IWCAM INDICATORS MECHANISM AND CAPACITY ASSESSMENT

PART ONE

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for the

GEF Project on "Integrating Watershed & Coastal Areas Management in Caribbean Small Island Developing States (GEF-IWCAM)"

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ACRONYMS & ABBREVIATIONS

ACS	Association of Caribbean States
AGRRA	Atlantic and Gulf Rapid Reef Assessment
BPoA	Barbados Programme of Action for Sustainable Development of Small Island Developing States
BSS	Barbados Statistical Service
BWA	Barbados Water Authority
CANARI	Caribbean Natural Resources Institute
CAR/RCU	Caribbean Regional Coordinating Unit (UNEP)
CARDI	Caribbean Agricultural Research and Development Institute
CAREC	Caribbean Epidemiology Centre
CARICOM	Caribbean Community
CARICOMP	Caribbean Coastal Marine Productivity Programme
CAST	Caribbean Alliance for Sustainable Tourism
CBD	Convention on Biological Diversity
CCCCC	Caribbean Community Climate Change Centre
CCD	Convention to Combat Desertification
CCDC	Caribbean Coastal Data Centre
CDERA	Caribbean Disaster Emergency Response Agency
CEHI	Caribbean Environmental Health Institute
CERMES	Centre for Resource Management and Environmental Studies
CFRAMP	CARICOM Fisheries Resources Assessment and Management Programme
CIDA	Canadian International Development Agency
CIMH	Caribbean Institute of Meteorology and Hydrology
CITES	Convention on Trade in Endangered Species
CLAWRENET	Caribbean Land and Water Resources Network
CMA	Caribbean Marine Atlas
CMS	Centre for Marine Studies
CPACC	Caribbean Planning for Adaptation to Climate Change Project
CRED	Centre for Research on the Epidemiology of Disasters
CRFM	CARICOM Regional Fisheries Mechanism
CRIS	Coastal Resource Information Systems
CRIS	Coastal Resources Information System
CSD	Commission on Sustainable Development (UN)
CTO	Caribbean Tourism Organization
CWSA	Central Water and Sewage Authority
CWWA	Caribbean Waste Water Association
CWWA	Caribbean Waste Water Association
CZM	Coastal Zone Management
CZMU	Coastal Zone Management Unit
DPSIR	Driver-Pressure-State-Impact-Response
ECLAC	Economic Commission for Latin America and the Caribbean
EMA	Environmental Management Authority (Trinidad & Tobago)
EPD	Environmental Protection Department
EVI	Environment Vulnerability Index
FAO	Food and Agriculture Organization
GCRMN	Global Coral Reef Monitoring Network

GEF	Global Environment Facility
GEO	Global Environment Outlook
GIS	Geographic Information System
GPA	Global Programme of Action for the Protection of the Marine Environment from Land-based Sources of Pollution
GPS	Global Positioning System
ICOM	Integrated Coastal and Oceans Management
ICRI	International Coral Reef Initiative
ICZM	Integrated Coastal Zone Management
IDB	Inter-American Development Bank
IITF	International Institute of Tropical Forestry
ILAC	Latin American and Caribbean Initiative for Sustainable Development
IMA	Institute of Marine Affairs (Trinidad & Tobago)
IOCARIBE-GOOS	Intergovernmental Oceanographic Commission (Caribbean) Global Ocean Observing System
IODE	International Oceanographic Data and Information Exchange
ITTO	International Tropical Timber Organization
IUCN	World Conservation Union
IWCAM	Integrating Watershed and Coastal Areas Management
IWRM	Integrated Water Resource Management
JPOI	Johannesburg Plan of Implementation
MACC	Mainstreaming Adaptation to Climate Change
MDG	Millennium Development Goals
MEA	Multilateral Environment Agreement
NALIN	National Land Information Project
NBSAP	National Biodiversity Strategy and Action Plan
NEPA	National Environment and Planning Agency (Jamaica)
NEPA	National Environment and Planning Agency
NSO	National Statistical Office
OAS	Organization of American States
OECS	Organization of Eastern Caribbean States
PAHO	Pan-American Health Organization
PC	Participating Country (in the GEF-IWCAM project)
REDESA	Network of Institutions and Experts on Social and Environmental Statistics
ROLAC	Regional Office for Latin America and the Caribbean (UNEP)
SCCS	Standards Committee for Caribbean Statistics
SGD	St. George's Declaration of Principles for Environmental Sustainability (OECS)
SIDS	Small Island Developing States
SLM	Sustainable Land Management
SOPAC	South Pacific Applied Geoscience Commission
SPAW	Specially Protected Areas and Wildlife Protocol
TNC	The Nature Conservancy
UNCED	UN Conference on Environment and Development
UNCSD	United Nations Commission on Sustainable Development
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNECLAC	Economic Division of Latin America and the Caribbean
UNEP	United Nations Environment Programme

UNFCCC	UN Framework Convention on Climate Change
UNSD	UN Statistical Division
USGS	United States Geological Survey
UWI	University of the West Indies
VCD	Vector Control Division
WCMC	World Conservation Monitoring Centre (UNEP)
WECAFC	Western Central Atlantic Fisheries Commission
WHO	World Health Organization
WRMA	Water Resources Management Authority
WSA	Water and Sanitation Authority
WSSD	World Summit on Sustainable Development
WTO	World Tourism Organization

EXECUTIVE SUMMARY

A desk study that was conducted under the Project “Integrating Watershed and Coastal Areas Management in Caribbean Small Island Developing States (IWCAM)”, which is funded by the Global Environment Facility (GEF), co-implemented by the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP), and co-executed by the Caribbean Environmental Health Institute (CEHI) and the UNEP Caribbean Regional Coordinating Unit. (UNEP/CAR-RCU) The objectives were to assess indicators mechanisms and capacity in the countries to utilize and monitor indicators for the IWCAM approach, and to develop an indicators template based on GEF International Waters indicators (Process, Stress Reduction, and Environmental Status Indicators). Data and information sources included published and unpublished documents and reports, internet searches, and a questionnaire distributed among the countries. In order to validate the findings of the desk study, groundtruthing was conducted in Barbados, Dominican Republic, and St. Vincent and the Grenadines. A workshop to discuss the assessment findings was held in March 2008, in Ocho Rios, Jamaica, and the report is available as one of the outputs of this study.

INDICATORS MECHANISMS

The results of the assessment are presented according to 12 themes, which reflect the main issues of relevance to IWCAM, and which cover some of the main sustainability concerns of the countries. Indicators/data and principal agencies and frameworks are presented under each theme.

Atmosphere
National meteorological and hydrological datasets are among the most complete in all the countries, and generally consist of long time series. The Caribbean Institute of Meteorology and Hydrology maintains an archive of meteorological and hydrological data from member countries. Arising from the GEF-funded Caribbean Planning for Adaptation to Climate Change (CPACC) project, 18 sea level/climate monitoring systems is the CARICOM Climate Change Centre, which is the official repository and clearing house for regional climate change data. Countries that are Parties to the Kyoto Protocol report on greenhouse gas emissions and inventory of greenhouse gases in their national communications to the Conference of the Parties of the UN Framework Convention on Climate Change. Monitoring of air quality is conducted in only a few of the countries.

Biodiversity
The responsibility for the management of biological resources is fragmented among several government ministries. A number of non-government organizations and academic and research entities are also involved in biodiversity conservation and biodiversity studies in the region. Biodiversity indicators have been proposed under a number of national (e.g. National Biodiversity Strategy and Action Plans, regional (e.g.

Latin America and Caribbean Initiative - ILAC) and international frameworks (e.g. biodiversity-related international conventions and protocols; Millennium Development Goals). The Convention on Biological Diversity has compiled a large number of national level indicators for biodiversity. The 2010 Biodiversity Indicators Partnership will coordinate the development of a suite of indicators measuring progress towards the 2010 biodiversity target.

Coasts and seas

Fisheries: In all the PCs, the Department of Fisheries (or equivalent) routinely collects fisheries landings statistics at the national level. Assessment of major commercial fish stocks have been conducted on an *ad hoc* basis, using standard fisheries indicators. Periodic assessment and monitoring of fisheries stocks are undertaken through the Caribbean Regional Fisheries Mechanism and by the Western Central Atlantic Fisheries Commission, among others. The FAO, under its Code of Conduct for Responsible Fisheries, has provided guidelines for developing sustainability indicators for marine capture fisheries. National catch data are submitted to the FAO, and are available by countries in FAO online databases.

Coastal ecosystems: Countries are increasingly implementing monitoring programmes, especially for coral reefs. The CPACC project developed coastal resources inventory systems using a Geographic Information System (GIS) approach, and established coral reef monitoring protocols. The Caribbean Coastal Marine Productivity Programme has been monitoring coral reefs, mangroves, and seagrasses at a number of sites throughout the region, including in eight of the participating countries (PCs). At the international level, programmes for coral reef monitoring include Reef Check, the International Coral Reef Initiative, and the Global Coral Reef Monitoring Network. Indicators related to mangroves at country level have been compiled by the United Nations Food and Agriculture Organisation (FAO) Forest Resource Assessment thematic study on mangroves.

Water quality: Water quality is sporadically monitored in most of the countries, with few countries routinely monitoring coastal water quality. Studies of coastal water quality are undertaken by the national and regional institutions such as the Institute of Marine Affairs (Trinidad and Tobago) and CEHI, using standard indicators. The UNEP Land-based Sources Protocol (LBS) of the Cartagena Convention and the Global Programme of Action for the Protection of the Marine Environment from Land-based Sources of Pollution (GPA) are important regional and international frameworks for the development of benchmarks and indicators of coastal water quality.

Sea level: The CPACC project has installed 18 sea level/climate monitoring systems, along with the related data management and information networks in 12 countries.

Freshwater resources

Monitoring programmes for freshwater for human use are among the most comprehensive and best established in the countries. Monitoring is often carried out by Ministries of Health and agencies responsible for water utilities. Several indicators are

routinely used in all the countries to monitor freshwater quality in ground and/or surface water (bacteriological, chemical, and physical parameters) and quantity or availability. The number of parameters monitored and the frequency of monitoring of freshwater vary widely, and are dependent on the availability of human, financial, and other resources in the respective countries. At the international level, the UNESCO World Water Assessment Programme (World Water Development Report) and FAO Aquastat and FAO Land and Water Development Division are among the principal sources of data and indicators related to freshwater resources at country level.

Land use and vegetation cover

Countries are increasingly adopting the use of indicators on land use and vegetation cover, as well as of land degradation, and are developing national capacity for use of geo-referenced indicators. The larger countries generally have well-organized systems for procuring land-use information. Existing databases relating to droughts, water use, land degradation, and other physical or biophysical indicators generally cover only short periods. Efforts to assist the countries in land cover mapping include the Caribbean Vegetation and Landcover Mapping Initiative by The Nature Conservancy, International Institute of Tropical Forestry, US Forest Service EROS Data Center, and the US Geological Survey. The use of benchmarks and indicators in land degradation in the Caribbean islands has received impetus from the UN Convention to Combat Desertification. FAO is engaged in several ongoing efforts to update land use and agriculture information for the Caribbean. The FAO State of the World's Forests Report and Global Forest Resources Assessment provide forest indicators for some of the countries.

Natural disasters

The Caribbean Small Island Developing States (SIDS) are highly vulnerable to extreme climatic events. Common indicators relate to the incidence, intensity, as well as to the social and economic impacts of natural disasters. Each country has a national agency responsible for disaster preparedness and response. At the regional level, the Caribbean Disaster Emergency Response Agency is the central disaster management organization. The Centre for Research on the Epidemiology of Disasters maintains an international database on disasters, with data available by country.

Sanitation and human health

The relevant Ministries and government departments collect information through surveys for a number of indicators related to sanitation and human health. At the international level, the major freshwater assessment programmes include the World Health Organisation (WHO) – United Nations Children's Fund (UNICEF) Joint Monitoring Programme for Water Supply and Sanitation and United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Water Assessment Programme. The indicators used are based on data obtained from a number of sources, including national surveys, global networks, and other UN and partner organizations. These indicators are used to monitor the achievement of the relevant international development targets. The biennial World Water Development Report aims to develop indicators and monitors progress against targets for sanitation and wastewater. The

Caribbean Epidemiology Centre and the Pan-American Health Organization (PAHO) are among the agencies that maintain databases on incidences of water-related diseases.

Waste

Responsibility for waste management is shared among various agencies, depending on the type of waste. Data for the development of pertinent indicators are available, although limited in some of the countries, with the most commonly used including the generation of waste by type and sector, waste treatment and disposal by method. The LBS Protocol and the GPA are appropriate frameworks for development of benchmarks and indicators for land-based pollution of the coastal zone.

Tourism

Data for a number of indicators related to tourism, including its social and economic significance, are routinely collected. The identification of sustainable tourism indicators is undertaken by the World Tourism Organization (WTO). The Caribbean Tourism Organization (CTO) is collaborating with the Caribbean Alliance for Sustainable Tourism (CAST) and others to identify suitable indicators for sustainable tourism. The Blue Flag Programme rates the environmental quality of beaches and seeks to develop sustainable development indicators on tourism. The CTO, Association of Caribbean States (ACS), and Caribbean Epidemiology Centre (CAREC) are collaborating in an initiative to develop indicators for the Sustainable Tourism Zone of the Caribbean. Another tourism-related international organization is Green Globe, which benchmarks its participants against specific Sector Benchmarking Indicators.

Socioeconomics

Socioeconomic factors are considered to be among the major driving forces of environmental change. Population, demographic, and economic indicators have long been in use in the countries. Most of the countries have relatively long time series of demographic and socio-economic data, available at national level and by economic sectors. The CARICOM Secretariat has compiled demographic and socioeconomic indicators for its member states, while indicators for all the PCs are available through a number of different sources, including UNDP Human Development Report and the World Development Indicators (World Bank).

Environment and Sustainable Development

A number of national, regional, and international initiatives exist for the development of indicators under the overarching theme of environment and sustainable development. All the PCs are formulating sustainable development strategies and environmental action plans (or their equivalent), and have made variable progress in identifying and selecting associated indicators. Trends in a number of socioeconomic and environmental indicators are reported in national state of environment reports and environmental profiles. Indicator frameworks include the OECS St. George's Declaration of Principles for Environmental Sustainability, Latin American and Caribbean Initiative for Sustainable Development, Barbados Programme of Action for

Sustainable Development of SIDS and Mauritius Declaration and Strategy, and Millennium Development Goals, targets, and indicators.

Governance

Governance indicators relate to institutional setting, policy/legislation, technical/technological capability, stakeholder participation, etc. Among the governance indicators are institutional and policy measures taken to implement the various multilateral environmental agreements (MEAs) of which the PCs are Parties. Governance indicators could be placed in the GEF Process Indicators category. While governance indicators are not explicitly mentioned in the various national frameworks, these must be included and monitored in national IWCAM programmes.

CAPACITY ASSESSMENT

Development and implementation of an indicators mechanism requires capacity in a number of aspects. An indicators mechanism requires monitoring and data collection to calculate the indicators, and a mechanism for uptake of the information in decision-making processes as well as for its reporting and dissemination to all stakeholders in an open and transparent process. The assessment reviewed the existing capacities and capacity development needs in the 13 PCs in relation to the systemic level, institutional capacity, human resources, data and information, technology, and financial resources.

Existing capacities

All the PCs have the basic elements in place, although in varying stages of development, for an IWCAM indicators mechanism. They include but are not limited to: Government ministries and agencies; academic and research institutions; thematic monitoring and assessment activities; and nascent national data collection and management mechanisms. At the regional level capacities reside in several institutions/organizations. A number of capacity building initiatives for environmental statistics and indicators have been undertaken in the region, in collaboration with regional and international organizations. As a result of these and other initiatives, some capacity already exists in the PCs for indicators mechanisms development, although the level of capacity varies among the countries. The existing capacity consists mainly of capacity specifically for compilation of environmental statistics and indicators, and do not focus on IWCAM indicators within an IWCAM framework. A number of capacity gaps still remain.

Systemic capacity

Systemic capacities provide the enabling environment that promote or constrain the development of capacity at the institutional and individual levels. Weakness and deficiencies in the enabling environment for environmental monitoring and the development and use of environmental indicators in the PCs has stymied the development of a culture of, and capacities for, monitoring, evaluation and results-based adaptive management. The absence of an overarching IWCAM framework in the PCs, within which national development and decision-making processes take place has far reaching implications for the development of IWCAM indicators mechanisms.

Institutional capacity

The institutional arrangements for natural resources management in general, and IWCAM in particular, are characterized by multiple agencies and organizations, with overlapping mandates and roles. National capacities for monitoring and systematic observation vary with country, national agency, and the environmental resource or system being monitored. Deficiencies in national institutional capacity are reflected by inadequate equipment; insufficient financial resources; uncompetitive staff remuneration; obstacles to effective staff recruitment and retention; inadequate and/or un-sustained training; and limited coordination among agencies, among others. A number of regional institutions and agencies exist that could contribute to IWCAM indicators mechanisms (e.g. CARICOM, CEHI, Caribbean Institute of Meteorology and Hydrology – CIMH, UNEP CAR RCU). The lack of national and regional institutional mechanisms to promote and coordinate the development of environmental indicators mechanisms have been a major constraint.

Human resources

The skills and capacities required to establish and sustain a national IWCAM indicators mechanism include knowledge of IWCAM concepts and approaches, of conceptual frameworks for assessment, monitoring, and evaluation of IWCAM programmes, as well as the skills and methodologies for selecting appropriate indicators, data collection and analysis, interpretation of results, communicating and reporting of results, and their utilization in adaptive management. In the PCs there is a pervasive lack of capacity to develop indicators and undertake their monitoring, analysis, and reporting. Strategically there is a need for a regional approach to the development of a cadre of trained professionals to support the development and use of environmental indicators. This will involve the development and introduction of continuing development programmes for professionals in collaboration with a range of partners at national, regional, and international levels. Human resource constraints in these areas might also be addressed by adopting a regional or sub-regional model for the coordinated pooling and/or sharing of trained staff with the assistance of the thematically appropriate regional and/or inter-governmental agencies.

Data and information

An effective IWCAM indicators framework must be accompanied by supporting data and information as well as appropriate data and information management systems and analysis mechanisms to calculate, review, and revise the indicators on a continuous basis. National policies for coordinated environmental data collection or national development policies supported by explicitly identified environmental performance indicators are rare in the PCs. As a result, monitoring and data collection have been poorly funded and undertaken on an *ad hoc* or project basis. The data situation is similar in the PCs: available data and information are usually scattered across various agencies, and there are spatial and temporal gaps. Lack of standard methodologies for data collection has resulted in often inconsistent and incompatible datasets. An important issue relate to the quality control of data to ensure data reliability and accuracy. Data handling and processing procedures have not kept pace with changes in

computer technology, data management, and decision support applications. Furthermore, metadata and metadata standards are often lacking in the region.

Technology

In order to obtain accurate and timely data, a significant financial investment would be required for transfer of technology and training. As mentioned above, new data management, decision support applications, and computer technologies require updated data collection, handling, and processing procedures, which has not taken place. A substantial proportion of time-series data is stored in hard-copy formats. Full benefit has not been taken of developing technological infrastructure for information management. Much of the data relating to IWCAM has a strong spatial component and GIS capabilities are important in managing and utilizing this information. All the PCs have some capability for GIS, mainly related to land use. In the majority of cases the introduction of Caribbean government agencies to GIS technology has been driven by donor-funded technical assistance projects. Donor funded initiatives that provide hardware and software without the requisite capacity development have given rise to instances in which equipment has remained unused.

Financial resources

The lack of financial resources has been identified as one of the two most common impeding factors for the development of both environment statistics and environmental-economic accounting programmes. The majority of respondents to the survey indicated that although data collection, processing and analysis activities were identified in annual work plans and budgets, funding and staffing compliments were inadequate. While the funds that are made available to government agencies with natural resource management responsibilities tend to be sufficient to maintain staff compliments, they may not meet the costs of implementation. The survey also revealed that data collection and management activities identified in the annual budgets and work plans of responding organizations received varying levels of financial support from their respective governments. Indicators mechanisms have not historically been built into programmes and projects, and as a result, budgetary allocation for this type of activity is often not provided.

INDICATORS TEMPLATE

The indicators template constitutes Part II of the report. The selection of indicators for the template was based on three main criteria: The objectives and expected outcomes of the overall GEF-IWCAM project and of the demonstration projects; relevance to regional and international frameworks; and the availability of data and statistics for compiling the indicators. Six major IWCAM objectives, each with a number of issues (see table below), were considered to be of interest under the project, based on the project document. Core and supplementary indicators in each of the three GEF indicators categories were arranged according to these objectives and issues. Among the core indicators are those proposed under sub-regional, regional, and international frameworks.

Major objectives and issues used to select stress reduction and environmental status indicators for the template

IWCAM OBJECTIVE	ISSUE
1. Sustainable water resource use	Declining water resources; human health risks
2. Conservation/protection of ecosystems and natural living resources	Forest loss; Land degradation; Coral reef, mangrove, seagress degradation/loss; Biodiversity loss; Degradation of water quality; Beach loss; Unsustainable fisheries exploitation; Unsustainable tourism development
3. Sustainable agricultural practices	Harmful agricultural practices
4. Pollution control/reduction	Solid waste; Industrial waste; Sewage/domestic wastewater; human health risks; Atmospheric emissions
5. Improved water quality	Reduction in quality of coastal/marine waters; Reduction in quality of freshwater
6. Reduction in exposure to natural disasters	Increased vulnerability to natural disasters

The indicators template includes: Stress reduction indicators - core: 73, supplementary 28; Environmental status/socioeconomic indicators- core: 65, supplementary: 11; Process indicators: 11 core indicators, with a number of supplementary indicators. Brief descriptions are given for 17 core stress reduction indicators and 25 core environmental state/socioeconomic indicators, the core process indicators.

CONCLUSION and RECOMMENDATIONS

The countries participating in the GEF-IWCAM project do not have monitoring programmes and indicators mechanisms specifically linked to an IWCAM framework, although a number of them plan to or have been developing indicators within other national frameworks (e.g. National Sustainable Development Strategies; National Biodiversity Strategy and Action Plan, National Environmental Action Plans), as well as international frameworks (e.g. Millennium Development Goals – MDGs, MEAs), and which are pertinent to IWCAM. All the countries have some basic elements for developing IWCAM indicators mechanisms, including relevant ministries and other agencies, trained personnel (in some of them), data and information for a large number of environmental and socioeconomic variables, elements of monitoring programmes, and existing indicators, all of which could be used as a baseline to develop IWCAM indicators mechanisms. The basis for such a mechanism also exists at the regional level through a number of regional entities, as well as at the international levels in a number of initiatives to develop environmental indicators.

A number of capacity gaps exist in several areas, and need to be addressed. The countries have been engaged in a number of capacity building initiatives for environmental statistics, but progress has been disparate, with the larger countries and/or those with greater resources being more advanced than the others. Opportunities should be explored for bringing all these indicator initiatives under a common, well-coordinated framework or mechanism, for which IWCAM provides a good opportunity. A number of the PCs have advanced indicators initiatives, and could assist the other PCs in developing indicator frameworks. This means that there is already a substantial basis in the region to provide the momentum for developing IWCAM indicator mechanisms and the required capacity in the PCs.

A number of recommendations are proposed for development of national indicators mechanisms in the PCs and strengthening the required capacity. Timeframes are also proposed for implementing the recommendations: short-term (within 2 years) and medium- to long-term (5 to 10 years). Actions to be implemented on the short-term include:

- Each PC should identify a suite of basic, priority IWCAM indicators that address national needs and priorities, i.e., develop national indicators templates. These indicators should be administratively practical and cost effective;
- A minimum environmental monitoring system and required capacity for using these indicators should be evaluated and the cost of such a system determined. Existing data should be used as a baseline for the monitoring programme;
- A set of core indicators should be selected and tested in pilot studies in one of the PCs with more advanced indicators initiatives and capacity, and lessons disseminated to other PCs;
- The required capacity for implementing the indicators framework should be determined and options and opportunities for strengthening capacity identified and pursued, including creation of a cadre of trained personnel at national/regional levels, and pooling of resources;
- National and regional data and information management systems should be strengthened.

Medium- to long- term actions include addressing a number of deficiencies, including at the systemic and institutional levels. These would include policy and institutional measures at the national and regional levels required to underpin the IWCAM indicators mechanisms.

1. INTRODUCTION

This report presents the results of a desk study conducted under the Project “Integrating Watershed and Coastal Areas Management in Caribbean Small Island Developing States (IWCAM)”, which is funded by the Global Environment Facility (GEF), co-implemented by the United Nations Development Project (UNDP) and the United Nations Environment Programme (UNEP), and co-executed by the Caribbean Environmental Health Institute (CEHI) and the UNEP Caribbean Regional Coordinating Unit (UNEP CAR-RCU). The overall objective of the Project is to strengthen the commitment and capacity of the 13 participating Small Island Developing States (SIDS) to implement an integrated approach to the management of watersheds and coastal areas. In adopting IWCAM as a management approach, the countries will be required to re-orient their systems and mechanisms as well as address the issue of policy and legislative re-alignment to fully mainstream IWCAM at the national level.

