# Information Management Issues Relating to A National Environmental Information Strategy[1]

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This document provides guidance for the management issues that must be addressed in the establishment or strengthening of a national environmental information system. These issues fall into two broad categories — those dealing with *administrative* matters and those relating to the *management of natural resource-based information*. In each category the basic principles, which should govern the response to these needs, are presented. In addition, this rewrite of this paper includes an extended discussion of environmental indicators, as they might be developed and applied in the insular Caribbean.

The premises of this chapter are based on the values of increasing accountability and transparency in environmental information management and are as follows:

- Responsibility for data generation and information management should be at the lowest practicable levels of the organization;
- All sources of data and information should be given the opportunity to review and comment on data about their operations;
- Environmental information serves public purposes best when it is most widely available to the public; and
- The only perfect information is information that is not used. (In other words, frequently used data require regular revision, correction, and updating that can be employed without sanctions or other negative consequences for data generators.)

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[1] This document was prepared as a draft chapter of a forthcoming book, *National Environmental Information Strategies for Developing Countries*, edited by Barbara Gumbs of Trinidad-Tobago to be published in 1999 by the International Federation for Information (FID). The excerpted chapter provides guidance on the major issues affecting national environmental information system design, with some detailed discussion of the special problems and opportunities faced by new environmental management agencies.

# A. Administration Issues

An examination of the information required by the national environmental agency for making decisions is critical to the successful fulfillment of the mandate of the agency. Such decisions are usually served by the data and information that belong to, are routinely generated by, or are purchased by the environmental agency. The national environmental agency is usually not an autonomous body, but one that reports to a Ministry or Council. Consequently, one of the most important information management issues is that of establishing sound administrative systems that could provide information for the smooth operation of the agency itself and by extension the national environmental information system.

Administrative systems are stressed because too often environmental management and protection agencies are penalized in the bureaucratic and political processes of government because they do not adequately document their own systems and procedures.

The documentation of these administrative systems is especially important in developing states for a number of reasons:

- Many environmental protection agencies are new organizations, without strong bureaucratic traditions or a legacy of established administrative costs ;
- Many environmental agencies are managed by senior scientists or academic leaders who are not well-versed in administrative processes or applications;
- Environmental agencies tend to have a number of enforcement duties that stimulate political and bureaucratic reactions. Without good documentation of the administrative reality of agency enforcement activities, the agency will be penalized, based on rumor, innuendo and anecdote.
- Administrative data are often the first elements of indicators of agency *response* to environmental degradation (see "Indicators," below).

Information management needs to encompass full accounting for all resources available to agency administrators, including personnel, appropriated operating funds, appropriated capital funds, permits and fees, and the wide variety of special grants and assistance projects that might be used for environmental management activities. In some agencies, voluntary activities of environmental NGOs may account for a significant portion of total environmental monitoring activities and should also be noted in the resource accounts.

Optimally, measures of agency output are related to the effects of agency action on public health and safety or environmental functions. Agency planners need to be alert to opportunities to document these effects, based on existing information systems of other agencies (such as public health or epidemiological records), or one-time-only or *ad hoc* studies that will illuminate the results of agency programmes. The reality, however, is that output measures are generally very hard to identify and collect, and agencies most often need to document process-based measures of activity as interim or surrogate indicators of output.

Administrative systems should also target complete inventories of agency capital assets, including information systems. The ability to locate and re-assign under-utilized resources is a powerful tool for under-budgeted environmental management agencies.

Environmental management agencies will often feel they have no autonomy in selecting information management tools for administrative systems because of the need to interface closely with government-wide budget, financial, and administrative systems. By placing a priority on the design and implementation of automated interfaces with government-wide systems, agency mangers can have the best of both worlds, by using easy-to-program PC-based database and spreadsheet software for internal purposes, while exporting accurate and up-to-date reports to the government-wide systems on demand.

Agency administrative systems need to focus on rapid generation of administrative information, and equally prompt review and publication of the data. This information should be maintained in publicly accessible archives at appropriate levels of aggregation, with due regard for protection of confidential information from private or public sources. This is the best, first step in building and maintaining the confidence of the public for environmental protection activities.

The use of Internet-based tools eases the system-design and implementation problems for environmental information. These tools will work both for internal, agency-wide "intranet" applications and also for low-cost "publication" of information and more refined data products.

