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Development of Environmental Indicators in Selected Asian and Pacific Countries

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DEVELOPMENT OF ENVIRONMENTAL INDICATORS IN SELECTED ASIAN AND PACIFIC COUNTRIES

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Foreword

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INTRODUCTION

The rapid pace of modernization, industrialization, and infrastructure development, often unplanned and ad hoc, has led to a significant deterioration of the environment in the Asian and Pacific developing countries. This has necessitated broad-based environmental management policies. Major environmental issues that are presently a cause for concern in these countries are deforestation, land degradation, loss of biodiversity, pollution of inland water and groundwater, and air pollution (particularly in urban areas due to industrial and automobile emissions).

Solutions to these problems will require a well-designed long-term strategy that meets the needs and suits the circumstances of the individual country. When formulating the strategy, the techno-economic parameters of the country need to be considered to ensure that growth is environmentally sustainable. A key step in this process is the development of appropriate environmental indicators focusing on major environmental concerns of the country. This *Note* provides a brief overview of the work undertaken by the Asian Development Bank (ADB) and other agencies, their approaches and methodologies, as well as the scope and coverage of work that needs to be taken up in the future.

USES OF AND SELECTION CRITERIA FOR ENVIRONMENTAL INDICATORS

Environmental indicators are an efficient way of measuring the environmental issues in a country. Properly derived indicators can serve to highlight changes in environmental conditions that warrant further investigation. The need for environmental indicators varies among countries, depending on their requirements. Major uses of these indicators include the following:

- measurement of environmental performance;
- integration of environmental concerns in sectoral policies;
- integration of environmental and economic decision making (e.g., through environmental accounting); and
- reporting on the state of the environment.

Environmental indicators can be generally classified into three groups: pressure, state, and response indicators. Pressure indicators show the causes of environmental problems (Bartelmus 1994) and chart certain flow quantities such as emissions or interventions that place a burden on the environment. State indicators reflect the quality of the environment in relation to the effect of human activity. Response indicators pertain to measures that improve the environment. These indicators can tell whether things are getting worse or better, whether problems are growing, or whether current policies are achieving the desired goals.

There is no single set of indicators suitable for every purpose. Different sets must be developed for different situations and locations. However, all good indicators have a number of common attributes. In selecting indicators, the following attributes have to be considered:

(i) **Policy relevance.** Environmental indicators need to provide a picture of the current state of the environment and society's response. They need to be simple, easy to interpret, and show trends over time. They must also be responsive to change and have a threshold or reference value against which to make comparisons.

(ii) **Analytical soundness.** Indicators should be robust in technical and scientific terms. It would also be useful to be able to incorporate them into models and forecasting systems.

(iii) **Measurability.** The data required to support a particular set of indicators must be readily available at reasonable cost and be of known quality. They must also be updated at regular intervals by reliable procedures.

For effective use of environmental indicators in national policy formulation and decision making, a reliable environmental statistics database is a necessary precondition. Such a database would be useful not only for measuring changes in the quality of the environment, but also for monitoring the effectiveness of the country's programs on environmental improvement and sustainable development.

HISTORICAL DEVELOPMENT OF ENVIRONMENTAL INDICATORS

The need for indicators on the environment and sustainable development has been evident for a long time. The Organisation for Economic Co-operation and Development (OECD) initiated the development of environmental indicators as early as 1989 (OECD 1993). Its first major work, "Environmental Indicators: OECD Core Set" published in 1994, introduced 50 commonly accepted indicators, which have since been widely accepted in OECD countries as a basis for public policy making at all levels (EUROSTAT 1998).

However, it was only after the historic United Nations Conference on Environment and Development held in Rio de Janeiro in 1992 that work on environmental indicators gained momentum. In 1994, the United Nations Statistics Division (UNSD)[1] in collaboration with the Inter-Governmental Working Group on the Advancement of Environment Statistics proposed a list of selected environmental indicators that was adopted by the United Nations Statistical Commission, as recommendations for international compilation (see Appendix 1). After pilot testing these indicators in a sample of non-OECD countries, the UNSD circulated a revised questionnaire to all non-OECD countries for data collection. Based on the data collected, an environment statistics database is expected to be developed and will be used in preparing the "Compendium of Environmental Indicators" to be published sometime in 2000 (Shah 1998).