The underlying concept of IWCAM is the management of watersheds and coastal areas as a single management unit, using an approach that integrates economic, social, cultural, governance, and environmental issues. This integrated approach implies the

involvement of all traditional sectors of economic and government activity, such as economic planning, agriculture, health, energy, water, natural resources, industry, education, and the environment at all levels – government, non-governmental organizations (NGOs), civil society, and the private sector.

As there is a wide range of natural forces and processes operating in watersheds and coastal zones, there is a multitude of factors and variables that should be measured to assess and monitor the state of the systems involved. In these small island states, nearly the entire population lives and all economic activities take place on or near to coastal areas. Because of their small physical size, the entire island mass is often considered as coastal. As such, small island states need environmental management that considers the whole island system, from ridge to reef. This concept is embodied in the Island Systems Management approach (Nichols and Chase, 1998), which is seen as the new paradigm for the management of the natural resources of SIDS. This approach is structured around a participatory, multi-sectoral strategy within an appropriate institutional and legal framework for integrated approach to natural resource use and management, and was adopted by the First Ministerial Meeting (in 1997) on the Implementation of the Barbados Programme of Action for Sustainable Development of SIDS (BPoA) and further endorsed in the Mauritius Strategy.

Against this background, it is clear that an assessment of indicators mechanisms must take into consideration the entire island system and a number of relevant environmental and sustainable development themes. Effective monitoring of IWCAM programmes also requires that the countries possess the necessary capacity (human, financial, technological, etc.). Gaps in capacity must be identified and where capacity is lacking, it must be developed and strengthened. Another component of this exercise focuses on assessment of capacity in the countries to utilize and monitor indicators for IWCAM.

2. OBJECTIVES AND SCOPE

The main objectives of this assessment were to:

- Conduct a review of national and regional indicators mechanisms for IWCAM and identify gaps and weaknesses. This includes a desk exercise to review literature on what participating countries have in place related to indicators.
- Identify Process, Stress Reduction, and Environmental Status/Water Resources Indicators, and prepare a draft template of indicators (based on the evaluations and assessments conducted).
- Conduct rapid assessment (groundtruthing) in 3 representative PCs, to confirm and validate the findings of desk exercise and to update any previous work.
- Assess relevant institutional infrastructure/administrative protocols related to indicator monitoring in PCs.
- Assess relevant human resource capacities and training needs related to indicator monitoring in PCs.
- Make recommendations in order to bring capacity up to a level where indicators can be utilized, manipulated, and shared among PCs.

3. OUTPUTS

The outputs of this assignment are:

Assessment Report containing findings of the assessment and evaluation of existing indicators framework and mechanisms and of institutional and human capacities in the PCs, and recommendations for strengthening capacities (Part I);

Preliminary Indicator Template of recommended Environmental Status/Water Resources, Stress Reduction and Process Indicators (Part II);

Regional Workshop and workshop report.

This document presents Part 1, the Assessment Report.

4. ASSESSMENT METHODOLOGY

4.1. Approach

In this study, an indicator mechanism is considered as consisting of the relevant institutional framework, monitoring programme and associated indicators used, as well as observation/data collection activities and data and information to calculate the indicators. Assessment of indicator mechanisms would not be complete without the consideration of the availability of data and information to support the indicators, and the institutional mechanisms for implementing them. In general, established long term monitoring programmes do not exist, but data and statistics are collected that could be used to calculate indicators. These are also considered in this study. In addition, since most of the countries do not have established IWCAM (or ICZM or its variants) programmes, it was necessary to examine monitoring activities and data collection within other programmes and initiatives that are relevant to IWCAM. At the regional and international levels, while a large number of indicator initiatives exist, this report focuses only on the major ones that are of relevance to IWCAM and/or in which the PCs participate or contribute. Within government agencies, monitoring programmes are conducted within the development and management framework of the respective sectors.

The assessment of indicator mechanisms and capacity focused on identification of existing monitoring programmes and associated indicators, data collection, environmental, and other statistics and data/information management systems to support these indicators, which were considered to be of relevance to IWCAM. Based on the Island Systems Management approach, it was necessary to take a broad approach to the indicators assessment, to include a wide number and diversity of themes. This also reflects the integrated approach required for the management of watersheds and coastal areas, particularly in SIDS.

4.2. Sources of information

Information for the indicators mechanism assessment and capacity assessment were obtained from a variety of sources:

i) The desk study involved the review of published and unpublished reports, preliminary IWCAM reports prepared for the IWCAM project, project reports, and technical documents, country reports prepared under the BPoA, regional and international organizations (e.g. CARICOM, UN organizations) and multinational environmental conventions, national, regional and global state of environment reports prepared under the UNEP Global Environment Outlook (GEO) programme, and the UNEP Initiative for Latin America and the Caribbean (ILAC) on indicators (UNEP/World Bank/University of Costa Rica 2004). Internet searches were conducted for information on past and current initiatives involving the development and/or assessment of indicators mechanisms. A valuable source of information was the report of a workshop on Environment Statistics organized by the United Nations Statistics Division (UNSD) in collaboration with the Caribbean Community (CARICOM) Secretariat in Belize in 2000.

ii) A questionnaire was distributed by electronic mail at the national and regional levels to solicit information on existing monitoring programmes, indicators, and existing capacity and gaps. Following the first survey, a shorter questionnaire was distributed to encourage further responses (Annex 1). Prospective respondents were identified by the IWCAM Project Coordinating Unit (PCU) and the consultants, on the basis of their involvement in watershed and coastal areas management and/or data collection, monitoring, or research in watersheds or coastal areas. Responses were received from 13 agencies in 9 of the participating countries, and from three regional institutions (Annex 2).

iii) Groundtruthing was undertaken to verify the findings of the desktop study and questionnaire survey in three representative countries: Barbados (representative of the larger English-speaking countries and which has an advanced indicators programme); Dominican Republic (representative of the non-English speaking SIDS); and St. Vincent and the Grenadines (representative of the OECS and the Bahamas - smaller islands). Visits to each of these countries were undertaken by the consultants. Results of the groundtruthing exercises are given in Section 6.

5. ASSESSMENT FINDINGS

5.1. INDICATORS MECHANISM ASSESSMENT

The major national, regional, and international frameworks, including MEAs in which the countries participate, and under which indicators are required for monitoring and reporting purposes, are presented in Table 1. The results of the assessment are presented according to 12 themes and sub-themes (Tables 2 to 13), which reflect the main issues of relevance to IWCAM, and which cover some of the main sustainability concerns of the countries. In these tables, indicators/data and principal agencies and frameworks are presented under each theme. Responses to the survey are summarized

in Table 14. All responses are included by country and theme in one table for comparative purposes. It must be noted that some of these responses might not reflect the situation at the country level, and relate only to a particular theme (s), depending on the respondent agency. This is as a result of responses being received from some individual agencies, and not from all the relevant agencies within each country or synthesized at the country level.

Because of the relatively large number of PCs involved in this project, the even larger number of themes and sub-themes and indicators/variables, as well as the wide disparity in the situation regarding indicators and data among the PCs, it is not possible to present the assessment results in detail for individual countries and by themes. However, Tables 2 - 13 provide an insight into the indicators and data available, as well as major sources, which readers are encouraged to consult. Table 14 provides further details by country and themes.

Table 1. Major national, regional/international frameworks of relevance to IWCAM, in which the countries participate and under which indicators are required for monitoring and reporting.
(BPoA: Barbados Programme of Action; LBS: Land-based Protocol; SPAW: Specially Protected Areas and Wildlife Protocol; CBD: Convention on Biological Diversity; CCD: Convention on Combating Desertification; UNFCCC: UN Framework Convention on Climate Change; CITES: Convention on International Trade in Endangered Species; SGD: St. George's Declaration; MDGs: Millennium Development Goals; NEMS: National Environmental Management Strategy; NEAPS: National Environmental Action Plans)

Country	BPoA	Cartagena Convention			CBD	CCD	UNFCCC	Kyoto Protocol	CITES	SGD	MDGs	Nat'l SD strategy	NEMS/ NEAPS
		LBS	SPAW	Oil Spill									
Antigua & Barbuda	x		x	x	x	x	x	x	x	x	x	x	x
Bahamas	x				x	x	x	x	x		x	x	x
Barbados	x		x	x	x	x	x	x	x		x	x	x
Cuba	x		x	x	x	x	x	x	x		x	x	
Dominica	x			x	x	x	x	x	x	x	x	x	x
Dominican Republic	x	x	x	x	x	x	x	x	x		x	x	x
Grenada	x			x	x	x	x	x	x	x	x	x	x
Haiti	x				x	x	x	x			x	x	x
Jamaica	x		x	x	x	x	x	x	x		x	x	x
St. Kitts & Nevis	x				x	x	x	x	x	x	x	x	x
St. Lucia	x		x	x	x	x	x	x	x	x	x	x	x
St. Vincent & Grenadines	x		x	x	x	x	x	x	x		x	x	x
Trinidad & Tobago	x	x	x	x	x	x	x	x	x		x	x	x

5.1.1 Atmosphere

Meteorological departments, government ministries (e.g. Ministry of Agriculture), as well as airport authorities routinely measure meteorological and hydrological parameters. A number of indicators under this theme have historically existed in all the countries, especially those related to climate (Tables 2 and 14). National meteorological and hydrological datasets are among the most complete in all the countries, and generally cover relatively long time frames. CIMH maintains an archive of meteorological and hydrological data from member countries, dating back to about 1970 but some earlier records, particularly for rainfall, are also available.

Under the GEF-funded CPACC project, 18 sea level/climate monitoring systems, along with the related data management and information networks, were installed in 12 countries. Arising out of this project is the CARICOM Community Climate Change Centre (CCCCC), which is the official repository and clearing house for regional climate change data.

The only report of monitoring of air quality was obtained in the survey response from the Jamaica National Environment and Planning Agency (NEPA) and the Trinidad and Tobago Environmental Management Authority (EMA). These agencies monitor a number of chemical compounds and particulate matter in air. The United States Geological Survey (USGS) Centre for Coastal and Watershed Studies has been conducting studies on Saharan dust reaching the Caribbean and its impact on corals. Dust sampling stations are located in Barbados and Trinidad and Tobago. Countries that are Parties to the Kyoto Protocol report on greenhouse gas emissions and inventory of greenhouse gases in their national communications to the Conference of the Parties of the UN Framework Convention on Climate Change (UNFCCC).

Table 2. Atmosphere

Sub-theme	Indicator/data collected	Principal agencies/frameworks; data sources
Climate	Rainfall	CIMH (www.cimh.org)
	Air Temperature	
Air	Air quality (ambient pollution; emissions)	National level; USGS monitoring sites in Barbados and Trinidad (Saharan dust & impacts on corals)
Energy	Greenhouse gas emissions; GHG inventories; Ozone Depleting Substances	Kyoto Protocol; Montreal Protocol
	Energy consumption	

5.1.2 Biodiversity

The responsibility for the management of biological resources is fragmented among several government ministries. There are also a number of non-government organizations and academic and research entities involved in biodiversity conservation and biodiversity studies in the region. Biodiversity indicators have been proposed under

a number of national (e.g. National Biodiversity Strategy and Action Plans - NBSAP), regional (e.g. ILAC); and international frameworks (e.g. biodiversity-related international conventions and protocols; Millennium Development Goals - MDGs).

The Convention on Biological Diversity Conference of Parties (CBD COP) has identified 22 indicators at the global level for assessing progress towards the 2010 biodiversity targets, 13 of which are ready for immediate testing, while the others require further development (Annex 3). The 2010 Biodiversity Indicators Partnership (2010BIP), a GEF-funded project, has been launched. The Partnership will coordinate the delivery and communication of a suite of indicators measuring progress towards the 2010 biodiversity target. Activities under this project will include developing and delivering the range of indicators showing progress towards the 2010 target at a global scale and increasing the capacity of national governments and regional organizations to develop and use biodiversity indicators in the context of the 2010 target. The CBD has compiled a large number of national level indicators.

Within the context of the CBD, indicators may be required to show status and trends of biodiversity, progress on the implementation of the Convention, and the effectiveness of the measures taken by the countries. In their reporting to the CBD, countries are asked to provide information on indicators used in relation to the CBD targets, including institutional measures undertaken to implement the Convention, which could be interpreted as process indicators. Similarly, the countries that are Parties to the other biodiversity-related MEAs and protocols (e.g. Specially Protected Areas and Wildlife Protocol - SPAW - of the Cartagena Convention, Ramsar, CITES, Natural Heritage) are required to submit national reports on progress made in their implementation, which could be demonstrated by the use of appropriate indicators (Table 3).

The development of biodiversity indicators are at various stages of progress in the different countries (Table 14). Eight of the countries have developed NBSAPs, within the framework of the CBD. Most of these NBSAP do not specifically mention the development and use of indicators in any detail, with few exceptions such as Barbados and Grenada, which have proposed a number of key indicators for monitoring changes in the environment and progress in achieving the objectives of their respective action plans. Barbados has identified five indicators for measuring biodiversity in the context of sustainable development.

At the national/local level, a substantial amount of data is available in descriptive formats (e.g. presence/absence of a particular species). The Inter-American Biodiversity Information Network (IABIN) was created in 1996 as an initiative of the Santa Cruz Summit of the Americas meeting of Heads of State. It is developing an Internet-based platform to give access to scientifically credible biodiversity information currently scattered throughout the world in different institutions. IABIN's Five-year Project Implementation Plan has a focus on the collection, exchange and use of biodiversity data. Elements of the programme involve assisting countries to establish national databases and the development of an information structure for data exchange. UNEP-World Conservation Monitoring Centre (WCMC) and the World Conservation Union

(IUCN) are among the international organizations engaged in compiling databases on species and protected areas (marine and terrestrial). These online databases provide access to country-level data for most of the SIDS, although there are spatial and temporal gaps in data (Table 3). Additionally, the United States Agency for International Development (USAID) is funding the PERB project which plans on working with OECS countries in the identification and management of indicators related to biodiversity.

Table 3. Biodiversity

Sub-theme	Indicator/data collected	Principal agencies/frameworks; data sources
Habitats	Protected areas (nos; % total habitat area); extent of loss/damage to ecosystems; habitat area	CBD (www.cbd.int/indicators/testedindicators.shtml); NBSAP; RAMSAR; CITES; UNEP-WCMC/IUCN world database of protected areas (www.unep-wcmc.org/wdpa/); IUCN (www.iucn.org); Global Biodiversity Assessment 2002 (CBD); Country profiles (www.cbd.int/countries/default.shtml); NBSAP (www.cbd.int/doc/world/default.asp); IABIN (www.iabin.net/index.php); SPAW Protocol; CCA, CANARI
Species	Known/threatened/endangered species	

5.1.3 Coasts and seas

Fisheries: In all the PCs, the Department of Fisheries (or equivalent) routinely collects fisheries landings (by weight) of major species, and to a lesser extent, fishing effort data (e.g. number of fishing vessels) at the national level (Table 14). Commonly used indicators of the status of exploited fish stocks include landings (total and by major species), catch rates (catch/unit fishing effort), maximum sustainable yield, and mean sizes. There are uncertainties in these data, arising from a number of factors including aggregation of species, under-reporting of catches, difficulties brought about by the artisanal nature of the fisheries in the PCs, poor documentation of fishing effort, etc. Catch production data are submitted to the FAO, and are available by countries in online databases, including through the Sea Around Us Project of the Fisheries Centre, University of British Colombia. Through this project, total catch and catch by major species by country have been reconstructed from 1950 - 2003, and are available online (Table 4a). Recording of size frequencies, mean sizes, length-weight relationships, and trophic status of the catch is not conducted on a regular basis.

Assessments of major commercial fish stocks have been conducted on an *ad hoc* basis, and provide information for a number of fisheries indicators. Much of the fisheries assessment activities in the CARICOM countries have been conducted under the CARICOM Fisheries Resources Assessment and Management Programme (CFRAMP). Assessments of some of the main fisheries (shrimp and groundfish, large pelagics, wahoo, dolphinfish, reef fish, flying fish, conch, lobster) have been conducted under CFRAMP and the Western Central Atlantic Fisheries Commission (WECAFC). Periodic assessment and monitoring of these stocks continue through the Caribbean Regional Fisheries Mechanism (CRFM), which was established under CFRAMP, and by WECAFC *ad hoc* working groups (Shrimp and Groundfish Resources in the Brazil-Guianas Shelf, Caribbean Spiny Lobster, Flying fish of the Eastern Caribbean, and Queen Conch). The FAO, under its Code of Conduct for Responsible Fisheries (which

has been adopted by the PCs), has provided guidelines for developing sustainability indicators for marine capture fisheries (FAO 1999).

Most of the countries have national fisheries management plans, but the level of development, implementation, monitoring and enforcement varies. At the sub-regional level, the OECS are developing a Fisheries Management and Development Strategy and Implementation Plan for this area (http://www.oecs.org/esdu/documents/Fisheries%20Strategy.pdf). CARICOM is also developing a common fisheries policy for its member states (http://www.caricom.org).

Table 4a. Coasts and Seas: Fisheries

Sub-theme	Indicator/data collected	Principal agencies/frameworks; data sources
Fisheries	Fisheries landings; mean size; species abundance	CFRAMP; CRFM (www.caricom-fisheries.com); FAO State of the World Fisheries & Aquaculture; FAO Yearbook of Fisheries Statistics; FISHSTAT Plus; Figis (www.fao.org); Indicators for sustainable development of fisheries (www.fao.org/docrep/W4745E/w4745e0f.htm)
	Mean trophic level of catch (adopted by CBD as an indicator)	Univ. British Columbia Fisheries Centre Sea Around Us project (www.seaaroundus.org)

Coastal ecosystems: Historically, studies on coastal habitats such as coral reefs, mangroves, and sea grass beds have been conducted on an *ad hoc*, project basis by government ministries, and academic and research institutions, with many of them focusing on species inventories. More recently, however, countries are increasingly implementing longer-term monitoring programmes, especially for coral reefs, in various locations using indicators such as live coral cover, algal cover, and incidence of disease and coral bleaching (Tables 4b and 14).

Among the achievements of the CPACC project were coastal resources inventory systems based on a GIS approach and establishment of coral reef monitoring protocols, which resulted in a significant increase in monitoring and early warning capabilities in the countries. Two primary indicators were identified: change in live coral over time and the percentage of bleached coral cover. The most comprehensive study on the state of the region's coral reefs is the publication 'Reefs at Risk in the Caribbean' (Burke and Maidens 2004), which also provides information on threat levels from a number of land-based sources. The Atlantic and Gulf Rapid Reef Assessment (AGRRA) programme has conducted studies on the status of coral reefs and reef fish abundance in a number of locations throughout the Caribbean, using standard indicators and protocols. At the international level, programmes for coral reef monitoring include Reefcheck (www.reefcheck.org), the International Coral Reef Initiative (ICRI) and the Global Coral Reef Monitoring Network (GCRMN). Coral reefs at a number of sites in the region are monitored using standard protocols, and online databases and map-based products at country level are available on the Reefcheck website. These data could be used to develop indicators of coral reef health.

Since 1993, the Caribbean Coastal Marine Productivity Programme (CARICOMP) has been monitoring coral reefs, mangroves, and seagrasses at a number of sites throughout the region, including in eight of the PCs. Data on biological and environmental parameters are collected according to prescribed methods on a daily, weekly, and twice-annual basis throughout the region using the same indicators and monitoring protocols. Monitoring programmes of coastal habitats at the country level include that of the Institute of Marine Affairs (IMA) of Trinidad and Tobago at a number of localities in the country.

Indicators related to mangroves at country level have been compiled by the Forest Resource Assessment 2005 thematic study on mangroves (FAO 2006), which was coordinated by FAO and co-funded by the International Tropical Timber Organization (ITTO). It provides an overview of the current extent of mangroves, their species composition, uses and threats, and changes in the extent of mangroves over time for the 124 countries or areas in which they exist, including the PCs. Data on mangrove extent (estimated) is submitted by the countries to the FAO and used in its Global Mangrove Assessment. The database by country is available through the FAO website (Table 4b). Despite the economic and social implications of ongoing decline in mangrove cover across the Caribbean region, there is little current data on the extent and status of mangroves on which informed planning and policy decisions can be based. The "most recent data" for 11 of the 14 CARICOM countries is over 10 years old. Only Jamaica and St. Lucia have data that were collected after 1996 (http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/007/j1533e/j1533e00.htm).

Table 4b: Coasts and Seas: Coastal Ecosystems

Sub-theme	**Indicator/data collected**	**Principal agencies/frameworks; data sources**
Coral reefs	Coral cover; algal cover; reef fish abundance; bleaching; diseases; socio-economics	CARICOMP (www.mona.uwi.edu/cms/caricomp.htm; www.ccdc.org.jm/caricomp.html); Reefs at Risk in the Caribbean; AGRRA (coral.aoml.noaa.gov/agra/); UNEP-WCMC (www.unep-wcmc.org/GIS/coraldis/index.cfm); Reefcheck (www.reefcheck.org); GCRMN (www.gcrmn.org/default.aspx)
Seagrass	Areal extent, growth, productivity	CARICOMP; UNEP-WCMC World Atlas of Seagrasses (www.unep-wcmc.org/marine/seagrassatlas/index.htm)
Mangroves	Areal extent, growth, productivity	FAO Global Forest Assessment; FAO Status & Trends in Mangroves; FAO country mangrove extent (www.fao.org/docrep/007/j1533e/J1533E03.htm#P1966_37230); UNEP-WCMC World Mangrove Atlas (bure.unep-wcmc.org/imaps/marine/mangroves/viewer.htm); CARICOMP
Beaches	Beach profiles (erosion/accretion)	National/local level

Water quality: Coastal water quality indicators are used in all the countries (Tables 4c and 14), although water quality is sporadically measured in most of the countries, with few countries routinely monitoring coastal water quality, except in the more popular tourist beaches. The larger countries such as Cuba have a national network of monitoring stations for both marine and fresh water. The GEF-IWCAM regional synthesis report noted the absence of appropriate water quality standards and guidelines for each of the uses of marine waters such as contact recreation, propagation of marine life, protection of marine ecosystems, and assimilation of waste.

Studies of coastal water quality are undertaken by CEHI, using standard indicators. The LBS Protocol of the Cartagena Convention, which is administered by UNEP CAR/RCU in Jamaica, and the UNEP GPA are important regional and international frameworks for the development of benchmarks and indicators of coastal water quality. Standards for coastal water quality have been established by WHO and PAHO, but are not fully implemented in the PCs.

Table 4c: Coasts and Seas: Water Quality

Sub-theme	**Indicator/data collected** (examples)	**Principal agencies/frameworks; data sources**
Water quality	BOD, COD	UNEP GPA; UNEP RCU Cartagena Convention LBS Protocol; CEHI; National/local level
	Coliform	
	Dissolved oxygen	
	Turbidity	
	Nutrients	
	Chemical pollutants	
	pH, temperature	

Sea level: Monitoring of sea level (Table 4d) is gaining momentum in the region, with the installation of tidal gauges in a number of the PCs. As previously mentioned, the CPACC project has installed 18 sea level/climate monitoring systems, along with the related data management and information networks in 12 countries. Sea level is also monitored by the UNESCO Intergovernmental Oceanographic Commission (Caribbean) Global Ocean Observing System (IOCARIBE-GOOS).

Table 4d: Coasts and Seas: Sea Level

Sub-theme	**Indicator/data collected**	**Principal agencies/frameworks; data sources**
Sea level; SST	Mean sea level; mean SST	CARICOM Climate Change Centre (//caribbeanclimate.bz/news.php); CPACC; IPCC; IOCARIBE-GOOS

Integrated Coastal and Oceans Management (ICOM): IOC/UNESCO has produced a toolkit on indicators for integrated coastal and ocean management (UNESCO 2006; http//ioc3.unesco.org/icam). IOC has embarked on a pilot project to develop a marine atlas for Caribbean SIDS, through its International Oceanographic Data and Information Exchange programme. The atlas will depend heavily on indicators and supporting data and information.

5.1.4 Freshwater resources

Monitoring programmes for freshwater for human use are among the most comprehensive and best established in the countries, as a consequence of its significance for human basic needs and human health. Several indicators are routinely used in all the countries to monitor freshwater quality in ground and/or surface water (bacteriological, chemical, and physical parameters) and quantity or availability. Focus is essentially on meeting the required health standards for drinking water. A number of the countries also monitor salinity in groundwater aquifers, where there is concern about saline intrusion. Table 5 provides information on data related to freshwater.

