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Report on the International Symposium on Core Data Needs for Environmental Assessment and Sustainable Development Strategies

Volume II

Bangkok, Thailand, 15 - 18 November, 1994

UNEP

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United Nations Development Programme
United Nations Environment Programme

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National Aeronautics and Space Administration
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Universities Space Research Association

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VOLUME II: APPENDICES

DETAILED DESCRIPTIONS OF INTERNATIONAL CASE STUDIES , TOPICAL PANEL DISCUSSIONS, BACKGROUND MATERIALS

CONTENTS OVERVIEW

EXECUTIVE SUMMARY

A. Synopsis of the Symposium

The United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP) organized this international symposium to:

- Seek consensus on priority environmental assessment and sustainable development issues and the core data sets needed to respond to these issues;
- Define the minimum characteristics of these data in relation to national and transnational purposes;
- Establish collaborative mechanisms to foster the harmonization of core environmental data; and
- Examine the barriers to general access and use of these data.

For the purposes of this symposium, a core data set is defined as: a consistent set of basic data that can be used in the analysis of a variety of environmental assessment and sustainable development issues.

Following keynote and background presentations, participants reviewed the successes achieved and challenges faced in three international case studies:

- The Pan-Amazonia Project
- The Zambezi Project
- The Mekong Project

A variety of UNEP programs were also reviewed. Summaries of these case studies and UNEP programs are provided in Appendix 5.

Through a series of discussions in plenary and panel sessions, the participants exchanged views on critical environmental assessment and sustainable development issues, core data needs, and developed conclusions and recommendations related to five key topical areas:

- Land use change and degradation
- Fresh water and coastal zone management
- Sustainable use of natural resources
- Human health, pollution, waste management, and natural and environmental disasters
- Food and energy for an increasing population

Specific core data needs also were examined from a regional viewpoint, for the following five regions:

- Latin America
- Asia and the Pacific

- Africa
- Middle East, Eastern Europe, and Russia
- Western Europe and North America

Sixty-six high-priority core data sets were identified by panel participants. These core data sets were then discussed in open forum and aggregated into summary tables to graphically illustrate core data sets identified as important by more than one panel. Summaries that contain the results are provided in Appendix 7. Detailed descriptions of the topical workshops are provided in Appendix 6. Core data needs identified as a result of this process are described in the conclusions, below.

B. Conclusions

Ten high-priority core data sets central to many types of studies that produce environmental assessment information and sustainable development strategies were identified. These ten priority core data sets are:

- Land use/land cover
- Demographics
- Hydrology
- Infrastructure
- Climatology
- Topography
- Economy
- Soils
- Air quality
- Water quality

Having identified these priority core data sets, the participants then agreed that methods must be established to develop, maintain, and make openly accessible core data. Participants also concluded that:

- These core data sets are essential for environmental assessments and sustainable development strategies;
- Adequate representations of these types of data do not exist for many countries;
- These core data sets support a wide variety of uses specific to given locations, but often no single use can justify the cost of their development;
- Development of these core data sets is often labor- and technology-intensive and, as a result, expensive;
- A variety of factors inhibit availability, accessibility, and use of core data sets, including costs, national security/sovereignty, lack of knowledge of existence, and lack of standardization/harmonization.

C. Recommendations

Based upon the conclusions presented in paragraph B, above, the following recommendations were made:

- A forum should be established to provide follow-up and develop action plans to carry out the recommendations of this symposium.

  - To avoid a duplication of efforts, the forum, under the sponsorship of UNDP and UNEP, should have a standing core membership and should link with other fora addressing core data-related issues.

  - The forum should provide focus to all core data issues related to awareness, availability, access, use, education, and training.

- UN agencies and donor organizations should influence national bodies to provide local funding for the creation and maintenance of core data sets.

  - UN agencies and donor organizations should develop funding policies and mechanisms that encourage national organizations to acquire and provide core data sets.

  - National organizations should consider participation in cooperative programs that purchase/share core data and their products.

- National governments, donor agencies, and international organizations should:

  - Support the development and maintenance of core data sets;

  - Over the next 18 to 24 months, conduct surveys to document the status of core data sets;

  - Recognize existing differences in national policies on government-provided data, but work toward decreasing the cost, increasing the availability, and improving access to core data sets for scientific, environmental assessment and sustainable development purposes;

  - Expand communications, networking, and metadata efforts to increase knowledge of existing data bases;

  - Work toward the development of guidelines for standardization/harmonization of core data within the next 12 months.

