000 vascular plants species of which 37% are endemic comprising approximately 300 species of rubiaceae, 300 species of orchidaceae, 330 species of asteraceae, 300 gramineae and three species of conifers. Overall, the Haitian landscape hosts, according to the Holdridge classification, a total of nine zones which supports the diversity of forest formations.

The country boasts a rich fauna as well, with more than 2000 species of vertebrates of which 75 % are considered endemic. The mainland and satellite islands reflect a high degree of endemism, including 54 endemic species of frogs, 212 species of mollusks and 2 species of terrestrial mammals.

A recent biological inventory of one offshore island, Navassa island ( 7 km<sup>2</sup> ) , found more than 800 species, many of which may not exist anywhere else in the world, and as many as 250 that might be entirely new to science ( Center for Marine Conservation, 1999).

The diversity of life is also found at the ecosystem level. Indeed, it is possible to encounter an impressive range of ecosystems while traveling from high altitude habitats ( e.g forests, wooded areas, agrosystems), to inland freshwater ecosystems ( e.g. lakes ponds, rivers, springs and other wetlands) to coastal and marine ecosystems ( e.g. mangroves forests, coral reefs, estuaries, seagrass beds, wetlands, high seas etc).

The genetic diversity of native species of Haiti is largely unknown. A limited of economically important native species were selected in the late 1980s. Progeny testing, the establishment of seed orchards and seed production areas and the harvest of seed has been undertaken for native species in an effort a) to maintain genetic diversity and b) to ensure that the best available tree germplasm be available to peasant farmers for reforestation and agroforestry purposes.

### **G – ECONOMY AND SOCIO-ECONOMIC CONDITIONS**

Haitian economy is largely dominated by an important agricultural sector which provides livelihood to 80 % of the haitian population. The export of agricultural commodities accounted for more than 50 % of total exports in the early 1980s dropped drastically and the contribution of this sector to the Gross Domestic Product systematically decreased every year.

Food crops cover approximately 80% of the cultivated area and are grown by small farmers on hillside plots. Production of these crops is generally made without any soil conservation practice and exposes most of these lands to severe erosion, decreases yields and forces haitian peasants to clear a new plot, burn the vegetation and start a new cycle of production.

Haiti's agricultural sector faces many physical, socio-political, institutional and economic constraints. The potential of arable land area is limited by topography and high erosion risk. Natural disasters, floods, droughts, tropical storms make unsecure essential incomes from permanent crops.

Only about half of the land situated on plains are utilized. Approximately 400,000 hectares of mostly flat lands are not cultivated due to salinization, urbanization or lack of appropriate technology and investment ( USAID 1986).

Haiti is the poorest country in the western hemisphere with a GNP of 250 \$ US. The following illustrates the country' situation in comparison with other Caribbean countries:

#### **SOME HAITI SOCIAL INDICATORS IN COMPARISON WITH OTHER CARIBBEAN COUNTRIES (World Bank and UNDP 1997)**

<b>Criteria</b>	<b>HAITI</b>	<b>DOM. REP</b>	<b>JAMAICA</b>
GNP (\$ US)	250	1,460	1,510
EXPECTANCY OF LIFE	57	71	74
HUMAN DEV. INDEX	0,338	0,589	0,718

*Crisis for space and land in Haiti is tremendous. An array of complex social issues complicate sound and sustainable management of Watersheds and Coastal Areas. Population growth and poverty create important stresses on the environment. Demand for natural resources rises. Water/Watershed and Coastal management to succeed needs to be linked with a poverty-focused development strategy.*

## SECTION TWO. CURRENT WATERSHED/WATER RESOURCES MANAGEMENT ISSUES IN HAITI

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### 2.1 The freshwater habitats and ecosystems

The Haiti's freshwater system is composed of :

- *Watersheds, rivers basins* that cover all the lands above the river-discharges to sea and represent in fact area drained by a single water course system forming sometimes several sub-watersheds and constituting a functional unit established by physical relationships where upstream land use can incite a chain of environmental impacts affecting downstream areas;
- *Wetlands* , with the exceptions of some coastal/marine ecosystems ( marshes, estuaries etc), that include a variety of habitat types from flood and alluvial plains or geological disturbances to shallow lakes and ponds.

In watersheds and wetlands are included spring water that feeds these systems in water.

#### **2.1.1 The Watersheds**

Haiti is divided into thirty three ( 33) watersheds units ( Fig III) which include over 158 rivers. Among them, four are considered as transboundary watersheds. The most spectacular watershed unit is represented by the *Fleuve de l'Artibonite* ( The Artibonite River), 9,500 km<sup>2</sup>, which is a transboundary basin shared with Dominican Republic. The principal watershed and hydrological zones of Haiti are shown in the table I.

#### **2.1.2 - The Wetlands**

Wetlands are a key component of Haiti's freshwater system providing flood control, carbon storage, water purification and goods such as fish, timber and fiber. The most important wetlands for freshwater ecosystems in Haiti are represented by lakes and ponds. The country boasts two principal lakes ( Azuei and Peligre), one main pond ( Etang de Miragoâne) and 69 small ponds forming an area approximately of 20 km<sup>2</sup>.

The Azuei is the main lake of the country with an area of 113 km<sup>2</sup> , a maximum depth of 24 meters. Its constitutes in fact a transboundary lake with DR ( Lago Enriquillo in the Dominican side). Peligre is an artificial lake with an area of 48 km<sup>2</sup> and a maximum depth of 170 meters. It harbours, as already stated, the main hydroelectric power facility of the country. The Miragoâne spond is extending on an area swinging from 9 km<sup>2</sup> to 25 km<sup>2</sup> depending of the rainy season. Its presents a maximum depth of 45 meters.

**Tabl I – Principal Watersheds and Hydrological zones of Haïti; Source UNDP 1988, La gestion de l'environnement en Haïti : Réalités et perspectives and MARNDR 2000**

<b>Basin or Zone</b>	<b>Catchment Area/ Km<sup>2</sup></b>	<b>Basin or Zone</b>	<b>Catchment Area/km<sup>2</sup></b>
Môle St Nicolas- Moustique	987	Cap Haïtien	312
Bombardopolis_ Gonaïves	1147	Grande Rivière du Nord	699
Trois Rivières	897	Limonade- Ouanaminthe	1065
Port de Paix-Port Margot	543	Estère	834
La Quinte	690	Artibonite	9500
Limbé	312	St Marc-Cabaret	1090
Fonds Verettes	190	Cul-de-Sac	1580
Cayes-Jacmel-Anse à Pitres	1219	Côte de Fer-Bâinet	1060
Léogane-Carrefour	651	Petite Rivière de Nippes – Grand Goâve	661
Grande Rivière de Jacmel	535	St Louis du Sud- Aquin	706
Cavaillon	380	Grande Rivière de Nippes	459
Corail-Anse à Veau	877	Tiburon-St Jean	660
Cayes	634	Ile de la Tortue	179
Roseaux-Voldroque	540	Ile de la Gonâve	680
Grande Anse	556	Jérémie-Les Irois	364

### **2.1.3 - Watershed areas and Protective areas systems**

Protected areas, as integral parts of the development process and basic tools for sustainable development, were recently integrated in the development scheme of Haïti even if from an historical perspective establishment of protected areas was pronounced during the 1920's.

Officially, the Haitian Government has identified a total of 35 protected areas covering about 6 % of the national territory. However, the percentage of effective protected areas is evaluated at no more than 0,3% of the overall surface of the country. With the latter statistic in mind, the Haitian Republic stands far behind other Caribbean countries ( IUCN 1994) namely Jamaica ( 8,2%), the Bahamas (8,9%), Cuba ( 14,3%), the Dominican Republic ( 21,7%), Turk and Caicos (39,7%) and Martinique (66,3%).

In respect to this situation, few watershed areas have been included in the protective areas system in Haïti. In a practical way, only watershed located in the *Réserve Nationale de la Forêt des Pins*, the *Parc National de Macaya* and the *Parc National de la Visite* should be considered as being a part of the protected area systems. These watershed roughly correspond to Fonds Verettes, Grande Anse, Cul de Sac, Roseaux-Voldrogue, Ravine du Sud, Rivière l'Acul, Rivière Port-à-Piment, Rivière les Anglais, Rivière Cavailon, Rivière Glace, Rivière Roseaux and Grande Rivière de Jacmel Basins.

### **2.1.4 – Major threats to management of freshwater ecosystems**

Threats to management of freshwater ecosystems in Haïti can be divided into two categories: 1) Direct threats and indirect threats.

#### **Direct threats:**

They are:

- *Over exploitation of the forest resources and erosion of drainage basins*

Forests have been steadily exploited as wood for construction, as a source of energy ( 71% of the consumption) and as an expendable resource in the clearing of land for agriculture development. Deforestation is the major cause of erosion and the most crucial environmental concern of the nation.

At present, of the thirty (30) major watersheds within the country, twenty five (25) are completely deforested ( Ministry of Environment 1999). The forest cover was reduced from 60 % in 1960 to 6.7 % in 1978 ( USAID 1986). It has been estimated that the percent of the country remained forested represents less than 3% of the land surface today.

The removal of vegetative cover negatively impacted freshwater ecosystems in Haïti by decreasing their capacities for sustained production. Non forested land use activities place at risk the continued availability of reliable sources of domestic water, create

general denudation of the landscape and increase erosional potential of upper water areas.

- *River alteration*

Due to massive deforestation and increasing erosion, the process of hydrologic systems is malfunctioning. It prevails a situation characterized by Haitian technicians as the *Phénomène des rivières sèches* describing the fact that many wetlands and rivers are frequently subject to flooding and many critical basins do not have permanent flow.

- *Mismanagement and non sustainable use of groundwater*

It is characterized by contamination of aquifers due to unplanned water pumping, disorganizing open quarries etc( see 1.2.1).

### **Indirect threats**

They involve socio-economic and institutional factors:

- The accelerated population growth coupled with increasing rate of poverty and uncontrolled urbanization process ( shanty town): The Haitian population will reach 40 millions by 2040 according to projections of the *Secrétairerie d'Etat à la Population* and as already stated the GNP per capita is \$US 250, the lowest GNP in the western hemisphere ( World Bank and UNDP 1997) ;
- The lack of application of existing laws and land use control measures to fully protect upper water catchment against illegal squatting and land clearing;
- The lack of application, up to now, of existing policy in domestic water and its integration into a *Schéma National d'Aménagement du Territoire* and decision making;
- The lack, up to now, of official strategy and action plans for critical wetlands of the country.

## **2.2 Water resources: surface water, ground water, supply and demand**

Water resources problematic in Haïti is characterized by a great paradox. The country has ample water supplies meanwhile the water crisis is a great concern. Unsustainable management, inequal distribution, low supply level are the main causes of this situation.

Haïti receives an average of 40 milliards ( billions) cubic meter water per year in form of precipitations distributed as fallow: infiltration (10%), evaporation (60%), runoff (30%). Source: UNDP1998, MARNDR 1991



## **2.2.1 SURFACE WATER AND GROUNDWATER**

### **WATER FLOWS**

Surface water is concentrated in a reduced number of important rivers ( 60% of the annual average of the water flow, World Bank 1991) and the wetlands ( lakes and ponds) of the country.

Waterflows surface are characterized by a great irregularity. During rainy seasons, the flow of most streams is torrential and of short duration. As already stated, few rivers have permanent flow. The following table shows some characteristics of main river systems in Haïti:

**Tabl II – Principal river systems in Haïti. Source MARNDR/MOE 2000**

<b>Main River</b>	<b>Catchment Area Km<sup>2</sup></b>	<b>Average flow m<sup>3</sup>/sec</b>	<b>Run off coefficient %</b>
Artibonite	9,500	99	22.6
Trois Rivières	880	6.5	18.6
L'Estère	700	3.1	12.7
Grande Rivière du Nord	640	5.4	20.5
Grande Anse	490	12	46.2
Grande Rivière du Cul de sac	1,377	?	?
Cavaillon	400	8.0	42.0
Momance	330	5.6	?
Rivière Grise	290	3.3	24.0
Grande Rivière du Sud	205	3.9	32.4

Geographically speaking, water resources are mainly concentrated in the South West and the Center North of the country: 2/3 of the potential ( POW/WHO 2000)). The rest of the country detains a little more than 1/3 of the resources distributed in several small basins ( Tabl III).