The number of parameters monitored and the frequency of monitoring of freshwater vary widely, and are dependent on the availability of human, financial, and other resources in the respective countries (Table 14). For instance, the Water Resources Authority (Water and Sewerage Authority of Trinidad and Tobago) regularly monitors at least 18 water quality parameters throughout the country, including petroleum hydrocarbon concentration (survey responses from WASA Trinidad & Tobago, and Dept. Natural Resources and the Environment, Tobago; GEF-IWCAM Country Report). In Cuba, the National Institute of Hydraulic Resources operates a water quality observation network throughout the country. Similarly, in the Dominican Republic, the National Hydrographic Institute (INDRHI) monitors the quality and quantity of fresh water resources. In contrast, in some of the smaller countries, fewer indicators are used, e.g. faecal coliform, nitrates, and water levels (survey responses from St. Kitts and Nevis; GEF-IWCAM National Reports).

The responsible national agencies include water supply and sanitation agencies (e.g. Water and Sewerage Authority, Water Corporation), as well as Ministry of Health. Water quality standards set by the WHO are routinely used in these countries. The water and sanitation authority in the various countries have fairly detailed databases on production and abstraction/consumption of freshwater. At the international level, the UNESCO World Water Assessment Programme (World Water Development Report) and FAO Aquastat and FAO Land and Water Development Division are among the principal sources of data and indicators related to freshwater resources at country level.

Table 5. Freshwater

Sub-theme	**Indicator/data collected** (examples)	**Principal agencies/frameworks; data sources**
Water quality	Coliform (total, fecal)	National/local level; CEHI; World Water Assessment Programme (UNESCO) – World Water Development Report; FAO Aquastat (www.fao.org/ag/agl/aglw/aquastat/dbase/index.stm); CIMH
	Nitrate, nitrite conc.	
	BOD, COD	
	Heavy metals	
	Sediments	
Water availability and usage	Ground water level	
	Stream flow	
	Renewable water resources	
	Annual withdrawals, consumption by sector (domestic, irrigation, etc.)	

5.1.5 Land and vegetation cover

A number of agencies collect data on land and forest resources (Tables 6 and 14). Countries are increasingly adopting the use of indicators pertaining to land use and vegetation cover, as well as of land degradation, and are developing national capacity for use of geo-referenced indicators. All the PCs have a Ministry with departments responsible for agriculture, land, and forestry. The status of information for land use planning is very different when comparing the larger states such as Jamaica and Trinidad and Tobago, with the other countries. The larger countries have generally have well-organized systems for procuring land-use information, and for integrating,

analyzing, and applying this information towards development planning. In the smaller states, land-use information is spread out among various government ministry departments (e.g. housing, agriculture, land evaluation, town, and county planning). In the area of forestry Jamaica produces comprehensive forest cover information while a number of the OECS members (Dominica, St. Lucia, St. Vincent and the Grenadines, Grenada) have developed forest inventories or possess dated forest cover maps. By comparison, there is no recent forest cover information available for Trinidad and Tobago (from 1981), Barbados, Montserrat, and St. Kitts and Nevis.

In general, existing databases relating to droughts, water use, land degradation, and other physical or biophysical indicators cover only short periods. Where longer time series of data have been collected, the data resides externally, often in universities or former colonial offices (Murray, undated[1]). Land degradation data for the Eastern Caribbean is even more scant. Apart from crude geological maps of soil types and characteristics found in Environmental Profiles of the islands, not much is published about land degradation in the English Speaking Caribbean. Although Ministries/departments of Agriculture in the various islands periodically conduct agricultural censuses, none of the records include any reference to loss of topsoil, soil fertility, structure, or integrity. Landslide hazard maps for St. Vincent were produced in the 1980s under the Organization of American States (OAS). Similar maps exist for other CARICOM countries including Trinidad and Tobago, Barbados, and Antigua and Barbuda.

There are a number of efforts and initiatives to assist the countries in land cover mapping. Among these is an initiative to produce vegetation/land cover maps for the Caribbean islands (Caribbean Vegetation and Landcover Mapping Initiative) by The Nature Conservancy (TNC), International Institute of Tropical Forestry (IITF), US Forest Service EROS Data Center, and the USGS. These maps are based on available Landsat Thematic Mapper satellite images, other remote sensed data, and a standardized vegetation classification system for the greater Caribbean region, based on earlier work by UNESCO. A region-wide standard vegetation classification system and a preliminary Atlas of existing vegetation/land cover maps for the Caribbean islands have been completed. Past work has mapped land cover and forest formations for Jamaica and Dominica. Recent work has included a pioneering international effort to map land cover and forest formations of five countries (St. Kitts and Nevis, St. Vincent and the Grenadines, St. Lucia, Grenada, and Barbados).

FAO is engaged in several ongoing efforts to update land use and agriculture information for the Caribbean. Among other efforts, FAO has developed a global database on the state of soil, water, and plant nutrient resources in the Caribbean as part of its Gateway to Land and Water Information project. This PROCICARIBE-managed database is housed at the Caribbean Agricultural Research and Development Institute (CARDI). PROCICARIBE also manages the Caribbean Land and Water

[1] Physical and Bio-physical Indicators of Drought and Desertification in the Caribbean. R.Reynold Murray (unpubl)

Resources Network (CLAWRENET), which has developed a regional GIS database of national land and water resources.

The countries occasionally conduct agricultural censuses, using standard indicators under the FAO Programme for the World Census of Agriculture. The last round of censuses was conducted in 1996 – 2005. FAO has also assisted Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, Saint Lucia, and St. Vincent and the Grenadines to develop a Land Resources Information System which comprises a GIS package (ArcView 8.1), as well as a database management system, to enter and manage land attribute data and integrate the data with the GIS software.

FAO works with member countries to support the development and implementation of national forest monitoring systems. FAO maintains an online database of national forest statistics (Table 6), which are obtained through national surveys and other sources. The FAO State of the World's Forests Report and Global Forest Resources Assessment provide indicators such as forest area and area change over time, for some of the countries. The data have been reported by the countries to FAO and are available online.

The use of benchmarks and indicators in land degradation is a relatively recent development in the Caribbean islands, with impetus from the UN Convention to Combat Desertification (CCD). All the countries are Parties to the CCD, and are in the process of developing National Action Plans, most of which have proposed benchmarks and indicators related to land degradation and progress in implementation of this convention. These countries are also required to submit national reports to the Convention, which include information on biophysical indicators related to desertification and drought, including vegetation cover, land use, land degradation, and land rehabilitation, although a number of countries have not fully adopted the use of these indicators. Institutional measures to implement the Convention are also required to be included in the national reports, and could form the basis for the development of process indicators.

A number of agencies, organizations, and entities exist in the region through which lateral cooperation can be pursued for effective collaboration within a framework as regards development of benchmarks and indicators for the monitoring of land degradation and drought within the region (Sweeney, 2003). Through their mandates and structures, as well as commonalities of interest, the possibilities exist for a strong collaborative grouping to address these indicators.

Table 6. Land and Land Cover

Sub-theme	**Indicator/data collected**	**Principal agencies/frameworks; data sources**
Forests	% cover; area/change; reforestation; deforestation; protected forest area	CARDI/PROCICARIBE Caribbean Land and Water Resources Network (www.procicaribe.org/networks/clawrenet/index.htm); FAO Global Forest Resources Assessment 2005; Country data at www.fao.org/forestry/site/country/en/; global database at http://www.fao.org/forestry/site/43035/en/ FAO Aquastat (www.fao.org/ag/agl/aglw/aquastat/dbase/index.stm); State of the World's Forests 2007
Urbanization	area	
Agriculture	Area; fertilizer & pesticide use; crop	

	type/area	(www.fao.org/docrep/009/a0773e/a0773e00.htm; Annex with country level data: ftp.fao.org/docrep/fao/009/a0773e/a0773e10.pdf; National agriculture census (FAO); FAO Compendium of Agricultural Indicators (www.fao.org/es/ess/os/envi_indi/part_11.asp); Caribbean Vegetation and Landcover Mapping Initiative (edcintl.cr.usgs.gov/tnc/index.html); Caribbean Vegetation Atlas by country (edcintl.cr.usgs.gov/tnc/products/atlas.html); CCD (www.unccd.int/cop/officialdocs/menu.php)
Land degradation	Area degraded; soil erosion; soil fertility, rate of topsoil loss	

5.1.6 Natural disasters

The Caribbean SIDS are highly vulnerable to natural disasters, especially those related to extreme climatic events, a number of which has been experienced in the region in recent years. Common indicators relate to the incidence, intensity, as well as to the social and economic impacts of natural disasters (Tables 7 and 14). Each country has a national agency responsible for disaster preparedness and response. At the regional level, the Caribbean Disaster Emergency Response Agency (CDERA) is the central disaster management organization. The Centre for Research on the Epidemiology of Disasters (CRED), maintains an international database on disasters, with data available by country, type of disaster, and corresponding human and economic impacts.

Table 7. Natural Disasters

Sub-theme	**Indicator/data collected**	**Principal agencies/frameworks; data sources**
Occurrence	Frequency & intensity	CDERA (www.cdera.org/doccentre/index.php); CRED global disasters database (www.em-dat.net/)
Human Impacts	Loss of life; injuries; displacement	
Economic impacts	Economic losses	
Environmental impacts	Habitat damage	

5.1.7 Sanitation and human health

The relevant Ministries and government departments (e.g. Ministry of Health, Public Utilities) collect information through surveys at different time intervals for a number of indicators related to sanitation and human health (Tables 8 and 14).

At the regional level, CEHI undertakes projects to assess water quality at specific locations. At the international level, among the major freshwater monitoring and assessment programmes are WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation; UNESCO World Water Assessment Programme and World Water Development Report; and FAO Land and Water Development Division.

The indicators used in these assessments are based on data obtained from a number of sources, including national surveys, global networks, and other UN and partner organizations. These indicators are used to monitor the achievement of the relevant international development targets, for instance the MDG related to freshwater and sanitation. National statistics on freshwater for the PCs are available in databases on these agencies websites and in various publications (Table 8). The biennial World Water Development Report aims to develop indicators and monitors progress against

targets for sanitation and wastewater. The WHO/UNICEF Joint Monitoring Programme is the only one regularly conducting surveys on water supply and sanitation coverage worldwide, and provides statistics on a number of indicators by country.

Indicators of water and sanitation related diseases are also used to monitor the impacts of poor water quality on the human population. At the regional level, CAREC and PAHO are among the agencies that maintain databases on incidences of water-related diseases.

Table 8. Sanitation and Human Health

Sub-theme	**Indicator/data collected**	**Principal agencies/frameworks; data sources**
Access to sanitation	Sanitation coverage (% population)	WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (www.wssinfo.org/en/25_wat_dev.html; www.wssinfo.org/en/35_san_dev.html); CEHI; PAHO/WHO; CAREC
Access to freshwater	Freshwater coverage (% population)	
Illness	Incidence of water/environment-related illnesses	

5.1.8 Waste

Pollution prevention and waste management are critical issues in the PCs. Responsibility for waste management is shared among various agencies, depending on the type of waste. Data for the development of pertinent indicators are available (Table 9), although limited in some of the countries, with the most commonly used including the generation of waste by type and sector and the disposal of waste by method (CARICOM Secretariat 2003).

Point source pollution from industrial wastes and sewage, inappropriately located and poorly managed solid waste disposal sites, and the inadequate disposal of toxic chemicals are significant contributors to marine pollution and coastal degradation in the region (CARICOM Secretariat 2003). In this regard, the LBS Protocol of the Cartagena Convention and the GPA are appropriate frameworks for development of benchmarks and indicators for land-based pollution of the coastal zone.

Table 9. Waste

Sub-theme	**Indicator/data collected**	**Principal agencies/frameworks; data sources**
Waste generation	Waste generation, incl. wastewater	CEHI; LBS Protocol; GPA
Waste management	Wastewater treatment coverage; waste handling; disposal methods (% of waste)	

5.1.9 Tourism

Because of the importance of tourism in the PCs, data for a number of indicators related to tourism, including its social and economic significance, are routinely collected (Tables 10 and 14). However, it is only more recently that efforts have begun to qualify and

monitor the impacts of tourism on the environment. The identification of sustainable tourism indicators began in 1992 with the launch of a taskforce by the WTO.

The CTO has conducted a study on the identification of indicators of sustainable tourism in the Caribbean, categorized into Nature Environment, Social Aspects, and Culture and Economy, which also includes topics such as data availability, comparability, robustness, etc. CTO is collaborating with various agencies such as tourism Boards and environmental agencies, as well as CAST, to identify suitable indicators for sustainable tourism. CAST has implemented a project jointly with the CTO – the Blue Flag Programme – which rates the environmental quality of beaches in the region, and seeks to develop sustainable development indicators on tourism. The CTO, ACS, and CAREC are collaborating in an initiative to develop indicators for the Sustainable Tourism Zone of the Caribbean, to guide the development of and to measure the progress being made in achieving sustainable tourism in the region.

Another tourism-related international organization is Green Globe, which is dedicated to furthering sustainable travel and tourism. The Green Globe framework is currently implemented in 52 countries worldwide. The Green Globe standard underpins its programme and forms the basis to benchmark an operations environmental and social performance. Each Green Globe participant is benchmarked against specific Sector Benchmarking Indicators appropriate to their operations.

Table 10. Tourism

Sub-theme	**Indicator/data collected**	**Principal agencies/frameworks; data sources**
Tourism intensity	Tourist arrivals; hotel density…..	CTO; ACS (www.acs-aec.org/Documents/Tourism/Projects/ACS_ST_000/Tourism_Stats0603.pdf); ACS project -*Development of indicators for the Sustainable Tourism Zone of the Caribbean)*; WTO
Environmental impacts	Natural resource consumption; waste generation, number of ecotourism initiatives….	

5.1.10 Socioeconomics

Socioeconomic activities impact the environment through the unsustainable use of natural resources, the generation of pollution and wastes, and the infringement on, and subsequent degradation, of ecosystems. In fact, socioeconomic factors are considered to be among the major driving forces of environmental change. In SIDS, socioeconomic activities in watersheds have severe impacts on coastal areas, and must be taken into consideration in the development of IWCAM strategies and plans.

Population, demographic, and economic indicators have long been in use in the countries. In fact, most of the countries have relatively long time series of demographic and socioeconomic data, available at national level and by economic sectors (Tables 11 and 14). The CARICOM Secretariat (2003) has compiled demographic and socioeconomic indicators for its member states, while indicators for all the PCs are

available through a number of different sources, including the UNDP Human Development Reports and the World Bank World Development Indicators.

Table 11a. Socioeconomics

Sub-theme	**Indicator/data collected**	**Principal agencies/frameworks; data sources**
Population	Total population; density	CARICOM; UNDP Human Development Report 2006 (indicators at hdr.undp.org/hdr2006/statistics/indicators/default.cfm); World Bank country profiles at //web.worldbank.org; ILAC; CSD; MDG
Socioeconomic development	Socioeconomic indicators (GDP, GDP/cap; poverty; etc)	
Human development	Human Development Index	

5.1.11 Environment and Sustainable Development

While the themes and indicators discussed above are environmental and sustainable development themes and indicators, a number of national, regional, and international initiatives currently exist for the development of indicators under the overarching theme of environment and sustainable development within an integrated framework. The PCs have seen the onset of, *inter alia*, Agenda 21, BPoA, and multilateral environmental agreements; meeting their obligations and reporting requirements all demand the collection of environmental statistics and use of indicators.

All the PCs have formulated or are in the process of formulating sustainable development strategies and environmental action plans (or their equivalent), and have made variable progress in identifying and selecting associated indicators. For instance, the Barbados Policy on Sustainable Development has adopted 170 core indicators for sustainable development under its national indicators programme in three major thematic areas (Human Well-being, Ecological Welfare, and Sustainable Interaction). The first pilot study that was conducted in 1996 indicated that the major data sources were widely spread across the different governmental institutions. In 1998, a workshop on Sustainable Development Indicators further promoted the development of environmental statistics. A Steering Committee is now implementing the Barbados National Indicators Programme.

Countries have prepared national environment outlook reports (or equivalent) in which trends in a number of socioeconomic and environmental indicators are reported. Jamaica has a National Sustainable Development Plan, implemented by the National Environment and Planning Agency (NEPA), which attempts to integrate development and capital infrastructure investment decisions into a spatial context.

Initiatives and frameworks at the sub-regional and regional levels include:

- Organization of Eastern Caribbean States (OECS): The OECS has embarked on an initiative to establish a robust set of indicators of progress towards the goals of the St. George's Declaration of Principles for Environmental Sustainability in the Member States. The revised SGD and a draft SGD reporting instrument were approved in November 2006 by the Environment Policy Committee of the OECS,

and both documents include a set of indicators (Annex 4). An assessment and recommendations for each SGD indicator, as well as recommendations for establishing baselines and frequency of monitoring are presented in Geoghegan and Renard (2006). The OECS member countries have embarked on the development of National Environmental Policies, National Environmental Management Strategies and Action Plans (http://www.oecs.org/esdu/nems-docs.html), which include the formulation and adoption of specific targets and indicators in all relevant sectors and programmes

In 2003, the United Nations through its Department of Economic and Social Affairs (UNDESA) and the OECS Secretariat entered into an agreement, through which the OECS undertook the responsibility to manage the implementation of two projects related to National Sustainable Development Strategies and Indicators of Sustainable Development. Under this framework a national project for St. Lucia ("Integrated Planning for Sustainable Development and Supporting National Sustainable Development Indicators for St. Lucia") resulted in a draft set of national indicators for sustainable development and a first draft framework national sustainable development strategy for this country.

- Barbados Programme of Action for Sustainable Development of SIDS: In April 1994, the first Global Conference on Sustainable Development of SIDS was convened in Barbados (www.sidsnet.org). The conference adopted the BPoA that sets forth specific actions and measures to be taken at the national, regional and international levels in support of the sustainable development of SIDS. The BPoA has been adopted by the PCs. The 10-year review of implementation of the BPoA was held in Mauritius in 2005, and resulted in the Mauritius Declaration and Strategy. Regional programmes for implementation of the Mauritius Strategy include indicators of progress and milestones under a number of themes of relevance to IWCAM (including climate, natural disasters, waste management, coastal and marine resources, freshwater resources, land resources, tourism). These indicators mainly relate to process and stress reduction. The Caribbean Development Bank is responsible for the coordination of the Sustainable Development Indicators programme of the BPoA.

- CARICOM Single Market and Economy (CSME): The CSME seeks to foster regional growth and development among its Member States through the creation of an integrated market for goods and services and the free flow of capital and individuals across traditional borders. In order to ensure the achievement of the objectives of the CSME, the regular and timely production by all Member States of a broad scope of statistics and indicators will be crucial. These statistics and indicators will provide the essential tools to assist in monitoring and evaluating the achievement of the key objectives of the CSME. A number of environmental indicators are proposed for the CSME, and are pertinent to the development of IWCAM indicators mechanisms (Annex 5).

- Latin American and Caribbean Initiative for Sustainable Development: At its 14th Meeting, the Forum of Ministers of the Environment for Latin America and the Caribbean agreed to support an initiative to produce a core set of national environmental, economic, social, and institutional indicators to assess progress in the implementation of the Latin American and Caribbean Initiative for Sustainable Development (ILAC), within the framework of the WSSD. A project on the proposed ILAC indicators is being undertaken by UNEP and the Government of Costa Rica, with support from the World Bank. A number of the ILAC indicators are of relevance to IWCAM (Annex 6).

- OAS Declaration of Santa Cruz de la Sierra and Action Plan: The OAS Heads of States and Governments committed themselves to implementing the first Plan of Action for the Sustainable Development of the Americas, based on the principles of the 1996 Declaration of Santa Cruz de la Sierra (www.oas.org/dsd/Summit/bolivia_declaration.htm). This plan calls for the generation of basic information on environmental criteria and indicators at regional, sub-regional, and national levels to evaluate progress toward sustainable management of biodiversity and toward sustainable forest management. The plan also calls for the development and strengthening of research and monitoring capabilities pertaining to the conservation of inland, coastal, and marine water resources, especially in relation to environmental health parameters. Data collected will be incorporated into a study that will document the current state of health of the coastal and marine environment; establish benchmark indicators for assessing the effectiveness of national, regional, and international instruments and initiatives; and identify and categorize land and marine-based sources of pollution.

- UNEP: UNEP has an ongoing initiative to develop environmental indicators under the GEO project. The UNEP/GEO Core Indicators are a compact set of selected quantitative parameters that reflect headline trends for the major global and regional environmental issues addressed under the GEO assessment and reporting process. Information and data on a wide range of environmental indicators relevant to each country are available at http://countryprofiles.unep.org/profiles. UNEP has also developed indicators of relevance to SIDS, and through the GEO project works with countries to build capacity for environmental assessment and reporting (http://islands.unep.ch/; http://islands.unep.ch/isldir.htm).

  The GEO data portal (http://geodata.grid.unep.ch/) is the authoritative source for data sets used by UNEP and its partners in the GEO report and other integrated environment assessments. Its online database holds more than 450 different variables, as national, sub-regional, regional, and global statistics or as geospatial data sets, covering a number of themes.

  UNEP is also collaborating with the South Pacific Applied Geoscience Commission (SOPAC) and other partners to develop an Environment Vulnerability Index (EVI) for the natural environment (http://www.vulnerabilityindex.net/index.htm). The EVI is a dimensionless numerical indicator that reflects the status of a country's

environmental vulnerability. The first conceptual EVI for SIDS was presented by SOPAC in 1999. The EVI is calculated based on 50 'smart indicators' that capture the key elements of environmental vulnerability. EVI country profiles, including for some of the PCs that are collaborating in developing the EVI, are available at http://www.vulnerabilityindex.net/EVI_Country_Profiles.htm.

- UN Commission on Sustainable Development (CSD): Chapter 40 of Agenda 21 calls on countries and the international community to develop indicators of sustainable development. The CSD has been involved in the development of indicators of sustainable development, in collaboration with other international organizations and experts from developing and developed countries. The UN has also been focusing on the use of indicators to monitor the implementation of National Sustainable Development Strategies (NSDS). The revised CSD indicators set consists of 50 core indicators, which are part of a larger set of 96 indicators of sustainable development. These indicators and their detailed methodology sheets are available as a reference for all countries to develop national indicators of sustainable development. Information by countries (including Caribbean SIDS) is available at http://unstats.un.org/unsd/ENVIRONMENT/qindicators.htm and http://www.un.org/esa/sustdev/natlinfo/natlinfo.htm.

  Based on the list of environmental indicators approved by the Statistical Commission, UNSD, in collaboration with UNEP, has been conducting biennial data collection in all countries (except OECD countries), which is intended to contribute to the development of the UNSD International Environment Statistics Database. The 2004 data collection focused on water resources and pollution, air pollution, waste generation and management, land use and land degradation. National information includes information submitted biennially in national reports by member States to the CSD. The first results from the 2004 UNSD/UNEP data collection on environment statistics are available at http://unstats.un.org/unsd/environment/q2004indicators.htm.

  With regard to environmental accounting, conventional national accounts, in their assessment of cost and capital, neglect new scarcities of natural resources, as well as the degradation of environmental quality. A System of Integrated Environmental and Economic Accounting was developed by UN Statistical Division as a satellite system of the system of national accounting to analyze environmental and economic concerns in a common and flexible framework. A *Handbook of Integrated Environmental and Economic Accounting* was published by UNSD in 1993.

- Millennium Development Goals: To monitor progress towards the MDGs and targets, the United Nations system, the World Bank, and the International Monetary Fund, as well as the Development Assistance Committee of the Organization for Economic Co-operation and Development, came together under the Office of the UN Secretary General and agreed on 48 quantitative indicators. The indicators built upon an inter-governmental process to identify relevant indicators in response to global conferences. Country data should be used for compiling the indicators where such

data are available and of reasonable quality. UN Country Teams have been helping countries prepare national reports that measure progress towards the MDGs. The emphasis is on national ownership as well as accurate benchmarking of progress, so wherever possible these are done in close collaboration with the government as well as civil society groups.

Monitoring of the MDGs is taking place globally, through annual reports of the UN Secretary General to the General Assembly and through periodic country reporting. For global reporting, use is made of indicators compiled by international organizations. Internationally compiled indicators, based on standard concepts, definitions and methodologies, more readily facilitate cross-country comparisons. For country reporting, use is generally made of indicators compiled from national sources, generally by the national statistical system. The metadata sheets for the indicators reflect national and international standards. A number of these indicators are very pertinent to IWCAM (Annex 7).

- Environmental Performance Index: The 2008 Environmental Performance Index (EPI) was launched at the 2008 World Economic Forum in Davos, Switzerland. The Index is produced by a team of environmental experts at Yale University and Columbia University. The 2008 EPI ranks 149 countries on 25 indicators tracked across six established policy categories: Environmental Health, Air Pollution, Water Resources, Biodiversity and Habitat, Productive Natural Resources, and Climate Change. The EPI identifies broadly-accepted targets for environmental performance and measures how close each country comes to these goals. EPIs have been calculated for Cuba, Dominican Republic, Haiti, Jamaica, and Trinidad and Tobago (http://epi.yale.edu/Home).