## Special Requirements for Privatization

For a variety of administrative, budgetary, and public policy reasons, there is pressure to privatize, or "contract out" many of the monitoring activities of environmental management and protection agencies. These activities range from relatively simple local monitoring activities such as beach profiling, which can be conducted by local NGOs or units of local government, to buying testing services

from commercial analytical laboratories, to highly specialized remote sensing interpretation and mapping services[2].

When key activities of the environmental management agency are thus privatized or contracted out, the management responsibilities and information management processes for administrative information become more complex. In brief, personnel of the environmental management agency need to apply both technical judgements, for which they have probably been trained as biologists or chemists, for example, and also contract management judgments, for which they often have no training at all.

As with other elements of this information management chapter, openness and transparency should be guiding principles of contract-based management systems. Pressures against such openness are strong. For example, in general it is thought that public agencies should publish their quality control data for laboratory tests. For private laboratories, however, it is often argued that publication of detailed quality control information infringes on proprietary, confidential information. Because of the complexity of the issues involved, information systems for contracted services should be carefully reviewed by specialists.

## Legacy Systems

One of the realities often overlooked by information managers of new environmental management agencies is that the underlying reason for creating new agencies is often that the "old" systems and responsibilities were *not* being done. Before seeking new challenges, information managers need to carefully review the strengths and weaknesses of antecedent information systems. These include both national, legal and regulatory reports, and regional and international reporting required by some of the two-dozen or more major environmental agreements which most developing countries have signed in recent years.

The second important step in the review of legacy information and reporting systems is to carefully study the existing systems for ways to combine data gathering and information processing to increase the efficiency and effectiveness of these existing systems. One of the costliest elements of many monitoring systems is simply the process of mobilization for field activities. Cost savings are significant if two or more types of monitoring can be combined in the same field activity. For example, physical monitoring of beaches can often be combined with the collection of biological measures.

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[2] It also should be noted that the United States Environmental Protection Agency, one of the models for environmental management agencies on a worldwide basis, was organized from the ground up to maximize private sector involvement in activities of the agency.

A second source of savings derives directly from the use of systematic information collection techniques, which often permit the use of sampling technologies, instead of universal data collection from all participants. While statistical methods have their critics (witness the opposition in the United States Congress to the use of sampling procedures to conduct the US Census), the use of such procedures, properly designed and quality-controlled, usually results in both cost savings, and better insights into data integrity itself.

The new information needs of a newly organized environmental management agency are often easy to identify. New statutes and regulations often define the new requirements in straightforward fashion. As with existing systems, integration of new organizational needs with those of existing systems is a key to cost effective design and implementation of a national environmental information system.

## B. Natural Resource-Based Information Issues

This section addresses some of the major information management issues that specifically affect the natural resource-based information needs of the environmental management agency. These include:

- The importance of building, maintaining, and restoring time-series environmental data;
- The need for consistent geographic frameworks;
- Metadata and data repatriation;
- Taxonomic consistency;
- The use of advanced decision-support software, and
- An extended discussion of the state-of-the-art in the development and use of indicators of environmental status, cause, and response.

### *1. Legacy Systems: The Importance of Building and Maintaining Time-series Data*

In modern sustainable development planning it is no longer sufficient to know the status of environmental conditions at isolated points-in-time. Sustainable development necessarily implies the ability to measure trends and tendencies over time. It is still true that the analytical tools available to fully assess natural trends in the face of the high natural variability do not yet exist, but it is important that information systems be designed, operated and maintained to capture all of the various time-series information that is potentially available.

A costly omission that affects many developing countries is the abandonment of monitoring time series that had been collected over many generations at some sites. In examining the priorities for new information collection, information system planners need to place high values on going back to sites for which data exist from times in the past, but which have been abandoned more recently.

## 2. The Importance of Consistent Geographic Frameworks

Time series data is the fourth dimension of environmental information. The other three dimensions (horizontal coordinates—*e.g.*, latitude and longitude—and altitude or depth) are extremely important, and will only become more important as population densities increase and as pressures on natural systems intensify. Interestingly, the development of more accurate and consistent geographic coordinates for historical data is one way that environmental information system managers can upgrade the quality of legacy information.