**Tabl III – Distribution of water resources by hydrographic regions. Source PHO/WHO 2000**

Hydrographic regions	Area Km <sup>2</sup>	Total Run off		Run off relatively regular Mm <sup>3</sup> /an
		Average Flow Mm <sup>3</sup> /an	% q/Q Q=Flow	
I North	2,490	Q= 920	7.7	300 – 400
II North West	4,400	1,130	9.4	100 – 200
III Center North	7,200	3,465	28.9	700 – 1,000
IV Center South	3,630	1,100	9.2	300 – 350
V South East	1,810	775	6.4	50 – 1,200
VI South East	7,350	4,270	35.6	1,000 – 1,200
VII Satellite Islands	880	340	2.8	50
<b>Total</b>	<b>27,750</b>	<b>Q=12,000</b>	<b>100.0</b>	<b>2,500 – 3,300</b>

### **GROUND WATER**

Ground water resources in Haiti are classified into two categories:

a) *Continuous aquifers* illustrated by flood and alluvial plains generally are situated in the coastal zones. Water resources in these aquifers reach 48 billions of m<sup>3</sup> and represent more than 75% of the groundwater resources potential.

The most important continuous aquifers are:

- Les Cayes and Leogane Plains, the most significant in terms of potential. They are not actually exploited;
- Cul de Sac and Gonaïves Plains subject to an intensive exploitation;
- Artibonite Valley and Plaine du Nord.

**Tabl IV – Ground water resources potential from continuous aquifers. Source PHO/WHO 2000**

Category of Continuous Aquifers	Area of Continuous Aquifers (km <sup>2</sup> )	Thickness Considered (m)	Coefficient of accumulation	Accumulated Volume of water (10 <sup>9</sup> m <sup>3</sup> )
Alluvial plains and Coastlines	4,800	10 <sup>2</sup>	10 <sup>-1</sup>	48

- b) Discontinuous aquifers situated in the relief zones. Among them are: aquifers with karst, carbonated aquifers, calcareous coral reefs etc. It has been estimated that they represent 8.2 billions of m<sup>3</sup> and constitute 15% of the groundwater resources potential.

**Tabl V - Ground water resources potential from Discontinuous aquifers. Source PHO/WHO 2000**

Category of Discontinuous Aquifers	Area Km <sup>2</sup>	Exploitable Volume of water	Coefficient of accumulation	Accumulated Volume of water (10 <sup>9</sup> m <sup>3</sup> )
Facies with fissures	7,000	700	10 <sup>-2</sup>	7.0
<u>Facies</u> with karst	4,200	420	3 x 10 <sup>-3</sup>	1.2
<b>Total</b>	<b>11,200</b>	<b>1,200</b>	-	<b>8.2</b>

### **RENEWABLE WATER RESOURCES AND WITHDRAWAL**

According to a study conducted by the Ministry of Environment (MOE) and funded by the InterAmerican Development Bank (IDB) in 1998, the potential of renewable water resources represents 14 milliards m<sup>3</sup>/year of which 12,5 milliards m<sup>3</sup> correspond to superficial runoff and 1,5 milliards m<sup>3</sup> to the regulatory underground water table resources. To these renewable water resources should be included the groundwater potential estimated at 56 milliards m<sup>3</sup> of which 48 milliards m<sup>3</sup> are concentrated in the continuous aquifers and 8 milliards m<sup>3</sup> in the discontinuous aquifers. The water reserve formed by lakes and sponds is 1,1 milliard m<sup>3</sup> but the most part is briny.

The valorization of all these renewable water resources potential is not easy given institutional, socio-economic and technical constraints. In 1990, it has been estimated that less than 10% of the potential were exploited.

### **SALTWATER INTRUSION AND CONTAMINATION OF AQUIFERS**

Saltwater intrusion and contamination of aquifers are a major concern in the country. Due to high rates of deforestation coupled with intensive and unplanned water pumping and disorganizing open quarries, water table levels are decreasing allowing for the increased intrusion of sea water into aquifers.

This problem particularly affects agricultural production in continuous aquifers such as Cul de Sac and Gonaïves Plains. In the coastal zones, karstic aquifers are often contaminated by saltwater intrusion that complicate the exploitation of these aquifers.

## **POLICY AND MEASURES**

In relation to surface water and groundwater problematic, the Haitian government prioritized planning as a tool to develop comprehensive approach to tackle problems linked to the matter.

The *Ministère de l'Agriculture, des Ressources Naturelles et du Développement Rural (MARNDR)* has prepared a sectoral policy paper entitled : "*La politique sectorielle du MARNDR pour la Gestion des Bassins Versants*". The policy paper highlights institutional vision of this Ministry and efforts to be undertaken to control erosion problems in the watersheds.

The Ministry of Environment published two important policy documents: the *Programme de Formulation de la Politique de l'Eau* and the National Environmental Action Plan (NEAP). Actually, the MOE is developing sectoral policies related to biodiversity, desertification and climate changes that will influence status and trends of surface water and groundwater.

Due to intersectoral nature of watershed management, five Ministries including the Ministry of Environment are actually preparing an integrated national policy for watershed management to address priority problems. The new policy should target many critical issues such as groundwater recharge area, protection of important aquifers etc.

Other actions, being implemented by the *Service National d'Eau Potable (SNEP)* and the *Centrale Autonome Métropolitaine d'Eau Potable (CAMEP)*, include several infrastructure projects that cover construction of new facilities to improve the availability and the quality of drinking water, rehabilitation protection and extension of systems etc.

### **2.2.2 SUPPLY AND DEMAND**

#### **DEMANDS FOR SAFE DRINKING WATER AND COVER RATE**

In 1997, demands for safe drinking water of the whole country rise to the level of 137 millions m<sup>3</sup> (MOE/IDB 1998) divided as follow:

- 52 millions m<sup>3</sup> for rural areas;
- 85 millions m<sup>3</sup> for urban areas of which 33,5 millions m<sup>3</sup> only from Port-au-Prince, the capital.

Projections established by the MOE indicate by 2015 that the demands should rise to the level of 230 millions m<sup>3</sup> of which 65 millions m<sup>3</sup> for rural areas and 165 millions m<sup>3</sup> for urban area including 68 millions m<sup>3</sup> for Port-au-Prince ( MOE/IDB, 1998).

It is very interesting to observe, in the light of these projections, meanwhile demands for rural area will increase by 25% those for Port-au-Prince will practically increase by more than the double.

Accordingly although some progress, Supply Drinking Water ( SDW) is still low at the national level: less than half of the Haitian population get access to drinking water.

**Tab VI.- Evolution of cover rate of supply drinking water. Source PWO/WHO 2000**

Zones	Cover rate in % per year				
	1980	1990	1995	1996	1999
SDW in Port-au-Prince and surrounding areas	48.0	53.2	35.0	48.0	47
SDW in secondary Cities	47.0	58.6	45.0	43.0	46
SDW in rural area	8.0	33.5	39.0	41.0	48
<b>SDW in the whole country</b>	<b>18.0</b>	<b>33.5</b>	<b>39.0</b>	<b>43.0</b>	<b>48</b>

### **WATER DEMANDS FROM IRRIGATION SECTOR**

The potential irrigable lands has been estimated to 180,000 hectares. On the basis of irrigation systems efficiency ranging from 25 to 50%, total demand for the sector was fixed between 750 millions and 1,5 milliard m<sup>3</sup> in 1997 ( MOE/IDB 1998) .

In the future, with an irrigation systems efficiency comprised between 30 and 70%, water demand would range from 2,3 to 4,3 milliards m<sup>3</sup> by 2050 (MOE/IDB 1998).

### **WATER DEMANDS FROM OTHER SECTORS AND RELATIVE IMPORTANCE OF IRRIGATION SECTOR**

In relation to water demands from animal husbandry, aquaculture, industry, mining and tourism, the demands of these sectors are very low in comparison with irrigation. *Accordingly, the dominant water use in Haiti is the irrigation sector with approximately 80% of the demand* ( MOE/IDB, 1998).

### **TARIFFS STRUCTURE AND TARIFFS APPLIED**

Tariff system applied to drinking water is very complex. The system does not charge directly the amount of water used but the connections according to the diameters of branches. Accordingly, there are no meters in the households.

The CAMEP- Organism in charge of management and distribution of drinking water in Port-au-Prince, the capital – is using a tariff system based on three categories of consumers: Family consumers, industrial consumers and other categories. This

Institution is in the process to adopt a new tariff structure that takes into account the margin cost of the production of the water/m<sup>3</sup> and the purchasing power of the consumers.

Some *Charges forfaitaires (Contractual charges)* are applied to the connections and calculations are made on the basis of an average use. Organisms in charge of water distribution are obliged to periodically proceed to new calculations in order to not underestimate the average use.

It has been estimated that 1 m<sup>3</sup> of drinking water costs in local currency 13,75 gourdes ( \$US 1= 25 gourdes) for the ones who own private branches and 29,05 gourdes for households taking water from public fountains ( Evans Emmanuel 2000).

### **DISTRIBUTION OF WATER IN LAISON WITH RAIN-FED AGRICULTURE AND IRRIGATED AGRICULTURE**

In general, dry season occurs in haiti during the winter period( December, January, February). In some places, July is also a month of drought. When Hurrricanes strike, they impact on the rise of the rainfall values.

General rainfall patterns have been captured in Haiti by determining an agro-climatological index known under the mean monthly Moisture Availability Index (MAI) defined as PD/ETP where PD is the 75% probability of monthly precipitation and ETP is the monthly evapo-transpiration potential.

MAI values enable to detect moisture deficiencies and are used for first approximation determination of irrigation needs.

Table 7 presents MAI for some selected stations in Haiti. MAI less than 0,50 indicates that dry fertilizers should not be used. A MAI at 0,75 is a signal that the soils have enough moisture storage to prevent moisture stress. A high MAI value>120 indicates a need for drainage.

**Tab VII -MONTHLY MOISTURE AVAILABILITY INDEX FOR SELECTED STATIONS. Source: MAI values from: Coffey, Lewis, Hauge (1984)/ Hargreaves and Samani (1983) Cited by USAID 1986**

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Camp Perrin	0.30	0.28	0.39	0.74	1.17	0.66	0.45	0.64	1.11	1.65	0.86	0.18	1.15
Cerca la Source	0.0	0.00	0.00	0.10	0.80	0.43	0.49	0.57	0.66	0.78	0.05	0.00	0.60
Cap-Haitien	0.45	0.33	0.12	0.12	0.32	0.27	0.05	0.10	0.32	0.89	1.44	0.85	0.87
Ennery	0.00	0.00	0.02	0.09	0.92	0.69	0.17	0.23	0.48	0.43	0.13	0.012	0.58
Furcy	0.00	0.02	0.01	0.15	0.55	0.64	0.67	0.93	1.48	1.62	0.45	0.00	1.11
Desdune	0.00	0.00	0.00	0.00	0.07	0.20	0.20	0.21	0.15	0.06	0.00	0.00	0.23
Saut Mathurin	0.94	1.12	0.85	1.59	2.00	1.09	1.20	1.96	2.38	2.19	1.37	1.37	2.10
Soubois	0.44	0.52	0.58	1.03	1.80	0.94	0.76	0.99	1.83	1.64	0.86	0.86	1.44

Table 8 shows the number of months that irrigation is needed for some geographical locations in relation to MAI values:

- Values between 0,50 and 0,74 send the signal that supplemental irrigation would increase agriculture yields by removing moisture stress during growing season;
- Values between 0,33 and 0,49 indicate greater water demand;
- Values less than 0,33 shows not only is irrigation needed but fields generally require large quantities of water when riverflows are low.