Table 12. Environment and Sustainable Development

Frameworks of relevance to environmental and sustainable development to the PCs	
BPoA	http://www.sidsnet.org
Caribbean Action Plan	http://www.cep.unep.org
CARICOM	http://www.caricom.org
CEHI	http://www.cehi.org
Environmental Performance Index	http://epi.yale.edu/Home
Environment Vulnerability Index	http://www.vulnerabilityindex.net/index.htm; http://www.vulnerabilityindex.net/EVI_Country_Profiles.htm
GEO data portal	http://geodata.grid.unep.ch/
ILAC	http://www.odd.ucr.ac.cr/ilac
MDG indicators	http://unstats.un.org/unsd/mdg/default.aspx; http://unstats.un.org/unsd/mdg/Host.aspx?Content=Indicators/OfficialList.htm
OAS Santa Cruz Declaration & Action Plan	http://www.summit-americas.org/boliviaplan.htm
OECS St. George's Declaration	http://www.oecs.org/esdu/SGD.htm
UN Commission on Sustainable Development; UN Statistical Div.	http://unstats.un.org/unsd/ENVIRONMENT/qindicators.htm; http://unstats.un.org/unsd/environment/q2004indicators.htm http://www.un.org/esa/sustdev/natlinfo/natlinfo.htm; http://www.un.org/esa/sustdev/natlinfo/indicators/guidelines.pdf
UNDP Human Development	http://hdr.undp.org/en/media/hdr_20072008_en_complete.pdf

Report	
UNEP GEO Country profiles	http://countryprofiles.unep.org/profiles
UNEP island websites	http://islands.unep.ch/; http://islands.unep.ch/isldir.htm
World Bank	http://www.worlbank.org

5.1.12 Governance

Governance indicators include indicators related to institutional setting, policy/legislation, technical/technological capability, stakeholder participation, etc. Among the governance indicators are institutional and policy measures taken to implement the various MEAs of which the PCs are Parties. All the PCs have begun implementing policy and institutional reforms for environment and sustainable development, have environment education programmes, and are increasingly embarking on wider stakeholder participation. A few of the PCs also have limited integrated watershed and coastal area management programmes, integrated coastal areas management programmes and plans, and natural resource management plans (e.g. fisheries management plans). Institutional and policy reforms and investments for IWCAM are among governance indicators. In terms of the GEF-IWCAM project, governance indicators could be placed in the Process Indicators category. While governance indicators are not explicitly mentioned in the various national frameworks, these must be included and monitored in national IWCAM programmes. The OECS St. George's Declaration includes a number of governance indicators (Annex 4), as does ILAC (Annex 6).

Table 14. Summary of indicators/data in the PCs, based on survey responses* and country reports prepared for the GEF-IWCAM project.**
Group 1: OECS members and the Bahamas; Group 2: Larger English-speaking countries; Group 3: Non-English speaking countries

THEME	SUB-THEME	INDICATOR/DATA COLLECTED	GROUP 1							GROUP 2			GROUP 3		
			*Antigua & Barbuda	*Bahamas	**Dominica	**Grenada	**St. Lucia	*St. Kitts & Nevis	*St. Vincent & Grenadines	**Barbados	*Jamaica	*Trinidad & Tobago	*Cuba	*Dominican Republic	*Haiti
1. Atmosphere	*Climate & air quality*	Rainfall	X	X	X	X	X	X	X	X	X	X	X	X	X
		Air Temperature	X	X	X	X	X	X	X	X	X	X	X	X	X
		Evaporation												X	
		Wind speed & direction												X	
		Air quality									X	X	X		
		Greenhouse gas emissions; GHG inventories; ODS										X	X		
	Energy	Energy consumption											X		
		% pop using solid fuels											X		
2. Biodiversity	*Habitats*	Protected areas (marine, terrestrial)		X							X		X	X	X
		% protected areas effectively managed											X		
	Species	Threatened/endangered species									X			X	
		Invasive species									X				
		Species abundance (flora, fauna)									X	X		X	
		Biodiversity (unspecified)	X												X
3. Coasts and seas	*Fisheries*	Fisheries landings	X	X	X	X	X	X	X	X	X	X	X	X	X
		Mean fish size									X				
		Species abundance									X				
		Mean trophic level of catch (adopted by CBD)													
		Fisheries management plans/incentives		X							X				
	Coral reefs	Coral cover; algal cover; bleaching; diseases								X	X	X	X	X	X
		Fish abundance									X				
	Seagrass	Cover									X	X	X		X
		Biomass, density, productivity										X			

	Mangroves	Cover, species diversity									X	X		X	
		Biomass, leaf litter										X			
		Stem diameter										X			
		Disease										X			
		Wetlands restored										X			
	Beaches	Beach profiles (erosion/accretion)	X							X	X	X			
	Sea level	Mean Sea level; tidal level								X			X		
	SST	SST									X	X			
	Water quality	BOD/COD									X		X		
		Coliform	X								X	X			
		Dissolved oxygen										X	X		
		Turbidity/suspended solids									X	X			
		Chlorophyl *a*										X			
		Nitrates, nitrites									X	X	X		
		Ammonia										X	X		
		Phosphates									X	X			
		Silicate											X		
		Dissolved oxygen										X	X		
		pH									X	X	X		
		Heavy metals										X	X		
		Petroleum hydrocarbons										X			
		Chemical pollutants	X												
		Temperature									X	X			
		Water quality (unspecified)	X				X			X					X
	Other	Population density in coastal areas; population within distance of coast											X		
4. Freshwater	*Water quality*	BOD/COD									X		X	X	
		Coliform				X	X	X			X	X		X	
		Dissolved oxygen										X	X		
		Dissolved solids										X			
		Turbidity/suspended solids						X			X	X			
		Nitrates, nitrites		X				X	X		X	X	X	X	
		Ammonium											X		
		Chloride						X				X			
		Calcium										X			
		Magnesium										X			
		Phosphate									X	X			
		Sulphate										X			
		Silicate											X		
		pH						X			X	X	X		
		Salinity				X				X		X			
		Heavy metals										X	X		
		Petroleum hydrocarbons										X			
		MTBE (groundwater)										X			
		BTEX (groundwater)										X			
		Chlorinated pesticides (groundwater)										X			

		Organophosphate pesticides (groundwater)										X			
		Petroleum hydrocarbons (groundwater)										X			
		Salinity (groundwater)										X			
		Dissolved oxygen (groundwater)										X			
		Chemical pollutants	X												
		Temperature						X			X	X			
		Water quality (unspecified)			X	X				X					
		Water treatment plants											X		
	Water availability and use	Ground water level								X		X			
		Stream flow/river discharge			X		X	X			X	X			
		Renewable water resources													
		Water extraction/availability/production						X		X	X	X	X	X	
		Recharge rate (groundwater)									X				
		Incentives for sustainable water use										X			
		Integrated Water Resources Management (IWRM) plans		X								X			
5. Land	*Forests*	% cover; area		X							X		X	X	
		Reforestation; deforestation							X		X	X			
		Lichen cover										X			
		Forest fires											X		
		Area of watershed under management											X		
	Urbanization	Area													
	Agriculture	Area									X			X	
		Yields									X				
		Fertilizer/pesticide use		X							X				
		Incentives for sustainable agric										X			
	Land degradation/soil	Area degraded; soil erosion; soil fertility									X		X		
	Land use	% land use										X	X		
		Land use planning		X				X			X	X			
6. Natural disasters	*Occurrence*	Frequency & intensity (hurricanes, landslides, storm surges, earthquakes, etc)										X			
		Vulnerable areas												X	
		Dwelling type									X				
		Environmental vulnerability													X
	Human Impacts	Loss of life; injuries; displacement													
	Economic impacts	Economic losses													
	Environmental impacts	Damage to habitats & natural resources													
7. Sanitation/ human health	*Access to sanitation*	Sanitation coverage (% population)		X							X	X	X	X	
	Access to freshwater	Freshwater coverage (% population; availability/capita)		X							X	X	X	X	

	Illness	Incidence of environment-related diseases											X		
	Basic services	Access to basic services												X	
8. Waste	*Waste generation*	Waste generation/discharge									X		X	X	
	Waste management	Wastewater treatment coverage											X		
		Waste collection, treatment & disposal (incl. recycling)									X		X	X	
9. Socio-economics	*Population/ demography*	Total population; density		X							X	X		X	
	Socio-economic development	Socio-economic indicators (GDP; poverty; etc)		X							X			X	
	Human development	Human Development Index													
		Income										X			
10. Tourism	*Tourism intensity*	Tourist arrivals; tourist penetration ratio; hotel density		X							X			X	
	Environmental impacts	Natural resource consumption; waste generation….													
11. Environment & Sustainable development	NEMS														
	NEAPS														
	Env. Health (unspecified)		X												
12. Governance	*Institutional; policy/legislation technical/technological; data & information; capacity; stakeholder participation, etc.*	Information available to develop a number of indicators (dependent on sector, issues, etc)	X	X	X	X	X	X	X	X	X	X	X	X	X
	High level political commitment		X	X	X	X	X	X	X	X	X	X	X	X	X
	Legal, policy, institutional reforms			X							X	X		X	
	Responsible agency/committees			X							X	X		X	
	Environmental education programmes			X					X		X	X	X	X	
	Parties to MEAs (see Table 1)		X	X	X	X	X	X	X	X	X	X	X	X	X
	Monitoring programmes			X				X	X		X	X			
	Valuation of natural resources/ ecosystems										X	X		X	
	Economic instruments											X			

	Stakeholder participation			X							X	X			

5.2. CAPACITY ASSESSMENT

Another component of this desk study was a capacity assessment exercise, with the following objectives:

- Assess current capacities and identify gaps and weaknesses in institutional capacities for indicator development and application in the participating countries;
- Assess relevant institutional infrastructural and administrative protocols related to indicator monitoring in the PCs. This includes, but is not limited to, assessing agencies, staffing, structure, etc;
- Assess the relevant human resource capacities and training needs related to indicator monitoring in participating countries;
- Provide recommendations for bringing capacities up to a level where indicators can be utilized, manipulated, and shared among PCs.

Development and implementation of an indicators mechanism requires capacity at the systemic, institutional, and individual levels, in a number of aspects ranging from the existence of an appropriate policy and legal framework that creates an enabling environment, institutional arrangements and means for its implementation, and human as well as financial and technological resources. An indicators system also requires monitoring and data collection to calculate the indicators, and a mechanism for uptake of the information in decision-making processes as well as for its reporting and dissemination to all stakeholders in an open and transparent process. An effective indicators mechanism does not exist in a vacuum – it must be an integral part of a management framework (in this case IWCAM), with a comprehensive understanding of the issues to be addressed, well-defined goals, objectives, and targets, as well as a mechanism to facilitate feedback and adaptive management.

This assessment seeks to appraise the ability of institutions, organizations, and individuals to perform tasks associated with indicator formulation and application, and related monitoring and data collection, processing, information dissemination and uptake, and management, in an effective, efficient, and sustainable manner. The capacities required to perform these task can be broadly classified as systemic, institutional, human, financial, data and information, and technical/technological capacities. The assessment characterizes the existing capacities and capacity-development needs at the national levels in the 13 PCs as they relate to the employment of indicators for IWCAM. Capacity was assessed in relation to the systemic level, institutional capacity, human resources, data and information, technology, and financial resources.

Information related specifically to the capacity for developing and applying IWCAM-specific indicators was scant in the PCs. Attempts were made to obtain information through a questionnaire, as described in Section I. Responses on capacity are summarized in Tables 15 and 16. Information on environmental statistics and indicators developed in complementary thematic areas was available at the national and regional levels. These statistics and indicators and the associated capacities and institutions involved were viewed as representing the uncoordinated elements of an IWCAM

indicators mechanism. In this light, they were considered to be proxies for the capacities required to develop and use IWCAM indicators, and are included in this report as appropriate. An assessment of capacity for environmental statistics was undertaken between 2006 and 2007 by the UNSD to determine the status of national implementation of environmental-economic accounting and related statistics, priorities, and future plans. Capacity development initiatives in support of the environmental sector have direct implications for capacity development for IWCAM and the development and maintenance of indicators mechanisms.

5.2.1 Existing capacities and capacity building initiatives

All the PCs have the basic elements in place, although in varying stages of development, for an IWCAM indicators mechanism. They include but are not limited to:

- Government ministries and agencies with mandates for environmental/natural resources assessment and management;
- Universities, research institutes, and national laboratories;
- National statistics offices and regularly produced statistical reports;
- Thematic monitoring, data collection, and assessment and reporting activities conducted by government agencies, research and teaching institutions, intergovernmental organizations, and international agencies;
- Nascent national data coordination and management mechanisms (national land information agencies and GIS repositories);
- Legislation mandating government agencies to submit data to the national statistical agency;
- National development policies that identify environmental statistics as measures of performance;
- Trained and experienced personnel who have been involved in a number of initiatives at national and regional levels.

Thematic indicator mechanisms exist at the national level in relation to natural living resources management and productive sectors (e.g. water resources, fisheries, forestry, agriculture), environment, and risk management (meteorology and human health). As mentioned in the previous section (indicators mechanism assessment), countries are parties to a number of MEAs (e.g. Cartagena Convention, CBD, CCD) that promote the use of indicators for reporting purposes. In addition, some of the countries are also developing indicators to track progress in achieving the MDGs. Some capacity for the development and use of indicators is gradually being developed under these frameworks.

At the regional level capacities reside in institutions/organizations such as CARICOM, UWI, CIMH, UNEP CAR RCU, UNEP ROLAC, CEHI, and CANARI. A number of capacity building initiatives for environmental statistics and indicators have been undertaken in the region. These were promoted by a number of organizations including UN organizations (e.g. UNDESA, UNCSD, UNSD, UNECLAC, and regional and sub-regional organizations (e.g. UNEP ROLAC, OAS, CARICOM, OECS). At the international level the Environment Statistics Section of the UNSD is engaged in the

development of methodologies, data collection, technical cooperation, and coordination in the field of environmental statistics and indicators.

Capacity building efforts related to indicators and environmental statistics have included:

- "CARICOM Programme on Strengthening Capacity in the Compilation of Social Gender and Environment Statistics and Indicators" in the CARICOM Region" (http://www.caricomstats.org/caricomprog.htm), which is supported by a data dissemination strategy that makes use of developments in Information Communication Technology. It is coordinated by the CARICOM Secretariat at the regional level relative to the compilation of regional databases. The National Statistical Offices (NSOs) coordinate data compilation at the national level;
- "Strengthening Capacity in the Compilation of Statistics and Indicators for Conference Follow-up in the CARICOM Region", which was jointly carried out by UNSD and the CARICOM Secretariat between 2000 and 2003 (http://unstats.un.org/unsd/environment/caricom.htm). The Project was executed in the CARICOM Member States, which include all but two of the 13 PCs (Cuba and Dominican Republic). The environment statistics component of the project was launched at the workshop on Environment Statistics in Belize in 2000 (http://unstats.un.org/unsd/environment/envpdf/caricomrep.pdf). The Project provided capacity building and led to the publication of environment statistics compendia in Antigua and Barbuda, Dominica, Grenada, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, and Trinidad and Tobago, as well as the publication "The CARICOM Environment in Figures 2002 (CARICOM Secretariat 2003a)";
- Two projects undertaken in 2003 - 2004 under a collaborative agreement between UNDESA and the OECS: "Integrated Planning for Sustainable Development and Supporting National Sustainable Development Indicators for St. Lucia" and "Caribbean Regional Workshop on National Sustainable Development Strategies and Indicators of Sustainable Development" under the theme National Sustainable Development Strategies and Indicators of Sustainable Development;
- "Capacity-Building in Creating Information Management Systems to Improve Decision- making for sustainable development of SIDS". This pilot project, which builds on the CARICOM/UNSD project, was undertaken by the OAS in collaboration with UNDESA in November 2002 – October 2003;
- UNEP Global Environmental Outlook: The GEO process has directly addressed capacity needs for developing environmental indicators for use in regional and global state of environment reporting. A number of the PCs have participated in these efforts and have produced national state of environment reports. At the regional level, two Environment Outlook reports for Caribbean SIDS have been published (2003, 2005);
- UN,ECLAC REDESA: The UN Commission for Latin America and the Caribbean (ECLAC) Network of Institutions and Experts in Social and Environmental Statistics (REDESA) project aimed to strengthen the capacity of Latin American and Caribbean countries to produce timely and reliable statistics on social and

environmental issues. Under this initiative the Dominican Republic has published a compendium of 108 environmental and socioeconomic variables for the country;

- Ocean and Data Information Network for the Caribbean and South America (ODINCARSA, www.odincarsa.net/): ODINCARSA's mission is to strengthen Ocean Data and Marine Information Management capacity in the Caribbean and Latin America in order to contribute to ocean sciences, operational oceanography development and integrated coastal management activities at regional level. ODINCARSA's network includes the following PCs: Bahamas, Barbados, Cuba, Dominica, Haiti, Jamaica, St. Lucia, and Trinidad and Tobago;
- Caribbean Marine Atlas (CMA): A number of Caribbean countries are embarking on an initiative to develop a Caribbean Marine Atlas (CMA) (www.iode.org/index.php?option=com_content&task=view&id=75&Itemid=11). The purpose of the CMA is to identify, collect and organize available geo-spatial datasets into an atlas of environmental themes for the Caribbean region, under the sponsorship of the IOC International Oceanographic Data and Information Exchange (IODE) and ICAM Programmes. A prototype version of the Caribbean Marine Atlas will be prepared by nine participating countries (Barbados, Cuba, Dominica, Grenada, Guyana, Jamaica, St Lucia, Trinidad and Tobago, Turks and Caicos), and is expected to be released in October 2008. It is planned to extend the Atlas to include other countries in the region. Personnel from the countries are undergoing training in data management and other relevant skills at the IODE Headquarters in Belgium.

As a result of these and other initiatives in the region, some capacity already exists in the PCs for indicators mechanisms development. The level of capacity varies among the countries, however, as confirmed by the groundtruthing exercises. The existing capacity consists mainly of capacity specifically for compilation of environmental statistics and indicators, and do not focus on IWCAM indicators within an IWCAM framework. A number of capacity gaps still remain, and are discussed in the following sections. The groundtruthing exercises in the three countries also confirmed these capacity gaps and deficiencies. It must be noted that a number of other efforts to evaluate capacity in the region for environmental indicators and data and information have reported similar findings, particularly with respect to existing gaps.

5.2.2 Systemic capacity

Systemic capacities are of critical importance as they provide the enabling environment that can facilitate and create incentives/disincentives that promote or constrain the development of capacity at the institutional and individual levels. The enabling environment can affect the performance of individuals, institutions, and sector organizations. At the systemic level, the capacity assessment considered the overall policy and legislative framework in which individuals and organizations operate and interact, as well as the formal and informal relationships among institutions. The systemic-level capacities confer legitimacy, provide appropriate incentives, establish the norms, and facilitate the development, implementation, and maintenance of

environmental monitoring and indicators mechanisms in support of national decision-making processes. For this reason, the results of the systemic assessment form the overarching context in which the results of the institutional/organizational and human resource capacity assessments can be interpreted.

Institutional and human capacity gaps are the direct and indirect consequences of deficiencies in the enabling environment that supports natural resource management and by extension, the associated evaluation, monitoring, and reporting processes. The absence of an overarching IWCAM framework in the PCs, within which national development and decision-making processes take place has far reaching implications for the development of IWCAM indicators mechanisms. Systemic weakness and deficiencies in the PCs have stymied the development of a culture of, and capacities for, monitoring, evaluation and results-based adaptive management. There is also the reluctance to set targets and to have greater accountability. Indicators are useful in assessing progress towards or away from a specific target and can help achieve greater participation and transparency in the planning and programming process in the countries. Within the agencies with natural resources management mandates, the needs for, and benefits from, appropriate indicators mechanisms may be clear, although stymied by resource constraints. Until indicator mechanisms are mainstreamed into the national development process framework, there will be no national development context or purpose to prioritize, rationalize, guide, and focus environmental monitoring activities. The need for environmental monitoring will continue to be driven by line agencies, and will remain marginal and expendable unless environmental statistics and indicators are recognized to be of critical strategic importance to national planning and sustainable development processes.

National development polices supported by explicitly identified environmental performance indicators as well as by coordinated environmental data collection are rare. This has given rise to a syndrome of *ad hoc* data collection and monitoring. This situation has created systemic barriers to awareness, and to the sharing of data and information on environmental statistics and indicators. In the absence of a formally articulated demand for environmental statistics and indicators to support sustainable national development planning, most PCs demonstrated:

- The absence of an overarching national environmental/natural resources management framework (specifically an IWCAM framework), with an integrated indicators mechanism and supporting monitoring programme;
- The absence of a clearly identified role for environmental statistics and indicators in the development planning and decision-making processes;
- Weak national oversight and coordination of environmental monitoring and the development and use of environmental statistics and indicators;
- Uncoordinated and often *ad hoc* approaches to environmental monitoring and indicators development at the national level;
- Chronic inability to effectively address undesirable environmental trends that undermine sustainable development objectives;
- Gaps in environmental monitoring and indicators development capacity;

- Obstacles to the access and sharing of environmental data and information.

With the exceptions of a few of the PCs (such as Barbados, Cuba, Dominican Republic, and Jamaica) there is limited oversight, leadership, and coordination at the systemic level to support and facilitate the institutional arrangements that would permit integrated management of watersheds and coastal areas (UNEP, 2001). The management of natural resources has traditionally been approached from a sectoral perspective. Mandates for the management of natural resources have been allocated among government ministries and municipalities without regard to the spatial scope of the supported natural systems and processes or the functional inter-relationship between elements of the environment. Policies and programmes under various institutions have traditionally been developed in isolation from one another, with the promulgations of multiple laws dealing separately with various aspects of natural resource management (UNEP, 2001).

As a result of this syndrome, data collection, monitoring, data processing and analysis, and the utilization of indicators, has been approached in a similarly *ad hoc* manner. Exceptions include the case of the Dominican Republic, where the Ministry of Environment and Natural Resources is the primary institution with responsibility for IWCAM. The same law that created the Ministry also established a National System of Information on the Environment and Natural Resources. All Government Departments are legally mandated to contribute data to this system. The legislation overcomes a major hurdle to the development of national environmental indicators and access of the designated central coordinating agency to environmental data generated by other government agencies.

In the absence of a coordinated national approach to data collection, management, use, and reporting to meet clearly defined conservation and development goals, there is limited awareness of gaps and deficiencies in capacity to develop indicator mechanisms. More importantly, there is limited appreciation of the negative impact that these gaps and deficiencies have on national sustainable development planning. A number of initiatives for capacity development in environmental statistics and indicators have been undertaken in the PCs, mainly in collaboration with international organizations. However, these initiatives have not catalyzed the high level commitment to integrated approaches to natural resources management (UNEP, 2001). This high-level commitment is essential if there is to be a demand for systematic monitoring and reporting. Two significant factors contributing to the limited impact of extra-regional initiatives at the systemic level have been the limited coordination between extra-regionally driven initiatives on the one hand, and on the other, the limited or absence of coherent visions for national development in which strategically important natural resource management considerations are recognized and considered.

5.2.3 Institutional capacity

Capacity assessment at the institutional/organizational level focused on those factors that contribute to overall performance and functional capabilities. These included the

tools, guidelines, and information management systems that enable the organization to adapt to the changing information needs and demands of the organization and its institutional partners while developing its staff and stakeholder clients. The institutional arrangements for natural resources management in general, and IWCAM in particular, are characterized by multiple agencies and organizations, with overlapping mandates and roles (Box 1). Furthermore, the current capacities of national institutions to effectively support their respective mandates to monitor environmental parameters and report on findings and trends tend to be inadequate. National institutional capacities for monitoring and systematic observation vary by country, agency, and the environmental resource or system being monitored. In general, the culture of systematic monitoring and data collection reside in those government ministries responsible for natural resources with market values, as well as in national meteorological services and freshwater resources agencies. As a result, extensive time-series data sets tend to be rare outside of these entities. Inadequate institutional capacities appear to be a major contributing factor to the fragmented approach to research and data/information management on natural resources, and the difficulty in accessing information and data. Few mechanisms existed to facilitate the inter-disciplinary and inter-sectoral exchange of information and experiences for decision-making on sustainable development (IDSD, 2003).

At the institutional level, the commitment to environmental monitoring and data collection has been weak and transient and driven by projects, research initiatives, and/or donor funded initiatives. The fragmentation of institutional mandates for the management of natural resources has given rise to institutionally compartmentalized and uncoordinated data collection and monitoring. The impact of fragmentation of natural resource management mandates on data collection and data quality was revealed in the recently completed Integrated Water Resources Management Capacity Needs Assessment for the Caribbean (CEHI, 2007). The assessment found that the institutional arrangements for integrated water resources management (IWRM) in the region were generally weak and in some cases non-existent. All of the countries surveyed demonstrated fragmentation of the IWRM mandate among institutions and agencies.