New Geographic Position Systems (GPS) radio receivers provide low-cost means of achieving 100-meter accuracy in geo-locating all significant geographic features, which is generally sufficient to up-grade most local geographic locational standards. As mentioned above, using GPS to increase the accuracy of fixed site locations used for monitoring over time is one way to substantially upgrade the quality of the entire environmental information database.

At an annual cost of less than US$15,000, local agencies can build a "differential GPS" community base station, which increases the accuracy of GPS locations to less than 10 meters. This level of accuracy will be available eventually (February, 2006) to even the simplest GPS receiver when the United States Department of Defense turns off electronic features of the current GPS (termed Selective Availability) which purposely degrade the accuracy of the signal. Ten-metre accuracy is sufficient for planning and management activities in even the smallest local jurisdiction, permitting accurate locations for small buildings, trails and utility systems.

*Locational Data Standards* are an important tool for environmental information management. Such standards have many applications outside of the environmental arena, and development of such data standards can be a government-wide activity.

Referring specifically to the needs for environmental data, Locational Data Standards should be chosen with attention to both the needs of the national environmental management agency, and also with concern for selecting standards which will permit or encourage data interchange with neighboring and regional environmental programs.

### 3. *Metadata and Data Repatriation*

A common feature of most developing countries is that much of the key environmental information—especially historic data from colonial periods, and basic research data gathered in more recent times by scholars and researchers from research centres in Europe or the United States—lies in overseas archives, heretofore inaccessible to local researchers, planners and managers. Environmental information managers in developing countries can take two vital steps to increase the accessibility of this information for sustainable development decision-makers.

The first step is to support the collection of "metadata" about these information sources, so that Web-linked query systems can track down the sources of these data, and determine in advance of actually getting the data if it is likely to be appropriate for the intended purposes. The world information management community is moving to a series of common "metadata content standards" for information for a variety of applications. Draft metadata international standards are emerging from the International Organization for Standardization (ISO), including the publication of a standard for a global locator systems (GLS) for documents, and a draft standard for geographic data, which will permit querying the worldwide information nodes with geographic coordinates.

Collecting metadata about environmental datasets is neither fun nor quick-and-easy, but it does provide a means to build an overview of the data resources—and critical data gaps—that are available for decision making.

In a forwarding-looking initiative by the Caribbean Environmental Programme's networking project (CEPNET), the United Nation's Environment Programme's Regional Coordination Unit for the Wider Caribbean has committed to providing a metadata query node for metadata that is compliant with the United States Federal Geographic Data Committee's content standard for geographic data. (This standard will be changed to the ISO-compliant international standard as this is developed). This access node will provide a means for anyone with World Wide Web access to query all catalogued data that refers to specific areas in the Caribbean.

The Biological Resources Division of the US Geological Survey (USGS) has designed a superset of the Geographic Metadata Content Standards. This "NBII" (National Biological Information Infrastructure) content standard is well documented for use by mid-level administrative staff, and the USGS provides a web site with downloadable software which permits the collection of this information in a standardized format. Although the NBII is not yet being used as an ISO metadata standard, it should be considered at least on a pilot basis by environmental information managers in developing countries. It satisfies many of their

needs to have foreign users document their data sets in a way that is directly searchable even now on the World Wide Web.

The second step environmental information managers need to take is to establish contact with major overseas repositories of environmental information (possibly those identified through the metadata collection efforts). They should request either direct data repatriation, or "virtual data repatriation" by means of digitizing the source data sets and making them available over the Internet, based on mutually agreed criteria. To the extent that the national environmental information system has developed specific standards, it may be possible to ask the outside repositories to perform adjustments to the source data to conform to the national standards.

### 4. Taxonomic Consistency

One of the problems faced by managers of the information resources of developing countries is that in addition to incompatible geographic systems, foreign languages, inconsistent measures, and alienation of data sets, the basic vocabulary used to characterize the biota of a place is inconsistent and variable over time. Environmental information systems need to establish a single taxonomic system to organize past and future classification and community studies and to support biodiversity planning.

### 5. The Use of Advanced Decision-Support Software

Geographic Information Systems are but one variety of decision-support software systems that are useful in integrating large volumes of complex data to address identified policy issues. While these systems are extremely powerful in many circumstances, they are also high-maintenance systems that require the implementing agency to devote a large effort in technology and the most expensive staff resources to support over time.