The World Bank has also been engaged in developing environmental indicators for a number of years. Initiatives of the World Bank include the development of wealth estimates, indicators of genuine saving, and environmental performance indicators. The wealth estimate is a stock measure and is a new way of estimating a

[1]The working paper entitled "Towards a Framework for Indicators of Sustainable Development" (UNSD 1994) links the concerns of potential data users as reflected in Agenda 21 with the United Nations Framework for the Development of Environment Statistics. UNSD has worked closely with the United Nations Department for Policy Coordination and Sustainable Development to produce a set of indicators that is now part of the work program approved by the Commission on Sustainable Development.

country's total resources, whereas genuine saving is a flow measure that adjusts gross savings numbers by deducting the value of depletion of the underlying resource asset and pollution damages. The environmental performance indicators were developed as part of a broader set of indicators used to monitor project performance and impact. The World Bank's series of *World Development Indicators* also features a number of indicators designed to monitor the state of environment of its member countries.

The ADB started incorporating environmental concerns of various development projects into its lending strategy in the mid-1980s. In 1993, it initiated a regional technical assistance project (RETA 5542) to develop a set of indices for monitoring environmental changes in its developing member countries (DMCs). The project resulted in the development of a set of three environmental indices: cost of remediation, environmental elasticity, and "environmental diamond" (Rogers et al. 1997). The cost of remediation assesses the cost of moving the environment from its present condition to a more desirable state in the future. Environment elasticity is defined as the percentage change of an aggregate measure of environmental quality or stress as a result of a 1 percent change in per capita GDP over a period of time. The environmental diamond is a graphical representation of four subindices simultaneously covering air, water, land, and ecosystem, and graphically shows how the environment in a country varies along each of the above four environmental dimensions. These indices are useful in supporting the environmental monitoring goals of the ADB and the DMC governments, and can also be utilized for cross-country comparison of environmental performance.

These initiatives taken by international agencies are expected to contribute substantially in developing environmental indicators in the DMCs. However, such indicators will be of little use as long as there is a lack of basic environmental statistics in the DMCs. Since many DMCs lack the ability to generate such statistics, efforts should be made, first of all, to strengthen the institutional capacities for collection and compilation of environmental statistics.

STATUS OF COLLECTION OF ENVIRONMENTAL STATISTICS IN DMCs

The collection and compilation of environmental statistics is a recent development in most developing Asian and Pacific countries. The present system of data collection in these countries is weak, unorganized, and poorly funded. Most of these countries do not collect core environmental statistics; what they have are environment-related statistics. Where some core environmental data exist, their quality, comparability, and accessibility normally fall short of the standard required for decision making. There is a wide variance among countries with respect to the extent of statistical expertise and knowledge. There are also variations in terminology, data classifications and standards, estimation methods, training for personnel, and resources allocated for data collection (UNSD 1982).

It is generally agreed that high-quality data are vital for decision making, yet a systematic approach to their generation is rare in developing countries. The acquisition, processing, and storage of environmental data are time-consuming and expensive, and not a priority for most governments. Consequently, baseline and trend data about how the ecosystem functions, and how its components interact, are insufficient. Available data tend to be scattered and difficult to collate, while proprietary and security factors can inhibit dissemination and open access. Environmental and socioeconomic data do not generally exist in usable and integrated formats for reporting. There are often deficiencies in infrastructure and standards to facilitate the easy exchange and correlation of data from different jurisdictions and disciplines.

The sources of environmental data include agencies responsible for environmental and resource monitoring, as well as results of statistical surveys, mapping, and remote sensing. Environmental statistics is a challenging field, in part because of its unique nature. One crucial element is the procedure for data collection. Economic and social statisticians collect data they require by using official registers of firms and relying on censuses and field surveys of enterprises and individuals. The same methods cannot be used for environmental statistics. Instead, much of the raw data are obtained from instrument reading and other collection activities

conducted by sources outside national statistics offices (NSOs) (Rump 1996).

Another distinguishing characteristic of environmental statistics is the lack of a precise system to compile and record quantitative data, unlike the System of National Accounts (SNA). The SNA is an intricate system founded on a generally accepted model of economic exchanges and flows and is supported by a standard set of concepts and definitions. Relationships between different parts of the SNA are clearly specified in terms of accounting identities, and elements can be easily aggregated or disaggregated. No equivalent system exists for environmental statistics, probably due to practical and theoretical difficulties in the valuation of environmental resources and the difficulties in expressing results in terms of a common numeraire.