Box 1. Institutional Capacity Building: Trends in Freshwater and Coastal Area Resources

Evidence suggests that with very few exceptions notably Barbados, Cuba, and Jamaica, Caribbean countries are some distance away from the ideal institutional arrangement that would permit integrated management of watersheds and coastal areas. The extent of the integration that is required is one that would permit a continuous and evolutionary process and that unites all stakeholders and disciplines in the planning and management of coastal areas and watersheds, taking into account, traditional, cultural, spatial, and historical perspectives and conflicting interests and uses.

The Integrated Management ideal is not being enhanced in the current situation in the Caribbean given:

- The multiplicity of institutions and jurisdictions that deal with various aspects of resource management, often developing and implementing policies and programmes in isolation of one another;
- The multiplicity of laws, each dealing separately with various aspects of resource management, thus encouraging a compartmentalized approach to environmental management;
- The institutionally divided approach to dealing with environment and development;
- The absence of credible arrangements for sustained involvement of civil society in sustainable development initiatives.

A collaborative assessment was undertaken by the UNSD and CARICOM in 1999 to determine Caribbean needs in the area of social, gender, and environmental statistics, and information technology. This assessment was undertaken as part of an initiative to strengthen intra-regional

cooperation among national statistical systems. The assessment found gaps in statistical capacity, particularly in the area of coordination among the main data producing and data using institutions in some of the countries.

Inadequacies in national institutional capacity are illustrated by insufficient, outdated, or non-functional equipment; poor organization; high levels of dependency on outside consultants; insufficient financial resources; uncompetitive remuneration; obstacles to effective staff recruitment and retention; and inadequate and/or un-sustained training. At the regional level, institutional capacity to gather and generate information was found to be weak, with information and data on water resources, and on water demand and supply being inadequate (CEHI, 2007).

Established units dedicated to coastal zone management, such as in Barbados (Coastal Zone Management Unit - CZMU) and Jamaica (National Environmental Planning Agency - NEPA), have played a leading role in the development and implementation of environmental monitoring programmes to address national needs and priorities. In countries without dedicated CZM units such as the Bahamas, St. Kitts and Nevis, St. Vincent and the Grenadines, and Trinidad and Tobago most ecosystem monitoring is conducted by government agencies with other natural resource management priorities or foci. In the Bahamas, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines, the national Fisheries Departments are primarily responsible for coastal ecosystem monitoring. Coral reef monitoring programmes have been institutionalized in some of the countries such as Barbados (CZMU), Jamaica (NEPA), and Trinidad and Tobago (Fisheries Division, Institute of Marine Affairs).

A number of regional institutions and agencies exist that could assume leading roles in developing IWCAM indicators, with responsibility consistent with their respective mandates. For instance, CARICOM, CEHI, and CIMH provide training and capacity development, as well as a range of services pertaining to environmental indicators development and monitoring and the development of associated capacities. Despite the existence of a number of relevant institutions at the national and regional levels, the lack of national and regional institutional mechanisms to promote and coordinate the development of environmental indicators mechanisms have been a major constraint.

5.2.4 Human resources

This section deals with the assessment of current human resource capacities for IWCAM indicator mechanism development and implementation, and the availability of appropriate training opportunities and processes. A review of the intra-institutional enabling environment served to provide information on the critical support areas of management of resources, mechanisms for performance enhancement, staff motivation and moral building, and accountability and responsibility, as they relate to the development of capacities to develop and sustain indicator mechanisms in support of IWCAM. Human resources were assessed in terms of the number of technical and professional experts as well as the level of technical expert knowledge and skills for indicator development and environmental monitoring and assessment.

The skills and capacities required to establish and sustain a national IWCAM indicators mechanism include knowledge of IWCAM concepts and approaches, of conceptual frameworks for assessment, monitoring, and evaluation of IWCAM programmes, as well as the skills and methodologies for selecting appropriate indicators, data collection and analysis, interpretation of results, communicating and reporting of results, and their utilization in adaptive management. As previously discussed, while the PCs have been involved in a number of capacity development initiatives that have led to the existence of significant capacity for environmental indicators and statistics, important gaps still exist.

A major constraint to the use of indicators is the poor understanding and lack of consensus among technical experts of how economic, social, and environmental forces interact. Considerable knowledge and research is required to better understand the interactions among these three components, and the implications of these interactions for sustainable development and the parameters that must be assessed.

Inadequate human and financial resources have been identified as the most common impeding factor for the development of both environment statistics and environmental-economic accounting programmes in the CARICOM countries (CARICOM, 2003; UNSD, 2007). The non-English speaking PCs (Cuba, Dominican Republic, and Haiti) also cite inadequate human resources as a serious constraint to environmental monitoring. A report on the challenges and constraints to the development of a set of indicators to track effective environmental management in the OECS countries found a pervasive lack of capacity to undertake the monitoring of many important parameters (Geoghegan and Renard, 2006). This deficiency has created a dependence on external, project-driven support for monitoring activities, which has raised issues of data relevance, monitoring frequency, and continuity of monitoring programmes.

The human resource capacities available to support effective indicators development and use for IWCAM vary between countries and between organizations and agencies within countries. The survey undertaken in this study found that, with the exception of the Environmental Management Authority in Trinidad, all of the respondent institutions indicated that the quality of monitoring, observation and data collection was affected by human resource constraints (Table 15). Where the human resource capacity to support IWCAM indicators was assessed to be adequate, productivity and effectiveness, however, were frequently limited by the lack of appropriate facilities, well-trained support staff and labour, or restrictive intra-ministerial organizational structures, such as in Antigua and Barbuda (Government of Antigua and Barbuda, 2001).

In contrast, St. Kitts and Nevis reported a severe shortage of trained technical staff to support IWCAM through water resources management, water quality monitoring, and coastal areas management (Government of St. Kitts and Nevis, 2001). The Bahamas reported limited technical expertise in hydrologic, meteorological, and water quality data (CoB, 2003). Coastal resources management in Barbados was found to suffer from a general lack of adequately trained manpower due to inadequate remuneration, failure to

retain qualified staff, and a corresponding lack of structured training programmes (Government of Barbados, 2001).

The countries participating in the IWRM Capacity Needs Assessment for the Caribbean (CEHI, 2007) lacked an adequate stock of skills to effectively manage their respective water resource endowments. This problem was found to be gravest in the Eastern Caribbean States. The CEHI assessment confirmed that human resource development is a major concern in the water sector, with limited training and research programmes at the tertiary level to meet the identified training needs. Available training opportunities were found to be limited to short courses in one or two aspects of water resources management. The CEHI assessment identified the main obstacles to the development of capacity for IWRM in the region as:

- Limited interest in training programmes by persons involved in IWRM;
- Limited enrolment in the training programme;
- Insufficient financial resources to undertake the programme;
- Difficulty in finding trained personnel to act as instructors and/or tutors.

These findings have implications for the design of effective capacity development initiatives for strengthening national and regional environmental indicators mechanisms in support of IWCAM.

Where training is provided, the newly acquired knowledge, skills, and capacities make the trained individuals more marketable. Consequently, they move on to other agencies and organizations, both internally and externally. The end result is that trained individuals may not remain in their positions long enough to fully implement skills learned on the job or to train others. The impact of the loss of trained personnel is illustrated in Barbados, where an extensive GIS database was developed by the Environmental Management and Land Use Project with support from the IDB. Although human resource capacity has been developed within the GIS community, the high rate of staff turnover has hampered plans to establish a dedicated cadre of GIS personnel in the country (CEHI, 2007).

An illustration of human capacity gaps in watershed/water resources management and coastal areas management is provided by the assessment of current human resources in relation to Trinidad and Tobago's future requirements in these areas. Capacity (additional skills) needs were identified in 16 areas (Table 16), consistent with the complexity of integrated watershed and coastal areas management. The analysis demonstrated the existence of gaps between current and required staffing levels in most of the technical areas. While all of these areas are not essential for the development of an IWCAM indicators mechanism, it illustrates some of the deficiencies in human capacity that is often faced by the PCs. Specific capacity development strategies were suggested and ongoing training was identified as an additional capacity development need for professional and technical staff. The requirements of smaller PCs may differ substantially from those of larger PCs, where the staff complements of government agencies tend to be smaller than those of the larger PCs, creating an even

greater challenge to cover all of the skills sets required for effective watershed and coastal areas management, and indicators development and use.

Capacity development in support of indicators development and use, data analysis, data storage, and reporting must be supported by training that is relevant and that prepares professionals for the emerging trends in technology development. Advances and changes in technology and in the structure of water and waste water operations were seen as having growing implications for human resources development, with available human resources, particularly at the technical level, likely to be largely untrained or under-trained (CWWA, 2003).

IWCAM-related monitoring and indicators capacities, proficiencies, and staff complements vary greatly among PCs. Human resource constraints in these areas might be addressed by adopting a regional or sub-regional model for the coordinated pooling and/or sharing of trained staff with the assistance of the thematically appropriate regional and/or inter-governmental agency (Box 2). Strategically there is a need for a regional approach to the development of a cadre of trained professionals to support the thrust towards integrated watershed and coastal areas management, including appropriate indicator mechanisms. This will involve the development and introduction of continuing development programmes for professionals in collaboration with a range of partners, including but not limited to CARICOM, CEHI, CIMH, UNEP CAR RCU, UWI (CERMES, Centre for Marine Studies - CMS), in conjunction with international organizations (e.g. UNDESA) and national environmental, public utilities, and statistical agencies. The approach should be based on the thematic elements that contribute to IWCAM, with each thematic area coordinated and supported by a designated institution or group of institutions with demonstrated capacities and expertise.

Table 16: Skills gap analysis for watershed/water resources and coastal zone management in Trinidad and Tobago (Gov't Trinidad & Tobago, 2001)

Job Title	Nos. Required	Nos. Available	Deficit (Surplus)
Hydrologist	8	3	5
Land Use Planner	2	0	2
Water Resources Engineer	2	0	2
Coastal Zone Engineer	3	0	3
Irrigation Engineer	1	0	1
Oceanographer	3	0	3
Geologist	2	0	2
Ecologist	3	0	3
Compliance Lawyer	2	0	2
Watershed Specialist	2	0	2
Water Economist	2	0	2
Communication Engineer	1	0	1
Environmental Specialist	3	0	3
GIS Specialist	1	0	1
Geological Assistants	2	0	2
IT Specialist	2	2	0
Hydrological Technicians	30	42	(12)

Box 2. Collaborative Solutions to Capacity Constraints

A number of precedents exist for this collaborative approach to meeting technical and human resource needs. For a number of years the Barbados CZMU provided technical assistance to OECS countries in the area of coastal zone management through a formal agreement, which is still in place.

To address capacity constraints in OECS countries the GEF-funded CPACC Project designated the CMS at UWI, Jamaica, as a technical support node to provide assistance to participating countries (Bahamas, Belize, Jamaica) in coral reef monitoring and the processing of the monitoring data. In 2007 the CMS expanded this model of technical support under the Mainstreaming Adaptation to Climate Change (MACC) Project to include the OECS. A number of options have been considered to address deficiencies in capacity to service and maintain the 18 sea-level/hydro-meteorological monitoring stations established 1998 in 12 participating CARICOM countries under the CPACC project. A specially trained technical support team comprising Senior Instrumentation Technicians from Belize, Jamaica, and CIMH was formed to assist in inspections, repairs, and the submission of status reports. Consideration has been given to designating one of the stronger national meteorological services in the OECS as the technical support node to other OECS countries for the purpose of maintaining the sea-level monitoring stations and recovering stored data. The CIMH and CCCCC would provide oversight and back-up support to the designated entity.

5.2.5 Data and information

An effective IWCAM indicators framework must be accompanied by supporting data and information as well as appropriate data and information management and analysis systems and mechanisms to calculate, review, and revise the indicators on a continuous basis. As previously mentioned, a number of initiatives have been undertaken in the region to improve environmental statistics. The main agencies involved in data collection and storage include the Central Statistical Offices and government ministries and agencies, laboratories, universities (national, regional, international), national research institutes (e.g. IMA), and regional bodies (e.g. UNEP CAR RCU, CEHI, CARICOM). Data are also collected through a number of programmes such as CARICOMP and Reefcheck, using standard methodologies for which training is provided to persons involved. Environmental statistics have not previously received high priority, as the focus had been on socioeconomic statistics, for which relatively good datasets are available for the PCs. Furthermore, environmental indicators and statistics have been historically more readily available for the terrestrial environment (e.g. forests) and for meteorological parameters than for the aquatic environments. The fisheries sector is an exception as government fisheries departments have traditionally demonstrated a culture of data collection and analysis, with fisheries datasets spanning periods of up to 30 - 50 years in the PCs.

A pivotal factor determining the ability of institutions to address environmental reporting and national policy development issues are the availability of adequate social, economic, and environmental information for planning and decision-making. The key impeding factors to the compilation of environmental statistics and environmental-economic accounting programmes were determined to be the availability and quality of data (UNSD/CARICOM, 2000). This is underpinned by a number of contributing factors including: lack of agreement on a standard list of environmental indicators on which to focus data collection efforts; absence at national and regional levels of a policy-defined demand for environmental data and indicators, as well as of the actual mechanisms that allow data to be used in decision-making processes and the lack of understanding of the value of such data in decision-making processes; and the fragmented and overlapping institutional mandates for environmental management.

National policies for coordinated environmental data collection or national development policies supported by explicitly identified environmental performance indicators are rare. As a result monitoring and data collection have been poorly funded and undertaken on an *ad hoc* basis. The required human and financial resources are usually inadequate, and the absence of national data management and coordinating mechanisms severely compromise the capacity of government agencies to efficiently retrieve and exchange data and information. National capacities for monitoring and systematic observation vary with country, national agency, and the environmental component or natural resource being monitored. There is insufficient knowledge on how to extract and manage environmental data in ways that are productive for decision-making. The large data gaps and lack of time-series data have hampered efforts to track IWCAM-related issues, identify emerging problems, assess policy options, and gauge policy effectiveness.

Baseline environmental statistics were found to be lacking in most of the countries, with fundamental gaps in environmental datasets still present. The data situation is similar in the PCs: some relevant data and information are available but usually scattered across various agencies, including research and academic institutions whose data do not enter the country's data archives. Due to a lack of coordination and collaboration among these agencies and in some cases proprietary and confidentiality factors, these data are not easily accessible. Moreover, lack of standard methodologies for data collection has resulted in often inconsistent and incompatible datasets. An important issue relate to the quality control of data to ensure data reliability and accuracy. Where extensive time-series datasets do exist the data tend to be stored in analogue or hard-copy formats. Data handling and processing procedures have not kept pace with changes in computer technology, data management, and decision support applications. Furthermore, even existing datasets may not be properly described, that is, metadata and metadata standards are often lacking in the Caribbean. As a result, institutions often do not know what datasets exist or are held by others. This was confirmed by the GIS capacity assessment, which found contradictions amongst institutions as to what datasets are held and by whom.

The above is well-illustrated by the situation regarding the land-use datasets in the PCs, as revealed by the GIS assessment: Available land-use datasets in all the countries were outdated and most of the existing digital datasets lack metadata. In general, there has been no infrastructure determined for standards, copyright, or ownership, and no strategy had been developed for GIS use, sharing, and cost recovery in the region. An assessment of the nine countries involved in the FAO Lesser Antilles Pelagic Ecosystem Project found the geo-referenced data was fragmented, poorly documented, and often limited in distribution.

Some countries have taken steps to promote environmental data availability and coordination. For instance, the Dominican Republic has recently introduced a law that requires all relevant government ministries and agencies to submit data to a centralized system. The development of the GEF-IWCAM Project Information Management System, which includes a clearing house mechanism, databases (including indicator node), and possibly web GIS, is being considered. A number of capacity strengthening initiatives for environmental data and information have been undertaken in the region, as mentioned above.

5.2.6 Technology

As previously mentioned, the limited availability of comprehensive environmental data and information is partly as a result of the failure to ensure that data collection, handling, and processing procedures keep pace with changes in technology and decision support applications. Various national and foreign agencies contribute to field data collection and remote sensing. It is recognized that in order to obtain accurate and timely data, a significant financial investment would be required for transfer of technology and training, accompanied by appropriate mandates and policies. A number of constraints still exist throughout the region. The majority of the data in long time-series data sets were

collected prior to the widespread availability of relatively inexpensive computer capacity. As a result, a substantial proportion of time-series data is stored in analogue (hard copy) formats such as computer cards, data cards, data sheets, or data log books. For instance, approximately 70% of the region's meteorological data is stored in data cards. The human, technical, and financial capacities required to digitize these data records is substantial. In the absence of a comprehensive and coordinated programme of data transfer and recovery, the analogue storage format presents a barrier to data use and exchange.

The rapid increase in institutional capacity to develop and downscale climate change scenarios and models to the sub-regional and national levels has created a significant demand for computer memory. Medium- and long- term decision-making in support of IWCAM can no longer rely solely on historical meteorological trend data, and climate change scenarios and models are essential for the assessment of climate change impacts on environmental, economic, and human systems. Whereas the CIMH has excess capacity for storing modeling outputs, the two UWI departments involved in scenario development and modeling (Physics Department in Jamaica, and Mathematics and Computing Department in Barbados) have limited storage capacity.

Full benefit has not been taken of developing technological infrastructure for information management. Where technological advances have been embraced, challenges remain in the development of coordinated data networks and data exchange due to incompatibilities in technology arising from the proliferation of diverse computer systems and software programmes, and decision support applications. Capacity development must be supported by changes in the way data is managed from collection though archiving and dissemination. An information management system that encourages continued updating/uploading of quality data is necessary.

The development of technical and human resource capacity does not guarantee the technology and associated decision support system or database will facilitate the process of IWCAM monitoring. For instance, the national Coastal Resource Information Systems (CRIS) and associated human resource capacities developed by the CPACC Project between 1998 and 2001 have not realized the goals of widespread application within the countries and often only serve as static sources of data.

Much of the data relating to IWCAM has a strong spatial component and GIS capabilities are important in managing and utilizing this information. All the PCs have some capability for GIS, mainly related to land use. In the majority of cases the introduction of Caribbean government agencies to GIS technology has been driven by donor-funded technical assistance projects. A project funded by the Canadian International Development Agency for the OECS countries provided funding exclusively for hardware and software with little if any investment in training and data development. The provision of hardware and software without the requisite capacity development has given rise to instances in which GIS equipment has remained unused for prolonged periods. The FAO Lesser Antilles Pelagic Ecosystem Project found that there was limited maintenance of GIS capacity in the nine participating countries, as manifested by

stagnant databases, non-functioning equipment, and limited GIS analyses undertaken, partly as a result of GIS not being fully incorporated into the workflow of the institutions concerned.

A number of spatial data information and GIS initiatives have been undertaken in the Caribbean at both the regional and national levels, with varying degrees of success. The processes being guided by the GEF-IWCAM project probably represents the most comprehensive regional initiative focused specifically on environmental issues. The project has taken a strategic approach to the regional development of GIS capacity as a tool for integrated data analysis and management for watershed and coastal management with the goal of incorporating GIS technology in the various components of the IWCAM project. Given the cross-cutting nature of IWCAM this would require the expansion and use of GIS in all participating countries.

To this end the IWCAM Project commissioned an assessment of GIS capabilities in the PCs. The capacity needs assessment examined the functions, procedures, products, data, tools, and human resources available in national agencies and used this information to determine GIS and Information and Communications Technology requirements in relation to the performance of the functions of the agencies (CEHI, 2007). The assessment formed the basis for the formulation of a Caribbean GIS Road Map. For further information on the outcomes of this assessment see the GEF-IWCAM project website (www.IWCAM.org).

There is reluctance to create a central repository of GIS data in some of the countries. Several of them have probably not yet considered the setting up of such an agency as decision-makers often do not understand the value of the tool. GIS application is often driven by one or two individuals or units for very specific purposes. Few countries realize the benefits that a more coordinated approach, such as a central repository or unit, might have. As such, it is often difficult to justify the cost of setting up a new agency.

5.2.7 Financial resources

The lack of financial resources has been identified as one of the two most common impeding factors in the development of both environment statistics and environmental-economic accounting programmes (UNSD, 2007). This assessment is supported by the national reports prepared for the GEF-IWCAM project and the survey conducted under this study. Furthermore, indicators mechanism have not historically been built into programmes and projects (but this is changing), and as a result, budgetary allocation for this type of activity is often not provided.

Government funding for natural resource management has traditionally been inadequate. With government revenues in many of the Caribbean SIDS being eroded by the loss of preferential markets and rising fuel and energy costs, this situation is unlikely to change, and will probably become more acute. A substantial proportion of the funding to support IWCAM initiatives in the Caribbean is provided through projects and donor-

funded initiatives. The limited government funding to support IWCAM initiatives may require agencies to develop capacities to financing IWCAM programmes and activities through donor-funded projects. This will require considerable knowledge of, and familiarity with the complex procedures and performance criteria of donor agencies. Countries have resorted to a number of measures to deal with funding constraints. For instance, in a number of countries such as Trinidad and Tobago data and information are being collected through project-funded contracts with private consultants. This type of arrangement has the potential to further divert capacity and resources away from the continuous, programmatic approach to data collection, with data acquisition opportunities becoming more project-specific and uncoordinated, and data holdings being disbursed among various agencies, institutions, and/or ministry departments. The PCs are often recipients of various funds that cover technical assistance and other components on a project basis, but there is generally a lack of sustainable institutional capacity building and human resources development, and limited implementation of the projects' recommendations.

While the funds that are made available to government agencies with IWCAM-related responsibilities tend to be sufficient to maintain staff levels, they may not meet the costs of implementation. In St. Vincent and the Grenadines government funding for the Environmental Services Unit (CCD National Focal Point) forms part of the budgetary allocation to the Ministry of Health and the Environment. More than 75% of budgetary allocations cover staff salaries, leaving minimal funding for project design, implementation, and evaluation.

The sectoral approach to the allocation of natural resource management responsibilities has adversely affected the financial capacity of government agencies to effectively undertake and discharge natural resource management responsibilities. In Antigua and Barbuda the fragmentation of responsibilities for the CCD-related activities precluded the targeted budgetary allocation of funds to address land degradation issues. Although the budget line items of several government agencies were intended to fund activities related to the prevention of land degradation, only a fraction of the funds allocated to non-salary expenditure was received. Similar reasons were given for the delays experienced by the Forestry Unit and the Environment Division in initiatives for reforestation, further development of the national database, and environmental capacity building.

The capacity survey undertaken in this study revealed that data collection and management activities identified in the annual budgets and work plans of responding organizations received varying levels of financial support from their respective governments (Tables 17 and 18). The following is a summary of the survey findings:

Data collection, processing, and analysis: The majority of respondents indicated that although data collection, processing, and analysis were identified in annual work plans and budgets, funding and staffing compliments were inadequate. The exceptions were the IMA and the EMA in Trinidad and Tobago and CERMES. The EMA reported that funding and staffing levels were adequate. In the case of the IMA, funding for monitoring

was considered to be adequate but staff compliments were considered to be inadequate. Both funding and staffing in support of data processing and analysis were considered to be adequate. In the case of CERMES data collection, processing, and analysis activities were not considered in its annual work plan and budget. However, adequate funding and staff compliments were available to undertake these activities. The situation described in the survey response from CERMES was the converse to that described in the majority of survey responses.

Data storage and access: The majority of the respondents reported that data storage and access were identified in work plans and budgets, but were constrained by inadequate funding and staffing. The exceptions were the EMA and NEPA, which reported both adequate funding and staffing for this area.

Maintenance of observational monitoring equipment: The EMA, NEPA, and the Water Resources Authority of Trinidad and Tobago were the only respondents that reported adequate staffing and funding in support of the maintenance of observational monitoring equipment.

Purchase of equipment and software: With the exception of the EMA all respondents reported inadequate funding for the purchase of monitoring equipment; software and technological aides for the processing and analysis of data; and the development and maintenance of data storage and retrieval systems. The EMA reported adequate financial and human resources in all areas except the development and maintenance of data storage and retrieval systems for which both financial and human resources were considered inadequate.

Table 17. Summary of survey responses: Financial support for data collection and management

Question	DR	REG	JA	SKN	SVG	TT	TT	TT	TT
CAPACITY FOR ANALYSIS – Financial Support	Ministry. Environment & Nat. Resources	CERMES	NEPA	WATERSERVICES DEPT	FORESTR DEPT.	DNRE	EMA	IMA	WRA
Are the monitoring, data-collection and sample-collection activities performed by your institution:									
o identified in the annual work plan and budget	Y	N	Y	Y	Y	Y	Y	Y	Y
o adequately funded	N	Y	N	N		N	Y	Y	N
o supported by adequate staff complements	N	Y	N	N		N	Y	N	N
Are the data (or sample) -processing, -analysis, and - reporting activities performed by your institution:									
o identified in the annual work plan and budget	Y	N	Y	N		Y	Y	Y	Y
o adequately funded	N	Y	N	N		N	Y	Y	N
o supported by adequate staffing complements	N	Y	N	N		N	Y	Y	N
Are the data storage and acquisition[2] activities of your institution:									
o identified in the annual work plan and budget	Y	N	Y	N	Y	Y	Y	Y	Y
o adequately funded	N	Y	Y	N	N	N	Y	N	N
o supported by adequate staffing complements	N	Y	Y	N	N	N	Y	N	N
Is the maintenance of observational or monitoring equipment:									
o identified in the annual work plan and budget	Y	N	Y	Y		Y	Y	Y	Y
o adequately funded	N	Y	Y	N		N	Y	-	Y
o supported by adequate staffing complements	N	Y	Y	N		N	Y	-	Y
Is the purchase of observational or monitoring equipment									

[2] Data Acquisition: the purchase of data sets (raw data, model outputs), remotely sensed imagery (aerial photographs, satellite imagery).