For small countries with very limited resources (such as some small island developing states), the cost of these new technologies can be greater than the local system can afford. There is a need for regional and sub-regional service institutions that can provide these advanced analytic services to several countries at a time. Costs would be affordable for all, but would permit the central service group to pay the salaries and buy the equipment necessary to operate at the highest level of efficiency and effectiveness.

It is important to realize that the most difficult element of any decision-support system is not the data collection and processing, but it is casting and timing the proper policy *questions* so that the answers can be used to truly advance the policy making process. Too many times elaborate information products are produced as pretty maps and charts that never influence any development planning process.

## 6. Environmental Indicators

Environmental indicators define the measures that can be used to assess both environmental conditions and trends, and the effects of environmental management agency actions. Environmental indicators are the building blocks of the national environmental information strategy. By international consensus, environmental indicators are commonly classified in terms of their discrete impacts on the environment:

- **Stressors**-those factors that measure the natural and anthropogenic forces operating to change environmental conditions. In regular usage, many measures of population and economic activity have been used to generate stressor indicators

- **Condition Indicators**-These are the measures of natural functioning of environmental systems, ranging from conventional water quality measures to elaborate, experimental indices for biological integrity.

- **Response Indicators**-Measures of environmental and other agency effects on environmental conditions. As indicated in the previous discussion of administrative records of an environmental management agency, there are direct and indirect relations between measures of agency input to a problem and effects that resolve the problem or change the underlying conditions.

Most environmental management agencies already collect much of this information. It is useful for the information management function to tag and track these data so that they can later be assembled and analyzed for reporting purposes. At the highest levels, these data can be used to produce periodic national environmental assessments, such as the series of reports produced by the Jamaican National Resources Conservation Authority.

In recent years a number of major scientific research efforts have been directed at developing consistent large-scale environmental indicators useful for both national assessments and for comparative national assessments useful to international organizations and assistance agencies. Dr. Jan Bakkes of the Dutch environmental management agency has summarized much of this current information on international environmental indicators in a UNEP report on environmental indicators.

To adapt this high-level research to the decision-making needs of sustainable development policy makers, the Caribbean Development Bank has been working with member states to define a series of environmental indicators. These can be used to supplement annual economic reports to convey a more comprehensive and balanced picture of the changes occurring at the national level. A draft re-

port on this approach, by Tom Crowards of the Bank, is available from CDB under title of "Environmental Indicators for the Caribbean".

There is much work being done on environmental indicators. The following section quotes from the United Nations Commission on Sustainable Development publication of May of 1996 on Indicators of Sustainable Development, including the indicators listed in that publication for environmental factors.

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## *INDICATORS OF SUSTAINABLE DEVELOPMENT*

*On occasion of its third session, in April 1995, the Commission on Sustainable Development (CSD) approved a work programme on indicators of sustainable development. The work programme included a list of approximately 130 indicators organized in the Driving Force — State — Response Framework. In this framework, Driving Force indicators represent human activities, processes and patterns that impact on sustainable development, State indicators indicate the "state" of sustainable development, and response indicators indicate policy options and other responses to changes in the state of sustainable development.*

*The indicators are intended for use at the national level by countries in their decision-making processes. Not all of the indicators will be applicable in every situation. It is understood that countries will choose to use from among the indicators those relevant to national priorities, goals and targets.*

*Following the decision of the CSD and the adoption of an implementation plan by experts from various organizations involved in the follow-up, the process of developing methodology sheets for each of the indicators was started. The purpose of the methodology sheets is to provide users at the national level with sufficient information about the concept, significance, measurement and data sources for each indicator so as to facilitate data collection and analysis. The process was coordinated by the United Nations Department for Policy Coordination and Sustainable Development (DPCSD) but builds upon indicator work being carried out in several organizations. The process was marked by a high degree of collaboration among a large number of organizations of the United Nations system, other intergovernmental organizations, and non-governmental organizations.*

*Organizations which have contributed both to the development of the indicators and to the preparation of the methodology sheets include the following: the United Nations*

