

**INDICATORS OF SUSTAINABLE
DEVELOPMENT:
GUIDELINES AND METHODOLOGIES**

PREFACE

The present publication represents the outcome of a work programme on indicators of sustainable development approved by the Commission on Sustainable Development at its Third Session in 1995. The successful completion of the work programme is the result of an intensive effort of collaboration between governments, international organizations, academic institutions, non-governmental organizations and individual experts aimed at developing a set of indicators for sustainable development for use at the national level. The thematic framework, guidelines, methodology sheets and indicators set out in this publication have thus benefited from this extensive network of cooperation and consensus building.

This has been an iterative process built on the work of many other organizations and entities that have been concerned with developing a set of indicators that could help us better understand the various dimensions of sustainable development and the complex interactions that takes place between these dimensions. This publication should be seen as a starting point and flexible tool to assist those countries that may wish to develop their own national programmes for using indicators to measure progress towards nationally defined goals and objectives for sustainable development.

The purpose of this publication is to stimulate and support further work, testing and development of indicators, particularly by national governments. No set of indicators can be final and definitive, but must be developed and adjusted over time to fit country-specific conditions, priorities and capabilities. It is our hope that countries will take advantage of the useful information and practical experience represented by this publication to further advance the work on indicators of sustainable development by adding their own unique perspectives to what already has been learned. We look forward to including your experience in our database of information on the development and use of indicators of sustainable development.

On behalf of the United Nations, I would like to thank all of those organizations, agencies and individuals who have contributed their time and effort to make this publication possible.

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Director
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INTRODUCTION

CHAPTER 1: INTRODUCTION

Indicators can provide crucial guidance for decision-making in a variety of ways. They can translate physical and social science knowledge into manageable units of information that can facilitate the decision-making process. They can help to measure and calibrate progress towards sustainable development goals. They can provide an early warning, sounding the alarm in time to prevent economic, social and environmental damage. They are also important tools to communicate ideas, thoughts and values because as one authority said, “We measure what we value, and value what we measure.”

The 1992 Earth Summit recognized the important role that indicators can play in helping countries to make informed decisions concerning sustainable development. This recognition is articulated in Chapter 40 of Agenda 21 which calls on countries at the national level, as well as international, governmental and non-governmental organizations to develop and identify indicators of sustainable development that can provide a solid basis for decision-making at all levels. Moreover, Agenda 21 specifically calls for the harmonization of efforts to develop sustainable development indicators at the national, regional and global levels, including the incorporation of a suitable set of these indicators in common, regularly updated and widely accessible reports and databases.

In response to this call, the Commission on Sustainable Development approved in 1995, the Programme of Work on Indicators of Sustainable Development and called upon the organizations of the UN system, intergovernmental and non-governmental organizations with the coordination of its Secretariat to implement the key elements of the work programme.

The main objective of the CSD Work Programme was to make indicators of sustainable development accessible to decision-makers at the national level, by defining them, elucidating their methodologies and providing training and other capacity building activities. At the same time, it was foreseen that indicators as used in national policies could be used in the national reports to the Commission and other intergovernmental bodies.

The Nineteenth Special Session of the General Assembly held in 1997 for the five year review of UNCED affirmed the importance of the work programme on indicators of sustainable development (as contained in para. 111 and 133.b of the Programme for the Further Implementation of Agenda 21) in coming up with a practical and agreed set of indicators that are suited to country-specific conditions and can be used in monitoring progress towards sustainable development at the national level.

This report has been prepared as the culmination of the CSD Work Programme on Indicators of Sustainable Development (1995-2000). It provides a detailed description of key sustainable development themes and sub-themes and the CSD approach to the development of indicators of sustainable development for use in decision-making processes at the national level. This report also finalizes the presentation of the proposed framework and the core set of indicators that will be made available to member countries to assist them in their efforts to measure progress toward sustainable development.

ASSESSING PROGRESS TOWARDS SUSTAINABLE DEVELOPMENT

CHAPTER 2: ASSESSING PROGRESS TOWARDS SUSTAINABLE DEVELOPMENT

A. The CSD Work Programme on Indicators of Sustainable Development

The CSD work programme comprised the following key elements:

- (a) Enhancement of information exchange among all interested actors on research, methodological and practical activities associated with indicators of sustainable development, including the establishment of a freely accessible database (1995-continuing);
- (b) Development of methodology sheets, which would describe for each of the indicators its policy relevance, underlying methodology, data availability assessment and sources, to be made available to Governments (1995-1996);
- (c) Training and capacity building at the regional and national levels in the use of the indicators for monitoring progress towards sustainable development (1995-1999);
- (d) Testing of an appropriate combination of indicators and monitoring of experiences in a few countries to gain experience, assess applicability and further develop the indicators for sustainable development (1996-1999);
- (e) Evaluation of the indicators and adjustment as necessary (2000);
- (f) Identification and assessment of linkages among the economic, social, institutional and environmental elements of sustainable development to further facilitate decision-making at all levels (2000);
- (g) Development of highly aggregated indicators, involving experts from the areas of economics, the social sciences and the physical sciences and policy makers as well as incorporating non-governmental organization and indigenous views (2000).

B. Main Phases And Approaches To Implementation

Phase 1 (May 1995-August 1996)

(a) Development of the Indicator Methodology Sheets

One of the significant tasks of the first phase was the preparation of the methodology sheets for each indicator. Building on existing work, a cooperative, consultative, and collaborative approach was used to produce the methodology sheets. More than thirty organizations of the United Nations system, other intergovernmental, non-governmental and major group organizations supported this work, assuming lead roles in the drafting of methodology sheets appropriate to their mandate and experience.

An Expert Group, consisting of forty-five (45) members from non-governmental organizations and United Nations agencies, guided the overall process of developing the methodology sheets. In addition, approximately 100 individuals with indicator experience from international and national agencies, and non-governmental organizations participated in the process by providing advice and comments and contributing their ideas, information and expertise.

In February 1996, an international Expert Workshop on Methodologies for Indicators of Sustainable Development was held in Glen Cove, New York to review the preliminary methodology sheets. Several workshops sponsored by national governments were also held to further discuss and refine the draft methodology sheets.

The collection of methodology sheets was published by the United Nations in August 1996 under the title of “*Indicators of Sustainable Development: Framework and Methodologies*”. This document, commonly referred to as the ‘blue book’, was distributed to all governments with the invitation to use and test the indicators, and to provide feedback on the results. The goal was to have a more accepted and definitive set of sustainable development indicators by the year 2001.

(b) Content of the Methodology Sheets

The methodology sheets contain, inter alia, the following information:

- Basic information on the indicator, including its definition and unit of measurement. In addition, the relevant Agenda 21 chapter and the type of indicator are listed to locate the indicator in the DSR framework;
- Purpose and usefulness of the indicator for sustainable development decision-making (i.e., policy relevance); international targets where these are available; and the relevant international conventions, if the indicator is primarily of global significance;
- Conceptual underpinnings and methodologies associated with the indicator, including the underlying definitions, measurement methods, and a summary of its limitations and alternative definitions;
- Data availability to illustrate the importance of regular data collection and updating to support systematic reporting;
- Listing of the agency(ies) (lead and cooperating) involved in the preparation of the methodology sheets; and
- Other information (e.g., contact points, other references and readings).

A conscious effort has been made to use a consistent format to frame the contents of the methodology sheets. The methodology sheets were designed to assist countries with the task of developing the priority indicators that are considered most relevant in the context of their

sustainable development policies and programs. The methodology sheets were to form a base and starting point for the process of indicator development and were understood to be open for enhancement, refinement, amendment, and change.

Phase 2 (May 1996-January 1998)

(b) Training and Capacity-Building

To address the need for building the necessary capacity and knowledge on the use of indicators, a series of briefing and training workshops at the regional level was initiated from November 1996 through June 1997. These were organized by the CSD Secretariat with the support and cooperation of the Economic and Social Commission for Asia and the Pacific (ESCAP) and the Government of the Netherlands for Asia and the Pacific; the Government of Costa Rica for Latin America and the Caribbean; and by the Government of Ghana for the Africa region. The Africa regional workshop was co-sponsored by UNDP's Capacity 21 Programme.

The main objective of all the workshops was to provide an introduction and training in the use of indicators as tools for national decision-making and to explore related methodologies for indicator development. Special attention was given to identifying national priorities and relating them to the process of indicator identification and selection.

Several countries followed up on the regional workshops with national training workshops. In the Asian and Pacific region, ESCAP provided seed money for implementation of national training workshops, which were convened in China, the Maldives, Pakistan and the Philippines.

(b) National Testing

At the Fourth Session of the CSD in 1996, the Commission encouraged Governments to pilot test, utilize and experiment with the proposed initial set of indicators and related methodologies over a 2-3 year period. The purpose of the national testing was to gain experience with the use of indicators, to assess their applicability according to national goals and priorities of sustainable development, and to propose changes to the set and its organizational framework.

The national testing programme was launched in November 1996, on the occasion of the International Workshop on Indicators of Sustainable Development held in Ghent, Belgium and hosted by the Governments of Belgium and Costa Rica. The countries attending the meeting reviewed and endorsed the guidelines for national testing. The guidelines essentially provided suggested testing procedures, including modalities for its organization, implementation options, assessment and evaluation methods, institutional support and capacity building, and reporting requirements.

Twenty-two (22) countries covering all regions of the world participated, on a voluntary basis, in the testing process. By regions, the testing countries were:

Table 1: Testing Countries

Regions	Countries
Africa:	Ghana, Kenya, Morocco, South Africa, Tunisia
Asia and the Pacific:	China, Maldives, Pakistan, Philippines
Europe:	Austria, Belgium, Czech Republic, Finland, France, Germany, United Kingdom
Americas and the Caribbean:	Barbados, Bolivia, Brazil, Costa Rica, Mexico, Venezuela

In addition to the official testing countries, a number of countries (Canada, Nigeria, Switzerland, and the United States, among others) were affiliated with the process through voluntary sharing of information, participation in meetings and other forms of exchange of expertise. The Statistical Office of the European Communities (Eurostat) prepared a test compilation of 54 CSD indicators drawing on statistical data existing within the European Community. This pilot study was produced as an official publication of the European Communities in 1997. Eurostat provided invaluable technical and substantive support throughout the CSD Work Programme and latest produced a publication containing the CSD indicators for the European level¹.

Countries were requested to provide periodic reports on the testing phase to the DSD for analysis and for circulation to members of the Expert Group and testing countries. A format for reporting on the progress of national testing was issued in 1997 to facilitate the submission of consistent and detailed information that would allow for a final revision of the indicators and related methodologies. The reports of all the testing countries can be found on the Secretariat web site at: <http://www.un.org/esa/sustdev/isd.htm>.

Most of the testing countries adopted different approaches to the testing exercise, ranging from plain evaluation of data availability for all or a few selected indicators to embarking on the whole process of developing their own independent set of national indicators while using the CSD indicators as a point of reference. Nevertheless, the majority of the countries aligned their processes with the CSD Testing Guidelines while others integrated the guidelines into their own unique design.

All the testing countries employed participatory implementation strategies. This is evident in the respective institutional arrangements chosen by countries as the coordinating mechanism for the testing process. The majority of the countries adopted highly integrated multi-stakeholder strategies involving government ministries, NGOs, academia and relevant business organizations (as in the case of the Philippines, Ghana, Kenya, South Africa, Maldives, United Kingdom) while others confined the process within government ministries (as in the case of China, Austria, Belgium, Brazil).

¹ Statistical Office Of The European Communities, *Measuring Progress Towards A More Sustainable Europe*, April 2001.

Within these national coordinating bodies, most of the countries also created working groups, expert teams and committees that focused on the indicator work. The formation of an Indicator network (for instance, in South Africa and Finland) was also found useful in fostering the integration of ministries and research institutions.

Several countries also experimented with “twinning” where two or more countries agreed to either engage in mutual exchange of information and experience in indicator development (e.g., South Africa and Finland) or where one country provided significant technical and financial support to another participating country (France and Tunisia). These arrangements provided an excellent platform for information exchange and sharing of expertise creating win-win situations with the involved countries achieving a wider knowledge base.

Midway through the implementation of the testing programme, a global meeting of testing countries was hosted by the government of the Czech Republic in Prague in January 1998. The meeting took stock of the progress of implementation and discussed ways to improve the process and ultimately the results of the programme.

Phase 3 (January 1999 - December 2000) – Lessons Learned

(a) Evaluation of the Testing Results and Indicator Set

The testing phase was officially concluded in December 1999 with the International Workshop on CSD Indicators of Sustainable Development, hosted by the Government of Barbados, and supported by the Government of Germany and DSD. This meeting provided the forum for the assessment of the CSD indicators of sustainable development, their applicability and usefulness in supporting national decision-making; and served as a venue for exchange of information at the national, regional and global level on sustainability indicators and their practical use.

All relevant information on the testing programme including country reports was compiled and organized into a database (CSD ISD Database). This database served as an analytical tool for reviewing testing results, the indicator framework and the working list of indicators.

Many countries pointed out that the testing process was, in general, a successful exercise. The highly participatory approach adopted by countries in the testing exercise not only heightened awareness of the value and importance of indicators but also increased levels of understanding on sustainable development issues. Moreover, the testing has reportedly inspired the launching of other indicator initiatives and has tied many players together.

In many cases, making use of existing structures, such as national committees or councils for sustainable development was seen as useful in organizing the national coordinating mechanism. On the other hand, in some countries, the testing of indicators acted as a positive catalyst in the establishment of new mechanisms for coordinating both the indicators programmes and the formulation of sustainable development strategies and has demonstrated the potential of collaboration and cooperation in advancing the goals of sustainable development.

The involvement of major groups and stakeholders had been found effective in achieving the full integration of user perspectives in the identification of national sustainable development priorities and corresponding indicators. Many developing countries, NGOs, the private sector and other major groups have already been involved in the national coordinating committees for environment and sustainable development, and their participation gave impetus to the national testing process.

It was also noted that when high-level policymakers have been involved and are genuinely committed to sustainable development, the work on indicators progressed more rapidly.

Notwithstanding the aforementioned successes, several institutional constraints affected the implementation of the testing, such as, limitations on the availability of financial and human resources; difficulty in mobilizing the relevant experts and stakeholders, lack of coordination between statistical agencies and the indicator focal point, low level of awareness among stakeholders, low level of commitment on the part of participating institutions, competing work demands and government leadership transitions that resulted in discontinuities in the implementation of the indicator process. This called for beefing up capacity-building programs in the form of human resource and organizational development. A strong human resource base is central to the multi-stakeholder process as are properly coordinated and highly committed institutional mechanisms.

Time as well as financial constraints also affected the testing undertaken in some countries. In view of the need to go by the rather strict timetables of the testing process, adjustments had to be made on the degree and level of consultations.

To be more successful, it was also felt that the indicator programme should be viewed and treated as a more permanent programme that is closely linked with national reporting to the CSD and integrated with the development of national policy.

(b) The Working List of Indicators

Testing results showed that sustainable development indicators clearly have potential for assisting in national decision-making. Countries reported to have used or planned to use the indicators to:

- bring important issues to the political agenda;
- help to identify main trends in priority sectors;
- facilitate reporting on the state of sustainable development to decision-makers and the general public, both domestic and international;
- promote national dialogue on sustainable development;
- help to assess the fulfillment of governmental goals and targets, and in the revision of these goals and targets;
- facilitate the preparation and monitoring of plans;
- help to assess the performance of both policies and actions when implementing the plans;

- state the concept of sustainable development in practical terms; and
- focus the national and sectoral programmes and state budgets towards sustainability.

As can be expected, not all of the indicators in the working list were found relevant in the context of a testing country. In selecting the applicable indicators, most countries, engaged in a process of prioritising the indicators in relation to national goals using relevant criteria such as: availability and accessibility of data, usefulness and policy relevance. In general, however, the testing countries found the working list to be a good starting point for identifying options from which they could choose national indicators.

While testing had been carried out at the national level, it was nonetheless perceived to have an international context taking into account the mandate of CSD and the structure and content of the methodology sheets which describe commonly accepted methodologies, internationally harmonized terminology and internationally compatible classification systems. The primary goal of the indicator programme, however, is to develop a means to assist national decision-making. On the other hand, it is considered that a good indicator system should be able to reflect the specific issues and conditions of a country or a region but should nevertheless be harmonized internationally to the extent possible.

Some countries reflected in their reports the problem of establishing the link between national strategies and the indicators. This was particularly true for countries that had commenced their indicator programmes in the absence of an integrated sustainable development strategy. It is hoped that this will change as more countries develop national sustainability plans and the use of indicators of sustainable development gains momentum as a national planning tool.

Testing countries, however, also felt that improvements could be made both regarding the indicators and the methodology sheets. While the methodology sheets for the indicators were found particularly useful in drawing attention to improving the availability of data for monitoring the implementation of Agenda 21, a call was made for establishing more concrete and clearly defined concepts for the indicators.

Testing countries proposed to develop indicators to cover areas that had not been addressed in the testing such as: reef conservation and the health of reef ecosystems and specific coastal issues; energy; biotechnology; trade and environment; safeguarding of cultural heritage; social and ethical values; human resource development; under-employment; expatriate labour force; natural resource accounting; and capacity-building.

Most countries, nonetheless, shared the view that the final list of indicators should be short, focused, pragmatic and flexible so that it could be adapted to country-specific conditions.

(c) Revising the Framework and Indicator List

Guided by the reports from the testing countries and continuing expert discussions on the indicators and the framework, the DSD began, in early 1999, the process of defining the

appropriate measures to take in the light of the various concerns raised during the implementation of the work programme.

At its fifth meeting in April 1999, the Expert Group on Indicators of Sustainable Development discussed midstream actions to prepare for the conclusion of the work programme. The Group addressed the following issues: inclusion of new areas identified as priorities by the testing countries; deletion of issues less reported on by countries; possible revision of the DSR framework; selection of criteria for the core set of indicators and furthering the testing in selected countries.

While the DSR approach proved useful in organizing the indicators and the testing process as well, the Expert group felt that there was need to refocus the indicator framework to emphasize policy issues or main themes as recommended by a number of countries. It was felt that re-designing the indicator framework in this manner would make the value of indicator use more obvious and thereby help stimulate increased Government and civil society involvement in the use and testing of indicators. Following this resolution, a study was undertaken to design a theme-based indicator approach.

The resulting organization presents the indicators under four major dimensions, further broken down into themes and sub-themes. The determination of the major areas, themes and sub-themes was based on a broad range of information, the major ones of which were the reports of the testing countries and international initiatives that have measured or conceptualised sustainability. The testing reports were analysed to generate the following information: priorities that each country stated in order to achieve sustainable development, CSD indicators tested, considering why they tested them and what problems they had in the process, new indicators proposed and the criteria used by each country in the indicator selection. This is described in greater detail in Section III below.

Regarding other major international initiatives on indicator development, every effort was made to work towards convergence between the CSD effort and those of other organizations and agencies. Information was therefore analysed taking into account the goals identified by each international initiative and the indicators selected to measure progress towards those goals.

(d) Linkages and Aggregation

The Secretariat has initiated work on the linkages and aggregation of sustainable development indicators. An overview of the major initiatives in this area was produced as a Background Paper for the Ninth Session of the CSD in April 2001².

² United Nations Division for Sustainable Development, *Report on the Aggregation of Indicators for Sustainable Development: Background Paper No. 2*, CSD9 April 2001.

GUIDELINES FOR DEVELOPING A NATIONAL PROGRAMME OF INDICATORS OF SUSTAINABLE DEVELOPMENT

CHAPTER 3: GUIDELINES FOR DEVELOPING A NATIONAL PROGRAMME OF INDICATORS OF SUSTAINABLE DEVELOPMENT

The following guidance is intended to help countries in setting up their own national indicator programmes as a basis for monitoring the achievement of key national goals and objectives for sustainable development, using the framework and methodologies provided herein. These guidelines were used and enhanced by the 22 countries that volunteered to participate in the indicator pilot testing phase over a three-year period. To learn more of how countries have interpreted the guidelines as a starting point for national programmes please refer to Annex 3.

Procedures for the Development, Testing and Use of Indicators

The procedures and processes to be followed in developing, testing and using indicators of sustainable development will vary from country to country, depending on country specific conditions, national priorities and objectives, available infrastructure, expertise and the availability of data and other information for decision-making. Because the process requires the allocation of human and financial resources, a pragmatic, cost-effective approach is essential.

The following procedural issues are addressed: Organization; Implementation; Assessment and Evaluation; Institutional Support and Capacity Building; and Reporting.

3.1 Organization

The underlying theme of sustainable development is the integration of economic, social environmental issues in decision and policy making at all levels. This integration implies the involvement of virtually all traditional sectors of economic and government activity, such as economic planning, agriculture, health, energy, water, natural resources, industry, education and the environment, and so forth, according to the principal ministries of government. The assumption of integration is reflected in the indicators of sustainable development, which contain social, economic, environmental and institutional indicators, and should be taken up in mechanisms for institutional integration, such as national sustainable development councils, committees, and task forces as well as national strategies for sustainable development. This fundamental approach to sustainable development should be kept in mind in developing, testing and using indicators.

In many countries, responsibility for monitoring the achievement of national goals and objectives, including data collection, compilation and analysis of information resides in a number of institutions, including national statistical offices, sectoral ministries and national commissions for sustainable development. Responsibility may also be shared by governmental and non-governmental actors, and it may be supported by national, bilateral and international programmes and activities.

A coordination mechanism for the development of a national programme on indicators may be needed to facilitate networking amongst interested partners. The **national coordinating mechanism** could take a variety of forms depending on each countries' needs and requirements. It could be set up as a Task Force, Working Group or a Committee, among other possibilities. It

should, however, build upon and utilize already existing institutional arrangements and experience and should be flexible and transparent making use of the widest possible consultation and participation among all stakeholders involved. It should therefore involve among others, those ministries with programmes relevant to Agenda 21 (for example, Ministries of Planning, Health, Agriculture, Industry, Social Development and the Environment, among others) as well as those agencies charged with data collection, compilation and analysis in the country.

The **national coordinating** mechanism might usefully include officials from the national delegation to the UN Commission on Sustainable Development, when possible, or representatives of the Ministry of Foreign Affairs. Members of the scientific community could be included to provide technical support and expertise and linkage with other international or national programmes related to indicators of sustainable development.

Representation from national-level information activities sponsored by UN system organizations, such as the United Nations Development Programme, the Food and Agriculture Organization of the United Nations, the World Health Organization, the United Nations Environment Programme, and the UN Centre for Human Settlements (HABITAT), could also be included.

For countries that cooperate or “twin” with another country in developing indicators, it might also be useful to establish a bilateral committee, either as a subsidiary of the national coordinating mechanism or as a related entity. Twinning arrangements could include a broad exchange of views, learning from each other and supporting each other in setting up, starting and implementing the monitoring process.

Each national coordinating mechanism may wish to appoint a **National Focal Point** who would serve as the point of contact and liaison between members of the national coordinating mechanism. The **Focal Point** will be part of the national coordinating mechanism and serve to facilitate cooperation and communication among all participants. The focal point should be someone who can marshal the respect and commitment of the various cooperating ministries.

UN System organizations with indicator-related expertise at the country level could also be enlisted to assist the work of the national coordinating body.

3.2. Implementation

Before beginning implementation of the development phase, the national coordinating mechanism may, as a first step, wish to determine the current status of indicator use in the country. This includes, for example:

- determining which indicators are already being used within the country, by whom they are used, for what purposes and the degree of parallels with the CSD approach; and
- reviewing data already being collected for indicators or other uses, by whom, where and its availability.

An important step in the development process is to make clear the relationship between national priorities and strategies and the indicators to be selected for testing. The initial stages of implementation might then include the following:

- specifying a number of selected priority issues identified in the national strategy and selecting indicators from the CSD list that correspond to those priorities, and selecting country-specific indicators not identified in the CSD list, as needed;
- matching the Apriority@ indicators selected with the list of indicators already in use in the country;
- assessing data availability for those Apriority@ indicators for which data are not already being collected;
- establishing necessary arrangements to collect the missing data, where possible, which may include modifying current data compilation arrangements where necessary;
- making an initial evaluation of any training and other capacity-building that may be needed to collect that data and to perform other functions required by the testing process;
- collecting and/or compiling data needed for the indicators selected; and
- developing a strategy for dissemination of indicator information to stakeholders (e.g., via annual reporting, headline indicators, news letters or bulletins).

3.3. Assessment and Evaluation

Assessment is a continuous process and should take place throughout the development phase and include members from ministries, experts, the scientific community and other sectors of civil society, as appropriate. It should focus, inter alia, on the technical, decision-making and institutional/capacity building issues outlined below:

Technical Issues:

- the **usefulness** of the **methodology sheets** for developing the indicators;
- the **availability of data** for the indicators and the **source, continuity, delivery** and **reliability** of that data;
- the **data product**; that is, the medium (e.g., print or electronic; short summaries, reports, or comprehensive publications) through which the analytical information is conveyed to the decision-makers; and
- planning for the short, medium – and long term data development.

Decision-Making Issues:

- the **usefulness** of the **indicators** for national decision-makers;

- the **analysis of the data** into concise, policy-relevant information; and
- the **use** to which the decision-maker puts the information.

Institutional Support and Capacity-Building Issues:

- the need for training;
- the need for institutional support for data collection and analysis;
- other capacity-building needs for the development of a national indicator programme; and
- an evaluation of the twinning process, where relevant, and of other international and bilateral cooperation of relevance to indicators of sustainable development.

3.4. Reporting

The national coordinating mechanism and the Focal Point may wish to establish a government web site or mechanism for regular reporting on progress during various phases of the indicator development work. This would provide a ready means of communicating results and obtaining feedback from the various participants. Regular meetings should also be held by the coordinating body during the course of its work. Results, difficulties and problems may also be reported to the CSD Secretariat in terms of any advice or support that the Secretariat may be able to provide.

At the end of the development phase, a final, comprehensive evaluation of the process may be needed in order to make further adjustments to the national indicators and methodology sheets. The CSD Secretariat would welcome such reports as a means of further assessing changes and modifications that may be required in the programme. The evaluation report could contain such items as:

- A. Introduction
 - 1. Background and objectives
 - 2. Identification of the users and relevance to national decision-making
 - 3. Institutional, organizational and resource arrangements for indicator development
 - 4. Experience with twinning, as applicable
- B. Identification and selection of the indicators

Description of the process through which the indicators were chosen, and the criteria for selection, including reference to:

 - 1. National strategies, targets and priorities
 - 2. Existing indicators and indicator programmes
 - 3. Data availability
 - 4. Other parameters
- C. Usefulness of the indicators
 - 1. Usefulness of the methodology sheets

2. Relevance of the data product
 3. Development of linkages among the indicators, of national indicator frameworks and of aggregated indicators
 4. Comments and suggestions on changes and improvements
- D. Challenges
1. Problems encountered in data availability, reliability and delivery
 2. Strengthening and training of human resources
 3. Other capacity-building needs
 4. Other
- E. Recommendations

CSD CORE INDICATOR FRAMEWORK

A framework for organizing the selection and development of indicators is essential. Nevertheless, it must be recognized that any framework, by itself, is an imperfect tool for organizing and expressing the complexities and interrelationships encompassed by sustainable development. Ultimately, the choice of a framework and a core set of indicators must meet the needs and priorities of users, in this case national experts, civil society groups and decision-makers responsible for the development and use of indicators to monitor progress towards sustainable development. It should be stressed that any country wishing to use indicators, in any systematic way, must develop its own programme drawing on the resources currently available. The CSD framework and core set of indicators outlined in this report provide a good starting point for such a national programme.

The framework employed in the CSD work programme to guide the selection of sustainable development indicators has evolved from a driving force-state-response approach to one focusing on themes and sub-themes of sustainable development. This change in organizational framework has been prompted by the experience of countries that assisted CSD in testing and developing indicators of sustainable development. An expert group advising CSD, as well as the testing countries themselves, recommended the adoption of a theme approach. What follows is a brief history of this evolution and the rationale for the change to achieve a small core set of sustainable development indicators useful for decision-makers.

The early indicator work under CSD organized the chapters of Agenda 21 under the four primary dimensions of sustainable development—social, economic, environmental, and institutional.³ Within these categories, indicators were classified according to their driving force, state, and response characteristics; adopting a conceptual approach widely used for environmental indicator development. Table 2 illustrates the essence of this framework. The term driving force represents human activities, processes, and patterns that impact on sustainable development either positively or negatively. State indicators provide a reading on the condition of sustainable development, while response indicators represent societal actions aimed at moving towards sustainable development. This organizational framework was an important starting point for the identification and selection of indicators, and was used to present a preliminary list of sustainable development indicators in the United Nations publication *Indicators of Sustainable Development: Framework and Methodologies*.⁴

³ United Nations Department of Economic and Social Affairs, *Work Programme on Indicators of Sustainable Development of the Commission on Sustainable Development*, Division for Sustainable Development, April 1999.

⁴ United Nations, *Indicators of Sustainable Development: Framework and Methodologies*, New York, 1996.

Table 2: DSR Framework for Sustainable Development Indicators

SD Dimension	Chapter of Agenda 21	Driving Force Indicators	State Indicators	Response Indicators
Social				
Economic				
Environmental				
Institutional				

Using this framework, methodology sheets for 134 indicators were developed by UN lead agencies and others as a preliminary working list for testing at the national level. Between 1996 and 1999, 22 countries from all regions of the world⁵ were engaged in the testing process on a voluntary basis to gain experience with the selection and development of sustainable development indicators and to assess their application and suitability to assist decision-making at the national level. The testing enabled countries to evaluate the appropriateness of the driving force-state-response framework; use alternative and supplementary indicators appropriate for national circumstances; and suggest additional indicators related to national priorities. In 1999, the testing results were reported to CSD at its Seventh Session and assessed at an International Workshop held in Barbados.⁶

Overall, testing countries reacted favourably to the testing experience especially from a capacity building perspective. However, countries made various comments and suggestions related to the framework, the selection of indicators, and the indicator methodology sheets. Some countries concluded that the driving force-state-response framework, although suitable in an environmental context, was not as appropriate for the social, economic, and institutional dimensions of sustainable development. Furthermore, gaps in the framework where appropriate indicators were unavailable hindered the selection of national indicator sets. This is particularly apparent with respect to response indicators. A further general reaction was that the working list of indicators was too long, which made it difficult to test and develop all indicators in a national context.

⁵ Austria, Barbados, Belgium, Bolivia, Brazil, China, Costa Rica, Czech Republic, Finland, France, Germany, Ghana, Kenya, Maldives, Mexico, Morocco, Pakistan, Philippines, South Africa, Tunisia, United Kingdom, and Venezuela.

⁶ See United Nations Department of Economic and Social Affairs, *CSD Work Programme on Indicators of Sustainable Development Progress Report*, Background Paper No. 7, Commission on Sustainable Development, Seventh Session, New York, 19-30 April 1999; and United Nations Department of Economic and Social Affairs, *Fifth International Workshop on CSD Indicators of Sustainable Development*, Division for Sustainable Development, Hosted by the Government of Barbados and sponsored by the Government of Germany, Bridgetown, Barbados, 7-9 December 1999.

4.1. Adoption of a Theme/Sub-theme Framework

With the background of the national testing experience and the overall orientation to decision-making needs, the Expert Group on Indicators of Sustainable Development recommended that the indicator framework be re-focused to emphasize policy issues or main themes related to sustainable development.⁷ To meet this recommendation, the framework has been revised and re-structured in an iterative and inclusive way through a consultant's study,⁸ the Barbados Workshop⁹, and a consultative group of experts.¹⁰

In essence, the rationale for the theme framework is to better assist national policy decision-making and performance measurement. More specifically, the following factors guided the development of the revised framework:

- country recommendations;
- the inclusion of common priority issues relevant to assessing sustainable development progress;
- the desire for comprehensiveness and balance across the sustainable development spectrum, as reflected in Agenda 21; and
- limiting the number of indicators to achieve a core set.

The theme framework has been developed to address the following considerations: future risks; correlation between themes; sustainability goals; and basic societal needs.¹¹ In addressing future risks, the framework becomes a proactive tool to assist decision-making especially where quantitative thresholds are known. Such sustainable development challenges, are reflected in many global, regional, and national assessments, such as UNEP's GEO-2000 report.¹² A successful framework should reflect the connections between dimensions, themes, and sub-themes. It should implicitly reflect the goals of sustainable development to advance social and institutional development, to maintain ecological integrity, and to ensure economic prosperity. Such goals echo basic human needs related to food, water, shelter, security, health, education, and good governance. The international community has established more specific benchmarks or targets for many of the themes and sub-themes. These reference levels are summarized in Annex 1.

⁷ United Nations Department of Economic and Social Affairs, *Report: Fifth Expert Group Meeting on Indicators of Sustainable Development*, Division for Sustainable Development, New York, 7-8 April 1999.

⁸ United Nations Department of Economic and Social Affairs, *UN CSD Theme Framework and Indicators of Sustainability*, Final Draft, PriceWaterhouseCoopers for Division for Sustainable Development, November 18, 1999.

⁹ United Nations Department of Economic and Social Affairs, *Fifth International Workshop on CSD Indicators of Sustainable Development*.

¹⁰ United Nations Department of Economic and Social Affairs, *Report of the Consultative Group to Identify Themes and Core Indicators of Sustainable Development*, Division for Sustainable Development, New York, 6-9 March, 2000.

¹¹ United Nations Department of Economic and Social Affairs, *UN CSD Theme Framework and Indicators of Sustainability*.

¹² United Nations Environment Programme, *GEO-2000: UNEP's Millennium Report on the Environment*, Earthscan Publications, 1999.

Each stage in the evolution of the theme framework carefully considered testing country priorities and experiences. A summary of these priorities, grouped according to the primary dimensions of sustainable development, is provided in Table 3. It should be noted that not all of these priorities are clearly reflected in the chapter structure of Agenda 21. Such priorities include, for example, significant sustainability elements such as crime, transportation, and energy. Furthermore, it is clear that the framework cannot totally capture all the themes or complexities of sustainable development. Users should be aware that elements such as mining, tourism, groundwater quality, and biotechnology, for example, are not specifically represented in the framework.¹³ For some of these areas, the primary difficulty lies in the absence of suitable and meaningful indicators, supported by well-tested and accepted methodologies for application at the national level. In other cases, there was a practical desire to limit the total number of indicators in the core set in order to be able to provide a synoptic overview of sustainable development progress at the national level.

Table 3: Key Themes Suggested by CSD Testing Country Priorities¹⁴

Social	Environmental
Education	Freshwater/groundwater
Employment	Agriculture/secure food supply
Health/water supply/sanitation	Urban
Housing	Coastal Zone
Welfare and quality of life	Marine environment/coral reef protection
Cultural heritage	Fisheries
Poverty/Income distribution	Biodiversity/biotechnology
Crime	Sustainable forest management
Population	Air pollution and ozone depletion
Social and ethical values	Global climate change/sea level rise
Role of women	Sustainable use of natural resources
Access to land and resources	Sustainable tourism
Community structure	Restricted carrying capacity
Equity/social exclusion	Land use change
Economic	Institutional
Economic dependency/Indebtedness/ODA	Integrated decision-making
Energy	Capacity building
Consumption and production patterns	Science and technology
Waste management	Public awareness and information
Transportation	International conventions and cooperation
Mining	Governance/role of civic society
Economic structure and development	Institutional and legislative frameworks
Trade	Disaster preparedness
Productivity	Public participation

¹³ United Nations Department of Economic and Social Affairs, *Report of the Consultative Group to Identify Themes and Core Indicators of Sustainable Development*.

¹⁴ Adapted from: United Nations Department of Economic and Social Affairs, *Testing the CSD Indicators of Sustainable Development: Interim Analysis: Testing Process, Indicators and Methodology Sheets*, Technical Paper prepared by the Division for Sustainable Development, 25 January 1999; and United Nations Department of Economic and Social Affairs, *UN CSD Theme Framework and Indicators of Sustainability*, Final Draft, PriceWaterhouseCoopers for Division for Sustainable Development, November 18, 1999

As a result of this iterative process, a final framework of 15 themes and 38 sub-themes has been developed to guide national indicator development beyond the year 2001. It covers issues generally common to all regions and countries of the world. It should be noted that the organization of themes and sub-themes within the four dimensions of sustainable development represents a 'best-fit' to guide the selection of indicators. This does not mean that issues should be considered exclusively within only one dimension. The social sub-theme of poverty, for example, has obvious and significant economic, environmental, and institutional linkages. The framework, together with the core set of sustainable development indicators, is summarized in Table 4 below. It is used to structure the methodology sheets for the core set of indicators contained in chapter 5.

For the full implementation of the CSD Indicator Programme and to assist countries to adopt and use the revised framework based on themes, it is important to note similarities and differences with respect to the driving force-state-response framework used during the testing phase. In the theme approach:

- the emphasis is on policy-orientated topics to better serve policy decision-making needs;
- the four primary dimensions of sustainable development--social, economic, environmental, institutional--are retained;
- the framework is not strictly organized by Agenda 21 chapters, but reference to pertinent chapters is provided in Table 4;¹⁵ and
- direct reference to the driving force-state-response framework has been discontinued, although it is still possible to categorize the individual indicators as driving force, state, or response measures (see Annex 2) and any country wishing to use this framework approach could easily do so according to this categorization.

¹⁵ The Agenda 21 context is also provided in the description of themes and sub-themes following.

Table 4: CSD Theme Indicator Framework

SOCIAL		
Theme	Sub-theme	Indicator
Equity	Poverty (3)	Percent of Population Living below Poverty Line
		Gini Index of Income Inequality
		Unemployment Rate
	Gender Equality (24)	Ratio of Average Female Wage to Male Wage
Health (6)	Nutritional Status	Nutritional Status of Children
	Mortality	Mortality Rate Under 5 Years Old
		Life Expectancy at Birth
	Sanitation	Percent of Population with Adequate Sewage Disposal Facilities
	Drinking Water	Population with Access to Safe Drinking Water
	Healthcare Delivery	Percent of Population with Access to Primary Health Care Facilities
		Immunization Against Infectious Childhood Diseases
		Contraceptive Prevalence Rate
Education (36)	Education Level	Children Reaching Grade 5 of Primary Education
		Adult Secondary Education Achievement Level
	Literacy	Adult Literacy Rate
Housing (7)	Living Conditions	Floor Area per Person
Security	Crime (36, 24)	Number of Recorded Crimes per 100,000 Population
Population (5)	Population Change	Population Growth Rate
		Population of Urban Formal and Informal Settlements
ENVIRONMENTAL		
Theme	Sub-theme	Indicator
Atmosphere (9)	Climate Change	Emissions of Greenhouse Gases
	Ozone Layer Depletion	Consumption of Ozone Depleting Substances
	Air Quality	Ambient Concentration of Air Pollutants in Urban Areas
Land (10)	Agriculture (14)	Arable and Permanent Crop Land Area
		Use of Fertilizers
		Use of Agricultural Pesticides
	Forests (11)	Forest Area as a Percent of Land Area
		Wood Harvesting Intensity
	Desertification (12)	Land Affected by Desertification
Oceans, Seas and Coasts (17)	Coastal Zone	Algae Concentration in Coastal Waters
		Percent of Total Population Living in Coastal Areas
	Fisheries	Annual Catch by Major Species
Fresh Water (18)	Water Quantity	Annual Withdrawal of Ground and Surface Water as a Percent of Total Available Water
	Water Quality	BOD in Water Bodies
		Concentration of Faecal Coliform in Freshwater
Biodiversity (15)	Ecosystem	Area of Selected Key Ecosystems
		Protected Area as a % of Total Area
	Species	Abundance of Selected Key Species

ECONOMIC		
Theme	Sub-theme	Indicator
Economic Structure (2)	Economic Performance	GDP per Capita
		Investment Share in GDP
	Trade	Balance of Trade in Goods and Services
	Financial Status (33)	Debt to GNP Ratio
		Total ODA Given or Received as a Percent of GNP
Consumption and Production Patterns (4)	Material Consumption	Intensity of Material Use
	Energy Use	Annual Energy Consumption per Capita
		Share of Consumption of Renewable Energy Resources
		Intensity of Energy Use
	Waste Generation and Management (19-22)	Generation of Industrial and Municipal Solid Waste
		Generation of Hazardous Waste
		Generation of Radioactive Waste
		Waste Recycling and Reuse
	Transportation	Distance Traveled per Capita by Mode of Transport
INSTITUTIONAL		
Theme	Sub-theme	Indicator
Institutional Framework (38, 39)	Strategic Implementation of SD (8)	National Sustainable Development Strategy
	International Cooperation	Implementation of Ratified Global Agreements
Institutional Capacity (37)	Information Access (40)	Number of Internet Subscribers per 1000 Inhabitants
	Communication Infrastructure (40)	Main Telephone Lines per 1000 Inhabitants
	Science and Technology (35)	Expenditure on Research and Development as a Percent of GDP
	Disaster Preparedness and Response	Economic and Human Loss Due to Natural Disasters

Numbers in brackets indicate relevant Agenda 21 chapters.

4.2. Core Indicators

Within the context of the theme framework, the objective of selecting a minimum number of indicators as a core set could be realized. Countries are encouraged to adopt and use this set as a starting point for their national indicator programmes. The core set is based on consultation with countries, particularly those represented in the testing programme, lead agencies within and beyond the UN system who have responsibilities for sustainable development including Agenda 21 implementation, and indicator experts. In addition, valuable guidance is provided by the results of the indicator testing experience itself. Table 5 provides a summary of the selection of indicators used by countries during the testing programme.

Table 5: Selection of CSD Indicators by Testing Countries¹⁶

Indicators Frequently Used	Indicators Used by Only One Country	New Indicators Suggested by Countries
Unemployment Rate	R&D expenditure for biotechnology	Incidence of environmentally related disease
Population growth rate	Population growth in coastal areas	% Population with access to health services
GDP per capita	Decentralized natural resource management	Crime rate
Domestic per capita consumption of water	Oil discharges into coastal waters	Incidence of street children
Land use change	Satellite derived vegetation index	Urban green space
Use of fertilizers	Welfare of mountain populations	Ground water pollution
Ratio of threatened species to total native species	Population living below the poverty line in dryland areas	Ratio of mining area rehabilitated to total mining area
Ambient concentration of urban air pollutants	Human and economic loss due to natural disasters	Area of specific ecosystems
Emissions of greenhouse gases		Ownership of agricultural land
Emissions of sulphur dioxides		Genuine savings ratio
Emissions of nitrogen dioxides		Traffic density
Annual energy consumption		Release of GMOs

With this background, the Consultative Group conducted an in-depth analysis of potential indicators appropriate for the core set.¹⁷ The Group vetted each indicator against selection criteria established under the CSD Indicator Work Programme.¹⁸ These criteria are that the indicators should be:

- primarily national in scope;
- relevant to assessing sustainable development progress;
- understandable, clear, and unambiguous, to the extent possible;
- within the capabilities of national governments to develop;
- conceptually sound;
- limited in number, but remaining open-ended and adaptable to future needs;
- broad in coverage of Agenda 21 and all aspects of sustainable development;
- representative of an international consensus to the extent possible; and
- dependent on cost effective data of known quality.

¹⁶ Adapted from: United Nations Department of Economic and Social Affairs, *Testing the CSD Indicators of Sustainable Development*; and United Nations Department of Economic and Social Affairs, *UN CSD Theme Framework and Indicators of Sustainability*

¹⁷ United Nations Department of Economic and Social Affairs, *Report of the Consultative Group to Identify Themes and Core Indicators of Sustainable Development*.

¹⁸ United Nations Department of Economic and Social Affairs, *Work Programme on Indicators of Sustainable Development*.

In applying the criteria, the Group relied particularly on the following factors during the selection process: feasibility to measure; relevance to national sustainable development priorities; and sub-theme representation. Subsequently, the Group examined the number of indicators in each sustainable development dimension, theme, and sub-theme to improve the balance of the core set. Throughout this analysis, emphasis was given to the use of absolute units for indicators wherever possible. Absolute values give a clear sense of what is being measured, and facilitate further analysis including the development of time series.

In summary, the theme framework and the core set have overcome many of the difficulties experienced with the 1996 Indicators of Sustainable Development Framework and Methodologies resource document used in the testing phase. The indicators clearly reflect common priorities among national and international issues. The number of indicators in the core set has been considerably reduced from the suggested preliminary list of indicators used in the testing phase. In total, 58 indicators are included in the core set compared to the original 134 presented by the 1996 publication. Problems associated with duplication, lack of relevance and meaningfulness, and absence of tested and widely accepted methodologies have largely been eliminated. Those indicators retained in the core set represent a better balance of the sustainable development themes common to national policy development, implementation, and assessment needs. Nevertheless, any suggested set of indicators must be adapted to country-specific conditions and needs and be subject to revision and updating over time as new experience is gained and new approaches and methodologies become available.

The theme framework and its set of sustainable development indicators meets the CSD indicator programme objective of having an agreed core set available for all countries to use by the year 2001. Wherever possible, the core indicators are common to other international initiatives. In this way, the core set represents a sound launching pad for national governments to develop their own indicator programmes and to monitor their own progress; especially against the goals and objectives of national sustainable development strategies and plans. It also represents a common tool to assist governments in meeting international requirements for reporting, including national reporting to CSD. Wide adoption and use of the core set would help improve information consistency at the international level.

As noted, countries will need to exercise flexibility and judgment in their efforts to develop national indicator sets for sustainable development. In this context, it is important to emphasize that the core set is considered sound and appropriate at this point in time. As the testing process clearly demonstrated, the institutional area needs further development and refinement in comparison to the other three dimensions.¹⁹ In addition, considerable care will need to be taken in the interpretation of certain indicator trends in the context of sustainability and linkages among themes. For example, the *use of agricultural pesticides* as an indicator recognizes the potential for enhanced productivity. Increased pesticide use, however, also has implications for water quality. With the indicator *floor area per person*, a decrease may imply overcrowding and deteriorating living conditions, while an increase suggests a higher level of

¹⁹ The need for better institutional indicators is addressed in Spangenberg, Joachim H., Pfahl, Stefanie, and Deller, Kerstin, *Elaboration of Institutional Indicators for Sustainable Development*, E. Schmidt Publications, Berlin, Germany, 2001 (in press).

material and energy consumption and land use. In other cases, methodological deficiencies or data access may make it difficult to develop a few of the indicators within certain countries, for example *mortality rate under five years old* or *intensity of material use*. In recognition of these difficulties, improvements will need to be defined and tested, and the framework and indicators should be periodically revisited and updated to reflect these advances.

Countries are encouraged to use the framework and core indicators in the way that best meets their specific needs related to sustainable development priority setting, policy making, monitoring, and evaluation. The framework and core set will play different roles depending on the state of indicator development in a specific country. Countries may wish to use the core set as a starting point to develop national sets, others may take the opportunity of using the core set to broaden the focus for specific dimensions to achieve a more comprehensive perspective on sustainable development. It may be appropriate for others to use the core set as a benchmark to verify or consolidate existing indicator programmes. It is unrealistic to expect that all the indicators of the core set will be of equal relevance to all countries, recognizing their diversity.

In using the CSD framework, countries may wish to focus on the specific themes of particular relevance to their needs, or expand the set of indicators to better satisfy their requirements and circumstances. Wherever possible, gender disaggregated data is recommended for the compilation of core indicators, for example, percent of the population living below the poverty line, Gini index of income inequality, unemployment rate, life expectancy, school completion ratio, adult literacy and nutritional status of children, among others. Countries may also wish to disaggregate some of the indicators to better cover such factors as age group or sub-national areas. Small Island States, for example, will obviously want to focus on the ocean-land interface, for example the issues of sea level rise, a limited economic sphere, and fragile ecosystems; while mountainous countries would most likely have different needs, requiring a somewhat modified set of indicators.

Many countries have experience in using indicators relevant to sustainable development. The use of these familiar measures should be encouraged to supplement and expand the core set for priority national issues. In other cases, countries may wish to supplement the core set with specific indicators from other international initiatives or to include more detailed sectoral indicators in some cases. Examples of pertinent Internet Web sites that focus on indicator development include: Compendium of Sustainable Development Indicator Initiatives and Publications (<http://iisd1.iisd.ca/measure/compendium.htm>); Development Indicators (<http://www.oecd.org/dac/Indicators/index.htm>); Environmental Economics and Indicators (<http://www-esd.worldbank.org/eei>); and Recommendations for a Core Set of Indicators of Biological Diversity (<http://www.biodiv.org/doc/sbstta-5.html>).

4.3. Theme Descriptions

Social

4.3.1. Equity

Sub-themes	Indicators
Poverty	Percent of Population Living Below the Poverty Line
	Gini Index of Income Inequality
	Unemployment Rate
Gender Equality	Ratio of Average Female Wage to Male Wage

Social equity is one of the principal values underlying sustainable development, with people and their quality of life being recognized as a central issue. Equity involves the degree of fairness and inclusiveness with which resources are distributed, opportunities afforded, and decisions made. It includes the provision of comparable opportunities of employment and social services, including education, health and justice. The notion can be relevant both within and between communities and nations. Significant issues related to the achievement of social equity include poverty alleviation; employment and income distribution; gender, ethnic and age inclusiveness, access to financial and natural resources; and intergenerational opportunity. Impoverished people may feel powerless and isolated, and face pervasive and systematic problems related to insecure livelihoods, malnutrition and poor health, illiteracy, civil insecurity linked to violence and strife, and corruption. The concentration of the rural poor on marginal land leads to resource over-exploitation and land degradation.

Agenda 21 addresses equity in chapters on poverty, changing consumption patterns, women, children and youth, and indigenous people.²⁰ It is also a significant cross-cutting consideration in many of the resource chapters including land, deforestation, desertification, sustainable agriculture, and biological diversity. International cooperation, fiscal mechanisms, education, capacity-building, access to information, and technology transfer are approaches aimed at achieving greater equity.

Many international conventions and summits, in addition to the Earth Summit, have addressed the importance of equitable treatment for individuals or groups. These include the Vienna Declaration of Human Rights, the World Summit for Children, the International Conference on Population and Development, the Fourth World Conference on Women, and the World Summit for Social Development, the Second Conference on Human Settlements, and the International Convention to Combat Desertification.²¹ The following commitments, for example, are derived from the World Summit for Social Development:

- poverty eradication in the world;
- full employment;

²⁰ United Nations, *Agenda 21: Programme of Action for Sustainable Development*, United Nations Conference on Environment and Development, Chapters 3, 4, 24, 25, and 26, Rio de Janeiro, Brazil, 3-14 June 1992.

²¹ United Nations Economic and Social Council, *Combating Poverty*, Report of the Secretary General, Commission on Sustainable Development, Fourth Session, 18 April-3 May 1996.

- social integration including equality of opportunity;
- equality between women and men;
- universal and equitable access to quality education and primary health care; and
- accelerated development in the least developed countries.²²

Despite these commitments, it appears that the world community and the majority of its member states are in many respects failing to achieve equitable societies, with the gap between the well-off and the poor widening substantially even in some of the more advanced countries. The spread of democracy and the development of trade, technology, and communication represent potentially positive forces to foster greater equity. Nevertheless, according to the 1999 Human Development Report, increasing concentrations of income, resources and wealth among people, corporations, and nations have occurred over the past decade.²³ Moreover, the income gap between the wealthiest 20% of the world's population and the poorest 20% has more than doubled over the last three decades. Currently, more than 1 billion people in the world live in abject poverty. According to the World Bank, the number of people living on less than \$2 a day in developing and transitional economies increased about 10% between 1987 and 1998.²⁴ Global capital flows are not helping to effectively address equity disparities. Foreign direct investments, for example, are highly concentrated, favouring selected countries and regions.²⁵ Indeed, if these trends persist, it is highly unlikely that international targets with respect to poverty will be met.²⁶

The indicators in the core set cover the issues of poverty, income inequality, unemployment, and gender equality. They represent priority issues for countries and the international community. The indicators are widely used, well-tested measures, associated with established goals and targets. The target of reducing the proportion of the population living in extreme poverty in developing countries by half by 2015 was accepted at the World Summit for Social Development. The Fourth World Conference on Women called for the elimination of discriminatory practices in employment. The general goal of full employment to enable men and women to attain secure and sustainable livelihoods was upheld at the World Summit for Social Development, while many countries have more specific national targets for unemployment.

²² United Nations, *Report of the World Summit for Social Development*, Copenhagen, Denmark, 6-12 March, 1995.

²³ United Nations Development Programme, *Human Development Report 1999*, Oxford University Press, New York, 1999.

²⁴ World Bank Group, *Poverty Trends and Voices of the Poor*, <http://www.worldbank.org/poverty/data/trends>.

²⁵ Rosati, Dariusz, *Managing Globalization with Equity*, in United Nations First Global Forum on Human Development, New York, 29-31 July, 1999.

²⁶ World Bank Group, *World Bank Warns Global Poverty Fight Failing, Unveils Enhanced Poverty Strategy*, News Release No. 2000/059/S, <http://www.worldbank.org/html/extdr/extme/059.htm>.

4.3.2. Health

Sub-themes	Indicators
Nutritional Status	Nutritional Status of Children
Mortality	Mortality Rate Under 5 Years Old
	Life Expectancy at Birth
Sanitation	Percent of the Population with Adequate Sewage Disposal Facilities
Drinking Water	Population with Access to Safe Drinking Water
Healthcare Delivery	Percent of the Population with Access to Primary Health Care Facilities
	Immunization Against Infectious Childhood Diseases
	Contraceptive Prevalence Rate

Health and sustainable development are closely connected. Safe water supply and sanitation, proper nutrition and a safe food supply, unpolluted living conditions, the control of disease, and access to health services all contribute to healthy populations. Conversely, poverty, lack of information and education, natural and human-induced disasters, and rapid urbanization can all exacerbate health problems. Pollution control and health protection services have often not kept pace with economic development. As a consequence, poor health is associated with decreased productivity, particularly in the labour-intensive agricultural sector.

Development cannot be achieved or sustained when a high proportion of the population is affected by poor health and inadequate access to health care facilities. While economic growth and development can contribute to improved health and better health care facilities in the poorest countries, there are also high and middle-income countries where further improvements are warranted. A clean environment is important to citizens' health and well-being. Unsustainable economic growth can also cause environmental degradation which, together with inappropriate consumption, can adversely influence human health.

Protecting and promoting human health in Agenda 21 focuses on the following interrelated issue areas:

- meeting primary health care needs, especially in rural areas;
- controlling communicable diseases;
- protecting vulnerable groups;
- meeting urban health needs; and
- reducing health risks from environmental pollution and hazards.²⁷

Within this context, the Commission on Sustainable Development has also identified priority areas for consideration including: the cumulative health effects of chemicals in consumer products, plant and animal-based food, water, soil and air; the identification and control of newly

²⁷ United Nations, *Agenda 21, Chapter 6*.

emerging infectious diseases and their possible environmental linkages; and the health implications of ozone layer depletion.²⁸

Societal interventions are aimed at strengthening primary health care systems related to the provision of clean water, adequate sanitation, and safe food through community-based, scientifically sound, and socially acceptable approaches. Safe water and sanitation, vaccine use, and education are recognized as the principal tools to tackle communicable diseases such as malaria, cholera, and HIV/AIDS. In meeting basic health care needs, particular attention must be given to vulnerable groups, including children, women, indigenous people, the poor, and the elderly and disabled.

Rapid urban growth can outstrip society's capacity to protect the environment and provide health care services. Air and water pollution in urban areas are associated with excess morbidity and mortality, while overcrowding and inadequate housing contribute to respiratory and other diseases. Environmental pollution as a result of energy production, transportation, industry, or lifestyle choices adversely affects health. This would include such factors as ambient and indoor air pollution, water pollution, inadequate waste management, noise, pesticides, and radiation. In addition, displaced persons due to civil strife or natural disasters usually face a degraded environment including severely limited potable water and food supplies, and inadequate sanitation.

Since the Earth Summit, some progress has been made in improving human health. Most countries have experienced declining infant mortality rates and an increase in life expectancy.²⁹ Nevertheless, progress has been slow and inadequate to meet many of the goals established by the international community. Currently, for example, at least 1.1 billion people still do not have access to clean water, while about 2.5 billion are without adequate sanitation.³⁰ In Africa, Asia, and Latin America and the Caribbean, the water supply and sanitation coverage in proportional terms increased between 1990 and 2000. However, due to population growth, the absolute number of people in Africa without suitable water access and sanitation has increased. This is also the case in Latin America and the Caribbean with respect to water supply. With this slow pace of progress, it is not reasonable to anticipate universal access to drinking water before 2025 in Asia, 2040 in Latin America and the Caribbean, and 2050 in Africa.³¹

In terms of communicable diseases, malaria is endemic in 101 countries, affecting some 2.4 million people worldwide. Mortality due to malaria is estimated to be over 1 million deaths per year, mostly young children in Africa. Dengue fever has spread rapidly in recent years, now being endemic in over 100 countries in Africa, the Americas, the Eastern Mediterranean, South-East Asia, and the Western Pacific. It is estimated that some 2.5 billion people are currently at

²⁸ United Nations Economic and Social Council, *Overall Progress Achieved since the United Nations Conference on Environment and Development: Protecting and Promoting Human Health*, Addendum Report of the Secretary General, Commission on Sustainable Development, Fifth Session, 7-25 April 1997.

²⁹ United Nations, *Earth Summit +5: Programme for the Further Implementation of Agenda 21*, June 1997.

³⁰ United Nations Economic and Social Council, *Progress Made in Providing Safe Water Supply and Sanitation for All During the 1990s*, Report of the Secretary General, Commission on Sustainable Development, Eighth Session, 24 April-5 May, 2000.

³¹ Ibid.

risk of infection.³² HIV infection levels reached 34.3 million people in 1999, including 1.3 million children under the age of 15.³³

The core indicators for health cover the key issues with measures that are widely accepted and have been available and in use for some time. In addition, goals established by the international community are available for the majority of these indicators.³⁴ With respect to nutrition, countries are encouraged to reduce severe and moderate malnutrition among under five year old children by 50% from 1990 to 2000. Again for under five year-olds, the goal is to reduce the 1990 mortality rate by two-thirds by 2015. The goals for drinking water, sanitation, and primary health care are to provide universal access. Several specific goals related to communicable childhood diseases were included in Agenda 21 including: the eradication of polio by 2000; universal immunization against measles, reduction of deaths due to diarrhoea by 50% by 2000, and a one-third reduction of deaths due to acute respiratory infections by 2000. In term of family planning, the international goal is to provide access to reproductive health services for all individuals of appropriate ages by 2015.

The core indicators can be used to measure national progress towards these health goals. It should also be noted that indicators under other themes of the framework cover issues that are closely related to human health. These would include, for example, *ambient concentration of air pollutants in urban areas, floor area per person, and use of agricultural pesticides*. Nevertheless, countries may wish to supplement this nucleus of indicators with others to give a broader and more detailed national health picture. For this, the health sector indicators developed by the World Health Organization are recommended.

4.3.3. Education

Sub-themes	Indicators
Education Level	Children Reaching Grade 5 of Primary Education
	Adult Secondary Education Achievement Level
Literacy	Adult Literacy Rate

Education, as a lifelong process, is widely accepted as a fundamental prerequisite for the achievement of sustainable development. It cuts across all areas of Agenda 21, being a particularly critical element in meeting basic human needs, and in achieving equity, capacity building, access to information, and strengthening science.³⁵ Education is also recognized as a means of changing consumption and production patterns to a more sustainable path.

Education, both formal and informal, is regarded as a process by which human beings and societies can reach their full potential. There is a close association between the general level

³² Ibid.

³³ UNAIDS, *Report on the Global HIV/AIDS Epidemic*, http://www.unaids.org/epidemic_update/report/index.html, June 2000.

³⁴ See the World Summit for Children, the World Summit on Social Development, the Fourth World Conference on Women, the World Food Summit, the International Conference on Population and Development, and Agenda 21 of the Earth Summit.

³⁵ United Nations, *Agenda 21, Chapter 36*.

of education attained and the persistence of poverty irrespective of the level of a country's development. It is vital to changing people's attitudes to achieve ethical awareness, values, attitudes, skills, and behaviour consistent with the goal of building a more sustainable society. In this way, people are better equipped to participate in decision-making that adequately and successfully addresses environment and development issues.

Education in Agenda 21 is organized around the three issues of:

- reorienting education towards sustainable development;
- increasing public awareness; and
- promoting training.

The primary objectives in addressing these issues include: striving for universal access to basic education, reducing adult illiteracy, integrating sustainable development concepts in all education programmes to achieve interdisciplinary learning, promoting broad public awareness, and strengthening vocational and scientific training. In this context, the CSD, through its UNESCO partner, has established an educational work programme to re-orient education towards sustainable development.³⁶

Progress has been made in most countries in improving access to education and in reducing illiteracy. However, adequate levels have yet to be attained in many countries. In 1998, for example, the adult literacy rates for the world and the least developed countries for those over 15 were 78.8% and 50.7% respectively.³⁷ Over 100 million children between the ages of 6 and 11 never attend school; while many more drop out within a few months or years of starting school.³⁸ As a result, approximately a billion people remain illiterate.³⁹

Within the CSD framework, the education theme provides core indicators that measure education level achieved and adult literacy. These are two of the key policy-relevant issues for countries related to basic education. The global community has established goals relevant to these indicators through the Convention on the Rights of the Child, the World Summit for Children, the World Conference on Education for All, the World Summit on Social Development, and the Fourth World Conference on Women.⁴⁰ These goals are to provide universal access to basic education with the completion of primary education by at least 80% of primary school-age children; and to reduce the adult illiteracy rate to at least half of its 1990

³⁶ The work programme was initiated at the Fourth Session of CSD in 1996, and adopted as an expanded version at its Sixth Session in 1998.

³⁷ United Nations Development Programme, *Human Development Report 2000*, <http://www.undp.org/hdr2000>.

³⁸ United Nations Educational, Scientific and Cultural Organization, *Education, Public Awareness and Training*, Addendum, Report of the Secretary General, Commission on Sustainable Development, Sixth Session, 20 April-1 May, 1998.

³⁹ United Nations Children's Fund (UNICEF), *The Progress of Nations*, New York, 1999.

⁴⁰ United Nations, *The Convention on the Rights of the Child*, 1989; United Nations, *World Summit for Children*, New York, 1990; United Nations Interagency Commission (UNDP, UNESCO, UNICEF, World Bank), *Final Report of the World Conference on Education for All: Meeting Basic Learning Needs*, Jomtien, Thailand, 5-9 March, 1990; United Nations, *Report of the World Summit on Social Development*; United Nations, *Fourth World Conference on Women*, Beijing, 1995.

level.⁴¹ The core indicators, which are generally consistent with the educational indicators of other international initiatives, can be used to measure national progress towards these goals.⁴² Countries may wish to supplement the core indicators with national measures to also address the topics of awareness raising and training. In addition, it would be appropriate for countries to disaggregate the core education indicators by gender to capture an important aspect of gender equality.

4.3.4. Housing

Sub-theme	Indicator
Living Conditions	Floor Area per Person

Adequate shelter is one of the essential components of sustainable development. The availability of adequate shelter substantially contributes to safer, more equitable, productive, and healthier settlements. Living conditions, especially in urban areas, are influenced by excessive population concentration, inadequate planning and financial resources, and unemployment. Rural-urban migration exacerbates this situation contributing to the development of slums and informal settlements. Poor living conditions are associated with poverty, homelessness, poor health, social exclusion, family instability and insecurity, violence, environmental degradation, and increased vulnerability to disasters.

The right to adequate housing is part of the Universal Declaration of Human Rights, the International Covenant on Economic, Social and Cultural Rights, the International Convention on the Elimination of All Forms of Racial Discrimination, the Convention on the Elimination of All Forms of Discrimination Against Women, and the Convention on the Rights of the Child. It is a major focus of the Global Strategy for Shelter to the Year 2000, the human settlements chapter of Agenda 21, and the Habitat II commitments.⁴³

Nevertheless, it appears that the gap between progress, and current and future needs continues to widen. By the year 2005, the majority of the world's population will live in urban areas. It has been estimated that up to a third of urban people live in sub-standard housing.⁴⁴ Many countries have made improvements in the formulation of housing policies and strategies aimed at accelerating construction, providing housing for low income groups, improving land and market conditions, and facilitating access to credit.⁴⁵ Yet, the conditions of shelter and human settlements have continued to deteriorate in most developing countries during the 1990s

⁴¹ See <http://www.unicef.org/wsc/goals.htm>.

⁴² For example, the International Consultative Forum on Education for All (EFA) reported in: United Nations Commission on Sustainable Development, *Progress Report on the Implementation of the Work Programme on Education, Public Awareness and Training*, Report of the Secretary-General, Eighth Session, 24 April-5 May, 2000.

⁴³ United Nations, *Agenda 21, Chapter 7*; and United Nations, *Second International Conference on Human Settlements (Habitat II)*, Istanbul, Turkey, June 1996.