The participants also suggested that:

- More should be done to publicize the need, use and value of core data. Creating and maintaining these data are essential for assessing the status of the environment and developing our resources, both human and natural, in a sustainable fashion.

- UNEP and UNDP should evaluate the need to create national- and regional-specific data sets that are key to understanding significant environmental assessment and sustainable development issues on a case-by-case basis, and should fund the creation of these data sets as appropriate.

- International assistance projects should incorporate strong capacity building, education, and training components that enhance users' basic skills and the further use of the products, as well as facilitate the exchange of information between producers and users.

- An international symposium should be held to address the variety of issues related to how core data sets can be applied to policy formulation and decision-making.

Sixty-five individuals from 28 nations participated in this symposium, including policy makers, scientists, and researchers from developing and industrialized countries. Also present were representatives from the United Nations, industry, aid-to-development agencies, and data suppliers. A list of participants is provided in Appendix 1.

APPENDIX 1

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APPENDIX 2

SYMPOSIUM AGENDA

International Symposium on Core Data Needs for Environmental Assessment and Sustainable Development Strategies

Bangkok, Thailand
15-18 November 1994

Final Agenda

Tuesday, 15 November 1994

0800 Registration

0830 Welcome and Introductions - J. Estes, Chair

0845 Keynote Speech: "From Data to Policy!" - Nay Htun
(Rapporteurs: A. Jackson, B. Ranson)

0915 Invited Talk: Sustainable Development and Industry - D.T. Buzzelli
(Rapporteurs: K. Herberger, J. Scepan)

0945 Overview: Core Data Needs Availability and Accessibility - J. Estes
(Rapporteurs: S. Taggarse, L. Pentacost)

1015 *Break*

1045 Case Studies: Successes and Challenges
This portion of the agenda was devoted to case study presentations, which specifically addressed the successes as well as challenges associated with the need for core data in support of environmental assessments and sustainable development projects and case studies. Case studies presented included:

1045 The Pan-Amazonia Project - T. Krug
(Rapporteurs: K. Herberger, S. Taggarse)

1130 The Zambesi Project - T. Mpofu
(Rapporteurs: B. Ranson, L. Pentacost)

1215 *Lunch*

1330 Case Studies: Successes and Challenges (Cont'd)

1330 The Mekong Project - L. Nilsson
(Rapporteurs: A. Jackson, S. Taggarse)

1415 UNEP Projects: GTOS, CGIAR, ESCAP, ECLAC, and the Biodiversity Convention - H. Croze
(Rapporteurs: J. Scepan, B. Ranson)

1445 Core Data Needs and Availability

This portion of the agenda focused on core data availability and related issues. Topical panels were established to discuss specific data availability, needs and related issues. Each of the following five panels included presentations by expert resource persons with experience in core data needs, availability, and accessibility in each of the topic areas. These brief presentations were followed by a period of comment and discussion.

1445 Land Use Change and Degradation - Moderator: P. Backlund
(Rapporteurs: J. Scepan, B. Ranson)

Resource persons and topics included:
J-P. Malingreau: Tropical Deforestation
M. Sall: Desertificatoin in the Sahel
M. Scott: GAP Analysis - A Strategy to Combat the Loss of Biodiversity
F. Turyatunga: Access Issues for Land Use/Land Cover Data
H. Croze: Remarks

1615 *Break*

1630 Fresh Water and Coastal Zone Management - Moderator: G. Golubev
(Rapporteurs: B. Ranson, J. Scepan)

Resource persons and topics included:

J. Tundisi:	Fresh Water
J. Pernetta:	Coastal Zone Management
V. Tsirkunov:	Global Fresh Water Quality
G. Kelleher:	Coastal Zone Management
H. Croze:	Remarks

1800 *Adjourn*

1800 The steering committee met with the day-two panel and regional chairs and rapporteurs.

1900 *Reception*

Wednesday, 16 November 1994

0900 Core Data Needs and Availability (cont'd)

0900: Sustainable Use of Natural Resources - Moderator: D. Rhind
(Rapporteurs: A. Jackson, L. Pentecost)