The environmental data needs of policymakers change markedly over time and statisticians have to adapt as a country's network of environmental policies and regulations evolves. Whatever data are available are invariably collected for monitoring environmental change. Most of the available data are qualitative rather than quantitative (UNEP 1994). Therefore, to start with, the NSOs will have to make an inventory of data available, assess their quality, and compile environment-related data including meta data (or data as text or graphics that describe and document a data set) in the form of a "compendium of environmental statistics" (CES). Efforts to enhance environmental statistics should follow from there.

ADB EFFORTS

Following RETA Project 5542 of 1993, the ADB initiated another regional technical assistance (RETA Project 5555) in 1995 to strengthen the collection of environmental statistics in 11 selected DMCs (see Appendix 2) (ADB 1998). Major outputs in the first phase of the new Project consisted of establishment of environmental statistics units in NSOs, preparation of a framework for the development of environmental statistics and a CES from existing data sources, and identification of environmental indicators that are likely to be relevant for environmental policies of the government as well as for ADB operations. Regu-

lar updating of the CES would not only be useful for the DMCs, but also for the ADB to evaluate the performance of its programs for environmental improvement and sustainable development in various DMCs. The second phase began in 1999, which involves replicating the first phase in five additional Central Asian DMCs.

The ADB selected a set of environmental indicators for the participating DMCs from the CES prepared by each country (see Appendix 3). The selection was based on several criteria, including the environmental issues receiving the highest national priority (as evidenced during discussions held at the country level), the availability of data in the CES, and the list of environmental and related socioeconomic indicators developed by UNSD. The list of selected environmental indicators could be modified to include additional indicators of priority concern to individual DMCs and should be updated on a regular basis as and when data are available in the countries. The resulting databases can then be used in trend analysis and for monitoring changes in environmental attributes of DMCs.

LIMITATIONS OF AND WEAKNESSES IN DATA COMPILATION

While the ADB's present work on environmental indicators is a useful exercise, it has some limitations. Most of the participating DMCs were preparing their CES for the first time. The NSOs relied on data supplied by these various national agencies. Data on environmental and socioeconomic attributes were collected independently of NSOs by these various agencies, using different methods and classifications, and for specific purposes. Thus the format of data was designed to suit the needs of the original purpose and not necessarily the requirements of the NSOs.

The CES was prepared using administrative records as well as other existing data in the countries. No attempts were made to collect additional data for this purpose. However, in the future, some environmental surveys might need to be conducted to collect and compile specific environment data that would otherwise not be

available. Environmental surveys can be expensive and will need specific expertise. The NSOs, as well as concerned environment-related agencies, should examine the possibility of including some relevant environment-related questions in the schedules of various surveys that they undertake on a regular basis. With regard to the core environment statistics based on instruments, the NSOs will need to work closely with the pollution control board or related agencies to facilitate and improve the collection of these statistics. The NSOs should also start recruiting environmental experts to meet the demand for specific expertise. These experts—with appropriate statistical training—can contribute to the development of environmental statistics in DMCs.

Before ADB's RETA projects, there was a lack of coordination among various agencies responsible for generating environmental statistics. After the projects, some coordination through the creation of interagency committees headed by the NSOs was established in all participating countries (ADB 1999). This has created an opportunity for NSOs to access environmental and socioeconomic data, and compile them in the CES. Even then, complete sharing of all the available data in the countries has not always been possible. There is a need to further strengthen the coordination mechanism so as to avoid duplication in the collection and compilation of environmental statistics from various environment-related agencies.

The countries did not use a common year for data compilation in their CES; there were variations not only between countries, but also between data sets developed within countries. This limitation made it difficult to compare environmental indicators not only across but also within countries. There were also significant difficulties in making intercountry comparisons due to significant variations in the interpretations of terminology, classifications and standards, and methodology adopted in the collection of data, etc.

CONCLUSIONS AND RECOMMENDATIONS

RETA Project *5555* acquainted the DMCs with the concepts and methodologies related to collection and compilation of environmental statistics. It made possible the compilation of available data

into the CES within the United Nations Framework for the Development of Environment Statistics. The Project provides an insight into the future scope of work that needs to be carried out to improve environmental statistics and broaden their coverage. Building on existing information, questionnaire surveys can be carried out by the agencies responsible for dealing with environmental statistics, and common data formats identified to improve the quality of the current output and to update existing databases. The technical assistance will need to be extended to all DMCs so as to improve their environmental statistics capability. Its scope will also need to be widened.