⁴⁴ United Nations Economic and Social Council, *Assessment of Progress Achieved in Promoting Sustainable Human Settlement Development*, Report of the Secretary-General, Commission on Sustainable Development, Second Session, 16-27 May, 1994.

⁴⁵ United Nations Economic and Social Council, *Promoting Sustainable Human Settlement Development*, Addendum, Report of the Secretary-General, Commission on Sustainable Development, Fifth Session, 7-25 April, 1997.

reflecting the need for additional financing; improved partnerships between the private sector, governments, and communities; technology transfer, and increased capacity building.⁴⁶

To assess housing and living conditions, the CSD core set of indicators uses *floor area per person*--a key measure for the assessment of progress with respect to housing quality. Data to support the indicator are generally available at the country level, at least for specific urban areas. This indicator is part of the Housing Indicators Programme of the United Nations Centre for Human Settlements and the Common Country Assessment Framework.⁴⁷ No specific targets or thresholds have been established for this measure, although it does reflect the goal established at Habitat II of providing sufficient living space while avoiding overcrowding.

While the indicator provides a measure of overcrowding, it does not take into account cultural differences. In addition, high values for the indicator may suggest undue use of material, energy, and land detrimental to sustainable development. The interpretation of the indicator, therefore, requires care and judgement. Consideration of other core indicators such as *area* and *population of urban formal and informal settlements*, and *population growth rate* would support the commentary on this living condition measure.

4.3.5. Security

Sub-theme	Indicator
Crime	Number of Recorded Crimes per 100,000 Population

Crime prevention and criminal justice are an integral part of the development process. Civil society, good governance, and democracy rest on the promotion of justice as an essential condition for social stability, security, peace, human rights, and long-term sustainable development.⁴⁸ Such a stable and secure climate is necessary to support the goals of poverty eradication, economic investment, environmental stewardship, gender equality, participation, and sustainable livelihoods.

Security represents a new dimension in the revised framework for CSD indicators. This recognition reflects the growing priority given to security, including crime prevention, within the context of sustainable development in recent years. In Agenda 21, for example, while social security is a persistent theme, the aspect of crime is only briefly mentioned with respect to urban disorder and related health issues, violence against women, and the need for public awareness. Subsequently, the World Summit for Social Development and Habitat II advocated stable, safe, and just societies for promoting social integration and development. Member states were encouraged to address the problems of crime, violence and illicit drugs as factors of social disintegration.⁴⁹ As a follow-up to the Summit, the UN Economic and Social Council made

⁴⁶ United Nations, *Earth Summit +5*.

⁴⁷ See <http://www.urbanobservatory.org/indicators>; and United Nations Development Group, *Guidelines: Common Country Assessment (CCA)*, Sub-group on Programme Policies, Draft, 26 February, 1999.

⁴⁸ United Nations Economic and Social Council, *Technical Cooperation, Including Resource Mobilization, and Coordination of Activities*, Report of the Secretary-General, Commission on Crime Prevention and Criminal Justice, Sixth Session, Vienna, 28 April-9 May 1997.

⁴⁹ United Nations, *Report of the World Summit for Social Development*; and United Nations, *Second International Conference on Human Settlements*.

violence, crime, and illicit drugs and substance abuse, all factors of social disintegration, a priority theme in 1998.⁵⁰ This momentum will culminate in 2000 with the expected completion and signing of the UN Convention against Transnational Crime.

Overall, crime appears to be on the increase and represents a challenge for sustainable development. Globalization is creating an environment conducive to new and expanded forms of criminality including the smuggling of migrants, drug trafficking, corruption, computer crime, and the illegal firearms trade.⁵¹ On a global scale, an increase in total recorded crime of about 13% has been estimated for the time period 1990-1997.⁵² While the number of reported crimes dropped or stayed the same for member states of the European Union, increases were experienced in countries of Eastern Europe, members of the Commonwealth of Independent States, and countries of Asia and the Pacific.

The core set of indicators recognizes crime as a significant sub-theme of security. From the experience of testing countries, the sub-theme reflects an important priority for policy decision makers at the national level. The general goal to significantly reduce violence and crime was accepted at the Ninth Congress on the Prevention of Crime and Treatment of Offenders.⁵³ The *number of recorded crimes per 100,000 population* represents the most commonly used indicator and is included as a measure in the Common Country Assessment Guidelines. Countries may wish to disaggregate the indicator by type of crime, for example, violent versus non-violent crime or violence against women.

4.3.6. Population

Sub-theme	Indicators
Population Change	Population Growth Rate
	Population of Urban Formal and Informal Settlements

Population provides an important contextual reference on sustainable development for decision makers looking at the interrelationships between people, resources, the environment and development. Population change is a significant signal as countries try to reduce poverty, achieve economic progress, improve environmental protection, and move to more sustainable consumption and production. More stable levels of fertility can have a considerable positive impact on quality of life. In many countries, slower population growth has bought more time to adjust to future population increases.

Urbanization has become a dominant trend in the growth and distribution of the population. Rapid population growth and migration can lead to unsustainable living conditions and increased pressure on the environment, especially in ecologically-sensitive areas. The search for better living conditions in urban areas reflects rural unemployment and underemployment;

⁵⁰ United Nations Economic and Social Council, *Technical Cooperation, Including Resource Mobilization, and Coordination of Activities*.

⁵¹ United Nations, *The State of Crime and Criminal Justice Worldwide*, Report of the Secretary-General, Tenth United Nations Congress on the Prevention of Crime and the Treatment of Offenders, Vienna, 10-17 April 2000.

⁵² Ibid.

⁵³ United Nations Development Group, *Guidelines: Common Country Assessment (CCA)*.

poor rural social services; unavailability of arable land; natural disasters, particularly drought; and civil unrest. It implies the need for more effective programmes to support rural development. The informal urban settlements that often develop are precarious and marginal. They tend to lack basic services and tenure security; are located in areas predisposed to natural disasters; and are characterized by poverty, inadequate health and education facilities, and high crime rates.

Agenda 21 provided a framework for the emerging consensus on the need for increased international cooperation on population issues. The global programme stressed the importance of taking population trends and factors into account when building national policies and programmes integrating environment and development.⁵⁴ The 1994 Conference on Population and Development, in contrast to previous international population fora, continued this integrative perspective focusing on the relationships between population, poverty, gender equity, production and consumption, and the environment.⁵⁵

Fertility rates and population growth rates are declining in most countries. Nevertheless, absolute population numbers are still increasing in all regions. The world fertility rate has dropped from 4.5 to 2.7 births per woman from 1970-1975 to 1995-2000.⁵⁶ Furthermore, the global population growth rate has declined from 1.7% per annum during the 1985 to 1990 period to its current level of 1.3% per annum. In 1998, this rate added 78 million people to give a world population of 5.9 billion.⁵⁷

By 2030, the world population is expected to be 8.1 billion, with virtually all the growth concentrated in urban areas, particularly the cities of developing countries.⁵⁸ The proportion of people living in urban areas is expected to increase from 46.6% in 1998, to 54.5% in 2015, and to 60.5% in 2030. Such trends will continue the rural to urban migration patterns and rapid transformation of rural settlements into cities. This will place enormous strain on existing social services and infrastructure in cities, much of which will not be able to expand at the same rate as the population increases.

Both predominant factors of population change, total population growth and urban growth, are reflected in the core set of indicators. The *population growth rate* is a standard indicator supported by data for all countries. The *population of formal and informal settlements* is likely to be more infrequently available for specific urban areas, but is a significant measure from a policy perspective. While the Cairo Conference implicitly recognized the stability of the global population as an ultimate objective, no specific international goals have been established for these indicators. Nevertheless, several countries have adopted targets for population growth in the context of national planning and development.

⁵⁴ United Nations, *Agenda 21*, Chapter 5.

⁵⁵ United Nations, *Report of the International Conference on Population and Development*, Cairo, 5-13 September, 1994.

⁵⁶ United Nations Development Programme, *Human Development Report 2000*.

⁵⁷ United Nations Department of Economics and Social Affairs, *Revision of the World Population Estimates and Projections*, Population Division, <http://www.popin.org/>.

⁵⁸ United Nations Department of Economics and Social Affairs, *World Urbanization Prospects: The 1999 Revision: Key Findings*, Population Division, <http://www.popin/wdtrends/urbanization>.

Countries may wish to augment reporting on population change with information on fertility rate, migration, age structure, and rate of growth of urban areas. In addition, it may be appropriate to ascertain sub-national population trends for national planning purposes.

Environment

4.3.7. Atmosphere

Sub-themes	Indicators
Climate Change	Emissions of Greenhouse Gases
Ozone Layer Depletion	Consumption of Ozone Depleting Substances
Air Quality	Ambient Concentration of Air Pollutants in Urban Areas

Priority atmospheric issues include climate change, stratospheric ozone depletion, acidification, eutrophication, urban air quality, and tropospheric ozone levels. The impacts of these issues relate to human health, biodiversity and the health of ecosystems, and economic damage. Many of the effects are long-term, global in nature, and irreversible with consequences for future generations.

Agenda 21 suggests an integrated approach to protection of the atmosphere,⁵⁹ coordinated with social and economic development, which focuses on:

- improving the scientific basis for addressing uncertainties;
- preventing stratospheric ozone depletion;
- addressing transboundary air pollution; and
- promoting more sustainable and efficient energy use, transportation, consumption, industrial development, and land and marine resource use.

The principal human activities contributing to atmospheric change relate to fossil fuel consumption for energy production and transportation. In addition, land use change, including deforestation, industrial processes, intensive agriculture, and waste disposal contribute to atmospheric pollution. Conversely, forest ecosystems are also significant carbon sinks for greenhouse gases. While some gains have been achieved through greater efficiency, fuel substitution, and the use of renewable energy, emission levels have continued to climb due to overall increases in energy use and transportation.

Climate change is widely recognized as a serious threat to the world's environment and is largely a consequence of unsustainable consumption and production patterns. Expected impacts include sea level rise with the possible flooding of low lying areas, higher temperatures, melting of glaciers and ice caps, and more extreme weather patterns with implications for floods and droughts. The socio-economic effects are expected to be widespread, but have particular significance to agriculture, forests, marine ecosystems, and small island states.

⁵⁹ United Nations, *Agenda 21, Chapter 9*.

The problems associated with climate change are being addressed under the United Nations Framework Convention on Climate Change. So far insufficient progress has been made to stabilize greenhouse gas emission levels.⁶⁰ However, under its Kyoto Protocol, developed countries have agreed to reduce their collective emissions of six greenhouse gases by 5% of 1990 levels by 2008-2012.⁶¹ In addition, the Protocol encourages joint implementation and emissions trading among developed countries; and cooperation between developed and developing countries under a Clean Development Mechanism.

The thickness of the ozone layer, which protects the earth from damaging ultraviolet radiation, has decreased significantly over the last 20 years. The anthropogenic emissions of ozone-depleting substances are derived from their use as solvents, refrigerants, foam-blowing agents, spray propellants, fire extinguishers, and agricultural pesticides. Increases in ultraviolet radiation at the earth's surface can damage human health resulting in skin cancer, eye cataracts, and suppression of the immune system. In addition, marine and terrestrial ecosystems can be affected through reduced photosynthesis and production of phytoplankton.

International cooperation under the Vienna Convention, the Montreal Protocol, and subsequent amendments has resulted in a significant decrease in global production and consumption of the major ozone-depleting substances.⁶² Nevertheless, due to the long life times of these substances in the atmosphere, complete recovery of the ozone layer is not expected until 2050.⁶³ Human health and environmental impacts are projected to continue even longer.

The rapid increase in urbanization and the transportation sector have resulted in many environmental impacts. High mobility levels and congestion have led to substantial increases in emission levels of air pollutants such as suspended particulate matter, sulphur dioxide, nitrogen oxides, volatile organic compounds, and ozone, in both developed and developing countries. These substances magnify human health risks, adversely affect flora and fauna, and damage buildings in both urban and rural areas.

Three indicators related to the atmosphere are included in the CSD core set: *emissions of greenhouse gases*; *consumption of ozone depleting substances*; and *ambient concentration of air pollutants in urban areas*. These indicators were selected as either relevant or measurable by a majority of the testing countries.⁶⁴ They represent driving force measures; the point of entry for sustainable development policy interventions. The first indicator measures the net emissions of the six greenhouse gases which are driving climate change and which are subject to the Kyoto Protocol. The second indicator assesses the phase-out of ozone depleting substances subject to the Montreal Protocol and its subsequent amendments. The third indicator measures the exposure of people to various air pollutants. In this last case, it is important to consider the indicator against national air quality standards.

⁶⁰ United Nations, *Earth Summit +5*.

⁶¹ United Nations Framework Convention on Climate Change, *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, December 1997.

⁶² United Nations Economic and Social Council, *Protection of the Atmosphere*, Addendum, Report of the Secretary-General, Commission on Sustainable Development, Fourth Session, 18 April-3 May, 1996.

⁶³ European Environment Agency, *Environmental Signals 2000*, Environmental Assessment Report No. 6, 2000.

⁶⁴ United Nations Department of Economic and Social Affairs, *UN CSD Theme Framework and Indicators of Sustainability*.

These three indicators are closely associated with other themes of the indicator framework; for example land (forests and urbanization) and consumption and production patterns (energy use and transportation). Countries may wish to supplement these three core measures with impact and response indicators for the atmosphere theme. Consideration of sea level rise, for example, would be particularly important to small island and coastal states.

4.3.8. Land

Sub-themes	Indicators
Agriculture	Arable and Permanent Crop Land Area
	Use of Fertilizers
	Use of Agricultural Pesticides
Forests	Forest Area as a Percent of Land Area
	Wood Harvesting Intensity
Desertification	Land Affected by Desertification
Urbanization	Area of Urban Formal and Informal Settlements

Land consists not only of the physical space and the surface topography, but includes the associated natural resources of soil, mineral deposits, water, and plant and animal communities. Use of the land in an unsustainable way affects these resources, as well as the atmosphere and marine ecosystems. Land is becoming an increasingly scarce resource, particularly quality land for primary production of biomass and for conservation, due to expanding human requirements. The magnitude of land use and land cover changes threatens the stability and resilience of ecosystems through, for example, global warming and disruption of the global nitrogen cycle.⁶⁵

Agenda 21 advocates a holistic approach using an integrated, ecosystem-based management to achieve sustainable development of the land resource.⁶⁶ The implementation of such an approach is intended to resolve conflicts between competing land uses, while addressing access and rights to land; and to increase productivity, while protecting the environment and natural resources. This approach is supported by the United Nations Convention to Combat Desertification, the United Nations Convention on Biodiversity, the Habitat Agenda of the Second International Conference on Human Settlements, and the Plan of Action of the World Food Summit.

The priority land-based issues faced by many countries include land degradation, desertification, deforestation, urban growth, and agricultural and rural development. Other significant challenges associated with land use, such as the maintenance of particularly valued ecosystems are covered by other themes of the CSD indicator framework, for example coastal zone and biodiversity.

⁶⁵ United Nations Economic and Social Council, *Integrated Planning and Management of Land Resources*, Report of the Secretary-General, Commission on Sustainable Development, Eighth Session, 24 April-5 May, 2000.

⁶⁶ United Nations, *Agenda 21, Chapter 10*.

At its Eighth Session, the Commission on Sustainable Development suggested the following areas for future work related to integrated land management:⁶⁷

- prevention and/or mitigation of land degradation;
- access to land and security of tenure;
- critical sectors and issues including forests, drylands, rehabilitation of land-mined areas, and rural-urban and land management interactions;
- access to information and stakeholder participation;
- international cooperation for capacity building, information sharing, and technology transfer; and
- rehabilitation of land degraded by mining.

Many of these priorities were supported by the decisions related to agriculture and rural development. In addition, the Commission emphasized the need to focus on poverty eradication, appropriate use of biotechnology, conservation and protection of genetic resources, integrated pest management, integrated plant nutrition, emergency preparedness, and protection of water resources. Governments were encouraged to integrate agricultural production, food security and food safety, environmental protection, and rural development into national sustainable development strategies.

Agriculture plays a pivotal role in the context of sustainable land use. The sector is being called on to both increase production to achieve food security and improve its stewardship of the land resource. In addition, agriculture supports social and economic development, and the maintenance of rural lifestyles. If practiced in a sustainable manner, it contributes to the conservation of the countryside and related natural resources.

Global food production has increased in the 1990s, particularly in the developing countries. The average annual growth in agricultural production was 2.2% between 1994 and 1998: 0.4% in developed countries and 3.4% in developing countries.⁶⁸ Despite the overall production increases, 64 countries faced serious food shortages in 1998 and 1999. Nevertheless, the number of undernourished people in the world has decreased from 860 million in 1990-92 to 825 million in 1995-97, although increases have been experienced in some regions including sub-Saharan Africa and countries with economies in transition. However, this improvement will have to be magnified two and a half times to meet the World Food Summit target of reducing the number of undernourished people by half by 2015.⁶⁹ This has significant implications for the land resource.

Agriculture and the state of rural development are associated with most land resource issues. Increasing land degradation, desertification, and deforestation are caused by poverty, population pressure, unsuitable land allocation, inappropriate farming and grazing practices, and lack or misuse of appropriate technologies. Desertification affects 1.6 billion people in over 100

⁶⁷ United Nations Commission on Sustainable Development, *Report of the Eighth Session*, Economic and Social Council, Official Records 2000, Supplement No. 9, 30 April 1999 and 24 April-5 May, 2000.

⁶⁸ United Nations Economic and Social Council, *Sustainable Agriculture and Rural Development*, Report of the Secretary-General, Commission on Sustainable Development, Eighth Session, 24 April-5 May, 2000.

⁶⁹ Ibid.

countries.⁷⁰ Land degradation, including compaction, erosion, fertility decline, loss of biomass and soil biodiversity, occurs on about 2 billion hectares. It is estimated that about 30% of the world's irrigated lands, 40% of the rainfed agricultural lands, and 70% of rangelands are affected by land degradation.⁷¹ Between 1980 and 1990, it is estimated that the global forest area declined by 180 million ha; with a further decline of 56 million ha from 1990 to 1995.⁷² Although successes are apparent in specific countries, efforts at implementing integrated land management have yet to significantly ameliorate these trends.

The rapid urbanization trend discussed previously brings land use adjustment pressures to both urban and rural areas. Migration forces may be too strong and society's resources insufficient to prevent the spread of informal settlements. In addition, urbanization tends to shift consumption patterns towards horticultural crops, meat, and dairy products. Increased livestock numbers, while creating income opportunities, could amplify overgrazing, encourage deforestation, and increase health risks.⁷³ Meanwhile, in rural areas, labour shortages can encourage the adoption of labour-saving technologies based on agro-chemicals and machinery, with implications for land and water resources.⁷⁴

The indicators under the land theme in the CSD framework focus on the key sub-themes of agriculture, forests, desertification, and urbanization. The selected indicators are relevant for assessing sustainable development at the national level, and are generally supported by appropriate data sets. As illustrated above, indicators from other environmental sub-themes complement these measures of land sustainability, for example ecosystems, water quality, climate change, and coastal zones. In addition, pressures on land and land use impacts are reflected in social, economic, and institutional themes, such as poverty, drinking water, population change, energy use, and natural disaster preparedness and response. Specific international goals have generally not been established for the land resource, although national targets may apply (for example, *forest area as a percent of land area* and *wood harvesting intensity*). Existing international goals do apply to food security and the trade of tropical timber.⁷⁵

The importance of interpretation in the context of sustainable development is illustrated by some of the land indicators. The *use of fertilizers*, for example, while enhancing productivity also reflects soil fertility decline and potential impacts on the environment including eutrophication, acidification, and contamination of water supplies. Specific countries may wish to expand the range of land indicators for national purposes. In this case, indicators to portray

⁷⁰ United Nations Economic and Social Council, *Integrated Planning and Management of Land Resources: Combating Desertification and Drought*, Addendum, Report of the Secretary-General, Commission on Sustainable Development, Eighth Session, 24 April-5 May, 2000.

⁷¹ United Nations Economic and Social Council, *Integrated Planning and Management of Land Resources*.

⁷² Ibid.

⁷³ Food and Agriculture Organization, *The Coming Livestock Revolution*, Background Paper No. 6, Department of Economic and Social Affairs, Commission on Sustainable Development, Eighth Session, 24 April-5 May, 2000.

⁷⁴ United Nations Economic and Social Council, *Sustainable Agriculture and Rural Development: Urbanization and Sustainable Agricultural Development*, Addendum, Report of the Secretary-General, Commission on Sustainable Development, Eighth Session, 24 April-5 May, 2000.

⁷⁵ See Annex 1.

progress with mining rehabilitation, agricultural productivity, or the impacts of increasing livestock numbers may be pertinent.

4.3.9. Oceans, Seas and Coasts

Sub-themes	Indicators
Coastal Zone	Algae Concentration in Coastal Waters
	Percent of Total Population Living in Coastal Areas
Fisheries	Annual Catch by Major Species

Occupying about 70% of the earth's surface, oceans and seas represent highly productive ecosystems that continuously recycle chemicals, nutrients, and water. This recycling regulates weather and climate, including global temperature. In addition, marine, estuary and coastal ecosystems (such as coral reefs, wetlands, and mangrove forests) are significant to biodiversity and support valuable natural resources.⁷⁶ It is estimated, for example that 90% of the world's fish production is dependent on coastal areas at some point in its life cycle.

Coastal zones, at the interface of land and water, occupy less than 15% of the earth's surface; yet accommodate over 2 billion people, more than one-third of the world's population. This population primarily lives in large cities frequently sited in association with key ecosystems such as river estuaries. The proportion of people living in the coastal zone (within 100 kilometers of the shore) is estimated to be approximately 37% of the global population and is expected to grow substantially by the year 2020.⁷⁷

Agenda 21, based on the United Nations Convention on the Law of the Sea, advocates an integrated, ecosystem approach to protect oceans and coastal areas.⁷⁸ Such an approach is heavily dependent on the application of precautionary and anticipatory principles to maintain biodiversity and ecosystem productivity while improving the quality of life of coastal communities. Various international instruments have adopted the concept of integrated marine and coastal area management. These include the United Nations Framework Convention on Climate Change, the United Nations Convention on Biological Diversity, the International Coral Reef Initiative, and the Code of Conduct for Responsible Fisheries.

The marine and coastal issues significant to sustainable development include:

- degradation from land-based activities;
- unsustainable exploitation of fish and other living resources;
- marine pollution from shipping and offshore oil and gas projects;
- the protection of biodiversity and fragile ecosystems; and
- the relationship to climate change, including the implications of sea level rise.⁷⁹

⁷⁶ United Nations Economic and Social Council, *Oceans and Seas*, Report of the Secretary-General, Commission on Sustainable Development, Seventh Session, 19-30 April, 1999.

⁷⁷ The estimate is based on calculations by Andrew Mellinger, et.al., Harvard University, Boston, Mass., 1997 and by Joel E. Cohen and Christopher Small, Columbia University, New York city, USA.

⁷⁸ United Nations, *Agenda 21*, Chapter 17.

⁷⁹ Ibid.

While a measure of success is evident in the control of marine pollution, the unsustainable development of coastal and marine resources largely continues. The Commission on Sustainable Development concluded in 1996 that the most important traditional ocean resources, including coastal environments and conventional fishery resources, are over-used and require improved management.⁸⁰ While international conventions⁸¹ have proved effective at controlling marine pollution from shipping (except for ships flying flags of convenience) and marine dumping of industrial waste; and progress is being made with respect to the dumping of hazardous waste and ship's ballast, marine pollution continues to increase. Furthermore, effective measures are still required to address degradation of the marine environment from offshore oil and gas activities.

Land-based activities contribute about 80% of marine pollution. Over half of the world's coastal ecosystems face moderate to high potential risk of degradation as a result of inappropriate development. The influence of climate change on sea level rise, and the frequency and intensity of floods and storms is particularly pertinent to small island states and densely populated delta areas.

Coral reefs, which occupy only 1% of the marine environment, are particularly susceptible to damage. It is estimated that 58% of the world's reefs are potentially threatened by human activities.⁸² Marine fishery production began to stagnate in the second half of the 1990s after two decades of expansion. Many fisheries have surpassed their optimum long-term sustainability, with recent increased production stemming from aquaculture. It is estimated that about 60% of world fisheries are either fully exploited or over-fished. In addition, discard and waste levels remain high, with an estimated 27 million tons of fish discarded each year. With better management, processing, and conservation practices, it is possible that sustainable management and conservation, including stock rehabilitation and reduction of wastage, could increase marine fisheries production.

In general, suitable candidate indicators for oceans and the coastal zone are not readily available or supported by commonly accepted goals. However, the CSD core set includes three indicators under the sub-themes of coastal zone and fisheries that are national in scope and within the capabilities of most countries to develop. The *total population in coastal areas* and the *algae concentration in coastal waters* provide measures of the overall pressure on the coastal resource particularly from land-based activities. Bathing water quality represents an impact indicator that some countries may wish to consider, although a standard methodology is not well advanced or widely accepted. The *annual catch by major species* provides a core indicator where data is generally available to measure the intensity of fishery activity. In terms of key

⁸⁰ United Nations Economic and Social Council, *Protection of the Ocean, all Kinds of Seas, including Enclosed and Semi-enclosed Seas, and Coastal Areas and the Protection, Rational Use and Development of Their Living Resources*, Report of the Secretary-General, Commission on Sustainable Development, Fourth Session, 18 April-3 May, 1996.

⁸¹ Including the International Convention for the Prevention of Pollution from Ships; International Convention on Oil Pollution Preparedness, Response and Cooperation; and Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.

⁸² Ibid.

marine ecosystems such as coral, mangrove, and sea grass, countries may wish to consider trends in the extent of these areas under the biodiversity ecosystem sub-theme.

4.3.10. Freshwater

Sub-themes	Indicators
Water Quantity	Annual Withdrawal of Ground and Surface Water as a Percent of Total Available Water
Water Quality	BOD in Water Bodies
	Concentration of Faecal Coliform in Freshwater

Freshwater is essential to support human life, ecosystems, and economic development. It supports domestic water supplies, food production, fisheries, industry, hydropower generation, navigation, and recreation. The ecosystem services of freshwater systems include food production, reduction of flood risk, and the filtering of pollutants. The global issues of health, poverty, climate change, deforestation, desertification, and land use change are all directly associated with the water resource and its management.

The long-term sustainability of water is in doubt in many regions of the world. Currently, humans use about half the water that is readily available. Water use has been growing at more than twice the population rate, and a number of regions are already chronically short of water. About one third of the world's population lives in countries with moderate to high water stress. With population increases, economic growth and rising living standards, as much as two thirds of the world's population could be living in water-stressed countries by 2025.⁸³ This has serious implication for socio-economic development, in particular future food production.

Both water quantity and water quality are becoming dominant issues in many countries. Problems relate to poor water allocation and pricing, inefficient use, and lack of adequate integrated management. The major withdrawals of water are for agriculture, industry, and domestic consumption. Most of the water used by industries and municipalities is often returned to watercourses degraded in quality. Irrigation agriculture, responsible for nearly 40% of world food production, uses about 70% of total water withdrawals (90% in the dry tropics).⁸⁴ Groundwater, which supplies one third of the world's population, is increasingly being used for irrigation. Water tables are being lowered in many areas making it more expensive to access.

Major water quality problems stem from sewage pollution, the intensive agricultural use of fertilizers and pesticides, industrial wastes, saltwater intrusion, and soil erosion. In many developing countries, rivers downstream of large cities are little cleaner than open sewers. Only 2% of sewage in Latin America receives any kind of treatment, while the faecal coliform count in many Asian rivers is 50 times recommended water quality guidelines.⁸⁵ Nitrate pollution from high fertilizer use is a serious concern in both developed and developing countries. High nitrate levels in drinking water are dangerous to human health, and cause algae growth and

⁸³ United Nations Environment Programme, *GEO-2000*.

⁸⁴ United Nations Economic and Social Council, *Comprehensive Assessment of the Freshwater Resources of the World*, Report of the Secretary-General, Commission on Sustainable Development, Fifth Session, 7-25 April, 1997.

⁸⁵ United Nations Environment Programme, *GEO-2000*.

eutrophication in waterways. Industrial wastes are a source of heavy metal and persistent organic pollutants in the environment. About 20% of the world's irrigated land is salt-affected to such an extent as to significantly reduce crop production. Salt water intrusion is of particular concern to arid and semi-arid regions, and small island states. Poor land use practices aggravate soil erosion resulting, for example, in degraded fish habitat and loss of reservoir capacity.

In calling for integrated water resource management, Agenda 21 emphasized the need to protect water, its quality, and ecosystem functions through improved assessment and greater understanding of the impacts of climate change.⁸⁶ Water for drinking supply, food production, and sustainable urban and rural development were recognized as key priorities.

There is evidence of progress in improving some aspects of freshwater resources management since 1992. In specific watersheds, water quality has improved, the application of demand management is raising efficiency levels, and conservation efforts are improving fish habitat. However, overall progress has been neither sufficient nor comprehensive enough to reduce the overall trends of increasing water shortages, deteriorating water quality, and growing ecosystem stress. To address this gap, the Commission on Sustainable Development has identified the following priority areas:⁸⁷

- access to urban and rural water supply and sanitation;
- water for sustainable food production and rural development;
- the use of clean and efficient wastewater technologies for industry;
- a greater appreciation of the water resource requirements of ecosystems;
- the efficient use of water based on its economic value; and
- strengthening water management institutions.

The freshwater indicators in the core set capture the two essential dimensions of quantity and quality. The withdrawal of available water measures a country's demand for water and reveals its vulnerability to water shortages. The measurement of biological oxygen demand and faecal coliform concentration reflect respectively the two significant aspects of ecosystem health and human health. These three indicators are policy-relevant and generally measurable at the national level.

4.3.11. Biodiversity

Sub-themes	Indicators
Ecosystems	Area of Selected Key Ecosystems
	Protected Area as a Percent of Total Area
Species	Abundance of Selected Key Species

⁸⁶ United Nations, *Agenda 21*, Chapter 18.

⁸⁷ United Nations Economic and Social Council, *Strategic Approaches to Freshwater Management*, Report of the Secretary-General, Commission on Sustainable Development, Sixth Session, 20 April-1 May, 1998.

Biological diversity consists not only of variety among species, but also genetic variation within species, and variation between communities of species, habitats and ecosystems. This biodiversity of genes, species, and ecosystems contributes essential products and services to human welfare. Maintaining biodiversity helps ensure that the Earth will continue to perform natural ecological processes upon which all life depends. Major changes, loss, or degradation of biodiversity can result in serious economic, social, and cultural impacts; and have profound ecological and ethical implications. More than 40% of the world's economy and about 80% of the needs of the world's poor are dependent upon biological diversity.⁸⁸ Food security, climatic stability, freshwater security and human health needs are all directly associated with the maintenance and use of biodiversity.

The total number of species on Earth is very large with estimates ranging from 5 to 100 million. The most species-rich environments are the moist tropical forests that probably contain over 90% of the world's species.⁸⁹ Africa, Asia and the Pacific, and Latin America are the richest biodiversity regions. The conservation status of most species is not known in detail. However, in a 1996 assessment, 25% of the world's mammals and 11% of birds were threatened with a significant risk of extinction.⁹⁰ Many other species now exist in reduced numbers, as fragmented populations, or are threatened on a national scale.

Loss of biodiversity results when policies and development activities fail to properly value natural resources and the environment. Inequity in ownership and access to natural resources also contribute to unsustainable use. Biodiversity can be adversely affected by the following causes:

- over-harvesting or illegal take of species;
- habitat loss or fragmentation;
- the introduction of exotic species;
- pollution and land degradation; and
- climate change and natural disasters.

Many international treaties were in effect before the 1992 Earth Summit aimed at protecting biodiversity. These instruments include: the International Plant Protection Convention, the Convention on Wetlands of International Importance Especially as Wildlife Habitat, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, and the International Tropical Timber Agreement. Agenda 21 and the Convention on Biological Diversity both provide a comprehensive perspective for future action to address biodiversity conservation; the sustainable use of ecosystems, species, and genetic material; and the equitable sharing of benefits arising from genetic resources.⁹¹ Countries are encouraged to complete national assessments of biodiversity, develop national strategies and action plans, integrate

⁸⁸ United Nations Economic and Social Council, *Implementation of the Convention on Biological Diversity*, Preparations for the Special Session of the General Assembly for the Purpose of an Overall Review and Appraisal of the Implementation of Agenda 21, Note by the Secretary-General, Commission on Sustainable Development, Fifth Session, 7-25 April, 1997.

⁸⁹ United Nations Environment Programme, *GEO-2000*.

⁹⁰ Ibid.

⁹¹ United Nations, Agenda 21, Chapter 15; and United Nations, *Convention on Biological Diversity*, 1992.

biodiversity considerations into national development strategies, use traditional methods and knowledge, and foster the sharing and sustainable use of biotechnology.

The development of suitable indicators of biodiversity is at a relatively early stage due to the incomplete scientific knowledge and understanding of biodiversity, especially with respect to ecosystem functions and processes.⁹² Promising work in this area is being pursued under the auspices of the Convention on Biological Diversity.⁹³ Nevertheless, it is feasible at this time to include three pertinent indicators in the core set which capture significant aspects of the ecosystem and specie attributes of biodiversity. It should also be noted that other core indicators in the land, marine, and freshwater themes of the framework are significant from a biodiversity viewpoint.

The selected biodiversity indicators measure the *area of selected key ecosystems*, the *abundance of selected key species*, and the *protected area as a percent of total area*. They are relatively easy to calculate, meaningful to decision makers, and allow countries flexibility in determining the most important ecosystems and species from a national perspective. Area of key ecosystems, for example, was suggested as a valuable indicator by testing countries and could include those areas subject to greatest change or those with special biodiversity value. It may also be possible in some countries to disaggregate the protected area indicator by ecosystem type to provide information on ecosystem representation.

Economic

4.3.12. Economic Structure

Sub-themes	Indicators
Economic Performance	GDP per Capita
	Investment Share in GDP
Trade	Balance of Trade in Goods and Services
Financial Status	Debt to GNP Ratio
	Total ODA Given or Received as a Percentage of GNP

Trade and investment are important factors in economic growth and sustainable development. Improved access to markets, transfer of financial resources and technology, and debt relief are critical to assisting developing countries meet the objectives of sustainable development. Poverty, natural resource exploitation, and consumption and production are all intimately connected to economic growth or the lack of it. It represents a considerable challenge to ensure that economic growth leads to social equity and does not contribute to environmental degradation.

⁹² United Nations Economic and Social Council, *Integrated Planning and Management of Land Resources: Conservation of Biological Diversity*, Addendum, Report of the Secretary-General, Commission on Sustainable Development, Eighth Session, 24 April-5 May, 2000.

⁹³ See United Nations Environment Programme, *Development of Indicators of Biological Diversity*, Subsidiary Body on Scientific, Technical and Technological Advice, Fifth Meeting, Montreal, 31 January-4 February, 2000, <http://www.biodiv.org/doc/sbstta-5.htm>.

To support economic performance within the context of sustainable development, Agenda 21 recommends trade liberalization; making trade and environment mutually supportive; providing new and additional financial resources to developing countries; and encouraging macroeconomic policies favourable to environment and development.⁹⁴ Trade liberalization usually has positive effects on sustainable development. It can stimulate economic diversification, improve the efficiency of resource allocation, reduce environmentally unsound trade restrictions, and encourage the transfer of cleaner, more efficient technology. Freer trade can also result in increased resource use when the environmental costs of production are not fully internalized and reflected in market prices.

In principle, the financing of policies and programmes to attain sustainable development comes from a country's own public and private resources. Nevertheless, external resource flows are essential to assist developing countries. Official Development Assistance (ODA) remains the primary source of external funding, but a basic shift is occurring with flows of foreign direct investment (FDI) steadily expanding and flows from financial markets increasing dramatically. Whatever the source, it is essential that all funding contribute to sustainable development through the integration of economic growth, social development, and environmental protection.

Total net resource flows from Development Assistance Committee (DAC) countries and multilateral organizations to aid-receiving developing countries increased between 1991 and 1996, but have since fallen in both absolute and relative terms.⁹⁵ Collective ODA disbursements from member countries of DAC declined from 0.33% of GNP in 1987/88 to 0.24% of GNP in 1998;⁹⁶ both figures well below the United Nations target of 0.7%. For developing countries, the per capita ODA has fallen from US\$11.8 to US\$8.3 between 1992 and 1998. A few countries have been able to take advantage of rising FDI and have experienced substantial economic growth. However, many other countries, particularly the poorest ones, have shown slow or negative growth and continue to be marginalized.⁹⁷

The level of external debt continues to impede the progress of developing countries towards sustainable development. Comparing 1985 and 1998, debt levels in relation to GNP remained at about 42% for developing countries as a whole, while increasing from 67% to nearly 100% for the least developed countries.⁹⁸ For most of these countries, effective solutions to the debt problem through debt rescheduling, reduction, or cancellation; debt swaps; or grants and concessional flows, are essential to help restore credit worthiness and encourage investment.

The indicators selected for the core set under the economic structure theme are well known and commonly used measures at international and national levels. They reflect the important issues of economic performance, trade, and financial status discussed above. Trade and economic dependency represented key indicator theme areas for testing countries.

⁹⁴ United Nations, *Agenda 21*, Chapters 2 and 33.

⁹⁵ United Nations Economic and Social Council, *Financial Resources and Mechanisms*, Report of the Secretary-General, Commission on Sustainable Development, Eighth Session, 24 April-5 May, 2000.

⁹⁶ United Nations Development Programme, *Human Development Report 2000*.

⁹⁷ United Nations Economic and Social Council, *Economic Growth, Trade and Investment*, Report of the Secretary-General, Commission on Sustainable Development, Eighth Session, 24 April-5 May, 2000.

⁹⁸ United Nations Development Programme, *Human Development Report 2000*.

GDP per capita is a standard measure of basic economic growth, while *investment share in GDP* shows the level of financial capital available to stimulate economic development. The *balance of trade in goods and services* illustrates the openness and/or vulnerability of an economy. High levels of debt inhibit a country's ability to address socioeconomic and environmental priorities related to sustainable development. The provision of ODA is a measure of commitment of the international community, while its receipt shows one measure of reliance on external funding.

4.3.13. Consumption and Production Patterns

Sub-themes	Indicators
Material Consumption	Intensity of Material Use
Energy Use	Annual Energy Consumption per Capita
	Share of Consumption of Renewable Energy Resources
	Intensity of Energy Use
Waste Generation and Management	Generation of Industrial and Municipal Solid Waste
	Generation of Hazardous Waste
	Generation of Radioactive Waste
	Waste Recycling and Reuse
Transportation	Distance Traveled per Capita by Mode of Transport

Unsustainable patterns of consumption and production, particularly in developed countries, are the major cause of the continued depletion of natural resources and deterioration of the global environment.⁹⁹ It is widely acknowledged that the Earth cannot support the consumption levels of industrialized countries on a global scale. In addition, such high levels of consumption affect the current and future consumption and production options of developing countries.

A change to more sustainable lifestyles calls for the concerted, combined efforts of governments, producers, and consumers. It requires less emphasis on material consumption, more emphasis on resource and energy-efficient technologies, a stronger commitment to meeting the needs of the poor, and a focus on economic systems that account for social and environmental costs. Such a fundamental change is very difficult to achieve because of strongly ingrained beliefs and behaviours.

Agenda 21 calls on developed countries to take the lead in promoting and implementing more sustainable consumption and production patterns. It recommends five actions to assist in reaching this objective:

- encouraging greater efficiency in the use of energy and resources;
- minimizing the generation of wastes;
- assisting individuals to make environmentally sound consumer decisions;
- showing leadership through government purchasing; and

⁹⁹ United Nations, *Earth Summit +5*.

moving towards environmentally sound pricing.¹⁰⁰

Since the Earth Summit, only limited progress has been made in the adjustment to more sustainable consumption and production patterns. Overall, insufficient progress has been achieved in the more efficient use of materials, reducing energy demand and waste, and using more sustainable transportation systems. In industrialized countries, there has been progress in reducing energy and material consumption per unit of production. However, the improvement in efficiency has been more than offset by increases in the volume of production and consumption.¹⁰¹ Meanwhile, developing countries require sharp increases in energy services to improve the standard of living of a growing population. World commercial energy use increased 74% between 1980 and 1997.¹⁰² Over the near term, transportation is expected to be the major driving force behind a growing world demand for energy.

Current patterns of transportation and their energy requirements are not sustainable and will significantly compound future environmental and human health problems.¹⁰³ While there has been progress in fuel and emission efficiency of vehicles, the number of vehicles has dramatically increased and consumers are driving longer distances.¹⁰⁴ Some predictions estimate a five-fold increase in global waste generation by 2025. In the developed world, per capita waste generation increased three times between 1977 and 1997 and is approximately five to six times higher than in the developing world.¹⁰⁵

The United Nations General Assembly and testing countries have advocated that consumption and production patterns be represented in the core set of indicators. This reflects the policy priority of this issue area. The core indicators provide a good coverage of the significant sub-themes of consumption and production patterns; namely material consumption, energy use, waste generation and management, and transportation. The core indicators, except for those for waste, are included in the recommended set of consumption and production indicators published by the United Nations in 1998.¹⁰⁶ It will be possible to relate the solid waste and recycling indicators to national waste reduction targets in countries where such national objectives have been established. It should be noted that other indicators in the environmental dimension of the core set are complementary to the consumption and production theme. These include, for example, *emissions of greenhouse gases, use of fertilizers, wood harvesting intensity, and annual withdrawal of ground and surface water.*

¹⁰⁰ United Nations, *Agenda 21*, Chapter 4.

¹⁰¹ United Nations Economic and Social Council, *Comprehensive Review of Changing Consumption and Production Patterns*, Report of the Secretary-General, Commission on Sustainable Development, Seventh Session, 19-30 April, 1999.

¹⁰² United Nations Development Programme, *Human Development Report 2000*.

¹⁰³ United Nations, *Earth Summit + 5*.

¹⁰⁴ United Nations Economic and Social Council, *Comprehensive Review of Changing Consumption and Production Patterns*.

¹⁰⁵ United Nations Economic and Social Council, Overall Progress Achieved since the United Nations Conference on Environment and Development: Environmentally Sound Management of Solid Wastes and Sewage-Related Issues, Addendum, Report of the Secretary General, Commission on Sustainable Development, Fifth Session, 7-25 April 1997.

¹⁰⁶ United Nations Department of Economic and Social Affairs, *Measuring Changes in Consumption and Production Patterns: A Set of Indicators*, Population Division, New York, 1998.

Some of the core indicators, such as *annual energy consumption per capita*, are well tested and already commonly used at the national level. The indicator for intensity of energy use is covered by five methodology sheets that include: (1) Energy Intensity – Commercial/Service sector, (2) Energy Intensity-Transportation, (3) Energy Intensity – Residential Sector, (4) Energy Intensity – Manufacturing and (5) Energy Use per unit of GDP. Other indicators, such as *intensity of material use* and *distance traveled per capita by mode of transport* are not so well developed or used, probably reflecting methodological and data difficulties. Nevertheless, it is important to include these indicators because of their policy relevance and in order to achieve a comprehensive core set. Where they are not feasible in the short term, countries may wish to use alternative measures, such as total material requirement and total number of road vehicles.

Institutional

4.3.14. Institutional Framework

Sub-themes	Indicators
Strategic Implementation of Sustainable Development	National Sustainable Development Strategy
International Cooperation	Implementation of Ratified Global Agreements

Appropriate legal and policy instruments are required as an institutional framework to encourage and implement sustainable development. The integration of social, economic, and environmental factors is a particular important feature of such instruments. Implementation of sound sustainable development strategies and international treaties by countries should contribute to improved socioeconomic and environmental conditions, and help reduce potential sources of conflict between countries.

Agenda 21 calls for the adoption of national strategies of sustainable development. The goal of such strategies should be to ensure socially responsible economic development while protecting the environment and the natural resource base for future generations.¹⁰⁷ The strategies should build on existing initiatives, such as environmental action plans, reflect current priorities, and take into account emerging issues. They should be based on the widest possible participation and involvement of all segments of society. Agenda 21 also advocates improving the effectiveness of national and international legal instruments and mechanisms with respect to achieving sustainable development. In this context, the action plan supports the participation of developing countries in formulating international law; the coordination and consistency among international legal instruments; and the identification of new and emerging issues in the field of sustainable development relevant to international law.

Since the Earth Summit, countries have made considerable progress in establishing an appropriate institutional framework for the implementation of sustainable development.¹⁰⁸ This includes the development of national strategies aimed at integrating social, economic, and environmental priorities; and action to sign, ratify, and initiate the implementation of global

¹⁰⁷ United Nations, *Agenda 21*. Chapter 8.

¹⁰⁸ United Nations Commission on Sustainable Development, *Assessment of Progress in the Implementation of Agenda 21 at the National Level*, Report of the Secretary-General, Fifth Session, 7-25 April, 1997.

agreements. Much of the strategy development has been accomplished through the involvement of major stakeholders. There is considerable diversity in the types of strategies that have been established reflecting considerable differences in national priorities and circumstances. In addition to national strategies, many countries have also contributed to regional strategies, such as the Mediterranean Action Plan. Nevertheless, for developing countries there remains the need to improve the technical and financial capacity to implement the provisions of national strategies and international agreements.

Core indicators under the institutional framework theme point to a country's willingness and commitment to shift from a segmented sector approach to a holistic, integrated sustainable development process. The two indicators selected, *national sustainable development strategy* and *implementation of ratified global agreements*, address the key themes of integrated decision-making and international conventions suggested by testing countries. Both indicators are relatively easy to develop and reflect comprehensive institutional actions in support of sustainable development. It is suggested that countries assess the degree of implementation of these indicators to improve their relevance. As a goal, it is anticipated that countries will have developed effective national sustainable development strategies reflecting the interests of all stakeholders by 2002.

4.3.15. Institutional Capacity

Sub-themes	Indicators
Information Access	Number of Radios or Internet Accounts per 1000 Inhabitants
Communication Infrastructure	Main Telephone Lines and Cell Phones per 1000 Inhabitants
Science and Technology	Expenditure on Research and Development as a % of GDP
Natural Disaster Preparedness and Response	Human and Economic Loss Due to Natural Disasters

The ability of a country to progress towards sustainable development is largely determined by the capacity of its people and institutions.¹⁰⁹ Capacity can be measured by a country's human, scientific, technological, organizational, institutional, and resource capabilities. Institutional capacity enhances participatory planning, implementation, and monitoring related to sustainable development. An increase in capacity improves community skills and abilities to address crucial questions, evaluate policy options and implementation approaches, and appreciate constraints and limitations.

Communication systems, information access and availability, the support for science and technology, and the prevention and mitigation of natural disasters are all elements of a country's institutional capacity. Although a wealth of data and information may be available, finding the appropriate scale and currency of information is not always easy. This situation is exacerbated in the absence of modern communications infrastructure. In this context, the Commission on Sustainable Development reported little progress in making national telecommunications

¹⁰⁹ United Nations, *Agenda 21*. Chapter 34.

systems responsive to the growing demand for electronic information.¹¹⁰ The innovative delivery of health and educational services, the alleviation of the isolation of remote areas, and the reduction of the need for transportation represent some of the tangible sustainable development benefits that can be derived from up-to-date electronic and telecommunications systems.

Science and technology represent avenues for improving sustainable development decision-making through better understanding of ecological and social processes, enhanced efficiency of resource utilization, and systematic assessments of current conditions and future prospects. To maximize this potential, Agenda 21 advocates interdisciplinary research and better communication between scientists, decision makers, and the general public. Despite its significant role, the funding of scientific activity, including investment in research and development, has declined in most countries since 1992.¹¹¹

Further to the International Decade for Natural Disaster Reduction (1990-1999), the UN General Assembly established the International Strategy for Disaster Reduction (ISDR). The objectives of this programme are to enable communities to become resilient to the effects of natural, technological and environmental hazards, and to proceed from protection against hazards to the management of risk, by integrating disaster prevention strategies with sustainable development.

Institutional capacity is a significant means for facilitating movement towards sustainable development, but is difficult to assess appropriately with a limited number of core indicators. The indicators selected for this theme measure information access, communications infrastructure, science and technology, and natural disaster preparedness and response. These represented important issues for the testing countries. The four indicators are primarily national in scope and suitable for measuring trends. They are structured to be useful to both developing and developed countries.

¹¹⁰ United Nations Economic and Social Council, *Overall Progress Achieved since the United Nations Conference on Environment and Development*, Report of the Secretary-General, Commission on Sustainable Development, Fifth Session, 7-25 April, 1997.

¹¹¹ Ibid.

METHODOLOGY SHEETS

CHAPTER 5: METHODOLOGY SHEETS

PERCENT OF POPULATION LIVING BELOW POVERTY LINE		
Social	Equity	Poverty

1. INDICATOR

- (a) **Name:** Percent of Population Living Below Poverty Line.
- (b) **Brief Definition:** The proportion of the population with a standard of living below the poverty line.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Social/Equity/Poverty.

2. POLICY RELEVANCE

(a) **Purpose:** The most important purpose of a poverty measure is to enable poverty comparisons. These are required for an overall assessment of a country's progress in poverty alleviation and/or the evaluation of specific policies or projects. An important case of a poverty comparison is the *poverty profile* which shows how the aggregate poverty measure can be decomposed into poverty measures for various sub-groups of the population, such as by gender region of residence, employment sector, education level, or ethnic group. A good poverty profile can help reveal a number of aspects of poverty-reduction policies, such as the regional or sectoral priorities for public spending. Poverty comparisons are also made over time, in assessing overall performance from the point of view of the poor.

(b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Measures of poverty are a very significant consideration of sustainable development. The eradication of poverty remains a major challenge for policy decision makers. Furthermore, an integrative viewpoint which simultaneously takes account of development issues, resource use and environmental quality, and human welfare must be taken if sustainable progress is to be achieved.

The % Population Living Below Poverty Line captures the prevalence of poverty by measuring the proportion of population for whom consumption (or any other suitable measure of living standard) is below the poverty line. An increase in this indicator implies a worsening of the poverty situation with a greater proportion of the population falling below the poverty line.

- (c) **International Conventions and Agreements:** Not available.
- (d) **International Targets/Recommended Standards:** To reduce income poverty by half by 2015.

(e) **Linkages to Other Indicators:** In general, this indicator is linked to many other sustainable development measures, for example, net migration rate, adult literacy rate, Gross Domestic Product per capita, and population living below the poverty line in dryland areas. In particular, the % Population Living Below Poverty Line is closely associated to the Poverty Gap Index and the Squared Poverty Gap Index which capture successively more detailed aspects of the poverty situation. The % Population Living Below Poverty Line measures how widespread poverty is, the Poverty Gap Index measures how poor the poor are, and the Squared Poverty Gap Index measures the severity of poverty by giving more weight to the poorest of the poor.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** A poverty measure is a summary statistic on the economic welfare of the poor in a society. There is no one universally accepted single measure of poverty. A number of different approaches exist (see, for example, the methodology sheets for the Poverty Gap Index and the Squared Poverty Gap Index). This methodology sheet guides the reader along certain key issues, such as the different approaches to measuring individual welfare, without prescribing decisions. Consequently, it is directed at comparability over time within a given country, as it helps national practitioners specify poverty indicators that match their specific situation and preferred approach. However, this is at the expense of international comparability.

To compute poverty measures, the following questions related to identifying and defining the poor must be addressed first:

- i) How do we measure an individual's economic welfare?
- ii) At what level of measured welfare is a person considered poor?

(b) **Measurement Methods:** The % Population Living Below Poverty Line (H) is the proportion of the population whose economic welfare (y) is less than the poverty line (z). If q people are deemed to be poor in a population of size n then $H=q/n$. For computing the % Population Living Below Poverty Line, estimates of individual economic welfare and the poverty line are required.

i) Measuring Individual Welfare: There are a number of different approaches to measuring welfare. The approaches differ in terms of the importance attached to the individual's own judgment of well-being versus a concept of welfare decided upon by somebody else. The former would focus on measuring an individual's consumption of a bundle of goods and services. An example of the latter would be defining welfare by the level of nutritional intake, even though people do not live on food alone, or make food choices solely on the basis of nutrition. Approaches in practice also differ according to how difficult it is to obtain certain types of data in specific settings.

Typically one finds that poverty comparisons in developing countries put a high weight on nutritional attainments, consistent with the behaviour of poor people in a specific society. A comprehensive measure of consumption (for example, total expenditure on all goods and services consumed, including non-market goods, such as consumption from a farmer's own product) has been more popular than using current income in the development literature. This is

due in part to the fact that incomes are harder to measure accurately. Current consumption is also likely to give a better indication than current income of a household's typical, long-term, economic welfare; income may fluctuate greatly over time, particularly in rural economies (see Ravallion reference in section 6a below).

The following methods can be used for measuring individual standards of living:

--*Consumption per equivalent male adult*: Since households differ in size and composition, a simple comparison of aggregate household consumption can be misleading about the welfare of individual members of the household. Therefore, for any given household, an equivalence scale is used to approximate the number of single adults, based on observed consumption behaviour. There are a number of value judgments embedded in this practice; for example, differences in needs are reflected in differences in consumption. Adult females and children are assigned a male equivalence of less than one since they typically consume less; however, that may not mean that they have lower "needs" but rather have less power within the household. The existence of size economies in consumption may also mean that two people can live more cheaply together than apart (for a further discussion of these issues, see Ravallion reference in section 6 below).

--*Undernutrition*: This is a distinct concept, although closely associated with poverty. Undernutrition can be viewed as a specific type of poverty, namely food energy poverty. There are a number of arguments for and against using this as a measure of well-being. A practical advantage is that this measure does not have to be adjusted for inflation and would not be constrained by any inadequacy of price data. Measures of child nutritional status can help capture aspects of welfare, such as distribution within the household which are not adequately reflected in other indicators. However, nutrition is not the only aspect that matters to the well-being of people, including the poor. Thus, poverty comparisons based solely on nutrition alone may be limited and deceptive.

ii) Defining the Poverty Line: In practice, there are a number of alternative approaches to defining poverty lines:

--*Absolute poverty lines*: An absolute poverty line is one which is fixed in terms of the living standard indicator being used (consumption, nutrition). It is fixed over the entire domain of comparison, that is, a poverty line which assures the same level of economic welfare would be used to measure and compare poverty across provinces or different situations. The poverty line may still vary, but only so as to measure the differences in the cost of a given level of welfare. Absolute poverty lines are more common in developing country literature.

The most common approach to defining absolute poverty lines is to estimate the cost in each region or at each date of a certain bundle of goods necessary to attain basic consumption needs (this is called the *basic needs approach*). The most important component of basic needs is a recommended food energy intake, supplemented by essential non-food goods. To measure food energy requirements, one needs to make an assumption about activity levels which in turn determine energy requirements to maintain the body's metabolic rate at rest. Once the food energy intake has been determined, and its cost has been calculated, an allowance for non-food

spending can be added by finding the total expenditure level at which a person typically attains the food component of the poverty line. An alternative (lower) allowance for non-food goods is to use the average non-food spending of people who can just afford the food component of the poverty line: it can be argued that this is a reasonable lower bound for the non-food component of the poverty line (see Ravallion reference in section 6a below).

--*Relative poverty lines*: These have dominated developed country literature where many studies have used a poverty line which is set at, for example, 50% of the national mean income. When the poverty line is fixed as a proportion of the national mean, if all incomes increase by the same proportion, there would be no change in relative inequalities and the poverty line would simply increase by the same proportion; that is, the poverty measure will not change. This can make such poverty lines deceptive for some purposes, such as assessing whether poor people are better or worse off.

A cross-country comparison of 36 countries, both developed and developing, revealed that real poverty lines will tend to increase with economic growth, but they will do so slowly for the poorest countries. Therefore, the concept of absolute poverty appears to be more relevant to low income countries, while relative poverty is of more relevance to high-income countries.

(c) **Limitations of the Indicator:** In practice, most applications in developing countries have used consumption per person. This probably overstates the extent to which poverty is associated with larger family sizes. But other aspects of the poverty profile (such as assessments of the regional or sectoral poverty profiles) tend to be more robust as a measurement choice.

It is important to note that a certain amount of arbitrariness and value judgement are unavoidable in defining individual welfare and any poverty line. Therefore, the overall assessment of the poverty situation should pay particular attention to how the choices made affect poverty comparisons, since these are generally what matter most to policy implications. An increasingly common practice is to recalculate the poverty measures using various poverty lines, and to test whether the qualitative poverty comparisons are robust to the choice.

It should be noted that there are several comparability problems across countries in the use of data from household surveys (see section 4 below). In addition, definitions of poverty are lacking in some countries or vary from country to country. These problems are diminishing over time as survey methodologies are improving and becoming more standardized, but they remain.

(d) **Status of the Methodology:** Not Available.

(e) **Alternative Definitions/Indicators:** The Poverty Gap Index and the Squared Poverty Gap Index represent alternative definitions for a poverty indicator (see section 2e above).

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The most important source of data on living standards is household surveys.

(b) **National and International Data Availability and Sources:** The results of household surveys can be obtained from government statistical agencies, often via published reports. About two thirds of the developing countries have done sample household surveys which are representative nationally, and some (but certainly not all) of these provide high-quality data on living standards.

Data can also be obtained from international agencies such as The World Bank (mostly data for low and middle income countries emerging from the Living Standards Measurement Study and Social Dimensions of Adjustment Project for Sub Saharan Africa). Data for developed countries can be obtained from the Statistical Office of the European Union (Eurostat), the Luxembourg Income Study, or the Organisation for Economic Co-operation and Development (OECD).

(c) **Data References:** Not Available.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the World Bank (WB). The contact point is the Chief, Indicators and Environmental Valuation Unit, Environment Department, WB; fax no. (202) 477 0968.

(b) **Other Contributing Organizations:** None.

6. REFERENCES

(a) **Readings:**

Ravallion, M. *Poverty Comparisons*. Fundamentals in Pure and Applied Economics, Volume 56, Harwood Academic Press, Switzerland. 1994.

Shaohua, C. and Ravallion, M. Global Poverty Measure 1987-98 and Projections for the Future. World Bank, Development Research Group, Washington, D. C. Forthcoming.

(b) **Internet site:** www.worldbank.org/data

GINI INDEX OF INCOME INEQUALITY		
Social	Equity	Poverty

1. INDICATOR

- (a) **Name:** Gini Index of Income Inequality.
- (b) **Brief Definition:** A summary measure of the extent to which the actual distribution of income, consumption expenditure, or a related variable, differs from a hypothetical distribution in which each person receives an identical share.
- (c) **Unit of Measurement:** A dimensionless index scaled to vary from a minimum of zero to a maximum of one; zero representing no inequality and one representing the maximum possible degree of inequality.
- (d) **Placement in the CSD Indicator Set:** Social/Equity/Poverty.

2. POLICY RELEVANCE

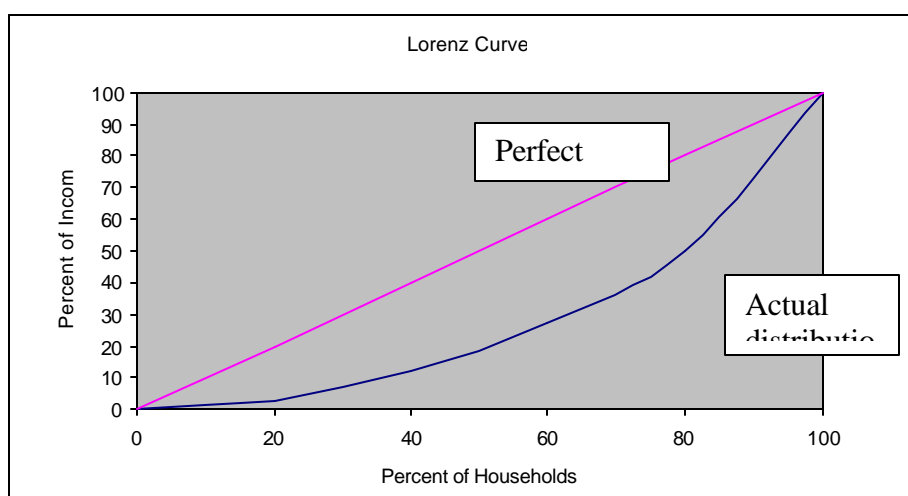
- (a) **Purpose:** The Gini Index provides a measure of income or resource inequality within a population. It is the most popular measure of income inequality.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** This indicator is particularly relevant to the equity component of sustainable development. Income or resource distribution has direct consequences on the poverty rate of a country or region. Broadly speaking, average material welfare can be defined by the per capita Gross Domestic Product (GDP). However, statistical averages can mask the diversity that exists within any country. Therefore, from a sustainable development perspective, it is informative to examine income and wealth distribution throughout a population. A country can, for example, have a high per capita GDP figure, but its income distribution so skewed that the majority of people are poor. This indicator is useful both to measure changes in income inequality over time and for international comparisons.
- (c) **International Conventions and Agreements:** None.
- (d) **International Targets/ Recommended Standards:** None.
- (e) **Linkages to Other Indicators:** This indicator is linked to several other sustainable development measures, including the Poverty and Gender Equality Indicators as well as Economic Indicators to include GDP per capita among others, and sustainable development strategies.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The concept and definition of this indicator are well understood and readily available. The Gini Index measures the area between the Lorenz Curve and a hypothetical line of absolute equality, expressed as a percentage of the maximum area under the line of perfect equality (see Figure 1 in section 3b below). The Gini Index is defined as one half of the average value of the absolute differences between all possible pairs of "incomes".

(b) **Measurement Methods:** The Lorenz Curve plots the cumulative percentages of total income received (on the vertical axis) against the cumulative percentage of recipients, starting with the poorest individual or household (see Figure 1).

Figure 1: The Lorenz Curve and Gini Index of Income



There are a number of choices about data, which can influence the precise value of the Gini Index obtained. For example, a Gini Index for consumption expenditure will typically be lower in value than one for income, even within the same population. This is because households smooth their consumption over time in response to income changes. At any one date, there will be some households with unusually low incomes and others with unusually high ones; with some opportunities for saving and/or borrowing. Thus, household consumption will be less unequal.

It is important how "income" is measured, for example whether it is total household income or per capita household income, or income per equivalent adult. In addition, it matters whether or not the incomes are weighted by household size, since households with lower income per person tend to be larger. Thus, the income share of the poorest 20% of households will be higher than the income share of the poorest 20% of persons.

The World Bank, for example, prefers to weight by household size and calculate the shares held by persons rather than households for most purposes. As a general rule, the Bank also considers consumption expenditure to be the more reliable indicator of welfare than income, which can be excessively variable over time, and is also more difficult to measure accurately, particularly in

developing countries. Looking at the sample of 112 countries for which Gini indices of income are reported in the World Bank's *2000 World Development Indicators*, this coefficient ranges from a low of 19.5% to a high value of 62.9%.

There are a number of ways of estimating the Gini Index of income, and the choice depends in part on the type of data available. Distributional data are often available in grouped form, such as the income share of the lowest decile of households, where households are ranked by income per person. To estimate the Lorenz Curve, and thus the Gini Index, from such data, the World Bank often uses a software package called POVCAL. Having specified the type of data, the program calculates both the General Quadratic specification for the Lorenz Curve and the Beta specification. It then calculates the Gini Index and various other statistics, including poverty measures for each Lorenz Curve. The program also advises which is the better specification for the Lorenz Curve for the specific data used.

(c) **Limitations of the Indicator:** The Gini Index is not a very discriminating indicator. Two very different distributions--one having more inequality amongst the poor, the other having more amongst the rich--can have exactly the same Gini Index.

Measurement errors in data sets are thought to be greater for incomes compared to consumption expenditure, which will add to measured inequality (see section 3b above). Differences between countries in the measured Gini index may thus reflect in part differences in the welfare measures used.

While the Gini Index of income (in common with most other measures of inequality) captures information on the pattern of relative levels of wellbeing in the population, it is independent of any considerations of absolute living standards. So, there is nothing to guarantee that a lower Gini Index of income entails higher social welfare in any agreed sense, since the mean income may have also fallen. The Gini Index is at best a partial indicator, and other measures will be needed to complete the picture of how levels of economic welfare are evolving in a society.

It should be noted that there are several comparability problems across countries in the use of data from household surveys (see section 4 below). These problems are diminishing over time as survey methodologies are improving and becoming more standardized, but they remain.

(d) **Status of Methodology:** Not Available.

(e) **Alternative Definitions/Indicators:** There are many other measures of inequality, with various strengths and weaknesses. These are discussed in Sen (1973) (see section 6a below).

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** See 3(b) above.

(b) **National and International Data Availability and Sources:** The most important source of data on living standards is household surveys. The results of these surveys can be obtained from government statistical agencies, often via published reports. About two thirds of the developing

countries have done sample household surveys which are representative nationally, and some (but certainly not all) of these provide high-quality data on living standards.

Data can also be obtained from international agencies such as The World Bank (mostly data for low and middle-income countries emerging from the Living Standards Measurement Study and Social Dimensions of Adjustment Project for Sub Saharan Africa). Data for developed countries can be obtained from the Statistical Office of the European Union (Eurostat), the Luxembourg Income Study, or the Organisation for Economic Co-operation and Development (OECD).