Question	DR	REG	JA	SKN	SVG	TT	TT	TT	TT
○ identified in the annual work plan and budget	Y	N	Y	Y		Y	Y	Y	Y
○ adequately funded	N	Y	N	N		N	Y	N	N
○ supported by adequate staffing complements	N	Y	N	N		N	Y	N	N
Are the purchase of software, and technological aides for processing and data analysis:									
○ identified in the annual work plan and budget	Y	N	Y	Y		Y	Y	Y	Y
○ adequately funded	N	Y	N	N		N	Y	N	N
○ supported by adequate staffing complements	N	Y	N	N		N	Y	N	N
Is the development and maintenance of data storage and retrieval systems (hard copy or digital):									
○ identified in the annual work plan and budget	Y	N	Y	N		Y	Y	Y	Y
○ adequately funded	N	Y	N	N		N	N	N	N
○ supported by adequate staffing complements	N	Y	N	N		N	N	N	N

Table 18. Summary of survey responses: Constraints to monitoring and data management

CAPACITY FOR ANALYSIS	DR	REG	JA	SKN	SVG	TT	TT	TT	TT
	Ministry. Environment & Nat. Resources	CERMES	NEPA	WATERSERV ICES DEPT	FORESTR DEPT.	DNRE	EMA	IMA	WRA
Is the quality of monitoring/observation/data collection affected by:									
○ human resource constraints	Y	N	Y	Y	Y	Y	N	Y	Y
○ inadequate training	Y	N	Y	Y	Y	Y	N	Y	Y
○ funding constraints	Y	N	Y	Y	Y	Y	N	Y	Y
○ equipment constraints	Y	N	Y	Y	Y	Y	N	Y	Y
○ technology constraints	Y	N	Y	Y	Y	Y		Y	N
Is the quality of the analysis affected by:									
○ data constraints	Y	N	Y	Y		Y	N	Y	Y
○ human resource constraints	Y	N	Y	Y		Y	N	Y	Y
○ inadequate training	Y	N	Y	Y		Y	N	Y	Y
○ funding constraints	Y	N	Y	Y		Y	N	Y	Y
○ equipment constraints	Y	N	Y	Y		Y	N	Y	Y
○ technology constraints	Y	N	Y	Y		Y	N	Y	Y
Is the quality of storage/archiving and processing affected by:									
○ data constraints	N	N	Y	Y		Y	N	N	N
○ human resource constraints	Y	N	N	Y		Y	N	Y	Y
○ inadequate training	N	N	N	Y		Y	N	Y	Y
○ funding constraints	Y	N	N	Y		Y	N	Y	Y
○ equipment constraints	Y	N	N	Y		Y	N	Y	Y
○ technology constraints	Y	N	N	Y		Y	N	N	Y
Is the quality of reporting affected by:									
○ data constraints	Y	N	Y	Y		Y		Y	Y
○ human resource constraints	Y	N	Y	Y		Y		Y	Y
○ inadequate training	Y	N	Y	Y		Y		N	N
○ funding constraints	Y	N	Y	Y		Y		N	Y
○ equipment constraints	Y	N	N	Y		Y		N	N
○ technology constraints	Y	N	N	Y		Y		N	Y

6. GROUNDTRUTHING EXERCISES

6.1. Dominican Republic

Interviews: The agencies visited and persons with whom discussions were held are shown in the table below. In addition, a number of publications were examined (Table 19). The consultant, Sherry Heileman (SH) also had a courtesy visit with officials of UNDP.

Table 19. Agencies and persons interviewed in the Dominican Republic

Ministry	Official and Department
Ministry of Environment and Natural Resources	Ernesto Reyna Alcantara, Head, Gestion Ambiental, Subsecretario, Soil and Water (GEF-IWCAM National Focal Point, CCD Focal Point)
	J. Felipe Ditrén Flores (GEF-IWCAM Technical Focal Point) Director, Environmental Quality, Subsecretariat of Environmental Management
	Juan Alcantara, Deputy Head, Dept. of Project Formulation and Planning
	Patricio Devers, Head, Dept. Environmental Statistics
	Silmer Gonzalez Ruiz, Head, Dept. of Research
	Miguel Espinosa, Environmental Auditing
	Nina Lysenko, Director, Conservation and Management, Subsecretariat of Coastal and Marine Resources
	Victor Viñas Nicolas, Evaluator, Dept. Soil and Water
Ministry of Public Health and Social Assistance	Lic. Luis Roa, Director General, Environmental Health
UNDP (DR)	Sixto J. Inchaustegui**,** Maria Eugenia Morales

Major findings

Agencies responsible for natural resources and environment

1. Ministry of Environment and Natural Resources (Secretaría de Estado de Medio Ambiente y Recursos Naturales. http://www.medioambiente.gov.do/cms/

In the Dominican Republic the major responsibility for environmental and natural resources management, and for IWCAM, lies with the Ministry of Environment and Natural Resources (Secretaría de Estado de Medio Ambiente y Recursos Naturales - SEMARN). Within this Ministry, there are six principal departments or Subsecretariás with responsibility for: environmental quality, water and soils, forestry, protected areas and biodiversity, coastal and marine resources, and education and environmental information (Table 20). In addition, a number of agencies are involved in land management (Table 21). Each agency has its own data collection system, and basically works individually, although they are moving towards greater collaboration and sharing of data and information. One of the GEF-IWCAM pilot projects is being conducted in the Dominican Republic, specifically within the Haina River Watershed.

Table 20. Ministries and departments responsible for natural resources, and their major functions in the Dominican Republic

Sub-secretariats	Major Functions
Soils & Waters	Formulates and directs the soil and water national policy regarding its normative use and management; Establishment of rural communities' participation in plans, projects, and programmes on watershed management; CCD National Focal Point.
Forest Resources	Collaborates in the formulation of the country's forestry policy; Plans the establishment of commercial forestry plantations; Evaluates, approves, and monitors private forestry management plans.
Environmental Quality Management	Ensures that human activities are in accordance with regulations on established environmental quality criteria; Implementation of prevention and mitigation system on natural disasters; UNFCCC National Focal Point.
Biodiversity & Protected Areas	Coordinates the design and application of the national policy on development of protected areas and the country's biological diversity conservation; Development and application of the norms, regulations, and procedures for sustainable management of protected areas and the biodiversity; Manages the national protected areas system.
Coastal & Marine Resources	Establishment of the national marine and coastal policy; Establishment of the necessary base and coordination for an adequate use and management of the coastal and marine zones; MARPOL National Focal Point.
Environmental Education & Information (Directorate)	Promotes the national environmental policy among the various sectors, through educational and cultural programmes; Establishes the environmental education policy; Generates and analyzes environmental and natural resources geospatial information.

Table 21. Institutions involved in land management in the Dominican Republic

Institutions	Areas of intervention and relevant issues
Environment and Natural Resources Secretariat	Policy and Strategic orientation, Soil, Water, Forest, Biodiversity, etc; Awareness Campaigns.
Agriculture Secretariat	Production, Planning, and Trade - Agricultural sector
Secretariat for Economics, Planning, and External Cooperation, formerly the Technical Secretariat for the Presidency and the National Planning Office	Economic and social planning; Annual national budget development; Zoning and mapping; Land use planning, norms and regulation.
Public Works, Transportation and Communication Secretariat	Public works, Mines, Energy
Finance Secretariat	Public finances and taxation
Women's Secretariat	Gender Issues
Education Secretariat & Higher Education , Science & Technology	Education, research and extension
Public Health & Social Assistance Secretariat	Public health and sanitation
Foreign Relations Secretariat	International Environmental Conventions, Joint Bi-national Commission
Superior Land Tribunal	Land - Legal Matters
General Directorate for Frontier Development	Sustainable development activities along DR-Haiti frontier
National Institute for Hydrological Resources	Water works infrastructure and regulations; Water resources management: dams, rivers, canals, etc.
National Meteorology Office	Weather parameters, forecasts, etc.

Among the legal mandates of SEMARN is the development of a free-access information system on the environment and natural resources. In 2000, the same law that created this Ministry also established a National System of Information on the Environment and Natural Resources. All Government Departments are legally mandated to contribute data to this system. Further, in 2004, the law related to Free Access to Public Information was established.

Since 2002 the Ministry has been engaged in an initiative under the Economic Commission for Latin America and the Caribbean (ECLAC) REDESA project to develop a system of sustainable development indicators for the country. The objective of this project was to strengthen the production of social and environmental statistics in the Latin American and Caribbean countries. The Dominican Republic has also been engaged in developing environmental indicators under the UNEP Global Environment Outlook project for Latin America and the Caribbean (GEO LAC).

National environmental statistics for a large number of environmental indicators are available on the Ministry's website (www.medioambiente.gov.do/cms/index.php?option=com_mosforms&Itemid=278). The Dominican Republic has published a number of reports and data products, including:

- The publication in 2004 by SEMARN of a compendium of 108 environmental and socio-economic variables for the country (see list below). Where available, time series of data are presented, although some discontinuities exist, and in many cases, geographical coverage is limited. A number of these variables are of relevance to IWCAM indicators (e.g. related to fresh water, forest cover, land degradation, coastal water quality, marine natural living resources, etc).

- Publication of a compendium of indicators of environmental sustainability of hydrological resources (2000 – 2005) in 2006. This was the first product of the National System of Indicators of Hydrologic Resources, under the System of Indicators of Sustainable Development. The compendium covers the sub-themes: watershed management, administration and availability of potable water, and water quality.

- National environmental profiles have been published (in 1981, 2001, 2002), under the sponsorship of USAID. (www.usaid.gov/dr/docs/resources/dr_environment_assessment092001.pdf). These reports include data on a number of indicators under various themes (soils and land use, water resources, forests, coastal and marine resources, biodiversity and protected areas, environmental quality in urban and industrial sector, institutions and regulatory framework). Although time series data are presented for some of the indicators, discontinuities exist and geographical coverage is limited.

- Atlas of Environmental Statistics (2004).

2. Secretaría de Estado de Salud Publica y Asistencia Social (Ministry of Public Health and Social Assistance)

   This Ministry has a national monitoring programme for a number of variables, for example, water quality in recreational beaches, lakes, and rivers (e.g. under the Blue Flag programme, chemical and biological parameters are monitored on 10 beaches around the country); potable water; contamination of food and beverage, particularly

in imported products; chemical residues in agricultural produce and incidence of poisoning; milk and dairy products along the production chain; contamination in fish and meat.

3. Instituto Nacional de Recursos Hidráulicos (Institute for Hydrological Resources)

The national water resources development agency monitors water quality and quantity, and has a water quality monitoring programme, which was launched in 1997, to systematize water quality measurement. This agency makes wide use of GIS and satellite data. There is a project for management of watersheds and coastal areas.

International Frameworks

The Dominican Republic is party to a number of multinational environmental agreements - MEAs (Table 1), under which there are initiatives to develop and use appropriate indicators for monitoring and reporting purposes. The country also contributes national level data to global efforts, for example, sustainable development indicators to UNCSD (through annual questionnaire), UNDP Human development Report, WHO/UNICEF Status of Health and Sanitation in LAC, FAO fisheries statistics, etc.

Monitoring activities

Programmes for regular monitoring and with wide geographical coverage are limited to those for potable water and public health. In most other cases, data are collected on a project basis (datos punctuales); projects are geographically localized and limited in duration.

Monitoring activities at the national level include:

- Potable water quality, in which a number of variables are monitored (refer to Table 14);
- Coastal water quality in tourist areas (e.g. Punta Plata). A number of biological and chemical variables are monitored;
- Hydrological resources;
- Public health (see above);
- Environmental auditing: a number of standards have been established for industries and urban treatment plants, as well as for agriculture. SEMARN conducts environmental auditing of industries, treatment plants and agricultural activities, in which checks are carried out for compliance. A programme to monitor heavy metals is being developed.

There are recommended parameters for monitoring of beaches, but these are not implemented. Ecosystem criteria for monitoring of coastal ecosystems using a standard set of indicators have been developed (using standards established by CARICOMP and the AGGRA programmes), but monitoring is not conducted on a regular basis. In fact,

most of the data collection is project-based, and lack continuity. A CARICOMP site was located in the Dominican Republic, but this is no longer in existence. A Reefcheck proposal has been developed for coral reef monitoring, but has not been implemented.

Capacity

A number of relevant capacity building initiatives have been undertaken in the country. Among these have been support to develop and implement an environmental indicators system from UNECLAC REDESA and GTZ; development of environmental indicators under the GEO-LAC project; and environmental accounting under UNSD. Capacity for GIS is well developed in the country. As described above, a significant amount of data on a large number of indicators of relevance to IWCAM already exists in the country.

A number of constraints regarding capacity for environmental (and IWCAM) indicators exists. These include:

- Limited human capacity, including qualified persons;
- Sporadic training opportunities;
- Inadequate financial resources, although national fund for the environment and natural resources is in existence;
- Limited laboratory facilities and lack of accreditation of existing laboratories. For instance, samples for agricultural chemicals have to be sent to Puerto Rico for testing;
- Limited technical capacity, especially for air and water quality;
- Absence of a committee at the national level for developing indicators;
- Poor implementation of indicators and monitoring system at the national level;
- Limited sharing of data among agencies (although this is improving).

Documents and website reviewed

Estadísticas Ambientales de América Latina y el Caribe. Caso: Republica Dominicana. Secretaria de Estado de Medio Ambiente y Recursos Naturales, 2004.

Indicadores de sostenibilidad ambiental del recursos hídricos en la Republica Dominicana 2000 -2005. Secretaria de Estado de Medio Ambiente y Recursos Naturales, 2006.

Republica Dominicana. Objetivo Desarrollo del Milenio Numero 7: Garantizar la Sostenibilidad Ambiental. Evaluación d necesidades para la Republica Dominicana. Metas 9 a 11. Secretaria de Estado de Medio Ambiente y Recursos Naturales, 2006.

Environmental Atlas 2004. Secretaria de Estado de Medio Ambiente y Recursos Naturales

SEMARN website: http://www.medioambiente.gov.do

Summary

The Dominican Republic has a number of initiatives to develop indicators and a programme for environmental statistics is in place. In fact, the country has produced significant sets of environmental data on a wide number of indicators, and has produced several important publications and data products. Based on discussions held during this exercise and publications and products examined, this country has a significant base for the further development and implementation of IWCAM indicators. Nevertheless, existing indicator mechanisms are not fully implemented at the national level, and data collection and monitoring are sporadic, except for a few areas such as fresh water and issues related to public health. Much of the studies and data are in the form of surveys and inventories of natural resources, without regular and continuous monitoring of trends using a standard system of indicators, except for resources such as fresh water and fisheries landings. This is attributed to limited human, financial and technical capacity.

Indicator frameworks and data collection are aimed at national priorities as well as to contribute to global initiatives and frameworks. These indicators are used for policy decisions, to help focus projects to investigate or address particular problems or issues, for instance related to achieving the MDGs. However, the need was recognized to have greater linkage between environmental indicators and decision-making. The view was expressed that efforts should focus on using existing indicators and strengthening the related methodologies. Moreover, indicators must be linked with ongoing efforts and national priorities, and with existing global frameworks such as MEAs and MDGs.

6.2. Barbados

Interviews:

- Ministry of Environment: Travis Sincler, Senior Environmental Officer, Amrikha Singh, Environmental Officer
- Statistical Department: Victor Brown, Senior Statistician
- Environmental Protection Department: Anthony Headley, Deputy Director
- Coastal Zone Management Unit: Angélique Brathwaite

Major findings

The elements of a national indicators mechanism are present in the form of institutions and their respective mandates, their monitoring activities, as well as a list of national indicators. There are instances of semi-formal agency-to-agency arrangements for the coordination of monitoring activities and the sharing of data. An enabling environment is required to formalize and extend these arrangements to encompass and coordinate the environmental monitoring activities of all the government agencies. The creation of such an enabling environment appears to be a national objective. The impetus to make this objective a reality may be provided by a project to develop the capacity of the Barbados Statistical Service (BSS) and update existing legislation.

Systematic data collection and monitoring is undertaken to inform the planning and decision making processes as they relate to health, coastal development, planning, infrastructure investment and design, and land use. Technical capacity and expertise is of a high caliber. For the CZMU, the size of its staff complement has posed a challenge to sustaining long-term coastal monitoring programmes. However, the challenge has been overcome by establishing collaborative partnerships with UWI and the Bellaire Research Laboratory. Similar partnerships among government agencies have provided opportunities for coordinated monitoring and data collection, and data and information sharing. These arrangements have in turn reduced duplication of effort.

A number of challenges exist for the development of a national indicators mechanism in this country (Box 3).

Box 3. Challenges to the development of a National Indicators Mechanism

The main issues thwarting the coordinated production, management, and dissemination of statistics in Barbados include: (i) weak legal framework; (ii) insufficient coordination among governmental agencies that produces statistical data; (iii) inadequate timeliness and quality of data, particularly in the social field, but also in the economic area; (iv) insufficient experienced staff; (v) outdated technical infrastructure; and (vi) difficulties for the public, businesses, and government to access relevant statistics and information.

Agencies and monitoring programmes

IWCAM-related responsibilities and activities are vested in a number of government agencies (Table 22). The types of data collected by the various agencies in Barbados are shown in Table 23.

The Environmental Protection Department (EPD) and the Barbados Water Authority (BWA) conduct a joint groundwater quality monitoring programme. Sampling is conducted monthly at 22 potable supply and nine agricultural supply wells. Groundwater samples are analyzed for 25 chemical parameters and three bacteriological parameters and are compared with the WHO Drinking Water Quality Guidelines. Near-shore water quality is monitored at 18 beaches on the north and south coasts on a weekly basis. The samples are analyzed for *enterococci* and *faecal coliform* at the Sir Winston Scott Polyclinic Laboratory and should conform to the standards of the proposed Marine Pollution Control (Discharge) Regulations. Package and municipal wastewater treatment plants are monitored periodically for biochemical oxygen demand, biochemical oxygen demand removal rate, total suspended solids, and volatile suspended solids.

The Solid Waste and Hazardous Substances Section monitors and regulates the solid waste management and government-operated solid waste disposal sites. This Section was developed with the aim of improving the regulation of solid waste management. The Integrated Solid Waste Management Programme is a coordinated effort by a number of Government agencies and the private sector to protect the environment,

improve the standard of public health in Barbados, and foster the participation of the private sector in a structured manner.

The BSS was established in June 1956 and reports to the Ministry of Economic Affairs and Development. In 1958 the Statistics Act was passed, empowering the BSS to conduct any census in the country; to collect, compile, and publish statistics in a wide array of topics; and to coordinate the statistical activities of other government agencies. There is no specific reference to environmental data, although some relevant data may be captured under agriculture, fisheries, health, and land-use. Much of the data and statistics of national importance are produced by government agencies other than the BSS.

Table 22. Institutions responsible for land, soil, water, and coastal resources in Barbados (FAO, 2001).

Institution		**Responsibility**
Town and Country Planning Department		Overall responsibility for development applications guided by the Physical Development Plan
Ministry of Agriculture and Rural Development	Crops Section	Food crops and floriculture; plant/foodstuff quarantine at air & sea ports
	Fisheries Division	Fisheries resources
	Soil Conservation Unit	Scotland District conservation; landslide and erosion mitigation; Forestry
	Meteorological Department	Meteorological forecasting
	Analytical Services Lab.	Soil, plant, water analysis
	Pesticide Control Board	Agrochemical import certification
	Quarantine Unit	Sanitary and phytosanitary certification
	Land and Water Use Unit	Hydrology and agro-meteorological data; irrigation extension and agronomy
	Extension section	Crop husbandry advice and extension
Ministry of the Environment, Energy and Natural Resources	Environmental Unit	Environmental policy and international treaties; environmental education
	Coastal Zone Management Unit	Coastal area management
	National Conservation Commission	Parks and beaches; Marine Museum Underwater Park Caves of Barbados
	Energy Division	Mined resources and energy
Ministry of Health	Environmental Protection Division	Water quality; hazardous waste disposal
	Solid Waste Unit	Landfills and solid waste disposal
Barbados Water Authority		Assessment, development, management, licensing of water resources; potable water supply; Bridgetown sewage treatment plant
Barbados Agricultural Development and Marketing Corporation		Government irrigation water supply schemes
Barbados Agricultural Management Company		Manages sugar lands for Government
Lands and Surveys Department		Cartography, map production
Educational institutions	Barbados Community College	Associate degree in Agriculture
	SJP Polytechnic	General
	Caribbean institute for Meteorology and Hydrology	Certificates in meteorology and hydrology

Table 23: Types of data collected by various institutions in Barbados and their GIS capability (FAO, 2001)

PARAMETER MONITORED	Land and Water Use Unit	Soil Conservation Unit	Meteorological Department	Barbados Agric. Dev. & Marketing Cooperation	Barbados Agricultural Management Company	Barbados Water Authority	Coastal Zone Management Unit	Environmental Eng. Div.	Caribbean Institute for Hydrology & Meteorology	Private plantations	Environmental Unit	Town and Country Planning Department
Rainfall (total)	✓	✓	✓		✓	✓			✓	✓		
Rainfall intensity		✓							✓			
Wind speed	✓		✓						✓			
Sunshine									✓			
Temperature & humidity	✓		✓						✓			
Evaporation	✓	✓							✓			
Groundwater abstraction	✓	✓		✓		✓						
Groundwater quality	✓	✓		✓		✓		✓				
Spring/stream flow rate		✓										
Spring/stream water quality		✓					✓					
Established GIS		✓				✓	✓				✓	✓

Currently the BSS consists of four divisions: trade and national accounts, business surveys, census and household surveys, and socioeconomic statistics. The national objective is for the Statistical Department to serve as the central repository for national statistics. This function would extend to the responsibility of the BSS to securing, compilation, processing, and reporting of environmental data and/or statistics. This objective may be addressed through the creation of a 5th subject matter division, or by incorporating responsibility for environmental statistics into an existing division. Some elements related to the capacity of the BBS are shown in

Box 4. Barbados Statistical Service

Human Resources

In order to meet current commitments and obligations as well as to position itself to fulfill the expanded role envisaged under the vision of the Green Economy the capacities, competencies and experience of the BSS staff needs to be developed in the areas of the collection, processing, and timely provision of statistical information to support and facilitate improved results-based policy and decision-making, and management for green development in Barbados

The inability of the BSS to provide competitive salary limits the ability of the BSS to retain some qualified personnel, whose technical skills make them highly marketable. As a result the turnover of staff at the BSS is high. This has implications for the maintenance of technical capacity, institutional memory, operational continuity, and inter-agency collaboration and coordination. The situation is compounded by the lack of good opportunities for career advancement through training and capacity development.

Technical Infrastructure

The computer equipment and statistical software being used by technical staff with the responsibility of producing the statistical information is several years old and requires replacement or updating. Available technologies need to inform and be incorporated into the institutions data collection, management, analysis, and reporting processes. This includes, but is not limited to the use of GIS for managing, geo-referencing, querying, analyzing, and reporting statistical information. There is also need for an appropriate system for data backup and storage. In addition, the BSS does not have the equipment necessary to create digital maps that would allow the institution to improve the use of its data for social programs targeting.

Given the objectives of the IDB project to strengthen the BSS (IDB, 2006) and the of the goals of the Green Economy and Fiscal Proposals of the Government of Barbados (Government of Barbados, 2007), a data management network will be required for the BSS to coordinate, access and use the statistics and indicators produced by the various government agencies. This will in turn require the establishment of data standards and formats, protocols, and mechanisms for effective and efficient data sharing and access.

A Clerical Officer has been assigned to follow up on activities identified for completion under the UNSD/CARICOM project on environmental statistics. In the post-project period the Statistical Department is depending on the Ministry of Energy and the Environment to undertake the data collection necessary to generate the environmental statistics. The intention of the Statistics Department is to develop a unit to deal with environmental statistics. The capacity requirements for such a unit have not been defined. It is anticipated that these and other details related to the establishment and operation of a unit for environmental statistics will be addressed under the IDB project “Modernization of the Barbados Statistical Service”, designed to support the improvement in the availability of gender and environmental related statistics, which is expected to come on stream in 2008.