Resource persons and topics included:
E. Rodenburg, Global Resource Consumption and Depletion
D. MacDevette, Core Resource Data Availability in Southern Africa
S. Shrestha, Core Data Needs for Environmental Models

1030 *Break*

1100 Human Health, Pollution, Hazardous Waste Management, and Natural and Environmental Disasters - Moderator: J. Lawless
(Rapporteurs: S. Taggarse, K. Herberger)

Resource persons and topics included:
B. Rock: Environmental Pollution in Eastern Europe and the GLOBE Program
M. Rodriquez: Human Health Data Needs and Availability in Mexico
V. Sharma: Human Health Data in India
K. Rolfe: Human Health - WHO

1230 *Lunch*

1400 Core Data Needs and Availability (cont'd)

Food and Energy for an Increasing Population - Moderator: B. Levinson
(Rapporteurs: K. Herberger, S. Taggarse)

Resource persons and topics included:
S. Zziwa: Early Warning and Food Information in Africa
Z. Karim: Core Data Needs for Agriculture in Bangladesh
P. Sengupta: Energy in India

1530 Regional Needs

Working groups of participants organized by region met concurrently during this portion of the agenda to discuss common core data needs and priorities. At the end of this session, each regional working group presented a list of identified, prioritized data needs for presentation to the full symposium. Regional groupings and co-chairs were:

Latin America - J. Tundisi and F. Mata (Rapporteur: J. Scepan)
Asia/Pacific - K. Nonomura and S. Shrestha (Rapporteur: A. Jackson)
Africa - F. Gichaga and D. MacDevette (Rapporteur: L. Pentecost)
Middle East, Eastern Europe, and Russia - G. Golubev and A. Al-Hassan (Rapporteur: S. Taggarse)
Western Europe and North America - B. Levinson and D. Rhind (Rapporteur: K. Herberger)

1715 Presentation of Working Groups' Needs and Data sets

1715 Latin America - J. Tundisi
1730 Asia/Pacific - K. Nonomura
1745 Africa - F. Gichaga
1800 Middle East, Eastern Europe, and Russia - G. Golubev and A. Al-Hassan
1815 Western Europe and North America - D. Rhind

1830 *Adjourn*

1900 Moderators for days one and two, rapporteurs, and steering committee met to discuss common issues and priorities for Thursday presentations.

Thursday, 17 November 1994

0900 Presentation of Common Issues and Priorities - D. Rhind

1000 Core Data Needs in Support of Environmental Assessment and Sustainable Development Strategies

Working groups were established according to the five topical areas that were the subject of presentations and discussions the first two days of the symposium. Discussion of the possibility of other topics was raised by the chair; however, the participants decided to stay with the topical areas listed. Each working group was asked to prepare conclusions and recommendations in response to the following questions:

1. What are the minimum core data sets required for environmental assessments and sustainable development within your topical area?
2. What data are available?
3. How accessible are these data?
4. What are the barriers to data availability and accessibility?
5. Where are the gaps in the data?
6. What needs to be done to fill the gaps?
7. How do we build national and international capacity?

The topical areas for this portion of the agenda were:

Land Use Change and Degradation - Moderator: P. Backlund
(Rapporteur: J. Scepan)
Fresh Water and Coastal Zone Management - Moderator: G. Golubev
(Rapporteur: B. Ranson)
Sustainable Use of Natural Resources - Moderator: D. Rhind
(Rapporteur: A. Jackson)
Human Health, Pollution, Hazardous Waste Management, and Natural and Environmental Disasters - Moderator: J. Lawless
(Rapporteur: S. Taggarse)
Food and Energy for an Increasing Population - Moderator: B. Levinson
(Rapporteur: K. Herberger)

Discussion of the possibility of other topics was raised by the Chair; however, it was decided by the participants to stay with the topics listed.

12:15 *Lunch*

1330 Core Data Needs in Support of Environmental Assessment and Sustainable Development Strategies (continued)

Working group discussions continued.

1445 *Break*

1515 Working Group Presentations

In this session, each working group made a presentation communicating their conclusions and recommendations. Each working group was provided approximately fifteen minutes for presenting their results and additional time for discussion.