(c) **Data References:** Not Available.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the World Bank (WB). The contact point is the World Development Indicators Team, Development Data Group, the World Bank; fax no. (1 202) 522-1785.

(b) **Other Contributing Organizations:** None.

6. REFERENCES

(a) **Readings:**

Chen, S., G. Datt, M. Ravallion. *POVCAL: A Program for Calculating Poverty Measures from Grouped Data*. Poverty and Human Resources Division, Policy Research Department, Washington DC: World Bank. 1992.

Ravallion, M., and S. Chen. *What Can New Survey Data Tell Us About Recent Changes in Living Standards in Developing and Transitional Economies?*. Working Paper 1. Research Project on Social and Environmental Consequences of Growth-Oriented Policies, Washington DC: World Bank.

Sen, A. *On Economic Inequality*. Oxford: Oxford University Press. 1973.

The World Bank. *2000 World Development Indicators*. 2000.

(b) **Internet site:** www.worldbank.org/data

UNEMPLOYMENT RATE		
Social	Equity	Poverty

1. INDICATOR

- (a) **Name:** Unemployment Rate.
- (b) **Brief Definition:** Unemployment rate is the ratio of unemployed people to the labour force.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Social/Equity/Poverty.

2. POLICY RELEVANCE

- (a) **Purpose:** The unemployment rate is a measure of the unutilized labour supply of a country. If employment is viewed as the desired portion of the economically active population (labour force), unemployment can be seen as, for the most part, the undesirable portion (although some short-term unemployment can be both desirable and necessary). Unemployment rates by specific groups- such as by age, sex, occupation or industry- are also useful statistics in identifying groups of workers and sectors most vulnerable to joblessness.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Unemployment is useful and relevant to measuring sustainable development, especially if uniformly measured over time, and considered with other socioeconomic indicators. It is one of the main reasons for poverty in rich and medium income countries and among persons with high education in low income countries (no work, no income but compensation from insurance schemes or other welfare state systems whenever they exist). It should be noted, however, that it is common to find people working full-time but remaining poor due to the particular social conditions and type of industrial relations prevalent in their country, industry, or occupation.
- (c) **International Conventions and Agreements:** The measurements of unemployment and the labour force are defined in the International Labour Office (ILO): Resolution concerning statistics of the economically active population, employment, unemployment and underemployment, 13th International Conference of Labour Statisticians, Geneva, 1982.
- (d) **International Targets/Recommended Standards:** There are no international targets regarding the rate of unemployment.
- (e) **Linkages to Other Indicators:** The indicator is one among many that measure utilization or underutilization of the labour market. Other measurements focus on parts of the unemployment experience: youth unemployment, long-term unemployment, unemployment by educational attainment, time-related underemployment and the inactivity rate.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The definitions for labour force, employed population, and unemployed population are well established by international agreements (see section 6 below).

i) *Labour Force:* The current economically active population or labour force has two components: the employed and the unemployed population. The international standard definition of labour force established by the Thirteen International Conference of Labour Statisticians (International Labour Office (ILO), 1982) is based on the following elements:

-- *The survey population:* All usual residents (de jure population) or all persons present in the country at the time of the survey (de facto population). Some particular groups, such as the armed forces or other populations living in institutions, nomadic people, etc., may be excluded.

-- *An age limit:* In countries where compulsory schooling and legislation on the minimum age for admission to employment have broad coverage and are widely respected, the age specified in these regulations may be used as a basis for determining an appropriate minimum age limit for measuring the economically active population.

In other countries, the minimum age limit should be determined empirically on the basis of (i) the extent and intensity of participation in economic activities by young people, and (ii) the feasibility and cost of measuring such participation with acceptable accuracy. Some countries also determine a maximum age for inclusion in the labour force.

-- *The involvement in economic activities during the survey reference period:* The concept of economic activity adopted by the Thirteenth International Conference of Labour Statisticians (1982) is defined in terms of production of goods and services as set forth by the United Nations System of National Accounts, (revised in 1993).

-- *A short reference period:* For example, one week or a day.

ii) *Employed population:* According to the 1982 international definition of employment (ILO, 1983) the employed comprise all persons above the age specified for measuring the labour force, who were in the following categories:

-- *Paid employment:* (i) at work: persons who, during the reference period, performed some work (at least one hour) for wage or salary, in cash or in kind; (ii) with a job but not at work: persons who, having already worked in their present job, were temporarily not at work during the reference period but had a formal attachment to their job;

-- *Self-employment:* (i) at work: persons who, during the reference period, performed some work (at least one hour) for profit or family gain, in cash or in kind; (ii) with an enterprise but not at work: persons with an enterprise, which may be a business enterprise, a

farm or a service undertaking, who were temporarily not at work during the reference period for some specific reason.

iii) *Unemployed population*: According to the 1982 international definition of employment (ILO, 1983) the unemployed comprise all persons above the age specified for measuring the labour force, who during the survey reference period were at the same time: (i) not in paid employment or self-employment, not even for an hour; (ii) available for work; and (iii) seeking work.

(b) **Measurement Methods:** Household or labour force surveys are generally the most comprehensive and comparable sources for unemployment statistics. Other sources include population censuses, “employment office records” and “official estimates”. Data based on registration at employment offices tend to understate unemployment, in comparison with household or labour force surveys, because not all persons who are looking for work will register on account of eligibility requirements which may exclude those who have never worked or have not worked in a recent period. (In some countries, registration data can overstate unemployment, largely because of double-counting and failure to track persons registering, not all of whom, in any case, may be job-seekers). Official estimates are often based on a combination of sources. Population censuses generally do not probe very deeply into labour force status, resulting in magnitudes of unemployment that differ substantially (either higher or lower) from those obtained from household surveys where more questions are asked.

(c) **Limitations of the Indicator:** As important as the unemployment rate is, it should not be interpreted as a measure of economic hardship. Doing so can produce some unfortunate results, giving unemployment a greater degree of significance than it deserves. The unemployment rate, if based on the internationally recommended standards, simply tells us the proportion of the labour force that does not have a job but is available and actively looking for work. It says nothing about the economic resources of the unemployed worker or the worker’s family. The scope of unemployment should therefore be limited to its use as a measurement of the utilization of labour, and should not be extended to other spheres of the economy of a country. Broader measures, including income-related indicators, are needed to evaluate economic hardship.

Paradoxically, low unemployment rates may well disguise substantial poverty in a country, whereas high unemployment rates can occur in countries with significant economic development and low incidences of poverty. In countries without a safety net of unemployment insurance and welfare benefits, many individuals simply cannot afford to be unemployed. Instead they eke out a living in the informal sector. In countries with well-developed social protection schemes, workers can better afford to take the time to find desirable jobs.

(d) **Status of the Methodology:** Well developed and employed although discrepancies do occur.

In an effort to resolve the international comparability issue for its member-countries and building on work carried out by the United States Bureau of Labour Statistics in the 1960’s, the Organization for Economic Co-operation and Development (OECD) initiated research on and

has published “standardized unemployment rates” adjusted to the International Labour Office (ILO) concepts. The ILO extended the process even further, beginning in 1990. The ILO-comparable unemployment rates show historical data for 25 of the ILO member States based on the ILO-comparable series (produced in ILO: 1999 Key Indicators of the Labour Market, Geneva, 1999). This table represents unemployment rates from national labour force surveys that have been reconciled with and adjusted to make the estimates conceptually consistent, with the strictest application of the ILO statistical standards. This implies that participating countries must be able to provide detailed information on the composite elements of their labour forces. At the same time, the unemployment rates obtained are in conformity with the OECD’s programme of standardized rates, which itself is based on the ILO standards. This avoids a proliferation of “international” estimates, which might not be the same. Further, all the data are expressed in terms of annual averages (or a period that is currently found to be the most representative over the year), thereby avoiding the variances that would occur if different reference periods were observed. These estimates, based on official national data, should provide the best basis currently available for making reasonable international comparisons and assumptions, although they may still contain very minor discrepancies.

(e) **Alternative Definitions/Indicators:** Underemployment rate; discouraged workers rate.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Labour force (total number of persons) and total number of unemployed persons, derived from the same survey.

(b) **National and International Data Availability and Sources:** Unemployment rate data are available for a total of 113 countries, all of which are broken down by gender, in the 1999 KILM with the majority of data resulting from household or labour force surveys with the remainder from employment office records, official estimates or population censuses.

(c) **Data References:** The data repositories used are International Labour Office (ILO) Yearbook of Labour Statistics, OECD Labour Force Statistics, and ILO Digest of Caribbean Labour. For seven countries, data were taken from national sources.

5. AGENCIES INVOLVED WITH THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the International Labour Office (ILO) of the United Nations, located in Geneva. The contact point is the Focal Point for Environment and Sustainable Development, ILO; fax no. (41-22) 798 8685.

(b) **Other Contributing Organizations:** None.

6. REFERENCES

(a) **Readings:**

Yearbook of Labour Statistics, ILO, Geneva;

Bulletin of Labour Statistics (quarterly) and its *Supplement* (January/February, April/May, July/August and October/November), ILO, Geneva;

Statistical yearbooks and other publications issued by the national statistical offices.

Surveys of Economically Active Population, Employment, Unemployment and Underemployment -An ILO Manual on Concepts and Methods, ILO, Geneva, 1992.

Sources and Methods: Labour Statistics, Volumes 3 and 5, ILO, Geneva, 1991 and 1990, currently updated.

System of National Accounts 1993, Commission of the European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, World Bank, Brussels/Luxembourg, New York, Paris, Washington, D.C., 1993;

Current international recommendations on labour statistics, ILO, Geneva, 1988. See particularly the *Resolution Concerning Statistics of the Economically Active Population, Employment, Unemployment and Underemployment*, adopted by the Thirteenth International Conference of Labour Statisticians (October 1982).

(b) **Internet sites:**

For 1999 Key Indicators of the Labour Market, Geneva, 1999:
<http://www.ilo.org/public/english/employment/strat/polemp/kilm/>

For the text of the resolution concerning statistics of the economically active population, employment, unemployment and underemployment see:
<http://www.ilo.org/public/english/bureau/stat/res/ecacpop.htm>

For the ILO database on labour statistics, see <http://laborsta.ilo.org>

RATIO OF AVERAGE FEMALE WAGE TO MALE WAGE		
Social	Equity	Gender Equality

1. INDICATOR

- (a) **Name:** Ratio of average female wage to male wage.
- (b) **Brief Definition:** Obtained as the quotient of average wage rates paid to female and male employees at regular intervals for time worked or work done for particular occupations.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Social/Equity/Gender Equality.

2. POLICY RELEVANCE

- (a) **Purpose:** To assess the remuneration offered women vis-a-vis their male counterpart to ultimately determine the level of women's participation in the economy.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The lower the ratio of wages offered to women, the less the attraction for women to join the labor force, which in turn deprives the economy of a vital component of development. This disadvantage could also be attributed to inequalities in educational opportunities for women and the need for policy makers to correct this inequity. It is generally acknowledged that if women are more educated, they are more likely to contribute to the broader productivity of society while enhancing child and maternal health and welfare.
- (c) **International Conventions and Agreements:** None.
- (d) **International Targets/Recommended Standards:** Eliminate discriminatory practices in employment (Beijing).
- (e) **Linkages to Other Indicators:** The indicator has close linkages with the unemployment rate indicator because both deal with employment as a principal generator of production. It is also closely linked to indicators pertaining to education and poverty.

3. METHODOLOGICAL DESCRIPTION

- (a) **Underlying Definitions and Concepts:** There are two international sources of definitions and concepts:
 - (i) The concept of earnings, as applied in wages statistics, relate to remuneration in cash and in kind paid to employees, usually at regular intervals, for time worked; or work done

together with remuneration for time not worked, such as for annual vacation, other paid leave or holidays. Wage rates, as part of earnings, include basic wages, cost-of-living allowances and other guaranteed and regularly paid allowances, but exclude overtime payments, bonuses and gratuities, family allowances and other social security payments made by employers. *Ex gratia* payments in kind, supplementary to normal wage rates are also excluded (UN International Labor Office).

(ii) Wages and salaries, as part of compensation to employees, are payable in cash or in kind and include the values of any social contributions, such as income taxes, payable by the employee even if they are actually withheld by the employer for administrative convenience or other reasons and paid directly to social insurance schemes, tax authorities, etc. on behalf of the employee. Wages and salaries in cash include payments at regular intervals, supplementary allowances payable regularly, payments to employees away from work for short periods such as holidays, and *ad hoc* bonuses linked to performance, commissions, gratuities and tips (UN System of National Accounts SNA).

(b) **Measurement Methods:** The indicator is measured by taking the average wage rates per day, week or month received by female employees as a ratio of the corresponding average wage rates for males. It could be classified further according to major divisions of economic activity, for example, agriculture, mining and quarrying, etc., to facilitate measurement of sectoral impact on the development process. Similarly, breakdowns according to age classes would provide additional information related to sustainable development trends.

(c) **Limitations of the Indicator:** A serious limitation is the reliability and comprehensiveness of wage rate data paid to female labor. Although data is available for many countries, the quality varies significantly among countries. Wage rates determine total remuneration and measure women's contribution to total production. However, since most of the basic remuneration for women's economic and social activities remain unreported or unrecorded--and even if reported, are grossly undervalued--only imputations are possible in many countries. The indicator will be greatly influenced by the selection of wage sectors, and type and level of job. The cost of collecting the data from questionnaires and surveys can be significant. Another limitation is that female wage rates do not tell the whole story. Wages, particularly for females, may reflect under-employment. Women, especially in developing countries, may participate in informal activities where they are not classified as wage earners. The household work is outside of the production boundary in the SNA therefore these activities are not covered by this indicator.

(d) **Status of the Methodology:** The resolution covering the institution of an integrated system of wages statistics, including defined earnings and wage rates, was adopted by the Twelfth International Conference of Labor Statisticians in Geneva in 1973.

(e) **Alternative Definitions/Indicators:** An alternative indicator to the male-female wage would be the percentage contribution of women to GDP which measures activities in the production boundary that incorporate the contribution of women in the economic process as proposed in the 1993 SNA. Another alternative indicator would be the employment distribution per gender (source: labor statistics) that measures the share of women in employment. An

additional alternative indicator could be the number of elected women in positions in government as % of total elected, which measures gender equality through female participation in the government (Source: national election statistics).

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The average wage rates paid to female and male employees provide the basic information to compile this indicator.

(b) **National and International Data Availability and Sources:** The data are mainly reported by departments or ministries of labor in most countries. It is obtained either through questionnaires or surveys from the different economic sectors of the economy. Average earnings are usually derived from payroll data supplied by a sample of establishments together with data on hours of work and on employment. Occasionally, wage indices are reported in the absence of absolute wage data. In some other cases, information is compiled on the basis of social insurance statistics.

(c) **Data References:** Data are published by the ILO in the Yearbook of Labor Statistics.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the International Labor Office (ILO). The contact point is the Focal Point for Environment and Sustainable Development; fax no. (41 22) 798 8685.

(b) **Other Contributing Organizations:** None.

6. REFERENCES

(a) **Readings:** The full text of the resolution listed in section 3e above can be found in *Current International Recommendations on Labor Statistics* (Geneva 1988).

Further information can be obtained from other ILO publications: *An Integrated System of Wages Statistics: A Manual on Methods* (Geneva 1979).

Statistical Sources and Methods; Vol. 2 *Employment, Wages and Hours of Work* (Establishment Surveys) (Geneva 1987); Vol. 4 *Employment, Unemployment, Wages and Hours of Work* (Administrative Records and Related Sources) (Geneva 1989).

(b) **Internet site:** International Labor Office: <http://www.ilo.org>

NUTRITIONAL STATUS OF CHILDREN		
Social	Health	Nutritional Status

1. INDICATOR

- (a) **Name:** Nutritional Status of Children.
- (b) **Brief Definition:** Children under age five whose weight-for-age and height-for-age is between either 80% and 120% of the reference value of the country, or within two standard deviations of this value.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Social/Health/Nutritional Status.

2. POLICY RELEVANCE

- (a) **Purpose:** The purpose of this indicator is to measure long term nutritional imbalance and malnutrition, as well as current under-nutrition.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Health and development are intimately interconnected. Meeting primary health care needs and the nutritional requirement of children are fundamental to the achievement of sustainable development. Anthropometric measurements to assess growth and development, particularly in young children, are the most widely used indicators of nutritional status in a community. The percentage of low height-for-age reflects the cumulative effects of under-nutrition and infections since birth, and even before birth. This measure, therefore, should be interpreted as an indication of poor environmental conditions and/or early malnutrition. The percentage of low weight-for-age reflects both the cumulative effects of episodes of malnutrition or chronic under-nutrition since birth and current under-nutrition. Thus, it is a composite indicator which is more difficult to interpret.
- (c) **International Conventions and Agreements:** The WHO Global Strategy for Health for All by the Year 2000 and its Ninth General Programme of Work, together with the United Nations World Summit for Children represent international agreements relevant to this indicator.
- (d) **International Targets/Recommended Standards:** At least 90% of children within a population should have a weight-for-age that corresponds to the reference values given in section 1b above by the year 2000. This target has been established by the World Health Organization's (WHO) *Global Strategy for Health for All by the Year 2000*.
- (e) **Linkages to Other Indicators:** This indicator is closely linked with adequate birth weight. It is also associated with such socioeconomic and environmental indicators as squared poverty gap index, access to safe drinking water, infant mortality rate, life expectancy at birth, national health

expenditure devoted to local health care, Gross Domestic Product (GDP) per capita, environmental protection expenditures as a percent of GDP, and waste water treatment coverage.

3. **METHODOLOGICAL DESCRIPTION**

(a) **Underlying Definitions and Concepts:** A national or international reference population is used to calculate the indicators for weight-for-age and height-for-age. A WHO Working Group has recommended that the best available data for this has been established by the United States National Center for Health Statistics (see references in section 6 below). This data may be used for children up to five years of age, since the influence of ethnic or genetic factors on young children is considered insignificant.

Low weight and low height are defined as less than the value corresponding to two standard deviations below the median of the respective frequency distributions for healthy children (see WHO, 1981 in section 6 below).

(b) **Measurement Methods:** The proportion of children under five with acceptable weight-for-age (or height-for-age) can be calculated by using the following formula:

Numerator: number of children under five with weight-for-age (or height-for-age) acceptable x 100.

Denominator: total number of children under five weighed.

For height, supine length is measured in children under two, and stature height in older children.

(c) **Limitations of the Indicator:** Available data may be outdated, site-specific, and lack a time series perspective. In some countries, the age of children is difficult to determine. It is also difficult to measure the height of children under two with accuracy and consistency.

(d) **Status of the Methodology:** Not Available.

(e) **Alternative Definitions/Indicators:** Not Available.

4. **ASSESSMENT OF DATA**

(a) **Data Needed to Compile the Indicator:** The data needed to compile this indicator are the number of children under five weighed; and the number of children under five with weight-for-age or height-for-age within the national reference values.

(b) **National and International Data Availability and Sources:** The data are routinely collected by ministries of health at the national and subnational levels for most countries. The primary national sources of data are the ministries of health.

(c) **Data References:** Not Available.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the World Health Organization (WHO). At WHO, the contact point is the Director, Department of Nutrition for Health and Development; fax no. (41 22) 791 3111.

(b) **Other Contributing Organizations:** None.

6. REFERENCES

(a) **Readings:**

WHO Working on Infant Growth. An evaluation of infant growth: the use and interpretation of anthropometry in infants. *Bulletin of the World Health Organization*, 1995, 73(2): 165-174.

An Evaluation of Infant Growth. WHO Working Group on Infant Growth (WHO/NUT/94.8). Geneva, World Health Organization, 1994.

Physical Status: The Use and Interpretation of Anthropometry. Report of a WHO Expert Committee. Geneva, World Health Organization, 1995 (WHO Technical Report Series, No. 854).

The Growth Chart. A Tool for Use in Infant and Child Health Care. Geneva, World Health Organization, 1986.

WHO Global Database on Child Growth and Malnutrition (WHO/NUT/97.4). Geneva, World Health Organization, 1997.

A Guide to Nutritional Assessment. Geneva, World Health Organization, 1988.

(b) **Internet site:** World Health Organization. <http://www.who.org>

MORTALITY RATE UNDER 5 YEARS OLD		
Social	Health	Mortality

1. **INDICATOR**

- (a) **Name:** Mortality Rate Under 5 Years Old.
- (b) **Brief Definition:** Under-5 mortality refers to the probability of dying before age 5, per 1,000 newborns.
- (c) **Unit of Measurement:** Per thousand live births.
- (d) **Placement in the CSD Indicator Set:** Social/Health/Mortality.

2. **POLICY RELEVANCE**

- (a) **Purpose:** This indicator measures the risk of dying in infancy and early childhood.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The reduction of childhood mortality is one of the most strongly and universally supported development goals. In high-mortality settings, a large fraction of all deaths occur at ages under 5 years. Despite considerable progress in reducing child mortality, there remains a large gap between more- and less-developed countries in risks of dying before the age of 5 years: for instance, during 1995-2000, under-5 mortality stood at 11 per thousand in the more developed regions but at 156 per thousand in the least developed countries (DESA, *World Population Prospects: The 1998 Revision*). The gap between more- and less- developed countries is larger in proportional terms for death rates in early childhood than during the adult ages. Under-5 mortality levels are influenced by poverty; education, particularly of mothers; the availability, accessibility and quality of health services; health risks in the environment, such as access to safe water and sanitation; and nutrition, among other factors.
- (c) **International Conventions and Agreements:** The 1990 World Summit for Children Programme of Action adopted a target of reducing the 1990 under-5 mortality rates by one third, or to 70 per 1,000 live births, whichever is less, by the year 2000. The Programme of Action of the International Conference on Population and Development further encouraged countries with intermediate mortality levels to achieve an under-5 mortality rate below 60 deaths per 1,000 births by the year 2005, and all countries to achieve an under-5 mortality rate below 45 per 1,000 live births by 2015. It is currently one of the indicators included in the Augmented Physical Quality of Life Index, which is among the quantitative criteria for the identification of least developed countries within the United Nations. Many other international agreements, including Agenda 21, also refer to the general goal of reducing childhood mortality.

(d) **International Targets/Recommended Standards:** In addition to the quantitative goals mentioned in section 2(c) above, the World Health Organization's Ninth General Programme of Work includes the goal of reducing the under-5 mortality rate by one third or to 70 per 1,000 live births, whichever is less, between the years 1990 and 2000.

(e) **Linkages to Other Indicators:** This indicator is closely related to life expectancy at birth. It is more generally connected to many other social and economic indicators, including those listed in section 3b above.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Standard statistical definitions of the terms "live birth" and "death" are put forth in the United Nations *Principles and Recommendations for a Vital Statistics System* (para. 46):

LIVE BIRTH is the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy, which after such separation breathes or shows any other evidence of life such as beating of the heart, pulsation of the umbilical cord, of definite movement of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached; each product of such a birth is considered live-born regardless of gestational age.

DEATH is the permanent disappearance of all evidence of life at any time after live birth has taken place (post-natal cessation of vital functions without capability of resuscitation).

(b) **Measurement Methods:** The under-5 mortality rate is derived from estimates of births and deaths gathered in vital statistical systems, censuses and surveys. Where data on deaths and births are complete, or adjustments for age misstatement and incompleteness can be made, the under-5 mortality rate can be calculated directly. The details can be found in demographic or actuarial references that describe construction of life tables, for example, Pressat (1972) or Shryock and Siegel (1980). When such data are unavailable from registration systems or maternity history data in sample surveys, the under-5 mortality rate can be calculated through indirect or modelling methods based on special questions asked in censuses or demographic surveys. For information on these estimates see the Manual X and MORTPAK-LITE references listed in section 6 below.

(c) **Limitations of the Indicator:** There are often problems in collecting the information required for calculating the under-5 mortality rate in less developed countries where routine data collection in the health services may omit many infant and child deaths. Some countries do not follow the standard definition, given above, of "live birth". However, adjustments can sometimes be made for incomplete registration and age misstatement, and in many developing countries maternity-history data gathered in nationally representative sample surveys provide a sound basis for estimating levels and trends of under-5 mortality. Sample surveys have been more successful at obtaining estimates of under-5 mortality than of adult mortality, and because of this, information about mortality of young children is currently substantially more complete and more timely than is information about the mortality of adults.

If the necessary data are available, the rate can be calculated separately for boys and girls, and for geographic and social subgroups (based on parents' characteristics). It is also useful to disaggregate the under-5 period into separate rates for under age one (infant mortality rate) and for ages 1-4 years.

(d) **Status of the Methodology:** Well developed and widely employed.

(e) **Alternative Definitions/Indicators:** The infant mortality rate is another indicator of early child mortality for which quantitative goals have been set forth at recent international conferences. The infant mortality rate is the number of deaths under 1 year of age during a period of time per 1000 live-births during the same period.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The under-5 mortality rate is derived from data on births and deaths occurring under the age of 5 years, as described in section 3(b) above.

(b) **National and International Data Availability and Sources:** Data are now available for most countries thanks to special surveys of representative samples of the population whenever vital registration systems are not available. Surveys that rely on maternity histories, in which women are asked to give the date of birth and age of death (if applicable) of each live-born child, are used in many household surveys, but care must be taken to avoid age misreporting and to ensure that there is a complete report of deaths. Retrospective questions about the survival of all children born included in censuses and surveys, and analyses using indirect estimation procedures, are also considered to be reliable sources.

(c) **Data References:** Original data sources include vital registration, sample registration systems, surveillance systems, censuses, and demographic surveys. Information needed for this indicator is collected by the United Nations on a regular basis. For all countries, survey and registration data are evaluated and, if necessary, adjusted for incompleteness by the Population Division, Department of Economic and Social Affairs (DESA) as part of its preparations of the official United Nations population estimates and projections. Past, current and projected estimates of infant mortality are prepared for all countries by the Population Division; DESA and appear in the United Nations publication, *World Population Prospects: The 1998 Revision*. Demographic monitoring done by government statistical offices often allows desegregation of information to show differences within countries. Surveys are generally designed to provide estimates for major regions within countries as well as at the national level.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Department of Economic and Social Affairs. The contact point is the Director, Population Division, fax no. (1 212) 963 2147.

(b) **Other Contributing Organizations:** The United Nations Statistics Division/ DESA; and the United Nations Children's Fund (UNICEF); and the World Health Organization (WHO).

6. REFERENCES

(a) **Readings:**

Pressat, R. *Demographic Analysis: Methods, Results, Applications*. London, Edward Arnold; Chicago, Aldine Atherton. 1972.

Shryock, H.S, and J.S.Siegel. *The Methods and Materials of Demography*. U.S. Government Printing Office, Washington, D.C. 1980.

WHO. *Development of Indicators for Monitoring Progress Towards Health for All by the Year 2000*. Geneva, 1981, p. 69.

WHO. *Global Health for All Data Base*. Geneva, 1994.

WHO. *Global Strategy for Health for All by the Year 2000*. Geneva, 1981.

DESA. *Manual X: Indirect Techniques for Demographic Estimation*. Population Division. United Nations Sales No. E. 83.XIII.2, New York, 1983.

DESA. *MORTPAK-LITE - The United Nations Software Package for Mortality Measurement*. Population Division. United Nations, New York, 1988.

DESA. *World Population Prospects: The 1994 Revision*. Population Division. United Nations Sales No. E.95.XIII.16, New York, 1995.

Hill K. Approaches to the measurement of childhood mortality: A comparative review. *Population Index* 57(3):368-382, Fall, 1991.

United Nations. *Report of the International Conference on Population and Development*, Programme of Action of the International Conference on Population and Development, Cairo, Egypt, September 5-13, 1994. United Nations Document A/CONF. 171/13.

United Nations. *Principles and Recommendations for a Vital Statistics System*. United Nations publication, Sales No. E.73.XVII.9.

UNICEF. *The State of the World's Children*. 2000.

WHO and UNICEF. *Measurement of overall and cause-specific mortality in infants and children*. Report of a Joint WHO/UNICEF Consultation, 15-17 December 1992. Unpublished document WHO/ESM/UNICEF/CONS/92.5.

DESA. *Demographic Yearbook 1997*. Statistics Division. United Nations Sales No. E/F.99.XIII.1, 1999.

(b) **Internet sites:**

Statistics are available at:

<http://www.undp.org/popin/wdtrends/wdtrends.htm>

<http://www.un.org/Depts/unsd/social/health.htm>

LIFE EXPECTANCY AT BIRTH		
Social	Health	Mortality

1. **INDICATOR**

- (a) **Name:** Life Expectancy at Birth.
- (b) **Brief Definition:** The average number of years that a newborn could expect to live, if he or she were to pass through life subject to the age-specific death rates of a given period.
- (c) **Unit of Measurement:** Years of life.
- (d) **Placement in the CSD Indicator Set:** Social/Health/Mortality.

2. **POLICY RELEVANCE**

- (a) **Purpose:** Measures how many years on average a new-born baby is expected to live, given current age-specific mortality risks. Life expectancy at birth is an indicator of mortality conditions and, by proxy, of health conditions.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Mortality, with fertility and migration, determines the size of human populations, their composition by age, sex, and ethnicity, and their potential for future growth. Life expectancy, a basic indicator, is closely connected with health conditions, which are in turn an integral part of development. The International Conference on Population and Development (ICPD) Programme of Action notes that the unprecedented increase in human longevity reflects gains in public health and in access to primary health-care services (paragraphs 8.1 and 8.2), which Agenda 21 recognizes as an integral part of sustainable development and primary environmental care (paragraph 6.1). The ICPD Programme of Action highlights the need to reduce disparities in mortality and morbidity among countries and between socio-economic and ethnic groups. It identifies the health effects of environmental degradation and exposure to hazardous substances in the work-place as issues of increasing concern. Life expectancy is included as a basic indicator of health and social development in, among others, the Minimum National Social Data Set endorsed by the United Nations Statistical Commission at its 29th session in 1997, the UNDG-CCA indicator set and the OECD/DAC core indicators.
- (c) **International Conventions and Agreements:** The Declaration of Alma Ata (1978) set a target of life expectancy greater than 60 years by the year 2000; the World Summit for Social Development (WSSD) also included this goal. The ICPD Programme of Action specified that: life expectancy should be greater than 65 years by 2005 and 70 years by 2015 for countries that currently have the highest levels of mortality; and 70 years and 75 years, respectively, for the other countries (ICPD Programme of Action, paragraph 8.5).

(d) **International Targets/Recommended Standards:** See above.

(e) **Linkages to Other Indicators:** This indicator reflects many social, economic, and environmental influences. It is closely related to other demographic variables, and it is related to human health and the environment as well as economic indicators.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Calculation of life expectancy at birth is based on age-specific death rates for a particular calendar period. The death rates are commonly tabulated for ages 0 to 1 years, 1 to 5 years, and for 5-year age groups for ages 5 and above.

(b) **Measurement Methods:** Several steps are needed to derive life expectancy from age-specific death rates; the details can be found in demographic or actuarial references that describe construction of life tables, for example, Pressat (1972) or Shryock and Siegel (1980). For a description of the methodology that is linked to computer routines to aid in the calculation, see MORTPAK-LITE (section 6, below).

(c) **Limitations of the Indicator:** Where data on deaths by age are of good quality, or adjustments for age misstatement and incompleteness can be made, the life expectancy at birth can be calculated directly from registered deaths and population counts, which are usually based on census enumerations, evaluated and, if necessary, adjusted. When data on deaths by age are unavailable from registration systems or sample surveys, the life expectancy at birth can be calculated through "indirect" methods based on special questions asked in censuses or demographic surveys. For information on these indirect estimates, see Manual X and MORTPAK-LITE (section 6, below).

(d) **Status of the Methodology:** Not available.

(e) **Alternative Definitions/ Indicators:** Another indicator of general mortality in common use is the Crude Death Rate (CDR), which is the number of deaths in a period (commonly a one-year period) divided by the mid-period population; it is usually expressed in units of deaths per 1,000 population. The CDR requires less detailed data for its calculation than does life expectancy at birth, but it has the drawback of being influenced to a substantial degree by population age structure: two populations with the same CDR could have markedly different mortality risks, age by age.

Life expectancy may be calculated separately for males and females, or for both sexes combined. If the underlying data permit, life expectancy may also be calculated for subnational regions, or for other population subgroups. Life expectancy can also be presented for particular ages after birth. For instance, life expectancy at age 60 represents the number of additional years an individual who has just reached age 60 can expect to live, given current age-specific mortality rates for older ages.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Some data sources yield estimates of age-specific mortality for only some age groups, so that it may be necessary to employ separate adjustments to data from different sources in order to arrive at a complete and consistent set of rates for a given period of time. Most countries tabulate data from death registration systems at the sub-national level. The under-5 mortality rate and the crude death rate are more readily available for sub-national units than is life expectancy at birth.

(b) **National and International Data Availability and Sources:** Data are collected by the United Nations on a regular basis and are available for most countries from vital registration systems or surveys. For all countries, census and registration data are evaluated and, if necessary, adjusted for incompleteness by the Population Division, United Nations Department of Economic and Social Affairs (DESA) as part of its preparations of the official United Nations population estimates and projections.

(c) **Data References:** Past, current and projected estimates of life expectancy at birth are prepared for all countries by the Population Division, DESA and appear in the United Nations publication, *World Population Prospects: The 1998 Revision* (see section 6, below).

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Department of Economic and Social Affairs (UN/DESA). The contact point is the Director, Population Division, fax no. (1 212) 963 2147.

(b) **Other Contributing Organizations:** The United Nations Statistics Division/DESA; and the United Nations Children's Fund (UNICEF); and the World Health Organization (WHO).

6. REFERENCES

(a) **Readings:**

DESA. *World Population Prospects: The 1998 Revision. Vol. I Comprehensive Tables* Population Division. United Nations Sales No. E.99.XIII.9, New York, 1999.

DESA. *World Population Prospects: The 1998 Revision. Vol. III Analytical Report.* Population Division. United Nations, ESA/P/WP.156, New York, 1999.

DESA. *Manual X: Indirect Techniques for Demographic Estimation.* Population Division United Nations Sales No. E.83.XIII.2, New York, 1983.

DESA. *MORTPAK-LITE: The United Nations Software Package for Mortality Measurement.* Population Division. United Nations, New York, 1988.

DESA. *Demographic Yearbook*. Statistical Division. United Nations Sales No.E/F.95.XIII.1,1995. 1993.

Pressat, R. *Demographic Analysis: Methods, Results, Applications*. London, Edward Arnold; Chicago, Aldine Atherton. 1972.

United Nations. *Report of the International Conference on Population and Development*. Programme of Action of the International Conference on Population and Development. United Nations Document A/CONF. 171/13. Cairo, Egypt, September 5-13, 1994.

Shryock, H.S, and J.S.Siegel. *The Methods and Materials of Demography*. U.S. Government Printing Office, Washington, D.C. 1980.

(b) **Internet sites:**

Statistics are available at:

<http://www.undp.org/popin/wdtrends/wdtrends.htm>

<http://www.un.org/Depts/unsd/social/health.htm>

PERCENT OF POPULATION WITH ADEQUATE SEWAGE DISPOSAL FACILITIES		
Social	Health	Sanitation

1. INDICATOR

- (a) **Name:** Percent of Population with Adequate Sewage Disposal Facilities.
- (b) **Brief Definition:** Proportion of population with access to a sanitary facility for human excreta disposal in the dwelling or immediate vicinity.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Social/Health/Sanitation.

2. POLICY RELEVANCE

- (a) **Purpose:** To monitor progress in the accessibility of the population to sanitation facilities.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** This represents a basic indicator useful for assessing sustainable development, especially human health. Accessibility to adequate excreta disposal facilities is fundamental to decrease the faecal risk and the frequency of associated diseases. Its association with other socioeconomic characteristics (education, income) and its contribution to general hygiene and quality of life also make it a good universal indicator of human development. When broken down by geographic (such as rural/urban zones) or social or economic criteria, it also provides tangible evidence of inequities.
- (c) **International Conventions and Agreements:** Agenda 21 UNCED (1992) indicates the need for universal coverage and the Second World Water Forum and Ministerial Conference, The Hague, March 2000 established the target of universal coverage by the year 2025.
- (d) **International Targets/Recommended Standards:** International targets for this indicator have been established under the auspices of the World Health Organization (WHO). The Vision 21 of the Water Supply and Sanitation Collaborative Council provides targets of 100% coverage by the year 2025.
- (e) **Linkages to Other Indicators:** The indicator is closely associated with other socioeconomic indicators (see section 2(b) above), particularly the proportion of population with access to improved water sources. The indicator represents two of the eight elements of primary health care.

3. **METHODOLOGICAL DESCRIPTION**

(a) **Underlying Definitions and Concepts:** Definitions for sanitary facility and population covered are required.

i) *Sanitary facility:* "A sanitary facility is a unit for disposal of human excreta which isolates faeces from contact with people, animals, crops and water sources. Suitable facilities range from simple but protected pit latrines to flush toilets with sewerage. All facilities, to be effective, must be correctly constructed and properly maintained".

ii) *Population covered:* This includes the urban and rural population served by connections to public sewers; (pit privies, pour-flush latrines, septic tank, etc.)

(b) **Measurement Methods:** This indicator may be calculated as follows: The numerator is the number of people with improved excreta-disposal facilities available multiplied by 100. The denominator is the total population.

(c) **Limitations of the Indicator:** The availability of facilities does not always translate into their utilization.

(d) **Status of the Methodology:** Not Available.

(e) **Alternative Definitions/Indicators:** This indicator could also be expressed as the percent of people without access to improved excreta disposal facilities. The population that must be used in the numerator is the number of people without access to improved excreta disposal facilities. If the data available are in terms of proportion of households for which sanitation is available, it should be possible to convert this into a percentage of population, using average figures for household size. Also see section 3(c) above.

4. **ASSESSMENT OF DATA**

(a) **Data Needed to Compile the Indicator:** The number of people with access to improved excreta disposal facilities, and the total population.

(b) **National and International Data Availability and Sources:** Routinely collected at the national and sub-national levels in most countries using censuses and surveys. In order to arrive at more robust estimates of sanitation coverage, two main data source types are required. First, administrative or infrastructure data which report on new and existing facilities. Second, population-based data derived from some form of national household survey.

(c) **Data References:** Not Available.

5. **AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR**

(a) **Lead Agency:** The lead agency is the World Health Organization (WHO). The contact point is the Coordinator, Water, Sanitation and Health, WHO; fax no. (41 22) 791 4159.

(b) **Other Contributing Organizations:** None.

6. **REFERENCES**

(a) **Readings:**

WHO, *Development of Indicators for Monitoring Progress Towards Health for All by the Year 2000*. Geneva, WHO, 1981, p. 29.

WHO, *Global Strategy for Health for All by the Year 2000*. Geneva, WHO, 1981.

WHO, *Ninth General Programme of Work Covering the Period 1996-2001*. Geneva, WHO, 1994.

World Health Organization, Division of Operational Support in Environmental Health, October 1995.

World Health Organization. *National and Global Monitoring of Water Supply and Sanitation*. CWS Series of Cooperative Action for the Decade, No. 2, 1982.

World Health Organization. *Water Supply and Sanitation Sector Monitoring Report (WSSSMR)*, 1990.

(b) **Internet site:** World Health Organization. <http://www.who.org>

POPULATION WITH ACCESS TO SAFE DRINKING WATER		
Social	Health	Drinking Water

1. INDICATOR

- (a) **Name:** Population with Access to Safe Drinking Water.
- (b) **Brief Definition:** Proportion of population with access to an improved water source in a dwelling or located within a convenient distance from the user's dwelling.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Social/Health/Drinking Water.

2. POLICY RELEVANCE

- (a) **Purpose:** To monitor progress in the accessibility of the population to improved water sources.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Accessibility to improved water sources is of fundamental significance to lowering the faecal risk and frequency of associated diseases. Its association with other socioeconomic characteristics, including education and income, which also makes it a good universal indicator of human development. When broken down by geographic (such as rural/urban zones), or social or economic criteria, it provides useful information on equity issues.
- (c) **International Conventions and Agreements:** Agenda 21 of UNCED (1992) indicates the need for universal coverage and the Second World Water Forum and Ministerial Conference, The Hague, March 2000 established the target of universal coverage by the year 2025.
- (d) **International Targets/Recommended Standards:** International targets for this indicator have been established under the auspices of the World Health Organization (WHO). The Vision 21 of the Water Supply and Sanitation Collaborative Council provides targets of 100% coverage by the year 2025.
- (e) **Linkages to Other Indicators:** This indicator is closely associated with other socioeconomic indicators on the proportion of people covered by adequate sanitation. These indicators are among the eight elements of primary health care. It also has close links to other water indicators such as withdrawals, reserves, consumption, or quality. (See section 2(b) above.)

3. METHODOLOGICAL DESCRIPTION

- (a) **Underlying Definitions and Concepts:** This indicator requires definitions for several elements.

- i) ***Population covered:*** This includes urban and rural population served by house connections, or without house connections but with reasonable access to other sources.
- ii) ***Reasonable access to water:*** In urban areas, a distance of not more than 200 metres from a house to a public stand post or any other adequate point source may be considered reasonable access. In rural areas, reasonable access implies that people do not have to spend a disproportionate part of the day fetching water for the family's needs.
- iii) ***Minimum amount of water:*** The amount of water needed to satisfy metabolic, hygienic, and domestic requirements. This is usually defined as twenty litres of safe water per person per day.
- iv) ***Safe water:*** The water does not contain biological or chemical agents at concentration levels directly detrimental to health. It is likely that treated surface waters, and water such as that from protected boreholes, springs, and sanitary wells are safe. Untreated surface waters, such as streams and lakes, should be considered safe only if the water quality is regularly monitored and considered acceptable by public health officials.

(b) **Measurement Methods:** This indicator may be calculated as follows: The numerator is the number of persons with access to an adequate amount of safe drinking water in a dwelling or located within a convenient distance from the user's dwelling multiplied by 100. The denominator is the total population.

(c) **Limitations of the Indicator:** The existence of a water outlet within reasonable distance is often used as a proxy for availability of safe water. The existence of a water out let, however, is no guarantee in itself that water will always be available or safe, or that people always use such sources.

(d) **Status of the Methodology:** Not Available.

(e) **Alternative Definitions/Indicators:** This indicator may be also expressed as the percent of population without access to improved water sources. Thus the population indicated in the numerator would be those who do not have access to improved water sources. If these data are available in terms of the proportion of households, it should be possible to convert this into a percentage of the population, using average figures for household size.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The number of people with access to improved water sources, and the total population. Data on the source of water, for example, house tap or yard pipe, would provide additional meaning to this indicator.

(b) **National and International Data Availability and Sources:** Routinely collected at the national and sub-national levels in most countries using censuses and surveys. Two data sources are common: administrative data that report on new and existing facilities, and population data derived from some form of household survey or census.

- (c) **Data References:** Not Available.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

- (a) **Lead Agency:** The lead agency is the World Health Organization (WHO). The contact point is the Coordinator, Water, Sanitation and Health, WHO; fax no. (41 22) 791 4159.
- (b) **Other Contributing Organizations:** None.

6. REFERENCES

- (a) **Readings:**

WHO, *Global Strategy for Health for All by the Year 2000*. Geneva, WHO, 1981.

WHO, *Ninth General Programme of Work Covering the Period 1996-2001*. Geneva, WHO, 1994.

WHO, *Development of Indicators for Monitoring Progress Towards Health for All by the Year 2000*. Geneva, WHO, 1981, p. 40.

World Health Organization. *National and Global Monitoring of Water Supply and Sanitation*. CWS Series of Cooperative Action for the Decade, No. 2, 1982.

World Health Organization. *Water Supply and Sanitation Sector Monitoring Report (WSSMR)*, 1990.

Program of Action of the Ministerial Drinking Water Conference, 1994.

- (b) **Internet site:** World Health Organization. <http://www.who.org>

PERCENT OF POPULATION WITH ACCESS TO PRIMARY HEALTH CARE FACILITIES		
Social	Health	Healthcare Delivery

1. INDICATOR

- (a) **Name:** Percentage of Population with Access to Primary Health Care Facilities.
- (b) **Brief Definition:** Proportion of population with access to primary health care facilities.
- (c) **Unit of Measurement:** %.
- (d) Placement in the CSD Indicator Set: **Social/Health/Healthcare Delivery.**

2. POLICY RELEVANCE

- (a) **Purpose:** To monitor progress in the access of the population to primary health care.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Accessibility of health services, going beyond just physical access, and including economic, social and cultural accessibility and acceptability, is of fundamental significance to reflect on health system progress, equity and sustainable development. It should, however, be supplemented by indicators of utilization of services, or actual coverage, and quality of care. In addition, accessibility is an instrumental goal, a means to an end, to achieving the final intrinsic goals of the system. The more accessible a system is, the more people should utilize it to improve their health.
- (c) **International Conventions and Agreements:** World Health Assembly Resolution WHA34.36, Global Strategy for Health for All by the Year 2000.
- (d) **International Targets/Recommended Standards:** International targets have been outlined in the Global Strategy for Health for All and more recently in the Ninth General Programme of Work. In addition, many countries have established national targets.
- (e) **Linkage to Other Indicators:** This indicator is associated with other socioeconomic indicators on the proportion of people covered by other essential elements of primary health care. It should also, as indicated above, be linked with indicators of utilization of services and quality of care.

3. METHODOLOGICAL DESCRIPTION

- (a) **Underlying Definitions and Concepts:**

(i) **Primary health care:** is essential health care made accessible at a cost the country and community can afford, with methods that are practical, scientifically sound and socially acceptable.

(ii) **Population covered:** All the population living in the service area of the health facility.

(iii) **Access:** Definition of accessibility may vary between countries, for different parts of the country and for different types of services.

(b) **Measurement Methods:** The numerator - the number of persons living within a convenient distance to primary care facilities; the denominator - the total population.

(c) **Limitations of the Indicator:** The existence of a facility within reasonable distance is often used as a proxy for availability of health care. If the existing primary care facility, however, is not properly functioning, provides care of inadequate quality, is economically not affordable, and socially or culturally not acceptable, physical access has very little value as this facility is bypassed and not utilized. Therefore, other factors, as mentioned in 3(e) have to be taken into account.

(d) **Status of the Methodology:** Not Available.

(e) **Alternative Definitions/Indicators:** In the light of 3(c) the indicator must be supplemented by indicators of availability of services, quality of services, acceptability of services, affordability of services, or utilization of services.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The number of people with access to primary health care facilities, total population in service areas of health facilities.

(b) **National and International Data Availability and Sources:** No routinely available data. Information has to be acquired through surveys. Data Sources include Ministries of Health and National Statistical Offices.

(c) **Data References:** Not Available.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the World Health Organization (WHO). The contact point is the Director, Department of Organization of Health Services Delivery, fax: 41 22 791 4747.

(b) **Other Contributing Organizations:** None.

6. **REFERENCES**

(a) **Readings:**

HIS Development Strategy and Catalogue of Health Indicators, Geneva 2000 (EIP/OSD/00.12)

WHO, *The World Health Report 2000; Health Systems: Improving Performance*, Geneva, 2000.

El-Bindari-Hammad, Smith, DL, *Primary Health Care Reviews, Guidelines and Methods*, WHO, Geneva, 1992.

WHO, *Development of Indicators for Monitoring Progress towards Health for All by the Year 2000*, Geneva, 1981.

WHO, *Evaluating the Implementation of the Strategy for Health for All by the Year 2000, Common Framework: Third Evaluation*, Geneva, 1996.

WHO, *Health Centres: the 80/20 Imbalance; Burden of Work Vs Resources*, Geneva, 1999.

(b) **Internet site:** World Health Organization. <http://www.who.org>

IMMUNIZATION AGAINST INFECTIOUS CHILDHOOD DISEASES		
Social	Health	Healthcare Delivery

1. INDICATOR

- (a) **Name:** Immunization Against Infectious Childhood Diseases.
- (b) **Brief Definition:** The percent of the eligible population that have been immunized according to national immunization policies. The definition includes three components: (i) the proportion of children immunized against diphtheria, tetanus, pertussis, measles, poliomyelitis, tuberculosis and hepatitis B before their first birthday; (ii) the proportion of children immunized against yellow fever in affected countries of Africa; and (iii) the proportion of women of child-bearing age immunized against tetanus.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Social/Health/Healthcare Delivery.

2. POLICY RELEVANCE

- (a) **Purpose:** This indicator monitors the implementation of immunization programs.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Health and sustainable development are intimately interconnected. Both insufficient and inappropriate development can lead to severe health problems in both developing and developed countries. Addressing primary health needs is integral to the achievement of sustainable development. Particularly relevant is the provision of preventative programmes aimed at controlling communicable diseases and protecting vulnerable groups. Good management of immunization programmes, essential to the reduction of morbidity and mortality from major childhood infectious diseases, is a basic measure of government commitment to preventative health services.
- (c) **International Conventions and Agreements:** See sections 2(d) and 6.
- (d) **International Targets/Recommended Standards:** In the *Global Strategy for Health* and the *Ninth General Programme at Work*, all children and 90% of children respectively, should be immunized against diphtheria, tetanus, pertussis, measles, poliomyelitis, tuberculosis and hepatitis B (see section 6 below). The 1992 *World Health Assembly* agreed that all children should be immunized against hepatitis B as part of expanded national programmes of immunization. In addition, all children in affected countries of Africa should be immunized against yellow fever. At the *World Summit for Children* it was resolved that all pregnant women should be immunized against tetanus.

(e) **Linkages to Other Indicators:** This indicator is linked to other health indicators, particularly those associated with the young, such as infant mortality and life expectancy. It is influenced by such indicators as health expenditure and the proportion of population in urban areas.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** A child is considered adequately immunized against a disease when he or she has received the following number of doses: tuberculosis (1 dose); diphtheria, tetanus and pertussis (DTP) (2 or 3 doses according to the immunization scheme adopted in the country); poliomyelitis (3 doses of live or killed vaccine); measles (1 dose); hepatitis B (3 doses); and yellow fever (1 dose). A pregnant woman is considered adequately immunized against tetanus if she has received at least 2 doses of tetanus toxoid during pregnancy or was already previously immunized.

(b) **Measurement Methods:**

- i) Infant population: The numerator is the number of infants fully immunized with the specified vaccines x 100, while the denominator is the number of infants surviving to age one. For immunizations against tuberculosis the denominator is the number of live births. If the national schedule provides for immunization in a different age group, such as measles in the second year of age, the value should be the percentage of children immunized in the target age group. For the proper management of immunization programmes, it is however essential to be able to break down the data in such a way as to show the percentage covered in the first year of life (or second year for measles immunization).
- ii) Women of child-bearing age: The numerator is the number of women immunized with two or more doses of tetanus toxoid during pregnancy x 100, while the denominator is the number of live births.

(c) **Limitations of the Indicator:** It is useful to have a composite indicator of adequate coverage by immunization. However, it is easier to collect data on the global coverage of a population against one disease than on the immunization of each child against all target diseases at the same time. This is why in most countries only the former data are easily available and collected.

The percent of pregnant women immunized with two or more doses of tetanus toxoid during pregnancy is rather easy to monitor through routine data collection in the health services. However, it underestimates the percent of pregnant women actually immunized against tetanus. It does not take into account women who are already adequately immunized when becoming pregnant and therefore do not require new doses of tetanus toxoid during pregnancy. Women in this category are not numerous in countries where neonatal tetanus is still an issue and where, accordingly, this indicator is mainly used. But in some countries in transition, with long-standing child immunization programmes, the percent of pregnant women receiving tetanus toxoid is misleading as a significant number of them may be already immunized at the moment of pregnancy.

The indicator does not reflect other health preventative measures, such as education, diet, and pollution prevention. The international targets are not very meaningful for many countries.

(d) **Status of the Methodology:** Not Available.

(e) **Alternative Definitions/Indicators:** Not available.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The number of infants fully immunized against: DTP; poliomyelitis; measles; the number of infants surviving to age one year; against tuberculosis; the number of births; the number of infants living in African countries exposed to yellow fever; the number of pregnant women immunized against tetanus; and the number of live births.

(b) **National and International Data Availability and Sources:** Data is readily available from national immunization programmes of most countries, at least at the national level. Reporting of vaccinations performed annually or nation-wide surveys are the most common data sources.

(c) **Data References:** Not Available.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the World Health Organization (WHO). The contact point is the Director, Office of Global and Integrated Environmental Health, WHO; fax no. (41 22) 791 4123.

(b) **Other Contributing Organizations:** The United Nations Children's Fund is a cooperating agency.

6. REFERENCES

(a) **Readings:**

WHO. *Global Strategy for Health for All by the Year 2000*. Geneva, WHO, 1981.

WHO. Ninth General Programme of Work Covering the Period 1996-2001. Geneva, WHO, 1994.

WHO. *World Health Assembly Resolution*. WHO45.19, 1992.

WHO. *WHO Vaccine Preventable Diseases Monitoring System*; 1999 Global Summary.

WHO/V&B/99.17,1999.

WHO. *WHO-Recommended Standards for Surveillance of Selected Vaccine-Preventable Diseases*. WHO/EPI/GEN/99.012,1999.

UNICEF. *World Summit for Children*. Paris, UNICEF, 1990.

(b) **Internet site:** World Health Organization. <http://www.who.org>

CONTRACEPTIVE PREVALENCE RATE		
Social	Health	Healthcare Delivery

1. INDICATOR

- (a) **Name:** Contraceptive Prevalence Rate.
- (b) **Brief Definition:** This indicator is generally defined as the percent of women or reproductive age using any method of contraception. It is usually calculated for married women of reproductive age, but sometimes for other base population, such as all women of reproductive age, or for men of a specified age group.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Social/Health/Healthcare Delivery.

2. POLICY RELEVANCE

- (a) **Purpose:** The measure indicates the extent of people's conscious efforts to control their fertility. It does not capture all actions taken to control fertility, since induced abortion is common in many countries.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Increased contraceptive prevalence, is, in general, the single most important proximate determinant of inter-country differences in fertility, and of ongoing fertility declines in developing countries. Contraceptive prevalence can also be regarded as an indirect indicator of progress in providing access to reproductive health services including family planning, one of the eight elements of primary health care. Agenda 21 discusses reproductive health programmes, which include family planning, as among the programmes that promote changes in demographic trends and factors towards sustainability.

Health benefits include the ability to prevent pregnancies that are too early, too closely spaced, too late, or too many. Current contraceptive practice depends not only on people's fertility desires, but also on availability and quality of family planning services; social traditions that affect the acceptability of contraceptive use; and other factors, such as marriage patterns and traditional birth-spacing practices, that independently influence the supply of children.

- (c) **International Conventions and Agreements:** Family planning is discussed in the broader context of reproductive, sexual health, and reproductive rights by Chapter VII of the Programme of Action, International Conference on Population and Development (ICPD); and Strategic Objective C of the Platform for Action adopted at the Fourth World Conference on Women.

(d) **International Targets/Recommended Standards:** International agreements do not establish specific national or global targets for contraceptive prevalence. Recent international conferences have strongly affirmed the right of couples and individuals to choose the number, spacing and timing of their children, and to have access to the information and means to do so. The ICPD Programme of Action states that "Governmental goals for family planning should be defined in terms of unmet needs for information and services. Demographic goals, while legitimately the subject of government development strategies, should not be imposed on family-planning providers in the form of targets or quotas for the recruitment of clients" (paragraph 7.12).

(e) **Linkages to Other Indicators:** The level of contraceptive use has a strong, direct effect on the total fertility rate (TFR) and, through the TFR, on the rate of population growth. Use of contraception to prevent pregnancies that are too early, too closely spaced, too late, or too many has benefits for maternal and child health. This indicator is also closely linked to access to primary health care services particularly those pertaining to reproductive health care. Furthermore, it has broader and predictive implications for many other sustainable development indicators and issues, such as rate of change of school-age population, woman's participation in the labour force, and natural resource use.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The standard indicator is the percentage currently using any method of contraception among married women aged 15-49 or 15-44. In this context, the married group usually includes those in consensual or common-law unions in societies where such unions are common. Contraceptive prevalence is also frequently reported for all women of reproductive age, and statistics are sometimes presented for men instead of, or in addition to, women.

Users of contraception are defined as women who are practising, or whose male partners are practising, any form of contraception. These include female and male sterilization, injectable and oral contraceptives, intrauterine devices, diaphragms, spermicide, condoms, rhythm, withdrawal and abstinence, among others.

For this indicator, *too early* is defined as under age 15. Such adolescents are 5 to 7 times more likely to die in pregnancy and childbirth than women in the lowest risk group of 20-24 years. *Too closely spaced* means women who become pregnant less than two years after a previous birth. Greater adverse consequences to women and their children are experienced under such circumstances. Women who have had five or more pregnancies (*too many*) or who are over 35 (*too late*), also face a substantially higher risk than the 20-24 year old group.

When presenting information about contraceptive use, it is useful to show the data according to specific type of contraception; by social characteristics such as rural/urban or region of residence, education, marital status; by 5-year age group, including specific attention to adolescents aged under 18 years; and by family size.

(b) **Measurement Methods:** Measurements of contraceptive prevalence come almost entirely from representative sample surveys of women or men of reproductive age. Current use of

contraception is usually assessed through a series of questions about knowledge and use of particular methods.

(c) **Limitations of the Indicator:** For surveys, under-reporting can occur when specific methods are not mentioned by the interviewer. This can be the case with the use of traditional methods such as rhythm and withdrawal, and use of contraceptive surgical sterilization. The list of specific methods is not completely uniform in practice, but in most cases is sufficiently consistent to permit meaningful comparison. "Current" use is often specified in surveys to mean "within the last month", but sometimes the time reference is left vague, and occasionally longer reference periods are specified. With statistics from family planning programmes, the accuracy of the assumptions is often difficult to assess. The derived estimates obviously omit contraceptive users who do not use the programme's services, and thus tend to underestimate the overall level of use.

Service statistics maintained by family planning programmes are also sometimes used to derive estimates of contraceptive prevalence. In such cases it is necessary to apply assumptions in order to derive estimates of numbers of current users from the records of numbers of family planning clients. Base population statistics (numbers of women or of married women) are in this case usually derived from census counts, adjusted to the reference date by the Population Division of the Department of Economic and Social Affairs (DESA), as part of its preparations of the official United Nations population estimates and projections.

(d) **Status of the Methodology:** The methodology is widely used in both developed and developing countries.

(e) **Alternative Definitions/Indicators:** None.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Number of women of childbearing age using family planning methods. Number of women of childbearing age. Both data sets are frequently limited to married women.

(b) **National and International Data Availability and Sources:** The most recent United Nations review of contraceptive prevalence includes statistics for 119 countries and areas with information dating from 1975 or later. These countries include 90 per cent of world population. This review includes contraceptive prevalence measures for all women of reproductive age in 64 countries and areas and for samples of men in 27 countries and areas.

Contraceptive prevalence is one of the few topics for which data coverage is more complete and more current for developing than for developed countries. Most surveys provide estimates for major regions within countries as well as at the national level. Less frequently the sample design permits examining prevalence at the state, provincial, or lower administrative levels. In addition to those with national or near-national coverage, surveys covering this topic are sometimes available for particular geographic areas. Data are much less widely available for population groups other than married women, although such information has increased in recent years.

(c) **Data References:** Executing agencies for surveys covering this topic vary. National statistical offices and ministries of health are the most common source, but other governmental offices, non-governmental voluntary or commercial organizations are frequently involved. Many surveys are conducted in collaboration with international survey programmes. The Population Division, DESA regularly compiles information about contraceptive prevalence and publishes it in the annual *World Population Monitoring* report.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the World Health Organization (WHO). The contact point is the Director, Office of Global and Integrated Environmental Health, fax no. (41 22) 791 4123.

(b) **Other Contributing Organizations:** The United Nations Department of Economic and Social Affairs (DESA), with the contact point as the Director, Population Division, fax no. (1 212) 963 2147.

6. REFERENCES

(a) **Readings:**

Levels and Trends of Contraceptive Use as Assessed in 1988 (United Nations, Sales No. E.89.XIII.4).

Levels and Trends of Contraceptive Use as Assessed in 1994 (United Nations, ST/ESA/SER.A/146, forthcoming).

Programme of Action of the International Conference on Population and Development, *Report of the International Conference on Population and Development*, Cairo, Egypt, September 5-13, 1994. (United Nations Document - A/CONF. 171/13).

World Population Monitoring, 1993 (Sales No. E.95.XIII.8, New York).

World Population Monitoring, 1996 (ESA/P/WP.131).

(b) **Internet site:** World Health Organization. <http://www.who.org>

CHILDREN REACHING GRADE 5 OF PRIMARY EDUCATION		
Social	Education	Education Level

1. **INDICATOR**

- (a) **Name:** Children reaching grade 5 of primary education.
- (b) **Brief Definition:** The estimated proportion of the population entering primary school who reach grade 5.
- (c) **Unit of Measurement:** expressed as a percentage (%).
- (d) **Placement in the CSD Indicator Set:** Social/Education/Education Level.

2. **POLICY RELEVANCE**

- (a) **Purpose:** This indicator provides an estimate of the proportion of children entering primary school who reach grade 5 of primary education and thereby acquire basic literacy.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Education is a process by which human beings and societies reach their fullest potential. Education is critical for promoting sustainable development and improving the capacity of people to address environment and development issues. It is also critical for achieving environmental and ethical awareness, values, and skills consistent with sustainable development and effective public participation in decision-making.

Policy-makers concerned with children's retention in schools and their eventual acquisition of basic literacy and numeracy skills would find this indicator particularly useful as it indicates the functioning, or internal efficiency of the education system and its ability to turn out literate people.

Appropriate policies and measures could then be adopted to address problems of grade repetition and drop-out as well as bottlenecks with regard to retention in school. Indirectly, this indicator reflects the quality and performance of schools.

- (c) **International Conventions and Agreements:** None.
- (d) **International Targets/Recommended Standards:** With values that can vary from 0 to 100%, the general target would be 100%. This implies complete retention of children in school to grade 5 (or zero drop-out).

(e) **Linkages to Other Indicators:** Literacy is closely linked to indicators reflecting basic needs such as education, capacity-building, information and communications, and the role of major groups. Besides assessing the functioning of the education system, this indicator is often used together with enrolment ratios to depict respectively the complementary aspects of participation and retention in education. It can be cross-referenced with adult literacy which reflects the cumulative output of the education system over the years.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Efforts to extend literacy depend on the ability of the education system to ensure full participation of school-age children and their successful progression to reach at least grade 5, which is the stage when they are believed to have firmly acquired literacy and numeracy. By estimating the percentage survival to grade 5, this indicator measures the proportion of the population entering primary school who eventually reach grade 5.

(b) **Measurement Methods:** This indicator can be derived using the reconstructed cohort student flow method, which is analogous to that used in demography to determine survival rates from one age to the next. This method first derives the grade promotion, repetition and drop-out rates based on available data on enrolment and repeaters by grade for two consecutive years using Markov chain calculations. It then applies these rates to a cohort of 1,000 students in grade 1 to reconstruct their passage through the education system assuming that these student flow rates by grade remain unchanged throughout the life-time of the cohort. From the reconstructed cohort student flow, the percentage survival to grade 5 can be derived.

If p_i , r_i and d_i represent respectively promotion rate, repetition rate and drop-out rate at grade i of primary education, they can be derived but the following condition on the flow rates have to be satisfied:

$$p_i + r_i + d_i = 1$$

$$0 < p_i, r_i, d_i < 1$$

When these conditions are not satisfied, the method used to derive survival is no longer valid since it is not possible to isolate the original cohort and any inferences made will be of a dubious nature.

A fundamental assumption is that the probability of the cohort entering primary school, irrespective of the age of the pupils not reaching grade 5 is the same as that of the entrance age population for this level of education. That is, the drop-out rate is the same for all pupils regardless of the age at which they enter school.

(c) **Limitations of the Indicator:** The measurement method described in 4b above is rather a cumbersome one to administer. In addition, in some countries such as Germany and Austria, the concept of grade 5 does not exist in primary education. Moreover, data on enrolment and repetition by grade may not be available for consecutive years for some countries and certain regions or schools within a country. The reconstructed cohort student flow method assumes that

promotion rates, repetition rates and drop-out rates do not change from year to year. When applying this method to sub-national and school levels, the derived drop-out rates by grade may sometimes present a negative value due to transfers between schools. A suggested solution to this problem is to collect data on transferred students by grade, and to deduct them from the corresponding enrolment figures before applying the reconstructed cohort method.

(d) **Status of the methodology:** This indicator has the status of a recommendation since the basic data elements to derive it are included in the Revised Recommendation Concerning the International Standardization of Education Statistics adopted by the UNESCO General Conference at its twentieth session, Paris, 1978.

(e) **Alternative Definitions:** In the absence of data on repeaters, the methodology outlined in section 4 (b) above may be adjusted by assuming that the repetition rate is 0. However, this assumption, in addition to those described in 4 (b), presupposes that the repetition rates are quite low and that their magnitude does not vary much between grades.