**Table VIII -IRRIGATION NEED BASED ON MAI INDEX. Source USAID 1986**

Location	No. of Months having MAI Values			Months of Irrigation		Example of Irrigation Project
	0.50-0.74	0.33-0.49	<0.33			
So. Coast of the So. Peninsula	3	2	3	8	Moreau-Funfrede	
South East	3	2	6	11	Orangers	
Cul de Sac	2	3	7	12	Varreux	
Lower Artibonite	1	2	9	12	Artibonite dist. I-IV	
Upper Artibonite	1	2	6	9	Nan Paul	
North Coast	1	4	2	7	Limbé	
North West	0	3	9	12	Jean-Rabel	

Table 8 shows also the existing irrigation schemes that require the greatest quantities of water per area of irrigated land are found in the Cul de Sac, Lower Artibonite and NorthWest while the irrigated areas with the lowest water demands are on the North and South Coasts.

### **ECONOMIC VALUE OF WATER**

Little information exists concerning the economic value of water. Estimates have been made on the cost of 1 m<sup>3</sup> of drinking water. Groundwater is used for irrigation in significant amounts in Cul de Sac and Gonaïves. It is also widely used for domestic purposes and industrial needs especially in Port-au-Prince. Surface water resources have been inventoried and characterized in relation with hydroelectric potential.

**Tab IX – Synthesis of hydro-electric potential of Haïti, CIDA 1977 cited by USAID 1986**

<b>Region</b>	<b>River</b>	<b>Available Power</b>
North	Grande Rivière du Nord	600
	Limbé	279
	Caracol	282
	Petite Rivière	130
	Trois Rivières	1,778
	Artibonite/Verrettes	20,936
	Artibonite/Lachapelle	25,265
	Artibonite/Mirebalais West	11,850
	Artibonite/Mirebalais East	16,982
Transversale	Guyamouc/Thomonde	3,408
	Guyamouc/Thomassique	2,134
	La Theme	1,349
	Gobe	190
	Samana	776
	Roche Plate	2,570
Ouest	Grise/Site 31.0	720
	Grise/Site 41.7	379
	Momance	1,120
	Pichon	1,234
	Gosseline	13
	Petite Rivière de Jacmel	129
Sud	Cavaillon	240
	Grande Rivière de Nippes	382
	Grande Anse/Site 4.1	1,210
	Grande Anse/Site 35.4	970
	Grande Anse/Site 8.6	1,060
	Grande Anse/Site 15.4	2,460
	Grande Anse/Voldrogue	230

### **ENVIRONMENTAL IMPACTS OF IRRIGATION**

Environmental impacts of irrigation have not been systematically documented according to Environmental Impact Assessment standards. Cases of soil salinity have been identified and recorded in irrigated lands areas where drainage is insufficient such as Cul de Sac and Gonaïves Plains. The Artibonite Valley, the largest irrigated area cultivated in rice in the country, experiences also soil salinity problems.



## **PLANS TO INCREASE FOOD PRODUCTION**

Agricultural balance of the country is deteriorating. Food products imports have been considerably increased while exports were decreasing. Food demand grew more rapidly than the population .

**Tabl X – Evolution of population and food demand ( World Bank 1991)**

<b>Population and Food Demand</b>	<b>1985</b>	<b>2000</b>
Total population	100	132
Urban population	100	202
Rural population	100	111
<b>Food demand</b>	<b>100</b>	<b>140</b>

To deal with this situation, the Haitian Government with the assistance of the *Fonds International pour le Développement Agricole (FIDA)* is carrying out thru the MARNDR a rehabilitation of Small Irrigated Perimeters national project ( PPI Project) to increase food production. FIDA is also providing assistance to create an Agricultural Development Fund targeting agricultural production at the level of small farmers.

## **COMMENTS ON WATER CONSERVATION AND REUSE ATTITUDE AND APPLICATIONS**

Water conservation is handicapped by the lack of comprehensive National System of Protected Areas that could include different significant ecosystems of the country. Several policy efforts that have been made in relation with water are not yet at their phase of implementation due to financial constraint and political instability in the country.

Haiti produces an average of 34,515,000 m<sup>3</sup>/year of waste water ( PWO/WHO,1992 cited by Evans Emmanuel 2000). No system of waste water treatment exists. Recycling of such water could easily respond to irrigation needs when considering strategies that could overcome crisis water in the country.

Water quality is experiencing degradation and the impact of extreme hydrological events is exacerbated. Efficient management should be viewed in a context of integrated conservation and development solutions. Privatization of water markets should be analyzed in the light of national socio-economic policies. Managing water problematic pleads for the promotion of an intersectoral approach to land use and water resources management.

## **2.3 Land Use**

### **2.3.1 – Land use and conflicts**

It has been estimated that more than 1,300,000 ha are under some form of agricultural production ( USAID, 1986). Approximately, one third of all lands are eroded. Each year, the equivalent of 6,000 ha of valuable arable land are lost to erosion ( USAID 1986). Good soils with possibilities for irrigation represent 11.3% of the total land area of Haiti. Much of the 31.7% of the land having good soil (USAID 1986) but no potential irrigation is found on steep slopes subject to severe erosion.

Conflicts in relation to land use within watersheds have to deal with housing and quarries exploitations issues. In the watersheds situated close to urban and suburban areas, transformation of good lands for construction needs, degradation of landscape by unplanned quarries, proliferation of shanty towns and environmental problems associated constitute some serious concerns.

### **2.3.2 – Impact on sources protection**

Inappropriate land use practices ( indiscriminate tree cutting, overgrazing, cultivation of steep slopes without soils conservation techniques etc) have led to tremendous soil erosion problem and constant decline of flow of sources.

The diminution of flow mainly affects the sources located near of urban center. For example, the flow of Source Cerisier-Plaisance ( one of the source that feeds Port-au-Prince in water) passed in 1934 from 3 millions gallons/day to 250,000 gallons/day in 1988 (UNDP 1998).

### **2.3.3 – Existing GIS**

The Ministry of Planning,with the assistance of European Commission, has put in place a GIS Unit. This Unit is preparing a map of land use, erosion and density of housing for the entire territory. They are also working on a spatial data base at the national level.

The MOE in the context of the formulation of water policy has a data base allowing to calculate hydrological balance-sheet per river basin at the national level.

At the level of the civil society, Quisqueya University created a GIS Training Center.

### **2.3.4 – Historic data on floods and droughts at the national level**

Historic data and information exist concerning floods and droughts at the national level. They provide some details on the population affected ( number of persons died, injured etc), type and localization of the disaster and economic estimate of the destructions etc. Several national and international institutions have compiled data such as:

- The Civil Protection Direction of the Ministry of Interior which detains compilation from April 1<sup>st</sup> 1959 to November 25, 1996;
- The Canadian cooperation which published a list of natural disasters with their impact occurred from 1701 to November 25, 1997;
- The Red Cross and the *Institut haïtien de Statistique et d'Informatique* .

### **2.3.5 – Measures in place with respect to disaster preparedness for floods and droughts**

Measures in place with respect to disaster preparedness for floods and droughts give emphasis on planning and coordination:

The NEAP published by the MOE dedicated a program ( Program # 8) related to natural hazards and disasters management. A plan to combat desertification in the context of the UN Convention on Desertification is also in the process of formation. Measures are also being identified in the context of National Communication on Climate Change.

The Ministry of Interior published a disaster and hazards management national plan. The objective of this plan is twofold:

- Tackle causes and factors that generate hazards in order to reduce the impact of disasters;
- Strengthen the capacity of responses in the matter of disaster and hazards at the national level.

Under this Plan, a National Committee, intersectoral by nature, which covers Departmental and Commune Committees has been constituted by the Ministry of Interior to manage hazards and disasters. Meanwhile, this Ministry organizes every year in the approach of the Hurricane season in the Caribbean an educational campaign on radio and television warning the population against dangers of hazards and disasters and preventive actions to overcome these dangers.

### **2.3.6 – Existing Land use policy with special emphasis on water resources and water source protection**

An Inter-Ministry Commission is actually working on the implementation of a water resources policy. Final results of the work of this Commission are not yet available. As already stated in 1.2.1, The MOE with the assistance of IDB published a *Programme de Formulation de la Politique de l'Eau*. With also the assistance of World Bank, USAID, UNDP and CIDA, this Ministry published the NEAP that places emphasis on the valorization and conservation of natural resources. The NEAP also recommends to work on establishing systematic buffer zones to protect water sources against fecal pollution.

The MARNDR has published a sectoral policy paper on watershed management and an integrated concerted effort are in place to prepare a comprehensive national policy on watershed management.

## **2.4 Climate Change and Natural Disaster**

The effects of Climate Change on watersheds should be analyzed in terms of threats susceptible to jeopardize life and conditions of life ( ecosystems, health, socio-economic aspects etc) within these hydrological Units. This subsection presents preliminary results of a study supported by UNEP and conducted both by the MARNDR and the MOE under the UNFCCC entitled: "*Etude de Vulnérabilité d'Haïti face aux effets des Changements Climatiques*".

### **2.4.1 Impacts of Climate Change on Agriculture and forests in Haïti**

Based on some scenario, this study suggests that Climate Change would:

- Negatively impact conditions of water feeding for important crops like beans (*Phaseolus vulgaris*. L) production. Haïti is normally affected by drought every five years but this situation could change the periodicity and frequency of drought;
- Increase the occurrence of pests and diseases. There would be an expansion of fungi and bacterial diseases like *Ustilago scitaminea* ( Sugar cane), *Hemileia vastatrix* ( Coffee), *Pseudomonas salacearium* ( Solanaceae: tomato, tobacco etc);
- Increase the frequency of wider uncontrolled fire in the Pine Forest ( *Pinus occidentalis*) and affect the repartition and the abundance of mangrove forest in Haïti.

### **2.4.2 Impacts of Climate Change on Health**

Due to the modifications of environmental conditions brought by Climate Change, the study concludes that it is reasonable to expect an increasing occurrence of pathologies transmitted by vectors ( malaria, filariosis), pathologies related to conditions of drinking water ( diarrhea, typhoid fever... ) etc.

### **2.4.3 Impacts of Climate Change on Haitian economy**

These impacts are the following:

- Water level rise will negatively impact the production system particularly the system of roads, decrease the value of some real estate;
- Some terrestrial part of coastal cities like Gonaïves, Les Cayes, Miragoâne, Jérémie and St Marc etc could be found at less than 1,5 meters of the sea level;

- Some port installations could be submerged if sea level rise at 1,50 meters.

#### **2.4.4 Measures in place with respect to disaster preparedness and Climate Change**

See 1.3.5

### **2.5 Transboundary threats**

In the case of Artibonite River shared with Dominican Republic, these transboundary threats involve direct and indirect factors:

- *Direct factors* related to land use practices generating land-based pollution (pesticides and sedimentation);
- *Indirect factors* that deal with politics particularly political sovereignty impeding an integrated planning and management approach for this international River Basin. This pleads for an Artibonite Basin Management International Treaty between Haïti and Dominican Republic that could serve as an instrument between both countries to coordinate the management of this shared international basin and preserve water resources and associated ecosystems of this hydrological unit.

### **2.6 Pollution**

#### **2.6.1 Land-based pollution and Watershed management**

Specific study and data does not exist on how land-based pollution affect watershed management. Anecdotal information seems to suggest that sedimentation influences the availability of fish in some freshwater ecosystems.

#### **2.6.2 Main sources of land-based pollution of watersheds**

Solid waste and agricultural run-off represent major sources of land-based pollution of watersheds in Haïti.

#### **SOLID WASTE**

It represents the most important challenge in terms of land-based pollution of watersheds. Solid wastes are often discharged every where: water courses, drainage ditches, storm sewers etc. These practices generally lead to the obstruction of drainage facilities.