*Department for Economic and Social Information and Policy Analysis (DESIPA); the United Nations Department for Policy Coordination and Sustainable Development (DPCSD); the United Nations Department for Development Support and Management Services (DDSMS); the United Nations Department for Humanitarian Affairs (DHA); the secretariat of the Framework Convention on Climate Change; the United Nations Children's Fund (UNICEF); the United Nations Conference on Trade and Development (UNCTAD); the United Nations Development Programme (UNDP) and its Office to Combat Desertification and Drought (UNSO); the United Nations Environment Programme (UNEP) and the secretariat of the Basel Convention; the United Nations University; the Regional Commissions of the United Nations; the United Nations Centre for Human Settlements (Habitat); the International Labour Organization (ILO); the Food and Agriculture Organization of the United Nations (FAO); the United Nations Educational, Scientific and Cultural Organization (UNESCO); the World Health Organization (WHO); the International Telecommunication Union (ITU); the World Meteorological Organization (WMO); the United Nations Industrial Development Organization (UNIDO); the World Bank; the International Atomic Energy Agency (IAEA); the European Communities Statistical Office; the Organization for Economic Co-operation and Development (OECD); the International Centre for Tropical Agriculture (CIAT); the International Conservation Union (IUCN); the International Institute for Sustainable Development (IISD); the International Institute of Applied Systems Analysis (IIASA); the National Institute for Public Health and Environmental Protection of the Netherlands (RIVM); the New Economics Foundation; the Scientific Committee on Problems of the Environment (SCOPE); the Worldwatch Institute; the World Resources Institute (WRI); the World Wide Fund for Nature (WWF); and the Wuppertal Institute.*

*In February 1996, a meeting of government experts was organized by the Environment Agency of Japan, in cooperation with DPCSD, in Glen Cove, New York, to discuss and evaluate the methodology sheets from the point of view of potential users. The methodology sheets were also circulated among a roster of international experts for their comments.*

*The responsible organizations revised the methodology sheets accordingly and a first draft of the publication was presented as a Background Paper no. 15, at the fourth session of the Commission on Sustainable Development, in April/May 1996. Since then additional and revised methodology sheets have been submitted by the lead agencies and were incorporated into the revised edition of the document. In a few instances, methodology sheets are still being developed and in these cases, a "bookmark" has been included, stating the name of the indicator, a brief definition, the unit of measurement, and its placement in the framework. The work on completing and revising the methodology sheets will continue, as the CSD work programme on indicators now enters its second phase.*

*The second phase concentrates on enhancement of information exchange among all interested partners, training and capacity building at the regional and national levels and monitoring the use of the indicators in countries that have shown interest in this process. The publication will now be forwarded to all Governments to assist them in working with indicators in their decision-making processes. As feedback and results from testing, analytical work are discussed, further improvements in the indicators and methodology sheets will be implemented. This includes in the longer run, additional work on interlink-*

*ages, highly aggregated indicators and the conceptual framework and compilation of environmental indicators.*

## *CATEGORY: ENVIRONMENTAL*

### *Chapter 18: Protection of the quality and supply of freshwater resources*

*Driving Force Indicators:*
- *Annual withdrawals of ground and surface water*
- *Domestic consumption of water per capita*

*State Indicators:*
- *Groundwater reserves*
- *Concentration of faecal coliform in freshwater*
- *Biochemical oxygen demand in water bodies*

*Response Indicators:*
- *Waste-water treatment coverage*
- *Density of hydrological networks*

### *Chapter 17: Protection of the oceans, all kinds of seas and coastal areas*

*Driving Force Indicators:*
- *Population growth in coastal areas*
- *Discharges of oil into coastal waters*
- *Releases of nitrogen and phosphorus to coastal waters*

*State Indicators:*
- *Maximum sustained yield for fisheries*
- *Algae index*

*Response Indicators:*

### *Chapter 10: Integrated approach to the planning and management of land resources*

*Driving Force Indicators:*
- *Land use change*

*State Indicators:*
- *Changes in land condition*

*Response Indicators:*
- *Decentralized local-level natural resource management*

### *Chapter 12: Managing fragile ecosystems: combating desertification and drought*

*Driving Force Indicators:*
- *Population living below poverty line in dryland areas*

*State Indicators:*
- *National monthly rainfall index*
- *Satelite derived vegetation index*
- *Land affected by desertification*

*Response Indicators:*

***Chapter 13: Managing fragile ecosystems: sustainable mountain development***

*Driving Force Indicators:* - *Population change in mountain areas*

*State Indicators:*
- *Sustainable use of natural resources in mountain areas*
- *Welfare of mountain populations*