An alternative indicator for education effectiveness would be school drop-out rates, grade by grade.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Basic data required to derive this indicator include: enrolment and repeaters by grade for at least two consecutive years.

(b) **National and International Data Availability and Sources:** Data on enrolment and repeaters by grade in primary school are generally available in most countries and also at sub-national and school levels. For sound measurement, this indicator must be supported by consistent data for gender and area (such as rural/urban zones).

(c) **Data References:**

UNESCO, World Education Indicators.

UNESCO/USAID, Global Education Database.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Educational, Scientific and Cultural Organization (UNESCO). The contact point is the Director, UNESCO Institute of Statistics, UNESCO, fax: (33 1) 45 68 55 20.

(b) **Other Contributing Organizations:** None.

6. **REFERENCES**

(a) **Readings:**

World Education Report (UNESCO), 1995, 1998.

Education for All: Year 2000 Assessment (UNESCO)

International Standard Classification of Education Manuals

Statistical Information System in Education

(b) **Internet site:** <http://www.unesco.org/statistics>

ADULT SECONDARY EDUCATION ACHIEVEMENT LEVEL		
Social	Education	Education level

1. INDICATOR

- (a) **Name:** Adult Secondary Education Achievement Level.
- (b) **Brief Definition:** The proportion of the population of working age (25-64 years) which has completed at least (upper) secondary education.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Social/Education/Education Level.

2. POLICY RELEVANCE

- (a) **Purpose:** This indicator provides a measure of the quality of the human capital stock within the adult population of approximately working age. Those who have completed secondary education can be expected either to have an adequate set of skills relevant to the labour market or to have demonstrated the ability to acquire such skills. The indicator can be made more dynamic by presenting the results in 10-year age bands (25-34, 35-44, 45-54, 55-64) in order to give an indication of changes over time in actual secondary education completion rates.
- (b) **Relevance to Sustainable/Unsustainable Development:** Education is a process by which human beings reach their fullest potential. It is critical for promoting and communicating sustainable development and improving the capacity of people to address environment and development issues. It facilitates the achievement of environmental and ethical awareness, values, and skills consistent with sustainable development and effective public participation in decision-making.
- (c) **International Conventions and Agreements:** None.
- (d) **International Targets/Recommended Standards:** International agreements do not establish specific national or global targets for this indicator.
- (e) **Linkages to Other Indicators:** Education is closely linked to indicators reflecting basic needs such as literacy, capacity-building, information and communications and the role of major groups. This indicator also is a broad measure of the quality of the human capital stock within countries (and hence, an indication of the potential for future sustained development).

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The *International Standard Classification of Education (1997)* defines levels of education (pre-primary, primary, secondary etc) in an internationally comparable manner.

(b) **Measurement Methods:** To calculate the adult secondary education achievement level, divide the number of adults aged 25-64 years who have completed secondary or tertiary education by the corresponding total population aged 25-64 years and multiply by 100.

(c) **Limitations of the Indicator:**

Educational achievement levels are mostly based on self-declaration or declaration of the head of household, which may give rise to concerns about data reliability and consequently comparability, especially for females in many developing countries. Some countries determine completion of secondary education by making inference using data on the number of years of schooling received rather than qualifications obtained. In some cases, the available data only indicate whether an individual has studied at secondary level as opposed to having completed secondary education.

(d) **Status of the methodology:**

This indicator has the status of an international recommendation since the basic data elements to derive it are included in the *Revised Recommendation concerning the International Standardization of Education Statistics* adopted by the UNESCO General Conference at its twentieth session, Paris, 1978. In the latest revised Principles and Recommendations for Population and Housing Censuses in 1999, the concerned UN agencies co-operated with international experts in upgrading the methodology used in collecting statistics on literacy and educational characteristics.

(e) **Alternative Definitions:**

Where relatively small numbers of the population have completed secondary education, alternative indicators are either the Adult Primary Education Achievement Level (although this may be closely correlated with the Adult Literacy Rate) or the Adult Lower Secondary Education Achievement Level.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Data on the number of people of the relevant age (recommended to be 25-64) who have completed at least secondary education and the corresponding population of the same age.

(b) **National and International Data Availability and Sources:** Data are usually collected during national population censuses, or during household surveys such as Labour Force Surveys. Official statistics exist for many countries in the world but are often out-of-date due to censuses

taking place every ten years and late census data release. For sound measurement, the ratio must be supported by consistent data by gender and age-group.

- (b) **Data References:** <http://www.unesco.org/statistics>

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Educational, Scientific and Cultural Organization (UNESCO). The contact point is the Director, UNESCO Institute for Statistics, UNESCO; e-mail: uis@unesco.org and fax (33-1) 45 68 55 20.

(b) **Other Organizations:** The International Labour Organization (ILO) also collects statistics on educational attainment from national Labour Force Surveys and the Organisation for Economic Co-operation and Development (OECD) publishes such data.

6. REFERENCES

- (a) **Readings:**

UNESCO, World Education Report, 1995, 1998.

UNESCO, Statistics of Education in Developing Countries: an Introduction to their Collection and Analysis, 1983.

- (b) **Internet site:** <http://www.unesco.org/statistics>

ADULT LITERACY RATE		
Social	Education	Literacy

1. **INDICATOR**

- (a) **Name:** Adult literacy rate.
- (b) **Brief Definition:** The proportion of the adult population aged 15 years and over that is literate.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Social/Education/Literacy.

2. **POLICY RELEVANCE**

- (a) **Purpose:** This indicator provides a measure of the stock of literate persons within the adult population who are capable of using written words in daily life and to continue to learn. It reflects the accumulated accomplishment of education in spreading literacy. Any shortfall in literacy would provide indications of efforts required in the future to extend literacy to the remaining adult illiterate population.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Literacy is critical for promoting and communicating sustainable development and improving the capacity of people to address environment and development issues. It facilitates the achievement of environmental and ethical awareness, values, and skills consistent with sustainable development and effective public participation in decision-making.
- (c) **International Conventions and Agreements:** The World Declaration and The Dakar Framework for Action on Education for All.
- (d) **International Targets/Recommended Standards:** The general target is full literacy, i.e., 100% adult literacy rate. This is the goal of most national efforts and international campaigns to eradicate illiteracy.
- (e) **Linkages to Other Indicators:** Literacy is closely linked to indicators reflecting basic needs such as education, capacity building, information and communication, and the role of major groups. The literacy rate indicates the status, or stock of literates at a given point in time. It is often linked to school enrolment ratios and population reaching grade 5 of primary education, both of which influence the accumulation of the stock of literates.

3. **METHODOLOGICAL DESCRIPTION**

(a) **Underlying Definitions and Concepts:** The *Revised Recommendation concerning the International Standardization of Educational Statistics* suggests the following definitions for statistical purposes:

(i) A person is literate who can with understanding both read and write a short simple statement related to his/her everyday life.

(ii) A person is functionally literate who can engage in all those activities in which literacy is required for effective functioning of his/her group and community and also for enabling him/her to continue to use reading, writing and calculation for his/her own and the community's development.

Persons who do not fulfill (i) or (ii) are termed illiterates or functional illiterates respectively. Adult literacy, in international practice, applies only to the population aged 15 years and over, classified by sex, by five-year age-groups, and by urban/rural zones.

(b) **Measurement Methods:** To calculate the adult literacy rate, divide the number of literates aged 15 years and over by the corresponding total population aged 15 years and over and multiplied by 100.

(c) **Limitations of the Indicator:** As literacy is a relative concept, no single measure can separate the literate from the illiterate. A cut-off point is not totally appropriate because there are many different forms and degrees of literacy. A person might be literate in numeric terms, but have difficulty with text comprehension. Literacy can be defined in terms of work, school, home, and social spheres. Each area of life requires different types of literacy skills.

Literacy status is mostly based on self-declaration or declaration of the head of household, which gives rise to concerns about data reliability and consequently comparability, especially for females in many developing countries. Some countries estimate literacy rates by making inference using data on educational attainment, such as by equating persons with no formal schooling as illiterates in the absence of theoretical and empirical basis. Increasingly, literacy should be determined by actual test measurement of reading, writing and numeracy abilities of each person within a social context. It may, however, be time-consuming, costly and operationally complex to organize such measurements during national population censuses.

(d) **Status of the methodology:** This indicator has the status of an international recommendation since the basic data elements to derive it are included in the *Revised Recommendation concerning the International Standardization of Education Statistics* adopted by the UNESCO General Conference at its twentieth session, Paris, 1978. In the latest revised Principles and Recommendations for Population and Housing Censuses in 1999, the concerned UN agencies co-operated with international experts in upgrading the methodology used in collecting statistics on literacy and educational characteristics. Further development of easy-to-use, robust and low-cost literacy test methodologies and their use in spreading the practice of

literacy test measurement shall help to improve the quality of international statistics on literacy in the future.

(e) **Alternative Definitions:** To meet the limitations discussed in 4c above, the definition and measurement of functional literacy represents an alternative indicator. This is usually measured for four or five components of literacy such as "prose", "document", and "quantitative" domains. The aim is to measure the degree of functionality, rather than the dichotomy literate vs. illiterate.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Data on the number of literates or illiterates and the corresponding population aged 15 years and over.

(b) **National and International Data Availability and Sources:** Data are usually collected during national population censuses, or during household surveys or literacy surveys. Official statistics exist for most countries in the world but are often out-of-date due to census taking every ten years and late census data release. The United Nations Educational, Scientific and Cultural Organization (UNESCO) carries out periodic estimations and projections to fill data gaps. In principle, literacy data are available at both the national and sub-national levels. For sound measurement, the ratio must be supported by consistent data by gender, age-group and area (such as rural/urban zones). The primary data sources are national population censuses and household surveys. International data sources include the Statistics Division of the United Nations Department of Economic and Social Affairs (DESA); and the UNESCO Institute for Statistics.

(c) **Data References:** The UNESCO Statistics WEB site <http://unescostat.unesco.org/>; UNESCO Statistical Yearbook 1999; UNDP Human Development Reports; World Bank World Development Reports.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Educational, Scientific and Cultural Organization (UNESCO). The contact point is the Director, UNESCO Institute for Statistics, UNESCO; e-mail: uis@unesco.org and fax (33-1) 45 68 55 20.

(b) **Other Contributing Organizations:** The Statistics Division of the United Nations DESA also collects and publishes statistics on literacy from national population censuses, besides providing the data to UNESCO for processing and dissemination.

6. REFERENCES

(a) **Readings:** UNESCO Statistical Yearbook (annual editions); Compendium of Statistics on Illiteracy: 1995 Edition, UNESCO, Paris. 1995.

(b) **Internet site:** <http://unescostat.unesco.org/>

FLOOR AREA PER PERSON		
Social	Housing	Living Conditions

1. **INDICATOR**

- (a) **Name:** Floor Area per Person.
- (b) **Brief Definition:** Defined as the median usable living space per person.
- (c) **Unit of Measurement:** m².
- (d) **Placement in the CSD Indicator Set:** Social/Housing/Living Conditions.

2. **POLICY RELEVANCE**

- (a) **Purpose:** This is a key indicator of housing quality, which measures the adequacy of living space in dwellings. A low value for the indicator is a sign of overcrowding.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** This is a key indicator measuring the adequacy of the basic human need for shelter. Human settlement conditions in many parts of the world are deteriorating mainly as a result of a low level of investment, although such investment has been shown to generate considerable public and private sector investment. Housing policies, particularly in urban areas, greatly affect the living conditions of people. In low income settlements, reduced space per person can be associated with certain categories of health risks.
- (c) **International Conventions and Agreements:** This indicator is one of ten "key" housing indicators approved by the Commission on Human Settlements (Resolution 14/13), to be collected in all countries and in a number of cities in each country, to measure progress towards meeting the objectives of the Global Shelter Strategy. Countries are to use the indicators to provide the basis for their country reports to the Second United Nations Conference on Human Settlements. Also, the Habitat Agenda, endorsed at the Second United Nations Conference on Human Settlements (Habitat II), explicitly mentions 'provision of sufficient living space and avoidance of overcrowding', as part of the commitments of UN member states, to be measured by this indicator. This indicator has also been selected for the Common Country Assessment (CCA) indicators' framework prepared by the UNDG for evaluation, advocacy and policy dialogue at the country level.
- (d) **International Targets/Recommended Standards:** No targets have been developed for this indicator.
- (e) **Linkages to Other Indicators:** This indicator is closely linked to several other socio-economic indicators with which it should be considered, including population density, rate of

growth of urban population, area and population of informal settlements, and infrastructure expenditure per capita.

3. **METHODOLOGICAL DESCRIPTION**

(a) **Underlying Definitions and Concepts:** The floor area should include all living space, along with bathrooms, internal corridors and closets. Covered semi-private spaces such as corridors, inner courtyards or verandas should be included in the calculation if used by the household for cooking, eating, sleeping, or other domestic activities. Floor area refers to a housing unit, defined as a separate and independent place of abode intended for habitation by one household at the time of the census or other inquiry.

(b) **Measurement Methods:** The median floor area of a unit should be divided by the average household size. If data from household surveys or from a recent census are available, these can be used. In the absence of better data, the floor area of the median priced dwelling may be used as an approximation, although this may not be an accurate estimate. If the median cannot be estimated, then the average should be provided.

(c) **Limitations of the Indicator:** Results for this indicator may vary considerably if collected at the city, national, urban/rural levels, given the variations in land availability and types of human settlements and activities. Informal settlements in particular are likely to have much less space per person, as are disadvantaged groups. Various levels of data collection are necessary to provide a full picture of this specific housing outcome. Housing size and housing quality are usually but not necessarily linked, and floor area per person may not give a complete picture of living conditions. Cultural values affect sensitivity to crowding. For these reasons, interpretation of this indicator is difficult, and should be completed in conjunction with related indicators.

(d) **Status of the Methodology:** Not Available.

(e) **Alternative Definitions:** Alternative measures of crowding have been the subject of data collection and reporting in international statistical compendia. The two most common are persons per room and households per dwelling unit, each of which was included among data collected during the first phase of the Housing Indicators Programme (UNCHS, World Bank, 1992). Surveys have shown that floor area per person is more precise and policy-sensitive than the other two indicators. Habitat, the United Nations Centre for Human Settlements (UNCHS) has developed and tested a series of crowding indicators in low-income settlements. They include, among others, percentage of housing units with more than one household, in-house living area per person, percentage of housing units with more than three persons per room, number of households per building and per housing unit, number of persons per building.

4. **ASSESSMENT OF DATA**

(a) **Data Needed to Compile the Indicator:** Median floor area of housing units; average number of persons per household.

(b) **National and International Data Availability and Sources:** The data are generally available at the country level. This indicator was collected in 52 countries (one city per country) by the Shelter Sector Performance Indicators Programme in 1992 (UNCHS, World Bank). It has been collected worldwide by the UNCHS Indicators Programme in preparation for the Habitat II Conference (1996). Results are available from the following Habitat website: www.urbanobservatory.org/indicators.

(c) **Data References:** Primary data sources include censuses or household surveys. The indicator is reported in *the Housing Indicators Programme* report listed in section 6 below.

5. AGENCIES INVOLVED WITH THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Centre for Human Settlements (Habitat). The contact point is the Head, Urban Secretariat, UNCHS (Habitat); fax no. (254 2) 623080.

(b) **Other Contributing Organizations:** The World Bank.

6. REFERENCES

(a) **Readings:**

World Bank. *Housing: Enabling Markets to Work*. The World Bank, Washington D.C., 1993 (A World Bank Policy Paper).

UNCHS (Habitat), World Bank. *The Housing Indicators Programme*. Report of the Executive Director (Volume I). UNCHS, Nairobi, 1993.

UNCHS (Habitat). *Monitoring the Shelter Sector*. Housing Indicators Review. UNCHS, Nairobi, 1995.

UNCHS (Habitat). *Human Settlement, Interventions Addressing Crowding and Health Issues*, UNCHS, Nairobi, 1995.

(b) **Internet site:**

UNCHS (Habitat) home page: <http://www.urbanobservatory.org/indicators/database>

NUMBER OF RECORDED CRIMES PER 100,000 POPULATION		
Social	Security	Crime

1. **INDICATOR**

- (a) **Name:** Number of Recorded Crimes per 100,000 Population.
- (b) **Brief Definition:** Total crimes recorded in criminal (police) statistics, regardless of type.
- (c) **Unit of Measurement:** Police recorded cases/100,000 population, per country and year.
- (d) **Placement in the CSD Indicator Set:** Social/Security/Crime.

2. **POLICY RELEVANCE**

(a) **Purpose:** The Economic and Social Council, in its resolution 1984/48 of 25 May 1984, requested the Secretary-General to maintain and develop a United Nations crime-related database by continuing to conduct surveys of crime trends and operations of criminal justice systems. The major goal of the United Nations Surveys on Crime Trends and the Operations of Criminal Justice Systems is to collect data on the incidence of recorded crime and the operations of criminal justice systems with a view to improving the analysis and dissemination of that information globally.

(b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** It is widely recognized that crime is not merely a problem of illegal behaviour and law enforcement but also a phenomenon closely associated with economic and social development. The phenomenon of crime, through its impact on society, can hamper the overall development of nations. It can undermine people's spiritual and material well-being, compromise human dignity and create a climate of fear and violence that endangers personal security and erodes the quality of life. If development is to be sustainable, it should be able to provide living conditions that would enable people to lead peaceful and secure lives.

On the other hand, imbalanced or inadequately planned development can worsen social conditions that contribute to a rise in criminality especially where the fruits of development are not equitably distributed among the people.

(c) **International Conventions and Agreements:** The United Nations Congress on the Prevention of Crime and Treatment of Offenders formulated a non-binding plan of action (e.g., Milan Plan of Action of 1985) and recommendations (The Caracas Declaration of 1980) on the subject.

(d) **International Targets/Recommended Standards:** None.

(e) **Linkages to Other Indicators:** This indicator is linked to other indicators of poverty and income disparities (e.g., percent of population living below poverty line, unemployment rate, gini index of income inequality), population change (e.g., population growth rate, population of urban formal and informal settlements) as well as those on economic performance (e.g., GDP per capita). Rapid population growth is included among those indicators that are generally considered crime-generating.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** *Total recorded crimes* regardless of type per year within a country as interpreted as such by the countries responding officials. These crimes refer to the number of penal code offences or their equivalent (i.e., various special law offences) but excluding minor road traffic and other petty offences, brought to the attention of the police or other law enforcement agencies and recorded by one of these agencies. It follows that this indicator refers only to police-reported crimes.

(b) **Measurement Methods:** Questionnaire sent to a single official statistical body officially representing the country. The indicator is computed as the number of total crimes reported to the police in a given year multiplied by 100,000 and divided by the total population of the country in the same year.

(c) **Limitations of the Indicator:** Definitions of what is or is not a crime may vary for different countries. So may readiness to report to the police, readiness to record by the police, methods of counting, accuracy and reliability of the recorded figures reported.

(d) **Status of the methodology:** While the indicator is used by many developed and developing countries, improvements are needed in the collection of the data/information needed to construct the indicator.

(e) **Alternative Definitions:** Results from ICVS (Percentage of pop, victimized by crime, regardless of police recording).

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Midyear population figures per country; (Police) statistics on total recorded crimes.

(b) **National and International Data Availability and Sources:** Data are normally available from local and regional police agencies and are collated by a national agency, often a statistical division within the Ministry or Department of Justice.

(c) **Data References:** National Statistical Institutes; UN Survey of Crime Trends and Operations of Criminal Justice Systems; UN Statistical Year Book, World Bank.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Office for Drug Control and Crime Prevention.

(b) **Other Contributing Organizations:** United Nations Interregional Crime and Justice Research Institute, Turin (Rome), Italy (UNICRI); European Institute for Crime Prevention and Control, Helsinki, Finland (HEUNI).

6. REFERENCES

(a) **Readings:**

International Crime Victim Survey (ICVS): International Conference on Surveying Crime – A Global Perspective, Conference Report, UNICRI, 1998.

Criminal Victimization in the Developing World, UNICRI, 1995.

United Nations Rules, Norms and Standards at website: <http://www.uncjin.org/Standards/standards.html>.

(b) **Internet sites:**

<http://www.uncjin.org>

<http://www.unicri.it/>

<http://www.vn.fi/om.heuni/>

POPULATION GROWTH RATE		
Social	Population	Population change

1. **INDICATOR**

- (a) **Name:** Population Growth Rate.
- (b) **Brief Definition:** The average annual rate of change of population size during a specified period.
- (c) **Unit of Measurement:** Usually expressed as a percentage.
- (d) **Placement in the CSD Indicators Set:** Social/Population/Population change.

2. **POLICY RELEVANCE**

- (a) **Purpose:** The population growth rate measures how fast the size of the population is changing.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Agenda 21 identifies population growth as one of the crucial elements affecting long-term sustainability (see especially paragraphs 5.3 and 5.16). Population growth, at both national and subnational levels, represents a fundamental indicator for national decision-makers. Its significance must be analyzed in relation to other factors affecting sustainability. However, rapid population growth can place strain on a country's capacity for handling a wide range of issues of economic, social, and environmental significance, particularly when rapid population growth occurs in conjunction with poverty and lack of access to resources, or unsustainable patterns of production and consumption, or in ecologically vulnerable zones (see paragraphs 3.14, 3.25 and 3.26 of the ICPD Programme of Action).
- (c) **International Conventions and Agreements:** None.
- (d) **International Targets/Recommended Standards:** International agreements do not establish national or global targets. A number of national governments have adopted numerical targets for the rate of population growth. However, in 1998, 14 percent of governments considered their rates of population growth to be too low, 44 percent were satisfied with the rate, and 41 percent considered it to be too high.
- (e) **Linkages to Other Indicators:** There are close linkages between this indicator and other demographic and social indicators, as well as all indicators expressed in per capita terms (for example, GDP per capita). Population growth usually has implications for indicators related to education, infrastructure, and employment. It is also related to human settlements and the use of natural resources, including sink capacities. Population growth can increase environmental degradation, although this is not always the case.

3. METHODOLOGICAL DESCRIPTION

The rate of population growth, r , between two times, t_1 and t_2 , is calculated as an exponential rate of growth, conventionally expressed in units of per cent per year:

$$r = 100 \ln (P_2 / P_1) / (t_2 - t_1)$$

Where P_1 and P_2 are the number of persons at times 1 and 2, respectively, and the time interval $(t_2 - t_1)$ is expressed in years.

For a country, the estimate is generally based on either (i) an intercensal population growth rate calculated from two censuses, each adjusted for incompleteness; or (ii) from the components of population growth (adjusted for incompleteness, when necessary) during a period; the components are numbers of births, deaths and migrants. Intercensal growth rates can also be calculated for subnational areas.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** As indicated above, the population growth rate can be calculated either from census data or from registration data (births, deaths and migrants). The United Nations recommends that countries take censuses every 10 years, and these data can be used to calculate an intercensal population growth rate.

(b) **National and International Data Availability and Sources:** In recent decades, most countries have carried out censuses and is widely available. For example, 204 countries or areas carried out a census during the 1990 census decade (1985 to 1994). Data on births, deaths and migrants may come from national registration systems or from special questions in demographic surveys and censuses. National and sub-national census data, as well as data on births, deaths and migrants, are available for the large majority of countries from national sources and publications; as well as from questionnaires sent to national statistical offices from the Statistics Division, UN Department of Economic and Social Affairs (DESA). For all countries, census and registration data are evaluated and, if necessary, adjusted for incompleteness by the Population Division, DESA, as part of its preparations of the official United Nations population estimates and projections.

(c) **Data References:** Past, current and projected population growth rates are prepared for all countries by the Population Division, DESA, and appear in the United Nations publication, *World Population Prospects: The 1998 Revision* (see item 6, below).

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Department of Economic and Social Affairs (DESA). The contact point is the Director, Population Division, DESA; fax no. (1 212) 963 2147.

(b) **Other Contributing Organizations:** None.

6. **REFERENCES**

(a) **Readings:**

Population Division, DESA, *World Population Prospects: The 1998 Revision. Vol. I. Comprehensive Tables* (United Nations publication Sales No. E.99.XIII.9, New York, 1999).

Population Division, DESA, *World Population Prospects: The 1998 Revision. Vol. III. Analytical Report* (United Nations. ESA/P/WP.156, New York, 1999).

Population Division, DESA, *Manual X: Indirect Techniques for Demographic Estimation* (United Nations Sales No. E.83.XIII.2, New York, 1983).

Population Division, DESA, *World Urbanization Prospects: The 1998 Revision* (United Nations publication, forthcoming).

Population Division, DESA, *MORTPAK-LITE - The United Nations Software Package for Mortality Measurement* (United Nations, New York, 1988).

Statistics Division/DESA, *1997 Demographic Yearbook*, (United Nations Sales No. E/F.99.XIII.1, 1999).

For information about government policies regarding this indicator, see:

Population Division, DESA, *National Population Policies* (United Nations Sales No. E.99.XIII.3., New York, 1998).

Population Division, DESA, *Results of the Eighth United Nations Population Inquiry Among Governments* (forthcoming).

(b) **Internet site:** <http://www.un.org/esa/population>

POPULATION OF URBAN FORMAL AND INFORMAL SETTLEMENTS		
Social	Population	Population Change

1. INDICATOR

- (a) **Name:** Population of Urban Formal and Informal Settlements.
- (b) **Brief Definition:** Number of inhabitants living in urban formal and informal settlements.
- (c) **Unit of Measurement:** Number of inhabitants.
- (d) **Placement in the CSD Indicator Set:** Social/Population/Population Change.

2. POLICY RELEVANCE

- (a) **Purpose:** The indicator measures the size of formal and informal urban settlements by their population. By focusing on the legality of human settlements, this indicator measures the marginality of human living conditions.

- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Settlements characterized by illegality of tenure and unauthorized shelter are generally marginal and precarious, and do not cater to basic human needs such as affordable housing. They affect sustainable human settlements development, human health, and socioeconomic development.

Illegal dwellers generally live in an unsafe and precarious environment, lack basic services, suffer from the absence of tenure security, and have no legal claim in case of eviction. Also, numerous illegal settlements are established on lands, which are predisposed to natural disasters. Informal settlements have usually a much higher population density than formal settlements and these living conditions constitute a threat to human health.

- (c) **International Conventions and Agreements:** Not applicable.
- (d) **International Targets/Recommended Standards:** No international targets have been established for this indicator.
- (e) **Linkages to Other Indicators:** This indicator is closely linked with several other socioeconomic and environmental indicators, such as rate of growth of urban population, human and economic losses due to natural disasters, access to adequate sanitation, primary health care, infant mortality, infrastructure expenditure, and land use.

3. METHODOLOGICAL DESCRIPTION

- (a) **Underlying Definitions and Concepts:** Informal settlements refer to: i) residential areas where a group of housing units has been constructed on land to which the occupant have no

legal claim, or which they occupy illegally; ii) unplanned settlements and areas where housing is not in compliance with current planning and building regulations (unauthorized housing). Formal settlements refer to land zoned residential in city master plans or occupied by formal housing.

(b) **Measurement Methods:** The number of inhabitants in formal and informal settlements is generally measured in censuses. Informal settlements do not cover dwelling units which have been regularized, that is those units for which land titles, leases or occupancy permits have been granted. They should only include those units which presently occupy land illegally and/or housing units which are not in compliance with current regulation.

(c) **Limitations of the Indicator:** The ephemeral nature and lack of an acceptable operational definition for this indicator, limit its usefulness, especially for trend analysis. The legal framework for settlements on which this indicator is based varies from country to country. Informal housing is not registered in official statistics, any measure of informal settlements remains limited. Information may be obtained from specific research studies, but it difficult to obtain and may be of variable quality. Homelessness, which is one of the extreme symptoms of human settlements inadequacy, is not accounted for by this indicator and in fact the existence of illegal settlements may reduce the incidence of homelessness.

(d) **Status of the Methodology:** Not available.

(e) **Alternative Definitions/Indicators:** Many concepts intended to measure marginality of human settlements have been formulated: unplanned, squatter, marginal settlements, unconventional, non permanent structures, housing in compliance, inadequate housing, slums, etc. "Unconventional dwellings" is one of the most common measures, defined by the number of housing units occupied by households, but considered inappropriate to human habitation. 'Improvised housing units' is another category used by the Census, defined as independent, makeshift shelters constructed of waste materials and without a predetermined plan for the purpose of habitation by one household. Included in this category are squatters' huts, favelas, hongos, jhuggis, etc. The type of building (permanent, semi-permanent, non permanent) which describe the building structures in which households live is another common measure, but the criteria widely vary from country to country.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Population of informal settlements.

(b) **National and International Data Availability and Sources:** These data are more likely to be available at the city level and are generally collected in large cities affected by informal settlements. Data sets at the national level will only occur sporadically.

(c) **Data References:** Data from research studies and census data.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nation Centre for Human Settlements (Habitat). The contact point is the Head, Urban Secretariat, UNCHS (Habitat); fax no. (254 2) 623080.

(b) **Other Contributing Organizations:** None.

6. REFERENCES

(a) **Readings:**

World Bank. *Housing: Enabling Markets to Work*. A World Bank Policy Paper. The World Bank, Washington D.C., 1993.

UNCHS (Habitat) and The World Bank. *The Housing Indicators Programme*. Report of the Executive Director (Volume I). UNCHS, Nairobi, 1993.

UNCHS (Habitat). *Monitoring the Shelter Sector*. Housing Indicators Review. UNCHS, Nairobi, 1995.

(b) **Internet site:**

UNCHS (Habitat) home page: <http://www.urbanobservatory.org/indicators/database>

EMISSIONS OF GREENHOUSE GASES		
Environmental	Atmosphere	Climate Change

1. INDICATOR

- (a) **Name:** Emissions of Greenhouse Gases (GHG).
- (b) **Brief Definition:** Anthropogenic emissions, less removal by sinks, of the greenhouse gases carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆), chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), together with the indirect greenhouse gases nitrogen oxides (NO_x), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOCs).
- (c) **Unit of Measurement:** Annual GHG emissions in gigagrams (Gg). Emissions of CH₄, N₂O, HFCs, PFCs and SF₆ can be converted to CO₂ equivalents using 100 year global warming potentials (GWPs) provided in the IPCC Second Assessment Report, 1995.
- (d) **Placement in the CSD Indicator Set:** Environmental/Atmosphere/Climate Change.

2. POLICY RELEVANCE

- (a) **Purpose:** This indicator measures the emissions of the six main GHGs which have a direct impact on climate change, less the removal of the main GHG CO₂ through sequestration as a result of land-use change and forestry activities.
- (b) **Relevance to Sustainable/ Unsustainable Development (theme/sub-theme):** For about a thousand years before the industrial revolution, the amount of greenhouse gases in the atmosphere remained relatively constant. Since then, the concentration of various greenhouse gases has increased. The amount of carbon dioxide, for example, has increased by more than 30% since pre-industrial times and is currently increasing at an unprecedented rate of about 0.4% per year, mainly due to the combustion of fossil fuels and deforestation. The concentrations of methane and nitrous oxide are increasing as well due to agricultural, industrial and other activities. The concentrations of the nitrogen oxides NO and NO₂ and carbon monoxide (CO) are also increasing. Although these gases themselves are not greenhouse gases, they affect atmospheric chemistry, leading to an increase in tropospheric ozone, which is a greenhouse gas. Chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) and some other halogen GHGs do not occur naturally in the atmosphere but have been introduced by human activities. They are strong greenhouse gases and have long atmospheric lifetimes. CFCs and HCFCs also deplete the stratospheric ozone layer (see ozone depleting substances).

Since the late nineteenth century, the mean global temperature has increased by 0.4-0.8°C and the sea level has risen by 10 to 15cm. A doubling of the CO₂ concentration in the atmosphere is believed to cause an increase in the global mean temperature of 1.5 to 4.5°C. To appreciate the

magnitude of this temperature increase, it should be compared with the global mean temperature difference of perhaps 5 to 6°C from the middle of the last ice age to the present interglacial period.

(c) **International Conventions and Agreements:** The United Nations Framework Convention on Climate Change entered into force in March 1994 and as of July 2000 has received 184 instruments of ratification or accession. The Convention includes a commitment by developed country Parties, including economies in transition (Annex I Parties), to aim to return emissions of CO₂ and other GHGs not controlled by the Montreal Protocol to their 1990 levels by 2000. The Kyoto Protocol was adopted in December 1997 and has received 84 signatures. It will enter into force after it has been ratified by at least 55 Parties to the Convention, including developed countries accounting for at least 55 per cent of the total 1990 CO₂ emissions from this group. Meanwhile countries are to continue to carry out their commitments under the Convention.

Ozone-depleting greenhouse gases (such as CFCs and HCFCs) are controlled by the Vienna Convention and the Montreal Protocol (see ozone depleting substances).

(d) **International Targets/Recommended Standards:** The Kyoto Protocol sets targets for each of the developed country Parties and economy in transition Parties with a view to reducing their overall emissions of the six main GHGs by at least 5 per cent below 1990 levels in the commitment period 2008 to 2012.

(e) **Linkages to Other Indicators:** This indicator is linked to many other socio-economic and environmental indicators, including GDP growth rate, energy consumption, environmental protection expenditures, and expenditures on air pollution abatement.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Greenhouse gases contribute in varying degrees to global warming depending on their heat absorptive capacity and their lifetime in the atmosphere. The global warming potential (GWP) describes the cumulative effect of a gas over a time horizon (usually 100 years) compared to that of CO₂. For example, the global warming potential of CH₄ (methane) is 21, meaning that the global warming impact of one kg of CH₄ is 21 times higher than that of one kg of CO₂. The global warming potentials of ozone-depleting greenhouse gases (such as CFCs and HCFCs) are highly uncertain, since they depend on the depletion of ozone, itself a greenhouse gas. No global warming potentials are provided for indirect greenhouse gases.

(b) **Measurement Methods:** In some cases, GHG emissions can be measured directly at the source. More commonly, emissions are estimated from data on emission sources, for example oil sales data or cattle numbers, using an emission factor for each source.

(c) **Limitations of the Indicator:** This indicator shows the net amount of GHGs entering the atmosphere for each reporting country each year. It does not show how much the climate will be affected by the increased accumulation of GHGs or the consequent effect of climate

change on countries. Data is available and reported mainly for developed countries and economies in transition.

(d) **Status of the Methodology:** Developed country Parties to the Convention have been reporting GHG data beginning with 1990 data since 1994. The IPCC has published two sets of guidelines on methodologies for the estimation of GHG inventories and further elaborated this with guidance on good practice in 2000.

(e) **Alternative Definitions/Indicators:** GHG emissions can alternatively be measured on a gross instead of net basis in which case no account is taken of removal by sinks. There are a number of other gases that indirectly produce GHGs and these could also be included in the scope of the definition. The GWP potential can be calculated over different time horizons, such as 20 years or 500 years.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Greenhouse gas emissions data.

(b) **National and International Data Availability and Sources:** National communications from Parties to the Convention, including both developed and developing countries, are available. Developing countries report on a limited basis. At the international level, the UNFCCC Secretariat database has information based on annual data inventory submissions from developed and economy in transition countries.

(c) **Data References:** Not Available.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC). The contact point is the Executive Secretary, Secretariat, UNFCCC, fax no. (41 22) 970 9034.

(b) **Other Contributing Organizations:** Intergovernmental Panel on Climate Change (IPCC).

6. REFERENCES

(a) **Readings:**

First review of information communicated by each Party included in Annex I to the Convention. UN document A/AC.237/81 and corr. 1.

UNFCCC in-depth review reports on individual countries.

(b) **Internet sites:**

www.unfccc.int (UNFCCC)

www.ipcc.ch (IPCC)

www.ipcc.nggip.iges.or.jp (IPCC technical support)

CONSUMPTION OF OZONE DEPLETING SUBSTANCES		
Environmental	Atmosphere	Ozone Layer Depletion

1. INDICATOR

- (a) **Name:** Consumption of Ozone Depleting Substances (ODS).
- (b) **Brief Definition:** This indicator will show the amounts of Ozone Depleting Substances being eliminated as a result of the Montreal Protocol.
- (c) **Unit of Measurement:** Tonnes of ODS weighted by their Ozone Depletion Potential (ODP).
- (d) **Placement in the CSD Indicator Set:** Environmental/Atmosphere/Ozone layer depletion.

2. POLICY RELEVANCE

- (a) **Purpose:** This indicator signifies the commitment to phase out the ODS of the countries which have ratified the Montreal Protocol on Substances that Deplete the Ozone Layer and its Amendments of London (1990), Copenhagen (1992), Montreal (1997) and Beijing (1999).
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The phaseout of ODS, and their substitution by less harmful substances or new processes, will lead to the recovery of the ozone layer. Stratospheric ozone absorbs most of the biologically damaging ultraviolet radiation (UV-B). Without the filtering action of the ozone layer more UV-B radiation can penetrate the atmosphere to have adverse effects on human health, animals, plants, micro-organisms, marine life, materials, biogeochemical cycles, and air quality.
- (c) **International Conventions and Agreements:** The Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol on Substances that Deplete the Ozone Layer and the London, Copenhagen, Montreal and Beijing Amendments to the Protocol.
- (d) **International Targets/Recommended Standards:** The international target under the agreements listed in 2 (c) is the complete phase out of ODS.
- (e) **Linkages to Other Indicators:** This indicator has links to other environmental and institutional indicators, such as number of chemicals banned or restricted and ratification of international agreements. It has significant implications to human health and natural resources.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts: Ozone Depleting Substance (ODS)** means any organic substance containing chlorine or bromine, which destroys the stratospheric ozone layer. **Controlled substance** means a substance in Annex A, Annex B, Annex C or Annex E of the Montreal Protocol, whether existing alone or in a mixture. It includes the isomers of any such substance, except as specified in the relevant Annex, but excludes any controlled substance or mixture which is in a manufactured product other than a container used for the transportation or storage of that substance. **Production** means the amount of listed, controlled substances produced, minus the amount destroyed by technologies to be approved by the Parties to the Montreal Protocol and minus the amount entirely used as feedstock in the manufacture of other chemicals. The amount recycled and reused is not to be considered as "production". **Consumption** is the sum of production plus imports minus exports of controlled substances. We are addressing apparent consumption. **Weighted tonnes of ODS** means the amount of ODS multiplied by their ozone depleting potential. **Ozone depleting potential (ODP)** is a relative index of the ability of a substance to cause ozone depletion. The reference level of 1 is assigned as an index to CFC-11 and CFC-12. If a product has an ODP of 0.5, a given weight of the product in the atmosphere would, in time, deplete half the ozone that the same weight of CFC-11 or CFC-12 would deplete. ODPs are calculated from mathematical models which take into account factors such as the stability of the product, the rate of diffusion, the quantity of depleting atoms per molecule, and the effect of ultraviolet light and other radiation on the molecules.

(b) **Measurement Methods:** Weighted Tonnes of ODS for production are the sum of national annual production (in tonnes) of each controlled substance (as reported to the Ozone Secretariat in accordance with Article 7 of the Montreal Protocol) multiplied by the ozone depleting potential of that substance (as listed in Annexes A, B, C and E of the Handbook for the International Treaties for the Protection of the Ozone Layer, 2000). It can be found at: <http://www.unep.org/ozone> or <http://www.unep.ch/ozone>. Weighted Tonnes of Ozone Depleting Substances for consumption are obtained through a similar calculation using national annual consumption values (in tonnes).

(c) **Limitations of the Indicator:** Availability and accuracy of data and timely reporting will determine the country's ability to use the indicator. The indicator by itself does not reveal much about current trends in the deterioration of the ozone layer because of delays in ecosystem response.

(d) **Status of the Methodology:** For more information, please consult the Reports of the Secretariat on information provided by the Parties in accordance with Article 7 of the Montreal Protocol or the Home Page at: <http://www.unep.org/ozone> or <http://www.unep.ch/ozone>.

(e) **Alternative Definitions/Indicators:** An alternative indicator could focus on the phase out of ODS.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Data on production, imports and exports of controlled substances by the Parties to the Montreal Protocol.

(b) **National and International Data Availability and Sources:** The data are available for most countries, on a national level, on a regular annual basis, as part of their reporting obligations to the Montreal Protocol. At the international level from the Ozone Secretariat in Nairobi and from the Multilateral Fund Secretariat in Montreal. The data sources are the Ozone Secretariat and the national government ministry responsible for reporting to the Montreal Protocol.

(c) **Data References:** UNEP, Report of the Secretariat on Information Provided by the Parties in Accordance with Article 7 and 9 of the Montreal Protocol, United Nations Environment Programme, pp. 105, 1999. UNEP, Production and Consumption of Ozone Depleting Substances, 1986-1998, United Nations Environment Programme, pp. 41, 1999. Web site: <http://www.unep.org/ozone> or <http://www.unep.ch/ozone>.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Environment Programme (UNEP)/Ozone Secretariat. The contact point is the Executive Secretary of the Ozone Secretariat, fax no. (254-2) 62-3601/62-3913.

(b) **Other Contributing Organizations:** Other organizations interested in the further development of this indicator would include: The Multilateral Fund Secretariat, the Global Environment Facility (GEF) Secretariat, United Nations Development Programme (UNDP), UNEP Division of Technology, Industry & Economics (UNEP DTIE), United Nations Industrial and Development Organization (UNIDO), the World Bank, the Technology and Economic Assessment Panel to the Montreal Protocol, the Parties to the Montreal Protocol, the Organisation for Economic Co-operation and Development (OECD), and members associated with the Alternative Fluorocarbon Environmental Acceptability Study (AFEAS).

6. REFERENCES

(a) **Readings:**

Ozone Secretariat, UNEP, Handbook for the International Treaties for the Protection of the Ozone Layer, pp.367, 2000. (ISBN: 92- 807-1867-3).

UNEP, Synthesis of the Reports of the Scientific, Environmental Effects and Technology and Economic Assessment Panels of the Montreal Protocol. A Decade of Assessments for Decision Makers Regarding the Protection of the Ozone Layer: 1989-1998, United Nations Environment Programme, pp. 161, 1999. (ISBN: 92-807- 1733-2).

UNEP, Reports of the Technology and Economic Assessment Panel of the Montreal Protocol.

Reporting of Data by the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer.

(b) **Internet sites:**

<http://www.unep.org/ozone>

<http://www.unep.ch/ozone>

<http://www.unmfs.org>

<http://www.uneptie.org/ozonaction.html>

<http://www.gefweb.org>

<http://www.teap.org>

<http://www.undp.org/seed/eap/montreal/index.htm>

<http://www.unido.org>

<http://www-esd.worldbank.org/mp>

AMBIENT CONCENTRATION OF AIR POLLUTANTS IN URBAN AREAS		
Environmental	Atmosphere	Air Quality

1. INDICATOR

- (a) **Name:** Ambient concentration of air pollutants in urban areas.
- (b) **Brief Definition:** Ambient air pollution concentrations of ozone, carbon monoxide, particulate matter (PM₁₀, PM_{2.5}, SPM, black smoke), sulphur dioxide, nitrogen dioxide, nitrogen monoxide, volatile organic compounds including benzene (VOCs) and lead.
- (c) **Unit of Measurement:** $\mu\text{g}/\text{m}^3$, ppm or ppb, as appropriate; or percentage of days when standards/guideline values are exceeded.
- (d) **Placement in the CSD Indicator Set:** Environmental/Atmosphere/Air Quality.

2. POLICY RELEVANCE

- (a) **Purpose:** The indicator provides a measure of the state of the environment in terms of air quality and is an indirect measure of population exposure to air pollution of health concern in urban areas.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** An increasing percentage of the world's population lives in urban areas. High population density and the concentration of industry exert great pressures on local environments. Air pollution, from households, industry power stations and transportation (motor vehicles), is often a major problem. As a result, the greatest potential for human exposure to ambient air pollution and subsequent health problems occurs in urban areas. Improving air quality is a significant aspect of promoting sustainable human settlements.

The indicator may be used to monitor trends in air pollution as a basis for prioritising policy actions; to map levels of air pollution in order to identify hotspots or areas in need of special attention; to help assess the number of people exposed to excess levels of air pollution; to monitor levels of compliance with air quality standards; to assess the effects of air quality policies; and to help investigate associations between air pollution and health effects.

- (c) **International Conventions and Agreements:** None.
- (d) **International Targets/Recommended Standards:** World Health Organization (WHO) air quality guidelines exist for all the pollutants of this indicator, except nitrogen monoxide. Many countries have established their own air quality standards for many of these pollutants.

(e) **Linkages to Other Indicators:** This indicator is closely linked to others which relate to causes, effects, and societal responses. These include, for example, the indicators on population growth rate, rate of growth of urban population, percent of population in urban areas, annual energy consumption per capita, emissions of sulphur oxides and nitrogen oxides, life expectancy at birth, total national health care as a percent of Gross National Product, share of consumption of renewable energy resources, environmental protection expenditures as a percent of Gross Domestic Product, expenditure on air pollution abatement, childhood morbidity due to acute respiratory illness, childhood mortality due to acute respiratory illness, capability for air quality management, and availability of lead-free gasoline.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The indicator may be designed and constructed in a number of ways. Where monitored data are available, it is usefully expressed in terms of mean annual or percentile concentrations of air pollutants with known health effects – e.g., ozone, carbon monoxide, particulate matter (PM₁₀, PM_{2.5}, SPM), black smoke, sulphur dioxide, nitrogen dioxide, volatile organic compounds including benzene (VOCs) and lead – in the outdoor air in urban areas. Alternatively, the indicator might be expressed in terms of the number of days on which air quality guidelines or standards are exceeded (though in this, comparisons need to be made with care because of possible changes or differences in guideline values).

Where monitoring data are unavailable, estimates of pollution levels may be made using air pollution models. Dispersion models, however, depend on the availability of emission data; where these are not available, surveys may be conducted using rapid source inventory techniques. Because of the potential errors in the models or in the input data, results from dispersion models should ideally be validated against monitored data.

(b) **Measurement Methods:** Suitable air monitors must fulfil several requirements, such as detection limits, interferences, time resolution, easy operation and of course, cost. There are several good references in the literature or available at agencies on air monitoring and analysis from where information can be obtained. It is important, however, to refer to the published scientific literature for the most appropriate and recent air monitoring methods.

A number of models are available for estimation of ambient concentration of air pollutants. Most of them are founded on the Gaussian air dispersion model.

(c) **Limitations of the Indicator:** Measurement limitations relate to detection limits, interferences, time resolution, easy operation, and cost. Evaluation of the accuracy of model results is critical before relying on model output for decision-making.

(d) **Status of the Methodology:** The methodology is widely used in many developed and developing countries.

(e) **Alternative Definitions:** None.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Data must be time and spatially representative concentrations such as, for example, mean annual concentrations (mean concentrations of the pollutant of concern, averaged over all hours of the year) or percentile concentration (concentration of the pollutant of concern exceeded in 100-X% of hours, where X is the percentile as defined by the relevant standards). In addition, information must be available on site location and type (e.g., industrial or residential area).

(b) **National and International Data Availability and Sources:** Data on ambient air pollution concentrations is often routinely collected by national or local monitoring networks. Data is often also collected for research purposes by universities and research institutes. In addition, industry collects many data.

(c) **Data References:** Data on ambient air pollution can be obtained from national and local monitoring networks. Sometimes, data is available from universities, research institutes and industry. In addition, a growing volume of data can be obtained from international sources such as the WHO Healthy Cities Air Management Information System (AMIS) of the European Environmental Agency.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the World Health Organization (WHO). The contact point is the Director, Department for the Protection of the Human Environment; fax no. (41 22) 791 4159.

(b) **Other Contributing Organizations:** The United Nations Environment Programme.

6. REFERENCES

(a) **Readings:**

WHO (2000 in print) *Air Quality Guidelines for Europe* (revision of Air Quality Guidelines for Europe 1987). WHO Regional Office for Europe, Bilthoven Division.

WHO (2000 in print) *Human Exposure Assessment*, Environmental Health Criteria Document 214, Programme of Chemical Safety.

WHO (2000) *Decision-Making in Environmental Health: From Evidence to Action*, edited by C. Corvalan, D. Briggs and G. Zielhuis, E & FN Spon, London, New York.

WHO (1999) *Monitoring Ambient Air Quality for Health Impact Assessment*, WHO Regional Publications, European Series, No. 85.

WHO (1999) *Environmental Health Indicators: Framework and Methodologies*. Prepared by D. Briggs, Occupational and Environmental Health.

WHO (1999) *Global Air Quality Guidelines: Occupational and Environmental Health* (available on the web only).

WHO (1987) *Air Quality Guidelines for Europe*, WHO Regional Office for Europe, Bilthoven Division.

Schwela & Zali (eds. 1999) *Urban Traffic Pollution*. Edited by D. Schwela and O. Zali, E & FN Spon, London, New York.

UNEP/WHO (1992) *Urban Air Pollution in Megacities of the World*, Blackwell Publishers, Oxford, UK.

UNEP/WHO (1994) *Global Environmental Monitoring System (GEMS/Air)*, Methodology Review Handbook Series. Volumes 2, 3, and 4.

(b) **Internet sites:**

<http://www.who.org>

<http://www.unep.org>

ARABLE AND PERMANENT CROP LAND AREA		
Environmental	Land	Agriculture

1. **INDICATOR**

- (a) **Name:** Arable and Permanent Crop Land Area.
- (b) **Brief Definition:** Arable and permanent crop land is the total of “arable land” and “land under permanent crops”. Arable land is the land under temporary crops, temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (for less than five years); and land under permanent crops is the land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest.
- (c) **Unit of Measurement:** 1000 ha.
- (d) **Placement in the CSD Indicator Set:** Environmental/Land/Agriculture.

2. **POLICY RELEVANCE**

- (a) **Purpose:** This indicator shows the amount of land available for agricultural production and, *inter alia*, the cropland area available for food production. The data when related to other variables such as population, total land area, gross cropped area, fertilizer use, pesticides use, etc., can also be used to study agricultural practices of the country. In order to be useful, it must be available as a time series.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Population growth in developing countries is driving a rapid increase in the demand for food and fibre. At the same time, rising population density in rural areas diminishes the farm size. Small farmers are forced to extend cultivation to new areas, which are fragile and not suitable for cultivation. Crop intensification, which has contributed significantly to agricultural growth in recent years, can ease the pressure on cultivating new lands but farm practices adopted for raising yields can also, in some situations, result in damaging the environment (such as when expanding into new areas). Changes in the indicator value over time or between various components may show increased or decreased pressure on agricultural land. This indicator is of value to land planning decision making.
- (c) **International Conventions and Agreements:** Not available.
- (d) **International Targets/Recommended Standards :** Not applicable.

(e) **Linkage to Other Indicators:** The indicator is primarily linked to other measures related to land resources covered in the Chapter 10: “Integrated Approach to the Planning and Management of Land Resources” and Chapter 14: “Promoting Sustainable Agriculture and Rural Development” of the Agenda 21. This includes indicators such as land use changes, share of irrigated area in the arable and permanent crop land area, *per capita* arable and permanent crop land area, etc.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The concept of arable land and land under permanent crop is clearly defined. Arable land is the land under temporary crops (double-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is not included in this category. Data for arable land are not meant to indicate the amount of land that is potentially cultivable. Similarly land under permanent crops is the land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee and rubber; this category includes land under flowering shrubs, fruit trees, nut trees and vines, but excludes land under trees grown for wood or timber.

(b) **Measurement Methods:** The indicator is connected to the use of land for agricultural activity and is historically based on point estimates derived from data collected in periodic agricultural censuses and surveys.

(c) **Limitations of the Indicator:** This indicator does not reveal anything about increased productivity of agricultural land, or of the spatial variation in land quality.

(d) **Status of the Methodology:** Concepts and methods of measurements for the indicator are well defined and documented. However, some of the countries follow somewhat different concepts. For example, some countries take arable land as the land that is potentially cultivable, whereas the actual definition excludes permanent fallow land and land under permanent meadows and pastures. Similarly, “permanent” status for pastures, etc., is taken as ten years by some countries instead of the period of five years recommended by the Food and Agriculture Organization of the United Nations (FAO).

(e) **Alternative Definitions/Indicators:** Agricultural land that includes permanent pastures and meadows is a more appropriate indicator which could universally be related to data on use of fertilizers, pesticides and statistics on irrigated area (as some countries have permanently cultivated pastures).

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Data on arable land and land under permanent crops. Data on permanent pastures and fallow land also would be useful for undertaking quality check.

(b) **National and International Data Availability and Sources:** National data for the indicator has been estimated generally through agricultural census/surveys. However, in the case of many countries such statistical exercises are undertaken only at selected points of time. At the international level data are being produced by FAO. This data set is produced as a continuous time series where missing data for intercensal/survey periods have been derived by using data from various official and non-official sources. Thus the data for many countries are of unknown reliability.

(c) **Data References:** The primary data source at the international level is the Production Yearbook released annually by the FAO and FAOSTAT database included in the World Agriculture Information Centre (WAICENT).

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the Food and Agriculture Organization of the United Nations (FAO). The contact point is the Assistant Director-General, Sustainable Development Department, FAO; fax no. (39 06) 5705 3152.

(b) **Other Contributing Organizations:** None.

6. REFERENCES

(a) **Readings:**

FAO. 1995. *Programme for the World Census of Agriculture 2000*. In: FAO Statistical Development Series (FAO), no. 5 / FAO, Rome (Italy). Statistics Div., 85 pp.

(b) **Internet site:**

FAO Statistical Databases. <http://apps.fao.org/>

USE OF FERTILIZERS		
Environmental	Land	Agriculture

1. INDICATOR

- (a) **Name:** Use of Fertilizers.
- (b) **Brief Definition:** Extent of fertilizer use in agriculture per unit of agricultural land area.
- (c) **Unit of Measurement:** kg/ha.
- (d) **Placement in the CSD Indicator Set:** Environmental/Land/Agriculture.

2. POLICY RELEVANCE

- (a) **Purpose:** The purpose of this indicator is to measure the intensity of fertilizer use in agriculture (crop husbandry).
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The challenge for agriculture is to increase food production in a sustainable way. This indicator shows the potential environmental pressure from agricultural activities. Extensive fertilizer use is linked to eutrophication of water bodies, soil acidification, and potential of contamination of water supply with nitrates. The actual environmental effects will depend on pollution abatement practices, soil and plant types, and meteorological conditions.
- (c) **International Conventions and Agreements:** Not available.
- (d) **International Targets/Recommended Standards:** Targets should be based on national situations.
- (e) **Linkages to Other Indicators:** This indicator is closely linked to others in the agricultural, water, and atmospheric groups, such as pesticide use, biochemical demand in water bodies, algae index, and emissions of greenhouse gases.

3. METHODOLOGICAL DESCRIPTION

- (a) **Underlying Definitions and Concepts:** The concepts are available. Data on the quantities of fertilizers used are converted into the three basic nutrient components and aggregated. The three components are nitrogen (N), phosphorous (P₂O₅), and potassium (K₂O). Factors for chemical breakdown are standardized. Agricultural land is the sum of arable and permanent crop land and land under permanent pastures and meadows. However, due to the limitations discussed in section 4(d) below, this indicator should be regarded as interim for sustainable development purposes.

(b) **Measurement Methods:** Data on fertilizers are compiled from industry sources and non-traditional sources. Data for developing countries generally refer to domestic disappearance based on imported products. The derived figures in terms of nutrients are then divided by the agricultural land area.

(c) **Limitations of the Indicator:** Environmental impacts caused by leaching and volatilization of fertilizer nutrients depend not only on the quantity applied, but also on the condition of the agro-ecosystem, cropping patterns, and on farm management practices. In addition, this indicator does not include organic fertilizer from manure and crop residues, or the application of fertilizers to grasslands. The indicator assumes even distribution of fertilizer on the land.

(d) **Status of the Methodology:** Not available.

(e) **Alternative Definitions/Indicators:** A more relevant and sophisticated indicator would focus on *nutrient balance* to reflect both inputs and outputs associated with all agricultural practices. This would address the critical issue of surplus or deficiency of nutrients in the soil. This would need to be based on agro-ecological zones.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Data on fertilizer use for N, P₂O₅, and K₂O; and agricultural area.

(b) **National and International Data Availability and Sources:** Data for all countries exist at the national level only. The data are updated on a regular basis. At the international level, the Food and Agriculture Organization of the United Nations (FAO) is the primary source.

(c) **Data References:** see 6(a).

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the Food and Agriculture Organization of the United Nations (FAO). The contact point is the Assistant Director-General, Sustainable Development Department, FAO; fax no. (39 06) 5705 3152.

(b) **Other Contributing Organizations:** The International Fertilizer Association is associated with the development of this indicator.

6. REFERENCES

(a) **Readings:**

FAO. 1998. *Food and agricultural sector profiles. Country tables 1997*. Statistics Div.; FAO, Rome (Italy). Agriculture and Economic Development Analysis Division, 427 pp.

FAO. 1996. *Fertilizer use by crop*, 3. International Fertilizer Industry Association, Paris (France); International Fertilizer Development Center, Muscle Shoals, AL (USA); FAO, Rome (Italy). Statistics Division, 49 pp.

(b) **Internet sites:**

FAO Statistical Databases. <http://apps.fao.org/>

International Fertilizer Association. <http://www.fertilizer.org/>

USE OF AGRICULTURAL PESTICIDES		
Environmental	Land	Agriculture

1. INDICATOR

- (a) **Name:** Use of Agricultural Pesticides.
- (b) **Brief Definition:** Use of pesticides per unit of agricultural land area.
- (c) **Unit of Measurement:** Pesticide use in metric tons of active ingredients per 10 km² of agricultural land.
- (d) **Placement in the CSD Indicator Set:** Environmental/Land/Agriculture.

2. POLICY RELEVANCE

- (a) **Purpose:** This indicator measures the use of pesticides in agriculture.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The challenge for agriculture is to increase food production in a sustainable way. One important aspect of this challenge is the use of agricultural pesticides which add persistent organic chemicals to ecosystems. Pesticides can be persistent, mobile, and toxic in soil, water, and air; and can have impact on humans and wildlife through the food chain. They tend to accumulate in the soil and in biota, and residues may reach surface and groundwater through leaching. Humans can be exposed to pesticides through food. Exaggerated use may result from government subsidies and/or failure of pesticide users to internalize health-related costs. The indicator is related to other agricultural intensification practices.
- (c) **International Conventions and Agreements:** Some agricultural pesticides are banned by international trade agreements.
- (d) **International Targets/Recommended Standards:** Not available.
- (e) **Linkages to Other Indicators:** This indicator is closely linked to others in the agricultural area, such as fertilizer use. Use of pesticides can have wide implications for the environment, and is linked to the indicators listed under toxic chemicals and biodiversity.

3. METHODOLOGICAL DESCRIPTION

- (a) **Underlying Definitions and Concepts:** The concepts are available, however, because of the limitations discussed below in section 4(d), it should only be regarded as an interim indicator. More work is required to develop a more suitable pesticide indicator pertinent to sustainable development.

(b) **Measurement Methods:** Data on pesticide use are usually derived from sales or “domestic disappearance” and expressed as active ingredients. Agricultural area data are widely available. Interpretation will benefit from information on types of active ingredients in use, seasonal doses, rate of application, and variability on use for different crops and regions.

(c) **Limitations of the Indicator:** This indicator provides an aggregation, which ignores toxicity, mobility, and level of persistence; and spatial and application variances. It does not consider the use of pesticides outside of agriculture, which can be significant in developed countries. Data omissions and errors often occur during the transfer of the primary data to statistical authorities.

(d) **Status of the Methodology:** Not available.

(e) **Alternative Definitions/Indicators:** To meet some of the limitations expressed above in section 4(d), an indicator could be developed which would recognize the classification of pesticide into classes, ranging from less harmful to highly toxic. Such a pesticide index would show if pesticide use is becoming more sustainable or not. The interpretation value of this indicator would benefit from its application to crop types or agro-ecological zones. However, data availability does not support this in many areas.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Pesticide sales data; agricultural land area.

(b) **National and International Data Availability and Sources:** The land area data are readily available for most countries. However, pesticide supply-use data in metric tons are only available from international sources for selected countries and limited to the major types of pesticide. Some pesticide data are available for about 50-60 countries. The data are not regularly collected and reported, and not usually available on a sub-national basis. Some data are available on total national pesticide use from the Food and Agriculture Organization of the United Nations (FAO) and the Organisation for Economic Co-operation and Development (OECD). Eurostat maintains a database of their members’ data. Landell Mills Market Research Ltd. (Bath, UK) also has data.

(c) **Data References:** see 6(b).

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the Food and Agriculture Organization of the United Nations (FAO). The contact point is the Assistant Director-General, Sustainable Development Department, FAO; fax no. (39 06) 5705 3152.

(b) **Other Contributing Organizations:** OECD, the European Union, and Landell Mills Market Research Ltd. have been involved in the development of this indicator.

6. **REFERENCES**

(a) **Readings:** Not available.

(b) **Internet sites:**

Food and Agriculture Organization of the United Nations (FAO). <http://www.fao.org/>

Organisation for Economic Co-operation and Development (OECD). <http://www.oecd.org/>

European Union Eurostat. <http://europa.eu.int/comm/eurostat/>

Landell-Mills. <http://www.landell-mills.com/>

FOREST AREA AS A PERCENT OF LAND AREA		
Environmental	Land	Forests

1. INDICATOR

- (a) **Name:** Forest Area as a Percent of Land Area.
- (b) **Brief Definition:** The amount of natural and plantation forest area tracked over time.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Environmental/Land/Forests.

2. POLICY RELEVANCE

- (a) **Purpose:** The purpose of the indicator is to show the area covered by the forest formations of a region/country over time.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Forests serve multiple ecological, socio-economic, and cultural roles in many countries. They are among the most diverse and widespread ecosystems of the world. Forests provide many significant resources and functions including wood products and non-wood products: recreational opportunities, habitat for wildlife, water and soil conservation, and a filter for pollutants. They support employment and traditional uses, and biodiversity. There is general concern over human impact on forest health, and the natural processes of forest growth and regeneration. Combating deforestation to maintain the production of wood and non-wood products and to preserve soils, water, air and biological diversity is explicitly considered in Agenda 21.

A continuing and fast decreasing forest area in a country might be an alarm signal of unsustainable practices in the forestry and agricultural sector. The availability of accurate data on a country's forest area, which is a basic characteristic of its forest resources, is an essential requirement for forest policy and planning within the context of sustainable development.

- (c) **International Conventions and Agreements:** Many international agreements cover forests. Countries are supported to maintain or increase their forested areas. Specific forest agreements would include the *Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests* (the Forest Principles of the United Nations Conference on Environment and Development (UNCED)); and the *International Tropical Timber Agreement*. Many other international agreements deal with forests within the context of natural resources and environment conservation, for example, the Convention on International Trade in Endangered Species (CITES), the Convention on the Conservation of Wetlands of International Importance (Ramsar Convention), the Convention on Biological Diversity, the Convention on Climate

Change and the Convention to Combat Desertification. In addition, several regional conventions cover forests.

(d) **International Targets/Recommended Standards:** There are no international targets or standard sets for size of forest or rate of deforestation. It is, however, understood that the higher the deforestation rate is, the more critical the forestry situation is in a country/region. Several countries have set targets for the extent of their forest area, either in absolute values or as a percentage of total land area of the country. Nevertheless, the International Tropical Timber Organization (ITTO) Year 2000 Objective states that by the year 2000 all tropical timber products traded internationally by Member States shall originate from sustainably managed forests.

(e) **Linkages to Other Indicators:** The indicator is closely linked with several other environmental indicators, such as land use and land condition change, wood and non-wood products harvesting intensity, protected forest area, arable land, threatened species, sustainable use of natural resources in mountain areas, etc. In some countries, it will also be generally linked to some of the socio-economic indicators, such as population growth and share of natural resource industries in manufacturing.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Definitions are available from the Food and Agriculture Organization of the United Nations (FAO) Forest Resources Assessments. The *forest area* is defined as "lands with a tree crown cover equal or more than ten percent of the area"; plantation as the artificial establishment of forests by planting or seeding; and *natural forests* as natural and/or semi-natural established forests. In addition, the definition of *forest* exists in most countries. The comparisons of forest area over time using reference years allows the calculation of change in absolute values, and as a percentage of the deforestation rate.

Different land uses practices and ranges of ecological condition result in different forest types, such as tropical or temperate. These differences should be recognized, especially in country comparisons.

(b) **Measurement Methods:** The measurement methods for forest area can be contained in national forest inventories, and obtained by sampling ground surveys, cadastral surveys, remote sensing, or a combination of these.

The forest area is calculated as the sum of plantations and natural forest areas with tree crown cover equal or more than ten percent. This calculation is made at given reference years as follows:

The deforestation rate (DR) is the compound annual rate in percent from year P to year N:

$$DR(\%) = 100 \times \left(1 - \left(\frac{\text{Forest_area}_{\text{year}N}}{\text{Forest_area}_{\text{year}P}} \right)^{\frac{1}{N-P}} \right)$$

(c) **Limitations of the Indicator:** The area figure does not give any indication of the quality of the forest, its ecosystem context, nor forest values or practices. The indicator does not provide information on the degradation of the forest resources in a country. The total forest area in a country might remain unchanged, but the quality of the forest can become degraded. Due to the definition used, the indicator covers a very diversified range of forests ranging from open tree savanna to very dense tropical forests.