There are formal and informal arrangements for coordinating monitoring activities and sharing monitoring data on an agency-by-agency basis. The EPD shares data on groundwater quality with the BWA and data on coastal water quality with the CZMU. However there is no national umbrella mechanism for coordinating monitoring activities and data sharing and management (Box 5). Certain surveys required to generate statistics for the BSS are not conducted by line ministries on a regular basis. The BSS experiences difficulty in collecting information from the various agencies involved in data production. There is a lack of priority in certain agencies for collection of data that may be deemed relevant to national needs. As a result line-ministries tend not to provide the BSS with operational statistics in a timely manner. Most information used by the BSS is

provided on demand or on a case-by-case basis (IDB, 2006). There is a lack of consistency in the statistics that are produced, each agency having its own standards, methodologies, definitions, and procedures. This situation confounds timely, efficient collection, processing and dissemination of high quality data and indicators.

Box 5. Challenges to coordinated reporting of environmental statistics

The long-term vision to institutionalize the management and reporting of environmental statistics began with the participation of the Statistical Department in the UNSD/CARICOM project to develop capacity to generate social environmental statistics and indicators. In the process of compiling data for the publication "CARICOM Environment in Figures 2002", the Statistical Division became increasingly involved in the collection and compilation of environmental statistics from government agencies. The Statistical Department requests environmental agencies to provide environmental statistics in specific formats based on specifications provided by the CARICOM Secretariat. Some of the requested datasets were provided. The operational links established during the UNSD/CARICOM Project were not sustained because the statistical department did not have the human resources in the post-project period to support the ongoing collection, compilation, and processing of environmental statistics for reporting purposes.

Although environmental statistics are not officially reported, the 2007 Budget (Economic and Financial Policies of the Government of Barbados 2007) presents *Green Economy and Fiscal Proposals* which speaks to the notion of a green economy underpinned by a philosophy of putting Barbados on a sustainable economic growth pattern that incorporates prudent environmental management principles. A task force has been created with representatives from the Ministries of Finance, Economic Affairs and Development, and Energy and the Environment to develop targets and indicators of Green Economics and of Sustainable Development to be published in the annual reports of the Central Bank and of the Ministry of Economic Affairs. The indicators will be internationally acceptable, objective, and technically sound, and will be applied to the activities of all Barbadian private and public enterprises. The relevant indicators mechanisms in Barbados were identified and assessed under the UNCSD testing programme coordinated by UNDESA. The assessment is documented in the report "Selections of Indicators for Sustainable Development for Barbados" (Singh, 1999). A total of 133 indicators were evaluated: economic (6), Environmental (88), institutional (9), and social indicators (30).

6.3. St. Vincent & The Grenadines

Interviews

- Ministry of Environment and Health: Neri James, Senior Health Officer, Vector Control Division
- Ministry of Environment and Health: Dr. Duncan, CHO
- Ministry of Environment and Health: Michael Bachas, CMO
- Forestry: Cornelius Richards, Deputy Director, Forestry Division; Fitzgerald Providence, Amos Glasgow, Bradford Lather

Major findings

There are limited examples of IWCAM-related data collection and monitoring in this country, although systematic data collection and monitoring have been established for environmental health. Data collection and monitoring in the non-health sectors tends to be sporadic and project driven. The placement of the small (two technical staff members) Environmental Unit in the Ministry with responsibilities for health may have led to environmental issues being overshadowed by health priorities. Communication within and among government agencies has been identified as a major obstacle to effective and coordinated monitoring.

The prospects of a formal overarching mechanism for coordinating IWCAM-related data collection and monitoring seem remote. The small number of players and the limited activity and capacity in this area presents an opportunity for establishing a modest, coordinated IWCAM-related indicators mechanism among the agencies. This would serve as a road map to guide, the development of enabling environment, institutional strengthening, capacity development, and donor assistance.

The small size of the OECS countries permits consensus changes to be promulgated quickly. The precedent for rapid and effective joint action and harmonization within the OECS suggests that the mainstreaming of IWCAM might be approached more effectively on a sub-regional level rather than on a country-by-country basis. It has been pointed out that there are a number of coordination issues that need to be addressed. The suggestion has been made that an advisory mechanism (Advisory Board) might usefully guide and facilitate this process.

A senior person interviewed suggested that St. Vincent and the Grenadines might be 10 years behind Barbados in capacity for effective natural resources management and monitoring. Given the progress that Barbados is making in the direction of establishing a coordinated national environmental statistics mechanism, the opportunity exists to formally share this experience for the purpose of developing a detailed road-map adapted to the needs and conditions of St. Vincent and the Grenadines. A precedent for this type of collaboration exists in the form of technical assistance in coastal zone management, provided by the Government of Barbados to the countries of the OECS, through the Barbados CZMU.

Agencies and monitoring programmes

IWCAM-related responsibilities and activities are vested in a number of government agencies:

The Public Health Department of the Ministry of Environment and Health monitors coastal water quality near two recreational beaches, three estuarine coastal locations, and one off-shore location. Monitoring tends to be reactive rather than programmatic or systematic, and is conducted upon request. A significant contributing factor to the responsive, haphazard nature of the monitoring response is that no government agency

has formal responsibility for coastal water quality monitoring. Monitoring activities that are undertaken are not linked to any MEA or protocol

The Vector Control Division has the capacity to monitor temperature, pH, salinity, heterotrophic plate count, and total and fecal coliform concentrations. Field-kits for water quality monitoring had been recently acquired to monitor ph, ortho-phosphate, ionic conductively, conductivity, total dissolved solids, temperature, salinity, resistivity, and dissolved oxygen. However, no person has the skills, or has been trained to use the recently acquired water quality field kits. There is no programme with personnel dedicated for environmental monitoring. While there are 12 environmental health Officers with wide ranging duties, but no specific training in IWCAM-related monitoring. As a result of this situation the task of monitoring falls to the Senior Environmental Health Officer.

The Central Water and Sewage Authority (CWSA) and the Public Health Department of the Ministry of Health both collect data on the quality of potable water for distribution. Sampling is conducted by the Ministry eight times/month in each of 10 Public Health Districts for the measurement of residual chlorine and detection of faecal coliform bacteria. The CWSA carries out independent controls on water quality, particularly at strategic points in the water distribution system. The CWSA reports its findings to the CHO of the Ministry of Environment and Health. There are no standards for potable and recreational water quality in the country's legislation although WHO guidelines are used. Water quality analysis is conducted by the Bureau of Standards.

The Fisheries Division's primary monitoring activity is in the area of fish stock assessments, which are conducted in collaboration with CRFM. Coral reef monitoring is project driven. The Division comprises six units (Biology and Research, Quality Assurance, Product Development, Conservation, Data Management, Extension, and Public Education and Outreach). The biological data that is collected is primarily fish catch data and coral reef condition data. There are 10 sites throughout the country that have been monitored on an annual basis since 2004 using the Reefcheck methodology. The Sustainable Grenadines Project has supported Reefcheck surveys at two locations. The designated coastal conservation areas are not managed because of limited personnel.

The Forestry Division is authorized to establish and manage forest reserves. Under the Wildlife Protection Act the Forestry Division receives authority to manage flora and fauna. However, the Act focuses primarily on the St. Vincent Parrot as opposed to wildlife in general. The Forestry Division considers "Forestry" to encompass all resources within the forest and not just the trees. The Forestry Division also collects IWCAM-related data on forest cover. The Division tracks deforestations, performs trend analyses, and monitors forest fires, particularly in the dry season. Records are kept of fire occurrence and acreage damaged. A monthly report on deforestation incidents and trends is produced. Forest plantation data is collected on the location of forest plantations, management prescriptions, and sales. Under the Watershed Management Project, the Forestry Division conducts critically important stream monitoring for turbidity

and stream flow. The Forestry Mapping and Inventory Unit is responsible for data management and day-to-day analysis of forest cover and deforestation data. The Unit has four professional GIS staff members.

The National Land Information (NALIN) Project serves as a repository for geophysical data on land coverage. A JAICA volunteer has been involved in a project to identify and map critical habitats for endemic species, geographic spread, and spatial overlap of ranges and critical habitats. This information will be incorporated into the NALIN database.

***Capacity Development Initiatives, Gaps, and Needs*.**

Capacity Development Initiatives

Coral Reef Monitoring for Climate Change Adaptation
Under the Mainstreaming Adaptation to Climate Change (MACC) Project executed by the CCCCC a regional capacity development and monitoring initiative in support of climate change adaptation planning. The project began as a sub-regional pilot project in 1999 under the CPACC Project. The lessons learned from this project have been applied to the extended regional programme of capacity building and systematic monitoring. A programmatic approach has been taken to the development of technical capacity and the provision of technical assistance to support in-country coral reef monitoring through the pooling of regional expertise.

Forestry Development Project
The Forestry Development Project was a five-year capacity development initiative, jointly supported by Canadian International Development Agency (CIDA) and the Government. The objective of the project was the strengthening the Forestry Department's capacity to formulate plans, implement policies and administer forestry programmes also involving the communities in the development and implementation stages. The public education component was designed to allow for the development of a people-centered approach to forest planning and management.

Integrated Forestry Management Project
The Integrated Forest Management and Development Programme was developed to spearhead the sustainable management of forest resources to ensuring protection of the nation's water supplies, eco-tourism potential, biodiversity, and forest livelihoods. The programme was established to address three major issues; the alarming rate of deforestation from legal and illegal agricultural activities; the loss of coastal forest for urban and other development; ineffective approach to enforcement against illegal agricultural activities in the forest; and the negative impact of global economic changes rural livelihoods.

Other Projects include:

- *Sustainable Integrated Development and Biodiversity Conservation in the Grenadines Islands (SVG and Grenada) Project*: The purpose of this project is to

develop a participatory co-management framework for integrated sustainable development and to implement those parts of the plan associated with the environment and the use of marine resources;
- *Integrated Watershed Management Project*: This is a joint effort between farmers in the Montreal and Majorca catchment area, the Forestry Department and the OECS National Resources Management Unit to maintain farming below the 1,400 ft contour and to reforest and protect denuded areas.

Capacity Needs

A coordinated review process is needed to address the challenges to effective monitoring resulting from insufficient staff, insufficiently trained staff, and poor intra- and inter- institutional communications and coordination, and scarce funding.

- A review of national IWCAM-related data needs
- A ministry-by-ministry review of IWCAM-related data needs and the related human resources and capacity requirements.
- A review and rationalization of the collective monitoring, human resource and training needs.
- Establishment of an advisory mechanism for overseeing and coordinating IWCAM-related parameters monitoring activities among government agencies.

Documents Reviewed

- St. Vincent and the Grenadines Report to the Regional Consultation on SIDS-Specific Issues (Culzac-Wilson, 2003);
- Irrigation water management in St. Vincent and the Grenadines: Viable or vulnerable? (Bons and Simon, 2005);
- National Report of St. Vincent and the Grenadines to the CCD (2002);
- The Conservation of the St. Vincent Parrot and the Integrated Forest Management and Development Programme (Providence, 2003);
- St. Vincent & The Grenadines Environmental Management Strategy and Action Plan 2004-2006 (Homer and Shim, 2004);
- Stabex ’94, St. Vincent and the Grenadines Water Resources Management Consultancy Draft Terms of Reference (Bons and Simon, 2005).

7. CONCLUSION

In the Caribbean SIDS, IWCAM is still in its infancy, although a number of these countries have Integrated Coastal Zone Management initiatives, or separate management programmes and plans for coastal areas and watersheds, or for natural resources. Available information in the IWCAM national reports prepared for this GEF-IWCAM project suggests that the countries do not have monitoring programmes and indicators mechanisms specifically linked to IWCAM initiatives, although a number of them plan to or have been developing indicators within other frameworks (e.g. National Sustainable Development Strategies; National Biodiversity Strategy and Action Plan,

National Environmental Action Plans), and under international frameworks (e.g. MEAs and MDGs), which are pertinent to IWCAM. The review revealed the lack of a suite of well-established and standard indicators, with few exceptions, for almost all the themes included in this study, both within and among countries. Where indicators are in use, it was not clear if or how these are used in goal setting and adaptive management. Nevertheless, while the development and use of indicators is not implemented within an IWCAM framework, in all the countries a large number of indicators exist, and environmental observations, data and information are collected, albeit generally in an inconsistent and sporadic manner (except for themes such as freshwater resources), that could be used as a baseline to develop IWCAM indicators.

Much of the data that are useful for developing IWCAM indicators are compiled by regional or international organizations, which often makes them easily available through online databases and also adds value through synthesis and analysis. In most cases, these organizations simply use information provided by the countries; if countries lack an adequate baseline, report infrequently, or base their figures on estimates, the data may be quite unreliable. In addition to those regional and international institutions with a mandate to compile environmental information, there has been an explosion in the number of “independent” international databases on a range of environmental parameters, and much of these data are available through the Internet. These data and information relate mainly to social and economic sectors, as well as environmental or ecological state of natural resources such as freshwater, fisheries, coral reefs, mangroves, and forests.

Despite the constraints to data collection and management faced by the PCs, data are available for a significant number of IWCAM-related indicators. While time series of data exist, there are discontinuities; geographic coverage is also limited, and information is outdated. Much of the data have been collected on a project basis, and as a result are intermittent. The best established monitoring programmes in all the countries are for potable water (although there are wide disparities among the countries in the number of variables monitored and in geographic coverage), rainfall, and fisheries landings.

All participating countries demonstrate some level of capacity to undertake environmental monitoring activities and to process and report the findings. As observed in the results of the groundtruthing exercise and the results of the survey, capacities varied considerably among PCs in various areas, which include but are not limited to:

- Enabling polices and legislation for natural resources management and environmental data management;
- Institutions mandated to manage the environment and natural resources;
- National statistics programmes and institutions;
- Environmental monitoring and data-collection programmes;
- Environmental data processing, management mechanisms and programmes;
- Environmental reporting mechanisms in government agencies, research and teaching institutions, inter-governmental organizations, and international agencies;

- National development policies that identify environmental statistics as measures of performance.

The countries have been engaged in a number of capacity building initiatives for environmental statistics, and are increasingly aware of the need for developing and implementing a system of environmental indicators. Progress has been disparate, however, with the larger countries and/or those with the required resources being more advanced than the others. Opportunities should be explored for bringing all these indicator initiatives under a common, well-coordinated framework or mechanism. A number of the PCs have advanced indicators initiatives, and could assist the other PCs in developing indicators frameworks. A suite of standard, robust indicators could help to focus data collection efforts, avoid the dispersion of effort on less meaningful data and *ad hoc* data collection, and better inform decision-making. Indicators should be linked to clearly defined goals and objectives, which themselves are sometimes not clear or explicitly stated. There is a need to sensitize all stakeholders (especially decision-makers) on the need for and utility of indicators.

The development of policy-relevant core indicators must be driven by national needs, capacities, and priorities. There is a practical challenge that countries might perceive in moving from the seemingly conceptual exercise of formulating indicators to applying indicators in the national development context. A way of overcoming this challenge is the recognition of the fact that countries are already collecting and using environmental data that can serve as indicators. The transition from data collection to indicators development and use is dependent on adoption of adaptive management practices that require indicators of effectiveness.

One of the next steps should be the development of national indicators templates based on the data that is already being collected within each country. The national indicators templates could serve as the focus and point of departure for national capacity development workshops designed to promote awareness and understanding of indicators concepts and benefits, and the adoption and further development of a national indicators template and mechanism. An indicators template should be seen as an opportunity to identify a small, manageable suite of essential indicators to inform sustainable national development. Countries should have the ability to choose indicators based on specific goals and objectives. Indicators must be mainstreamed into decision making-processes. Countries must decide if the issue of indicators should be brought to the political level, and how this could be accomplished.

The development of environmental indicator mechanisms in the PCs is feasible and achievable despite the apparent challenges. The success of implantation will be dependent on the recognition within the countries of the benefits of the mechanism in the critical support that it will provide to adaptive management processes. Commitment to the IWCAM process will accelerate progress and efficiency in data collection, monitoring, data analysis, data management and reporting, in the various sectoral and thematic areas.

In conclusion, there are a number of ongoing initiatives within the PCs and at the regional and international levels to develop indicators mechanisms and to strengthen the required capacities. Moreover, a number of the PCs already have good capacity for indicators. This means that there is already a substantial basis in the region to provide the momentum for developing IWCAM indicator mechanisms and the required capacity in the PCs, which should be fully taken advantage of.

8. RECOMMENDATIONS

The following recommendations focus on development of national indicators templates in the PCs and strengthening capacity for developing and using indicators in the region (including human capacity, training, data and monitoring, institutional mechanisms, etc). Recommendations arising from the GEF-IWCAM indicators workshop (March 2008, Ocho Rios, Jamaica) are incorporated in these recommendations (see workshop report). It is recognized that developing indicator mechanisms and mainstreaming of indicators into national development and natural resources/environmental management processes will be a long-term, iterative process with a number of components related to such aspects as selecting appropriate indicators, aligning indicator mechanisms with national development process and national/regional goals and priorities, development of requisite capacities, undertaking appropriate legal/policy/institutional arrangements and reforms to ensure that the indicator mechanism is implemented and sustained, mobilizing resources, etc.

While the recommendations below are not arranged in any order of priority, they are presented according to suggested timeframes for their implementation. These timeframes, however, should be flexible, in view of the different priorities, needs, and capacities of the PCs:

i). Short-term (ST): Recommendations that should be implemented within the first two 2 years. These focus on development of national indicators templates, i.e. selection of the indicators based on national needs, goals, objectives, and capacities; and developing human and institutional capacities;

ii). Medium to long-term (MLT): Recommendations that should be implemented within 5 years and beyond. These also include systemic and institutional aspects that should underpin the indicator mechanisms.

National indicator mechanisms (ST)

1. *Create awareness and commitment at all levels*:
   - The national indicators mechanism development process might best be initiated and supported by a series of national/regional workshops, designed to develop awareness, commitment, and action at the national level, through a participatory processes of consultation, conceptualization, and planning. This should involve medium to high level government officials to seek the necessary institutional commitments and allocation of resources necessary to ensure effective

coordination, data sharing, and integration. Key stakeholders from governments, economic sectors and others should also be involved.

2. *Develop national indicators templates*:
   - National indicators templates (using the template developed under this activity and other resources) should be developed, based on existing indicator frameworks and ongoing initiatives in the PCs and regional and international levels, as well as on data already being collected within the country. This will require the identification of existing environmental monitoring initiatives and the environmental indicators that are currently being used and reported.
   - The national indicators template should be country-specific rather than Project-specific in order to ensure that the initiatives and mechanisms developed under the GEF-IWCAM project are sustained after the project has ended. National indicators mechanisms must be linked to the overarching national policy framework comprising well-defined national goals and objectives, and should be designed to address priority issues, needs, goals and objectives at the national (or even local) and regional levels, and clearly defined environmental management goals and objectives. In addition, as far as possible, indicators should be also linked to regional and global objectives and targets, which would enable countries to report to several environmental frameworks using the same sets of indicators.
   - It is critical to include indicators that specifically monitor the pressures and the conditions of the natural resource environment or ecosystem in which the specific activities of the project or IWCAM programme take place, that is, an ecosystem-based approach should be used for developing the suite of indicators, using an integrated, multi-sectoral approach. An appropriate framework (e.g. DPSIR) could help structure the indicator template.
   - These indicators should be administratively practical and cost-effective to populate, as well as SMART[3]. To be efficient and useful the indicator framework should build on existing systems, target a few key specific and representative indicators that can be confidently used to deliver robust assessments of the impact generated by the project, as well as to be used in the post-project period for monitoring, evaluation, and adaptive management.

3. *Pilot testing of indicators*:
   - A national indicators mechanism can be developed incrementally from a pilot scale initiative designed to integrate and make operational the basic elements of the indicators mechanism. Pilot testing of a set of core indicators in one of the PCs with more advanced indicators mechanisms, to be determined in consultation with the IWCAM indicators working group, should be undertaken. This activity could also build capacity and generate lessons for replication in

[3] There is a so called "SMART" concept of indicators:
Simple (easily interpreted and monitored); Measurable (statistically verifiable, reproducible and show trends); Accessible (regularly monitored, cost effective and consistent); Relevant (directly address issues or agreed objectives, such as those of the Matters for Target for biodiversity conservation), and Timely (provide early warning of potential problems).

other PCs. The pilot project will allow the vertical integration among the various stakeholder agencies to be tested and made operational at a manageable scale, creating demonstrable achievements and benefits with a minimum of institutional change or legal and policy formulation. The low institutional and political "cost" of participating in the pilot project will allow the benefits of the mechanism to be demonstrated without requiring immediate major institutional change, a barrier in its own right.

Monitoring, data, and information (ST – MLT)

1. *Development of monitoring programme (ST)*:
   - Once the national indicators template is developed and agreed, a minimum environmental monitoring programme in support of the indicator framework should be developed. This would include an evaluation of existing monitoring programmes, methodologies, data collected, institutional arrangements, and existing and required capacities.
   - Existing data should be used as a baseline for the monitoring programme. Each country would determine the appropriate baseline, depending on the theme and data availability.
   - Determine the cost of such a monitoring programme, and identify possible sources of funding.

2. *Implementation of the monitoring programme* (MLT)
   - Appropriate institutional arrangements, roles and responsibilities agreed and mechanisms developed for coordinated implementation of the monitoring programme at national level.
   - Implementation of the monitoring programme, possibly using a phased approach.

3. *Data and information*:
   - Develop national/regional inventories of environmental data holdings (e.g. of government, private-sector, tertiary education institutions, research facilities), records, statistics, indicators, and relevant reports. Use existing metadata records (e.g. CPACC Coastal Resources Inventory Project) to jump-start ongoing national data inventory and catalogue processes. The countries, in collaboration with relevant partners, could work on the preparation of a meta-database and protocol for sharing of and access to information (ST).
   - Establish national and regional data recovery strategies to recover historical data-sets that are stored in non-digital formats or that are at risk of being lost. Funding for the recovery of strategically important environmental data would be required. Initiate coordinated regional data recovery and data mining initiatives through regional and intergovernmental agencies (MLT).
   - Establish a centralized data management system for environmental data and indicators, including centrally coordinated national data networks (MLT).
   - Explore options for establishing national and regional protocols for collection, exchange and sharing of environmental data and information. PCs should identify key partners and explore options for entering into arrangements with

relevant regional and international organizations and programmes to collect, compile, and analyze data for each indicator. They should also enter into dialogue with data providers/owners on access to required data (ST– MLT).

- Countries should work towards developing nationally and regionally consistent and compatible frameworks of environmental statistics, as appropriate. This is an essential step towards enabling the countries to share data and information and to make progress in addressing common issues. A harmonized system within and among PCs would allow for effectively acquiring comparable data and comparative assessments and for the sharing of tools, expertise, and other resources; this would allow efforts to be more cost effective and efficient (MLT).

Capacity (ST - MLT)

1. *Identification of required capacity*:
   - The systemic, institutional, financial, and human resources and capacities required for developing, monitoring, and reporting on the selected indicators need to be identified. This will also include an evaluation of existing capacities, skill sets, capacity gaps and deficiencies, etc. (ST).
   - Capacity of decision-makers, in so far as understanding the need for indicators and their application in decision making processes and adaptive management, should also be evaluated, with a view to strengthening this capacity (ST– MLT).

2. *Capacity development*:
   - Identify training opportunities at regional/international levels in the support areas for environmental indicators development and environmental statistics, and develop a strategic plan to address the human resource deficiencies and constraints (ST).
   - Identify and document existing capacities in the PCs and at sub-regional and regional levels (ST).
   - Develop appropriate training programmes in environmental monitoring and indicators development and use in consultation with stakeholders, technical agencies, and regional and national tertiary teaching institutions. More focused training should be provided on indicators (with appropriate partners) using existing data and case studies and building on existing capacity strengthening initiatives in the region. Training should also include concepts of monitoring and evaluation and application of indicators (ST– MLT).
   - Develop collaborative solutions (national and regional) to capacity development and the sharing of technologies, laboratory facilities, expertise, and human resources, including for participatory monitoring and mapping. This would include technical assistance through the coordinated pooling and sharing of technical expertise, formal education at the secondary and tertiary levels, short courses, skills training, staff secondments and exchanges, internships, creation of a cadre of trained personnel, pooling of human resources, etc. The assistance of the appropriate regional and/or inter-governmental agency (e.g. UNEP CAR RCU, CEHI, CIMH, UWI, CCCCC, CARDI) would be invaluable in the conduct of these initiatives (MLT).

- Document and share best practices and achievements in the development of environmental monitoring programmes and environmental indicators mechanisms development (SL –MLT).
- Convene national workshops/seminars on indicators to inform decision-makers and set up decision support systems (ST –MLT).