*Response Indicators:*

***Chapter 14: Promoting sustainable agriculture and rural development***

*Driving Force Indicators:*
- *Use of agricultural pesticides*
- *Use of fertilizers*
- *Irrigation percent of arable land*
- *Energy use in agriculture*

*State Indicators:*
- *Arable land per capita*
- *Area affected by salinization and waterlogging*

*Response Indicators:* - *Agricultural education*

***Chapter 11: Combating deforestation***

*Driving Force Indicators:* - *Wood harvesting intensity*

*State Indicators:* - *Forest area change*

*Response Indicators:*
- *Managed forest area ratio*
- *Protected forest area as a percent of total forest area*

***Chapter 15: Conservation of biological diversity***

*Driving Force Indicators:*

*State Indicators:* - *Threatened species as a percent of total native species*

*Response Indicators:* - *Protected area as a percent of total area*

***Chapter 16: Environmentally sound management of biotechnology***

*Driving Force Indicators:*

*State Indicators:*

*Response Indicators:*
- *R & D expenditure for biotechnology*
- *Existence of national biosafety regulations/guidelines*

***Chapter 9: Protection of the atmosphere***

*Driving Force Indicators:*
- *Emissions of greenhouse gasses*
- *Emissions of sulphur oxides*
- *Emissions of nitrogen oxides*
- *Consumption of ozone depleting substances*

*State Indicators:*
- *Ambient concentrations of pollutants in urban areas*

*Response Indicators:*
- *Expenditure on air pollution abatement*

***Chapter 21: Environmentally sound management of solid waste and sewage-related isues***

*Driving Force Indicators:*
- *Generation of industrial and municipal solid waste*
- *Household waste disposed per capita*

*State Indicators:*

*Response Indicators:*
- *Expenditure on waste management*
- *Waste recycling and reuse*
- *Municipal waste disposal*

***Chapter 19: Environmentally sound management of toxic chemicals***

*Driving Force Indicators:*

*State Indicators:*
- *Chemically induced acute poisonings*

*Response Indicators:*
- *Number of chemicals banned or severely restricted*

***Chapter 20: Environmentally sound management of hazardous wastes***

*Driving Force Indicators:*
- *Generation of hazardous wastes*
- *Imports and exports of hazardous wastes*

*State Indicators:*
- *Area of land contaminated by hazardous wastes*

*Response Indicators:*
- *Expenditure on hazardous waste treatment*

***Chapter 22: Safe and environmentally sound management of radioactive wastes***

*Driving Force Indicators:*
- *Generation of radioactive wastes*

*State Indicators:*

*Response Indicators:*

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Excerpted from the United Nations FTP site.

## *CARIBBEAN DEVELOPMENT BANK*

A more specific application of environmental indicators is summarized by the following report from the Caribbean Development Bank to the November, 1997, Ministerial Review of the Caribbean Small Island Developing States Achievements for the 1994 SIDS Program of Action. Although this summary is specific to the needs of the Caribbean, the issues are common to the information management needs of indicators for most developing countries.

### *Environmental Indicators for the Caribbean (Summary)*

*SIDS97/1997 Original: ENGLISH*

*This report was prepared by Tom Crowards, country economist, Caribbean Development Bank. The views expressed in this document are those of the author and do not necessarily reflect the views of the of the Caribbean Development Bank.*

## *SUMMARY*

*Many of the more widely publicised environmental issues within the Caribbean are common knowledge. These include marine pollution, coral reef degradation, threats to endangered species, and problems of solid waste disposal. However, there is very limited information readily available on the current state of these problems, on where the issues are most pressing, on general trends, and on their economic or developmental significance. A lack of coordination between donor agencies acting on environmental issues has led to the establishment of an Environmental Interagency Coordinating Committee, chaired by CDB. Whilst this committee seeks to address areas of duplication and disparity in the funding of environmentally focused projects, there remains a "glaring gap ... in the baseline environmental data necessary to measure the severity of environmental problems and monitor changes in environmental conditions" (Caribbean Group for Cooperation in Economic Development, 1994, p.38).*