(d) **Status of the Methodology:** Not available.

(e) **Alternative Definitions/Indicators:** Plantation area compared to natural forest would provide a measure of the intensity of forest practices for timber production and possible ecosystem implications.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The total forest area of a country, including plantations, at different yearly intervals.

(b) **National and International Data Availability and Sources:** Data on the extent of forest areas (natural and plantations) are available for most countries, both at national and sub-national scales. The data are often estimates, which are not always comparable because of changes in definitions and assessment methodologies. International data are available from FAO Forest Resources Assessments (FRA). National data is available from ministries responsible for forestry and statistics

(c) **Data References:** Not available.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the Food and Agriculture Organization of the United Nations (FAO). The contact point is the Assistant Director-General, Sustainable Development Department, FAO; fax no. (39 06) 5705 3152.

(b) **Other Contributing Organizations:** The United Nations Environment Programme (UNEP); United Nations regional commissions; and national agencies responsible for forestry, remote sensing and geographic survey; and universities and research institutes could all play a useful role in the development of this indicator.

6. **REFERENCES**

(a) **Readings:**

FAO. 1999. *State of the World's Forests* (FAO). / FAO, Rome (Italy). Forestry Dept., 154 pp.

FAO. 1995. *Forest resources assessment 1990: global synthesis*. FAO Forestry Paper (FAO), no. 124 / FAO, Rome (Italy). Forestry Dept., 100 pp.

FAO. 1993. *Forest resources assessment 1990: Tropical countries*. FAO Forestry Paper (FAO), no. 112 / FAO, Rome (Italy). Forestry Dept., 110 pp.

FAO. *Forest Resources Assessments* 1980, 1990 and 2000.

Harcharik, D.A. 1995. *Forest Resources Assessment 1990: non-tropical developing countries*. / FAO, Rome (Italy). Forestry Dept., 12 pp.

(b) **Internet sites:**

International data provided by other institutions, for example World Resources Institute, are mostly based on the FAO Forest Resources Assessment information and data.
<http://www.wri.org/>

FAO Statistical Databases. <http://apps.fao.org>

The FAO Forestry Department Information Note on *Criteria and Indicators for Sustainable Forest Management*. <http://www.fao.org/forestry/FODA/infonote/infont-e.stm>

The International Tropical Timber Organization (ITTO). <http://www.itto.or.jp/>

The United Nations Environment Programme (UNEP). <http://www.unep.org/>

WOOD HARVESTING INTENSITY		
Environmental	Land	Forests

1. INDICATOR

- (a) **Name:** Wood Harvesting Intensity.
- (b) **Brief Definition:** The indicator compares the total forest fellings as a percentage of the net annual increment.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Environmental/Land/Forests.

2. POLICY RELEVANCE

- (a) **Purpose:** The indicator aims at assessing whether forests are being used within the limits of their actual productivity. If the ratio is smaller or equal to one, it means that the country is harvesting less, or equal, to the annual forest increment. This represents the *sustained yield principle*. If the ratio is more than one, a country is over-harvesting its wood, or other specific forest resource.
- (b) **Relevance to Sustainable/Unsustainable Development:** Forests serve multiple ecological, socio-economic, and cultural roles in many countries. They are among the most diverse and widespread ecosystems of the world. Forests provide many significant resources and functions including wood products and non-wood products: recreational opportunities, habitat for wildlife, water and soil conservation, and a filter for pollutants. They support employment and traditional uses, and biodiversity. There is general concern over human impact on forest health, and the natural processes of forest growth and regeneration. Combating deforestation to maintain the production of wood and non-wood products but also to preserve soils, water, air and biological diversity is explicitly considered in Agenda 21.

This indicator is relevant for assessing the sustainability of forest management when interpreted over a long time period. The harvest rate set by a country is a function of the size of its forests, the proportion of the forest area dedicated to timber production, the productivity of the forest and its age class structure, and the management objectives and sustained yield policies of the country. The indicator relates sustained yield to actual harvest in terms of a relative balance between forest growth and harvest.

- (c) **International Conventions and Agreements:** Many international agreements cover forests. Countries are supported to maintain or increase their forested areas, and discouraged to strongly reduce their forest lands. Specific forest agreements would include the *Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management*,

Conservation and Sustainable Development of All Types of Forests (the Forest Principles of the United Nations Conference on Environment and Development [UNCED]); and the *International Tropical Timber Agreement*. Many other international agreements deal with forests within the context of natural resources and environment conservation, for example, the Convention on International Trade in Endangered Species (CITES), the Convention on the Conservation of Wetlands of International Importance (Ramsar Convention), the Convention on Biological Diversity, the Convention on Climate Change, the Convention to Combat Desertification. In addition, regional/ecoregional agreements on sustainable forest management have been established.

(d) **International Targets/Recommended Standards:** In general, the target would be set by the *sustained yield principle*. Several countries have calculated their total annual allowable cut, or total annual increment, and their total annual removals. Most developed countries are harvesting between 70 and 80 percent of the total annual increment of their forests. Targets still need to be established for tropical forests.

(e) **Linkages to Other Indicators:** This indicator is linked to other natural resource indicators within the environment category, such as protected forest area, and land use and condition change. It is also linked to such socio-economic indicators as share of natural resource industries in manufacturing.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Concepts and definitions are generally available for developed countries, and for all countries in the case of plantations. Additional work is required to determine the natural increment concept for tropical forests. The following definitions are available from the Food and Agriculture Organization of the United Nations (FAO). *Annual Roundwood Production* includes all wood obtained from removals from forest and from trees outside the forest. FAO statistics include recorded volumes as well as estimated unrecorded volumes. *Forest Growing Stock* means the above-ground volume of all living standing trees down to a stated minimum diameter. *Total Annual Increment* represents the total annual increment of wood due to the growth of the trees during a year.

(b) **Measurement Methods:** The enumerator is the total annual roundwood production. The denominator is the total annual productive forest increment. An adequate time series is required to show meaningful trends. For tropical natural forests, where no data is available on the forest annual increment, or where the harvested wood comes only from a few species, an adjustment is proposed which relates annual production to the total standing volume of the forest and the average rotation cycle applied in a country for a given reference year. This, for example, would be 120 years for teak forests in Burma.

(c) **Limitations of the Indicator:** The indicator is related to timber production. It does not relate to the production of non-wood products, nor to the provision of forest and forest ecosystems of environmental and social service which, together with wood production, should be measured and monitored to assess sustainability. It has implication for other forest resources, but an indicator considering all values of forest ecosystems would be more appropriate from a

sustainable development perspective. For the present indicator, reliable data are only available from a minority of countries, mostly developed, and for plantations. However, research data on the annual increment of tropical natural forests are improving, and it is expected that sufficient data and estimates should become available during the coming years.

Harvesting intensity gives us an indication of the degree of tree cover reduction at a given time, but does not refer to what will happen to the forest after it has been “intensely harvested”. Clearfelled forest, for example, maybe harvested at an intensity of 100 percent, but may also be reforested afterwards. Thus, additional indicators for deforestation are needed, which contain time components (time during which the area will stay without tree cover), and land uses other than forest.

This indicator should be interpreted over the longer term. In given cases, the annual roundwood production might exceed the forest increment for market reasons, age structure of forests, or other reasons for a few years without being an indication for unsustainable management. However, such an unsustainable situation should under no circumstances persist over several decades.

(d) **Status of the Methodology:** Not available.

(e) **Alternative Definitions/Indicators:** This indicator compares the amount of yearly, or other time period, harvested wood, or any other forest product, with the annual increment from the forest. If the annual increment is not known, allowable cut can be used as a surrogate.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Data are needed on growing stock, annual roundwood production, annual increment, and the rotation cycle.

(b) **National and International Data Availability and Sources:** Data are available for most countries at both national and sub-national levels. However, in many cases, especially for natural forests where rough estimates are only available, data are available for only one time period, with no time series data. The primary international source of data is FAO. At the country level, the data would be available from national ministries responsible for forestry.

(c) **Data References:** Not available.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the Food and Agriculture Organization of the United Nations (FAO). The contact point is the Assistant Director-General, Sustainable Development Department, FAO: fax No. (39 06) 5705 3152.

(b) **Other Contributing Organizations:** The International Tropical Timber Organization (ITTO) could assist with the development of this indicator.

6. **REFERENCES**

(a) **Readings:**

FAO. 1999. *State of the World's Forests (FAO)*. / FAO, Rome (Italy). Forestry Dept., 154 pp.

FAO Forestry publications including *Forestry Papers*.

United Nations Economic Commission for Europe, *Timber Studies*, Timber Bureau, Geneva.

(b) **Internet sites:**

FAO Statistical Databases. <http://apps.fao.org>

The International Tropical Timber Organization (ITTO). <http://www.itto.or.jp/>

LAND AFFECTED BY DESERTIFICATION		
Environmental	Land	Desertification

1. INDICATOR

- (a) **Name:** Land Affected by Desertification.
- (b) **Brief Definition:** This is a measure of the amount of land affected by desertification and its proportion of national territory.
- (c) **Unit of Measurement:** Area (Km²) and % of land area affected.
- (d) **Placement in the CSD Indicator Set:** Environmental/Land/Desertification.

2. POLICY RELEVANCE

- (a) **Purpose:** The indicator describes the extent and severity of desertification at the national level. It should be: (i) a measure of the state of the problem at any one time; (ii) an indication of the trend in the severity of the problem over time and success of response mechanisms; and (iii) a means of comparing the severity of the problem from one country to another.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The indicator should be a mechanism for determining the importance of this issue at the national level. Trend data over time can indicate success of response mechanisms. For dryland areas, desertification is a central problem in sustainable development. While many dryland ecosystems have generally low levels of absolute productivity, maintenance of that productivity is critical to the present and future livelihood of many hundreds of millions of people. Combating desertification is the core of sustainable development for large areas of the world. Severe degradation is a major impediment to sustainable development; moderate or slight degradation is also a significant barrier.
- (c) **International Conventions and Agreements:** The two most significant agreements are: Agenda 21 of the 1992 UN Conference on Environment and Development; and the UN Convention to Combat Desertification, 1994. In addition, the Desertification Convention texts (INCD-10/ New York) spell out a sound methodology for developing indicators. No definitive set of indicators has been agreed upon within the context of the desertification Convention.
- (d) **International Targets/Recommended Standards:** No specific targets have been defined, however, the goal should be to reduce the area and percentage of land affected by desertification, and/or reduce the severity of desertification.

(e) **Linkages to Other Indicators:** This state and trends indicator needs to be considered in conjunction with related driving force and response indicators, integrating physical and socio-economic processes, for meaningful interpretation and policy relevance at the national level. It is closely linked with indicators concerning land use, such as deforestation, use of marginal land, protected area as a percent of total land area, and population living below the poverty line.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** For the purposes of this indicator, desertification is defined as land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities (UN Convention to Combat Desertification, 1994). *Land degradation* means reduction or loss, in arid, semi-arid and dry sub-humid areas of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical and biological or economic properties of soil; and, (iii) long-term loss of natural vegetation. Land degradation, therefore, includes processes which lead to surface salt accumulation and waterlogging associated with salt-affected areas.

Arid, semi-arid, and dry sub-humid areas means areas, other than polar and sub-polar regions, in which the ratio of annual precipitation to potential evapotranspiration falls within the range from 0.05 to 0.65 (UN Convention to Combat Desertification, 1994).

(b) **Measurement Methods:** Measurement for this indicator initially requires an assessment of the extent of land degradation throughout the arid, semi-arid, and dry sub-humid zones of the nation. This is best done by a combination of previous assessments represented in map form, carried out by the United Nations Environment Programme (UNEP) with the United Nations Office to Combat Desertification and Drought (UNSO), and the Food and Agricultural Organization (FAO); and updates from a combination of remote sensing and local knowledge.

The creation of an index that combines degrees of severity will require the following measures:

- (i) Area subjected to severe land degradation $x\text{Km}^2$ (severe here includes both the severe and very severe categories of UNEP).
- (ii) Area subjected to moderate land degradation $y\text{Km}^2$.
- (iii) Area subjected to slight land degradation $= z\text{Km}^2$.
- (iv) National area (excluding surface water bodies) $n\text{Km}^2$.
- (v) National area of drylands (vulnerable to desertification, assuming that all drylands are potentially vulnerable to desertification. Hyper-arid lands are excluded), consisting of arid, semi-arid, and dry subhumid land $= d\text{Km}^2$.

From the above measurements, the following sets of numbers can be derived:

Indicator computations:

a. National area affected by desertification

$$= x + y + z \text{ Km}^2$$

b. Percent of national area affected by desertification

$$= \frac{x + y + z}{n} \times 100$$

c. Percentages of national area affected by severe, moderate and slight desertification respectively can be calculated in the same way.

d. Percent of national drylands affected by desertification

$$= \frac{x + y + z}{d} \times 100$$

e. National area not affected by desertification

$$= n - (x + y + z) \text{ Km}^2$$

f. National dryland area not affected by desertification

$$= d - (x + y + z) \text{ Km}^2$$

Trends can be determined by comparing results computed for a sequence of years (for example, every five years).

A useful extension of the indicator would be for countries to report dryland areas (d) as a percentage of all agriculturally productive areas (e=n-hyper arid land) to give an indication of the overall vulnerability of the country to desertification.

While it is based on a combination of analytical and subjective assessment, if these are done systematically on an annual basis, a sound database can be developed. Given the importance of determining the extent and severity of desertification to the index, it may be that a periodic special survey using remote sensing and ground assessment may be important, though this may only be technically feasible for some countries.

An important issue in the basis measurement of degradation is the factors that are measured to assess the degree of local degradation. As Bie (1990) clearly points out, the two factors of *productivity* and *resilience* are the most important elements in assessing the existence and the

extent of dryland degradation. Accurate measurement of land affected by desertification is a problem about which there is not yet complete consensus and further work needs to be done to agree on a comparable methodology for the various countries affected by desertification (UNEP, Atlas of Desertification; UNEP/ISRIC/ISS/FAO, Global Assessment of the Status of Human-induced Soil Degradation (GLASOD)).

(c) **Limitations of the Indicator:** There are a number of issues to be resolved before this indicator can be entirely satisfactory. The ecosystems addressed in this definition undergo cyclic episodes of more or less rainfall, as well as long-term degradation in many cases. Separating short-term fluctuations from longer-term trends is important, though scientists often find this difficult to determine, except for longer time periods. Also, the United Nations Environment Programme (UNEP) has generally defined desertification (degradation) in categories (severe, moderate, slight), and a national indicator needs to include an assessment of this kind. It has been a practice to include problems of waterlogging and salinization as part of desertification, if they occur within the ecosystems as defined above. In this case, the area affected by these problems should also be included in the desertified area.

Because of these issues, the indicator may well benefit from further refinement and definition. The concepts of land degradation in arid, semi-arid, and dry sub-humid areas are well defined and described in a number of UNSO, UNEP, and other UN publications, as well as in the academic literature. The translation of these concepts into agreed national level indicators has not been so well articulated. (Mabbutt, J.A. 1986; Maimuet 1991).

(d) **Status of the Methodology:** The methodology for the compilation of the above statistics has not yet been agreed upon by any inter-governmental fora, however negotiations are underway. It has therefore the status of a recommendation for guidelines.

(e) **Alternative Definitions/Indicators:** Not available.

4. ASSESSMENT OF DATA

(a) **Data Needed to Complete the Indicator:** The data needed to compile the indicator are the extent and severity of dryland degradation in the country concerned, the dryland area, and national area (excluding surface water bodies). The degree of accuracy and reliability of both spatial and statistical data varies considerably and are often poorly documented and/or out of date. For some countries, the data do not yet exist. Benchmark data on desertification is critical to measuring progress.

(b) **National and International Data Availability and Sources:** Dryland and national areas can be obtained from national statistical institutions and publications, and can also be found in standard World Resources Institute (WRI), UN and World Bank publications. Some data on extent and degree of land degradation are available at the country level in national institutions or from non-government organizations, in donor countries, and in publications of the United Nations Development Programme (UNDP)/UNSO, UNEP, FAO and other international institutions.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the Office to Combat Desertification and Drought (UNSO) of UNDP. The contact point is the Director, UNSO; fax no. (1 212) 906-6345.

(b) **Other Contributing Organizations:** Other contributing organizations include: UNEP, FAO, Consultative Group on International Agricultural Research (CGIAR), International Fund for Agricultural Development (FAD), ISRIC, the International Union for the Conservation of Nature (ACNE), and selected national governments.

6. REFERENCES

(a) **Readings:**

Bie, Stein W. 1990. *Dryland Degradation Measurement Techniques*, World Bank, Environment Work Paper No. 26, 42 p.

Dregre, H., Kassas M. and Rozanov, B. 1991 A new assessment of the world status of desertification. *Desertification Control Bulletin* 20. p. 6-18.

Dumanski, J. And Pieri, C. 1994. Comparison of available frameworks for development of land quality indicators. *Agr. Tech. Div.*, World Bank. p. 14.

Mabbutt, J.A. 1986. Desertification Indicators. *Climatic Change* 9. P. 113-122.

Mainguet, M. 1991 *Desertification: Natural Background and Human Mismanagement*. Springer-Verlag, Berlin. 306 p.

Organisation for Economic Co-operation and Development. 1998. *"Towards Sustainable Development: Environmental Indicators"*. OECD. Paris.

O Connor, J. et al. 1995. *Monitoring Environmental Progress*(Draft). World Bank. 72 p.

UNDP/UNSO and NRI. 1995. *Development of Desertification Indicators for Field Level Implementation*. 53 p.

UNEP. 1992. *World Atlas of Desertification*. Edward Arnold. London.

UNEP. 1994. United Nations Convention to Combat Desertification in those countries experiencing drought and/or desertification, particularly in Africa. Text with Annexes. 71 p.

UNEP/ISRIC. 1988. Guidelines for General Assessment of the Status of Human-induced Soil Degradation (GLASOD).

UNEP/ISRIC. 1990. World Map of the Status of Human-induced Soil Degradation: *An Explanatory Note* (GLASOD).

UNEP/ISRIC. 1991. *World Map of the Status of Human-induced Soil Degradation*. (GLASOD).

UNEP/ISRIC/ISSS/FAO. 1995. Global and National Soils and Terrain Digital Databases (SOTER), Procedures Manual (revised edition). ISBN 90-6672-059-X.

UNEP/Netherlands National Institute of Public Health and Environment (RIVM). 1994. An Overview of Environmental Indicators: State of the art and perspective. UNEP/EATR.94-01:RIVM/402001001. Environmental Assessment Sub-Programme, UNEP, Nairobi. ISBN 92-807-1427-9.

WB/FAO/UNDP/UNEP. In print. *Land Quality Indicators*. World Bank Discussion Papers.

(b) **Internet sites:**

United Nations Convention to Combat Desertification. <http://www.unccd.ch>

United Nations Development Programme's Office to Combat Desertification and Drought (UNSO). <http://www.undp.org/seed/unso.html>

AREA OF URBAN FORMAL AND INFORMAL SETTLEMENTS		
Environmental	Land	Urbanization

1. INDICATOR

- (a) **Name:** Area of Urban Formal and Informal Settlements.
- (b) **Brief Definition:** Urban residential area in square kilometres occupied by formal and informal settlements.
- (c) **Unit of Measurement:** km².
- (d) **Placement in the CSD Indicator Set:** Environmental/Land/Urbanization.

2. POLICY RELEVANCE

- (a) **Purpose:** The indicator measures the sizes of both formal and informal settlements. By focusing on the legality of human settlements, this indicator measures the marginality of human living conditions.

- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Settlements characterized by illegality of tenure and unauthorized shelter are generally marginal and precarious, and do not cater to basic human needs such as affordable housing. They affect sustainable human settlements development, human health, and socioeconomic development.

Illegal dwellers generally live in an unsafe and precarious environment, lack basic services, suffer from the absence of tenure security, and have no legal claim in case of eviction. Also, numerous illegal settlements are established on lands which are predisposed to natural disasters. Informal settlements have usually a much higher population density than formal settlements and these living conditions constitute a threat to human health.

- (c) **International Conventions and Agreements:** Not applicable, see section 2(d).
- (d) **International Targets/Recommended Standards:** No international targets have been established for this indicator.
- (e) **Linkages to Other Indicators:** This indicator is closely linked with several other socioeconomic and environmental indicators, such as rate of growth of urban population, human and economic losses due to natural disasters, access to adequate sanitation, primary health care, infant mortality, infrastructure expenditure, and land use.

3. **METHODOLOGICAL DESCRIPTION**

(a) **Underlying Definitions and Concepts:** Informal settlements refer to: i) residential areas where a group of housing units has been constructed on land to which the occupant have no legal claim, or which they occupy illegally; ii) unplanned settlements and areas where housing is not in compliance with current planning and building regulations (unauthorized housing). Formal settlements refer to land zoned residential in city master plans or occupied by formal housing.

(b) **Measurement Methods:** Area of formal and informal settlements can be evaluated through aerial photography or land use maps. Informal settlements should not cover dwelling units which have been regularized, that is those units for which land titles, leases or occupancy permits have been granted. They should only include those units which presently occupy land illegally and/or housing units which are not in compliance with current regulation. Where feasible, the interpretation and meaning of this indicator would be supported by the comparison of formal and informal settlement areas to total urban area.

(c) **Limitations of the Indicator:** The ephemeral nature and lack of an acceptable operational definition for this indicator, limit its usefulness, especially for trend analysis. The legal framework for settlements on which this indicator is based varies from country to country. Informal housing is not registered in official statistics, any measure of informal settlements remains limited. Information may be obtained from specific research studies, but it difficult to obtain and may be of variable quality. Homelessness, which is one of the extreme symptoms of human settlements inadequacy, is not accounted for by this indicator and in fact the existence of illegal settlements may reduce the incidence of homelessness. This indicator does not cover informal settlements in rural areas.

(d) **Alternative Definitions/Indicators:** Many concepts intended to measure marginality of human settlements have been formulated: unplanned, squatter, marginal settlements, unconventional, non permanent structures, housing in compliance, inadequate housing, slums, etc. "Unconventional dwellings" is one of the most common measures, defined by the number of housing units occupied by households, but considered inappropriate to human habitation. 'Improvised housing units' is another category used by the Census, defined as independent, makeshift shelters constructed of waste materials and without a predetermined plan for the purpose of habitation by one household. Included in this category are squatters' huts, favelas, hongos, jhuggis, etc. The type of building (permanent, semi-permanent, non permanent), which describes the building structures in which households live, is another common measure but the criteria widely vary from country to country.

4. **ASSESSMENT OF DATA**

(a) **Data Needed to Compile the Indicator:** Area of formal and informal settlements.

(b) **National and International Data Availability and Sources:** These data are more likely to be available at the city level and are generally collected in large cities affected by informal settlements. Data sets at the national level will only occur sporadically.

- (c) **Data References:** Data from research studies, census data, and aerial photographs.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

- (a) **Lead Agency:** The lead agency is the United Nation Centre for Human Settlements (Habitat). The contact point is the Head, Urban Secretariat, UNCHS (Habitat); fax no. (254 2) 623080.

6. REFERENCES

- (a) **Readings:**

World Bank. *Housing: Enabling Markets to Work*. A World Bank Policy Paper. The World Bank, Washington D.C., 1993.

UNCHS (Habitat) and The World Bank. *The Housing Indicators Programme*. Report of the Executive Director (Volume I). UNCHS, Nairobi, 1993.

UNCHS (Habitat). *Monitoring the Shelter Sector*. Housing Indicators Review. UNCHS, Nairobi, 1995.

- (b) **Internet site:**

UNCHS (Habitat) home page: <http://www.urbanobservatory.org/indicators/database>

ALGAE CONCENTRATION IN COASTAL WATERS		
Environmental	Ocean, Seas and Coasts	Coastal Zone

1. **INDICATOR**

- (a) **Name:** Algae Concentration in Coastal Waters.
- (b) **Brief Definition:** This indicator will use the concentration of algae growing in coastal waters to represent the health of the coastal zone ecosystem, and the effectiveness of measures aimed at reducing nutrient inputs from run-off and discharge.
- (c) **Unit of Measurement:** mg of chlorophyll per meter cubed, or a production rate in grammes of carbon per meter squared per year.
- (d) **Placement in the CSD Indicator Set:** Environmental/Ocean, Seas and Coasts/Coastal Zone.

2. **POLICY RELEVANCE**

- (a) **Purpose:** This indicator has the potential to illustrate the effectiveness of measures designed to reduce nutrient inputs in accordance with the goals of the Regional Seas Conventions and Action Plans.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Coastal ecosystems provide important economic benefits, such as fisheries, tourism and recreation. They are also important for biodiversity, which is recognised by the Convention on Biological Diversity (CBD) as having its own intrinsic value as well as importance for human life and sustainable development. High algal concentrations in coastal waters reflect high nutrient inputs, which can represent serious threats to coastal ecosystem health. A large concentration of algae restricts the available light, reduces dissolved oxygen levels and may increase sedimentation, which smothers other organisms. Increasing concentrations of algae can also indicate threats to human and animal health by toxic algal blooms.
- (c) **International Conventions and Agreements:** This indicator is especially relevant to the United Nations Convention on the Law of the Sea (UNCLOS, 1982), the non-binding Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, and the Washington Declaration (1995), implemented by the United Nations Environment Programme.

In addition, each of the Regional Seas has its own convention or action plan; details of these can be found at: <http://www.gpa.unep.org/>.

The conservation of biological diversity and the sustainable use of its components are among the primary objectives of the Convention on Biological Diversity. This indicator is of particular relevance to several articles of the CBD, e.g., Article 6 - General measures for conservation and sustainable use; Article 7 - Identification and monitoring.

Related regional agreements include: the Arusha Resolution on ICZM; Convention for the Protection of the Marine Environment of the North East Atlantic; Protocol on Protection of the Black Sea Marine Environment Against Pollution from Land Based Sources; Convention for the Protection of the Natural Resources and Environment of the South Pacific Region; Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region; Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region; Convention for the Protection of the Marine Environment and Coastal Area of the South-East Pacific.

(d) **International Targets/Recommended Standards:** The proposed target is to reduce nutrient inputs into areas where they are causing or likely to cause pollution and to reduce the number of marine areas where eutrophication is evident. By the year 1995, in industrialised countries, and by the year 2005, in developing countries, at least 50 per cent of all sewage, waste water and solid wastes need to be treated and disposed of in conformity with national and international environmental and health quality guidelines.

(e) **Linkages to Other Indicators:** This indicator can be linked to many of the CSD core environmental indicators, especially those relating to fisheries, biodiversity, fresh water quality and fertiliser use. Economic indicators that are linked include those on waste management. It also has significant implications for human and animal health and may be directly related to human population growth.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Algae, both phytoplankton (or microalgae) and macroalgae, along with cyanobacteria are the primary producers of the sea as they convert sunlight and dissolved nutrients into energy-rich compounds. Inputs of nutrients from point sources such as sewage outputs and non-point or diffuse sources like the fertiliser run-off from agricultural practices cause increases in growth of algae. Proliferations of microalgae in marine or brackish waters can cause massive fish kills, contaminate seafood with toxins, and alter ecosystems. A survey of affected regions and of economic losses and human poisonings throughout the world demonstrates very well that there has been a dramatic increase in the impacts of these harmful algal blooms over the last few decades.

The impact of harmful microalgae is particularly evident when marine food resources, e.g., aquacultures, are affected. Shellfish and in some cases finfish are often not visibly affected by the algae, but accumulate the toxins in their organs. The toxins may subsequently be transmitted to humans and, through consumption of contaminated seafood, seriously threaten health.

(b) **Measurement Methods:** Guidelines have been produced by the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), set up by the United Nations (UN) in 1969, in an effort to standardise the methods used for algae measurements. Publications are: Guidelines for Marine Environmental Assessments, 1994, Report No. 54 and Biological indicators and their use in the measurement of the condition of the marine environment, 1995, Report No. 55, both found at: <http://gesamp.imo.org/publicat.htm>.

Measurements of chlorophyll concentration using spectrophotometric and fluorometric techniques are often used as an indirect method of assessing algal biomass. Ratios of the different chlorophylls give an indication of major divisions of algae present. Ratios of chlorophylls to their degradation products (phaeophytins) give an indication of the health of the phytoplankton community. These measures of algal biomass can be used indirectly to determine the levels of nutrients entering the coastal zone, taking into account the many variables such as size and carrying capacity of the marine environment. The spatial distribution of sampling points and the methods for combining data from them require careful consideration and further development of appropriate methods.

(c) **Limitations of the Indicator:** The major constraints to the use of this indicator will be the availability of appropriate data and the consistency of sampling and measurement methods over time as well as adequate data synthesis methods. The measurement of algae concentrations in the coastal zone does not take into account levels of nutrients that enter the marine environment naturally. The effects of algae build-up will also depend upon the assimilative capacity of the water body. This indicator does not allow for the assessment of proportional contribution of nutrients to the coastal environment from point and non-point sources. It is also difficult to determine what role atmospheric nutrients play in the accumulation of algae.

(d) **Status of the Methodology:** Guidelines have been drawn up in an attempt to standardise the various methodologies used by United Nations Regional Seas Programmes to measure algae concentrations. For more information, consult the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) and the reports 54 and 55 listed in 3(b).

(e) **Alternative Definitions/Indicators:** Direct measurement of nutrient inputs to coastal zones from both point and non-point sources could provide an alternative indicator, but would be costly and subject to a number of problems.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Standardised quantitative data on chlorophyll concentrations or the population and biomass of algae from an appropriately distributed network of sampling stations.

(b) **National and International Data Availability and Sources:** Limited data are available at the national level under the Regional Seas Programme of the UN. Until recently these data were not collected in standardised format, but with the introduction of guidelines, it is hoped that the results of future studies can be compared globally. The Environmental Assessment

subprogramme of the UN is tasked with collecting data through a series of global databases and the information being used for effective decision-making.

(c) **Data References:** Data at the regional level contact Regional Seas Programme of United Nations, web site: <http://www.unep.ch/seas/rshome.html>. Data at the international level contact the United Nations Environmental Assessment subprogramme to access their database, web site for the UN: <http://www.unep.org>.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Environment Programme (UNEP)/GPA Coordination Office. The contact point is the GPA Coordination Office, tel. no. (+31 70) 311.4467 , fax no. (+31 70) 345.6648 and email gpa@unep.nl.

(b) **Other Contributing Organisations:** Other organisations interested in the further development of this indicator would include: United Nations Development Programme (UNDP), Food and Agricultural Organisation of the United Nations (FAO), Global Environment Facility (GEF), International Maritime Organisation (IMO), United Nations Industrial Development Organisation (UNIDO), World Bank, World Health Organisation (WHO) and the World Meteorological Organisation (WMO), Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), the Global Ocean Observing System (GOOS), the Global Investigation of Pollution in the Marine Environment (GIPME).

6. REFERENCES

(a) **Readings:**

IMO, 1994. Guidelines for Marine Environmental Assessments, Report No. 54.

UNEP, 1995. Biological indicators and their use in the measurement of the condition of the marine environment, Report No. 55.

(b) **Internet sites:**

<http://www.gpa.unep.org/>

<http://www.un.org/Depts/los/index.htm>

<http://www.un.org/esa/sustdev/agenda21.htm>

<http://www.unep.ch/seas/main/hglomon.html>

http://www.ioc.unesco.org/iocweb/activities/ocean_sciences/marpol.htm

<http://www.fao.org/sd/epdirect/epre0018.htm>

<http://gesamp.imo.org/>

<http://ioc.unesco.org/hab/intro.htm>

http://www.gpa.unep.org/documents/technical/rseas_reports/

<http://www.dominet.com.tr/blacksea/>

<http://www.cep.unep.org/>

<http://www.unepmap.org/>

<http://www.ospar.org/>

PERCENT OF TOTAL POPULATION LIVING IN COASTAL AREAS		
Environmental	Ocean, Seas and Coasts	Coastal Zone

1. INDICATOR

- (a) **Name:** Percent of Total Population Living in Coastal Areas.
- (b) **Brief Definition:** Percent of total population living within 100 kilometers of the coastline. A country might also consider measuring the % of population living within 100 kilometers of the coastline including major rivers that empty into the ocean.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Environmental/Ocean, Seas and Coasts/Coastal Zone. Because of the economic dimension of this indicator, its placement in the CSD Indicator framework might also be related to: Economic/Economic Structure/Trade.

2. POLICY RELEVANCE

- (a) **Purpose:** This indicator represents the impact population and population growth in the coastal zone has on economic development as well as on the degradation of coastal ecosystems. It also represents relative access of populations to the ocean which is important for trade and economic development.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Coastal ecosystems provide important economic benefits, such as fisheries, tourism and recreation. They are also important for biodiversity, which is recognised by the Convention on Biological Diversity (CBD) as having its own intrinsic value as well as importance for human life and sustainable development. A high concentration of population within the 100 kilometer coastal zone can dramatically affect the coastal ecosystem through habitat alteration or loss and increased pollutant loads. Either of these processes -- the degradation of the coastal ecosystem through conversion or modification of habitat or through increased pollution -- can lead to loss of biodiversity, influx of invasive species, coral reef bleaching, new diseases among organisms, hypoxia, harmful algal blooms, siltation, reduced water quality, and a threat to human health through toxins in fish and shellfish and pathogens such as cholera and hepatitis A residing in polluted water.

High population densities affect the coastal region's ecosystem. At the same time, a higher proportion of population in coastal areas with good access to internal, regional, and international trade appears to be favourable for economic development. This may reflect increasing returns to scale in infrastructure networks or the enhanced division of labour in settings with high population densities. On the other hand, high population densities far from the coast seem to

hinder development. In the absence of liberal trade arrangements, landlocked countries are particularly disadvantaged by their lack of access to coastal-based trade and development.

Fishing, tourism, and recreation are some of the important economic benefits coastal ecosystems provide. However, exploitation of the coastal ecosystem like overfishing puts future economic uses of the resource at risk.

Access to the sea is important for international trade, success in manufactured exports, and long-run economic growth. Countries with lower shipping costs have experienced faster manufactured export growth and overall economic growth during the past thirty years than countries with higher shipping costs. Significant coastal populations represent the ability of a country to participate competitively in international trade as well as expand from traditional sectors like agriculture or natural resource extraction to development strategies based on the advantages of reduced transport costs.

(c) **International Conventions and Agreements:** The indicator is relevant to the United Nations non-binding Global Programme of Action for the Protection of the Marine Environment from Land-based Activities which is implemented by the United Nations Environment Programme.

The conservation of biological diversity and the sustainable use of its components are among the primary objectives of the Convention on Biological Diversity. This indicator is of particular relevance to several articles of the CBD, eg: Article 6 - General measures for conservation and sustainable use; Article 7 - Identification and monitoring.

(d) **International Targets/Recommended Standards:** None.

(e) **Linkages to Other Indicators:** Many of the CSD core environmental indicators can be linked to this one, particularly those relating to urbanization, biodiversity, agriculture, fisheries, algae concentration, and fresh water quality. A social indicator directly linked is the population growth rate. It also has significant implications for economic performance and GDP per capita.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The coastal zone provides numerous ecological and economic benefits (from tsunamis to invasive species brought in ballast water, it also provides numerous hazards.). The primary ecological services coastal ecosystems provide are biodiversity both on land and underwater and pollutant filtering. Coastal wetlands, mangroves, sea grasses, and peat swamps could be considered the lungs of the oceans for their ability to filter pollutants. Loss of this habitat not only decreases biodiversity but also the ability of a coastal ecosystem to soak up pollutants from human activities, such as farming, aquaculture, urban runoff, sewage effluent, and oil spills. For example, excessive nutrient runoff from intensive agricultural practices can increase underwater plant growth. Decomposition of the excessive plant matter reduces the available oxygen in the water. This oxygen depletion condition known

as hypoxia puts marine organisms and human health at risk. Some of the most populated coastal regions of the world also contain some of the world's worst hypoxic zones.

(b) **Measurement Methods:** A Geographic Information System (GIS) should be used to measure this indicator. Generally, GIS is software used to perform spatial analyses. Many different types of free and proprietary GIS packages exist.

The first step is to calculate a 100 kilometer buffer from the coastline. Due to the curvature of the earth, the 100 kilometer buffer should be created in an equidistant map projection appropriate to each country. The map projection used to create the 100 kilometer buffer for Iceland won't create an accurate 100 kilometer buffer for India. Subsequently, the buffer should be converted into the same map projection as the population data (which is the generic Geographic non-projection). To correct for undercounting errors where the coastline and population data aren't exactly matched, one can also include in the 100 kilometer buffer a thin band extending from the coastline into the "ocean".

(c) **Limitations of the Indicator:** The indicator may under-represent population pressure on coastal ecosystems by not taking into account population within 100 kilometers of major waterways flowing to the coast. Similarly, the indicator may under-represent the proportion of population available for coastal economic development by not counting population within 100 kilometers of a sea-navigable waterway. The width of the 100 kilometer band may be too wide to capture within country variance of population pressure on coastal ecosystems (Cuba, United Kingdom, Japan, small island nations, etc). The spatial resolution of the population data may not be detailed enough to capture within country variance.

(d) **Status of the Methodology:** No guidelines yet exist on how to measure the proportion of a country's population living within 100 kilometers of a coast.

(e) **Alternative Definitions/Indicators:** To better gauge the impact of population on coastal ecosystems, measuring population within 100 kilometers of major waterways flowing to the coast might be more appropriate. To better gauge access to international and regional trade, measuring population within 100 kilometers of a coast and all waterways navigable to the sea by ocean-going vessels might be more appropriate.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The two pieces of digital geographic data needed to measure this indicator are a coastline and a model of the distribution of population. The freely available digital database of global population distribution in 1990 and 1995 was developed jointly by the Socio-economic Data and Applications Center (SEDAC) and by the Center for International Earth Science Information Network at Columbia University (CIESIN). The coastline of the population data closely matches the widely available coastline from the Digital Chart of the World.

(b) **National and International Data Availability and Sources:** The primary source for the digital model of population distribution at the global, continental and country level is the Socio-economic Data and Applications Center (SEDAC).

(c) **Data References:** The web site for SEDAC is: <http://sedac.ciesin.org/>. The Digital Chart of the World coastline can either be acquired on an individual country basis from the Pennsylvania State University Map Library web site, <http://www.maproom.psu.edu/dcw/>, or by purchasing the entire CD-ROM from ESRI (<http://www.esri.com>).

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the Center for International Development at Harvard University, Boston, Mass., USA. The focal point is Mr. Andrew Mellinger.

(b) **Other Contributing Organisations:** the United Nations Environment Programme (UNEP)/GPA Coordination Office. The contact point is the GPA Coordination Office, tel. no. (+31 70) 311.4467, fax no. (+31 70) 345.6648 and e-mail gpa@unep.nl.

6. REFERENCES

(a) **Readings:**

UNDP, UNEP, World Bank, World Resources Institute, 2000. *World Resources 2000-2001: People and Ecosystems: The Fraying Web of Life*. World Resources Institute, Washington, DC. <http://www.wri.org/wr2000/>

Gallup, John L., Jeffrey D. Sachs, and Andrew D. Mellinger. 1998. Geography and Economic Development. In *Annual World Bank Conference on Development Economics 1998*, eds. Boris Pleskovic and Joseph E. Stiglitz. The World Bank, Washington, DC.

(b) **Internet sites:**

<http://www.cid.harvard.edu/cidglobal/economic.htm>

<http://www.gpa.unep.org/>

<http://www.un.org/esa/sustdev/agenda21.htm>

http://www.ioc.unesco.org/iocweb/activities/ocean_sciences/marpol.htm

<http://www.fao.org/sd/epdirect/epre0018.htm>

<http://ioc.unesco.org/hab/intro.htm>

http://www.gpa.unep.org/documents/technical/rseas_reports/

<http://www.cep.unep.org/>

<http://www.unepmap.org/>

<http://www.ospar.org/>

ANNUAL CATCH BY MAJOR SPECIES		
Environmental	Ocean, Seas and Coasts	Fisheries

1. INDICATOR

- (a) **Name:** Annual Catch by Major Species.
- (b) **Brief Definition:** Annual catch of major species in relation to spawning biomass if available or in relation to the year of maximum catches in the time series.
- (c) **Unit of Measurement:** Metric tons.
- (d) **Placement in the CSD Indicator Set:** Environmental/Ocean, Seas and Coasts/Fisheries.

2. POLICY RELEVANCE

- (a) **Purpose:** This indicator, in particular, if the data on spawning biomass are available, can provide a snapshot of the present status of a stock/species in a given country/area in respect to past trends.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** A reduced spawning biomass or a very high ratio of the catch peak value respect to present catches, can be considered as a warning that the fisheries could soon become unsustainable. However, it is necessary to take into account the high variability of populations of some commercial marine species as a consequence of changes of environmental conditions.
- (c) **International Conventions and Agreements:** The Food and Agriculture Organization of the United Nations (FAO) Code of Conduct for Responsible Fisheries (1995).
- (d) **International Targets/Recommended Standards:** Targets could be national or regional institutions responsible for fisheries management, although where a management of fishery stocks is already in place others and more complex indicators are usually considered.
- (e) **Linkages to Other Indicators:** As at the moment this is the only indicator related to productivity of the oceans it has no one direct relationships to other indicators presently listed.

3. METHODOLOGICAL DESCRIPTION

- (a) **Underlying Definitions and Concepts:** The annual catches reported to FAO by countries are nominal catches that refer to the quantities on a landed weight basis. The Spawning Stock Biomass (SSB) is the total weight of all sexually mature individuals in the population (both males and females). The year of maximum catches based on five-year running means, is

the year in which the biggest quantities of catches have been reported along the available time series (presently 1950-98) for a species in a given country/area.

(b) **Measurement Methods:** If measurements of SSB are available, their time series values should be compared to those of catches of the same species. If SSB values are not available, the catches in the peak year, based on five-year running means, can be compared with the quantity of catches of the last year available. The elapsed time and the trend in the period since the catch peak should also be examined. The five-year running means is the average of catches of five continuous years. The calculated value is assigned to the middle-year in the five-year period.

(c) **Limitations of the Indicator:** The evaluation of marine resources presents further difficulties in respect to the already complicated estimates of terrestrial wild populations. Oceans are obviously less accessible by human beings than land and most of marine animals are highly movable. Furthermore, the populations of many important fishery species are strongly influenced by environmental and climatic changes (e.g., strong fluctuations of Peruvian anchovy, the most caught species worldwide, in response to the El Niño phenomenon). Fishery scientists have developed many parameters for the assessment of marine populations target of fisheries. Notwithstanding the progress made in more than one century of scientific work, recent failures have demonstrated that the present understanding of the complex interactions in marine ecosystems is still incomplete. In this framework, the indicator proposed, based only on the annual catch data and, if available, on SSB, can be considered as providing only a very general information on the sustainable exploitation of a stock/species.

(d) **Status of the Methodology:** Not available.

(e) **Alternative Definitions/Indicators:** FAO (1999) provides details on more specific indicators for a Sustainable Development Reference System (SDRS) for the marine capture fisheries sector.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Annual catch by major species and Spawning Stock Biomass (SSB) values if available.

(b) **National and International Data Availability and Sources:** National annual catches are collected by the FAO Fishery Information, Data and Statistics Unit (FIDI) by countries for major species in given marine fishing areas. The Spawning Stock Biomass (SSB) values are produced by scientific surveys for the most important fishery stocks, but are available mainly for species of temperate seas. FAO/FIDI makes available to the public the global annual catch statistics in a compiled annual yearbook format in both hard copy and digital format (either in CD-ROM or downloadable from the FAO Fishery Department web site). The SSB data are available through fishery commissions and national institution bulletins and publications or from current scientific literature.

(c) **Data References:** see 4(b).

5. **AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR**

a) **Lead Agency:** The lead agency is the Food and Agriculture Organization of the United Nations (FAO). The contact point is the Assistant Director-General, Sustainable Development Department, FAO; fax no. (39 06) 5705 3152.

(b) **Other Contributing Organizations:** Not available.

6. **REFERENCES**

(a) **Readings:**

FAO. 1999. Indicators for sustainable development of marine capture fisheries. *FAO Technical Guidelines for Responsible Fisheries*, no. 8, 68 pp.

FAO. 1995. *Code of conduct for responsible fisheries*. FAO, Rome, 41 pp.

Grainger, R.J.R. & S.M. Garcia, 1996. *Chronicles of marine fishery landings (1950-94): Trend analysis and fisheries potential*. FAO Fish. Tech. Pap., no. 359, 51 pp.

Vandermeulen, H., 1998. The development of marine indicators for coastal zone management. *Ocean & Coastal Management*, no. 39, 63-71 pp.

(b) **Internet sites:**

FAO Statistical Databases. <http://apps.fao.org/>

FAO Fisheries Department. <http://www.fao.org/fi/default.asp>

ANNUAL WITHDRAWALS OF GROUND AND SURFACE WATER AS A PERCENT OF TOTAL RENEWABLE WATER		
Environmental	Freshwater	Water Quantity

1. INDICATOR

- (a) **Name:** Annual Withdrawals of Ground and Surface Water as a Percent of Total Renewable Water.
- (b) **Brief Definition:** The total annual volume of ground and surface water abstracted for water uses as a percentage of the total annually renewable volume of freshwater.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Environmental/Freshwater/Water Quantity.

2. POLICY RELEVANCE

- (a) **Purpose:** The purpose of this indicator is to show the degree to which total renewable water resources are being exploited to meet the country's water demands. It is an important measure of a country's vulnerability to water shortages.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The indicator can show to what extent freshwater resources are already used, and the need for adjusted supply and demand management policy. When the indicator is calculated by sector, it can reflect the extent of water resource scarcity with increasing competition and conflict between different water uses and users. Scarce water could have negative effects on sustainability constraining economic and regional development, and leading to loss of biodiversity. Sustainability assessment of changes in the indicator is linked to total renewable water resources. The indicator's variation between countries as well as in time is a function of climate, population, and economic development, as well as the economic and institutional capacity to manage water resources and demand.
- (c) **International Conventions and Agreements:** For international water law, see reference in section 6(a) below. International water sharing agreements also exist between many countries.
- (d) **International Targets/Recommended Standards:** No international target exists other than those set by international treaties between countries.
- (e) **Linkages to Other Indicators:** The indicator's interpretation would benefit from linkage with established water vulnerability indicators, such as freshwater resources *per capita*, measures of the country's economy, such as Gross Domestic Product (GDP) (by industry), and poverty incidence as an indicator of equity of access. The indicator also needs to be matched with

population, social and economic indicators, irrigation as a percentage of arable land, and drought frequency. Interpretation will benefit from linking this indicator with groundwater reserves and unused buffer water resources.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The *total renewable water resources* are defined as the sum of internal renewable water resources and incoming flow originating outside the country, taking into consideration the quantity of flows reserved to upstream and downstream countries through formal or informal agreements or treaties and reduction of flow due to upstream withdrawal. This gives the maximum theoretical amount of water actually available for the country. The in this definition mentioned *internal renewable water resources* is defined as the average annual flow of rivers and recharge of groundwater generated from endogenous precipitation. For total renewable water resources, no differentiation has been made between surface water and groundwater. This approach brings a number of limitations which are described below.

(b) **Measurement Methods:** The indicator measures total water abstractions divided by total renewable water resources.

(c) **Limitations of the Indicator:** This indicator has several important limitations, most of them related to the computation of *total renewable water resources*:

- Accurate and complete data are scarce.
- Local sub-national variation of water resources and water use abstractions could be considerable, and this indicator does not reflect the local or individual watershed situation.
- Seasonal variation in water resources is not reflected. There is no consideration of distribution among uses and policy options for mitigating scarcity, for example, re-allocation from agricultural to other uses
- Total renewable water resources do not consider water quality and its suitability for use.

(d) **Status of the Methodology:** Not available.

(e) **Alternative Definitions/Indicators:** The indicator could consider withdrawals and water resources at the basis of a watershed. It could also take into account the efficiency of use and economic and environmental water costs and values. The data for such calculations, however, are not readily available. For some countries, calculation of the indicator at sub-national levels would be more appropriate. The indicator could be disaggregated to show total renewable water resources, withdrawals for different users, and efficiencies for these different users.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Annual water withdrawals divided by total renewable water resources. Current water uses need to be known.

(b) **National and International Data Availability and Sources:** Data is available for most countries, at the national level. Data consistency is a problem in AQUASTAT (see 4(c) below) as the data are estimated by country level at various periods, they are sometimes interpolated and national data on withdrawals are sometimes biased and could be intentionally over- or underestimated.

(c) **Data References:** Recent data are available at the country level and recorded at the international level by the Food and Agriculture Organization (FAO) of the United Nations in AQUASTAT (1994/1995).

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the Food and Agriculture Organization of the United Nations (FAO). The contact point is the Assistant Director-General, Sustainable Development Department, FAO; fax no. (39 06) 5225-3152.

(b) **Other Organizations:** Not available.

6. REFERENCES

(a) **Readings:**

Barberis, J.A. 1986. International groundwater resources law. *In: FAO Legislative Study* (FAO), no. 40 / Rome (Italy), FAO, 1986, 74 pp.

Caponera, D.A. 1992. *Principles of water law and administration: national and international*. Rotterdam (Netherlands), Balkema, 260 pp.

FAO. 1998. Sources of international water law. *In: FAO Legislative Study* (FAO), no. 65 / FAO, Rome (Italy). Legal Office, 346 pp.

Shiklomanov, I.A. 1990. Global water resources. *In: Nature and Resources* (UNESCO), v. 26(3) p. 34-43.

UN. 1977. Water development and management; proceedings of the United Nations Water Conference, Mar del Plata, Argentina, 1977 - pt. 1-4 *In: Water Development, Supply and Management*, v. 1(pt.1-4); United Nations Water Conf., Mar del Plata (Argentina), 14-25 Mar 1977 / United Nations, New York, N.Y. (USA), 1978, 1 v. in 4.

WMO. 1990. *International Conference on Water and the Environment: Development Issues for the 21st Century*, Dublin (Ireland), 26-31 Jan 1992 / WMO, Geneva (Switzerland), 55 pp.

Mar del Plata 1977, Dublin ICDE 1992. International Water Law. Helsinki Rules on Use of Waters of International Rivers 1966 and Seoul Rules, International Groundwaters 1986.

Shiklomanov. Global Water Resources. 1990.

(b) **Internet site:**

FAO AQUASTAT. <http://www.fao.org/ag/AGL/AGLW/aquastat/aquastat.htm>

BIOCHEMICAL OXYGEN DEMAND IN WATER BODIES		
Environmental	Fresh Water	Water Quality

1. INDICATOR

- (a) **Name:** Biochemical oxygen demand (BOD) in water bodies.
- (b) **Brief Definition:** BOD measures the amount of oxygen required or consumed for the microbiological decomposition (oxidation) of organic material in water.
- (c) **Unit of Measurement:** mg/l of oxygen consumed in 5 days at a constant temperature of 20°C.
- (d) **Placement in the CSD Indicator Set:** Environmental/Fresh water/Water quality.

2. POLICY RELEVANCE

- (a) **Purpose:** The purpose of this indicator is to assess the quality of water available to consumers in localities or communities for basic and commercial needs. It is also one of a group of indicators of ecosystem health.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Sustainable development is heavily dependant on suitable water availability for a variety of uses ranging from domestic to industrial supplies. Strict water quality standards have been established to protect users from health and other adverse consequences of poor water quality. The presence of high BOD may indicate faecal contamination or increases in particulate and dissolved organic carbon from non-human and animal sources that can restrict water use and development, necessitate expensive treatment and impair ecosystem health. Human ill health due to water quality problems can reduce work capability and affect children's growth and education. Increased concentrations of dissolved organic carbon can create problems in the production of safe drinking water if chlorination is used, as disinfection by products, such as trihalomethanes and other compounds toxic to humans, may be produced. Increased oxygen consumption poses a potential threat to a variety of aquatic organisms, including fish. It is, therefore, important to monitor organic pollution to identify areas posing a threat to health, to identify sources of contamination, to ensure adequate treatment, and provide information for decision making to enhance water sustainability.
- (c) **International Conventions and Agreements:** The Resolution II and Plan of the United Nations Water Conference recommended governments reaffirm the commitment made at Habitat to "adopt programmes with realistic standards for quality and quantity to provide water for rural and urban areas". The goal of universal safe water coverage was reiterated at the World Summit for Children in 1990.

(d) **International Targets/Recommended Standards:** Not available.

(e) **Linkages to Other Indicators:** Several indicators are directly linked to the concentration of organic material in freshwater. These measures include annual withdrawals of ground and surface water, domestic consumption of water per capita, concentration of faecal coliforms in freshwater, percent of population with adequate excreta disposal facilities, access to safe water, infant mortality rate, nutritional status of children, environmental protection expenditures as a percent of Gross Domestic Product, and expenditure on waste collection and treatment, and ecosystem health.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Biochemical oxygen demand (BOD) is an empirical test to provide a measure of the level of degradable organic material in a body of water. The test involves the incubation of a diluted sample for a period of five days at a constant temperature of 20°C. The sample is diluted to bring it within the operational parameters of the test procedure. The test represents a standard laboratory procedure usually referred to as the BOD5 test.

The procedure is used to estimate the relative oxygen requirements of wastewaters, effluents, and other polluted waters. Microorganisms (mainly bacteria although other microorganisms, algae, plants and animals can also make significant contributions in some aquatic systems) use the oxygen in the water for oxidation of polluting organic matter and organic carbon produced by algae, plants and animals.

(b) **Measurement Methods:** The method used consists of filling to overflowing an airtight bottle of specified size with the water sample to be tested. It is then incubated at a constant temperature for five days. Dissolved oxygen is measured initially and after incubation. The BOD5 is then computed from the difference between the initial and final readings of dissolved oxygen.

(c) **Limitations of the Indicator:** The main limitation of the indicator is that it provides empirical and not absolute results. It gives a good comparison among samples, but does not give an exact measure of the concentration of any particular contaminant. Further, the BOD can increase due to an increase in nutrient (e.g., nitrogen and phosphorus) loads to a water body (eutrophication) without a concomitant increase in external organic carbon loading. The increase in nutrients stimulates the growth of algae and aquatic plants (primary production), which causes an increase in biological (usually mainly bacterial) oxygen consumption. It is important to follow laboratory procedures precisely to obtain consistent results. The five-day time frame to obtain results represents the main operational drawback of the indicator.

(d) **Status of the Methodology:** Operational.

(e) **Alternative Definitions/Indicators:** Chemical Oxygen Demand (COD) is an alternative measure of the oxygen equivalent of the organic matter content of a sample that is susceptible to oxidation by a strong chemical exigent. COD can be empirically related to BOD5. After this correlation is determined for a specific source, it is a useful measure obtained from an instantaneous chemical test.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** BOD5 results from laboratories.

(b) **National and International Data Availability and Sources:** Data are normally available on a routine basis from municipal wastewater treatment and discharge facilities, the laboratories of water or public health authorities, water research institutes, and universities. At the national level, the data sources include national water authorities, water supply utilities, ministries of health or environment, and research institutions.

(c) **Data References:** None.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Environment Programme (UNEP). The contact point at UNEP is the Director, Division of Environmental Information, Assessment and Early Warning, fax no. (254-2) 62- 4274.

(b) **Other Contributing Organizations :** Other agencies assisting in the development of this indicator include the World Health Organization (WHO), the UNEP Global Environment Monitoring System (GEMS/Water) Collaborating Centre, the United Nations Children's Fund (UNICEF); United Nations Centre for Human Settlements (Habitat); and the United Nations Food and Agriculture Organization (FAO).

6. REFERENCES

(a) **Readings:**

American Public Health Association, American Water Works Association, and Water Pollution Control Federation. *Standard Methods for the Examination of Water and Wastewater*. 20th Edition. 1999.

International Standards Organization. *Water Quality--Determination of Biochemical Oxygen Demand after Five Days (BOD5)*. ISO 5815. 1989.

International Standards Organization. *Water Quality--Determination of the Chemical Oxygen Demand*. ISO 6060. 1989.

(b) **Internet site:**

UNEP/GEMS Collaborating Centre for Freshwater Quality Monitoring and Assessment at the National Water Research Institute of Environment Canada: <http://www.cciw.ca/gems/intro.html>

CONCENTRATION OF FAECAL COLIFORM IN FRESHWATER		
Environmental	Fresh Water	Water Quality

1. INDICATOR

- (a) **Name:** Concentration of Faecal Coliforms in Freshwater.
- (b) **Brief Definition:** The proportion of freshwater resources destined for potable supply containing concentrations of faecal coliforms which exceed the levels recommended in the World Health Organization (WHO) Guidelines for Drinking-water Quality.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Environmental/Fresh Water/Water Quality.

2. POLICY RELEVANCE

- (a) **Purpose:** The indicator assesses the quality of water available to communities for basic needs. It identifies communities where contamination of water with human and animal excreta at source or in the supply is posing a threat to health.
- (b) **Relevance to Sustainable/Unsuitable Development (theme/sub-theme):** The concentration of faecal coliforms in freshwater bodies is an indirect indicator of contamination with human and animal excreta. Water contaminated with human and animal excreta poses a serious health risk and is therefore unsuitable for potable supply unless it has been suitably treated. Faecal indicator bacteria remain the preferred way of assessing the hygienic quality of water. *Escherichia coli* (*E. coli*), the thermotolerant and other coliform bacteria, the faecal streptococci and spores of sulphite-reducing clostridia, are common indicators of this type used. This measure indicates situations where treatment is required or has to be improved to guarantee safety of supply. As population density increases and/or more people are provided from a supply, the more critical the supply of safe, potable water becomes.

Diarrhoeal diseases, largely the consequence of faecal contamination of drinking-water supply, are variously estimated to be responsible for 80% of morbidity/mortality, or more, in developing countries. A prerequisite for development is a healthy community. Ill health not only reduces the work capability of community members but frequent diarrhoeal episodes disrupt children's development and education, which, in the longer term, can have serious consequences for sustainable development.

- (c) **International Conventions and Agreements:** The United Nations Water Conference recommended that governments reaffirm the commitment made at 'Habitat' to adopt programmes with realistic standards for water-quality to provide sanitation for urban and rural areas. The goal of universal coverage was reiterated at the World Summit for Children, in 1990.

(d) **International Targets/Recommended Standards:** The standards are available in the WHO Guidelines for Drinking-water Quality. These have been adopted by most countries.

(e) **Linkages to Other Indicators:** The indicator is closely linked with several others in the environmental and socio-economic (health) categories, including annual water withdrawals, domestic consumption of water *per capita*, biochemical oxygen demand in water bodies, wastewater treatment coverage, and percent of population with adequate excreta disposal facilities.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Ideal faecal indicator characteristics are difficult to find in any one organism. However, many useful characteristics are found in *E. coli* and, to a lesser extent, in the thermotolerant coliform bacteria. For this reason, *E. coli* tends to be the preferred/recommended faecal contamination indicator. Faecal streptococci satisfy some of the criteria and tend to be used as supplementary indicators of faecal pollution indicating both human and animal faeces.

(b) **Measurement Methods:** For the purposes of this indicator, the term “faecal coliforms” encompasses *Escherichia coli* and thermotolerant coliforms.

Microbiological examination provides the most sensitive, although not the most rapid, indication of pollution by faecal matter. Because the growth medium and the conditions of incubation, as well as the nature and age of the water sample, can influence microbiological analysis, accuracy of results may be variable. This means that the standardization of methods and laboratory procedures are extremely important. Established standard methods are available through the International Organization of Standardization (ISO), American Public Health Association (APHA), the UK Department of Health (DHSS), and the Guidelines for Drinking-water Quality (WHO).

Determination of sample size is the first important step in the examination. The source of the sample will determine, in the first instance, the concentration of organisms. Under normal conditions, the volume of sample for a lake or reservoir sample would be 100 ml, while in the case of raw municipal sewage, only 0.001 ml would be required. Larger samples would result in too large a number of organisms to make counting possible. Time-of-travel may often be of relevance, and changes in the bacterial characteristics of samples can be reduced to a minimum by ensuring the samples are not exposed to light and are kept between 4 and 10°C for the shortest feasible time – preferably analysed within six hours. Such precautions are particularly important in tropical climates where ambient temperatures are high and sunlight (ultra-violet radiation) is brightest.

(c) **Limitations of the Indicator:** Concentration of *E. coli* or thermotolerant or faecal coliforms in a water sample provides only one part of the picture with regard to water-quality. To assess the overall status of water at source and supplied for potable and other uses, it is necessary to combine the information of this indicator with complementary data on physical and

chemical quality. *E. coli* is predominantly an indicator but, under certain circumstances, can itself be a pathogen.

(d) **Status of the Methodology:** Not Available.

(e) **Alternative Definitions/Indicators:** The indicator could be shown as the proportion of the population using water source for domestic water supply that do not meet the standards. The microbiological quality of water in relation to faecal contamination can be currently defined in terms of *E. coli*, thermotolerant coliform bacteria, total coliform organisms, faecal streptococci, sulphite-reducing clostridia, bifidobacteria and coliphages.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Records of water authorities laboratories, hydro-geological institutes, universities, municipal public health laboratories, research institutes, and special studies, which show the level of *E. coli*, or thermotolerant coliform bacteria.

(b) **National and International Data Availability and Sources:** Data are normally available from municipal water supply authorities on a routine basis. Ministries of Health in many countries often check on the bacterial quality of new sources when they are being considered for supply purposes. The data are available from national water authorities and water supply utilities, Ministries of Health, and research institutes.

(c) **Data References:** Not Available.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the World Health Organization (WHO). The contact point is the Coordinator, Water, Sanitation and Health, Department of Protection of Human Health, WHO; fax no. (41 22) 791 4159.

(b) **Other Contributing Organizations:** Other organizations contributing to the development of this indicator include: the Water and Environmental Sanitation Section, United Nations Children's Fund (UNICEF); United Nations Centre for Human Settlements (HABITAT); and the Land and Water Division, Food and Agriculture Organization of the United Nations (FAO).

6. REFERENCES

(a) **Readings:**

WHO. *Guidelines for Drinking-Water Quality*. Second Edition, Volume 1 Recommendations, WHO, Geneva, 1993, and Volume 3: Surveillance and Control of Comments Supplies, WHO, Geneva, 1996.

American Public Health Association, American Water Works Association, and Water Pollution Control Federation. *Standard Methods for the Examination of Water and Wastewater*. 17th Edition, 1989.

International Organization for Standardization. *Water Quality: Detection and Enumeration of the Spores of Sulphite-reducing Anaerobes (clostridia)*. Part 1: Method by Enrichment in a Liquid Medium. ISO 646171.

International Organization for Standardization. *Water Quality: Enumeration of Viable Microorganisms—Colony Count by Inoculation in or on a Nutrient Agar Culture Medium*. ISO 6222.

International Organization for Standardization. *Water Quality: Detection and Enumeration of Coliform Organisms, Thermotolerant Coliform Organisms and Presumptive Escherichia coli*, ISO 9308-2; Part 1 Membrane Filtration Method, Part 2 Multiple Tube. ISO 9308-1.

International Organization for Standardization. *Water Quality: Detection and Enumeration of Faecal Streptococci*; Part 1 Method by Enrichment in a Liquid Medium, Part 2 Method by Membrane Filtration. ISO 7899/2.

(b) **Internet site:** World Health Organization. <http://www.who.org>

AREA OF SELECTED KEY ECOSYSTEMS		
Environmental	Biodiversity	Ecosystems

1. INDICATOR

- (a) **Name:** Area of Selected Key Ecosystems.
- (b) **Brief Description:** This indicator will use trends in the extant area of identified key ecosystems to assess the relative effectiveness of measures for conserving biodiversity at ecosystem level and as a tool to estimate the need for specific conservation measures to maintain the biological diversity in a country or region.
- (c) **Unit of Measurement:** Area (km² or ha) of selected ecosystem types.
- (d) **Placement in the CSD Indicator Set:** Environmental/ Biodiversity/Ecosystems.

2. POLICY RELEVANCE

- (a) **Purpose:** The indicator has the potential to illustrate the effectiveness of national measures designed to conserve biological diversity and ensure its use is sustainable, including the measures implemented in fulfilment of obligations accepted under the Convention on Biological Diversity (CBD).
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The CBD recognises that biodiversity has its own intrinsic value and that biodiversity maintenance is essential for human life and sustainable development. Many biological resources, at gene, species and ecosystem level, are currently at risk of modification, damage or loss.
- (c) **International Conventions and Agreements:** The conservation of biological diversity and the sustainable use of its components are among the primary objectives of the Convention on Biological Diversity. This indicator is of particular relevance to several articles of the CBD, e.g., Article 6 - General measures for conservation and sustainable use; Article 7 - Identification and monitoring; Article 8 - In-situ Conservation; and Article 10 - Sustainable use of components of biological diversity. The Convention has, in several COP decisions explicitly recognised the need for an ecosystem approach, and further formalised this position in Decision V/6 made at the fifth COP held in Nairobi in May 2000.