1700 *Adjourn*

1730 Working session for working group chairs, selected steering committee members, and rapporteurs to discuss cross-cutting issues, to synthesize the working group discussions, and to draft preliminary symposium results, which were presented to the full symposium the next morning.

1930 *Dinner for all participants*

Friday, 18 November 1994

0900 Review of Previous Day's Activities - J. Estes

0915 Presentation of the Preliminary Symposium Results - J. Estes

Based on the deliberations of the previous day, a presentation of the synthesis of results of the topical/issue-related working groups was presented. These preliminary results were presented to the symposium participants for comment and consensus. Preliminary results presentations included

1. Identified issues, needs, and recommendations in support of environmental assessment and sustainable development strategies;
2. A list of identified core data sets;
3. A list of identified gaps in core data sets; and
4. Recommendations for future efforts.

1015 *Break*

1045 Group Discussion of the Preliminary Symposium Results

1200 *Lunch*

1330 Donor Agency Response to Symposium Results
B. Lohani, Asian Development Bank
S. Gale, Joint Statement by USAID and DANIDA

1400 Sponsor Response to Symposium
H. Croze, UNEP
J. Estes, on behalf of Nay Htun of UNDP

1430 Summary and Conclusions - J. Estes

During this portion of the agenda, the symposium chair reviewed the final recommendations and identified the next steps and a schedule for completing this activity.

1500 *Adjourn*

APPENDIX 3

SYMPOSIUM OVERVIEW

International Symposium on Core Data Needs for Environmental Assessment and Sustainable Development Strategies

Bangkok, Thailand
15-18 November 1994

Purpose:

To identify and agree on consistent, core data sets needed to support policy and decision making for economic development, environmental planning, resource management, and ecological and social understanding on national, regional, and global levels.

It is anticipated that terrestrial data sets will be the primary focus of the discussion.

In support of this activity, data access and availability issues will be considered.

Expected Results:

- Statement of need for consistent, core data sets.
- Examples of applications for use of core data sets.
- List of optimal, core data sets and their characteristics.
- Sample inventories of existing core data sets.
- Sample source identification of core data sets.
- List of existing gaps in core data sets
- Recommended strategy for developing sources of funding and technical support for development of non-existent core data sets.
- Recommended mechanism to:
  - Develop approaches for providing funding and technical support to developing countries
  - Prescribe some methodologies and level of quality for core data sets
  - Prescribe consistent methodologies where non exist; and
  - Examine mechanisms for improving the archiving and access to core data sets.

The results of the meeting will be of use to national policy makers, planners, scientists, UNDP, UNEP, other UN entities, donor agencies, industry, investors, and data providers.

Participants:

The symposium is being organized under the auspices of the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP) and will include approximately 50 participants from developing and industrialized countries. These participants will include policy makers, scientists, and researchers. In addition, UN representatives, industry representatives, donor representatives, and data suppliers are expected to participate in the workshop.

Language:

English will be the working language of the symposium.

Symposium Overview (Cont'd)

Background Paper

The Problem

All countries have interests in environmental management and development. Just as meaningful environmental assessments can only be made on the basis of appropriate, high-quality data, the determination of whether development activities are sustainable must be based on the same data.

Adequate environmental data already exists for some, but not all, parts of the world. In many places, data is collected in a way specific to the local needs, often as they were defined long before current needs were formulated. In some parts of the world, even the most basic data such as soils, topography, vegetation cover and population density simply do not exist. As a result, comparisons from place to place or time to time are sometimes meaningless because the data are sometimes incompatible. This applies even when comparing "State of the Environment" reports, but is particularly true when data are combined inside a computer to carry out environmental assessments or developmental planning within a given country or especially in regional assessments and/or trans-boundary work. A good example of this is the incompatibilities demonstrated in the environmental data collected in the different countries of the European Union. As a result, the Commission of the European Community now seeks to harmonize the collection of such data wherever possible.

Satellite remote sensing provides data that is inherently more compatible over large areas than data collected by ground methods; however, many environmental variables cannot be collected remotely

A Solution

Any solution to the problems of incomplete and incompatible data must then:

- Establish ways of bringing together collected from different sources;
- Establish ways of progressively harmonizing data collection procedures and analytical practices so that national, regional and other bodies can be confident in any comparisons made: and
- Foster appropriate environmental data collection where none exists at present.