Solid waste collection and evacuation are a major concern of all the Haitian Municipalities. **In 1999, the evacuation rate of solid waste is 47 % for Port-au-Prince, the capital and 44% for secondary cities ( PHO/WHO 2000).**

**Tabl XI – Evolution of cover rate in waste disposal and collection. Source PWH/WHO 2000**

Areas served	Cover of needs in waste disposal and collection %			
	1995	1996	1997	1999
<b>Metropolitan area</b>	25	42	40	47
<b>Secondary cities</b>	40	39	46	44

### **AGRICULTURAL RUN-OFF**

Use of several chemicals in the Artibonite Valley present potential pollution problems, by their long residual effects, in the Artibonite River and Estuary. But the environmental impact has not been assessed yet in a scientific basis.

#### **2.6.3 Impacts of deforestation and sedimentation on watersheds**

They include ( see 1.1.5) :

- increasing of erosion problems that affect capacities for sustained production of watersheds;
- destruction of down stream communities by flooding;
- Siltation of hydroelectric power generating facility in the country. For instance, **the *Barrage hydro-électrique de Péligre*, the most important electric installation which provides 48 MW of hydro-electric energy lost 59 % of its capacity due to sedimentation ( UNDP 1998).**

## 2.7 Tourism

### **2.7.1 Major tourism concerns related to watershed management**

According to the Secretary of State for Tourism, the main tourism concern related to watershed management is to prevent attractive natural or historical site from degradation. Accordingly, the challenge for this Institution is to have a joint, coordinated and harmonized intervention targeting:

- The valorization of the site and environmental protection;
- Active involvement and participation of the stakeholders in the management of the site.

### **2.7.2 Significant impacts of tourism on watershed management**

Due to political instability, mass tourism activities are not really important by now in Haïti. The country only receives some Cruise international boats in Cap Haitian, the second city situated in the Northern part of the country. Some individual tourists also use to come thru Dominican Republic. Accordingly, tourism has no really significant impact on watershed management. However, it has been noted some impacts of national tourists on the Arcadin Coast ( 30 km North of the Port-au-Prince) and historical sites. These impacts consist of different kind of plastic bags.

## 2.8 Health

### **2.8.1 Major health concerns related to watershed management**

They are water quality and sanitation:

#### **WATER QUALITY**

Haiti has not determined yet national standards for water quality. National authorities are using standards recommended by WHO that they actualize every ten years. The Public Hygienic Division from the Ministry of Health is normally the entity in charge of controlling all categories of drinking water.

Water supplied by CAMEP to Port-au-Prince is reputed to have good physico- chemical qualities excepted water from Cerisier-Plaisance flows which contains high level of nitrates: 42 and 52 mg/l respectively ( PWO/WHO and IDB 1996). Water from Millet and Mariani/Carrefour flows present problems of mood after every rain.

According to some information, only CAMEP has equipments to make bacteriological analysis. The most common treatment applied to water consists in a High Test Hypochlorite (HTH) which shows, as inconvenient, to increase the excessive alkalinity of water already present in some flows surrounding Port-au-Prince.

In conclusion, water supplied by national authorities is disinfected and considered as relatively safe. What is not the case for other installations. Due to the absence of back-up equipments and breakdowns, water in rural area poses many safety problems. Water supplied for domestic uses by private vendors in the Port-au-Prince area is considered unsafe because it is not disinfected and its sources are not protected ( USAID 1986). Surface water presents a high risk of contamination.

The following table provides an overview of water quality for 23 secondary cities in the country:

**Tabl XII – Bacteriological and Physico-chemical analysis of water ( Data from the SNEP, 1991). Source PWO/WHO and IDB 1996**

Cities	PH	Color °Haz	Conductivity S/cm x 10 <sup>-6</sup>	Ammonium lpm	Turbidity °form	Coliforms Tot/100ml	Faecal coliforms Per 100ml
Kenscoff	7.69	12.0	233	0,3	5	22	1
Cx des Bouquets	7.52	5.0	465	0,01	465	5.0	7.52
Grand Goave	7.2	0	-	0,01	0	28	16
Hinche	7.65	10.0	477	0	0	26	18
Cayes	7.24	0	422	0,01	5	66	11
Anse à Veau	6.94	18.0	463	0,01	0	21	7
Jérémie	6.92	30.0	508	0,01	5	27	19
Pte Rivière De l'Artibonite	7.06	0	407	0,01	10	39	20
Cap Haïtien	7.4	0	601	0,01	0	-	-
Aquin	7.6	5.0	717	0,01	0	10	3
Miragoane	7.3	0	413	0,01	2,5	150	81
Léogane	7.88	0	287	0,01	0	69	9
Jacmel	7.44	0	445	0	0	76	19
St Marc	6.56	0	330	0	0	14	3
Port de Paix	7.12	0	339	0,12	0	15	2
Gonaïves	7.40	0	386	0,02	0	17	2
Thiotte	7.5	0	296	0	0	-	-
St Michel Attalaye	7.4	5	717	-	3	27	11
Petit Goave	7.3	6	-	0,12	-	21	8
Lascahobas	7.23	35.0	338	0	12	-	-
Anse Rouge	7.68	0	647	0	0	200	0
Jean Rabel	7.18	-	552	-	-	40	23
Estère/Desdunes	7.6	0	619	0,01	0	-	-
<b>Average</b>	<b>7.3</b>	<b>5.4</b>	<b>460</b>	<b>0,01</b>	<b>2</b>	<b>50</b>	<b>20</b>



## SANITATION

Environmental sanitation is posed in terms of solid waste management for urban areas and in terms of lack of latrines in rural area. In shanty towns where live crowded low-incomes people, sanitation is poor and wastes are disposed close to living quarters.

The Haitian hygiene code contains an article that stated: *All houses establishment must have latrines or septic tanks that must satisfy the requirements of the sanitary officer ...* However, the proportion of the population using latrines or septic tanks is not really high. **The cover rate of needs in evacuation of excreta is of 27 % for the whole country (44 % in urban area and secondary cities and 18 % in rural area. Source PHO/WHO and UNICEF 2000).**

**Tabl XIII – Evolution of cover rate in evacuation of excreta in urban area, rural area and in the whole country from 1990 to 1999. Source PHO/WHO 2000**

Years	Population in thousand inhabitants and cover rate in %								
	Urban Popula tion	Urban Popula tion served	Cover rate	Rural popula tion	Rural Popula Tion served	Cover rate	Total Popula tion	Total population served	Cover rate
1990	1,592.0	685.0	43.0	4,147.0	664.0	16.0	5,739.0	1,394.0	23.5
1995	2,588.4	1,113.6	43.0	4,591.7	734.7	16.0	7,180.3	1,847.8	26.0
1996	2,433.9	1,150.6	47.0	4,902.1	794.1	16.0	7,336.0	1,944.7	26.5
1997	2,532.7	1,158.0	46.0	4,959.1	817.4	16.5	7,491.8	1,975.4	26.4
1999	2,731.8	1,201.7	44.0	5,071.0	905.88	18.0	7,803.2	2,107.6	27.0

### 2.8.2 Water borne, water-washed and water-related diseases

Water-related diseases particularly prevail in rural area where potable water systems are deficient or rare. Most current infections concern diarrhea, malaria, intestinal infections and typhoid. Children are particularly affected by these diseases.

Diarrhea represents one of the two first causes of morbidity and mortality among children in Haiti. Malaria, specially the most dangerous form *Plasmodium falciparum*, is an endemic disease which affects populations living in rural area and shanty towns.

**Tabl XIV – Deaths caused by malaria from 1988 to 1994. Source PWO/WHO 2000**

<b>Years</b>	<b># malaria cases</b>	<b># of death</b>
1998	250,000	2,500
1991	25,511	101
1992	13,457	47
1993	29,773	5
1994	33,074	5

## **2.9 Data, Information and Research**

### **2.9.1 Monitoring programmes to collect data on water, equipment available and external data collection support**

Collection of data on water especially on rainfall, river flows, water quality is proceeded by:

- The National Meteorological Service and Water Resources Service of the MARNDR;
- Meteorological units of the *Autorité Portuaire Nationale ( National Port Authority)* and the *Autorité Aéroportuaire Nationale ( National Airport Authority)*;

Equipments available do not allow to cover all geographical regions to generate data on a regular basis for the entire territory. Professionals in the sector use to have recourse to US Meteorological Centers situated in Florida as an external data collection support source.

### **2.9.2 Data, Information , On going research in Watershed Management and Agencies involved**

The tendency is to prioritize data and research that could have immediately a practical scope on management practices. Fundamental research dealing for instance with variation of flow and variation of other important hydrological characteristics of watersheds is very scarce and sporadic. Current information deals with:

- Assessment and characterization of the natural resources and the communities that depend upon them;
- Project design and implementation;
- Preparation of management plan
- Management options for certain sub watersheds.

NGO and Universities carry out this kind of research to implement concrete projects. The Ministries play a normative role and are involved in policy design.

### **2.9.3 Research needs and additional needs to improve watershed management in Haiti**

They include:

- Inventory of key existing information on resources including priority ground water, sources of drinking water, habitat, wetlands, restoration sites;
- A systematic monitoring system to confirm or updates existing information or to fill gaps;
- Geographic references to monitor water, map water using GIS;
- Critical information on conditions of water ( threatened sources, habitats in need of special protection);
- Management Options Development Plans for Strategic Watersheds or Basins;
- Financial resources to develop Programs related to Watershed Management in the NEAP.

## **2.10 Stakeholder Participation/Awareness and Education**

### **2.10.1 Awareness activities and impact**

Awareness activities on Watershed Management are essentially the fruit of NGO efforts and private firms involved in the sector. They mainly consist of having field training and applied Manual teaching soils conservation practices to farmers. The Haitian government since the 1980's created thru the MARNDR the *Centre National de Formation en Aménagement des Bassins Versants du Limbé ( CFAIM)*. CFAIM provides training to Community Based NGO Groups and organizes specific seminar and workshops for professionals involved in the sector. State and private Universities assume also some important role in awareness activities.

Impacts of these actions are very mitigated in absence of an integrated comprehensive approach and policy related to watershed management and in the light of great poverty prevailing in the country.

### **2.10.2 Community Type Programmes**

Bilateral and multilateral organizations ( CIDA, FAO, FIDA, IDB, World Bank, USAID) are currently funding some Community Type Programmes in the country. At the government level, institutions mostly involved are the MOE, MARNDR, MPCE, the *Fonds d'Assistance et d'Economie Sociale (FAES)* and the *Unité Centrale de Gestion (UCG)*. In the most part of cases, funding to Government projects stopped since the political crisis is prevailing in Haïti.

At the civil society level, actions have been undertaken by international and national NGO. Among them are: CARE, Plan International, Catholic Relief Services, Action Contre la Faim, Pan American Development Foundation ( PADF), CARITAS, AGRO-ACTION-ALLEMANDE, ORE, ASSODLO etc.

### **2.10.3 Involvement of the public sector and the recognition of gender importance**

Stakeholders are generally involved in design and the implementation of projects, specific plans related to watershed management. Several local management committees exist and are playing a proactive role in the sector.

Feminist organizations have been very active in the recognition of gender issues in many aspects of development in Haïti including water/watershed management. The Haitian government created the *Ministère de la Condition Féminine* to address the issue at an intersectoral level.

The NEAP, in its strategic framework, recognizes that the role and status of women represent a constant concern for this plan and important actions should be taken to overcome barriers that impede women participation in the management of environment in Haïti.