This indicator is relevant to many other global agreements for which the maintenance of biological diversity is important, including: Convention on the Conservation of Migratory Species of Wild Animals (Bonn); Convention on International Trade in Endangered Species (CITES); United Nations Convention on the Law of the Sea (UNCLOS); Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar); Convention for the Protection of the World Cultural and Natural Heritage (World Heritage Convention).

Related regional conventions and agreements include: Convention on the Conservation of European Wildlife and Natural Habitats (Berne); Program for the Conservation of Arctic Flora and Fauna (CAFF); Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR); Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention).

(d) **International Targets/Recommended Standards:** Although there are no quantified international targets, there is a widely accepted need to avoid further loss of biological diversity. This could variously involve measures designed to maintain current levels of biodiversity, or to reverse current declining trends (e.g., in natural forest cover). Article 8 (In-situ Conservation) of the CBD, states that contracting parties shall, as far as possible and as appropriate, promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings.

The general objectives of the CBD provide targets for Parties to the Convention; these objectives could be used as a guide for non-Party states.

(e) **Linkages to Other Indicators:** This indicator has links to other environmental indicators relating to agriculture, forests, desertification, urbanisation, the coastal zone, fisheries water quality and species. Its trends are also linked to those in population and in economic indicators.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Few of the concepts and definitions are as yet clearly and consistently applied. Some important points are noted below.

‘**Ecosystem**’ refers to the plants, animals, micro-organisms and physical environment of any given place, and the complex relationships linking them into a functional system. Individual ecosystem types may be defined either according to composition in terms of life forms and species, or with respect to ecological processes such as nutrient cycling or carbon sequestration. The former is generally more straightforward for the purposes of area assessment. There is no standard classification of ecosystems.

‘**Key ecosystems**’ are at present not clearly defined. It is possible to suggest general criteria for selecting key ecosystems, but it will be the responsibility of countries to undertake this selection. This should be done in a consultative way that ensures that regional and global interests are evaluated in addition to national priorities. The choice will also be constrained by the level of detail in the data available. Among the criteria for selecting the key ecosystems are:

- Ecosystems containing *rare or locally endemic* or *threatened* species (see abundance of key species indicator), and especially those with concentrations of these species;
- Ecosystems of particularly high species richness;
- Ecosystems that represent rare or unusual habitat types;
- Ecosystems severely reduced in area relative to their potential original extent;
- Ecosystems under a high degree of threat.

Additional criteria might include the ease with which the ecosystem can be mapped (e.g., from remotely sensed data) and its actual or potential economic importance.

‘Area’ refers to the spatial extent of the ecosystem. This requires the definition of limits or boundaries to the ecosystem, which is difficult where similar or related ecosystems are adjacent. This is especially true if the condition or status of the ecosystem is also of concern. For example, forest area may remain relatively constant despite removal of a substantial proportion of the trees and attendant change in ecological processes.

(b) **Measurement Methods:** Ecosystem area will normally be derived from mapped data on land cover. This is most efficiently done using data in electronic form and Geographic Information System (GIS) software. Increasingly, land cover maps are derived from remotely sensed data, these will be combined with biological and other ancillary information to produce ecosystem maps. In some cases, retrospective information may be obtained from historical data sets to provide context and longer-term trends. The greatest difficulty is in arriving at an agreed ecosystem classification that is compatible with the available data. It is also fundamental to ensure consistency of the classification and the method of measurement, including considerations of spatial scale and resolution, over time.

How and whether data on different ecosystems should be combined into a single indicator has yet to be determined. It is possible that trends in ecosystem area may be combined in ways that are analogous to the approaches used for species population trends.

(c) **Limitations of the Indicator:** Application of this indicator is constrained by several factors, but these can mostly be overcome if resources and personnel are available. The main factor preventing the immediate and widespread application of this indicator is the scarcity of suitable time-series of land cover data. The reliability of evaluating the extent and uniqueness of ecosystem depends on the detail, quality and compatibility of ecosystem classification applied across continuous terrestrial and marine areas.

Ecosystem diversity distribution has not been mapped at an appropriate scale for many areas of high biological diversity. A structured monitoring framework using standardised classification procedures would provide one solution to this problem, but might well not meet the full range of needs for this type of data.

The indicator fails to account for variation in ecosystem status other than extent. Perturbations that do not affect total area will not be recognised through monitoring this indicator, nor will it be possible to anticipate likely future trends in ecosystem status through this indicator alone. Measures of ecosystem condition and protection status are needed to answer this deficiency.

(d) **Status of the Methodology:** No single universally accepted methodology currently exists. Assessments of land cover and of forest area have been carried out in a number of contexts, including the Forest Resources Assessment 2000 conducted by FAO, but the evaluation of specific forest types is more problematic. There has been little area assessment of other ecosystem types, although global and other land cover data sets do provide some relevant data. It

is possible that trends in the areas of many ecosystems can be standardised and combined into a single index using an approach similar to that developed by WCMC and WWF (Loh *et al.* (1998, 1999, 2000) for use with species population data (see abundance of key species). In this method, an index value for each period is derived by normalising the geometric mean change over the period in the sample of species populations. Using ecosystem area in place of population size, a line graph of these index values would provide an indicator of change in the area of key ecosystems. The numbers and types of ecosystems included would be decided according to the types of criteria outlined above.

(e) **Alternative Definitions/Indicators:** Area may not be the best indicator of ecosystem status for biodiversity preservation. Many alternatives are area-related and include measures of fragmentation and of naturalness or exposure to the impacts of human activities (WCMC-UNEP 2000), and analysis of the protection status of ecosystems (Lysenko & Henry 2000; Lysenko *et. al* 1995), particularly in areas of high conservation priority.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The principal data needed for this indicator are land cover data to which an agreed ecosystem classification has been applied. Agreement on the classification will depend upon consensus on key ecosystem types and on the type and quality of raw remotely sensed or other primary data. Supplementary data on distribution of key species, priority areas for biodiversity conservation, distribution of human population and infrastructure as well as protected areas could also be useful.

(b) **National and International Data Availability and Sources:** Land cover data are available at the global scale from the EROS Data Centre and also at regional (e.g., CORINE) and national scales for many countries. The challenge is in agreeing an appropriate classification that can be applied to the existing data. A further limitation is the frequency with which most such data sets are updated – the most current global data set relies on satellite data from 1992-93. Mapped data on global priority areas for biodiversity conservation, such as Centres of Plant Diversity, Endemic Bird Areas (EBAs), Important Bird Areas (IBAs), and Ramsar sites are held at WCMC-UNEP. Data on protected areas worldwide are held by WCMC-UNEP and updated frequently. Useful regional and national data sets are held by WWF-US, UNEP-GRID centres, national conservation and academic institutions.

(c) **Data References:** Selected references only are mentioned as a general guide to the kinds of data that are available for this type of work. UNEP-WCMC holds data on priority areas for biodiversity conservation and on coverage of some types of ecosystems (see <http://www.unep-wcmc.org>). Land cover data are available from Eros Data Centre (see <http://edcdaac.usgs.gov/glcc/glcc.html>) and from the CORINE programme (see <http://www.satellus.se>).

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is World Conservation Monitoring Centre/UNEP (WCMC/UNEP).

(b) **Other Contributing Organizations:** The number of other organisations and individuals with the potential to contribute data or advice, or otherwise interested in further development of this indicator is very large. At global level, they would include *inter alia*: the Secretariat of the Convention on Biological Diversity (CBD), the World Wide Fund for Nature (WWF), IUCN – The World Conservation Union. Other concerned organisations include the Organisation for Economic Cooperation and Development (OECD), the National Institute of Public Health and the Environment (RIVM) in The Netherlands, and a very large number of governmental and non-governmental organisations, mainly in developed countries.

6. REFERENCES

(a) **Readings:**

Groombridge, B. and Jenkins, M. D. 1994. *Assessing Biodiversity Status and Sustainability*. WCMC Biodiversity Series No. 5. World Conservation Press, Cambridge, UK.

Loh, J., Randers, J., MacGillivray, A., Kapos, V., Jenkins, M., Groombridge, B., Cox, N. and Warren, B. 1999. *Living Planet Report 1999*. WWF-World Wide Fund for Nature, Gland, Switzerland.

Loh, J., Randers, J., MacGillivray, A., Kapos, V., Jenkins, M., Groombridge, B. and Cox, N. 1998. *Living Planet Report 1998*. WWF-World Wide Fund for Nature, Gland, Switzerland.

Loh, J. (Ed). 2000. *Living Planet Report 2000*. WWF-World Wide Fund for Nature, Gland, Switzerland.

Lysenko I., Henry D. 2000. *GAP Analysis in Support of CPAN: The Russian Arctic*. CAFF Habitat Conservation Report No 9; CAFF International Secretariat, 2000.

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Mittermeier, R.A., N. Myers, J.B. Thomsen, G.A.B. da Fonseca, and S. Olivieri. 1998. *Biodiversity hotspots and major tropical wilderness areas: Approaches to setting conservation priorities*. Conservation Biology 12(3):516-520.

Stattersfield, A.J., Crosby, M.J., Long, A.J. and D.L. Wege. 1998. *Endemic Bird Areas of the World: Priorities for their conservation*. BirdLife Conservation Series No. 7. BirdLife International, Cambridge, UK. 846pp.

UNEP-World Conservation Monitoring Centre. 2000. *European Forests and Protected Areas Gap Analysis: Technical Report*. Cambridge, UK. 27pp.

UNEP-World Conservation Monitoring Centre. 2000. *Assessing forest integrity and naturalness in relation to biodiversity*. Cambridge, UK. 75 pp.

(b) **Internet sites:**

<http://www.biodiv.org/>

<http://www.unesco.org/whc/welcome.htm>

<http://www.ramsar.org>

<http://www.wetlands.agro.nl>

<http://www.ecnc.nl/doc/europe/legislat/bernconv.html>

<http://edcdaac.usgs.gov/glcc/glcc.html>

<http://www.satellus.se>

[Environmental Treaties and Resource Indicators \(ENTRI\)](#)

<http://www.fao.org/forestry>

<http://www.conservation.org/Hotspots/default.htm>

<http://www.gsf.de/UNEP/corine.html>

PROTECTED AREA AS A PERCENT OF TOTAL AREA		
Environmental	Biodiversity	Ecosystems

1. INDICATOR

- (a) **Name:** Protected Area as a Percent of Total Area.
- (b) **Brief Definition:** This indicator measures the area of protected land ecosystems, inland water ecosystems, and marine ecosystems expressed as a percentage of the total area of land ecosystems, inland water ecosystems and marine ecosystems respectively.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Environmental/Biodiversity/Ecosystems.

2. POLICY RELEVANCE

- (a) **Purpose:** The indicator represents the extent to which areas important for conserving biodiversity, cultural heritage, scientific research (including baseline monitoring), recreation, natural resource maintenance, and other values, are protected from incompatible uses. It shows how much of each major ecosystem is dedicated to maintaining its diversity and integrity.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Sustainable development depends on a sound environment, which in turn depends on ecosystem diversity. Protected areas are essential for maintaining ecosystem diversity, in conjunction with management of human impacts on the environment.
- (c) **International Conventions and Agreements:** This indicator shows implementation of Article 8(a) of the Convention on Biological Diversity.
- (d) **International Targets/Recommended Standards:** Recommendation 16 of the Fourth World Congress on National Parks and Protected Areas (Caracas, 1992) establishes a target of 10% protected area of each biome (major ecosystem type) by the year 2000 (McNeely 1993).
- (e) **Linkages to Other Indicators:** This indicator is linked to other indicators which have implications for land and resource use. These would include; Forest Area as a % of Land Area, Wood Harvesting Intensity, Area of Selected Key Ecosystems, Ratification of Global Agreements, etc.

This indicator is most meaningful when accompanied by indicators of the status of ecosystem diversity, particularly of ecosystem modification and conversion. Thus, the indicator of ecosystem protection would show how much of each major ecosystem is protected; and the indicator of ecosystem modification and conversion would show how much of each major

ecosystem has been lost or excessively fragmented. This indicator is also linked to indicators of species diversity and environmental quality.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The World Conservation Union defines six management categories of protected area in two groups. *Totally protected areas* are maintained in a natural state and are closed to extractive uses. They comprise Category I, Strict Nature Reserve/Wilderness Area; Category II, National Park; and Category III, National Monument. *Partially protected areas* are managed for specific uses (e.g., recreation) or to provide optimum conditions for certain species or communities. They comprise Category IV, Habitat/Species Management Area; Category V, Protected Landscape/Seascape; and Category VI, Managed Resource Protected Area (IUCN 1994).

Totally protected areas are necessary to protect as wide a range as possible of intact communities and the species that depend on them. For such communities to persist and evolve “naturally”, buffered as far as possible against human activities, the areas need to be large.

Partially protected areas are useful when certain human activities are actually required to protect particular species or communities. They are also necessary to protect landscapes and seascapes as valued expressions of human relationships with nature. The size of the area is usually less important. Therefore, it is desirable to distinguish:

- (i) the total percentage of the ecosystem area that is covered by totally protected areas;
- (ii) the percentages of the ecosystem area covered by totally protected areas in different size classes (e.g., < 1 000 ha, ≥ 1 000 ha, ≥ 10 000 ha, ≥ 100 000 ha, ≥ 1 000 000 ha [larger size classes are possible only in large countries]);
- (iii) the total percentage of the ecosystem area that is covered by partially protected areas.

For the purpose of this indicator, ecosystems are usually defined as ecoregional units. The minimum size of the units varies depending on the classification system and the size of the country (or other territory) being assessed.

(b) **Measurement Methods:** The usefulness of this indicator depends on clearly distinguishing totally protected areas and partially protected areas, since they have different, although complimentary, functions. Each requires a separate expression of the indicator as follows: Calculate the combined area of totally protected areas of 1000 ha. or more. Calculate the combined area of partially protected area regardless of size. Calculate the percentage of the total area occupied by each group.

The indicator can be mapped in two layers and linked to a database. One layer maps the ecosystems, the other the protected areas. The mapping software will usually calculate the sizes of the ecosystems and protected areas. Smaller protected areas may be mapped as points, in which case their size should be recorded in the database separately. The category of protected area should also be entered in the database, to distinguish totally protected and partially protected areas.

(c) **Limitations of the Indicator:** The indicator represents *de jure* not *de facto* protection. It does not indicate the quality of management or whether the areas are in fact protected from incompatible uses. It also gives a rather coarse picture of ecosystem protection. Additional detail would be needed to show the extent of disturbance of the ecosystem within each protected area, and coverage of rare or key ecological communities and habitats.

(d) **Status of the Methodology:** The methodology is increasingly used for land ecosystems, less so for marine ecosystems, and least for inland water ecosystems. Inland waters are usually lumped with the land in a terrestrial classification.

The methodology for this indicator has not been standardized.

(e) **Alternative Definitions/Indicators:** If a suitable ecosystem classification is not available, alternative indicators are terrestrial protected area (land and inland water) as a percentage of the total terrestrial area, and marine protected area as a percentage of the total marine area.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** A map of the ecosystems (ecoregions or equivalent) of the country or territory, preferably using a classification that is internationally compatible and valid for other countries and territories in the region. A map of the protected areas of the country or territory. A geo-referenced list of the protected areas, giving their sizes (area in hectares) and locations, and classifying them by protection category comparable to The World Conservation Union's six management categories of protected area, see 3(a).

(b) **National and International Data Availability and Sources:** Major ecosystem classifications have been mapped for most regions and many countries. However, national classifications may not be compatible with other countries in their region, and few regional classifications are sufficiently detailed or accepted for nation use. Global classifications are generally too coarse. Most countries keep statistics on protected areas, but their protected area systems may not be accurately mapped.

In cooperation with the World Conservation Monitoring Centre (WCMC), IUCN's World Commission on Protected Areas compiles the *United Nations List of Protected Areas*, which provides the name, IUCN category, location, size, and year of establishment of all protected areas of 1,000 hectares or more (plus smaller areas occupying entire islands) for all countries. WCMC maintains a copy of the UN list, compiles data on smaller protected areas, and has mapped most large areas and many smaller ones.

(c) **Data references:** United Nations List of Protected Areas (1997). Other data, including a prototype nationally designated protected areas database and a protected areas virtual library from WCMC.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

- (a) **Lead Agency:** The lead agency is the World Conservation Union (IUCN) and PADATA. The contact point is a member, International Assessment Team, fax no. (250) 474-6976.
- (b) **Other Contributing Organizations:** World Conservation Monitoring Centre (WCMC).

6. REFERENCES

- (a) **Readings:**

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A conservation assessment of the terrestrial ecoregions of Latin America and the Caribbean. The World Bank, Washington, DC. Ricketts, Taylor, Eric Dinerstein, *et al.* 1999.

A conservation assessment of the terrestrial ecoregions of North America. Volume I—the United States and Canada. Island Press, Washington, DC.

- (b) **Internet sites:**

www.wcmc.org.uk/parks/index.htm

www.iucn.org/themes/wcpa/index.html

United Nations List of Protected Areas 1997.

www.wcmc.org.uk/protected_areas/data/un_97_list.html

www.wcmc.org.uk/parks/index.htm

ABUNDANCE OF SELECTED KEY SPECIES		
Environmental	Biodiversity	Species

1. INDICATOR

- (a) **Name:** Abundance of Selected Key Species.
- (b) **Brief Definition:** This indicator uses estimates of population trends in selected species to represent changes in biodiversity, and the relative effectiveness of measures to maintain biodiversity.
- (c) **Unit of Measurement:** Number of mature individuals or other relevant indicator of abundance within a given area or population.
- (d) **Placement in the CSD Indicator Set:** Environmental/ Biodiversity/Species.

2. POLICY RELEVANCE

- (a) **Purpose:** The indicator has the potential to illustrate the effectiveness of national measures designed to conserve biological diversity and ensure its use is sustainable, including the measures implemented in fulfilment of obligations accepted under the Convention on Biological Diversity (CBD).
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The CBD recognises that biodiversity has its own intrinsic value and that biodiversity maintenance is essential for human life and sustainable development. Many biological resources, at gene, species and ecosystem level, are currently at risk of modification, damage or loss.
- (c) **International Conventions and Agreements:** The conservation of biological diversity and the sustainable use of its components are among the primary objectives of the Convention on Biological Diversity. This indicator is of particular relevance to several articles of the CBD, e.g., Article 6 - General measures for conservation and sustainable use; Article 7 - Identification and monitoring; and Article 10 - Sustainable use of components of biological diversity.

This indicator is relevant to many other global agreements for which the maintenance of biological diversity is important, including: Convention on the Conservation of Migratory Species of Wild Animals (Bonn); Convention on International Trade in Endangered Species (CITES); United Nations Convention on the Law of the Sea (UNCLOS); Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar); International Convention for the Regulation of Whaling.

Related regional conventions and agreements include: Convention on the conservation of European wildlife and natural habitats (Berne); Program for the Conservation of Arctic Flora and Fauna (CAFF); Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR); Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).

(d) **International Targets/Recommended Standards:** Although there are no quantified international targets, there is a widely accepted need to avoid further loss of biological diversity. This could variously involve measures designed to maintain current levels of biodiversity, or to reverse current declining trends (e.g., in threatened species) or to reverse current increasing trends (e.g., in problematic alien species). The general objectives of the CBD provide targets for Parties to the Convention; these objectives could be used as a guide for non-Party states.

(e) **Linkages to Other Indicators:** This indicator can be linked to the majority of the CSD Environmental Core Indicators, eg. annual fisheries catch by major species. There may also be indirect links to social indicators, such as changes in human population.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Few of the concepts and definitions are as yet clearly and consistently applied. Some important points are noted below.

‘Abundance’ - This may be defined as the number of mature individuals within the population or area under study. Where it is difficult or inappropriate to survey individuals, comparable surrogate units of measurement, such as number of nests (marine turtles) or spawning stock biomass (fishes), may be acceptable.

‘Key species’ - It is possible to suggest general criteria for selecting key species, but it will be the responsibility of nations to undertake this selection. This should be done in a consultative way that ensures that regional and global interests are evaluated in addition to national priorities. No single organism or related group of organisms can be expected to reflect comprehensively the patterns of distribution and abundance of all other taxa, and effective biodiversity indicators are likely in most cases to be based on an indicator group composed of several appropriate species. The following categories of species might be considered as ‘key species’ when developing a biodiversity monitoring programme:

- **Keystone species:** A taxon whose impact on the ecosystem or community studied is disproportionately large relative to its abundance (Caro and O’Doherty, 1998). The loss of these species will significantly impact upon the population sizes of other species in the ecosystem, potentially leading to further species loss (‘cascade effect’).
- **Rare or locally endemic species:** Any area contributes to global biodiversity by the overall number of different species within it (and the different higher taxa that are represented), and by the proportion of those that do not occur anywhere else (species endemic to the area). Conservation of endemic species, particularly those sharing a discrete geographic area, can be a cost-effective way to maintain global biodiversity levels.

- **Threatened species:** By definition, a threatened species represents actual or potential decline in biodiversity, and recovery of threatened species following management intervention is strongly indicative of successful conservation measures.

Any candidate 'key species' selected from the above categories, or whatever other categories may be deemed appropriate, can be further selected on the basis of other more general biological and logistic criteria. The following are among the characteristics that effective indicator species are likely to possess (e.g., Noss, 1990; Pearson, 1994):

- taxonomically well known, so that populations can be reliably identified, usually in the field,
- biologically well understood,
- easy to survey (e.g., abundant, non-cryptic) ,
- widely distributed at higher taxonomic levels (e.g., order, family, tribe, genus) across a large geographic and habitat range,
- diverse and include many specialist taxa at lower taxonomic levels (e.g., species or species populations) which would be sensitive to habitat change,
- representative to some extent of distribution and abundance patterns in other related and unrelated taxa,
- actually or potentially of economic importance.

(b) **Measurement Methods:** Information on species abundance should be collected through the consistent, long-term, application of an appropriate survey technique that is widely accepted by the scientific community. Examples of publications with details of field study methodologies for certain groups are given below. Retrospective population information may be obtained through review of published literature, including previous field study reports, seeking material that is appropriate for comparison with the ongoing methodologies adopted.

While it is in most cases impossible to count every individual within a population or area, a knowledge of habitat requirements and species population density in sample areas, coupled with data on climate, altitude, soil type or vegetation cover may be used to estimate population size in the area of interest. A geographic information system (GIS) is commonly used to analyse the spatial data. It is important that population size predictions are verified by fieldwork.

This indicator will be better capable of international integration if, after recording, abundance values are processed in a way that minimises or avoids the effects of different scales of change in species that are biologically very different. For example, raw abundance values derived from a large terrestrial predator and from Antarctic krill would need to be measured on scales possibly several orders of magnitude apart, making any comparison between them meaningless. This also bears on national selection of key species, whenever the goal is to derive a single integrated national indicator value for biodiversity change over time.

By definition, monitoring of indicator species will be a continuing process, but for studies within a set timeframe, species should have a life history that complements this period, i.e., there may be little benefit from attempting to monitor very long-lived species over a five-year period only.

For studies within a set area it is preferable to avoid selecting taxa that are directly influenced by external events, for example species that annually migrate outside of the study area. For many purposes, it will be preferable to avoid species that show high amplitude annual or irregular variation in population number.

(c) **Limitations of the Indicator:** Application of this indicator is constrained by several factors, but these can mostly be overcome if resources and personnel are available. The main factor preventing the immediate and widespread application of this indicator is the scarcity of suitable time-series of population data. In practice, change in biodiversity at species and habitat level has to date very often been identified retrospectively, on an ad hoc basis, by means of largely anecdotal evidence, and using terms and units of measurement that are highly case-specific. A structured monitoring framework is preferred, with a secure project lifetime of many years. For comparative purposes, perhaps seeking to build a comprehensive continental or global picture from national data, it is important that similar parameters are measured in similar terms. Care should be taken in interpreting the results of studies based on indicator groups, since the empirical relationship between biodiversity in different groups of organisms has been little investigated.

(d) **Status of the Methodology:** No single practicable and universally accepted methodology currently exists. However, WCMC and WWF (Loh *et al.* (1998, 1999, 2000) have designed and implemented a system to generate indicators of biodiversity change over time, principally at global or continental level. Output from this system was first used in the WWF Living Planet Report 1998 and is more fully used in the year 2000 edition. This method is designed to make use of the very imperfect data that are available. The index value for each period is derived by normalising the geometric mean change over the period in the sample of populations. A line graph of these index values provides an indicator of biodiversity change. In principle, range area could be used where population counts are not available. This system is limited ultimately by the number of populations for which quantitative size (or area) estimates are available. A similar method has been used in the UK Government's indicators programme (see <http://www.environment.detr.gov.uk/sustainable/>) to show population change in bird groups. Other related approaches have been used, and several other proposed biodiversity indicators remain at the design stage.

(e) **Alternative Definitions/Indicators:** The percentage of a country's flora or fauna that is categorised as threatened with extinction provides a static view of the status of national biodiversity, and change over time in this proportion, or the changing membership of particular status categories, e.g., 'Extinct in the Wild' or 'Critically Endangered' could illustrate the effectiveness of measures for maintaining particular elements of biological diversity. This approach requires a stable species-level taxonomy, and a standard system for assessing conservation status. The IUCN Red List categories and criteria offer such a system. The value of this indicator is limited by the observation that in many instances change can be attributed to changes in taxonomy or in the availability of information, rather than to actual change in the conservation status of species. Permanent reduction in habitat area or quality will tend to lead to loss of some species originally present. Change in habitat area and quality (assessment of the latter is problematic) thus have the potential to indicate change in overall biodiversity.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The preferred input would be sets of quantitative data on the population size of selected species within a given area, assessed at suitable time intervals using a standardised method.

(b) **National and International Data Availability and Sources:** In the absence of any comprehensive global programme for species monitoring, and of universal standards for national monitoring, suitable data are in relatively short supply. Several developed countries hold data that would be suitable as a basis for this indicator. These data have variously been collected by amateur field biologists or as part of official monitoring programmes. It is in some cases probable that much more information exists with individuals, groups and organisations than is generally known, and the problem is thus one of gaining access to suitable data. However, although the number of field surveys and biodiversity assessments has increased greatly in recent years, very little true monitoring has taken place in developing countries or biodiversity-rich countries in the tropics. These are the nations most likely to face difficulties in developing monitoring programmes, but also to be much in need of them. By far the greatest volume of readily available time-series data relate to stock estimates and catch levels (the latter not usually suitable for abundance estimation) in the marine fish populations targeted by industrialised fisheries of developed countries. The various management bodies are often sources of these data. The bird species that are surveyed regularly by networks of mainly amateur ornithologists in developed countries are by far the best known large terrestrial group.

(c) **Data References:** Selected references only are mentioned as a general guide to the kinds of work that exist in this field. Population data and analytic tools for birds and other groups can be accessed at the website of the United States Geological Survey Patuxent Wildlife Research Centre (<http://www.pwrc.usgs.gov>), and see, for example, Sauer *et al.*, 2000. Bird populations are the focus of one headline indicator in the UK Government's strategy for sustainable development: DETR Government Statistical Service, 1999, *Indicators for a Strategy of Sustainable Development for the UK: a baseline assessment* (and see <http://www.environment.detr.gov.uk/sustainable/>). Extensive documentation on fish populations in the North Atlantic region is available at the website of the International Council for the Exploration of the Sea (ICES) (<http://www.ices.dk>). Results of the Living Planet Index methodology are presented in Loh *et al.*, (1998, 1999, 2000), and the method itself will be submitted for publication at the end of 2000.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is World Conservation Monitoring Centre/UNEP (WCMC/UNEP).

(b) **Other Contributing Organisations:** The number of other organisations and individuals with the potential to contribute data or advice, or otherwise interested in further development of this indicator is very large. At global level, they would include *inter alia*: the Secretariat of the Convention on Biological Diversity (CBD), the World Wide Fund for Nature (WWF), IUCN – The World Conservation Union. Other concerned organisations include the Organisation for

Economic Cooperation and Development (OECD), the National Institute of Public Health and the Environment (RIVM) in The Netherlands.

6. REFERENCES

(a) Readings:

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Field study guidelines:

Bibby, C. J., N. D. Burgess, & D. A. Hill (1993) Bird census techniques. Academic Press, London.

Bibby, C. J., M. J. Jones, & S. J. Marsden (1998) Expedition field techniques: bird surveys. Expedition Advisory Centre, Royal Geographic Society/ BirdLife International, London.

Heyer, R. W., M. A. Donnelly, R. W. McDiarmid, L. C. Hayek, & M. S. Foster (eds.) Measuring and monitoring biological diversity: standard methods for amphibians. Smithsonian Institution, Washington.

Wilson, D.E., F.R. Cole, J.D. Nichols, R.Rudran, and M.S. Foster. (eds.). 1996. Measuring and Monitoring Biological Diversity, Standard Methods for Mammals. Smithsonian Institution Press, Washington, D.C.

(b) **Internet sites:**

<http://www.biodiv.org/>

<http://www.environment.detr.gov.uk/sustainable/>

<http://www.ices.dk>

<http://www.iucn.org/themes/ssc/guidelines.htm>

<http://panda.org/livingplanet/lprreport.cfm>

<http://www.redlist.org/>

<http://www.unep-wcmc.org/species/reports/>

<http://www.wri.org/wri/biodiv/cascade.html>

GROSS DOMESTIC PRODUCT PER CAPITA		
Economic	Economic Structure	Economic Performance

1. INDICATOR

- (a) **Name:** Gross domestic product (GDP) per capita.
- (b) **Brief Definition:** Levels of GDP per capita are obtained by dividing annual or period GDP at current market prices by population. A variation of the indicator could be the growth of real GDP per capita which is derived by computing the annual or period growth rate of GDP in constant basic producers' or purchasers' prices divided by corresponding population.
- (c) **Unit of Measurement:** \$US.
- (d) **Placement in the CSD Indicator Set:** Economic/Economic Structure/Economic Performance.

2. POLICY RELEVANCE

- (a) **Purpose:** The indicator is a basic economic growth indicator and measures the level and extent of total economic output. It reflects changes in total production of goods and services.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Growth in the production of goods and services is a basic determinant of how the economy fares. By allocating total production to each unit of population, the extent to which the rate of individual output contributes to the development process can be measured. It indicates the pace of per capita income growth and also the rate that resources are used up. As a single composite indicator of economic growth, it is a most powerful summary indicator of the economic state of development in its many aspects. It does not directly measure sustainable development but it is a very important measure for the economic and developmental aspects of sustainable development, including people's consumption patterns and the use of renewable resources.
- (c) **International Conventions and Agreements:** None.
- (d) **International Targets/Recommended Standards:** National targets are generally oriented towards priorities, availability of resources and, in large measure, to historical economic performance. International targets are most often established by financial institutions and international organizations only for the purposes of intercountry comparison of economic performance in determining the direction of aid distribution or resource allocation projects. Country groupings to form economic entities, for example, the European Union, Organization of Petroleum Exporting Countries (OPEC), also set international targets among constituent members to serve as guidelines in national policy priority setting. Moreover, the United Nations uses average world per capita income as a threshold in setting the level of relief allowance for countries with large population in its formulation of the scale of assessments of member states.

(e) **Linkages to Other Indicators:** As a highly aggregated composite measure, this indicator has close links with many, more disaggregated indicators. Examples would include population growth, net migration, other GDP indicators, land use change, arable land per capita, and forest area.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** GDP as described in the 1993 SNA can be defined in three ways: Firstly, it is the sum total value-added of all production units including all taxes and subsidies on products which are not included in the valuation of output. It is also equal to the sum of final uses of goods and services (except intermediate consumption) measured in purchasers' prices, less the value of imports of goods and services. Finally, it can be measured as the sum of primary incomes distributed by resident producer units.

(b) **Measurement Methods:** The current price estimates of GDP are adjusted to GDP at constant prices with the use of price deflators. Population estimates enable the conversion of total GDP to per capita levels, while exchange rates and other conversion factors are used to arrive at values based on a common unit of currency. Real GDP is derived by extrapolating total value-added in the base year with production indicators in physical terms or by deflating current price values by a price deflator.

(c) **Limitations of the Indicator:** As a necessary condition to being a key economic performance indicator of sustainable development, one of the often-cited limitations of GDP is that it does not account for the social and environmental costs of production; it therefore is not a good measure of the level of over-all well being. For example, GDP per capita reveals nothing concerning energy and material interactions with the environment. GDP is also not considered a good measure of sustainable consumption because it does not allow for the capital used up in the production process.

(d) **Status of Methodology:** The 1993 System of National Accounts (SNA) provides international standards for national accounts. There may exist some differences in national accounting and demographic reporting procedures and practices between countries. One other possible drawback could lie in the comparability of price information used in deflating current price data and technical differences in the choice of base year for the original data. Additionally, a considered basic limitation lies in the conversion of GDP into a common denomination as a result of current misalignments in exchange rates for some countries vis-a-vis the comparator currency (US dollar) particularly for those countries in transition whose market exchange rates produce unrealistic levels of GDP, making any meaningful inter-country interpretation difficult.

(e) **Alternative Definitions/Indicators:** Economic indicators that measure the achievement of higher levels of goods and services more efficiently are better indicators of sustainable development. Consumption trends are better reflected by such indicators as Personal Consumption expenditures as used in the USA. This indicator can be derived from the SNA.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The conversion rates used by the UN Statistics Division (UNSD) are normally the market or blended rates of exchange obtained from the International Monetary Fund (IMF). In some cases, use is made of UN operational rates that are established primarily for the settlement of administrative transactions between host countries and the UN. In very unique circumstances the use of purchasing power parities (PPP) or price-adjusted rates of exchange (PARE) is necessary. The World Bank also uses a special exchange rate where the official exchange rate produces distortion in the dollar levels of GDP.

(b) **National and International Data Availability and Sources:** The indicator has no serious limitations in terms of data availability. The principal data elements for a majority of countries are mostly and regularly available from national and international sources on a historical basis. Internationally accepted conceptual guidelines, are also available to assist with the compilation of the indicator. Annual GDP data in current and constant prices are generally reported by national statistical offices or central banks in the United Nations (UN) National Accounts questionnaire and supplemented by estimates prepared by the UN as well as other international organizations such as the World Bank and the IMF. The Organisation for Economic Co-operation and Development (OECD) compiles quarterly GDP estimates for its Members. Population data are mainly obtained either through censuses or surveys. These are supplemented by growth estimates prepared by the UN Population Division.

(c) **Data References:** Comprehensive national accounts statistics are published by the UN in the series *National Accounts Statistics: Main Aggregates and Detailed Tables*. A historical series of GDP is available from the national accounts database of the UN Statistics Division. Population data and projections are available in the World Population Prospects published by the Population Division of the UN Department of Economic and Social Affairs. Exchange rates are published by the IMF in *International Financial Statistics*.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Department of Economic and Social Affairs (DESA). The contact point is the Director, Statistics Division, DESA; fax no. (1 212) 963 9851.

(b) **Other Contributing Organizations:** None.

6. REFERENCES

(a) **Readings:** The 1993 SNA provides international standards on national accounts and is the product of collaborative efforts between EUROSTAT, IMF, OECD, UN and the World Bank.

(b) **Internet site:** United Nations Statistics Division: <http://www.un.org/Depts/unsd>

INVESTMENT SHARE IN GROSS DOMESTIC PRODUCT		
Economic	Economic Structure	Economic Performance

1. INDICATOR

- (a) **Name:** Investment Share in Gross Domestic Product (GDP).
- (b) **Brief Definition:** This indicator measures the share of investment in relation to total production. It is obtained by dividing gross production capital formation by gross domestic product, both at purchasers' prices.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Economic/Economic Structure/Economic Performance.

2. POLICY RELEVANCE

- (a) **Purpose:** The rate of investment measures the stimulus to economic development, reflecting the infusion of requisite capital to finance the development process.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** This indicator deals with the processes and patterns of economic activities. It is an important element of the sustainable development process in developing countries, aimed at increasing their partnership in the global economy. It reflects an important financial component aimed at accelerating the pace of development.
- (c) **International Conventions and Agreements:** None.
- (d) **International Targets/Recommended Standards:** None. National targets for investment share to GDP are usually included in government policy as a basis for budget funding programmes and for priority-setting exercises.
- (e) **Linkages to Other Indicators:** This indicator is closely linked with other measures of economic development, in particular GDP per capita and share of manufacturing in GDP.

3. METHODOLOGICAL DESCRIPTION

- (a) **Underlying Definitions and Concepts:** Gross capital formation (gross investment) is defined in the System of National Accounts (SNA) as the total value of gross fixed capital formation plus changes in inventories and acquisitions less disposal of valuables. Fixed capital formation is the total value of a producer's acquisitions of fixed assets, less disposal, together with certain additions to the value of non-produced assets. Gross capital formation includes outlays on additions of new durable goods to stocks of fixed asset by industries, producers of

government services, the private sector, non-profit services, and households, but excludes outlays of government services on durable goods for military use. It is further classified into new and existing tangible (dwellings, buildings and structures, machineries and equipment, etc.) and intangible (mineral exploration, computer software, entertainment, artistic and literary originals, etc.) assets.

(b) **Measurement Methods:** Gross capital formation at purchasers' prices (see under 3(a)) divided by gross domestic product at purchasers' prices.

(c) **Limitations of the Indicator:** Investments in SNA terms, as in this indicator, constitute only investments on produced assets. Any expenditure on non-produced assets, for example, land or payments for education and health that enhance the quality of human capital are not included.

(d) **Status of the Methodology:** The concepts of gross capital formation and GDP are standardized in the SNA and, therefore, comparable between countries.

(e) **Alternative Definitions/Indicators:** An alternative indicator would be one which would identify selected investment expenditures by sector, such as environmental protection, health and education, housing, nutrition, etc., that are individually considered relevant to sustainable development. A second alternative would report the indicator using gross fixed capital formation.

4. DATA ASSESSMENT

(a) **Data Needed to Compile the Indicator:**

(i) gross capital formation at purchasers' prices;

(ii) gross domestic product at purchasers' prices.

(b) **National and International Data Availability and Sources:** Data is of reasonable quality and commonly available from national sources on a historical basis. Data on gross capital formation and GDP are generally reported by national statistical offices or central banks to the UN National Accounts questionnaire. These are supplemented by estimates prepared by the United Nations Statistical Division (UNSD) as well as other international organizations, such as the World Bank and the International Monetary Fund (IMF).

(c) **Data References:** National accounts statistics are published in the series *National Accounts Statistics: Main Aggregates and Detailed Tables*.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Department of Economics and Social Affairs (DESA). The contact point in terms of SNA references as well as data

compilation on an international level is the Director, Statistics Division, DESA; fax no. (1 212) 963 9851.

(b) **Other Contributing Organizations:** None.

6. **REFERENCES**

(a) **Readings:** Further details on the conceptual definition of GDP are contained in the *System of National Accounts*, 1993.

(b) **Internet site:** United Nations Statistics Division: <http://www.un.org/Depts/unsd>

BALANCE OF TRADE IN GOODS AND SERVICES		
Economic	Economic Structure	Trade

1. **INDICATOR**

- (a) **Name:** Balance of trade in goods and services.
- (b) **Brief Definition:** The difference between the value of exported goods and services and the value of imported goods and services.
- (c) **Unit of Measurement:** \$US.
- (d) **Placement in the CSD Indicator Set:** Economic/Economic Structure/Trade.

2. **POLICY RELEVANCE**

- (a) **Purpose:** The indicator shows the relation of an economy with other economies in the world. The components of the indicator (exports and/or imports) are reflecting the change in economic behavior of the domestic trade enterprises, the change in exchange rate, the effect of the change in exchange rate, and international competitiveness. The change can imply economic policy changes. The components of the indicator show how an economy is participating in international co-operation. Its components show the openness of an economy if it is compared to the value of GDP and can also reflect an economy's dependence and vulnerability.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Trade liberalization, in general, may have positive effects on sustainable development. It can stimulate economic diversification, improve the efficiency of resource allocation and encourage the transfer of innovative technologies. On the other hand, it can also result in increased and unsustainable resource use when the environmental costs of production are not fully internalized and reflected in market prices.
- (c) **International Conventions and Agreements:** None.
- (d) **International Targets/Recommended Standards:** None.
- (e) **Linkages to Other Indicators:** This indicator is the balancing item of the External account of goods and services in the sequence of the national accounts in the 1993 SNA. It is a component of GDP. It is linked to other indicators of economic structure, financial status, production and consumption patterns.

3. **METHODOLOGICAL DESCRIPTION**

(a) **Underlying Definitions and Concepts:** The balance of trade in goods and services is defined in the 1993 SNA, and partly in the International Trade Statistics.

(b) **Measurement Methods:** Exports of goods and services are standard items in the balance of payments and national accounts. Exports of goods and services consist of sales, barter, or gifts or grants, of goods and services from resident to non-residents, while imports consist of purchases, barter, or receipts of gifts or grants, of goods and services by resident from non-residents. Exports and imports of goods in the SNA are recorded at border value. Total imports and exports of goods are valued free-on-board (at the exporter's customs frontier). The balance of trade in goods and services is the difference of the above-mentioned exports and imports of goods and services.

(c) **Limitations of the Indicator:** The indicator has no serious limitations in terms of methodology and data availability. In terms of interpretation, as it is the balancing item of exports and imports, it does not tell too much without looking at its components and their relation to other indicators.

(d) **Status of Methodology:** The treatment of exports and imports of goods and services in the 1993 SNA is generally identical with that in the balance of payments accounts as described in the Balance of Payments Manual (IMF, 1993).

(e) **Alternative Definitions/Indicators:** The material composition (goods/services, highly manufactured products/raw materials) of exports and imports also has direct relationship with sustainability.

4. **ASSESSMENT OF DATA**

(a) **Data Needed to Compile the Indicator:** (i) Exports of goods and services; (ii) Imports of goods and services.

(b) **National and International Data Availability and Sources:** The principal data elements for a majority of countries are mostly and regularly available from national and international sources on a historical basis. Internationally accepted guidelines, are also available to assist with the compilation of the indicator. Annual exports and imports of goods and services are generally reported by national statistical offices or central banks in the United Nations (UN) questionnaires and/or central bank/statistical agency reports/data transmissions, national publications.

(c) **Data References:** Comprehensive national accounts statistics are published by the UN in the series of National Accounts Statistics: Main aggregates and Detailed Tables, and in IMF's International Financial Statistics Yearbook.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agencies are the United Nations Department of Economic and Social Affairs, Statistics Division, and the International Monetary Fund, Statistics Department.

(b) **Other contributing organizations:** OECD Statistical Directorate, World Bank

6. REFERENCES

(a) **Readings:** 1993 System of National Accounts; Balance of Payments Manual, 1993 IMF; World Development Indicators 2000, CD Rom of the World Bank.

(b) **Internet sites:**

United Nations Statistics Division: <http://www.un.org/Depts/unsd>

International Monetary Fund: <http://www.imf.org>

World Bank: <http://www.worldbank.org>

DEBT TO GROSS NATIONAL PRODUCT RATIO		
Economic	Economic Structure	Financial Status

1. **INDICATOR**

- (a) **Name:** Debt to Gross National Product Ratio (GNP).
- (b) **Brief Definition:** The ratio of total external debt to gross national product.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Economic/Economic Structure/Financial Status.

2. **POLICY RELEVANCE**

- (a) **Purpose:** Debt/GNP is a measure of the degree of indebtedness, and the indicator helps to assess the external debt situation (and debt carrying capacity) of a country.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The ratio measures the outstanding obligations in relation to the broadest measure of the income-generating power of an economy. The higher the ratio, the greater is the output that has to be forgone from sustainable development to service the debt. A debt overhang exists when the debt stock exceeds that which could reasonably be serviced by the debtor country in the medium or long-term. There are no simple rules on what constitutes a reasonable burden, however, and it will vary from country to country.
- (c) **International Conventions and Agreements:** None.
- (d) **International Targets/Recommended Standards:** None.
- (e) **Linkages to Other Indicators:** This indicator, as a measure of unsustainability, is closely linked to other financial and international cooperation indicators. It also has general bearing on several of the social and environmental indicators that show progress towards sustainable development.

3. **METHODOLOGICAL DESCRIPTION**

- (a) **Underlying Definitions and Concepts:** Total external debt stock is defined as the sum of long-term external debt, the use of International Monetary Fund (IMF) credit, and short-term external debt. Long-term external debt is defined as debt that has an original or extended maturity of more than one year, that is owed to non-residents, and repayable in foreign currency, goods, or services. Long-term debt has three components:

- i) Public debt, which is an external obligation of a public debtor, including the national government, a political subdivision (or an agency of either), and autonomous public bodies;
- ii) Publicly guaranteed debt, which is an external obligation of a private debtor that is guaranteed for repayment by a public entity; and
- iii) Private non-guaranteed debt, which is an external obligation of a private debtor that is not guaranteed for repayment by a public entity.

Use of International Monetary Fund (IMF) credit denotes repurchase obligations to the IMF with respect to all uses of IMF resources, excluding those resulting from drawings in the reserve tranche. Use of IMF credits comprises purchases under the credit tranches, including enlarged access resources and all special facilities (the buffer stock, compensatory financing, extended fund, and oil facilities), trust fund loans, and operations under the Stand-by Arrangement, Extended Stand-by Arrangement, the Poverty Reduction and Growth Facility (formerly known as the Enhanced Structural Adjustment Facility).

Short-term external debt is defined as debt that has an original maturity of one year or less. No distinction is made between public and private non-guaranteed short-term debt. The *Global Development Finance* includes interest in arrears (defined as interest payment due but not paid) on long-term debt, on a cumulative basis, under short-term debt.

(b) **Measurement Methods:** Total external debt is measured by the sum of long-term external debt, the use of IMF credit and short-term external debt. For definition of these terms see 3(a) above.

Gross national product (GNP) is the sum of value added by all resident producers plus any taxes (less subsidies) not included in the valuation of output, plus net receipts of primary income (compensation of employees and property income) from abroad.

(c) **Limitations of the Indicator:** No one indicator can provide an exhaustive analysis of the debt situation of a country. While this indicator is a measure of the extent of the debt overhang of a country, it needs to be interpreted carefully. The nominal stock of outstanding debt fails to take into account the differing concessional terms of the external debt. This can give misleading indications regarding the future debt-servicing burden.

(d) **Status of Methodology:** Not Available.

(e) **Alternative Definitions/Indicators:** One measure that takes into account both the profile of debt servicing payments and the concessional aspect of the debt is the present value of external debt. When the debt stock of a country is mostly on non-concessional terms then the difference between the present and nominal value are small. Another reason why this ratio can be problematic is because of erratic changes arising from real exchange rate movements.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Data required includes the sum of total external debt stock to include long-term external debt, the use of International Monetary Fund (IMF) credit and short-term external debt. In addition, gross national product data (GNP) is needed.

(b) **National and International Data Availability and Sources:** The principal sources of the information for the long-term external debt indicator are reports from member countries to the World Bank through the Debtor Reporting System (DRS). These countries have received either IBRD loans or IDA credits. Reporting countries submit detailed loan-by-loan reports through the DRS on the annual status, transactions, and terms of the long-term external debt of public agencies, and that of private ones guaranteed by a public agency in the debtor country. Information on debt owed to multilateral institutions is drawn from the files of these institutions. A total of 137 individual countries report to the World Bank's DRS.

Data on the use of IMF credit is obtained from the IMF's Treasury Department.

The short-term debt data are as reported by the debtor country or estimates derived from creditor sources. The principal creditor sources are the semiannual series of commercial banks' claims on developing countries, published by the Bank for International Settlements (BIS), and data on officially guaranteed suppliers' credits compiled by the Organisation for Economic Co-operation and Development (OECD). For some countries, estimates are prepared by pooling creditor and debtor information.

Data on non-debt creating flows are derived from several sources. Data on FDI come from the IMF balance of payments, supplemented by detailed data on direct investment from source and recipient countries. Data on portfolio equity flows are obtained from market sources and national statistical offices or securities exchanges, and that on grants from the OECD Development Assistance Committee.

Data on GNP are from national statistical offices, complemented by World Bank staff estimates.

(c) **Data References:** The World Bank Global Development Finance and World Development Indicators (Annual Publications).

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the World Bank (WB). The contact point is the World Development Indicators Team, Development Data Group, the World Bank; fax no. (1 202) 522-1785.

(b) **Other Contributing Organizations:** None.

6. **REFERENCES**

(a) **Readings:**

The World Bank. *Global Development Finance*. 2000.

The World Bank. *2000 World Development Indicators*. 2000

(b) **Internet site:** www.worldbank.org/data

TOTAL OFFICIAL DEVELOPMENT ASSISTANCE GIVEN OR RECEIVED AS A PERCENTAGE OF GROSS NATIONAL PRODUCT		
Economic	Economic Structure	Financial Status

1. INDICATOR

- (a) **Name:** Total Official Development Assistance (ODA) given or received as a percentage of Gross National Product (GNP).
- (b) **Brief Definition:** This indicator is defined as the total ODA given or received as a share of GNP of the source or recipient country, respectively. When ODA flows by donor countries are measured, ODA comprises bilateral disbursements of concessional funds to developing countries and multilateral institutions. When ODA receipts by developing countries are measured, ODA comprises disbursement of concessional finance from both bilateral and multilateral sources.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Economic/Economic Structure/Financial Status.

2. POLICY RELEVANCE

- (a) **Purpose:** The indicator is a measure of the size of flows that are both concessional, and aimed mainly at promoting development and welfare of developing countries. It conveys information about the borrower's receipt of aid from official lenders or official lender's concessional flows to developing countries.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Financial resources are obviously needed for the attainment of sustainable development. Agenda 21 calls for the monitoring of the provision of financial resources, particularly in developing countries, so that the international community can take further action on the basis of accurate and reliable data.
- (c) **International Conventions and Agreements:** None.
- (d) **International Targets/Recommended Standards:** For developed countries, the United Nations has established that ODA should represent 0.7% of GNP.
- (e) **Linkages to Other Indicators:** This indicator is particularly linked with the other financial and international cooperation indicators.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Not Available.

(b) **Measurement Methods:** There are several ways of measuring Official Development Assistance (ODA) flows. The World Bank takes a developing-country/debtor perspective and the Organization for Economic Co-operation and Development (OECD) takes a donor/creditor-country perspective. ODA consists of grants or loans to developing countries that are undertaken by the official sector with the purpose of promoting economic development and welfare. Grants are defined as disbursements, in money or in kind, for which there is no repayment required. ODA loans are provided at concessional financial terms, that is with a grant element of 25 percent or more. The degree of concessionality is determined by the terms of a loan - interest rate, maturity, and grace period. The OECD includes grants for technical cooperation, but the World Bank excludes them because these grants mostly represent the provision of services rather than a flow of funds.

Gross national product (GNP) is the sum of value added by all resident producers plus any taxes (less subsidies) not included in the valuation of output, plus net receipts of primary income (compensation of employees and property income) from abroad.

(c) **Limitations of the Indicator:** Not Available.

(d) **Status of Methodology:** Not Available.

(e) **Alternative Definitions/Indicators:** Not Available.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Total Official Development Assistance (ODA) given or received and GNP data.

(b) **National and International Data Availability and Sources:** The principal source of the information are the OECD and the World Bank's Debtor Reporting System. The OECD data are obtained from donor and creditor sources through the information collected by the Development Assistance Committee. It includes information from the Creditor Reporting System and the joint OECD/Bank for International Settlements (BIS) system for identifying officially guaranteed claims of private banks on developing countries.

(c) **Data References:** The World Bank Global Development Finance and World Development Indicators (Annual Publications).

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the World Bank (WB). The contact point is the World Development Indicators Team, Development Data Group, the World Bank; fax no. (1 202) 522-1785.

(b) **Other Contributing Organizations:** The Organization for Economic Co-operation and Development (OECD) represents a contributing agency to the development of this indicator.

6. **REFERENCES**

(a) **Readings:**

The World Bank. *Global Development Finance*. 2000.

The World Bank. *2000 World Development Indicators*. 2000

(b) **Internet site:** www.worldbank.org/data

INTENSITY OF MATERIAL USE		
Economic	Consumption and Production Patterns	Material Consumption

1. **INDICATOR**

- (a) **Name:** Intensity of Material Use.
- (b) **Brief Definition:** The quantities of minerals and metals, including primary and secondary (recycled) materials, consumed per unit of real Gross Domestic Product (GDP).
- (c) **Unit of Measurement:** kgs, tonnes or m³ per \$1,000 of GDP.
- (d) **Placement in the CSD Indicators Set:** Economic/Consumption and Production Patterns/Material Consumption.

2. **POLICY RELEVANCE**

- (a) **Purpose:** The indicator provides a basis for policies to increase the efficient use of raw materials in order to conserve natural resources and reduce environment degradation resulting from primary production, material processing, manufacturing and waste disposal.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Primary production of raw materials, processing of the materials into products, and ultimate disposal of the waste material has major environmental impacts. Reducing the material intensity of production and consumption of goods and services is essential to environmental protection and resource conservation. Reductions in intensity of material use can be achieved by more efficient use of natural resources in production and consumption, by recycling used and waste material, and by shifts in consumption patterns to less material intensive goods and services. The indicator allows an analysis of consumption of natural resources, as well as trends in recovery and recycling.

The four-component structure of the indicator (consumption of primary material, consumption of secondary material, changes in stocks, and material embodied in imports and exports) provides a measure of the total material consumption of the economy. Per-capita consumption of the materials could also be determined, facilitating the interpretation of trends in material intensity.

The indicator can also be used as a proxy for assessing trends in industrial pollution. In the United States, for example, it is estimated that material-intensive industries account for about 70% of total air and water pollution. Throughput-to-pollution ratios can be used for this calculation, although technological change would affect the results.

- (c) **International Conventions and Agreements:** None.

- (d) **International Targets/Recommended Standards:** None.
- (e) **Linkages to Other Indicators:** This indicator is linked to other indicators which reflect the stage of economic development and the structure of the economy, such as share of manufacturing value-added in GDP and energy use per unit GDP.

3. METHODOLOGICAL DESCRIPTION

- (a) **Underlying Definitions and Concepts:** Not Applicable.
- (b) **Measurement Methods:** Using the UNCTAD database on minerals and metals, consumption of primary and secondary materials can be estimated. These data are then adjusted for (i) changes in stocks of producers, traders and manufacturers, and (ii) the volume of material contained in imports and exports of material-intensive semi-fabricates and manufactures. The calculated volume of material consumption is then divided by real GDP in order to compute material consumption per unit of GDP. Material intensity data can be disaggregated into intensity of use of primary and secondary materials.
- (c) **Limitations of the Indicator:** It is difficult to accurately estimate the consumption of secondary materials, changes in stocks and the material contained in traded semi-fabricates and manufactures. For manufactures, conversion factors for material content are being compiled and updated to take account of changing manufacturing technologies. National and regional differences in this regard, however, are difficult to reflect.
- (d) **Status of the Methodology:** There is limited use of indicators of material intensity in some developed countries, with varying methodologies.
- (e) **Alternative Definitions/Indicators:** None.

4. ASSESSMENT OF DATA

- (a) **Data Needed to Compile the Indicator:** Most of the required consumption and trade data are available in UNCTAD's database on minerals and metals. Information on consumption of secondary materials is incomplete but can be estimated with reasonable accuracy. Data on changes in stocks, in particular at the level of traders and manufacturers, are scant, although some reasonable estimates can be made. Conversion factors for material content in semi-fabricates are being compiled and updated in collaboration with various industry associations. Information, however, is often incomplete, not representative, or too general.
- (b) **National and International Data Availability and Sources:** New estimates of national consumption of some 20 commodities per unit of GDP are currently being prepared, updating the results of a 1991 survey. The analysis emphasizes consumption trends of primary versus secondary materials.
- (c) **Data References:** Not Available.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Conference on Trade and Development (UNCTAD). The contact point is the Coordinator, Sustainable Development, UNCTAD; fax no. (41 22) 907 0047.

(b) **Other Contributing Organizations:** Eurostat, World Resources Institute, and the Wuppertal Institute on Climate, Environment and Energy have contributed to the development of this indicator.

6. REFERENCES

(a) Readings:

Eurostat. *Primary Material Balances*.

Ndiaye, D. *Statistical Study on the Consumption of Metals*. Centre d'Economie des Ressources Naturelles, Ecole Nationale Supérieure des Mines de Paris. Paris, 1991.

World Resources Institute. *World Resources 1994-95*, part IV, Chapter 21, 1995.

Behrensmeier, R. and S. Bringezu. *On the Methodology of Analysing Macro-economic Material Intensity*. Wuppertal Institute on Climate, Environment and Energy, Wuppertal Papers, No. 34, April 1995.

Hammond, Allen, et al. *Environmental Indicators: A Systematic Approach to Measuring and Reporting on Environmental Policy Performance in the Context of Sustainable Development*, (Chapter VI and Appendix I). World Resources Institute, Washington, D.C., 1995.

Hoffmann, U and D. Zivkovic. *Demand Growth for Industrial Raw Materials and its Determinants: An Analysis for the Period 1965-1988*. UNCTAD Discussion Papers, No. 50, Geneva, November 1992.

(b) **Internet site:** None.

ANNUAL ENERGY CONSUMPTION PER CAPITA		
Economic	Consumption and Production Patterns	Energy Use

1. **INDICATOR**

- (a) **Name:** Annual energy consumption per capita.
- (b) **Brief Definition:** The per capita amount of energy - liquids, solids, gases and electricity – available in a given year in a given country or geographical area.
- (c) **Unit of Measurement:** Gigajoules.
- (d) **Placement in the CSD Indicator Set:** Economic/Consumption and Production Patterns/ Energy Use.

2. **POLICY RELEVANCE**

- (a) **Purpose:** The indicator is a widely used measure of access to and use of energy, individual and industrial energy consumption patterns and the energy intensity of a society.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Energy is a key factor in industrial development and in providing vital services that improve the quality of life. Traditionally energy has been regarded as the engine of economic progress. However, its production, use, and byproducts have resulted in major pressures on the environment, both from a resource use and pollution point of view. The decoupling of energy use from development represents a major challenge of sustainable development. The long-term aim is for development and prosperity to continue through gains in energy efficiency rather than increased consumption and a transition towards the environmentally friendly use of renewable resources. On the other hand, limited access to energy is a serious constraint to development in the developing world, where the per capita use of energy is less than one sixth that of the industrialized world.
- (c) **International Conventions and Agreements:** UNFCCC and the Kyoto Protocol call for limitations on total greenhouse gas emissions, which are dominated by CO₂ from the combustion of fossil fuels.
- (d) **International Targets/Recommended Standards:** The Kyoto Protocol sets targets for total greenhouse gas emissions for Annex I (developed) countries.
- (e) **Linkages to Other Indicators:** The indicator is closely linked with other indicators of the economy, with environmental indicators such as climate change, air quality and land use, and also with social indicators.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Gross inland consumption of energy is a key aggregate in the energy balances. Consumption of energy refers to “apparent” consumption and is derived from the formula that takes into account production, exports, imports and stock changes. Production refers to the first stage of production. International trade of energy commodities is based on the “general trade” system, that is, all goods entering and leaving the national boundary of a country are recorded as export and imports. Bunkers refer to fuels supplied to ships engaged in international transport, irrespective of the carriers’ flag. In general, data on stocks refer to changes in stocks of producers, importers and/or industrial consumers at the beginning and the end of the year.

(b) **Measurement Methods:** The indicator is calculated as the ratio of total energy requirement and mid-year population. Total energy requirement (gross inland consumption) is calculated from the following formula: Primary production + Imports – Exports – Bunkers +/- Stock changes = Total energy requirement.

(c) **Limitations of the Indicator:** Apparent consumption may in some cases represent only an indication of the magnitude of actual gross inland availability. The actual value of the indicator is strongly influenced by a multitude of economic, social and geographical factors. When using it as an indicator of sustainability the indicator has to be interpreted in connection with other indicators of economic development and energy use, as smaller or larger values of the indicator do not necessarily indicate more or less sustainable development.

(d) **Status of the Methodology:** The indicator is in widespread use, but without a standardized methodology. International recommendations are available.

(e) **Alternative Definitions/Indicators:** None.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Energy commodity data for production and consumption (energy balances) and mid-year population estimates.

(b) **National and International Data Availability and Sources:** Energy commodity data for production and consumption, and population data are regularly available for most countries at the national level; and for some countries, at the sub-national level. Both types of data are compiled by and available from national statistical offices and country publications.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Department of Economic and Social Affairs (DESA). The contact point is the Director, Statistics Division, DESA; fax no. (1 212) 963 9851.

(b) **Other Contributing Organizations:** Other organizations involved in the indicator development include the International Energy Agency of the Organisation for Economic Co-operation and Development (OECD/IEA), and Eurostat.

(c) **Data References:** United Nations: Energy Statistics Yearbook. United Nations: Energy Balances and Electricity Profiles.

6. **REFERENCES**

(a) **Readings:**

Concepts and Methods in Energy Statistics, with Special Reference to Energy Accounts and Balances. United Nations, 1982.

Energy Statistics: Definitions, Units of Measure and Conversion Factors. United Nations, 1987.

Energy Statistics: A Manual for Developing Countries. United Nations, 1991.

(b) **Internet site:** United Nations Statistics Division: <http://www.un.org/Depts/unsd>

SHARE OF CONSUMPTION OF RENEWABLE ENERGY RESOURCES		
Economic	Consumption and Production Patterns	Energy Use

1. INDICATOR

- (a) **Name:** Share of consumption of renewable energy resources.
- (b) **Brief Definition:** The percentage of a country's total energy consumption supplied from renewable energy sources.
- (c) **Unit of Measurement:** %
- (d) **Placement in the CSD Indicator Set:** Economic/Consumption and Production Patterns/ Energy Use.

2. POLICY RELEVANCE

- (a) **Purpose:** This indicator measures the proportion of energy mix between renewable and non-renewable energy resources.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Chapter 4 of Agenda 21 calls for an improvement of efficiency in the use of energy sources and for a transition towards the environmentally friendly use of renewable resources. Energy is a key aspect of consumption and production. Dependence on non-renewable resources can be regarded as unsustainable in the long term. Renewable resources, on the other hand, can supply energy continuously under sustainable management practices and their use in general create less environmental pressure. The ratio of non-renewable to renewable energy resources represents a measure of a country's sustainability.
- (c) **International Conventions and Agreements:** None.
- (d) **International Targets/Recommended Standards:** None.
- (e) **Linkages to Other Indicators:** Interpretation of this indicator is enhanced when combined with annual energy production, annual energy consumption per capita, and lifetime of proven energy reserves. It is also closely linked to some of the environmental indicators such as greenhouse gas emissions.

3. METHODOLOGICAL DESCRIPTION

- (a) **Underlying Definitions and Concepts:** The elements comprising this indicator are consumption of renewable energy resources and total energy consumption. Renewable energy sources refer to energy collected from current ambient energy flows or from substances derived from them. This definition includes energy derived from geothermal, hydro, solar, tide, wind and

wave power, and biofuels, such as fuelwood, bagasse, charcoal, animal and vegetal wastes, and other (industrial and municipal) wastes. Consumption refers to "apparent consumption".

(b) **Measurement Methods:** This indicator is computed by calculating the ratio of consumption of energy from renewable resources over total energy consumption. Apparent consumption is calculated by the following formula: Primary production + Imports – Exports – Bunkers +/- stock changes.

(c) **Limitations of the Indicator:** Due to the large variety of forms of renewables and their uses, data collection is difficult. Comparability of national data is limited due to the lack of standardized methodologies.

(d) **Alternative Definitions/Indicators:** None.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Consumption of energy from renewable resources; total energy consumption.

(b) **National and International Data Availability and Sources:** National data and estimates on renewable resources are available from national statistical offices and country publications for many countries. The United Nations Statistics Division, and the International Energy Agency of the Organisation for Economic Co-operation and Development compile data and estimates based on information from national and international sources.

(c) **Data References:** United Nations: Energy Statistics Yearbook and Energy Balances and Electricity Profiles; International Energy Agency: Energy Balances of OECD Countries, Energy Balances of Non-OECD Countries; World Energy Council: Survey of Energy Resources.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Department of Economic and Social Affairs, Statistics Division.

(b) **Other Contributing Organizations:** The agencies involved in the development of this indicator are the World Energy Council (WEC), the International Energy Agency of the Organisation for Economic Co-operation and Development (OECD/IAE), Eurostat, and the Economic Commission for Europe.

(c) **Data References:** World Energy Council: *Survey of Energy Resources*. United Nations: *Energy Statistics Yearbook*.

6. REFERENCES

(a) **Readings:** See 5(c)

(b) **Internet site:** United Nations Statistics Division: <http://www.un.org/Depts/unsd>

ENERGY USE PER UNIT OF GDP (ENERGY INTENSITY)		
Economic	Consumption and Production Patterns	Energy Use

1. INDICATOR

- (a) **Name:** Energy Use per unit of GDP.
- (b) **Brief Definition:** Ratio of total energy use to GDP.
- (c) **Unit of Measurement:** Megajoules (mJ) per \$.
- (d) **Placement in the CSD Indicator Set:** Economic/Consumption and Production Patterns/ Energy Use.