A coordinated approach among various international organizations is required to develop a common set of environmental indicators to avoid duplication of work. UNSD is collaborating with OECD in data compilation from countries. The UNSD circulated its questionnaire on environmental indicators to non-OECD countries in 1999. The ADB may also consider coordinating with other international organizations for conducting similar collaborative programs, taking the lead in collecting and compiling environmental statistics, and developing environmental indicators for the Asian and Pacific region.

In conclusion, a wide range of experience in other parts of the world leaves no doubt as to the usefulness of indicators as a tool for redressing environmental problems. DMCs are still at a very early stage in the development of these indicators and there is an urgent need for more rapid progress. However, the first steps have been taken and further improvements are expected over the years. It will be vital to concentrate on the compilation of basic environmental statistics by first organizing existing data sources, and slowly improving from there, rather than developing entirely new environmental indicators in the remaining DMCs.

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Appendix 1

UNSD LIST OF ENVIRONMENTAL AND RELATED SOCIOECONOMIC INDICATORS

Agenda 21 Issues (Clusters)	A. Socioeconomic Activities/Events (pressure/ driving force)	B. Impacts and Effects (part of state)	C. Responses to Impacts (response)	D. Inventories, Stocks, Background Conditions (part of state)
AIR/ CLIMATE	Emissions of CO_2, SO_2 and NO_2 Consumption of ozone-depleting substances	Ambient concentrations of CO, SO_2, NO_2, O_2 and TSP in urban areas		Weather and climate conditions
LAND/ SOIL	Land use change Use of fertilizers Use of agricultural pesticides	Area affected by soil erosion	Protected areas as percentage of total land area	Arable land per capita
WATER Freshwater Resources	Annual withdrawals of ground- and surface water	Concentration of lead, cadmium, mercury, and pesticides in freshwater bodies	Wastewater treatment, total and by type of treatment (percentage of population served)	Ground water reserves
	Domestic consumption of water per capita	Concentration of fecal coliform in freshwater bodies Acidification of freshwater bodies BOD and COD in freshwater bodies	Access to safe drinking water (percentage of population served)	

OTHER NATURAL RESOURCES	Annual roundwood production	Deforestation rate	Reforestation rate	Forest inventory
Biological Resources	Fuelwood consumption per capita Marine catches	Threatened, extinct species	Protected forest area as percentage of total land area	
Mineral (including energy) Resources	Annual energy consumption per capita Extraction of other mineral resources	Depletion of mineral resources (percentage of proven reserves)		Proven mineral reserves Proven energy reserves
WASTE	Municipal waste disposal Imports and exports of hazardous wastes			
HUMAN SETTLEMENT	Rate of growth of urban population Percentage of population in urban areas Motor vehicles in use per 1,000 habitants	Area and population in marginal settlements Percentage of population with sanitary services		
NATURAL RESOURCES	Frequency of natural disasters	Number of injuries and fatalities related to natural resources		

Notes: CO_2 – carbon dioxide
SO_2 – sulfur dioxide
NO_2 – nitrogen dioxide
O_2 – oxygen
TSP – total soluble phosphates
BOD – biological oxygen demand
COD – carbon dioxide demand

Appendix 2

RETA 5555: INSTITUTIONAL STRENGTHENING AND COLLECTION OF ENVIRONMENT STATISTICS IN SELECTED DMCS

A regional technical assistance (RETA Project 5555) for strengthening and collecting environment statistics was initiated by ADB in 1995 covering 11 Asian and Pacific DMCs.[1] The RETA had the following objectives:

- assist the selected DMCs in strengthening the institutional capacities of their national statistical agencies in the collection of environmental statistics and indicators, and in establishing institutional linkages with other agencies involved in the collection and compilation of environment-related data;
- assist in preparing country-specific frameworks for development of environmental statistics; and
- assist in developing a data base on environmental statistics and indicators through the preparation of a compendium of environmental statistics (CES).

Environmental indicators can be developed and organized using several frameworks. There is no particular framework unique to all environmental indicators. The DMCs prepared their CES applying the commonly used UN framework for development of environmental statistics. The country-specific frameworks were specially aimed at:

- reviewing the country's major environmental concerns and identifying the issues that can be measured in quantifiable terms;
- listing variables or indicators that can be used to measure different aspects of these environmental issues; and
- evaluating data requirements, availability, and sources.