## **2.11 Institutional Framework**

### **2.11.1 Characteristics of responsible Agencies in the Water/Watershed Management Sector**

In Haïti, a large number of actors - represented by six (6) Ministries, five (5) state autonomous Organizations, 133 Municipalities, Private and State Universities and more than 500 NGO and private institutions - is involved in the sector. They intervene in the field of production, regularization and water resources management and watershed management. Table 8 attempts to give an overview of their main characteristics:

**Tabl XV – Characteristics of Agencies involved in the Water/Watershed Management Sector in Haiti**

<b>Institution</b>	<b>Nature</b>	<b>Roles</b>
Ministry of Environment (MOE)	State	Conservation of ecosystems, water policy, protection of watersheds, formulation of related laws, policy and management strategies for environment, water quality
Ministry of Agriculture (MARNDR)	State	Meteorology, watershed management, water surface and ground water, soils and forest resources management
Ministry of Public Works (MTPTC) covering: - SNEP - CAMEP	State	Management of national and metropolitan potable water system, hydroelectricity, waste water, water supply, water quality, construction of water facilities
Ministry of Planning (MPCE)	State	Zoning of the territory, spatial management strategies
Ministry of Health (MSPP) covering : - POCHEP - DHP	State	Quality control, water supply
MI covering : - OPDES - OSAHM	State	Hazard and disaster management, watershed management
NGO, private commercial enterprises, University	Private	Water production, selling services, water resources and watershed management, water facilities construction, Research and study
Municipalities	State	Execution of different projects related to water/watershed management, fund raising etc

### **2.11.2 Legislation which governs the functioning of the Agencies mentioned above**

At the exception of MOE, most of the existing laws which guide the functioning of States Agencies are old. State Ministries are working under the Law of September 1982 on Public Administration. The most part of their organic laws are dated in 1983 and were promulgated during the Duvalier Dictatorship. In general, these laws are not consistent with the spirit of the actual democratic Constitution, the Constitution of 1987. The MOE, created in 1994, after Rio Summit, does not have until now an organic law. In fact, all of these Agencies are practically working outside of their organic law. The Haitian government created in December 1996 the *Commission Nationale de la Réforme*

*Administrative (CNRA)* to update their roles and solve overlaps existing in their mission. The CNRA has already introduced a bill to the Haitian government to reorganize and modernize the structure of States Agencies.

### **2.11.3 Policies formulation and their impacts on national development**

Recent tendencies are to formulate policies in a concerted, integrated and participatory manner. Ministries involved in the sector are undertaking consultations among them to clarify specific missions while they interact with the civil society to have their views and prospect in the water/water resources management orientations.

Given the fact most of these policies are relatively new or are being formulated, it is quite premature to assess their impacts on national development.

### **2.11.4 Financing and management strategies**

To improve the effectiveness and efficiency of water sector performances, the following financing and management strategies are in place and being envisioned:

- The possibility to create an *Agence Nationale de Gestion de l'Eau (ANGRE)* to harmonize actions in the sector;
- The conversion of the MOE into a new institution: Ministry of Environment and Water ( recommendation made by the actual Water National Commission);
- The existence of the FAES;
- The creation of environmental funds intended to target biodiversity loss and combat desertification;
- The possibility to create a specific fund to support actions in the water sector.

## SECTION THREE. CURRENT COASTAL MANAGEMENT ISSUES

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### 3.1 Coastal habitats and ecosystems

#### 3.1.1 Marine Protected Areas

Marine Protected Areas(MPA) are usually established for one or a combination of several reasons including protection of bio-ecosystems, protection of geo-ecosystems, protection of fishing grounds, protection of cultural resources etc. MPA may be established with varying degree of protection from complete ( no access) to various degrees of access for different activities such as fishing or scuba diving etc.

Although other nations in the wider Caribbean have established MPA with varying degrees of protection for the marine environment, Haiti did not establish yet a MPA as shown in the following table:

**Tabl XVI – Haiti and MPA in the wider Caribbean. Source: GBRMPA,WB,WCU 1995, A global Representative System of Marine Protected Areas**

Country	MPA	Other	Total
Cuba	15	15	30
Dominican Republic	7	4	11
Jamaica	4	0	4
<b>Haiti</b>	<b>0</b>	<b>0</b>	<b>0</b>
St Lucia	2	1	3
Trinidad & Tobago	1	7	8
Barbados	1	1	2
Belize	2	0	2
Dominica	1	0	1
Bahamas	9	0	9
St Vincent and the Grenadines	1	0	1
Guadeloupe	1	0	1

To fill this gap, the Haitian government has introduced thru UNDP a PDF B a proposal ( Integrating biodiversity conservation into an ecotourism strategy Project) to the GEF to have done different baseline studies and stakeholder consultations in order to establish in the North and North East Coasts the first MPA in Haiti.

### **3.1.2 The concept of coastal areas**

The concept of coastal areas incorporates land-sea-air interactions within the extent of the continental plains and continental shelves. This zone contains a disproportionate amount of total biodiversity, productivity and human resources (IUCN 1993).

### **3.1.3 Significant coastal habitats, ecosystems and wetlands**

With a Coastline of 1775 km and a coastal shelf of 5000 km<sup>2</sup> and five main offshore islands, Haïti's coastal and marine resources include examples of all types of life and geologic structures present in the Atlantic Ocean. All of these aspects together form a remarkably varied ecology and contribute to create a treasure of biodiversity.

### **COASTAL RESOURCES**

The coastal ecosystems play a crucial role in the production and the maintenance of fisheries and other biological resources of primary importance for the human population of Haïti and surrounding islands.

The seagrass beds, coral reefs, and forest mangroves constitute a predominant feature of the Haitian coastline.

Seagrass beds occur along the North Coast, Les Cayes in the South, La Gonave, Les Cayemites and l'Île à Vache areas. They represent a great source of primary productivity providing oxygen and nutrients to marine species and a mean of stabilizing substrates.

Coral reefs seem to be distributed along important coastal zones in Haïti. They provide food and shelter for resident and migratory species, play a protection role for coastal property from tropical storm damage and offer a storehouse for potential valuable species ( pharmaceuticals, commercial species)

Mangrove forests ( 180 km<sup>2</sup> in 1983) occur on the North and North east Coast ( Baie de Fort Liberté, Baie de Caracol and Baie de l'Acul), the Artibonite estuary, Les Cayes, L'Île à Vache, La Gonave and the Grand Cayemites. They play an important role in the reproduction cycle of numerous coastal and pelagic fishes species as well provide shelter for their offsprings. These species include the pike ( Centropomus undecimakis), and crustacean species like the prawn and the lobster ( Penaeus spp and Panulirus argus) or mollusks ( Strombus giga). They are thus considered important from an economic perpective since they are at the center of the fishing industry/productivity.

The mangrove forest habitat holds a rich and diversified fauna of which some representatives are permanent residents while others are seasonal visitors. At least 13 species considered either threatened or seriously in danger of extinction have been identified as inhabitants of mangrove forests and lagoons in the country. Among them are the west Indian manatee ( Trichelus manatus ), the American crocodile ( Crocodylus acutus), the Atlantic sea turtle ( Eretmochelys imbricata), the Flamingo ( Phaenicophilus palmarum) etc.



## **COASTAL WETLANDS**

In the Haitian Coastline are found deltas, estuaries, coastal plains, coastal lagoons. These wetlands provide diverse, renewable natural resources which support mixed traditional economies based on capture fisheries, the use of forest products and gathering. Grasslands and mangrove forests support useful plants. Coastal lagoons and mangroves are the nursery grounds for many species, both benthic and pelagic.

## **SIGNIFICANT COASTAL HABITATS**

### **A – Fort Liberté to Môle St Nicolas**

Characterized by the presence of productive bays and coves, sandy beaches, extensive seagrass beds and coral formations. Significant mangroves between Baie de Foprt Liberté, Baie des Caracoles and Baie de l'Acul. The three bays are identified to host that could be the first Haitian MPA in the context of MOE Project presented to the GEF ( See 1.2.1). In this area is found Labadie ( near of Cap haïtien), a small bay favored by tourists. Excellent shrimp habitat in Baie de l'Acul and good habitat for Manatee and green turtles.

### **B – Môle St Nicolas to Gonaïves**

Fishing and salt production zones. Deep water and salting of fishes species.

### **C – Gonaïves to Baie de St Marc**

Area of Artibonite Estuary. Harbors Manatees and mangroves that provide feeding habitat for flamingos and other shorebirds. Brine shrimp ( Artemia sp) is found.

### **D - Baie de St Marc to Ile à Cabrit**

Contains extensive fringing reefs and offshore reef formations surrounding Les Arcadins ( 30 km North of Port-au-Prince), an area prized by Scuba divers and identified to be declared as a MPA. Abundant specimen of both fish and invertebrates. Extensive seagrass beds are found.

### **E – Ile à Cabrit to Leogane**

Well-developped mangroves, lagoons and coral reefs. Area threatened by pollution.

### **F – Léogane to Jérémie**

Mangrove lagoon systems, coastal mangroves wetlands, rocky cliffs, offshore reefs and seagrass beds.

**G – Baradères to Les Cayémites**

Pristine coral reef system, relative large untouched mangrove formations. Identified for a MPA purpose.

**H – Jérémie to Tiburon**

Area of intensive fishing. Barrier reefs and sand bars.

**I – Port - Salut to Baie d’Aquin**

Vast seagrass beds and well-developped coral reefs systems. Intensive fishing. Flamingo and Crocodile habitats. Scenic landscape in St Louis du Sud, an area with a potential of 100,000 tons of shrimps.

**K – Baie d’Aquin to Anse à Pitre**

White coral sand beaches. Sea bird population near of Anse à Pitre. Jacmel city prized by tourists.

**L – La Gonave**

Large barrier and fringing reefs. Habitats for shorebirds and sea birds, conch, lobster, turtle and various fishes.

**3.1.4 – Major threats to management of coastal habitats, ecosystems and coastal wetland areas in Haïti**

Coastal ecosystems in Haïti are experiencing growing level of stress due to certain factors. The major direct threats to these ecosystems are divided into the following interrelated categories:

- *Overexploitation*: destruction of sensitive habitats, logging mangrove forests for their wood and bark and destructive harvesting methods used for fishes have led to the depletion of stock and species;
- *Coastal development*: Coastal development in the form of residential, tourist, unplanned construction, commercial development and road construction alter coastline ecosystems and lead to overexploitation of resources and habitat degradation;
- *Pollution*: Pollution caused by land-based sources ( solid wastes and toxins, siltation, agricultural runoff) and oil spills from vessels and aggravated by coastal development stress critical ecosystems such as wetlands, coral reefs and mangroves;

- *Extraction of sand* from the beaches for building is changing the morphology and the landscape, disturbing the hydrology, enhancing erosion and disturbing the whole ecosystem;
- *Corals death* due to high turbidity, sedimentation and other stress from human activities.

These threats are the symptoms of more fundamental forces that are driving coastal environment degradation: population growth, poverty and inequality, social change and development etc

## 3.2 Living and Non-living Marine Resource Exploitation

### 3.2.1 – Use of living and non-living resources and impacts

Haiti produces more than 6,000 tons of fish annually ( Badio Jean Robert 2001, Fish Service/MARNDR, oral communication). Estimates of the number of fishermen in the country are officially 27,000 ( Badio Jean Robert, oral communication) and the territory has been divided into seven (7) zones of fishing including continental fishing.

**Tabl XVII– Fishing zones and population of fishermen in Haiti. Source: Fish Service/MARNDR 2001**

Fishing Zones	Sites	# Fishermen
I	Derac to Cap Haitien	2,498
II	Port de Paix to Anse à Foleur including Petite Anse and Ile de la Tortue	3,268
III	Anse Rouge to Miragoane including La Gonave	3,453
IV	Miragoane to Tiburon including Les Cayemites Island	12,048
V	Tiburon to Aquin	6,000
VI	Cote de Fer to Anse à Pitre	4,494
VII	Continental Fishing	1,071

There is no accurate assessments of fish stock available by now. Potential yields of major fish resources are currently being assessed with the assistance of Cuban cooperation. Fish resources fall roughly into three categories: demersal, shellfish and pelagic species.