2. POLICY RELEVANCE

- (a) **Purpose:** Trends in overall energy use relative to GDP indicate the general relationship of energy consumption to economic development and provide a rough basis for projecting energy consumption and its environmental impacts with economic growth. For energy policy-making, however, sectoral or sub-sectoral energy intensities should be used.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Energy is essential for economic and social development, but consumption of fossil fuels is the major cause of air pollution and climate change. Improving energy efficiency and delinking economic development from energy consumption, particularly of fossil fuels, is essential to sustainable development.
- (c) **International Conventions and Agreements:** UNFCCC and its Kyoto Protocol call for limitations on total greenhouse gas emissions, which are dominated by CO₂ from fossil fuels.
- (d) **International Targets/Recommended Standards:** No specific target for energy intensity. The Kyoto Protocol sets targets for total greenhouse gas emissions for annex I (developed) countries.
- (e) **Linkages to Other Indicators:** The ratio of energy use to GDP is an aggregate of sectoral energy intensity indicators and is thus linked to the energy intensities for the manufacturing, transportation, commercial/services and residential sectors, for which separate methodology sheets have been prepared. This indicator is also linked to indicators for total energy consumption, greenhouse gas emissions and air pollution emissions.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The ratio of energy use to GDP is also called “energy intensity”. The term “energy intensity” is better used for sectoral or sub-sectoral ratios of energy use to output. The indicator could be called “aggregate energy intensity” or “economy-wide energy intensity”.

The ratio of energy use to GDP indicates the total energy being used to support economic and social activity. It represents an aggregate of energy consumption resulting from a wide range of production and consumption activities. In specific economic sectors and sub-sectors, the ratio of energy use to output or activity is the “energy intensity” (if the output is measured in economic units) or the “specific energy requirement” (if the output is measured in physical units such as tonnes or passenger-kilometers).

Due to the limitations described in section 3 (c) below, total energy use should be disaggregated into components, by sector (manufacturing, transportation, residential, commercial/services, industry, agriculture, construction, etc.) or sub-sector. For each sector or sub-sector, energy use can be related to a convenient measure of output to provide a sectoral or sub-sectoral energy intensity. Examples include energy use for steel-making relative to tonnes of steel produced; energy consumption by passenger vehicles relative to passenger- or vehicle-kilometers; energy consumption in buildings relative to their floor area. (See separate methodology sheets for manufacturing, transportation, commercial/services, and residential sectors).

The energy intensity of a process (energy consumed per unit of output) is the inverse of the “energy efficiency” of the process (output per unit energy consumed).

(b) **Measurement Methods:**

- **Energy Use:** Total and sectoral energy consumption is obtained from national energy balances. Household and services/commercial consumption should be carefully separated, and manufacturing (ISIC D, formerly 3) should be separated from other industrial uses (ISIC C and F, formerly 2 and 5) and agriculture (ISIC A and B, formerly 1).

Unit: Energy is measured in terajoules (TJ, 10^{12} J), petajoules (PJ, 10^{15} J), or exajoules (EJ, 10^{18} J).

- **Output:** Components of GDP should be deflated to constant dollars by chaining each component, not simply by deflating each component by the overall GDP deflator.

Unit: GDP is measured in US dollars, converted from real local currency at purchasing power parity for the base year to which local currency was deflated.

(c) **Limitations of the Indicator:** The ratio of aggregate energy use to GDP, often called “energy intensity” or the “energy ratio”, is not an ideal indicator of energy efficiency, sustainability of energy use, or technological development, as it has been commonly used. The aggregate ratio depends as much on the structure of the economy as on the energy intensities of

sectors or activities, and changes in the ratio over time are influenced almost as much by changes in the structure of the economy as by changes in sectoral energy intensities.

Measurement and interpretation of energy intensities are complicated by differences among products within a category, such as size (e.g., automobile weight or refrigerator capacity), features (power steering and automatic transmission in cars, freezer compartments in refrigerators), and utilization (hours per year a stove is used, vehicle occupancy if passenger-km is the measure of output).

Comparison among countries of the ratio of energy use to GDP is complicated by geographical factors. Large countries, for example, tend to have high levels of freight transportation as many goods are distributed nationwide. Compared with countries with moderate climates, cold countries may consume as much as 20 per cent more energy per capita due to demand for space heating, while hot countries may use 5 per cent more energy per capita, due to demand for air conditioning. Countries with large raw materials industries may use twice as much energy per unit of manufacturing output compared to countries that import processed materials, due to the high energy intensity of raw material processing. Canada, for example, has a high ratio of energy use to GDP, due in part to that fact that it is a large, cold country with a large raw materials processing sector. In Japan, the climate is milder, raw materials are limited, and high population density results in smaller residential units and less distance travelled, contributing to a lower ratio of energy use to GDP.

Interpreting the ratio of energy use to GDP in terms of environmental impact or sustainability is also complicated by differences in environmental impact among energy sources. Canada, for example, has substantial hydropower, nuclear power and natural gas, all of which have lower environmental impacts than coal or oil.

Given the large number of factors that affect energy consumption, the ratio of total energy consumption to GDP should not be used as an indicator of energy efficiency or sustainability for policy-making purposes.

(d) **Status of the Methodology:** The ratio of energy use to GDP, as well as sectoral and sub-sectoral energy intensities, are in widespread use, but without a standardized methodology.

(e) **Alternative Definitions/Indicators:** The ratio of sectoral or sub-sectoral energy use to the output or activity of the sector or sub-sector provides a more useful indicator of energy intensity. Four separate methodology sheets have been prepared for manufacturing, transportation, commercial/services, and residential sectors.

4. ASSESSMENT OF DATA

(a) **Data needed to compile the indicator:**

- (i) Sectoral energy consumption;
- (ii) Real GDP in US dollars.

(b) **National and international data availability and sources:** The International Energy Agency maintains the most thorough set of energy balances and energy accounts, based primarily on national data or data collected from reliable regional agencies. For OECD countries, the OECD maintains the most reliable set of national accounts with a breakdown of GDP by sector and sub-sector. IEA energy data now cover virtually all developing countries.

GDP and value-added by industry are published in the United Nations National Accounts Statistics. The IMF “International Financial Statistics” provides nominal and real GDP for most countries. Data on components of GDP are often available from regional development banks or national sources.

(c) **Data References:**

IEA: Energy Balances of Member Countries
Energy Balances of Non-Member Countries

Eurostat: Energy balances
Latin American Energy Organization/ Organización Latinoamericana de Energía (OLADE)
Asia Pacific Energy Research Centre (APERC)

UN: National Accounts Statistics

IMF: International Financial Statistics

5. **AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR**

(a) **Lead Agency:** The lead agency is the International Energy Agency (IEA).

(b) **Other Contributing Organizations:** Virtually every national and international energy agency uses the ratio of total energy use to GDP, often inappropriately. Key agencies involved in more detailed development of sectoral and sub-sectoral indicators, including energy intensity and energy efficiency indicators, are Eurostat and the Directorate-General for Energy and Transport of the European Commission. The IEA has a parallel effort with a particular focus on non-EU countries. Work is also being done by APERC, with a focus on the Asia-Pacific Region, and OLADE for Latin America.

6. **REFERENCES**

Internet site: International Energy Agency: <http://www.iea.org>

INTENSITY OF ENERGY USE: COMMERCIAL/SERVICE SECTOR		
Economic	Consumption and Production Patterns	Energy Use

1. INDICATOR

- (a) **Name:** Intensity of Energy Use in the Commercial/Service Sector.
- (b) **Brief Definition:** Energy consumption per unit of commercial/service sector output or per unit commercial/service sector floor area.
- (c) **Unit of Measurement:** Megajoules per US\$ (mJ/\$) or megajoules per square meters (mJ/m²).
- (d) **Placement in the CSD Indicator Set:** Economic/Consumption and Production Patterns/Energy Use.

2. POLICY RELEVANCE

- (a) **Purpose:** This indicator is used to monitor trends in energy consumption in the commercial/service sector, which is the largest sector of most economies.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The service sector is less energy intensive than manufacturing, and the growth of the sector relative to manufacturing contributes to the long-term reduction in the ratio of total energy consumption to GDP. The sector, however, is a large consumer of electricity, generation of which contributes to many local or global environmental problems.
- (c) **International Conventions and Agreements:** There are no international agreements. Some countries are promulgating energy-efficiency standards for lighting, office equipment or other devices, while others are negotiating voluntary agreements to reduce energy consumption per square meter of floor space.
- (d) **International Targets/Recommended Standards:** There are no international targets or standards. Many industrialized countries have previously set targets for reducing the space-heating component of service-sector energy consumption per unit of floor area. Now, many countries are trying to reduce electricity consumption for cooling, lighting, and information systems.
- (e) **Linkages to Other Indicators:** This indicator is one of a set for energy intensity in different sectors (manufacturing, transportation, commercial/services and residential), with the indicator for energy use per unit of GDP as an aggregate energy intensity indicator. These indicators are also linked to indicators for total energy consumption, greenhouse gas emissions, and air pollution emissions.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Energy consumption per unit of value added or per unit of floor area in the commercial/service sector is one way of measuring energy requirements and trends in the sector. As with the manufacturing sector, the commercial/service subsectors are diverse and difficult to classify. They include subsectors that require a great deal of electricity per unit of output (retail trade), those that use large quantities of fuel for water and space heating (health care establishments), and those that by their nature consume little energy (warehousing, parking). Energy efficiency in this sector is more directly related to the efficiency of general energy services (lighting, ventilation, computing, lifting, etc.) than to the efficiency of the particular sectoral activities. But there are almost no data on actual energy service outputs per unit of energy input (lumens of light, cubic meters of air moved, computing power or use, tonnes raised in lifts, etc.). Hence, the usual measure of energy intensity, megajoules per unit of output in economic terms (mJ/\$), can be a useful indicator provided it is clear that this summarizes many processes and types of buildings. Because of the differences in processes, it is very important to separate electricity from fossil fuel and purchased heat.

An alternative indicator is energy consumption relative to floor area (in sq. meters), which is a good measure of the total amount of physical activity for the sector. In warmer countries, built area is a less accurate proxy for the total amount of activity, since a substantial amount of business activity occurs outdoors. In low-income countries, substantial activity takes place in front of homes that also serve as stores.

It is often difficult to measure and interpret energy intensities per unit of value added within subsectors (private services, public service, etc.) because different activities often take place in the same building, hence, the real partition of energy use between activities is uncertain. In such cases, intensities expressed per unit area disaggregated by building type may be more easily related to real energy efficiencies. However, these have the similar problem that a variety of activities may take place in a particular type of building. A hospital, for example, will contain space for food preparation or laundry services, as well as for health care.

(b) **Measuring Methods:**

- **Energy Consumption:** Energy consumption is usually measured at the point of use, i.e., the building or enterprise. Data for buildings must be collected through surveys of building owners, operators, or tenants, while data for enterprises are usually collected through the enterprise's normal accounting of expenditures or consumption of energy. Note, however, that the correspondence between enterprise and building type can be very loose.

In a few countries, energy consumption in buildings is measured or imputed by surveys of actual buildings (United States, France and Japan, and Sweden for space and water heating only). Where these data exist, they can be used to represent real efficiencies. Heating energy consumption per sq. meter of floor area heated is an important example of such a measure. Electricity use per sq. meter is important to measure, but it is difficult to disaggregate into heating, cooling, water heating/cooking, lighting, etc., without

recourse to detailed surveys. Some colder countries (e.g., Norway) have very high energy intensities, which are clearly dominated by electric heating, while others (e.g., Canada, Finland) have very high intensities, yet do not have much electric space heating. Similarly, warmer countries have substantial amounts of space that are fully air-conditioned. For many countries, the amount of air-conditioned space is unknown.

Despite all these uncertainties, fuel intensities (plus district heating) and electricity intensities recorded separately give useful indicators of space/water heating/cooking on the one hand and electricity services on the other. Primary energy use should be used to aggregate electricity and fuel consumption (see methodology for manufacturing sector).

Unit: The preferable unit is a multiple of joules, usually terajoules (10^{12}J), petajoules (10^{15}J), or exajoules (10^{18}J).

- **Output.** There are different approaches to measuring output in the commercial/service sector, with value added as the most direct measure of economic output. However, for estimating energy efficiency, physical area is preferred because most energy services (heating, cooling, lighting, etc.) are related to the floor area and size of the building. Surveys of floor area by building type have been carried out in many IEA countries. Often, the building type is specifically related to the activity of the enterprise, e.g., school (education), hospital (health care), or restaurant (food services). However, in many cases, particularly for offices and restaurants, buildings contain a mix of activities and enterprises, each with its own energy system and with considerably different energy use patterns.

An alternative measure of output that may be useful for measuring the economic impact of the entire sector and its energy use is energy consumption of the sector relative to its GDP share. In this case, it may be desirable to remove the contribution of transportation services as well as the contribution of “implied value of household mortgages and rents”, as transportation is considered as a separate sector and mortgages and rents do not directly involve energy use. However, using service sector energy consumption relative to its share of GDP means that the resulting intensity should not be associated with energy efficiency. As with manufacturing, care must be taken in deflating sectoral GDP to the desired base year.

Unit: Constant US dollar. Market value of output in real local currency is deflated to a base year using GDP deflators corresponding to each branch. Local currency is then converted to a common international currency, normally US dollars, preferably using purchasing power parity for the base year. For floor area, sq. metres of built space is usually the unit, but in some colder countries, sq. meters of occupied or heated space is recorded. The difference, which can be significant (up to 10%), reflects unheated spaces, garages and stairwells, etc.

- (c) **Status of the Methodology:** The methodology is in use in many developed countries.
- (d) **Alternative Definitions/Indicators:** It has become increasingly desirable to measure CO_2 emissions per unit of production. IPCC Coefficients can be used to convert each fuel consumed

to CO² emissions. For electricity and heat, the broad rules suggested for primary energy can be followed, but the same uncertainties exist. Since in many countries more than half of all final energy consumed in this sector may be in the form of electricity, accounting for the emissions from electricity generation is extremely important.

4. ASSESSMENT OF DATA

(a) Data Needed to Compile the Indicator:

- (i) Energy use in the commercial / service sector;
- (ii) Real output (value added) of the commercial / service sector; and/or
- (iii) Built areas or occupied space (sometimes, heated space).

(b) National and International Data Availability: Value added or GDP in one-digit service sector branches is available for almost every country. More detailed data exist for OECD countries, both from national sources and from the OECD national accounts.

Energy consumption data at the sector-wide level are available from almost all OECD countries and most others, but there are some important caveats. First, one must check the residential sector data from the same source to determine whether liquid and solid fuels have been divided between these sectors. In many of the IEA time series, this division is not done, and one sector or the other has all of the liquid or solid fuels. For developing countries, this split is a problem for gas as well, which is often entirely allocated to either residential use or services rather than being split.

Second, one must ascertain whether the commercial/service sector contains data from other sectors. Data from western Germany for the sector (“Kleinverbraucher”) contained significant amounts of both agriculture and construction through the early 1990s. Other countries may include street lighting and even non-energy utilities like water and waste disposal. Some countries include anything that cannot be classified elsewhere.

Reliable time-series energy data disaggregated at the subsectoral level exist for only a few countries, namely, the United States, France, Japan, and Sweden (heating only).

IEA sent a questionnaire to OECD countries asking for data on floor area and energy use, but few responses on floor area were received. The IEA will pursue this and expects to report data for floor area in its future energy indicators.

(c) Data References:

IEA: Energy Balances of Member Countries
Energy Balances of non-Member Countries

Eurostat: Energy Balances

The Latin American Energy Organization / Organización Latinoamericana de Energía (OLADE)

Asia Pacific Energy Research Centre (APERC)

UN: Industrial Statistics

OECD: STAN database (structural analysis database)

EU: NACE system

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

- (a) **Lead Agency:** The lead agency is the International Energy Agency (IEA).
- (b) **Other Contributing Organizations:** None.

6. REFERENCES

- (a) **Readings:**

Krackeler, Tom and Lee Schipper, 1998. "Carbon Dioxide Emissions in OECD Service Sectors. The Critical Role of Electricity use". *Energy Policy* (February).

Schipper, L., and Steve Meyers, 1986. "Energy Use in the Service Sector. An International Comparison". *Energy Policy* (June).

Meyers, S., Ed., 1986. *Electricity Use in the Service Sector. Report of An International Workshop*. Palo Alto, CA: Electric Power Research Institute.

- (b) **Internet site:** The International Energy Agency: <http://www.iea.org>

INTENSITY OF ENERGY USE: MANUFACTURING		
Economic	Consumption and Production Patterns	Energy Use

1. INDICATOR

- (a) **Name:** Intensity of Energy Use in Manufacturing.
- (b) **Brief Definition:** Energy consumption per unit of manufacturing output.
- (c) **Unit of Measurement:** Megajoules (mJ) per unit output of the manufacturing sector in constant US dollars.
- (d) **Placement in the CSD Indicator Set:** Economic/Consumption and Production Patterns/Energy Use.

2. POLICY RELEVANCE

- (a) **Purpose:** The manufacturing sector is a major consumer of energy. This indicator is a measure of the efficiency of energy use in the sector that can be used for analysing trends and making international comparisons in energy efficiency, particularly when the indicator can be disaggregated to specific branches of manufacturing.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Sustainable development requires increases in energy efficiency in order to reduce fossil fuel consumption, greenhouse gas emissions and related air pollution emissions.
- (c) **International Conventions and Agreements:** UNFCCC and its Kyoto Protocol.
- (d) **International Targets/Recommended Standards:** Although there are no specific international targets regarding energy use or energy efficiency, many industrialized countries have targets for reducing energy use and carbon emissions from manufacturing branches.
- (e) **Linkages to Other Indicators:** This indicator is one of a set for energy intensity in different sectors (manufacturing, transportation, commercial/services and residential), with the indicator for energy use per unit of GDP as an aggregate energy intensity indicator. These indicators are also linked to indicators for total energy consumption, greenhouse gas emissions, and air pollution emissions.

3. METHODOLOGICAL DESCRIPTION

- (a) **Underlying Definitions and Concepts:** Energy consumption per unit of value added is one way of measuring energy requirements and energy efficiency in manufacturing. While energy consumption per unit of physical output is a better indicator of energy efficiency in specific

manufacturing processes, energy use per unit of economic output is more useful both for relating energy efficiency to economic activity and for aggregating and comparing energy efficiency across manufacturing sectors or across the entire economy.

(b) **Measurement Methods:**

- **Energy Use:** Energy use is usually measured at the point of consumption, i.e., the factory or establishment. “Own energy” (including internal use of hydropower, biofuels, or internal waste heat) should be combined with purchased energy at useful heating values. For combined production of heat and electricity, no simple method exists for dividing the total energy consumed between these two outputs. Where excess heat or electricity is sold or provided to outside establishments or a grid, the energy required for this out-going supply should not be allocated to the product of the establishment or branch and the income or apparent value added from these sales should be excluded from output value.

In some cases, it may be preferable to measure total primary energy consumption, including losses incurred in the external production and distribution of the purchased electricity and heat, since these losses would occur if the establishment or branch used the primary energy directly. Primary energy consumption is a better measure of the total energy burden on the economy of a unit of output from an industry. Generally, the energy loss from converting primary energy to electricity is estimated by the average ratio for electricity production in the economy.

Complications in interpreting energy intensity data arise from the fact that some branches of manufacturing may be concentrated in regions of a country rich in certain kinds of power or heat sources, such that those branches constitute a lower energy burden on the economy than the indicator would suggest. Interpretation is also complicated when a particular branch has significant internal energy resources, such as captive hydro, biofuels or coal. There are various conventions for calculating the primary energy corresponding to electricity produced by nuclear, hydro or geothermal sources.

It is also possible to measure total energy consumption, internal and external, for any final product by using input-output tables to measure the energy embodied in materials and intermediate products. This is much more data intensive, because the input-output tables are complex. Such tables are not produced regularly, so this approach is difficult to follow, except at long intervals.

Unit: Preferable units for measuring energy are multiples of joules, usually terajoules (10^{12} J), petajoules (10^{15} J), or exajoules (10^{18} J).

- **Output.** There are different approaches for measuring output in manufacturing. For some purposes, physical output would be preferable, but this is not possible using the energy consumption statistics available in many countries, and there are many sectors for which aggregate physical output cannot be easily defined.

There are two basic alternatives for measuring economic output. In either case, we use real local currency, deflated by the deflator for the sector or branch to a base year. This step is crucial, so that the weight of each sector or branch reflects the correct weight in the base year. The value of output is then converted to a common international currency, usually US dollars, preferably using purchasing power parities (PPP). One alternative is to calculate the total value of production or shipments. This measures literally the total output from an industry, and is defined for most countries. The other alternative is to calculate the value-added or contribution to GDP, representing only the increase in economic output produced by the sector or branch in question.

The total value of output tends to be more stable over time, but has the disadvantage that it cannot be aggregated to total output, because of double counting: inputs to one branch may be the outputs of another branch. Value added can be aggregated, but may have greater fluctuations from year to year if input costs or output prices change, which is common for many basic raw materials, particularly crude oil. Unfortunately, there is no simple correspondence between the two measures of output.

Unit: Constant US dollars. Market value of output in real local currency deflated to a base year using GDP deflators for each sector or branch. Local currency is converted to US dollars, using purchasing power parity for the base year.

(c) **Limitations of the Indicator:** The aggregate indicator for the manufacturing sector reflects both the energy intensity of various branches of manufacturing and the composition of the manufacturing sector. Changes in the aggregate indicator can therefore be due either to changes in energy intensity or to changes in relative branch output. Similarly, differences between countries may be due either to differences in energy efficiency or differences in the structure of the manufacturing sector. A country with large energy-intensive industries, such as pulping, primary metals or fertilizers, for example, will have a high energy intensity, even if the industry is energy efficient. For this reason, it is desirable to disaggregate energy intensity by branch of manufacturing.

Detailed calculations such as total energy consumption for particular products, using input-output tables, while desirable, are very data intensive and difficult to update regularly.

(d) **Status of the Methodology:** The methodology is in use in many developed countries.

(e) **Alternative Definitions/Indicators:** In the context of climate change, it has become increasingly desirable to convert energy consumption to carbon emissions per unit of production. The fuels consumed can be converted to carbon emissions using IPCC coefficients. Carbon emissions will therefore change both with changes in energy efficiency and changes in fuel type.

4. ASSESSMENT OF DATA

(a) **Data needed to Compile the Indicator:**

- (i) Energy consumption by manufacturing sector and branches;
- (ii) Real output of the sector and branches.

(b) **National and International Data Availability and Sources:** Value added in manufacturing at the three and four digit ISIC level for most OECD countries is now compiled by OECD as part of its STAN data base. The United Nations compiles value added at the two or three digit level for developed and developing countries. The European Union produces data on value added at the two and three-digit level in the NACE system, and suitable bridges exist to translate NACE into ISIC.

One persistent data problem at the aggregate level is distinguishing between “industry” (ISIC C, D, F and even E) and manufacturing (ISIC D). Some countries also lump agriculture, forestry and fishing (ISIC A, B) in the aggregate “industry” classification. For these reasons, it is strongly recommended that data be checked to ascertain exactly what sectors are covered. Manufacturing is the preferable aggregate, since inclusion of the other sectors mentioned can distort time series analysis and comparisons among countries.

(c) **Data References:**

IEA: Energy Balances of Member Countries
Energy Balances of non-Member Countries

Eurostat: Energy Balances

The Latin American Energy Organization /Organizac**o**n Latinoamericana de Energ**a** (OLADE)

Asia Pacific Energy Research Centre (APEREC)

UN: Industrial Statistics, National Accounts

OECD: STAN database (structural analysis database)

EU: NACE system

5. **AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR**

(a) **Lead Agency:** The lead agency is the International Energy Agency (IEA).

(b) **Other Contributing Organizations:** OECD and IEA have collected detailed value added and energy consumption data at the four-digit level in the ISIC database. Less detailed two-digit data are also available. IEA now collects two-digit energy consumption data for manufacturing for about half of the developing countries as well.

6. **REFERENCES**

(e) **Readings:**

Energy Policy, June/July 1997 issue, Elsevier Science Limited, various articles in this issue discuss the physical and monetary measures of output and various problems associated with indicators of manufacturing energy use and intensity.

Phylipsen, G.J.M, Blok, K., and Worrell, E., 1997. *Handbook on International Comparison of Energy Efficiency in the Manufacturing Industry*. Utrecht: Dept. of Science, Technology, and Society.

IEA, 1997. *Indicators of Energy Use and Energy Efficiency*. Paris: OECD.

(b) **Internet site:** International Energy Agency: <http://www.iea.org>

INTENSITY OF ENERGY USE: RESIDENTIAL SECTOR		
Economic	Consumption and Production Patterns	Energy Use

1. INDICATOR

- (a) **Name:** Intensity of Energy Use in the Residential Sector.
- (b) **Brief Definition:** Amount of energy used per person or household in the residential sector.
- (c) **Unit of Measurement:** Gigajoules (GJ) per capita or GJ per household.
- (d) **Placement in the CSD Indicator Set:** Economic/Consumption and Production Patterns/ Energy Use.

2. POLICY RELEVANCE

- (a) **Purpose:** The indicator is used to monitor energy consumption in the residential sector.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The residential sector is a major consumer of energy with a distinctive pattern of usage. Reducing energy consumption contributes to reducing air pollution and climate change. Many policies addressing energy efficiency and savings have been formulated for this sector. In colder countries, for example, the space heating component has been the focus of many energy-saving policies, while in almost all countries, the electric-appliance and lighting component is still the focus of many policies.
- (c) **International Conventions and Agreements:** None specifically for this sector.
- (d) **International Targets/Recommended Standards:** None as such. However, thermal standards for new homes are in effect in almost all OECD and Eastern European countries, China and some other countries in colder climates. Efficiency standards for boilers are also important in many countries. Efficiency standards on new electrical appliances are important in the United States and indirectly in Canada, and voluntary programmes have been important in Japan and Europe.
- (e) **Linkages to Other Indicators:** This indicator is one of a set for energy intensity in different sectors (manufacturing, transportation, commercial/services and residential), with the indicator for energy use per unit of GDP as an aggregate energy intensity indicator. These indicators are also linked to indicators for total energy consumption, greenhouse gas emissions, and air pollution emissions.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Household or residential energy use encompasses energy used in residential buildings, including urban and rural free-standing houses, apartment dwellings, and most collective dwellings such as dormitories and barracks. These energy uses typically include cooking, water heating, space heating and cooling, lighting, major appliances for refrigeration, washing and drying, TV and communications, computers, conveniences like food machines, vacuum cleaners, etc., as well as a myriad of small appliances. Household or residential energy use should exclude energy for farm processes, small businesses or small industry. The household sector must be separated from the commercial/services sector, although data for many IEA countries did not separate these two sectors in the past. The energy sources should include not only purchased energy, but also gathered energy such as fuelwood or other biomass and miners' coal.

(b) **Measurement Methods:**

- **Energy Use:** Purchased energy for residences/households is usually recorded in the energy statistics of a country with data provided by electric, gas, or heat utilities according to customer definitions that correspond to "households". Data on purchases of LPG, other oil products, coal or similar fuels and wood are not always recorded correctly since suppliers may not know where or how these fuels are being used.

Alternatively, household/residential energy use can be measured through household surveys. The most direct surveys collect detailed information on both fuels consumed and energy-consuming equipment owned or used. The most accurate surveys also obtain permission from households to ask energy suppliers for quantities consumed, or they leave fuel-use diaries for households to record what they consume. They measure usage in a variety of appliances and in heating equipment using miniature data loggers. Less detailed surveys estimate the use of each fuel for each major purpose through regression analysis over a large number of households.

Unit: Energy is measured in megajoules (mJ) or gigajoules (gJ) (net calorific value). In most cases, electricity and purchased heat are counted at final or delivered value. In some cases, primary energy is recorded. (See methodology for manufacturing sector).

- **Residential unit:** Energy consumption is calculated on a per capita or per household basis. In general, energy consumption depends both on the physical size and characteristics of the dwelling and on the number of people. As the number of people in a household declines, energy consumption per household declines, while the energy consumption per capita increases. As a rule of thumb, energy use for water heating, cooking and many appliances tends to vary with the square-root of household size.

For developing countries with large rural sectors or large numbers of homes without access to electricity, the share of homes in the urban sector and the share in each sector connected to grid electricity is an important factor in total residential energy consumption. The shares of homes using different kinds of biomass fuels are also important.

(c) **Limitations of the Indicator:** When energy consumption by end-use is not known, energy use per household is a valuable indicator of energy intensity, but it does not measure energy efficiency. Some important conclusions can be drawn, however, if the average winter temperature, ownership of energy-consuming appliances, and dwelling size are known. In a country with cold winters and high penetration of central heating systems, a low total consumption of energy for all purposes, relative to total floor area and the severity of winter climate, probably implies efficient heating practices. Conversely, high energy use relative to floor area in a country with mild winters may imply inefficiencies. However, since energy consumption habits vary so much, both among countries and among end-uses, few conclusions about “efficiency” can be drawn from the indicator on “residential energy use per household”. (See alternative definitions/indicators below).

(d) **Status of the Methodology:** The indicator, with some variations in the methodology, is used in many OECD countries. It is not widely used in developing countries.

(e) **Alternative Definitions/Indicators:**

- **Measurement of Efficiency:** A true energy efficiency can be expressed as energy use per unit of energy service. Examples of true energy efficiency would be litres of refrigerated volume at a given temperature divided by electricity use, lumens of light per watt of power consumed, or computer tera-flops per second divided by power consumption. In practice, these are not measured for large populations. Specific energy requirements for particular services, taking into account equipment efficiency and the time the service is used, are easier to estimate since these can be summed for a given household and compared with actual consumption.
- **Output (services provided):** Ideally, output units would be in energy services delivered, such as lumens of lighting, meals cooked, area and time heated, litres of hot water provided, litres refrigerated, kilogrammes of clothes washed, etc. In practice, such data are rarely available, even for individually metered homes. A suitable proxy for each service may be either the area heated (or lit), the number of people in the household receiving meals or hot water, and the average number of appliances, by type, per household or per capita.
- **Energy requirements:** If both energy use and equipment ownership for each major service is known, then specific energy requirements can be developed as follows:
 - Space heating: energy use per sq. meter heated or per sq. meter per degree day;
 - Energy use per capita for water heating and cooking; and
 - Energy use per year for each major appliance: refrigerator, freezer, clothes washer, dryer, dishwasher, TV, etc.

These specific energy requirements are related to, but not identical to, energy efficiencies. They differ in that they do not measure accurately the service provided, since, for example, a large refrigerator gives more service than a smaller one.

4. ASSESSMENT OF DATA

(a) Data Needed to Compile the Indicator:

- (i) Energy use in the residential sector (as indicated in section 3(b) above);
- (ii) Number of households and/or population.

(b) National and International Data Availability and Sources: Until the early 1980s, the residential or household sector was not well distinguished from the commercial/service sector in a majority of OECD member country energy statistics, particularly for liquid and solid fuels. In OECD countries, this distinction is now common. In developing countries, data often distinguish residential and commercial consumption of electricity and natural gas, but users of liquid and solid fuels are often not accurately identified. Many national energy balances thus fail to distinguish between the residential and commercial/service sectors. Such problems are indicated when data show electricity and natural gas consumption for both the residential and commercial/service sectors, while liquid and solid fuel consumption is shown for only one of the two sectors.

The other major challenge is to estimate the use of biomass fuels of all kinds in developing countries. This is important in almost all developing countries, even in urban areas.

Because of these two problems, aggregate national or international statistics must be used with caution.

Data on equipment are usually developed by electric and gas utilities, as well as by trade associations representing electric and gas appliance manufacturers. These have generally not been compiled in an internationally compatible form. No single agency collects all the data, except in a few IEA countries (United States, France, Netherlands) where detailed household surveys are undertaken. The World Bank has sponsored many one-time household surveys in developing countries, focusing either on rural or urban areas. As noted above, national or private energy companies often undertake marketing surveys. Oil industry sources in most IEA countries often compile data on oil-equipment sales and ownership.

(c) Data References:

IEA: Energy Balances of Member countries.
Energy Statistics of non-Member countries.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) Lead Agency: The lead agency is the International Energy Agency (IEA).

(b) Other Contributing Organizations: None.

6. REFERENCES

(a) Readings:

Schipper, L., Ketoff, A., and Kahane, A. “Estimating Residential Energy Use from Bottom-Up, International Comparisons. Ann. Rev. Energy 10. Palo Alto CA: Ann. Revs., Inc. 1985.

(b) Internet sites:

International Energy Agency: <http://www.iea.org>

World Bank: <http://www.worldbank.org/html/fpd/energy/>

INTENSITY OF ENERGY USE: TRANSPORTATION		
Economic	Consumption and Production Patterns	Energy Use

1. INDICATOR

- (a) **Name:** Intensity of Energy Use in Transportation.
- (b) **Brief Definition:** Energy consumption for transportation relative to the amount of freight or passengers carried and the distance traveled.
- (c) **Unit of Measurement:** Megajoules per tonne-kilometer (MJ/tonne-km) for freight, and Megajoules per passenger-kilometer (MJ/passenger-km) for passengers.
- (d) **Placement in the CSD Indicator Set:** Economic/Consumption and Production Patterns/ Energy Use.

2. POLICY RELEVANCE

- (a) **Purpose:** Transportation is a major consumer of energy, mostly in the form of fossil fuels, and the share of transportation in energy consumption is generally increasing. The indicator is a measure of how efficiently energy is used for moving goods and people. The indicator can be used to monitor trends in energy consumption for transportation and for international comparisons. Separation of freight and passenger travel is essential.
- (b) **Relevance to Sustainable/Unsustainable Development (theme-sub-theme):** Transportation serves economic and social development through distribution of goods and services and through personal mobility. However, energy consumption for transportation also leads to air pollution and climate change. Reducing energy intensity (increasing energy efficiency) in transportation can reduce the environmental impacts of transportation while maintaining the economic and social benefits.
- (c) **International Conventions and Agreements:** UNFCCC and its Kyoto Protocol. The European Union voluntary agreement on greenhouse gas (GHG) emissions from automobiles (to which Japanese and Korean producers have also agreed) require reductions in GHG emissions per kilometer from new automobiles.
- (d) **International Targets/Recommended Standards:** Many industrialized countries have targets for reducing energy use and carbon emissions from transportation, for which these energy intensities are key indicators.

(e) **Linkages to Other Indicators:** This indicator is one of a set for energy intensity in different sectors (manufacturing, transportation, commercial/services and residential), with the indicator for energy use per unit of GDP as an aggregate energy intensity indicator. These indicators are also linked to indicators for total energy consumption, greenhouse gas emissions, and air pollution emissions. This indicator is also linked to the indicator for distance traveled per capita by means of transport.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Energy consumption per unit of transportation activity is a key measure of how efficiently transportation systems convert energy into human mobility and goods distribution. Because it is not meaningful to add freight and passenger travel, these types of transportation must be disaggregated. Separating the two activity measures is generally not difficult, but separating the energy consumption is often complicated.

(b) **Measurement Methods:**

- **Energy Use:** Energy consumption should be measured for each kind of vehicle, including two-wheelers, automobiles, busses, small trucks, heavy trucks, and miscellaneous road vehicles, as well as trains, ships and aircraft for domestic transport, and even pipelines. In general, however, national energy balances are only disaggregated by fuel and broad traffic type: road, rail, water, and air. Considerable work is required to disaggregate road fuels consumed by vehicle type. It is important to take into account the different energy content and carbon emissions in different fuels and not simply add the weights or volumes of different fuels consumed (e.g., tonnes, or cubic metres in the case of natural gas). Some of the difficulties in disaggregating road fuels consumed by vehicle type are explained in Schipper et al. (1993). International air or marine transportation should not be included. Electric power consumption for rail, subway and trams, as well as electric road vehicles, should be converted to primary energy consumption, although there is no standard method for such conversion.

Unit: Preferable energy units are multiples of joules, usually terajoules (10^{12} J), petajoules (10^{15} J), or exajoules (10^{18} J), converted from weights or volumes of fuels at net heating values.

- **Output or Activity:** There are two different measures of activity. Vehicular activity, in vehicle-km, provides a measure of traffic that is important for transport policy and road and infrastructure planning. Most often, these data can be divided further into basic vehicle types. However, economic and human activity is better measured in passenger-km and tonne-km, taking into account utilisation or load factors. A bus carrying 20 passengers for 10 km (200 passenger-km) is less energy intensive (more energy efficient) than the same bus carrying 5 passengers for the same distance (50 passenger-km). Similarly, a fully-loaded truck is less energy intensive than the same truck carrying a partial load.

- **Indicators:**

(i) **Vehicle Intensities:** Energy consumption per vehicle-km by vehicle and fuel type is an important indicator, as many standards for air pollution (and more recently, goals for CO₂ emissions reduction) are expressed in terms of vehicle characteristics, i.e., emissions per vehicle-km.

(ii) **Modal Intensities:** Energy use per passenger-km or tonne-km should be disaggregated by vehicle type, i.e., two-wheeler, car/van, bus, air, local and long-distance rail, subway, tram, ship or ferry for passengers; and truck, rail, ship, air for freight.

Note: Aggregate energy intensity for travel or freight is a meaningful summary indicator, the value of which depends on both the mix of vehicles and the energy intensities of particular types of vehicles. The energy intensities of train and bus transportation per passenger-km are commonly 60 to 80 per cent less than the energy intensities for cars or air transportation. For freight, rail and ship transportation are commonly 65 to 90 per cent less than the energy intensive for trucking per tonne-km. These differences between modes are of the same order of magnitude as the differences between the lowest and highest energy intensities of transportation within each mode. It should also be noted that fuel consumption per vehicle-km also depends on traffic conditions as well as vehicle characteristics.

The energy intensity for a vehicle type depends on both capacity and capacity utilisation. A large vehicle that is fully loaded generally has a lower energy intensity per tonne-km than a fully-loaded smaller vehicle, but a small vehicle fully loaded will have a lower energy intensity than a large vehicle with the same load. Typical load factors for private cars are 1.5 people per car. Typical load factors for rail and bus vary from well below 10 per cent (e.g., United States city busses on average) to over 100 per cent of nominal capacity at peak times, and in many developing countries during most of the day. Typical load factors for trucking might be 60 to 80 per cent of weight capacity when loaded, but trucks commonly run 20 to 45 per cent of their kilometers empty, yielding a relatively low overall load factor. Under-utilized transport capacity means more pollution and road damage (and other impacts) per unit of transport service delivered, hence capacity utilisation itself is an important indicator of sustainable transportation.

(d) **Limitations of the Indicator:** Data availability may limit the disaggregation of the indicator to the desired level. Considerable work is often required to disaggregate energy balances into various modes of transportation.

Some countries' transportation energy statistics include fuel consumed by domestic airlines or shipping lines in international transportation. Efforts should be made to exclude such transportation and energy consumption from the indicators.

(e) **Status of the Methodology:** The methodology is in use in many developed countries.

(e) **Alternative Definitions/Indicators:** An alternative, simpler, broad measure of energy intensity for transportation could be average fuel consumption per vehicle for all vehicles, but the

results would be strongly influenced by the mix of vehicles, which varies enormously among countries and over time. In particular, it would be influenced by the number of two- and three-wheelers.

4. ASSESSMENT OF THE DATA

(a) **Data Needed to Compile the Indicator:**

- (i) Energy consumption by mode of transportation, vehicle type and fuel;
- (ii) Distance traveled by vehicles, passengers and freight, including load factors.

(b) **National and International Data Availability and Sources:**

Energy use by fuel type in each branch of road transport, rail, ship, and air transport is published by most transport ministries in OECD countries. National energy balances (as well as present IEA/OECD Energy Statistics) do not disaggregate road transport by mode. Few sources of energy data separate fuel consumption for rail or shipping into that for passengers and that for freight, but national or private rail and shipping organizations often do this. Energy consumption for local electric transport (commuter rail, subways, trams) is often published separately by national authorities.

Eurostat is a lead agency for collecting data on vehicle, passenger, and tonne-kilometers in Europe. Ministries of Transport in the United States, Canada, Japan, Australia and other countries, often through their statistical agencies, publish similar data. In developing countries, fewer data are available.

(c) **Data References:**

Eurostat: Transport Annual Statistics

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the International Energy Agency (IEA).

(b) **Other Contributing Organizations:** None.

6. REFERENCES

(a) **Readings:**

Schipper, L. and Marie-Lilliu, C., 1999. *Carbon Dioxide Emissions from Transport in IEA countries: Recent lessons and long-term Challenges*. KFB Meddelande 1999:11. Stockholm.

Schipper, L., Figueroa, M.J., Price, L., and Espey, M., 1993. "Mind the Gap: The Vicious Circle of measuring automobile fuel use". *Energy Policy* (October).

Samaras, Z., et al. 1999. *Study on Transport Related Parameters of the European Road Vehicle Stock*. Prepared for Eurostat and DG-7. Thessalonikai: Laboratory of Applied Thermodynamics, Aristotle University.

Schipper, L., and Tax, W., 1994. “Mind the Gap”. *Transport Policy*.

(b) **Internet site:** IEA: <http://www.iea.org>

GENERATION OF INDUSTRIAL AND MUNICIPAL SOLID WASTE		
Economic	Consumption and Production Patterns	Waste Generation and Management

1. INDICATOR

- (a) **Name:** Generation of Industrial and Municipal Solid Waste.
- (b) **Brief Definition:** The generation of industrial and municipal solid waste is derived from the production of waste on a weight basis at the point of production.
- (c) **Unit of Measurement:** Tonnes per capita per annum.
- (d) **Placement in the CSD Indicator Set:** Economic/Consumption and Production Patterns/Waste Generation and Management.

2. POLICY RELEVANCE

- (a) **Purpose:** The main purpose is to represent the production of solid waste produced by all types of human settlements activity.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Generation of waste as an indicator is intimately linked to the level of economic activity in a particular country. It is also an indication of the patterns of consumption of raw materials. Wealthier economies tend to produce more waste. In many developed countries, a reduction in the volume of waste generated is an indication of changes in consumption patterns with respect to raw materials and increase in recycling and reuse.
- (c) **International Conventions and Agreements:** No international agreements exist for reduction in solid waste production.
- (d) **International Targets/Recommended Standards:** Some countries have set national targets for the reduction of solid waste within a specified time frame.
- (e) **Linkages to Other Indicators:** This indicator is intimately linked to other socio-economic and environmental indicators especially those related to income-level and economic growth. Those would include: rate of growth of urban population, Gross Domestic Product (GDP) per capita, waste disposal, and waste recycling.

3. METHODOLOGICAL DESCRIPTION

- (a) **Underlying Definitions and Concepts:** The precise definition of what constitutes solid waste is variable, but principally it can be considered as that material which has no further useful

purpose and is discarded. It is, therefore, perceived to have no commercial value to the producer. This does not, however, preclude it being of value to some other party. Solid waste is generally produced in three ways: through the production and consumption of goods and services; through the processing of wastes from these services; and through end-of-pipe control or treatment of emissions. Waste is generally reported based on source under the following categories: mining and construction wastes; energy production wastes; agricultural wastes; municipal wastes; and industrial waste or sludge.

Industrial wastes can be expressed in terms of tonnes per annum or in some cases related to the production volume of the product being processed or manufactured. Municipal wastes are produced by a variety of establishments in the urban environment in addition to households, including institutions such as schools, government buildings, commercial establishments such as hospitals and hotels, and some scattered sources of hazardous wastes.

(b) **Measurement Methods:** Solid waste production at source is difficult to measure for municipal wastes, except by using intensive studies at the household level. It is highly dependent on the mode of collection by the local authorities and whether or not the waste is actually disposed of in the official system. For industrial wastes, the volume of waste can most easily be measured as the weight which leaves the factory compound.

(c) **Limitations of the Indicator:** Solid waste production is expensive to measure at source; thus, consistent and comparable statistics are difficult to obtain. The indicator does not distinguish between toxic and hazardous wastes, and those more benign; nor does it cover waste stored on site. It is often confused with the amount of solid waste disposed, which is measured by recording the weight or volume of waste disposed at the disposal or treatment site.

Volume of waste produced may be significantly affected by the presence of particular wastes. For example, the inclusion of construction wastes in domestic refuse will greatly affect the waste density and hence the indicator. The actual method of storage of waste and its moisture content will also affect the waste density. The volume of waste produced is often affected by seasonal variations in the production of various agricultural foodstuffs.

(d) **Status of the Methodology:** Not Available.

(e) **Alternative Definitions/Indicators:** The use of solid waste disposal, which is easier to measure, may be a suitable proxy measure for this indicator in some countries.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The weight of waste produced by municipal and industrial sources; and population.

(b) **National and International Data Availability and Sources:** Generally, data is scattered, may be difficult to obtain, and consist of only rough estimates. Where it is available, data for municipal wastes can be obtained from studies of representative cross-section of the

population. For industrial sources, data on the volume of waste is monitored by waste collection contractors.

(c) **Data References:** At the international level, specialised research surveys have been conducted by the Settlement Infrastructure and Environment Programme of the United Nations Centre for Human Settlements (UNCHS or Habitat). At the national level, data sources would include ministries responsible for urban affairs and the environment, and statistical agencies.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Centre for Human Settlements (Habitat). The contact point is the Head, Urban Secretariat, UNCHS (Habitat): fax no. (254 2) 623080.

(b) **Other Contributing Organizations:** The United Nations Environment Programme (UNEP), the World Bank, the World Health Organization (WHO), the Organisation for Economic Co-operation and Development (OECD), and Eurostat are involved in the development of this indicator.

6. REFERENCES

(a) **Readings:** Various publications from the Settlement Infrastructure and Environment Programme, Habitat.

UNEP. *Environmental Data Report*. 1993-94.

OECD. *OECD Environmental Data Compendium 1995*. OECD, Paris, 1995.

Eurostat. *Europe's Environment: Statistical Compendium for the Dobris Assessment*. 1995.

(b) **Internet site:**

UNCHS (Habitat) home page: <http://www.urbanobservatory.org/indicators/database>

GENERATION OF HAZARDOUS WASTES		
Economic	Consumption and Production Patterns	Waste Generation and Management

1. INDICATOR

- (a) **Name:** Generation of Hazardous Wastes.
- (b) **Brief Definition:** The total amount of hazardous wastes generated per year through industrial or other waste generating activities, according to the definition of hazardous waste as referred to in the Basel Convention and other related conventions (see sections 3(e) and 7 below).
- (c) **Unit of Measurement:** Metric tonnes or tonnes per unit of Gross Domestic Product (GDP).
- (d) **Placement in the CSD Indicator Set: Agenda 21:** Economic/Consumption and Production Patterns/Waste Generation and Management.

2. POLICY RELEVANCE

- (a) **Purpose:** It provides a measure of the extent and type of industrialization in a country and in this connection the nature of the industrial activities including technologies and processes generating hazardous wastes.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The generation of hazardous wastes has a direct impact on health and the environment through exposure to this kind of wastes. Normally, long-term exposure is required before the manifestation of harmful effects. Reduced generation of hazardous wastes may indicate either reduced industrial activities in a country, introduction of cleaner production in the industrial processes, or changing patterns in consumers' habits, which implies savings in the use of energy and raw material as well as improving protection of landscapes or change in statistical records. The introduction of environmentally sound management systems for hazardous wastes implies reduction of risks to health and environment due to lesser exposure to hazardous wastes.

A review of different categories of wastes being generated provides an indication of the nature of industrial activities being undertaken in a country. In the case of other hazardous wastes such as hospital wastes, it is first of all a measure of the size of the population, and secondly, the percentage of this population being treated in hospitals and other medical care units.

(c) **International Conventions and Agreements:** The following conventions and agreements pertain to this indicator: *Basel Convention* on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; *Bamako Convention* on the Ban on the Import into Africa and the Control of Transboundary Movement of Hazardous Wastes within Africa; *Waigani Convention* to Ban the Importation of Hazardous and Radioactive Wastes into Forum Island Countries, and to Control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region; *Central American Agreement*; Protocol for the *Prevention of Pollution of the Mediterranean Sea* by Transboundary Movements of Hazardous Wastes and Their Disposal; *Organisation for Economic Co-operation and Development (OECD)*, *Council Decisions*, and *EC Council Directives* and Regulation on Waste and Hazardous Wastes.

(d) **International Targets/Recommended Standards:** No quantitative targets exist at the international level. In Agenda 21, Chapter 20, an overall target of "preventing or minimizing the generation of hazardous wastes as part of an overall integrated cleaner production approach" is provided. Targets exist at the national level in many countries.

(e) **Linkages to Other Indicators:** This indicator is linked to the amount of hazardous wastes exported or imported; as well as to the indicators on area of land contaminated by hazardous wastes, and expenditures on hazardous waste treatment or disposal. It is further directly connected to indicators related to material consumption and energy use, including intensity of material use, annual energy consumption per capita, and intensity in energy use. In a wider context, it is also related to the indicators on international cooperation concerning implementation of ratified global agreements.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** In order to facilitate the definition of whether a waste, as defined under the Basel Convention, is hazardous or not, the Technical Working Group established under the Basel Convention has developed lists of wastes that are hazardous and wastes that are not subject to the Convention, as well as an outline of a review procedure for the inclusion, or deletion, of wastes from those lists. These lists were approved at the Fourth Meeting of the Conference of the Parties (UNEP, 1998). It is expected that such lists will considerably facilitate the development and application of indicators of hazardous wastes as mentioned later.

In relation to the definition of hazardous wastes under the Basel Convention (article 1 of the Convention), it should be noted that under article 3 of the Convention, Parties should inform the Secretariat of the Convention (SBC) of wastes, other than those listed in Annexes I and II of the Convention, considered as hazardous under national legislation. Such information is being disseminated by the Secretariat to all Parties in order to enable them to respect such definitions in relation to planned transboundary movements involving such wastes.

(b) **Measurement Methods:** In relation to the Basel Convention, its Secretariat requests information from the Parties to the Convention on a yearly basis regarding the amount of hazardous wastes generated at the national level. This information is being introduced in the

SBC database, which includes data and information on hazardous wastes related issues in accordance with Articles 13 and 16 of the Convention. Other agencies, such as OECD, are also collecting information on hazardous wastes generated by OECD countries.

(c) **Limitations of the Indicator:** The problem of defining whether a waste is hazardous or not will, in some cases, cause difficulties in relation to the use of an indicator on hazardous wastes generation. The quantity of the hazardous wastes generated alone may not reflect changes towards a more "sustainable" society. Consideration of the nature of the different kinds of hazardous wastes generated would be a better indicator of sustainable development progress. Availability and accuracy of data represents another limitation of this indicator. Finally, the nature of the waste itself makes it sometimes difficult to use them as indicators because wastes are often mixed and not produced to specifications.

(d) **Status of the Methodology:** The methodology has not at present been considered by Parties of the Basel Convention. However, Decision V/14 of the Fifth Meeting of the Conference of the Parties requested the Secretariat of the Convention to explore possibilities of developing indicators on hazardous wastes to facilitate decision-making and report thereon to the Conference of the Parties at its sixth meeting

(e) **Alternative Definitions:** The amounts and type of specific waste streams generated per year through industrial or other waste generating activities as defined in the Basel Convention represents an alternative indicator which would allow for normalization based on hazardous properties of the wastes (e.g., infectious, flammable, toxic, corrosive, ecotoxic).

Consideration of the waste management infrastructure at national level could constitute an indicator on the status of addressing hazardous wastes related issues in any particular country.

In general, hazardous waste indicators, in order to be useful for management, have to have some resonance with policy makers whether they are within the local community, or at the national level. There is, therefore, the need to develop hazardous waste indicators that reflect concern for the hazardous properties of waste, the implications of their impacts on the environment, on ecosystems and their functioning, as well as on human health. A profile or set of indicators that can address these multiple issues and meet the needs of a variety of users is essential. Such indicators would be broader than the indicator on generation of hazardous wastes as referred to in this paper and the Secretariat of the Basel Convention will take the lead in the further development of indicators on hazardous wastes in collaboration with relevant institutions.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Data on the generation of hazardous wastes.

(b) **National and international Data Availability and Sources:** Data are available for many developed countries, but, so far, few developing countries are collecting data on hazardous waste generation. The Parties of the Basel Convention are requested to provide data to the Conference of the Parties through the Secretariat of the Convention on a yearly basis.

Assistance to developing countries will be needed in identifying the main hazardous waste streams being generated in their countries in order to prepare and maintain inventories of hazardous wastes. In this connection difficulties may be encountered in relation to hazardous waste generation by small scale enterprises, since they are scattered and often operating on an informal basis and are therefore not registered. It may be less of a problem to identify amounts of hazardous waste generated by larger industries, since they are normally registered.

(c) **Data References:** The primary source of data at the international level is the Secretariat of the Basel Convention.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the Secretariat to the Basel Convention (SBC), United Nations Environment Programme (UNEP). The contact point is the Executive Secretary, SBC; fax no. (41 22) 797 3454, e-mail: sbc@unep.ch.

(b) **Other Contributing Organizations:** Other organizations include: UNEP, ICRED, OECD, European Topic Centre for Wastes, Denmark, US Environmental Protection Agency, Institute for Applied Environmental Economics, the Netherlands, European Institute of Business Administration, France, Technical University, Graz, Austria, Wuppertal Institute, CEFIC, Netherlands National Institute of Public Health and Environment, Canada. Additional organizations with expertise in the domaine of hazardous waste generation are: UN-ECE (Transport); IMO (Maritime); FAO (Pesticides); WHO; ILO; IAEA; UNIDO, SPREP.

6. REFERENCES

(a) **Readings:**

Basel Convention for the Control of Transboundary Movement of Hazardous Wastes and their Disposal.

Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa, 1991

Waigani Convention to Ban the importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region.

Protocol for the Prevention of Pollution of the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and Their Disposal.

Bakkes, J.A. et al. *An Overview of Environmental Indicators: State of the Art and Perspectives*. Environment Assessment Technical Reports. Netherlands National Institute of Public Health and Environmental Protection in cooperation with the University of Cambridge, United Kingdom. June 1994.

Å. Granados and P.J. Peterson “*Hazardous Waste Indicators for National Decision-makers*”, Journal of Environmental Management (1999).

1. Reporting and Transmission of Information under the Basel Convention for the year 1993. Geneva, 1996.
2. Reporting and Transmission of Information under the Basel Convention for the year 1994. Geneva, June 1997, document SBC No. 97/014, 175 p.
3. Reporting and Transmission of Information under the Basel Convention for the year 1995. Geneva, May 1999, document SBC No. 99/004, 130 p.
4. Reporting and Transmission of Information under the Basel Convention for the year 1996. Geneva, June 1999, document SBC No. 99/006, 178 p.
5. Reporting and Transmission of Information under the Basel Convention for the year 1997: Part II (Statistics on generation and transboundary movements of hazardous wastes and other wastes). Basel Convention Series SBC No. 99/001, Geneva, November 1999, 148 p.

(b) **Internet sites:**

Secretariat of the Basel Convention: www.basel.int

European Topic Centre on Waste: www.etc-waste.int

GENERATION OF RADIOACTIVE WASTE		
Economic	Consumption and Production Patterns	Waste Generation and Management

1. INDICATOR

- (a) **Name:** Generation of Radioactive Waste.
- (b) **Brief Definition:** Radioactive waste arises from various sources, such as nuclear power generation and other nuclear fuel cycle related activities, radioisotope production and use for applications in medicine, agriculture, industry and research.
- (c) **Unit of Measurement:** cubic metre (m³) per annum.
- (d) **Placement in the CSD Indicator Set:** Economic/Consumption and production patterns/Waste generation and management.

2. POLICY RELEVANCE

- (a) **Purpose:** The purpose is to represent the annual amounts of various radioactive waste streams that arise from the nuclear fuel cycle and from nuclear applications. Quantitative values are required so that appropriate resources (e.g., financial, human, etc.) for the proper management of these types of waste can be allocated.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Radioactive waste, if not properly managed, can have a direct impact on health and the environment through exposure to ionizing radiation. In order to protect human health and the environment, appropriate waste management strategies and technologies must be employed. Fundamental principles of radioactive waste management involve minimization of waste arisings and systematically considering the various steps in treatment, conditioning, storage and disposal. Minimization of waste arisings has a positive impact regarding sustainability, as it reduces the pressure on the environment and the commitment of resources. Waste management strategies are to confine and contain the radionuclides within a system of engineered and natural barriers, so that any releases to the environment are small compared to natural background.
- (c) **International Conventions and Agreements:** The Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management is open for signature and has about 2/3 the ratifications needed to enter into force. This convention binds Parties to manage spent nuclear fuel and radioactive wastes using sustainable waste management practices.
- (d) **International Targets/Recommended Standards:** The International Atomic Energy Agency (IAEA) has established Safety Standards (Fundamentals, Requirements and Guides) applicable to the management of radioactive wastes. It has also established Basic Safety

Standards for the Protection of Humans against Ionizing Radiation, that are consistent with recommendations of the International Commission on Radiological Protection (see references).

(e) **Linkages to Other Indicators:** A large portion of radioactive waste arises from practices within the nuclear fuel cycle, therefore a large production is usually related to a significant generation of electricity by nuclear means with an equivalent reduction of environmental impacts by other energy sources (Chapter 4 of Agenda 21). This implies a reduction in the release of atmospheric pollutants; notably the greenhouse gases, contributing to the protection of the atmosphere (Chapter 9 of Agenda 21). Since some radioactive waste arises from medical applications, such as treatment with radioisotopes or sealed radiation sources and nuclear medicine research, a link exists with the extent of these applications and with the protection and promotion of human health (Chapter 6 of Agenda 21). Additional links are with the transfer of environmentally sound technology (Chapter 34 of Agenda 21) and with the environmentally sound management of hazardous waste (Chapter 20 of Agenda 21).

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Principles regarding the protection of future generations are formulated in the International Atomic Energy Agency's Safety Fundamentals (Ref. 3). IAEA definitions and categories of radioactive waste are given in relevant standards (see list of references in 7(b) below).

(b) **Measurement Methods:** For radioactive waste in packaged/conditioned form, the volume should be the actual volume in cubic metres (m^3) as recorded in the appropriate waste package registry. For radioactive waste not yet in conditioned form, the volumes used should be those based on the most probable assumed conditioning method to be used later for disposal.

(c) **Limitations of the Indicator:** The volume of radioactive waste is only a first approximation of its hazard. Actual impact on human health and the environment requires a site specific analysis taking into account the isotopic and chemical composition of the waste.

(d) **Status of the Methodology:** Safety assessment of the radiological hazard of radioactive waste disposal is considerably advanced and is used as the basis for regulatory decisions in many countries.

(e) **Alternative Definitions/Indicators:** None.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The volumes of the various radioactive waste types arising annually, expressed in cubic metres per annum (m^3/a).

(b) **National and International Data Availability and Sources:** At the national level, the volume of radioactive waste arisings can be obtained from the waste accountancy records maintained by the various waste generators or, in consolidated form, from national regulatory bodies. Almost one third of the IAEA member states keep some type of national radioactive

waste registry. The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, when it comes into force, will required contracting parties to maintain a national radioactive waste inventory. Through this mechanism, both the availability and the quality of data is likely to increase over time.

(c) **Data References:** The primary source for data includes national or state level governmental organisations. A secondary source may be databases managed by international organisations such as the International Atomic Energy Agency (IAEA) or OECD/NEA.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the International Atomic Energy Agency (IAEA). The contact point is the Director, IAEA; fax no. (43-1) 260-07.

(b) **Other Contributing Organizations:** Governments and inter-governmental organizations, possibly EC, OECD/NEA and UNEP, non-governmental and other organizations, such as UNIPED and EPRI.

6. REFERENCES

(a) **Readings:**

IAEA's Safety Guides (Safety Series No. 111-G-1.1), 1994. *Classification of Radioactive Waste*.

IAEA's Safety Standards (Safety Series No. 111-S-1), 1995. *Establishing a National System for Radioactive Waste Management*.

IAEA's Safety Fundamentals (Safety Series No. 111-F), 1995. *The Principles of Radioactive Waste Management*.

IAEA's Safety Standards (Safety Series No. 115), 1996. *International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources*.

ICRP Publication 46, 1996. *Radiation Protection Principles for the Disposal of Solid Radioactive Waste*, Pergamon Press, Oxford.

ICRP Publication 60, 1991. *1990 Recommendations of the International Commission on Radiological Protection*. Annals of the ICRP 21 (1- 3), Pergamon Press, Oxford.

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, as adopted in September 1997.

(b) **Internet site:** Worldatom: www.iaea.org

WASTE RECYCLING AND REUSE		
Economic	Consumption and Production Patterns	Waste Generation and Management

1. INDICATOR

- (a) **Name:** Rate of Waste Recycling and Reuse.
- (b) **Brief Definition:** This is the volume of waste which is reused or recycled based on the volume actually generated at source on a per capita basis.
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Economic/Consumption and Production Patterns/Waste Generation and Management.

2. POLICY RELEVANCE

- (a) **Purpose:** The purpose of this indicator is to measure the proportion of waste which is reused or recycled.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Solid waste recycling and reuse is an important component of a sustainable approach for solid waste management. As communities expand, the available sinks for waste disposal will become limited and necessitate the transport of waste for greater distances. The ecological footprint of urban areas will therefore be greatly increased. The concept of the ecological footprint developed by Rees and Wackernagel (1994) is defined as the area of land required by a given group of people (household, city or country) to provide the goods and services it consumes, and to assimilate its waste products, wherever that land may be located. By stimulating recycling and reuse, landfill capacity is conserved and operational costs for solid waste management reduced. There is also the benefit of increased income generation for the urban poor through recycling schemes.

This indicator has a different relevance for developed and developing countries. In developed countries, it represents a willingness on the part of national and local governments to consider waste recycling as an environmentally sound policy option, whereas in developing countries, it represents the level of the informal sector waste recycling industry, which is usually promoted for its income-generating potential.

- (c) **International Conventions and Agreements:** No international agreements apply.

(d) **International Targets/Recommended Standards:** Some developed countries have established voluntary targets for the proportion of waste recycled.

(e) **Linkages to Other Indicators:** This indicator is intimately linked to other solid waste management indicators. It is also associated with some of the indicators for human settlements and financial mechanisms, such as percent of population in urban areas, and environmental protection expenditures.

3. **METHODOLOGICAL DESCRIPTION**

(a) **Underlying Definitions and Concepts:** The proportion of waste recycled requires accurate estimation of the proportion of waste generated, as much waste is recycled or pre-sorted at the household level before it reaches the formal waste management system. For this purpose, the measurement of the indicator is often completed by means of a specialised survey. Generally, the proportion of wastes recycled is reported based on the type of recyclable components. For example, metals, plastics, paper, glass, textiles, organic, etc. It should be noted that due to pre-separation of inorganic recyclables, organic waste often constitutes 50% of the total volume of the waste from developing countries.

In addition to recycling at the industrial and household level in many cities, waste is recycled outside the producer's premises, either on the street, by formal waste management employees, or at the dumpsite. The indicator must consider all sources of recycling and the additional methods combine to give a complex expression or the overall percentage of recycling. The amount of recycling undertaken outside the producer's premises has to be estimated from detailed surveys of all the dealers in recycled material and requires an inventory of all small-scale reproducers who recycle wastes.

(b) **Measurement Methods:** The volumes of waste produced and the percentage recycled at the industrial and household levels are measured by simple weighing. At the municipal level, the volume recycled is best estimated by quantifying the output by the producers of recycled products and the volume of waste that is disposed of by the formal sector.

(c) **Limitations of the Indicator:** The indicator should be expressed in terms of particular components to be useful in determining the actual recycling rate. If all components are lumped together on a weight or volume basis, the indicator is not particularly useful. Some recycling, for example, waste oils and solvents, is not captured by this solid waste indicator.

(d) **Status of the Methodology:** Not Available.

(e) **Alternative Definitions/Indicators:** Sometimes, it is worthwhile to express the % recycled based on the usage of a particular commodity, for example volume of aluminium recycled per volume produced. This enables a better estimation of the level of resource conservation, and for some industries, could be done on a national basis.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Weight of waste produced by component; weight of waste disposed or discarded, by component; weight of waste recycled by the formal and informal sectors, by component.

(b) **National and International Data Availability and Sources:** Generally, there is little problem in obtaining the data from municipal or industrial records. However, data can be scattered and time consuming to compile for indicator purposes. Some informal sector industries are reluctant to declare their activities and data collection from them could be difficult. At the international level, specialised research surveys have been conducted by the Settlement Infrastructure and Environment Programme of the United Nations Centre for Human Settlements (UNCHS or Habitat). Within countries, data sources would include national and local agencies responsible for urban affairs and the environment.