Systemic and institutional levels (MLT)

- Mainstream IWCAM into national decision-making processes, and environmental and natural resources management.
- Rationalize institutional mandates and responsibilities related to indicators development and environmental monitoring. This would include more efficient institutional modalities in support of national indicator mechanisms.
- Establish an inter-institutional, multi-sectoral mechanism at the national and ultimately at the regional level (within the appropriate regional entity) to coordinate the indicator mechanism, including monitoring, data analysis, and reporting.
- Enact policies and legislation to create a national environmental indicators mechanism, and that require relevant agencies to submit environmental data and statistics to the designated national data repository and/or statistical agency.
- Review and revise the statistics legislations in the PCs within the constraints of the confidentiality provisions, to allow National Statistical Authorities to submit data at appropriate levels of detail to the CARICOM Secretariat on a timely basis in support of a research and analytical programme at the regional level and of regional negotiations.
- Review and rationalize governmental environmental monitoring and indicators development responsibilities in the areas of management, monitoring, data collection, data processing, reporting, and evaluation with a view to facilitating targeted budgetary allocations for the implementation of the indicator mechanism.
- Establish sustainable institutional and financial mechanisms to support and coordinate capacity development within and among PCs. National governments should identify modalities and mechanisms for ensuring funding at levels proportional to the environmental monitoring and indicators responsibilities and resource requirements of respective institutions.
- Develop mechanisms to integrate information provided by the indicators into decision- making processes at all levels, and to facilitate adaptive management. This would include incorporating quantifiable environmental objectives and indicators in national development strategies.

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ANNEXES

ANNEX 1. Questionnaire distributed during conduct of desk study

Global Environment Facility-funded
Integrating Watershed and Coastal Areas Management in Caribbean Small Island Developing States (GEF-IWCAM) Project

INDICATORS MECHANISM ASSESSMENT – SURVEY

Survey Objectives:

1. To identify existing IWCAM indicator frameworks and monitoring mechanisms at national (and regional) levels;
2. To identify gaps in IWCAM indicator frameworks and monitoring mechanisms;
3. To identify and quantify the existing national human and institutional capacity for indicators monitoring;
4. To identify the national human and institutional capacity building needs for indicators monitoring.

Instructions:

This questionnaire is in two parts: Part 1 is related to objectives 1 and 2; and Part 2 to objectives 3 and 4. All Sections may not apply to all respondents. Please provide information/data in relevant sections. Please mark with 'X' where appropriate and provide the required responses/information in the allotted spaces (or 'NA' where information not available). Additional rows may be added as required. Where information is unavailable, indicate by 'NA'. All information provided would be used to fulfill the above stated objectives.

Please return completed questionnaire to *sh_heileman@yahoo.com* and *walling.leslie@gmail.com by* ***July 6, 2007****.* You can contact Vincent Sweeney, Regional Project Coordinator (vincent.sweeney@unep.org) or Sasha Beth Gottlieb, Technical Coordinator (sgottlieb@cehi.org.lc) of the GEF-IWCAM Project Coordinating Unit for any clarification.

Thank you for your time and cooperation in completing this questionnaire. Without your response, the objectives of this component of the project would not be fully met.

The information provided will be used in a regional report and will be treated with a high level of discretion.

Questionnaire - PART 1
Indicators and monitoring mechanisms assessment.

1. GENERAL INFORMATION

Country
Agency/organization & type (e.g. government)
Mailing address
Respondent/designation
Email address
Telephone No.
Fax No.
Website
Instant Message (e.g. Skype) user name

2. MAJOR LAND USE/ ACTIVITIES IN WATERSHED & COASTAL AREAS

[1]Rank in order of importance from 1-5, with 1 being the most important.
[2] List indicator used (if any). Add more rows as needed.
[3]Indicate the monitoring frequency, e.g. once per year.
[4]Indicate agency/institute responsible for monitoring.
[5]Indicate title of any relevant studies/reports and where available.

Land Use/ Activity	Rank[1]	Indicator[2]	Monitoring frequency[3]	Responsible agency[4]	Additional information; Major studies & reports[5]

Others (specify)

3. *SOCIO-ECONOMIC STATUS* (to be supplemented by Table 2)

Parameter	Indicator	Monitoring frequency.	Responsible agency	Additional information; Major studies & reports

Others (specify)

4. ENVIRONMENTAL STATUS INDICATORS.

These indicators demonstrate environmental/natural resources status. They are usually 'static' snapshots of environmental conditions at a given point in time, and are usually reported against a baseline year and level to show change/improvement.

[1]Each parameter may have a number of indicators – add more rows as needed. **The actual value of the indicator is not required**.
[2]Location of monitoring sites – rivers, coastal areas, etc.
[3]Baseline year and level against which indicator is reported to show change.
[4]Hypothetical example.

Parameter	System	Indicator[1]	Monitoring frequency	No. & location[2] of monitoring sites	Baseline year; level[3]	Responsible agency	Additional information; Major studies & reports
Water quality.	Rivers. Coastal/ marine water. Groundwater.						
Water volume/flow.	Rivers. Groundwater. Rainfall.						
Soil/sediment.	Rivers/land. Coastal areas.						
Liquid waste.	Rivers/land. Coastal areas						
Solid waste.	Rivers/land Coastal areas						
Air quality							
Ecological status	Forest Land (degradation) Coral reefs Mangroves Sea grass beds Beaches Biodiversity Threatened species Algal blooms/ red tides Sea level Sea surface temperature Others (specify)						
Natural resources	Fisheries Diseases in marine organisms Fish kills Contamination of						

animal tissue.
Deforestation
Groundwater abstraction (potable & irrigation)

Others (specify)

[3]Industrial Pollution Projection System

5. STRESS REDUCTION INDICATORS

These indicators characterize and quantify specific reductions in environmental/water resources stress (e.g. reduction in pollutant releases, improved freshwater flows). Like Environmental Status indicators, Stress Reduction indicators are usually reported against a baseline year and level to show change/improvement.

[1]In absence of a specific indicator, simply state 'yes' or 'no' to show whether or not these measures have been implemented.

[2]Hypothetical example.

Parameter	**Indicator[1]**	**Baseline year; level**	**Responsible agency**	**Additional information; Major studies & reports**
Sustainable fisheries practices				
Sustainable agriculture practices				
Increased reforestation				
Improved freshwater flows				
Improved solid waste collection/disposal				
Reduction in liquid waste pollution loads				
Increased industrial cleaner production technologies.				
Increased waste reduction/recycling programmes				
Reduced releases of pollution to groundwater recharge zones				
Reduction of point source pollution				
Reduction of non-point source pollution				
Improved air emission controls				
Increased ecosystem restoration				
Improved conservation/protection of land resources				
Improved conservation/protection of marine living resources				
Reduction in introduction of invasive species				
Others (specify)				

6. PROCESS INDICATORS

These indicators establish regional or national frameworks/conditions for improving environmental and natural resource status in the watershed and coastal areas, but do not in and of themselves deliver stress reduction or improved status (e.g. reformed legislation does not reduce stress or improve the aquatic environment until it is actually implemented/enforced).

Process indicator.	**Yes**	**No**	**Additional information; Major studies & reports**
Is there high-level political commitment to improving the status of watersheds and coastal areas?			
Is development guided by land use/and or land use zoning plans?			
Have Integrated Water Resources Management Plans been implemented?			
Have fisheries management plans been implemented?			

Are incentives provided for sustainable agriculture?
Are incentives provided for sustainable fisheries?
Are incentives provided for sustainable water use?
Have the relevant multilateral environmental agreements been ratified (indicate which ones)?
Are there environmental education programmes?
Are there institutionalized processes for stakeholder participation in watershed & coastal areas development & management?
Have responsible agency/institute/committees, etc. been established?
Has the country adopted specific water, environment, or sector-related legal reforms, policies, institutions, standards, and programmes to address the priority issues related to watershed and coastal areas development & management?
Are there effective or improved implementation, surveillance and enforcement related to watershed and coastal area management?
Are there economic instruments for environmental and natural resources management (e.g. pollution and water use tariffs, taxes, etc)?
Is there an environmental/water quality monitoring programme?
Is there valuation of natural resources/ecosystems?
Others (specify)

Questionnaire - PART 2
Institutional and human capacity assessment

Question	YES/NO	Status/ Comment
7. CAPACITY FOR ANALYSIS – SYSTEMIC		
Are the monitoring, data-collection and sample-collection activities performed by your institution:		
○ identified in the annual work plan and budget?		
○ adequately funded?		
○ supported by adequate staff complements?		
Are the data (or sample) -processing, -analysis, and - reporting activities performed by your institution:		
○ identified in the annual work plan and budget?		
○ adequately funded?		
○ supported by adequate staffing complements?		
Are the data storage and acquisition[4] activities of your institution:		
○ identified in the annual work plan and budget?		
○ adequately funded?		
○ supported by adequate staffing complements?		
Is the maintenance of observational or monitoring equipment:		
○ identified in the annual work plan and budget?		
○ adequately funded?		
○ supported by adequate staffing complements?		
Is the purchase of observational or monitoring equipment		
○ identified in the annual work plan and budget?		
○ adequately funded?		
○ supported by adequate staffing complements?		
Are the purchase of software, and technological aides for processing and data analysis:		
○ identified in the annual work plan and budget?		
○ adequately funded?		
○ supported by adequate staffing complements?		
Is the development and maintenance of data storage and retrieval systems (hard copy or digital):		
○ identified in the annual work plan and budget?		
○ adequately funded?		
○ supported by adequate staffing complements?		
8. CAPACITY FOR ANALYSIS - INSTITUTIONAL		
Which unit within your institution is responsible for monitoring, data collection, or observation?		
Which unit within your institution is responsible for data analysis and reporting?		
Is the quality of monitoring/observation/data collection affected by:		
▪ human resource constraints?		
▪ inadequate training		

[4] Data Acquisition: the purchase of data sets (raw data, model outputs), remotely sensed imagery (aerial photographs, satellite imagery).

Question	YES/NO	Status/ Comment
▪ funding constraints?		
▪ equipment constraints?		
▪ technology constraints		
▪ Other?		
Is the quality of the analysis affected by:		
▪ data constraints?		
▪ human resource constraints?		
▪ inadequate training		
▪ funding constraints?		
▪ equipment constraints?		
▪ technology constraints		
▪ Other?		
Is the quality of storage/archiving and processing affected by:		
▪ data constraints?		
▪ human resource constraints?		
▪ inadequate training		
▪ funding constraints?		
▪ equipment constraints?		
▪ technology constraints		
▪ Other?		
Is the quality of reporting affected by:		
▪ data constraints?		
▪ human resource constraints?		
▪ inadequate training		
▪ funding constraints?		
▪ equipment constraints?		
▪ technology constraints		
▪ Other?		

The following matrix has been developed to gather information on the type of activities that your institution undertakes and the level of capacity (numbers of individuals, training and skills levels) available to undertake these activities. In order to capture the maximum amount of information with the minimum number of questions, a combination of activities has been compiled to cover a reasonably wide number of disciplines:

e.g. ***"Species assessment and monitoring"*** might be an activity that is undertaken in the course of coral reef assessment, fish catch monitoring, invasive species monitoring, and biodiversity mapping.

e.g. **"Mapping"** might relate to invasive species distributions, ecosystem boundary demarcation, and coastal inundation projections due based on sea-level rise scenarios.

e.g. **"Data collection"** might apply to the collection of data on fish length, ground water salinity, vegetation cover, or industrial effluent quality.

In cases where the same response might be provided for two different questions e.g. "Data collection, monitoring, or observation" and "Species assessment and monitoring" place an asterisk (*) next to the activity that most accurately reflects your organizations/units mandate e.g. a Coastal Zone Management Unit would place the * next to "Species assessment and monitoring" if referring to coral reef monitoring.

9. Which specific IWCAM-related functions does your institution undertake (✓). How many staff are involved (number), and what levels of education have they attained (scale)?	**YES (✓) / NO (-)**	**Number of Staff**	**Highest Level of Education Attained (Scale 1 – On-the-Job Training 2 – Secondary 3 – Technical**	**Human & institutional capacity status (✓) / Comment**

				Inadequate	Adequate	Superior
DATA COLLECTION, PROCESSING AND APPLICATIONS.						
▪ Data and sample (e.g. water, soil, animal tissue) collection, analysis or observation.						
▪ Data processing/analysis.						
▪ Sample analysis.						
▪ Database management.						
▪ Statistical analysis.						
▪ Development of indicators mechanisms & protocols.						
▪ GIS development and management.						
▪ Systematic observations.						
▪ Instrumentation and equipment maintenance.						
▪ Mapping.						
ENVIRONMENTAL STATUS DATA COLLECTION/ MONITORING.						
▪ Watershed/catchment assessment and monitoring.						
▪ Ecosystem (e.g. coral reefs, mangroves) assessment and monitoring.						
▪ Species identification.						
▪ Species assessment and monitoring e.g. length, weight, abundance, diversity indices, community structure.						
▪ Natural resources assessment and monitoring.						
▪ Plant and animal populations assessment e.g. fish-stock size or structure, population size/structure, genetic diversity.						
▪ Animal tissue contamination monitoring.						
▪ Waste (solid or liquid) assessment and monitoring.						
▪ Waste (solid or liquid) assessment and monitoring						
▪ Water abstraction monitoring (potable water; irrigation)						
▪ Water quality monitoring (ground, surface, fresh, marine)						
▪ Water volume/flow monitoring (ground, surface water)						
▪ Soil/sediments monitoring						
▪ Air quality monitoring						
▪ Sea surface temperature monitoring						
▪ Sea level rise monitoring						
Others (specify).						
SOCIO-ECONOMIC STATUS DATA COLLECTION/MONITORING						
Demographics						
Social conditions(poverty, income, employment)						
Human health						
Social vulnerability						
Human Development						
Sustainable Development						
Others (specify)						
IWCAM-RELATED ACTIVITIES IN FULFILLMENT OF THE FOLLOWING:						
Cartagena Convention						

9. Which specific IWCAM-related functions does your institution undertake (✓). How many staff are involved (number), and what levels of education have they attained (scale)?	**YES (✓) / NO (-)**	**Number of Staff**	**Highest Level of Education Attained (Scale 1 – On-the-Job Training 2 – Secondary 3 – Technical 4 – Associate Degree 5 – Degree 6 – Post-graduate 7 – Doctorate)**	**Human & institutional capacity status (✓) / Comment**		
				Inadequate	**Adequate**	**Superior**
UNFCCC/Kyoto Protocol						
Convention on Biological Diversity						
Convention on Desertification and Land Degradation						
UNEP GPA (Global Programme of Action for Protection of the Marine Environment from Land-based Activities)						
Law of the Sea						
MARPOL						
Barbados Programme of Action						
OECS – St. Georges Declaration						
Caribbean Initiative for Sustainable Development						
Millennium Development Goals						
WSSD Plan of Implementation						
Others (specify)						

ANNEX 2. Respondents to questionnaire

Country	Agency
Antigua & Barbuda	Environment Division
Bahamas	BEST Commission
Cuba	CIGEA
	Centro Estudios Ambientales de Cienfuegos
Dominican Republic	Ministry of Environment and Natural Resources
Haiti	Ministère De L'Environnement
Jamaica	Centre for Marine Sciences, UWI, Caribbean Coastal Data Centre
	National Environment and Planning Agency
St. Kitts & Nevis	Water Services Department
St. Vincent & the Grenadines	Forestry Department
Trinidad & Tobago	Water & Sewerage Authority
	Institute of Marine Affairs
	Environmental Management Authority
	Department of Natural Resources and the Environment (Tobago)
Others (regional)	Caribbean Institute for Meteorology & Hydrology (Barbados)
	Centre for Resource Management and Environmental Studies (CERMES)
	UWI (Barbados)

ANNEX 3. Provisional CBD Indicators for Assessing Progress towards the 2010 Biodiversity Target (Non-italics: indicators considered ready for immediate testing and use; Italics: require more work)

A: Focal Area	Indicator
Status and trends of the components of biological diversity	Trends in extent of selected biomes, ecosystems, and habitats Trends in abundance and distribution of selected species Coverage of protected areas Change in status of threatened species Trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socioeconomic importance
Sustainable use	Area of forest, agricultural and aquaculture ecosystems under sustainable management *Proportion of products derived from sustainable sources* *Ecological footprint and related concepts*
Threats to biodiversity	Nitrogen deposition Trends in invasive alien species
Ecosystem integrity and ecosystem goods and services	Marine Trophic Index Water quality of freshwater ecosystems *Trophic integrity of other ecosystems* Connectivity / fragmentation of ecosystems *Incidence of human-induced ecosystem failure* *Health and well-being of communities who depend directly on local ecosystem goods and services* *Biodiversity for food and medicine*
Status of traditional knowledge, innovations and Practices	Status and trends of linguistic diversity and numbers of speakers of indigenous languages *Other indicator of the status of indigenous and traditional knowledge*
Status of access and benefit-sharing	*Indicator of access and benefit-sharing*
Status of resource transfers	Official development assistance provided in support of the Convention *Indicator of technology transfer*

ANNEX 4. OECS St. George's Declaration Indicators (Geoghegan and Renard, 2006)

Indicators for which systems of monitoring and data collection already exist and which can be tracked immediately:

1. Participation of Member States in the major international and regional environmental conventions and protocols that they have ratified or been extended to, particularly the Cartagena Convention and its Protocols and the so-called Rio Conventions and their Protocols;
2. Extent, quality and availability of data in national State of the Environment Reports;
3. Status and effectiveness of national consultative councils and forums related to sustainable development;
4. Number of companies and government departments adopting ISO 14001 standards;
5. Extent of key ecosystems, including *forests* and *coral reefs* (but not mangroves, the third ecosystem mentioned for this SGD indicator, for which no acceptable baselines or adequate monitoring initiatives are in place);
6. Proportion of population with access to waste collection;
7. Annual consumption of CFCs;
8. Per capita carbon dioxide emissions;
9. Ratio of protected (terrestrial, coastal and marine) areas to total national territory;
10. Number of protected recognised and important natural and cultural heritage sites;
11. Energy consumption as a percentage of GDP;
12. Contribution of alternative sources of energy relative to total energy use;
13. Extent of capacity in MS to plan for, respond to and mitigate the effects of natural disasters and other environmental emergencies;
14. Proportion of population with access to adequate sanitation and water supply, disaggregated by sex, age, household income, disability status and geographic location;

Indicators that require baseline assessments and further work:

1. Use of collaborative arrangements for the management of natural resources and sites;
2. Extent and quality of environmental education programmes;
3. Levels of environmental responsibility evidenced by different sectors of society;
4. Water availability per capita;
5. Extent of key ecosystems, including *mangroves;*
6. Number of formal environmental impact assessments conducted and proportion of these that had a formal consultative process;
7. Proportion of solid and liquid waste recycled, reused or properly treated and disposed;
8. Number of economic trade agreements signed by Member States that make provision for environmental safeguards and protection of natural assets;

9. Existence of legal provisions to guarantee access to sites and resources of public importance.

ANNEX 5. Priority list of core indicators for the CARICOM programme – Environment component (CARICOM Secretariat)

I. POPULATION AND HOUSEHOLDS
1. Annual population growth rate
2. Population size urban / rural
3. Distribution of households by type of dwelling
4. Distribution of households by type of tenure
5. Distribution of households by type of materials of outer walls
6. Distribution of households by type of roof
(Note: Proportion of households with access to secure tenure - MDG)

II. TOURISM
1. Tourist intensity / growth
2. No. of tourist nights
3. Tourist penetration ratio
   a. No. of cruise passenger arrivals
   b. No. of cruise ships arrivals
4. No. of rooms, beds and employees
5. Room occupancy rate
6. Estimates of visitor expenditure
7. No. of hotels by size
8. No. of hotels occupied by land area

III. ENVIRONMENTAL HEALTH
1. Number of reported cases and incidence of environmentally related diseases (gastroenteritis, typhoid, malaria, dengue, cholera, accidental pesticide poisoning, respiratory diseases)
2. Distribution of households by main source of drinking water
(Note: Proportion of population with sustainable access to an improved water source, urban / rural - MDG)
3. Distribution of households by type of toilet facilities
(Note: Proportion of urban population with access to improved sanitation -MDG)

IV. NATURAL DISASTER
1. Frequency and type
2. Economic loss
3. Human loss

V. ENERGY
1. Consumption of energy and renewable energy (import/export)
(Note: Energy use (kilogram oil equivalent) per US$1 gross domestic product (PPP) - MDG)
2. Distribution of households by fuel used for type of cooking
(Note: Proportion of population using solid fuels - MDG)
3. Distribution of households by type of lighting

VI. LAND USE
1. Total area
2. Land use
3. Land use change

VII. AGRICULTURE
1. Use of fertilizer by type (N,P,K), weight
2. Use of pesticides by type (weight)
(Note: total arable area and total area under Slash/Burn will be covered under Land Use" section)

VIII. WASTE
1. Disposal of waste
   a. Landfill
   b. Incineration
   c. Composting
   d. Re-cycling
2. Generation of waste by type and source / sector (household, industrial)
3. Toxic / Hazardous material (imported / exported)

IX. FRESH WATER
1. Quantity of water available
2. Water abstraction, water supply and water use
   a. water abstraction
   b. water supply
   c. Water use
3. Domestic consumption of water per capita
4. Water quality of rivers and lakes (concentration)

X. AIR / CLIMATE
1. Emissions of pollutants by stationary and mobile sources
   a. CO2
   b. NOx
   c. SO2
   d. CH4
   e. Volatile Organic Compounds (VOCs)
   f. Pb
(Note: Carbon dioxide (CO2) emissions (per capita) - MDG)
2. Consumption of ozone depleting substances – CFC - MDG)

XI. COASTAL ZONES
1. Total marine area (territorial sea area)
2. Protected marine area
a. Protected marine area as % of total territorial sea area
3. Fish landings (weight)
4. Maximum sustainable yield for fisheries (weight/time)
5. Population growth in coastal areas

XII. BIODIVERSITY
1. Ratio of area protected (as defined in IUCN classification) to maintain biological diversity to surface area - MDG
2. Total land area
3. Protected land area
   a. Protected land area as % of total land area

XIII. FOREST
1. Total forest area
(deforestation and reforestation can be generated)
2. Protected forest area
3. Protected forest area as % of total forest area
4. Forest area as % to land area (excludes inland waters; rivers, lakes etc.)
(Note: Proportion of land area covered by forest - MDG)

XIV. MINERALS
1. Production of gold, Aluminum or Bauxite, Sand & Gravel, Limestone, Crude oil

ANNEX 6. ILAC goals and indicators (UNEP/World Bank/University of Costa Rica, 2004)

Goal	Indicator
Increase of forest area	Proportion of land covered by forest
Territory included in protected areas	Ratio of areas protected with respect to total territory
Genetic resources – equitable sharing of benefits	Existence of national laws related to access to genetic resources and the distribution of benefits
Marine diversity	Protected coastal and marine areas with respect to the total costal and marine areas
Freshwater supply	The availability of water per capita and consumption of water per capita
Watershed management	Percentage of water basin areas under management
Management of marine and coastal areas and their resources	Fish catch
Better quality of inland waters	Proportion of population with access to sanitation
Land-use planning	Proportion of municipalities with land-use plans being implemented
Areas affected by degradation process	Proportion of degraded areas
Air pollution	Change in the density of the motor vehicle fleet and carbon dioxide emissions
Water pollution	Proportion of population with access to drinking water, and proportion of population with access to sanitation
Solid waste	Proportion of population with access to waste collection; production of solid wastes; and waste collected and properly disposed
Vulnerability to anthropogenic disasters and those caused by natural phenomena	Existence of national emergency commissions or rapid response groups
Health and environment	Rate of morbidity attributable to acute respiratory diseases; years of life lost due to incapacities as a consequence of water-borne diseases; morbidity from HIV/AIDS; size of urban green areas with respect to the urban population.
Poverty and inequity	Proportion of population with income below the purchasing power parity (PPP) of one dollar per day; proportion of homes with access to secure tenure; growth index of the number of small enterprises; and social cost as a percentage of the Gross Domestic Product.
Energy	Energy use per US$1 of GDP (PPP); proportion of population using solid fuels; and percentage of energy consumed from renewable sources with respect to the total energy consumed.
Cleaner production	Consumption of chlorofluorocarbons that deplete the ozone layer.
Environmental education	Total hours of teaching environmental science in primary education.
Evaluation and indicators	Reports on the state of the environment and Environment Statistics Systems

Participation of society	Existence of national sustainable development councils

Annex 7. Official list of MDG indicators related to environmental sustainability, after the 2007 revision. *Effective 15 January 2008*

(http://mdgs.un.org/unsd/mdg/Resources/Attach/Indicators/OfficialList2008.doc)

Goals and Targets (from the Millennium Declaration)	Indicators for monitoring progress
Goal 7: Ensure environmental sustainability	
Target 7.A: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources	7.1 Proportion of land area covered by forest 7.2 CO2 emissions, total, per capita and per $1 GDP (PPP), and consumption of ozone-depleting substances 7.3 Proportion of fish stocks within safe biological limits 7.4 Proportion of total water resources used
Target 7.B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss	7.5 Proportion of terrestrial and marine areas protected 7.6 Proportion of species threatened with extinction
Target 7.C: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation	7.7 Proportion of population using an improved drinking water source 7.8 Proportion of population using an improved sanitation facility
Target 7.D: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers	7.9 Proportion of urban population living in slums