Such steps must clearly be part of a long-term solution. Fortunately, it seems likely that only a few key (or core) environmental variables need and can be dealt with in this way in the near term.

As a first step in a process to identity the key environmental issues and related, supporting data sets, the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP) are sponsoring the *International Symposium on Core Data Needs for Environmental Assessment and Sustainable Development Strategies*. This symposium has been designed to:

- seek consensus on priority environmental assessment and sustainable development issues and the core data sets needed to respond to these issues;
- define the minimum characteristics of these data in relation to national and transnational purposes;
- establish collaborative mechanisms to foster the harmonization of core environmental data; and
- examine the barriers to general access and use of these data.

Symposium Overview (Cont'd)

What is a core data set?

For the purposes of this symposium activity, a core data set is defined as:

> A consistent set of basic data that can be used in the analysis of a variety of environmental assessment and sustainable development issues.

One example of a core data set is topography of the land surface, Which is important in dealing with projects in agricultural development, industrial plant siting, and land-use zoning.

APPENDIX 4

BACKGROUND PAPER

Core Data Needs for Environmental Assessments and Sustainable Development

by

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Universities Earth Science Program
Universities Space Research Association

and

D. Wayne Mooneyhan
Visiting Senior Scientist
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Introduction

Adequate spatial data, particularly data in map form, do not exist for many areas of the world today. Depending upon scale, thematic content and timeliness, this is equally true in both developed and developing countries. Many people find this hard to believe. Too often, we assume that the "map" needed exists and contains accurate and up-to-date information. However, spatial information is dated when it is collected and maps made from such data often have a limited useful life. The value of spatial data is many times related to its currency. Some mapped information is more perishable than others; e.g., continental outlines as opposed to forest clear cutting. Mapping is an important, complex, expensive, and time-consuming task that is not currently being performed in an acceptable fashion.

This paper discusses spatial data/information important for the development of policy and for environmental planning, and resources management. The focus is primarily on the need for spatial information in map form. However, as used in this paper, "map" encompasses, but is not limited to, the paper (analog) products with which most people are familiar. "Map," as used here, refers to spatial data/information in both digital and analog form. "Map" does not refer solely to a standardized base cartographic product that has been compiled by a national mapping agency to exact specifications, but applies as well to what might typically be termed as "maps" - e.g. charts, sketches, plans and any other geo-referenced measurement that could be used for environmental assessments and sustainable development studies. The terms "science-based" and "science-quality" are used interchangeably in this paper to refer to maps whose lineage is known and traceable. In this context, "science-based" or "science-quality" also means that, in so far as it is both practical and possible, the errors inherent in the overall production of these "maps" have been documented. For the purposes of this paper, scale may be referred to as specific representative fractions (e.g. 1:100,000). Scale also may be referred to by association to a particular area of study. In this respect the following scales would generally apply:

Site = 1:10,000 or larger
Local = 1:10,000 to 1:50,000
National/regional = 1:50,000 to 1:250,000
Continental = 1:250,000 to 1:1,000,000
Global = 1:1,000,000 or smaller

The authors realize that the concept of scale can be confusing. Yet, one more set of internal definitions is needed to help clarify what follows. The reader should be aware that large scale or high-resolution refers to maps whose scales would generally be in the range from 1:10,000 to 1:100,000; while small scale or low resolution data sets would generally be in the range from 1:1,000,000 to 1:5,000,000 and smaller.

For the purposes of environmental assessment and sustainable development studies, the world is not well mapped. The myth that the world is well mapped is perpetuated in a variety of subtle ways: from road maps to the atlases we possess. Merely because people can use road maps to guide them from one place to another does not mean that those maps will accurately depict how many acres of agriculturally active land one will pass through. Nor will they provide information on the timber volumes, the readiness of range land for grazing or the rate at which urban areas are gaining or losing population.

The myth is further perpetuated by material in the media and scientific literature concerning the state of the various parts of the Earth System: declining forests, expanding deserts, or the loss of soil productivity and biological diversity. How accurate are these materials? They may accurately indicate how many acres of old growth forest existed in Amazonia or Costa Rica, - but the need is to know the acreage of forest today. How much reliance can be placed on any of these published figures? What are the current facts? Most often we do not really now.