(c) **Data References:** Not Available.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Centre for Human Settlements (Habitat). The contact point is the Head, Urban Secretariat, UNCHS (Habitat): fax no. (254 2) 623080.

(b) **Other Contributing Organizations:** The United Nations Environment Programme (UNEP), the World Health Organization (WHO), and industry associations would be interested in the development of this indicator.

6. REFERENCES

(a) **Readings:**

Various publications from the Settlement Infrastructure and Environment Programme, Habitat.

UNEP. *Environmental Data Report*. 1993-94.

Rees W. and Wakernagel M., *Ecological Footprints and Appropriated Carrying Capacity: Measuring the Natural Capital Requirements of the Human Economy*, in Investing in Natural Capital: the Ecological Economics Approach to Sustainability, A.M Jannsson, M. Hammer, C. Folke and R. Constanza, eds. Washington Island Press, 1994.

United Nations Department of Economic and Social Affairs, *Measuring Changes in Consumption and Production Patterns: A Set of Indicators*, (ST/ESA/264), 1998.

(b) **Internet site:**

UNCHS (Habitat) home page: <http://www.urbanobservatory.org/indicators/database>

DISTANCE TRAVELLED PER CAPITA BY MODE OF TRANSPORT		
Economic	Consumption and Production Patterns	Transportation

1. INDICATOR

- (a) **Name:** Distance travelled per capita by mode of transport.
- (b) **Brief Definition:** The number of kilometres travelled per person in a given year by different modes of transport.
- (c) **Unit of Measurement:** Kilometers per year.
- (d) **Placement in the CSD Indicator Set:** Economic/Consumption and Production Patterns/Transportation.

2. POLICY RELEVANCE

- (a) **Purpose:** This indicator can contribute to monitoring the environmental impact and sustainability of the systems for personal mobility in a particular country or area.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Travel is an essential part of the economic and social life of a country. Non-motorised travel has low environmental impact, and due to the level of physical exertion involved, also brings health benefits. However, it is only suitable for local journeys. Motorised travel is the only suitable means of travelling longer distances, but has greater environmental and social impacts, such as pollution, global warming, and accidents. Sustainability implies using the most appropriate mode of transport for the journey in question and decoupling travel from economic development. Policies are needed which reduce the need for travel, support a shift towards less environmentally damaging means, provide incentives for changes in lifestyle, increase safety, and improve the standard of public transport (transit).
- (c) **International Conventions and Agreements:** Not applicable, see section 3 (d) below.
- (d) **International Targets/Recommended Standards:** No international targets have been established.
- (e) **Linkages to Other Indicators:** This mobility indicator is linked to GDP per capita, time spent on travelling, percent of population in urban areas, urban transit and automobile use, fossil fuel use by automobiles, infrastructure expenditure and ambient concentrations of pollutants in urban areas. Various other indicators of land use and settlement patterns are also related.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The aim of this indicator is to quantify the use of different modes of transport by people (passengers). The indicator should be broken down into the following modes of transport: walking, cycling, passenger cars, motorcycles and mopeds, buses and coaches, train, ship, and plane. For developing countries, other means of transport (donkey, ox-cart, rickshaw, etc.) may need to be considered. A further breakdown by purpose would provide useful additional information.

(b) **Measurement Methods:** Total passenger-kilometers travelled per year divided by the total population, according to the different modes of transport.

(c) **Limitations of the Indicator:** The reliability of passenger-kilometre statistics, with the exception of bus and train, leaves much to be desired. The indicator has an inbuilt bias against the longer distance modes of transport, especially planes. To some extent this can be offset by splitting the indicator by purpose (shopping, travel to school or work, professional travel, pleasure). Ideally, the indicator would measure the distance travelled by the population of a country both within and outside their country. In practice, national passenger-kilometer statistics normally include movements of all people within the national territory (regardless of their normal place of residence), and exclude movements outside their territory. This indicator measures only distance travelled by passengers and does not cover goods transport. In order to monitor efficiency changes in the transport sector, an indicator such as transport performance divided by vehicle performance (tonne-kilometers/vehicle-kilometers) could be considered.

(d) **Status of the Methodology:** An agreed methodology at the international level concerning passenger transport statistics has not yet been established and no specific projects on this direction are known at present. National definitions are being used.

(e) **Alternative Definitions/Indicators:** An alternative would be to use number of trips for different purposes. This would counter the bias against longer distance modes.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:**

- (i) Passenger-kilometer data by means of transport (as indicated in section 3(a) above);
- (ii) Population.

(b) **National and International Data Availability and Sources:** Passenger-kilometer data for at least some modes of transport, and population data are regularly available for most countries at the national level; and for some countries, at the sub-national level. Both types of data are compiled by and available from national statistical offices and various professional organizations.

(c) **Data References:**

Eurostat: Transport Annual Statistics.

ECMT: Statistical Trends in Transport.

UNECE: Annual Bulletin of Transport Statistics for Europe.

International Road Federation: World Road Statistics.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is Eurostat (the Statistical Office of the European Communities). The contact point is Ms. Inger Oehman, fax no, (35-2) 4301-37278.

(b) **Other Contributing Organizations:** Other organizations involved in the indicator development include International Road Transport Union (IRU) and the United Nations Economic Commission for Europe (UNECE).

6. REFERENCES

(a) **Readings:**

“EU transport in figures”, Statistical Pocketbook, EU Commission, 1999.

“Transport and Environment – Statistics for the Transport and Environment Reporting Mechanism (TERM) for the European Union”, 2000.

“Are we moving in the right direction? Indicators on transport and the environment integration in the EU”, European Environment Agency, 2000.

(b) **Internet site:** <http://europa.eu.int/comm/eurostat>

NATIONAL SUSTAINABLE DEVELOPMENT STRATEGY		
Institutional	Institutional Framework	Strategic Implementation of Sustainable Development

1. INDICATOR

- (a) **Name:** National Sustainable Development Strategy.
- (b) **Brief Definition:** A national sustainable development strategy aims to build upon and harmonize the various sectoral economic, social and environmental policies and plans existing in a country to ensure socially responsible economic development while protecting the resource base for the benefit of future generations.
- (c) **Unit of Measurement:** Qualitative Assessment. There are two dimensions: Does a country have a National Sustainable Development Strategy or not (yes/no measure) and Is the Strategy Being Implemented and the degree of its effectiveness.
- (d) **Placement in the CSD Indicator Set:** Institutional/Institutional Framework/Strategic Implementation of SD.

2. POLICY RELEVANCE

- (a) **Purpose:** The existence and implementation of a national sustainable development strategy reflects a country's commitment to put in place the institutional mechanisms needed to take a systematic and holistic approach to achieving sustainable development through integrated economic, social and environmental policy planning.
- (b) **Relevance to Sustainable/Unsustainable Development (the me/sub-theme):** Agenda 21 and the Programme for the Further Implementation of Agenda 21 approved by the 19th Special Session of the General Assembly (Earth Summit +5) called upon governments of all countries to adopt national strategies for sustainable development. These documents affirmed that sustainable development cannot be achieved without greater integration at all policymaking levels. National sustainable development strategies are an essential planning framework that unites priorities in the social, economic and environmental sectors. A well-designed, fully integrated and effectively implemented sustainable development strategy can enhance national prospects for economic growth and employment while protecting the environment. National sustainable development strategies are necessary in mobilizing and focusing society's efforts towards achieving sustainable development.
- (c) **International Conventions and Agreements:** The United Nations Conference on Environment and Development, 1992 (The Earth Summit) and the 19th Special Session of the General Assembly (Earth Summit +5) called upon governments to prepare national strategies for sustainable development.

(d) **International Targets/Recommended Standards:** The Programme for the Further Implementation of Agenda 21 (Earth Summit +5) approved by the 19th Special Session of the General Assembly stated that, “By the year 2002, the formulation and elaboration of national strategies for sustainable development that reflect the contributions and responsibilities of all interested parties should be completed in all countries, with assistance provided, as appropriate, through international cooperation, taking into account the special needs of the least developed countries. The OECD has set 2005 as the target for the implementation of national sustainable development strategies.

(e) **Linkages to Other Indicators:** National Sustainable Development Strategies seek to provide an overall framework and organizing principle for the achievement of sustainable development and hence are linked to many, if not all, of the indicators in the framework, but most particularly other institutional indicators.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** A national sustainable development strategy may be distinguished by having the following key characteristics:

- Process and outcome oriented;
- Built on existing processes and strategies;
- Comprehensive and integrated, bringing together objectives in the economic, social and environmental sectors;
- Demonstrates Awareness of future needs and goals;
- Iterative with regular monitoring, learning, feedback and improvement;
- Nationally owned and country led;
- People centred and participatory, engaging all levels and segments of society;
- Engages high-level political commitment with support from influential lead institution, such as Ministries of Planning and Finance or other key coordinating units;
- Based on national political realities and capabilities;
- Implementable, with short term and tangible objectives, including a practical plan for internal and external resource mobilization;
- Targeted with clear budgetary priorities;
- Promotes regular and transparent communication and information exchange;

(b) **Measurement Methods:** There are two levels of measurement involved. One level covers the existence of a national strategy for sustainable development and the other the effectiveness with which it is being implemented and the results achieved by having such a strategy.

Whether a country has formulated a national strategy for sustainable development can be monitored through periodic surveys or through the national reports submitted by countries to the Commission on Sustainable Development through the national information reporting system maintained by the Department of Economic and Social Affairs. Countries themselves can quickly verify whether they have prepared or formulated such a strategy.

The extent to which the strategy is actually being implemented and the effectiveness of its implementation would require preparation of a national system of monitoring and evaluation which should be part of the strategy formulation process itself. In this sense, use of the indicators set out in this book would provide an important means for assessing whether a national strategy is being effectively implemented.

(c) **Limitations of the Indicator:** There are no agreed international definitions or standards regarding what constitutes a national sustainable development strategy except in the general terms as set out in Agenda 21 and the Programme for the Further Implementation of Agenda 21. The key characteristics referred to above are based on consultations held among government representatives in three regional meetings convened by the Department of Economic and Social Affairs. Work has also been done by the OECD and some national governments to better define what a national sustainable development strategy process might entail, but none of these efforts have been officially endorsed by respective governing bodies. At this stage, the indicator and its measurement are largely qualitative in nature and difficult to measure objectively. Further work is required to develop criteria for assessing the effectiveness of national strategies once they are formulated.

(d) **Status of the methodology:** There is currently no internationally agreed methodology for this indicator.

(e) **Alternative Definitions:** Countries have been involved in a wide variety of planning and strategy formulation processes over the years and many on-going demands are made on countries for the formulation of comprehensive development frameworks, poverty reduction strategies, national conservation strategies, national environment policy frameworks or plans, national environmental action plans and other development strategies. Countries have to sort through these various possibilities and find approaches that are most suitable for country-specific conditions. International organizations for their part should work towards a convergence that brings together different approaches. National sustainable development strategies have the advantage of seeking to integrate the key economic, social and environmental dimensions of development.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile for the Indicator:** National country reports, policy reports, legislative reports, and various planning documents.

(b) **National and International Data Availability and Sources:** The UN-DESA compiles country reports that are organized into a national information database. At the national level, information is available through government planning and environment ministries.

(c) **Data References:** <http://un.org/esa/agenda21/natlinfo.htm>

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Department of Economic and Social Affairs (DESA). The focal point is the National Information, Strategies and Institutions Branch, Division for Sustainable Development with fax no: (212) 963-1267.

(b) **Other Organizations:** The United Nations Development Programme (UNDP); International Institute for Sustainable Development (IISD); Organization for Economic Cooperation and Development (OECD), Department for International Development (DFID)

6. REFERENCES

(a) Readings:

Carew-Reid, et. al., 1994. Strategies for National Sustainable Development: A Handbook for their Planning and Implementation, The World Conservation Union (IUCN).

United Nations, 1997. Earth Summit + 5: Programme for the Implementation of Agenda 21.

United Nations, 1992, Agenda 21: The United Nations Programme of Action from Rio.

United Nations, 2000. Reports of the Regional Consultative Meetings on Sustainable Development (Asia and the Pacific, Africa and Latin America and the Caribbean). See the DSD National Information Web Site: <http://un.org/esa/agenda21/natlinfo.htm>.

DFID, "Strategies for Sustainable Development: Can Country-level Strategic Planning Frameworks Converge to Achieve Sustainability and Eliminate Poverty?" Department for International Development, UK, Ltd., 2000.

(b) Internet sites:

<http://www.un.org/esa/sustdev.htm>

<http://www.nssd.net>

IMPLEMENTATION OF RATIFIED GLOBAL AGREEMENTS		
Institutional	Institutional Framework	International Co-operation

1. **INDICATOR**

- (a) **Name:** Implementation of Ratified Global Agreements.
- (b) **Brief Definition:** The existence of legislation for the implementation, at the national level, of international agreements related to sustainable development.
- (c) **Unit of Measurement:** The ratio between agreements legislated for and agreements ratified from the following list of international legal instruments related to sustainable development: Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; Convention on Biological Diversity; Framework Convention on Climate Change; International Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa; The Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol on Substances That Deplete the Ozone Layer; United Nations Convention on the Law of the Sea.
- (d) **Placement in the CSD Indicator Set:** Institutional/Institutional framework/International co-operation.

2. **POLICY RELEVANCE**

- (a) **Purpose:** This indicator signifies initial government action to effectively implement ratified international agreements related to sustainable development.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Ratified international agreements must be implemented at the national level in order to achieve the objectives of sustainable development.
- (c) **International Conventions and Agreements:** See 1c above.
- (d) **International Targets/Recommended Standards:** Provisions in national legislation for the implementation of all listed international agreements ratified by the government.
- (e) **Linkages to Other Indicators:** This indicator is linked to the issue areas addressed by the international agreements listed in 1c above. The closely linked indicators include, for example: ratification of global agreements, amount of new and additional funding for sustainable development, land affected by desertification, protected forest area, emissions of greenhouse gases, ozone depleting substances, and imports and exports of hazardous wastes.

3. **METHODOLOGICAL DESCRIPTION**

- (a) **Underlying Definitions and Concepts:** Implementation is the application of global agreements at the national level through various general and specific measures, including national programs (policies, plans, voluntary agreements with industry, capacity building, etc.), legislation (including laws, decrees, regulations, ordinances, orders, or any other legally-binding measure), financial measures, and institutional arrangements.
- (b) **Measurement Methods:** Determine the existence of national legislation for the implementation of ratified international agreements. Express the indicator as a ratio between agreements legislated for and agreements ratified.
- (c) **Limitations of the Indicator:** The content of national legislation for the implementation of international agreements can vary from general provisions to specific regulatory requirements. The more detailed the provisions, the greater the likelihood that the agreement will be fully implemented. However, the existence of legislation does not necessarily imply effective implementation or compliance. The indicator is not very suitable for showing meaningful trends.
- (d) **Status of the Methodology:** Not available.
- (e) **Alternative Definitions/Indicators:** Not available.

4. **ASSESSMENT OF DATA**

- (a) **Data Needed to Compile the Indicator:** Information on national measures.
- (b) **National and International Data Availability and Sources:** The data are available. The primary data sources include national governments, and the Treaty Section of the United Nations Office of Legal Affairs.
- (c) **Data References:** None.

5. **AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR**

- (a) **Lead Agency:** The lead agency is the United Nations Environment Programme (UNEP). The contact point is the Director, Division of Environmental Information, Assessment & Early Warning, UNEP; fax no. (254-2) 62-4274.
- (b) **Other Contributing Organizations:** Other interested parties include the Secretariat for the United Nations Framework Convention on Climate Change (UNFCCC), Secretariat for Basel Convention, UN Office of Legal Affairs, Economic and Social Council for West Asia, Network for Environment and Sustainable Development in Africa, and national governments.

6. **REFERENCES**

(a) **Readings:**

Reports of implementation/compliance committees of international agreements.
Reports of the Conferences of the Parties.

National reports to the Conferences of the Parties.

Secretary-General's Bulletin, ST/SGB/Organization (Section OLA/Rev.1), 14 November 1994.

(b) **Internet sites:**

Secretariat for the Basel Convention: www.basel.int

Secretariat for the Convention on Biological Diversity: www.biodiv.org

Secretariat for the Climate Change Convention: www.unfccc.de

Secretariat for the International Convention to Combat Desertification: www.unccd.de

Secretariat for the Vienna Convention for the Protection of the Ozone Layer:
www.unep.ch/ozone/home.htm

Division of Ocean Affairs and the Law of the Sea, UN Office of Legal Affairs:
www.un.org/Depts/los/index.htm

NUMBER OF INTERNET SUBSCRIBERS PER 1000 INHABITANTS		
Institutional	Institutional Capacity	Information Access

1. INDICATOR

- (a) **Name:** Number of Internet Subscribers per 1000 Inhabitants.
- (b) **Brief Definition:** Internet subscribers are those paying for or who have established subscription accounts to enable access to the internet. The indicator is derived by dividing the number of internet subscribers by total population and multiplying by 1000. Subscribers may be either individuals or organizations.
- (c) **Unit of Measurement:** Number of subscribers or subscriber accounts per thousand population.
- (d) **Placement in the CSD Indicator Set:** Institutional/Institutional Capacity/Information Access.

2. POLICY RELEVANCE

- (a) **Purpose:** The number of subscribers or subscriber accounts is a measure of internet access. The total number of individuals having access to the internet may be extrapolated or estimated based on the number of subscribers or subscriber accounts.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** As an information distribution system, the internet and its usage provide opportunities for bringing education and information within the reach of all. It can significantly shorten time lags as well as opening up a new range of information resources. It also opens up significant, new economic opportunities as well as possibilities for more environment-friendly options for the marketplace. The internet can allow businesses from developing nations to leapfrog into the development mainstream and offers considerable promise in facilitating the delivery of basic services, such as health and education, which are unevenly distributed at present.
- (c) **International Conventions and Agreements:** The four-year strategic Valetta Action Plan (VAP) adopted by the ITU World Telecommunication Development Conference in 1998 provides a six-point action plan that address the key elements needed to bridge the digital divide. It includes a special programme to take into consideration the needs of least developed countries.
- (d) **International Targets/Recommended Standards:** “The benefits of new technologies, especially information and communication technologies should be available to all”, United Nations Millennium Declaration, 55/2.

(e) **Linkages to Other Indicators:** There are also other variables (e.g., hosts and users) which provide a measure of how many people are using the internet. This indicator is also related to other telecommunication indicators (e.g. main telephone lines), as well as income and education indicators.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts.** The internet is a linked world-wide network of computers in which users at any one computer can, if they have permission, get information from other computers in the network. While many users obtain access for free, either as a member of a household, workplace, or school, a subscriber or a subscribing organization is one that pays for access to the internet. The number of subscribers or subscriber accounts, thus establishes a minimum threshold for the number of users in a country.

(b) **Measurement Methods:** The indicator can be measured by the number of actual subscriber accounts.

(c) **Limitations of the Indicator:** One problem is that the indicator does not measure overall access to the internet since there can be many users utilizing one subscriber account. Moreover, the statistic is not universally available although improvements in this area are being made quite rapidly. If not all ISPs provide national reports, country-level data may be hard to obtain. Requesting such reports, however, would be an important national level policy consideration.

(d) **Status of the methodology:** In the past, the number of subscribers was often based on multipliers (e.g., a certain number per host). As the commercialisation of the internet has grown, so has the use of surveys by both market research companies as well as statistical offices to count the number of subscribers.

(e) **Alternative Definitions:** The number of subscribers establishes a minimum threshold for calculating or estimating the number of users in a country.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Total population, number of internet subscribers or subscriber accounts.

(b) **National and International Data Availability and Sources:** Many Internet Service Providers (ISPs) report the number of their subscriber accounts. Some national ISPs also report the total number of subscribers for the country. A number of government agencies, typically communication regulators and national statistical agencies are compiling country-level subscriber data. At the international level, the International Telecommunication Union collects data across countries.

(c) **Data References:** World Telecommunication Indicators Database, International Telecommunication Union; World Telecommunication Development Report, ITU; Yearbook of Statistics, ITU.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the International Telecommunication Union (ITU). The contact point is the Head, Information Systems Unit, Telecommunication Development Bureau (BDT), ITU; fax no. (41-22) 730-6449.

(b) **Other Contributing Organizations:** None.

6. REFERENCES

(a) **Readings:**

World Telecommunication Report, various years, ITU

Telecommunication Indicator Handbook

(b) **Internet site:** <http://www.itu.int/ti>

MAIN TELEPHONE LINES PER 1000 INHABITANTS		
Institutional	Institutional Capacity	Communications Infrastructures

1. **INDICATOR**

- (a) **Name:** Main Telephone Lines per 1000 Inhabitants.
- (b) **Brief Definition:** The indicator is derived by dividing the number of main telephone lines in operation by the population and multiplying by 1000.
- (c) **Unit of Measurement:** Measured as the % of population with a telephone line.
- (d) **Placement in the CSD Indicator Set:** Institutional/ Institutional Capacity/ Communications Infrastructures.

2. **POLICY RELEVANCE**

- (a) **Purpose:** This indicator is the broadest and most common measurement of the degree of telecommunication development in a country.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Telecommunications and social, economic, and institutional development are closely linked. Modern communications is considered to be relatively benign to the environment. There is unlikely to be sustainable development without a well-developed communications infrastructure. Communications is critical to support sustainable development.
- (c) **International Conventions and Agreements:** None.
- (d) **International Targets/Recommended Standards:** Not available.
- (e) **Linkages to Other Indicators:** The linkages between this indicator and other sustainable development indicators are many. For instance, a well-developed communication infrastructure will reduce the need for transport with beneficial effects on the environment. Another example is the requirement of telecommunications for the innovative delivery of health and educational services. Yet, another example is the potential of telecommunications for reducing economic and social gaps within an economy and assisting to reduce the need for urbanization. Access to telecommunications provides those in rural and remote areas with contact to the outside world, reducing their sense of isolation and providing them with a tool to improve economic, social and cultural awareness. This indicator can be supplemented by the number of cellphone subscribers to give a more accurate picture of information access through telecommunications.

3. **METHODOLOGICAL DESCRIPTION**

(a) **Underlying Definitions and Concepts:** The definition of a main telephone line is a telephone line connecting the subscriber's terminal equipment to the public switched network and which has a dedicated port in the telephone exchange equipment. This term is synonymous with the term "main station" or "Direct Exchange Line" (DEL) which are commonly used in telecommunication documents.

(b) **Measurement Methods:** The indicator is derived by dividing the number of main telephone lines in operation by the population and multiplying by 1000.

(c) **Limitations of the Indicator:** There is concern that main lines per 1000 inhabitants does not always accurately reflect the degree of telecommunications development. First, there are other indicators of telecommunication development such as data network subscribers or mobile telephone subscribers. Second, main lines on a country level does not indicate the breakdown of the distribution of lines into business or residential or urban and rural although this disaggregated information is available. The indicator provides no measure of the quality or reliability of the telephone service.

(d) **Status of the methodology:** The indicator is widely used in over 200 economies around the world.

(e) **Alternative Definitions:** If accessibility is a main interest, then the number of households with telephone service may be more relevant especially for countries which have large households.

4. **ASSESSMENT OF DATA**

(a) **Data Needed to Compile the Indicator:** The data needed to compile the indicator are main lines and population.

(b) **National and International Data Availability and Sources:** The International Telecommunications Union (ITU) collects this information on an annual basis. Data are available for 1960, 1965, 1970, and annually from 1975 onwards. Population data is widely available from UN agencies. The ITU calculates main lines per 100 inhabitants based on population data from the World Bank.

(c) **Data References:** World Telecommunications Indicators Database.

5. **AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR**

(a) **Lead Agency:** The lead agency is the International Telecommunications Union (ITU). The contact point is the Head, Information Systems Unit, ITU; fax no. (41 22) 730 6449.

(b) **Other Contributing Organizations:** The World Bank, the United Nations including the United Nations Development Programme (UNDP), the Organisation for Economic Co-operation and Development (OECD), and Eurostat.

6. REFERENCES

(a) Readings:

Definitions, methodology and other information regarding telecommunication indicators can be found in the ITU's *Telecommunication Indicator Handbook*.

Application of the indicator including country data can be found in the ITU's *World Telecommunication Development Report*. The data are also provided by the ITU to other agencies and appear in the following publications: UN *Statistical Yearbook*, World Bank *World Development Report*, UNDP *Human Development Report*, and OECD *Communication Outlook and Aerostat Communications Statistics*.

(b) Internet site: <http://www.itu.int>

EXPENDITURE ON RESEARCH AND DEVELOPMENT AS A PERCENT OF GROSS DOMESTIC PRODUCT		
Institutional	Institutional capacity	Science and technology

1. INDICATOR

- (a) **Name:** Expenditure on R&D as a Percent of Gross Domestic Product (GDP).
- (b) **Brief Definition:** Total domestic expenditure on scientific research and experimental development (R&D) expressed as a percentage of Gross Domestic Product (GDP).
- (c) **Unit of Measurement:** %.
- (d) **Placement in the CSD Indicator Set:** Institutional/Institutional capacity/Science and technology.

2. POLICY RELEVANCE

- (a) **Purpose:** This ratio provides an indication of the level of financial resources devoted to R&D in terms of their share of the GDP.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** This indicator is required to assess the level and patterns of R&D expenditure in relation to GDP, at a given point of time, as well as its trends. Adequate R&D funding that is commensurate with economic growth and national income is necessary for ensuring sustainable development. Scientists are improving their understanding on policy-relevant issues such as climate change, growth in resource consumption rates, demographic trends, and environmental degradation. Changes in R&D investments in these and other areas need to be taken into account in devising long-term strategies for development. Scientific knowledge should be applied to assess current conditions and future prospects in relation to sustainable development.
- (c) **International Conventions and Agreements:** (i) The Second Conference of Ministers Responsible for the Application of Science and Technology to Development in Africa (CASTAFRICA II), 6-15 July 1987; and (ii) 'Social Development: Africa's Priorities, Audience Africa', United Nations Educational, Scientific and Cultural Organization (UNESCO), 6-10 February 1995.
- (d) **International Targets/Recommended Standards:** Currently only available for Africa: (i) African countries should devote 1% of their GNP to R&D by 1995; (ii) each African country should allocate at least 0.4 - 0.5% of its GDP to research by 2000 (see section 3c above).
- (e) **Linkages to Other Indicators:** This indicator can be most closely linked with indicator 40: Investment share of GDP, in providing more precise complementary indications on the level of financial resources devoted to R&D.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The *Recommendation concerning the International Standardization of Statistics on Science and Technology* defines total domestic expenditure on R&D activities as all expenditure made for this purpose in the course of a reference year in institutions and installations established in the national territory, as well as installations physically situated abroad; land or experimental facilities rented or owned abroad, and ships, vehicles, aircraft and satellites used by national institutions.

(b) **Measurement Methods:** The indicator is calculated by dividing total domestic expenditure on R&D by GDP and expressed as a percentage, that is,

$$\frac{\text{Total domestic expenditure on R\&D} \times 100}{\text{GDP}}$$

Both data on R&D expenditure and GDP can be expressed in current values and in the national currency.

(c) **Limitations of the Indicator:** The indicator does not show the proportion of expenditure on R&D which contributes specifically to sustainable development. Data on R&D expenditure are usually obtained through special surveys. To date, most developed and a few developing countries are able to regularly collect and provide internationally comparable and timely data.

(d) **Status of the Methodology:**

Concepts and the corresponding definitions as well as suggestions for the collection of data as set out in the *Recommendation Concerning the International Standardization of Statistics on Science and Technology* still apply, whilst work is in progress in revising the Frascati Manual which will have a direct impact on the need to revise the *Recommendation*.

(e) **Alternative Definitions/Indicators:** Gross domestic expenditure on R&D (GERD) as percentage of GDP can be used as an alternative indicator. It is already in use in a significant number of countries. The difference between total domestic R&D expenditure and GERD is that the former includes R&D expenditure on installations physically situated abroad but used by national institutions.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Total domestic expenditure on R&D and GDP expressed in national currency.

(b) **National and International Data Availability and Sources:** Data on R&D expenditure for 1990, or later years, are available for 46 countries only. At the national level, the availability of these data depends on the existence and frequency of R&D surveys. To derive this indicator at the international level, the GDP data needed can be obtained from the World Bank whilst those relating to R&D expenditure can be obtained through UNESCO's international surveys on scientific

research and experimental development. At the national level, data on R&D expenditure are collected normally through special R&D surveys conducted by the ministry/department/council of science and technology and/or the central statistical office and/or specialized institutions, whereas those on GDP can be obtained from either the ministry of finance or the central statistical office.

(c) **Data References:** UNESCO Statistical Yearbook.

5. **AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR**

(a) **Lead Agency:** The lead agency is the United Nations Educational, Scientific and Cultural Organization (UNESCO). The contact point is the Director, UNESCO Institute for Statistics, UNESCO; email: uis@unesco.org and fax (33-1) 45 68 55 20.

(b) **Other Contributing Organizations:** The OECD (Organisation for Economic Co-operation and Development) and EUROSTAT are two organizations that have been actively developing methodologies and collecting data from their respective member countries on R&D.

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OECD (Organisation for Economic Co-operation and Development). *Proposed Standard Practice for Surveys and Research and Experimental Development*, "Frascati Manual". 1995.

(b) **Internet site:** <http://unescostat.unesco.org/>

HUMAN AND ECONOMIC LOSS DUE TO NATURAL DISASTERS		
Institutional	Institutional Capacity	Disaster Preparedness and Response

1. INDICATOR

- (a) **Name:** Human and economic loss due to natural disasters.
- (b) **Brief Definition:** The number of persons deceased, missing, and/or injured as a direct result of a natural disaster; and the amount of economic and infrastructure losses incurred as a direct result of the natural disaster.
- (c) **Unit of Measurement:** Number of fatalities; \$US.
- (d) **Placement in the CSD Indicators Set:** Institutional/Institutional Capacity/Disaster Preparedness and Response.

2. POLICY RELEVANCE

- (a) **Purpose:** To provide estimates of the human and economic impact of disasters in order to measure the trends in population vulnerability and to determine whether a country or province is becoming more or less prone to the effects of disasters.
- (b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** Natural disasters can have devastating short and long-term impacts on the society and the economy of any country, adversely affecting progress towards sustainable development. They cause loss of life, social disruption and affect economic activities. This is particularly true for highly vulnerable, low-income groups. They also cause environmental damage, such as loss of fertile agricultural land, and water contamination. They affect urban settlements and may result in major population displacements.

The general increase in vulnerability of societies worldwide has caused the social, economic and environmental impact of natural disasters to become far greater now than ever before. In fact, the overall number of people affected by disasters has been growing by 6% each year since 1960. This trend is expected to continue primarily because of increased concentration of people and values in the areas exposed to natural hazards, such as floods and earthquakes.

- (c) **International Conventions and Agreements:** Based on the experience of the International Decade for Natural Disaster Reduction, the UN General Assembly adopted resolution A/54/219 which established a permanent mandate for the UN system in the field of disaster reduction, in the framework of the global programme named International Strategy for Disaster Reduction (ISDR).
- (d) **International Targets/Recommended Standards:** None.

(e) **Linkages to Other Indicators:** This indicator is linked with indicators that are related to issues of vulnerability: % Population Living Below Poverty Line, Floor Area Per Person, Population Growth Rate, Population of Urban Formal and Informal Settlements, Area of Urban Formal and Informal Settlements, and other institutional indicators like National Sustainable Development Strategy.

This indicator would have greater significance if correlated to indicators of vulnerability to specific hazards such as earthquakes and floods, which account for the majority of loss due to natural disasters, especially in developing countries.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** There is a recognized high degree of interdependency between sustainable development and vulnerability to natural hazards. High vulnerability means higher exposure to natural catastrophes in the absence of disaster reduction measures. Natural disasters have a strong negative impact on the development process in both industrialized and developing countries. Therefore, the degree of vulnerability to a given natural hazard provides a key measure of social welfare and development in a given country, as well as an indication of the risk (probability) of natural disasters.

For the purpose of this indicator, the following definitions have been used:

Natural disaster is the consequence of the impact of a natural hazard on a socio-economic system with a given degree of vulnerability, which overwhelms local capacity to respond to the emergency and has disruptive consequences on human, social and economic parameters.

Natural hazards comprise phenomena such as earthquakes; volcanic activity; landslides; tsunamis; tropical cyclones and other severe storms; tornadoes and high winds; river floods and coastal flooding; wildfires and associated haze; drought; infestations.

Vulnerability to hazards is a function of human activities. It describes the degree to which a socio-economic system is susceptible to the impact of natural and other related hazards. Vulnerability also depends on aspects such as hazard awareness, the characteristics of human settlements and infrastructure, public policy and administration, and organized abilities in all fields of disaster management. At present, poverty is one major cause of vulnerability in many parts of the world.

(b) **Measurement Methods:** The measurement methods proposed are based on the criteria used by the Centre for Research on the Epidemiology of Disaster (CRED). The data elements included here have been selected and modified according to the requirements of the sustainable development indicator methodology sheets. Overall, these data should be collected and validated at the country level by a public authority using these standard criteria and methods. Each element is presented first in a concise description, followed by comments and the proposed recording procedure.

i) *Onset Date*: This establishes the date when the disaster situation occurred. This date is well defined for all sudden-impact disasters. For disaster situations which develop gradually overtime (for example, drought) scientific (meteorology and seismology institutes) and governmental (civil defence authorities) sources.

ii) *Declaration Date*: The date when the first call for external assistance concerning the disaster is issued. This call for external assistance mentioned here is defined according to the definition of a disaster situation stated above. This date is available for all disaster situations to be included for the indicator. Only the date of the first appeal for external assistance is recorded.

iii) *Disaster Type*: This describes the disaster according to a pre-defined classification scheme. Disaster types should include all types of natural disasters, for example, earthquakes, cyclones, floods, volcanic eruptions, drought, and storms. Disasters may be further described as sudden onset, such as earthquakes and floods, and long-term, such as drought. Two or more disasters may be related, or other disaster types may occur as a consequence of a primary event. For example, a cyclone may generate a flood or landslide; or an earthquake may cause a gas line to rupture.

iv) *Country*: This defines the country in which the disaster occurred. Every disaster record will be by country. Autonomous regions, not yet recognised as countries, will not be used. The same disaster may affect more than one country, and here separate records are maintained.

v) *Fatalities*: This includes persons confirmed dead and persons missing and presumed dead. Official figures are used whenever available. The figure is updated as missing persons are confirmed to be dead.

vi) *Estimated Amount of Damage*: This represents the value of all damages and economic losses directly related to the occurrence of the given disaster. The economic impact of a disaster usually consists of direct (for example, damage to infrastructure, crops, housing) and indirect (for example, loss of revenues, unemployment, market destabilisation) consequences on the local economy. Although several institutions have developed methodologies to quantify these losses in their specific domain, no standard procedure to determine a global figure for the economic impact exists. Three different figures are recorded from sources which have a well-defined methodology for the assessment of economic impacts, including the World Bank and other international lending agencies; the host government; and, especially in the case of complex emergency situations, the total budget requirements listed in the consolidated appeals launched by UN agencies and other major non-government organizations.

(c) **Limitations of the Indicator**: The validity of this indicator is limited by the quality and the format of the data used for its calculation. Comparability over time may represent a particular problem for this indicator.

(d) **Status of the Methodology:** The methodology is in widespread use on both developed and developing countries although it is not standardized.

(e) **Alternative Definitions:** If the indicator has to reflect changing risk, the measurement should be losses per unit of time per capita. This is not possible without further development of the indicator methodology.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** As described in 4.b.

(b) **National and International Data Availability and Sources:** Data above is normally available within each country or easily obtainable; other sources are international scientific associations; insurance companies (Munich Re, Swiss Re), national geological survey agencies; space agencies and satellite service providers; the UN system and the ISDR framework. Internationally, some data is maintained by the Centre for Research on the Epidemiology of Disasters (CRED) in Brussels.

(c) **Data References:** The Centre serves as a reference source for most applications. CRED compiles and validates data from diverse sources.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the Secretariat for the International Strategy for Disaster Reduction (ISDR), United Nations, Geneva.

(b) **Other Contributing Organizations:** The Centre for Research on the Epidemiology of Disasters, Faculty of Medicine, University of Louvain, Belgium. The following organizations were consulted over the development and subsequent review of this indicator methodology sheet: World Food Programme, United Nations Environment Programme, Pan American Health Organization, International Federation of the Red Cross and Red Crescent Societies, and US Agency for International Development, ICSU – International Council of Scientific Unions, Munich Reinsurance Company.

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Annex 1

International Goals, Targets, and Standards Related to Themes and Sub-Themes of Indicators of Sustainable Development

SOCIAL		
Theme	Sub-theme	Goals, Targets, and Standards
Equity	Poverty	i) Reduce proportion of people living in extreme poverty in developing countries by at least one-half by 2015 compared to 1990 (<i>Copenhagen95</i>). ii) Universal access to paid employment (<i>Copenhagen95</i>).
	Gender Equality	Eliminate discriminatory practices in employment (<i>Beijing</i>)
Health	Nutrition Status	Reduce severe and moderate malnutrition among under 5 year old children by 50% from 1990 to 2000 (<i>New York90</i> , <i>Copenhagen95</i> , <i>Beijing95</i> , <i>Rome96</i> ,
	Mortality	Reduce mortality rate for children under 5 years old by two-thirds of 1990 levels by 2015 (<i>Cairo94</i> , <i>New York90</i>)
	Sanitation	Universal access to sanitary waste disposal (<i>Rio de Janeiro92</i> , <i>Copenhagen95</i> , <i>Beijing95</i>)
	Drinking Water	Universal access to safe drinking water supply by 2025 (<i>Rio de Janeiro92</i> , <i>Copenhagen95</i> , <i>Beijing95</i>)
	Healthcare Delivery	i) Universal access to primary health care and reproductive health services by 2015 <i>Cairo94</i> , <i>Copenhagen95</i> , <i>Beijing95</i>) ii) Universal immunization against measles (<i>New York90</i> ,) iii) Universal access to safe and reliable contraceptive methods (<i>Cairo94</i>)
Education	Education Level	Universal access, and completion of primary education by 2015 (<i>Jomtien90</i> , <i>Cairo94</i> , <i>Beijing95</i>)
	Literacy	Adult literacy reduced by half of the 1990 level by 2000 (<i>Jomtien90</i> , <i>Copenhagen95</i> , <i>Beijing95</i>)
Housing	Living Conditions	Provision of sufficient living space and avoidance of overcrowding (<i>Habitat II</i>)
Security	Crime	Significantly reduce violence and crime (<i>Cairo95</i>)
Population	Population Change	Stabilize world population (<i>Cairo94</i>)
ENVIRONMENTAL		
Theme	Sub-theme	Goals, Targets, and Standards
Atmosphere	Climate Change	i) Reduce overall developed country emissions of CO ₂ equivalents by 5% of 1990 levels by 2008-2012 (<i>Kyoto97</i>) ii) Stabilize GHG concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference with the climate system (<i>FCCC</i>)
	Ozone Layer Depletion	ODS consumption elimination schedule: halons by 1994; CFC, carbon tetrachloride, HBFC, and methyl chloroform by 1996; methyl bromide by 2010; and HCFC by 2030 (<i>Montreal Protocol and Amendments and Adjustments</i>)
	Air Quality	National air quality standards based on WHO air quality guidelines

ENVIRONMENTAL (continued)		
Theme	Sub-theme	Goals, Targets, and Standards
Land	Agriculture	Reduce the number of undernourished people to half their present level no later than 2015 (<i>Rome96</i>)
	Forests	i) All tropical timber products traded internationally shall originate from sustainably managed forest by 2000 (<i>International Tropical Timber Organization</i>) ii) National targets set under the sustained yield principle
	Desertification	
	Urbanization	
Oceans, Seas and Coasts	Coastal Zone	
	Fisheries	
Fresh Water	Water Quantity	Withdrawal limits may apply to specific international treaties between countries
	Water Quality	National water quality standards based on WHO guidelines for drinking water quality
Biodiversity	Ecosystem	10% protected area for each major ecosystem type by 2000 (<i>Caracas92</i>)
	Species	
ECONOMIC		
Theme	Sub-theme	Goals, Targets, and Standards
Economic Structure	Economic Performance	
	Trade	
	Financial Status	Total ODA from developed countries should be at least 0.7% of GNP (<i>United Nations</i>)
Consumption and Production Patterns	Material Consumption	
	Energy Use	
	Waste Generation and Management	i) National targets may apply for solid waste reduction and recycling ii) Prevent and minimize the generation of hazardous wastes (<i>Agenda 21</i>) iii) IAEA safety standards for the management of radioactive wastes
	Transportation	
INSTITUTIONAL		
Theme	Sub-theme	Goals, Targets, and Standards
Institutional Framework	Strategic Implementation of SD	National sustainable development strategies that reflect all interests formulated by all countries by 2002 (<i>United Nations General Assembly97</i>)
	International Coop.	
Institutional Capacity	Information Access	
	Communications Infrastructure	
	Science and Technology	One researcher engaged in R&D per 1000 population [for Africa] (<i>UNESCO95</i>)
	Disaster Preparedness and Response	Improve the capacity of each country to mitigate the effects of natural disasters expeditiously and effectively (<i>United Nations General Assembly89</i>)

Annex 2

Core Indicators and the Driving Force-State-Response Framework

SOCIAL					
Theme	Sub-theme	Indicator	DF	S	R
Equity	Poverty	Percent of Population Living below the Poverty Line		X	
		Gini Index of Income Inequality		X	
		Unemployment Rate	X		
	Gender Equality	Ratio of Average Female Wage to Male Wage		X	
Health	Nutrition Status	Nutritional Status of Children		X	
	Mortality	Mortality Rate Under 5 Years Old		X	
		Life Expectancy at Birth		X	
	Sanitation	Percent of Population with Adequate Sewage Disposal Facilities		X	
	Drinking Water	Population with Access to Safe Drinking Water		X	
	Healthcare Delivery	Percent of Population with Access to Primary Health Care Facilities			X
		Immunization Against Infectious Childhood Diseases			X
		Contraceptive Prevalence Rate			X
Education	Education Level	Children Reaching Grade 5 of Primary Education	X		
		Adult Secondary Education Achievement Level	X		
	Literacy	Adult Literacy Rate	X		
Housing	Living Conditions	Floor Area per Person		X	
Security	Crime	Number of Recorded Crimes per 100,000 Population		X	
Population	Population Change	Population Growth Rate	X		
		Population of Urban Formal and Informal Settlements		X	
ENVIRONMENTAL					
Theme	Sub-theme	Indicator	DF	S	R
Atmosphere	Climate Change	Emissions of Greenhouse Gases	X		
	Ozone Layer Depletion	Consumption of Ozone Depleting Substances	X		
	Air Quality	Ambient Concentration of Air Pollutants in Urban Areas		X	
Land	Agriculture	Arable and Permanent Crop Land Area		X	
		Use of Fertilizers	X		
		Use of Agricultural Pesticides	X		
	Forests	Forest Area as a Percent of Land Area		X	
		Wood Harvesting Intensity	X		
	Desertification	Land Affected by Desertification		X	
	Urbanization	Area of Urban Formal and Informal Settlements		X	
Oceans, Seas and Coasts	Coastal Zone	Algae Concentration in Coastal Waters		X	
		Percent of Total Population Living in Coastal Areas	X		
	Fisheries	Annual Catch by Major Species	X		

Annex 2 Continued

ENVIRONMENTAL					
Theme	Sub-theme	Indicator	DF	S	R
Fresh Water	Water Quantity	Annual Withdrawal of Ground and Surface Water as a Percent of Total Available Water	X		
	Water Quality	BOD in Water Bodies		X	
		Concentration of Faecal Coliform in Freshwater		X	
Biodiversity	Ecosystem	Area of Selected Key Ecosystems		X	
		Protected Area as a Percent of Total Area			X
	Species	Abundance of Selected Key Species		X	
ECONOMIC					
Theme	Sub-theme	Indicator	DF	S	R
Economic Structure	Economic Performance	GDP per Capita	X		
		Investment Share in GDP	X		
	Trade	Balance of Trade in Goods and Services		X	
	Financial Status	Debt to GNP Ratio		X	
		Total ODA Given or Received as a Percent of GNP	X		
Consumption and Production Patterns	Material Consumption	Intensity of Material Use		X	
	Energy Use	Annual Energy Consumption per Capita	X		
		Share of Consumption of Renewable Energy Resources		X	
		Intensity of Energy use		X	
	Waste Generation and Management	Generation of Industrial and Municipal Solid Waste	X		
		Generation of Hazardous Waste	X		
		Generation of Radioactive Waste	X		
		Waste Recycling and Reuse			X
	Transportation	Distance Traveled per Capita by Mode of Transport		X	
INSTITUTIONAL					
Theme	Sub-theme	Indicator	DF	S	R
Institutional Framework	Strategic Implementation of SD	National Sustainable Development Strategy			X
	International Cooperation	Implementation of Ratified Global Agreements			X
Institutional Capacity	Information Access	Number of Internet Subscribers per 1000 Population		X	
	Communication Infrastructure	Main Telephone Lines per 1000 Population		X	
	Science and Technology	Expenditure on Research and Development as a % of GDP			X
	Disaster Preparedness and Response	Economic and Human Loss Due to Natural Disasters	X		

Annex 3:

NATIONAL TESTING - IMPLEMENTATION APPROACHES AFRICA

<p>Ghana - http://www.un.org/esa/sustdev/indi4gh.htm</p> <p>The Government of Ghana established a National Committee on Sustainable Development (SD), which utilised a multistakeholder and participatory approach to testing and implementation. This Committee functioned under the National Committee for the Implementation of Agenda 21. The membership of the Committee includes the following organisations: the National Development Planning Commission; the Ministry of Environment, Science and Technology; Statistical Services; Environmental Protection Agency; Town and Country Planning Department; Institute of Statistical, Social and Economic Research, University of Ghana; Centre for Policy Analysis; Council for Scientific and Industrial Research; United Nations Development Programme; Private Enterprise Foundation; Rescue Mission Ghana; and the National Union of Environmental NGOs. The Ministry of Environment, Science and Technology will be the focal point for the work of the Committee.</p> <p>Apart from this multi-stakeholder approach, Ghana implemented the testing programme in conjunction with two programmes of the UNDP, the Poverty Reduction Programme and the Capacity 21 Programme. In view of the cross-sectoral nature of these programmes, they served as the focus of the testing and implementation programme for Ghana. Among the important aspects of these programmes were their decentralized nature, and the focus of action was at the district level, lowest level of political authority in Ghana.</p>	<p>Kenya - http://www.un.org/esa/sustdev/indi4ke.htm</p> <p>The co-ordinating mechanism for testing and implementation of the ISDs¹¹³ in Kenya involved both governmental and non-governmental collaboration. The focal point for the development of the ISDs was the National Environment Secretariat (NES) which is a department within the Ministry of Environment and Natural Resources. This Ministry is the arm of Government that is charged with co-ordinating all matters pertaining to the environment. The National Environment Secretariat carries out a co-ordinating role through an Inter-Ministerial Committee on Environment (IMCE).</p> <p>Within the IMCE, the sub-committee on Environmental Economics and Accounting chaired by the Ministry of Planning and Natural Development was the responsible unit for the development of ISD. Membership in this sub-committee includes Government Ministries/Departments, Planning and Statistical Department, academic and research institutions, NGOs and the private sector. This sub-committee worked closely with various other sub-committees as the issue of sustainable development cuts across a wide cross section of issues. At the regional and international level, Kenya has considered the option of twinning with another testing country, and is currently exploring potential partnerships.</p>
<p>South Africa - http://www.un.org/esa/sustdev/indi4za.htm</p> <p>In South Africa, the national co-ordinating mechanism for testing and implementation was the Sub-Committee on Sustainable Development. This sub committee is located within the Committee for Environmental Co-ordination, and is directly involved in matters concerning sustainable development. The committee consists of government and provincial level representatives who are actively involved in implementing sustainable development programmes at the various levels of Government. The Directorate for Sustainable Development in the Department of Environmental Affairs and Tourism served as the national focal point for international communication and co-ordination of the testing process.</p> <p>In February 1997, the Sub Committee on Sustainable Development agreed to form four (4) task groups for the social, economic, environmental, and institutional to test the indicators. The task groups comprised of the participating stakeholders. The process, therefore, was highly integrated and multi-stakeholder with the participation of Government Departments, NGOs, the scientific community, as well as agencies involved with data collection, compilation and analysis have all been approached to participate in the testing process, and to nominate representatives on the respective task groups.</p> <p>The co-ordinating mechanism within the South African Government also assisted the participating stakeholders to become more aware of the CSD guidelines for testing and implementation by familiarising them with the use of a questionnaire, data sheet and information sheet. Instructions on how to complete these sheets were developed in accordance with the testing and implementation guidelines stipulated by the CSD. Several information sessions were also held, during which the testing process was further explained to participants. The process in South Africa, therefore, emphasised awareness and understanding of the task to be undertaken. These efforts had been geared towards generating the country report, while creating a strong knowledge base.</p> <p>The testing and implementation of indicators in South Africa had been twinned to the indicator work being done in Finland. The twinning approach between both countries provided each country a greater opportunity to analyse and exchange information on the relevance of the CSD indicators with respect to the results of the testing process and lessons learnt. It was agreed that each country would test the indicators separately, but at the same time exchange information and ideas where possible. The results of the data collected were discussed in a consultative process involving workshops and meetings between both countries. The delegates and experts met three times. It was envisaged that both countries will submit a final combined report apart from their separate country reports to the CSD.</p>	

¹¹³ ISDs - Indicators of Sustainable Development

Tunisia

The Tunisian Government established a twinning arrangement with the Government of France with the view to encouraging collaboration between the two countries, and promoting an understanding of the process of testing and implementation as it is applied in the context of North/South or developing/developed country relations. The Tunisian Environmental Agency (ANPE) was the Focal Point for the testing and implementation process. The National Observatory on Environment and Development (OTED) worked in close collaboration with ANPE and assisted in co-ordinating the testing and implementation process.

Morocco

Implementation of a national indicators programmed in Morocco is underway in cooperation with the Government of France, under a twinning agreement coordinated by the French Institute for the Environment (IFEN).

ASIA AND THE PACIFIC

China - <http://www.un.org/esa/sustdev/indi4cn.htm>

China's approach to testing and implementation of the CSD indicators was one which involved strong governmental input through inter ministerial co-ordination. Two state-endorsed mechanisms were established: the National Testing Working Group, which involved governmental bodies such as Ministries, State Commissions and Agencies; as well as a National Co-ordinating Mechanism which co-ordinated the operation of the National Testing Working Group. This particular mechanism is chaired by the National Environmental Protection Agency (NEPA) and the State Statistics Bureau (SSB). The actual testing and implementation of indicators was carried out by the Policy Research Centre for Environment and Economy (PRCEE). The mechanism itself engendered a high level of consultation and liaison between the two groups by organising various workshops and seminars, in order to share knowledge gained of the process, and to arrive at a report that was representative of the bodies involved.

Maldives - <http://www.un.org/esa/sustdev/indi4mal.htm>

The Ministry of Planning, Human Resources and Environment was responsible for national testing of indicators. The process was a multi-stakeholder one, in which the Government collaborated with other ministries and institutions, as well as trade and tourist associations and related NGOs.

Pakistan - <http://www.un.org/esa/sustdev/indi4pak.htm>

The Pakistani Government conducted a case study of the Northwest Frontier Province (NWFP), in order to establish Pakistan's capacity for testing and measurement of the indicators. The case study involved Ministries, NGOs, individuals, as well as other interested stakeholders. A multi-stakeholder Steering Committee was proposed to be created under Planning and Development Division of Pakistan, in order to implement the findings of the case study on a larger scale.

Philippines - <http://www.un.org/esa/sustdev/indi4ph.htm>

Work on the formulation of sustainable development indicators in the Philippines started in September 1996. The participation of the Philippines as a CSD testing country provided impetus to existing efforts at developing a national core set of indicators. The coordinating mechanism for the testing institution was the Philippine Council for Sustainable Development, a pioneering multi-stakeholder body mandated to coordinate and oversee the implementation of the country's commitments at the Rio Summit. The Council established a Task Force on Indicators of Sustainable Development that served as a policy advisory body on matters pertaining to the testing and development of SD indicators. The Task Force built an early work done by the Technical Working Group on the Integration of Environment and Socio-Economic Policies which included a publication "A Sourcebook of Sustainable Development Indicators". The CSD publication "Indicators of Sustainable Development: Framework and Methodologies" provided significant input with the Sourcebook.

The Task Force was made up of policy decision-makers, academicians, representatives of statistical agencies as well as non-governmental organizations. Such multistakeholder composition enabled the Task Force to tackle the various practical, technical, and institutional aspects of developing and adopting a set of indicators of sustainable development. The approach of the Task Force on the testing exercise was largely an iterative process which included multi-level consultations, policy fora, seminars and workshops, commissioned expert work and established consultative bodies such as the committees and sub-committees under the PCSD.

EUROPE

<p style="text-align: center;">Austria</p> <p>http://www.un.org/esa/sustdev/indi4at.htm#Interim</p> <p>The co-ordinating mechanism for testing in Austria was the Inter-Ministerial Conference on the Environment. The Federal Environment Agency and Statistical Office supported this Conference. The Conference also acted jointly with the Austrian Council on Sustainable Development (ACSD), which consists of relevant stakeholder groups including NGOs. The ACSD is the national co-ordinating mechanism for sustainable development.</p>	<p style="text-align: center;">Belgium - http://www.un.org/esa/sustdev/indi4be.htm</p> <p>Belgium has a complex federal structure, which necessitated continuous collaboration and consultation between all levels of the Belgian Government. Consequently, the Belgian Government designated an Inter Ministerial Conference on the Environment (ICE) to serve as the testing mechanism. This Inter Ministerial Conference also established a working group for testing and implementation of the indicators. The Working Group consisted of civil servants from the Belgian regions: The Flemish Region, the Walloon Region, and Brussels Capital City Region as well as the Federal Environment Ministries, and a Federal Planning Bureau (FPB). The process was primarily intergovernmental.</p> <p>The FPB was the focal point for testing and implementation. The FPB provided and assisted the participants with the available information regarding the process of testing and implementation. Despite this strong governmental focus, however, inputs from the NGOs and the scientific community had been highly welcome.</p>
<p style="text-align: center;">Czech Republic</p> <p>http://www.ceu.cz/svis/indik/mainpage.htm</p> <p>The Ministry of Environment (MoE), the Charles University Environmental Centre, and the Czech Ecological Institute (CEI) spearheaded the testing process in the Czech Republic. The process of testing and implementing the SDIs was seen as part of a broader process of building up a comprehensive national information system on sustainable development. The Charles University Environmental Centre was the designated Focal Point and worked in close collaboration with other institutions- namely, the Czech Statistical Office.</p> <p>An Expert Working Group on Sustainability indicators was established. However, despite the establishment of an Expert Working Group, the ISD process remained the domain of experts from environmental organisations.</p>	<p style="text-align: center;">Finland - http://www.vyh.fi/eng/environ/sustdev/indicat/inds2000.htm</p> <p>The Government of Finland established the Finnish National Commission on Sustainable Development to be the primary co-ordinating mechanism for implementation and testing of the indicators. The national commission consists of representatives from various ministries, the scientific community, as well as regional and local authorities. The media, education sector and voluntary organisations are also members of the Commission. Local authorities and NGOs also participated in the testing and implementation process. Seminars were arranged for wider participation and comments. The work was organised by the Ministry of Environment in collaboration with the Institute for Environment.</p> <p>The Government of Finland considered co-operation and participation of key elements in developing and testing the indicators. In light of this, an Inter Ministerial Network on Developing and Testing Indicators of Sustainable Development (ISD) was established in October 1996. The CSD indicator testing in Finland was started in January 1997. A special data collection sheet was designed for the testing purpose.</p> <p>The Inter Ministerial Network on Developing and Testing Indicators includes various ministries as well as statistical and environmental institutions, and works in collaboration with the Government of South Africa. The Government assessed and evaluated the progress of indicator testing and development through workshops.</p> <p>Finland was also twinned with South Africa in order to give both countries access to more information, to share their experiences, and to provide a comprehensive view of the entire process. A small delegation from Finland visited South Africa to facilitate the consultative process between the two countries. Finland also established further contact with other testing countries, especially countries within Europe, such as Germany and the Czech Republic.</p>

France - <http://www.ifen.fr/onu/sommaire.htm>

France participated in a twinning arrangement with Tunisia; and has initiated co-operation with Morocco. The Ministry of Spatial Planning and Environment (DGAD/SAI) co-ordinated for testing and implementation of the indicators. Two working groups carried out the process of testing: a technical group involving 50 statistical and data experts; and a policy group with 100 members from the National Commission on Sustainable Development. The process was highly participatory, involving these two working groups, an inter ministerial group, the scientific community, and relevant NGOs. The French Institute for the Environment was designated the focal point. Their work was co-ordinated by the Ministry of Environment.

Germany - <http://www.umweltbundesamt.de/uba-info-daten-e/daten-e/csd.htm>

The national co-ordinating mechanism in Germany was spearheaded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. This Ministry functioned as the national focal point for the testing of the ISDs and was in charge of the entire political co-ordination of the testing process.

The overall organisation of the testing and implementation of ISDs involved several institutional pillars. Firstly, there was strong co-ordination within the Federal Government. This involved the establishment of an Interministerial Working Group (IMA). The Group consists of representatives from all German Federal Ministries, and was established under the Federal Environment Ministry. This IMA was very significant, as sustainable development comprises not only environmental but also economic and social aspects. The IMA was responsible for the Federal Government's interim report on the testing phase to the CSD by the end of 1997.

The Federal Environmental Agency and the Federal Statistical Office provided support concerning organisational co-ordination, data collection and processing as well as methodological questions. A co-ordination team with representatives from the Federal Environment Ministry, the Federal Environmental Agency and the Federal Statistical Office met for regular discussions on conceptual and organisational procedure.

A National Indicator Committee was established with more than 20 representatives from all relevant groups. These groups include environmental and development NGOs, business associations including environmentally oriented business associations, trade unions, churches, charitable organisations, scientific advisory boards, the German Bundestag "Enquete Commission on the Protection of Humanity and the Environment", and the Federal States and local communities.

The Federal Environment Ministry, in agreement with the other government departments, nominated the members of the National Indicator Commission. To be able to ensure high-level, expert dialogue, the appointed representatives were those who had prior experience in the development of indicators or had been involved in the debate on sustainable development for some time.

On the technical side of the implementation of indicators, an Expert Team of approximately 20 scientists from assorted disciplines was established. This group was overseen by the Federal Environmental Agency, with experts already involved in indicator development of various fields. This team built upon informal meetings of experts which the Federal Environment Ministry had been holding annually since 1994 for continuous exchange of information. Its task during the testing phase of the CSD indicators was, on one hand, to give an opinion on the range of priority issues and indicators and, on the other hand, to be a forum for discussing the conceptual and methodological development of indicators. Detailed discussions of the CSD concept took place in sub-working groups.

United Kingdom - <http://www.environment.detr.gov.uk/sustainable/consult/index.htm>

The CSD indicator exercise in the United Kingdom was incorporated into an exercise on testing and developing a set of national sustainable development indicators. The testing bodies included *inter alia*, the United Kingdom Round Table on Sustainable Development, a British Governmental Panel on Sustainable Development and an Indicators Working Group. The UK Round Table on Sustainable Development is an independent body comprising senior representatives of non-governmental organisations, businesses and local authorities, to advise Government on policies to achieve sustainable development. The Indicators Working Group comprises representatives of central government departments, local authorities, regulatory agencies, non-governmental organisations and technical and scientific experts. Their primary function is to advise on the development of the next set of national indicators. The process was highly participatory - involving multi-stakeholder interest – including NGOs and local authorities. The British Government proposed to establish a Sustainable Development Commission in 2000 to monitor and assess the indicator process.

In the United Kingdom, there were already a number of mechanisms in place through which the Government consults or receives advice on sustainable development and on sustainable development indicators. Rather than set up additional mechanisms for further consultation, Britain used and continues to use existing bodies such as the Indicator Working Group, the UK Round Table on Sustainable Development, and the Environmental Statistics Advisory Group (ESAG) and the Central and Local Intelligence Partnership (CLIP).

Switzerland - http://www.statistique.admin.ch/stat_ch/ber02/dev_dur_e_files/indicators.htm

Switzerland is an unofficial testing country which has effectively participated in and submitted reports on the CSD testing programme.

THE AMERICAS AND CARIBBEAN

<p>Barbados - http://www.un.org/esa/sustdev/indi4bb.htm</p> <p>For the Government of Barbados, a Steering Committee on Indicators for Sustainable Development was established to carry out the testing under the National Commission on Sustainable Development (NCSD). The Environment Division of the Ministry of Health and Environment co-ordinated the work of the NCSD. The NCSD was established in order to advise Government, foster collaboration and dialogue between stakeholders as well as develop policy recommendations and a plan for sustainable development. It is the advisory body on sustainable development issues in Barbados.</p>	<p>Brazil - http://www.un.org/esa/sustdev/indi4br.htm</p> <p>In Brazil, the Ministry of Environment served as the focal point for testing and implementation of the indicators, and also served to link the Federal and State agencies. The Brazilian Government also created an Inter Ministerial Commission for Sustainable Development (CIDES) in 1994, which coordinates the implementation of Agenda 21 activities. The Minister of Planning co-ordinates CIDES, which integrated other State Ministries into its framework.</p>
<p>Bolivia - http://www.un.org/esa/sustdev/indi4bo.htm</p> <p>The participation of the Bolivian Government in the testing has led to a project creating a National System of Information for Development (SNID). Moreover, the strategic thrust of the new National Plan of Social and Economic Development include sustainable development.</p>	<p>The testing of Sustainable Development Indicators was undertaken by networking state level agencies through the National Environmental System (SISNAMA).</p> <p>The central question in organising network co-operation for the testing and implementation of ISDs was the exchange of experiences between the State Agencies. In Brazil, each State has the autonomy to organise and implement its own environmental data inventory, therefore, an inventory of the available data and the methodologies of primary data generation became necessary before the start up of the testing process.</p>
<p>Mexico - http://www.ine.gob.mx/indicadores/ingles/portada.htm</p> <p>The Ministry of the Environment, Natural Resources and Fisheries (SEMARNAP) is the public institution in charge of environmental affairs in Mexico. The National Institute of Ecology (INE), is a decentralised organisation of the SEMARNAP. The INE oversees policy-making decisions for air quality, solid and hazardous waste management, environmental impact assessment, global climate change, ozone depletion, wildlife management and natural reserves. The INES's objectives are to create environmental policy guidelines, formulate standards and issue environmental permits.</p> <p>As part of the INE's objectives, the development of environmental indicators was carried out by the General Directorate of Environmental Management and Information in order to evaluate Mexico's environmental policy performance and achieve sustainable development.</p>	<p>Venezuela - http://www.un.org/esa/sustdev/indi4ve.htm</p> <p>In 1994, Venezuela established an Environmental Statistics and Information Centre, within the Directorate of Environmental Information of the Ministry of the Environment and Natural Renewable Resources. This was the first stage in the development of an environmental statistics programme, and the initial stages of a co-ordinating mechanism for implementation and testing of ISDs.</p> <p>The Centre has produced Venezuela's first State of the Environment Report, which was released in 1995, and a condensed English version was published in 1996</p>
<p>United States – http://www.sdi.gov</p> <p>In the United States, a Presidential Council on Sustainable Development (PSCD) has been established in response to Agenda 21. A Sustainable Development Indicator Group was also established in order to further develop national indicators for sustainable development. The US is not an official testing country.</p>	

Costa Rica - <http://www.mideplan.go.cr/>

The Government of Costa Rica, through the Ministry of National Planning (MIDEPLAN), promoted two capacity-building initiatives for sustainable development, with implications for the implementation of indicators of sustainable development. First, the organization of a National System for Sustainable Development (SINADES), and second, the creation and consolidation of a National System of Indicators of Sustainable Development, known as SIDES (Sistema de Indicadores sobre Desarrollo Sostenible). These initiatives led to the consolidation of a large database, which includes economic, social and environmental data. SINADES serves as a mechanism to articulate strategies, policies and actions within the Costa Rican public sector, oriented to the promotion of sustainable development, lead by MIDEPLAN. The SINADES initiative was supported by the Inter-American Development Bank (IDB) as a technical cooperation project. The project included two main activities that have contributed to create capacities for the implementation and use of indicators of sustainable development. The first is training, oriented to promote changes in attitudes, through workshops, courses and conferences focusing on sustainable development topics, including ISDs. The second is institutional strengthening, which includes activities related to: (a) the definition of operational procedures and legal instruments to institutionalize SINADES; (b) the creation of a networking mechanism to facilitate exchange of information and promote interaction; (c) the development of indicators of sustainable development and the definition and consolidation of institutional arrangements for their implementation; and (d) the consolidation of a National Geo-Computing. Finally, an Observatory of Sustainable Development was created at the University of Costa Rica, which is now responsible for the testing of CSD indicators of sustainable development