The CES listed the priority environmental and related socioeconomic issues of each country and compiled data on these priority issues. These data were later reviewed to generate the environmental indicators. Data generated by the CES and from various national and international publications tapped by ADB for its operational use have constituted an integrated data source of selected environmental indicators for the participating DMCs.

[1]The following DMCs were covered: Bangladesh, India, Indonesia, Malaysia, Nepal, Pakistan, Philippines, Samoa, Sri Lanka, Vanuatu, and Viet Nam.

Appendix 3

ADB's RECOMMENDED LIST OF ENVIRONMENTAL INDICATORS

I. **FLORA**

A. Threatened species as percentage of total native species
   1. Flowering plants
      i. Rare
      ii. Vulnerable
      iii. Endangered/endemic
   2. Nonflowering plants
      i. Rare
      ii. Vulnerable
      iii. Endangered/endemic
B. Extinct species as percentage of total native species
C. Possibly extinct species as percentage of total native species

II. **FAUNA**

A. Threatened species as percentage of total native species
   1. Vertebrates
      i. Rare
      ii. Vulnerable
      ii. Endangered/endemic
   2. Nonvertebrates
      i. Rare
      ii. Vulnerable
      iii. Endangered/endemic
B. Extinct species as percentage of total native species
C. Possibly extinct species as percentage of total native species

III. **CONSERVATION MEASURES**

A. Within habitats (in situ)
   1. Biosphere reserves
   2. National parks
   3. Sanctuaries
   4. Reserve forests
   5. Other protected measures
B. Outside habitats (ex situ)
   1. Botanic gardens
   2. Gene banks
   3. Others

IV. **AIR/ATMOSPHERE**

A. Ambient air quality in major cities
   (annual averages and 24-hour averages; in ug/m^3)

   1. Concentration of SO_x
   2. Concentration of NO_x
   3. Concentration of SPM

B. Emissions per WHO/National Standard
(e.g., parts per million, parts per volume)
1. Carbon dioxide
2. Hydrochloric acid
3. Lead concentration
4. Carbon dioxide
5. Others (e.g., CH_4, CFCs, etc.)

C. Energy consumption
1. Percentage of households using different fuels for cooking
i. Cow dung
ii. Electricity
iii. Coal/coke
iv. LPG
v. Fuelwood
vi. Solar power
vii. Biogas
viii. Kerosene
2. Electricity generation
i. Renewable (mgw)
ii. Nonrenewable (mgw)

D. Meteorological information
1. Rainfall
2. Humidity
3. Wind speed
4. Others

V. **WATER**

A. Fresh water
1. Surface water
i. Rainfall
ii. Water quality standard
a. Dissolved oxygen level
b. Biological oxygen demand level
c. Carbon dioxide level
d. Total solids
e. Coliform concentration
f. Heavy metal concentration
2. Ground water
i. pH
ii. Turbidity
iii. Metal concentration
a. Arsenic
b. F
c. Chlorine
d. Nitrate

B. Marine water
1. Length of marine coastline (km)
2. Area (sq km)
3. Population (m)

4. Coastal vegetation
    i. Mangroves as percentage of total forest cover
    ii. Lagoons
    iii. Estuaries
    iv. Coral reefs
5. Relative fragility (percent)
6. Preservation area (percent)

VI. **LAND/SOIL**

A. Land use (million ha)
    1. Geographic area (sq km)
    2. Reporting area for land utilization
B. Forest areas
    1. Forests
    2. Not available for cultivation
        i. Nonagricultural
        ii. Barren and uncultivated land
    3. Other cultivated land
        i. Permanent pastures and other grazing land
        ii. Miscellaneous tree crops and grooves
        iii. Cultivated wasteland
    4. Gross cropped areas
    5. Cropping intensity
C. Wetlands
D. Irrigated area
E. Soil erosion
    1. Percentage area
    2. Pesticide level
    3. Consumption of fertilizers (t)
F. Land area on waste disposal
    1. Industrial
    2. Municipal
    3. Hazardous
    4. Mining
    5. Others

VII. **HUMAN SETTLEMENTS**

A. Total population
    1. Urban
    2. Rural
B. Population below poverty line
    1. Urban
    2. Rural
C. Slum population (classwise)
D. Number and percentage of facilities
    1. Dwelling units
    2. Sanitation
    3. Drinking water
    4. Others
E. Urban agglomeration
F. Life expectancy and mortality rates and causes

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