About more than 300 species of demersal are recorded in Haiti waters. In this category, snappers and various kind are caught. Shellfish species ( lobster, shrimp, conch and other mollusks) are very popular and prized. Pelagic species are found in form of small

resident populations along the Southern and Northern Coasts of Haiti. Ornamental reef fishes are harvested by commercial fishermen and individuals from the tourism industry.

In relation to the impacts, information available suggests that shellfish species are overfished. Cases of overexploitation are also reported for ornamental reef fishes. Coral reefs are used for construction in some places.

Non-living resources uses are related to quarries of which exploitations have lead to siltation of coastal waters and alter the health of these ecosystems.

### **3.2.2 – Aquaculture activities and impacts**

Introduced since 1950's in Haiti, aquaculture seems to experience actually a revived interest with the construction of many artificial ponds along the North East and North west Coasts, Plateau Central and Artibonite Departments.

Massive introduction of exotic species are also being undertaken by the Ministry of Agriculture in some natural lakes and ponds within the country. Fishes cultured and introduced include Tilapia nilotica, Tilapia mossambica , common carp ( Cyprinus carpio) etc.

No scientific studies were conducted to assess the impacts of these introduced species into the aquatic environment of Haiti specially in terms of biodiversity loss.

## **3.3 Climate Change and Natural Disasters**

### **3.3.1 – Impacts of sea level rise and extreme weather occurrences on the coastal areas**

Evaluations of global sea level change suggest that the current average of rise is approximately 1.5mm yr<sup>-1</sup> meanwhile the global mean surface temperature risen around 0.5<sup>0</sup> C has been widely accepted ( IUCN 1993). Climate models suggests that the observed changes in global mean surface temperature and sea level are the result of the increased concentration of greenhouse gas projected to rise by around 0.3<sup>0</sup> C per decade. This rate would lead to a likely increase in global mean temperature of 1<sup>0</sup> C by 2025 ( IUCN 1993) and a rise in sea level of 20 cm.

In absence of specific data from regional scenario of changes for the Caribbean sea, it is quite difficult to be precise in terms of impacts of sea level rise in Haiti. Given the fact, rise in sea level are expected to have large impacts on beaches and delta, at least five main coastal cities ( Port-au-Prince, Cap Haïtien, Port-de Paix, Les Cayes and Les Gonaïves) in Haiti are an area of concern. It is expected that there may be a loss of certain beach area which may have a detrimental effect on the nation's tourism potential. Loss of residential areas close to the Coastline are also expected. Coral bleaching is also an area of concern even if there is not yet documented cases of this problem in the country.

Coastal erosion and flooding will increase. Sea level rise could severely affect coastal wetlands the mangrove forests in particular. It is well-known in the literature that geological records suggest that little wetland formation is possible at rates of sea level rise exceeding 10 millimeters ( 0,4 inches) per year ( CMC/IUCN/WWF/UNEP/WORLD BANK 1993). Loss of the mangroves would have enormous ecological and economic consequences given the fact they stabilize coastlines, protect against hurricanes and storm surges and serve as nurseries for commercially exploited crustaceans and fishes.

### **3.3.2 – Impacts of floods on marine ecosystems**

Information available suggests that the health of the continental shelf has been affected by mud and other debris. In some fishing areas, productivity decreased as a result of eutrophication.

### **3.3.3 – Measures in place with respect to disaster preparedness and climate change**

An array of measures are being defined in the context of UNFCCC ( National Communications). Other initiatives concern the National Committee created by the Ministry of Interior to manage natural disaster and hazards.

## **3.4 Transboundary threats**

Cases of conflicts are often reported between Haitian and Dominican fishermen along the North East Coast ( Fort Liberté) and the South East Coast ( Belle Anse). Other threats have to deal with pollution problems caused by plastic containers mismanagement and sedimentation.

## **3.5 Land- Based Pollution**

Land-based sources are the primary source of coastal and marine pollution. Due to the lack of proper collection, disposal, and processing measures there has been enormous increase in the dumping of wastes of all types into watersheds and in other open areas such as streets.

Plastics of all types have become a scourge on land, coastal regions and surface water. 98,2% of debris found along coastal zones were found to be composed of various types of plastics mostly beverage containers ( MOE 1996). Raw sewage, due to non-existent collection and treatment facilities, has added itself to the list of one of the major problems afflicting the marine environment. With every rain, domestic and industrial waste, oils, plastics and others are washed down, completely untreated, into the ocean and adding to the problems of destruction and eutrophication of the marine ecosystem. Liquid wastes from industries are usually discharged into the nearest gully, ditch or watershed. This includes all types of waste from oils from power station to chemicals from tanneries. Liquid wastes from homes ( grey water) are also usually disposed of in this manner. The largest source of oils in the marine environment comes from vehicular oil dumped into gullies and watersheds.

### 3.6 Tourism

Associated with economic concentration on coastal areas, tourism represents an area of intensifying coastal use in Haiti. Coastal development linked to tourism disturbs the traditional way of life in fishing villages and constitute the commencement of many problems in the fragile coral reefs (destructive methods of fishing to satisfy tourists needs) and lagoons and beach environment.

### 3.7 Health

Major human health concerns related to coastal area management are strictly associated to the issues of pollution described in 3.5. Various sources of land-based pollution decline the quality of coastal waters. In terms of quality of water affected by contaminants, a special reference has to be made for the Port-au-Prince Bay. Recent studies carried by the Ministry of Environment have shown a high level of nitrogen nutrients and phosphorus brought by divers debris. Presence of pathogen micro-organisms such *Escherichia coli* was also revealed. In some places of the Bay, concentrations of coliforms measured could have health consequences for bathers and consumers of sea products (Olivier Le Brun/MOE 2000).

### 3.8 Data, Information Management and Research

No systematic data collection, information management and research exists along the Haitian coastline. Research and data collection have been mainly made on a fragmented and sporadic basis. Universities and State Agencies play a major role by conducting these researches. The Ministry of Environment, under the Pilot Programme of Integrated Coastal Zones Management (GZC Programme) funded by IDB, has a component entitled "*Recherches et Surveillance relatives aux milieux marin et côtier en Haïti*". This component is being executed in four selected areas: Port-au-Prince Bay, La Gonave island, Delta and Artibonite River and Baradères Bay. The *Université d'Etat d'Haïti* (Haiti State University) thru the *Faculté d'Agronomie et de Médecine Vétérinaire* is also doing some extensive research in the Arcadins Bay (North of the Port-au-Prince).

### 3.9 Stakeholder Participation/Awareness and Education

The GZC Programme within the MOE is being promoted public awareness activities by organizing strategic workshops for fishermen, local decision makers and other relevant stakeholders involved in Coastal issues. The purpose of these events is to train fishermen on sound and sustainable management of coastal areas, to capture local prospect of Coastal management issues and recommended solutions to overcome problems identified. The recommendations will serve as inputs to be incorporated in a future full-scale Programme to be funded by IDB and other interested donors. The Ministry of Agriculture has played a catalyst role in the recently created *ANP: Association Nationale des Pêcheurs* (National Association of Fishermen). The ANP appears to be a powerful lobbyist group capable to generate the political will to take

actions among government policy makers in support of a sustainable coastal zones management.

## 3.10 Institutional Frameworks

### 3.10.1 Agencies involved

In Haiti, Coastal Area Management is especially the favoured field for actions of State Agencies. A really few organizations dependent of civil society intervene in the matter. The following table provides an illustration of the missions of institutions involved.

### 3.10.2 Legal instruments

Legal framework in Coastal management is mainly centered around the November 27, 1978 Fishing Law of Haiti. The spirit of this Law was to regulate size, limit, respect of harvest season, import and export quotas for fishing. Articles 97 and 112 of this Law stated the following:

#### **Art 97**

##### **It is forbidden:**

- a) to capture, to sell, to export the *triton* ( *Claromis variegata*);
- b) to capture the green and the Caray turtle during the nesting season between May and October;
- c) to collect turtle eggs of any kind within the boundaries of the territorial waters;
- d) to capture sea turtles and Caray on the beach;
- e) to collect sea crabs between Dec 11<sup>th</sup> and March 31<sup>st</sup>;
- f) to capture marine mammals such as sea lions, whales, dolphins, porpoises within the territorial waters without a special permit from the Ministry of Agriculture;
- g) to cut mangrove vegetation which serves as the natural habitat for numerous marine species ( oyster in particular).

#### **Art 112**

##### **It is forbidden:**

- a) to capture, sell, buy small conch shells and to engage in the commerce of their shells;
- b) export the shells of sea turtles without authorization of Fishery Service;
- c) to export the following shells without the authorization of Fishery Service: *Dent saignante* ( *Nerita poloronta*), *Brig noir* ( *Linova pica*), *Casques* ( *Cassis tuberoses*, *Cassis madascariensis*);
- d) to capture lobsters with eggs, weighing less than 151 gr or 5 oz;
- e) to capture lobster between Apr. 1 and Sept 30;
- f) to collect shell less than 10 cm in length
- g) to use of *hooka* ( air compressors) to dive for conch between Feb 1 and July 31

The Ministry of Agriculture is currently in the process of modernizing the Fishing Law of 1978. Legal and regulatory requirements in Coastal Area Management in Haiti have also to deal with global legal instruments focusing on the reduction, abatement and control of coastal marine degradation. Haiti is Party to the United Nations Convention on the Law of the Sea (UNCLOS) and the International Convention for Prevention of Pollution from Ships (MARPOL).

The Ministry of Environment is pushing to strengthen local capability to enforce in the national legislation these international laws dealing with regulation of exploitation of coastal and marine ecosystems. This Ministry is also working to have Haiti as a contracting party of relevant regional legal instruments addressing the preservation of unique and fragile coastal ecosystems and habitats of endangered species. It is essentially about the Cartagena Convention (Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region) with its three Protocols namely:

- The Protocol Concerning Cooperation in Combating Oil Spills;
- The Protocol Concerning Specially Protected Areas and Wildlife ( SPAW);
- The Protocol Concerning Land-based Sources of Marine Pollution.



**Tabl XVIII – Characteristics of Agencies involved in Coastal Area Management Sector in Haiti**

<b>Institutions</b>	<b>Nature</b>	<b>Mission</b>
Ministry of Agriculture	State	Enforcement of fishing regulations, policy formulation on fishery, promotion of different kind of aquaculture activities, training
Ministry of Environment	State	Policy formulation on Coastal Area Management, Conservation of coastal ecosystems, Abatement and control of coastal marine degradation including pollution, protection of landscape, training
Ministry of Public Works covering: - SEMANAH - APN National Port Authority) - BME ( Bureau des Mines et Energie)	State	Regulation of shipping transportation, regulation of sand mining
Ministry of Justice covering: - PNH ( Police Nationale d’Haïti) thru the Coast Guard - Several Courts	State	Enforcement of the Law
Ministry of Culture	State	Protection of natural and historic coastal and marine heritage
Ministry of Finance covering: Administration Générale des Douanes ( Custom General Office)	State	Tax collectorship
Ministry of Planning	State	Land – use policy
Ministry of Tourism	State	Coastal Development, promotion of tourism
Civil society organizations covering: - ANP: Association Nationale des Pêcheurs - Association Hotelière Nationale - Universités	Private	Lobbying, coastal development projects, tourism activities

## SECTION FOUR. INTEGRATING WATERSHED AND COASTAL AREA MANAGEMENT

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### PROBLEM IDENTIFICATION, INTENDED GOALS AND BARRIERS

#### 4.1 – Legal and policy issues

##### A – PROBLEMS

- Absence of a modern legal framework for actions in watershed management (laws in the field are old, non-adapted to new realities);
- Absence of a general legal framework for environmental management ( a kind of a *Loi cadre sur l'Environnement*) in Haiti;
- Absence of a general law dealing with water management. A draft exists but needs to be adopted after revision;
- Laws which need to be changed include: capture of sea turtles, protection of threatened species, use of spearguns, quarries exploitation from coastal and beach areas, respect of harvest seasons and fishes sizes;
- Haiti Non – Party of Basal Convention, SPAW ( Protocol Concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region), RAMSAR Convention;
- Deficiencies in the monitoring of UNCLOS III;
- Weakness of environmental protection enforcement agencies;
- Fragmented approach and absence of a coherent policy in watersheds and coastal management;
- Absence of bilateral treaties with Dominican Republic dealing with transboundary issues.