*This report outlines the rationale for deriving environmental indicators and their possible incorporation within routine analysis of national development performance. The theory and background literature on the formulation of environmental indicators and on integrating environmental concerns within an economic framework are outlined. Current international and regional initiatives aimed at deriving sets of indicators are discussed, and a potential set of primary environmental indicators presented. Possible sources of data are considered, focusing initially on international and regional sources. An ongoing pilot study deriving environmental indicators for Barbados is presented in the accompanying report.*

*Indicators are not merely assemblages of information but are instruments aimed at influencing decision making, and must therefore be geared towards achieving this final goal and shaped by the circumstances and processes peculiar to each situation. Hence, "there is no such thing as a universal set of environmental indicators" (Bakkes et al., 1994, p.2). Appropriate indicators can be expected to vary between regions, between countries, and*

*even within countries, although the focus of this report is on national-level indicators. These can serve to highlight national environmental management priorities, can facilitate international comparison and the establishment of regional benchmarks, and allow assessment alongside national economic indicators. The relevance of particular indicators can also be expected to vary over time, as environmental conditions and policy orientation change. Therefore, whilst a broad set of indicators is presented, this should not be taken as a definitive list. The list of appropriate indicators can be expected to vary between countries according to environmental conditions, policy priorities and, acknowledging that in many cases this may be a limiting factor, the availability of data.*

*Deriving a set of potential indicators is not in itself a novel exercise. Difficulties arise in focusing attention on environmental issues specific to the region, in fine-tuning indicators in order to satisfy criteria such as being representative, relevant and practical, and in determining the existence and accessibility of available data.*

*A possible set of indicators for assessing environmental quality is outlined in Appendix 1. This list has been split into 15 broad categories, based on different aspects of environmental concern, and an additional category for miscellaneous information. It is a set of 'primary' indicators, outlining datasets which could be collated to provide useful information on a range of environmental matters, and which can be further manipulated into more complex 'composite' indicators.*

*The fifteen broad categories are:*

- *Freshwater Supplies*
- *Energy*
- *Mineral Resources*
- *Beaches*
- *Fisheries*
- *Forests*
- *Land Use and Degradation*
- *Biodiversity*
- *Coral Reefs (Wetlands, Seagrass Beds)*
- *Water Quality (Fresh and Marine)*
- *Sewage Disposal*
- *Solid Waste Disposal*
- *Toxic/Hazardous Materials*
- *Air Pollution*
- *Urban Environment*

*Within each category, entries are grouped according to a 'Status — Cause — Response' model. Indicators are identified as representing:*

*the current status of the environment, implying both the state of environmental quality and the significance of the resource;*

*the causes of environmental change, either underlying or proximate sources of pressure; or*

*responses to environmental degradation, particularly from the perspective of government policies*

*(whilst acknowledging that action might also be taken, for instance, at the international level and the individual or local community level).*

*The points and recommendations arising from this report can be summarised as follows:*

*(i) To better enable countries to achieve sustainable development, policy formulation should explicitly consider:*

*(a) The environmental implications of current economic activity;*

*(b) The potential adverse impact that present environmental degradation could have on future economic performance;*

*(c) The link between 'natural capital' and long-term developmental objectives; and*

*(d) Policy options to deal with environmental issues directly, or limiting environmental damage arising from other initiatives.*

*(ii) In order to incorporate environmental concerns into macro-level assessment of developmental progress, environmental (and social) indicators should be considered alongside indicators of economic performance as standard practice.*

*(iii) As a provider of specialised services, the Caribbean Development Bank could perform a useful regional role in:*

*(a) Enhancing national capabilities in collation and assessment of environmental indicators, and*

*(b) Analysis of environmental indicators within the context of economic performance. In the future such analysis could evolve so that environmental indicators are in fact integrated within an economic framework to substantively link economy and environment, providing a more compelling guide to the sustainability of current economic performance.*

*(iv) With regard to (ii) and (iii) above, the Caribbean Development Bank is well situated to collaborate with international agencies involved in this field; to introduce advances in techniques to the region and perhaps tailor these techniques to suit regional circumstances; and to channel potential external funds related to such exercises into the region.*

*Such measures would complement ongoing work of many of the region's environment ministries, of regional natural resource and environmental institutions, and of international organisations such as other multilateral development banks and the United Nations who are actively involved in addressing these issues.*

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Extracted from the Web Site of the Economic Commission for Latin America and the Caribbean, Trinidad sub-regional office, http://community.wow.net/eclac/home.htm (which may no longer be operational).