**B – INTENDED GOALS**

- Formulate a clear legal framework dealing with watershed and coastal management issues;
- Complete the legal system by integrating some critical multilateral agreements important for watershed/coastal management;
- Establish a coherent public policy addressing various facets of problems in the sector.

**C – BARRIERS**

- Socio-economic factors linked to population growth and poverty problems
- Political instability
- Persistence of sectoral approaches *reflexes* in the Administration

**4.2 – Institutional issues****A – PROBLEMS**

- Lack of coordination and articulation among entities involved in the sector;
- Lack of human resources well-trained to face and challenge needs identified in this report to improve watershed management;
- Insufficient scientific information on coastal and marine challenges
- Overlapping jurisdictions and competition among agencies do not facilitate transfer of information;
- Absence of systematic EIA;
- Persistence of some *préjugés or taboos* about traditional management methods and knowledge;
- Intellectual Property Rights on traditional knowledge not addressed;
- Lack of a coherent Environmental Information System that could benefit from GIS methods and other NTIC ( New Technologies Information and Communication).

**B – INTENDED GOALS**

- Improve governance of the sector by establishing innovative mechanisms among agencies and increasing their capacities to make appropriate planning and interventions in the sector;

- Assist agencies to develop a proactive strategy in relation of critical issues of the sector.

### **C – BARRIERS**

- Persistence of vertical approach in the Administration;
- Lack of sensitivity on the need to integrate watershed and coastal management for some Ministries.

## **4.3 – Financial issues**

### **A – PROBLEMS**

- Precariousness of funding sources ( mainly based on international loans or grants);
- Environmental aspects not integrated in fiscal system ( no environmental taxes);
- Great influence of politics in environmental operations;
- Low investments in the environmental sector.

### **B- INTENDED GOALS**

- Institute a financial national system in support of environmental actions;
- Facilitate a best *mise à contribution* of the international cooperation ( systems of the Conventions).

### **C- BARRIERS**

- Given many infrastructure problems ( Electricity, road etc) in Haiti, environment may not receive sufficient attention;
- Non inclusion of environmental aspects in National Accounting.

## **SECTION V. NATIONAL ACTION PLAN TO IMPROVE INTEGRATED MANAGEMENT OF WATERSHEDS AND COASTAL AREAS IN HAITI**

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### **5.1 Rationale for an Integrated Management of Watersheds and Coastal Areas ( IMWACA)**

Haiti, as already shown in previous Chapters, is being experienced major alterations of its watersheds and coastal areas as a result of intensifying and unregulated human pressure due to increasing population and poverty problems. Lands are extremely eroded as a consequence of inappropriate land use practices such as exponential tree cutting, overgrazing and cultivation without adequate soils conservation practices. Population's needs for safe water supply and sanitary waste disposal system are being expanded. Hydrologic regime of the most part of Haiti's rivers has been severely disturbed.

Mangroves forest and coral communities are being cleared and destroyed. Many forms of coastal disturbance stem from physical developments associated with urban developments and maritime activities. Coastal environments are under pressure from human activities leading to pollution. Continental drainage carries effluents to the sea from urban sewage and some industrial activities. Plastic containers, faecal bacteria and heavy metals affect the quality of many coastal ecosystems. Transboundary threats associated with watersheds and coastal zones are a great concern.

To stop this worldwide assault on watersheds and coastal environments, a particular and useful framework for addressing various kinds of threats to watersheds and coastal zones must be found.

Therefore, an Integrated Management of Watersheds and Coastal Areas ( IMCAWA) policy must be developed and could be a valuable tool to create conditions for successful watersheds and coastal zones management. IMCAWA will consider the coastal areas and its associated watersheds as a single unit and attempt to integrate the management of all relevant sectors to the issue of watershed and coastal zones. It should cover soils and water management and planning mechanisms applied to the entire watershed and ecological needs of coastal and marine systems influenced by the drainage of river basins. In the context of IMCAWA, water resources management and planning should be viewed as a multidisciplinary process and included in a framework that seeks collaboration among all relevant agencies at the national/river basins levels and local communities.

## 5.2 The IMWACA National Action Plan

### OBJECTIVES

The general objectives of the IMWACA National Action Plan are set forth by socio-economic and ecological conditions that largely influence the well-being of Haitian population namely: high rate of poverty, crisis in the local economy, accelerated degradation of watersheds and coastal environments. The National Action Plan incorporates actions already recommended in some official policy papers prepared by competent authorities and proposes new ones intended to provide a coherent set of specific and concrete actions for operational activities conducive to the improvement of integrated management watersheds and coastal areas in the country. The focus of the Plan is to develop and implement initiatives in order to achieve to the maximum extent possible the reversal of environmental degradation affecting watersheds and coastal zones.

### STRATEGIC AREAS OF INTERVENTIONS

In response to changes in watersheds and coastal ecosystems in Haiti, IMCWA to play a stronger role in sustainable development of the country should cover four interlinked strategic areas and the following actions need emphasizing:

*Strategic Area I: Restoration of critical coastal ecosystems and watersheds associated*

The overall objective of this Area is to maximize the sustainable benefits to local communities from using resources within watersheds and coastal zones to generate food, employment and income, supply safe water and conserve biodiversity resources for the benefit of local and global communities.

Activities could be grouped into the following closely related components:

- **Development and Implementation of planning and management tools/guidelines** and other appropriate mechanisms to prepare integrated watershed and coastal areas management plans and to promote environmentally sound practices and forms of land-use, watershed management and coastal development;
- **Catchment afforestation and revitalizing farming systems** aiming to increase forest cover and arrest soil degradation through production of seedlings, tree planting, agroforestry techniques, soils conservation practices with the full involvement of communities; This component will also contribute to create forests to feed important aquifers and protect different sources of water.
- **Microprojects** consisting of small investments funds to generate incomes and which can directly address poverty concerns related to the communities;

- **Establishment of Marine Protected Areas** through relevant biogeographic criteria, empowerment of responsible stakeholders, zoning plans, co-management partnership, research and monitoring programme etc;
- **Protection of mangroves and coral reefs from encroachment and destruction** by giving more responsibility to fishermen organizations, replanting mangroves and formulating appropriate community management plans and promoting the recovery of damaged reefs thru restoration techniques ( transplanting corals, construction of artificial reefs, farming corals etc);
- **Wetlands Management ( Coastal wetlands or inland waters that are wetlands)** intended to work closely with communities to conserve the wetlands and use them sustainably in order to improve their buffering capacity;
- **Development of Ecotourism.** Sites with great potential of ecotourism will be identified in collaboration with local entrepreneurs and Territorial collectivities. Action plan to promote ecotourism will be elaborated and implemented.
- **Implementation of measures to promote sustainable fisheries management** by vulgarizing sound methods of fishery, establishing fishery data base ( information on fish biology and ecology, stock size, qualitative and quantitative information on aquatic biodiversity, socio-economic characteristics of fishery stakeholders etc);
- **Regulation of land-based sources of pollution** emphasizing ( with Municipalities) on the rehabilitation of the existing waste treatment facilities or construction of new facilities, demonstrating the use of artificial and natural wetlands in waste treatment and construction of dry or composting toilets, education etc;
- **Development of water projects.** Integration of hydroprojects and irrigation/drainage projects, with the participation of private sector and user associations, within the IMWCA approach will be also promoted. In this context, sustainable mariculture could be also encouraged.
- **Research and Monitoring of implementation success and impacts.** Collaboration of specific Universities or Environmental Groups will be profited by setting a monitorable performance indicators to generate different relevant information to measure progress and impacts. Research will be encouraged to identify and assess, in the impact area, available water supplies ( quantity and quality), projections of future use, impacts on aquifers, evaluate the efficiency of existing piezometer or hydrometeorological collection networks for appropriate measures, promote the use of GIS to create database on water resources and their management in a word *establish a National Information System on Assessment and Utilization of Water Resources for the decision support system.*

*Strategic Area II : A new Institutional and Legal framework to address Integrated Management of Watersheds and Coastal Areas*

The objective of this Strategic Area is to put in place innovative legal and institutional mechanisms and instruments to overcome obstacles, facilitate the planning and improve the overall governance of the sector related to the Integrated management of Watersheds and Coastal Areas. The following represents some important activities that could be achieved:

- **Elaboration/ Finalization of relevant Policy instruments related to water/watershed and coastal zones.** The valorization, conservation, management and appropriate use of watersheds and coastal zones rely on adequate policies at the national and local level. In this context, a remarkable efforts will be envisioned by Haitian competent authorities to a) prepare, as recommended by the *Atelier de Concertation Inter-Ministérielle pour la Gestion des Bassins Versants*, a Consensual National Policy on Watersheds Management b) take steps to formulate the National Action Plan to Combat Desertification c) finalize the Biodiversity National Strategy and Actions Plan as well the National Communication on Climate Change;
- **Decentralization and Institutional Strengthening.** This component will cover actions such as: a) Creation, as a recommendation of the *Atelier de Concertation Inter-Ministérielle pour la Gestion des Bassins Versants*, of Management Authorities in Strategic Watersheds ( Strategic Councils) to promote stakeholder participation and where representatives of the civil society can be empowered as decision makers and as partners in project execution and monitoring and in integrated management of watersheds and coastal zones. b) Adequate measures to concretize the creation of the *ANGRE*, the National Agency for Water Management and solve jurisdiction conflicts among State Agencies;
- **An innovative Legal Framework.** It will be critical that the work initiated both by the MARNDR and the MOE to revise legislation related to watersheds be achieved and adopted by the Haitian Parliament. Efforts will be also done to facilitate the adoption of the very important General Law on Environment ( *La Loi Cadre sur l'Environnement*) and the General Law on Water which includes important articles on a National Fund for Water Management and important measures to protect ground water. Standards in relation to EIA and other practices including aquaculture and mariculture should be envisioned by competent authorities. The legal system will be also completed by integrating critical multilateral agreements for watersheds and coastal zones such as Cartagena Convention ( Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region) with its three Protocols namely: The Protocol Concerning Cooperation in Combating Oil Spills, The Protocol Concerning Specially Protected Areas and Wildlife ( SPAW) and The Protocol Concerning Land-based Sources of Marine Pollution etc;



- **Human Resources Capacity Building for Integrated Management of Watersheds and Coastal Areas.** Given the lack of well-trained human resources involved in the sector, the objective is to strengthen water/watersheds and coastal zones institutions by training officials and decision makers, professionals, managerial staff and community leaders and organizing information campaign targeting key stakeholders etc.

*Strategic Area III : Reduction of Communities' Vulnerability to Natural Disasters*

The focus will be to prepare communities for and respond to natural and human-induced disasters such as floods, droughts, fires and non human-induced disaster like Hurricanes. Actions will include:

- **Improvement of the decision support system in the matter of Natural Disasters Management.** It will involve a non limited activities such as consolidation of hydrometeorological units and capacity building in this field, strengthening of participating structures such as National, Regional and Local Committees for Natural Hazards Management and Risk management Services or Directions, financing critical infrastructures etc;
- **Support to the formulation or implementation of relevant policies and strategic planning.** Efforts will be accomplished to initiate the National Communication on Ozone Depletion and the National Action Plan to Combat Desertification, to implement the existing National Action Plan to Natural Disasters and Risks through different kinds of consultation process, workshops and seminars, preparation of Detailed Implementation Plans and to have for exposed agglomerations urban environmental land use planning as a preventive tool etc;
- **Support to Awareness activities.** It will strengthen awareness at the national level thru radio information campaigns, training materials, mobilization of the civil society thru NGOs etc.

*Strategic Area IV : Transboundary Cooperation in Integrated Management of Watersheds and Coastal Areas with Dominican Republic*

The objective is to facilitate border integration with Dominican Republic ( DR), foster environmental management in the areas of Watersheds and Coastal Zones Management and strengthen national Agencies of both countries concerned with environmental planning and natural resources use and promote creation of mechanisms for joint interagency activities in support of sustainable development of borders populations of Haiti and DR. Actions could include:

- **Institutional and Legal Capacity Building.** Efforts could be accomplished by both countries to have the existing *Commission Mixte Haitiano- Dominicaine* played a more proactive role in the planning process for development of the border regions. The *Commission Mixte Haitiano-Dominicaine* could be evolved into

a Regional Secretariat, an operating structure dealing with binational border development programs. In the same way, the Hispaniola Development Fund being discussed between both countries, as a consequence of a debt alleviation process, should incorporate environmental issues in general and Watersheds/Coastal issues in particular. Haiti and Dr could also explore the possibility to negotiate and sign bilateral Treaties on Artibonite River and Fort Liberté and Mancenilla Bays etc;

- **Support to regional diagnosis of the border areas.** A process of regional diagnosis of each of the border areas could be made through specific workshops ( binational approach, relevant programs and projects, implementation of Rio Conventions etc) and served as the basis for preparing policy guidelines and strategies for structuring binational border development plans in Integrated Management of Watersheds and Coastal Areas or in other development issues.
- **Development and implementation of binational border projects and programs.** Haiti and DR could undertake dynamic cooperation to develop and implement joint projects and programs in the fields of Water/Watersheds and Coastal Zones with the vision to achieve the harmonious development of their respective border territories and for the benefit of their nations.

## SECTION VI. RECOMMENDED INPUTS TO REGIONAL ACTION PROGRAMME

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The Haiti IMWACA National Plan already described a coherent set of initiatives which may be more effectively executed at the regional level and included in the Regional Action Programme. These initiatives will:

- Assist countries to perform or establish Integrated Watershed/Coastal management ( plans formulation, legislative arrangements, MPA establishment or performing etc);
- Develop standards in relation to EIA and other practices including aquaculture and mariculture;
- Facilitate the establishment of a comprehensive Information Environmental System ( inventory and monitoring, access to modern technology);
- Provide assistance in cooperation to take responsibility to transboundary issues ( in relation to the threats);
- Contribute to educate people about interrelation watersheds and coastal management and train officials and decision makers ;
- Facilitate implementation of important multilateral agreements;
- Develop technologies to reduce waste ( Preventing pollution);
- Assist in the formulation of national policy relevant to the sector;
- Strengthen the knowledge base on addressing issues and challenges in watershed/coastal management for SIDS countries;
- Facilitate the collection of success cases in SIDS countries and facilitate their dissemination.

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## ANNEX I

### Outline for National Reports *Integrating Management of Watersheds & Coastal Areas in SIDS of the Caribbean*

#### Executive Summary

#### Introduction

#### Section One. Current Watershed/Water Resources Management Issues

##### i. Freshwater Habitats and Ecosystems

- What watershed areas are included in the protective areas system in your country?
- What are the major threats to management of these areas?
- What are the significant freshwater ecosystems in your country?
- What are the major threats to management of these ecosystems?

##### ii. Supply and Demand

- What are the various & relative demands placed on watersheds/water resources?
- What are the tariffs and how are tariff structures derived? Is cost recovery taking place
- What are the competing uses of water and which uses are given priority
- Comment on the economic value of water at the national level
- What other sources of water are available
- What percentage of overall water used at the national level is derived from these sources
- Describe the relative importance of irrigation with respect to water use at the national level
- What measures are in place with respect to drainage linked to irrigation schemes
- What are the current distribution with respect to rain-fed agriculture and irrigated agriculture
- Identify and describe any plans to increase food production through irrigation or through rain-fed agriculture
- What have been the environmental impacts of irrigation (e.g. increased soil salinity)?
- Comment on water conservation and reuse attitude and applications

##### iii. Ground Water vis-a-vis Surface Water

- To what extent are groundwater and surface water exploited?
- What policies and measures are in place to allow for protection of these sources?
- What conservation policies and incentives are in place?
- To what extent is saltwater intrusion a concern?
- What measures are in place to prevent contamination of aquifers by salt water?

- What data exists on sea level rise and/or land subsidence

#### **iv. Land Use**

- Describe any existing land-use policy with special emphasis on water resources and water sources protection
- What conflicts exist in relation to land use within watersheds?
- How does land use impact on source protection
- Are there any existing GIS?
- To what extent do incidences of flood and/or drought impact on watershed management?
- What historic data exist on floods and droughts at the national level?
- What measures are in place with respect to disaster preparedness for floods and droughts?

#### **v. Climate Change and Natural Disaster**

- What impacts have sea level rise had on watersheds?
- What impacts have extreme weather occurrences had on watersheds?
- What measures are in place with respect to disaster preparedness and climate change?

#### **vi. *Transboundary threats***

- What are the transboundary threats related to common watersheds?

#### **vii. Pollution**

- How is land-based pollution affecting watershed management?
- What are the main sources of land-based pollution of watersheds (e.g. urban and agricultural run-off; industrial commercial, port and solid waste)?
- What impacts have deforestation and sedimentation had on watersheds?

#### **viii. Tourism**

- What are the major tourism concerns related to watershed management?
- What significant impacts does tourism have on watershed management?

#### **ix. *Health***

- What are the major health concerns related to watershed management?
- Comment on water borne, water-washed, and water-related diseases.

**x. Data, Information Management and Research**

- What monitoring programmes are in place for collecting data on water (e.g., rainfall, river flows, water quality)?
- What equipment is available within country?
- What external data collection support is utilized?
- What data and information exists related to watershed management?
- What systems are used for capturing, collating and processing water resources data, e.g. GIS?
- Comment on data/information reliability and quality control.
- What agencies are involved and what are their roles?
- What are the additional needs in order to improve watershed management?
- Identify research needs in relation to watershed management in your country
- Identify research conducted or on-going on water resources management in your country

**xi. Stakeholder Participation/ Awareness and Education**

- What public awareness activities have been conducted in relation to watershed management?
- To what extent do these activities impact on management of watersheds?
- Do studies or data exist on public awareness and education impact?
- What community type programmes exist for water resources management
- What is the involvement of the public in the decision-making process?
- To what extent has the recognition of gender importance in watershed management been addressed?

**xii. Institutional Frameworks**

- What are the characteristics of responsible Agencies in the Water/Watershed Management Sector?
- What legislation guides the functioning of these agencies?
- How is policy formulated?
- What policies exist?
- How do these policies (positively or negatively) impact on national development?
- Identify investments made in the sector and the sources of funds for these investments
- What financing and management strategies are in place for improving the effectiveness and efficiency of water sector performance
  - What are the existing human resources in relation to water resources management
  - What are the human resource needs in relation to watershed management?

**Note: Identify /describe ongoing initiatives (both Governmental and Donor Agency funded) in all categories where possible.**



## **Section Two. Current Coastal Area Management Issues**

### ***i. Coastal habitats and ecosystems***

- What marine protected areas exist in your country and what are the major threats to management of these areas?
- What are the significant coastal habitats and ecosystems in your country and what are the major threats to management of these habitats/ecosystems?
- What are the significant coastal wetland areas in your country and what are the major threats to management of these areas?

### **ii. Living and Non-living Marine Resource Exploitation**

- To what extent are living and non-living resources being exploited in coastal areas? What impact is this having on coastal areas?
- How significant is aquaculture in the coastal areas?
- Identify the impacts of aquaculture on coastal areas?

### **iii. Climate Change and Natural Disasters**

- What impacts have sea level rise had on the coastal areas?
- What impacts have extreme weather occurrences had on coastal areas?
- What measures are in place with respect to disaster preparedness and climate change?
- What impacts do floods have on marine ecosystems?
- What development practices contribute to threats to life and property?

### **iv. Transboundary threats**

- What are the transboundary threats related to common coastal areas?

### **v. Land-Based Pollution**

- How is land-based pollution affecting coastal area management?
- What are the main sources of land-based pollution of the coastal area (e.g. urban and agricultural run-off; industrial commercial, port and solid waste)
- What impacts have deforestation and sedimentation had on the coastal areas?

### **vi. Tourism**

- What are the major tourism concerns related to coastal area management?
- What significant impacts does tourism have on coastal area management?

### **vii. Health**

- What are the major human health concerns related to coastal area management?
- What are the food safety concerns linked to coastal areas?

### **viii. Data, Information Management and Research**

- What monitoring programmes are in place for collecting data on water e.g. rainfall, river flows, water quality?
- What equipment is available within country?
- What external data collection support is utilized?
- What data and information exists related to watershed management?
- What systems are used for capturing, collating and processing water resources data, e.g. GIS?
- Comment on data/information reliability and quality control.
- What agencies are involved and what are their roles?
- What are the additional needs in order to improve watershed management?
- Identify research needs in relation to watershed management in your country
- Identify research conducted or on-going on water resources management in your country.

### **ix. Stakeholder Participation/ Awareness and Education**

- What public awareness activities have been conducted in relation to coastal area management?
- To what extent do these activities impact on management of coastal areas and watersheds?
- Do studies or data exist on public awareness and education impact?
- What community type programmes exist for water resources management
- What is the involvement of the public in the decision-making process?
- To what extent has the recognition of gender importance in watershed management been addressed?

### **x. Institutional Frameworks**

- What are the characteristics (mandate, functions/roles, type e.g. NGO,CBO,Government) of responsible Agencies in the Water/Watershed Management Sector?
- What legislation guides the functioning of these agencies?
- How is Policy Formulated?
- What policies exist?
- How do these policies (positively or negatively) impact on national development?

**Note: Identify/describe ongoing initiatives (both Governmental and Donor Agency funded) in all categories where possible.**

### **Section Three. Integrating Watershed and Coastal Area Management**

Describe the need to integrate watershed and coastal area management. In this regard, discuss the interactions of watersheds with coastal areas and their relationship to a particular sector.

Also address issues related to integrated management across various sectors. Literature relevant to the interactions of watersheds with coastal areas and their relationship should be provided.

This section should be divided into three components:

- i. Problem identification***
- ii. Intended Goals***
- iii. Barriers***

Each component should address the following issues:

- i) Legal and Policy
  - Development and /or enhancement
  - Enforcement, monitoring, and compliance
  - Harmonization
  - Multilateral environmental agreements
- ii) Institutional (Government, non-governmental, and private sector)
  - Institutional framework (development and/or enhancement)
  - Capacity building
  - Stakeholder participation and awareness
  - Research and development
  - Information and Decision Support Systems
  - Social and cultural issues
- iii) Financial
  - Investments/Funding (national and international funding institutions)
  - Economic Instruments

#### **Section 4. National Action Programme to Improve Integrated Management of Watersheds and Coastal Areas**

Elaborate on each of the following aspects of a National Action Programme. These are designed to eliminate and overcome the barriers identified in Section Three.

##### iv) Legal and Policy

- Development and /or enhancement
- Enforcement, monitoring, and compliance
- Harmonization
- Multilateral environmental agreements

##### v) Institutional (Government, non-governmental, and private sector)

- Institutional Framework (development and/or enhancement)
- Capacity building
- Stakeholder participation and awareness
- Research and development
- Information and Decision Support Systems
- Social and Cultural Issues

##### vi) Financial

- Investments/Funding (national and international funding institutions)
- Economic Instruments

#### **Section Five. Recommended inputs to Regional Action Programme**

This section should identify actions that are more effectively executed at the regional level. This section may include, but is not limited to:

- Training
- Information Exchange
- Transboundary Issues
- Model Legislation
- Multilateral Environmental Agreements