The types of spatial data that planners, resource managers and policy makers require do not exist for large parts of the world; they do not exist to the level of accuracy and timeliness necessary to make the data/information of real value -- value in environmental planning, resources management or in the public policy decision making process. How, then, can the myth that the world is well mapped with regards to environmental information be dispelled? Collectively, what can be done to influence policy makers concerning the need for better spatial data/information to support sustainable development and environmental assessment activities? This paper will provide some background on the need for improved spatial information. This is followed by material on projects that have attempted to produce data in support of country-level development projects. Policy level concerns and problems associated with the compilation of global maps and other types of spatial information are presented next. Finally, recommendations for future actions are made.

Background

At an Aspen Global Change Institute conference August 1993, Dr. Nay Htun, Deputy Executive Director of the United Nations Environment Programme, listed six high-priority issues of global concern: (1) biological diversity or biodiversity; (2) consumption and production; (3) demography; (4) desertification; (5) freshwater; and (6) poverty (Htun, 1993).

Dr. Htun noted that biodiversity supports human needs and is thought to increase the chances for the survival of all species. Forty-five percent of all pharmaceuticals produced today are of biological origin. Soybeans growing today in the United States came from five varieties found in Asia. Canadian wheat comes from a variety that has been grown for years in the highlands of Kenya. Such examples demonstrate the links between the economies of the industrialized and developing nations.

Today, 24 percent of the world's population consumes some 75 percent of the energy, 80 percent of the paper and chemicals, and -- depending upon how the calculation is done -- between 48 percent to 72 percent of the food. This disparity between consumption, production, and poverty is a major contributor of tensions between industrialized and developing nations. Indeed, economic and environmental threats affect national sovereignty and are real threats to the security of all nations.

In the area of demographics, the world's population is now between 5.5 billion and 6 billion. Global population is increasing by some 100 million individuals per year. By 1970, the population growth rate in the industrialized nations had slowed to less than 1 percent annually and absolute increases are expected to level off in less than a century. But in less-developed nations, populations continue to soar, in some cases doubling in the span of only 25 years.

Desertification affects 47 percent of the total land area of the earth (Htun, 1993). Only .01 percent of the world's freshwater is readily available. Of this .01 percent, 65 percent is used for irrigation, 25 percent for industry, and 10 percent for domestic use. One and a half billion people earn less than one U.S. dollar per day, have no health care, housing, sanitation, and cannot read or write (Htun, 1993).

These are startling statistics. However, when such figures are used, a number of key points should be remembered. These points include: (1) while each of these figures represents a measure associated with the magnitude of a global problem, there is an inherent spatial or geographic distribution associated with that measurement that is extremely important as well; (2) understanding the inherent spatial non-uniformity associated with these data is critical when one seeks to achieve resource management and/or policy-level approaches to solutions; and (3) at present there is little way of knowing just how accurate the sources from which these figure are. That is, without some means of verification or some means of assessing the accuracy of such figures, how much confidence can or should decision makers place in their accuracy?

Estimates of losses in biological diversity are open to serious question. Estimates of desertification are problematic and subject to challenges on the definition of desertification. Population monitoring at global scales within current reporting methodologies is impractical, and open to serious question (Estes, 1992).

There is no lack of issues of global importance for which geographically accurate up-to-date information is needed. There are many figures, such as those mentioned above, purporting to illustrate the magnitude and significance of these issues within the context of economic development, environmental management, science, or public policy decision making. Given the overlap in these issues and their impacts at scales from local to global, what are the key environmental variables that must be documented to establish a baseline, monitor status, and identify improvement or deterioration? While priorities of categories of environmental information (population, land cover, cloud cover, soil types, species richness, ocean temperature, wind speeds, ozone levels) can be debated, there can be no doubt that this type of information is required for analysis, assessment, planning and management decision making.

The Problem

With respect to the land, there is currently no comprehensive, coordinated, operational global measurement, mapping, monitoring, and modeling program in existence today (Estes, et al 1993). The key term that makes this statement correct is mapping.

The facts are:

1. Large scale, science-based data sets do not exist for most of the earth at the present time, even in well-developed countries;

2. The development of such data sets is labor intensive, in terms of both scientific and technical personnel and is, therefore, labor expensive;

3. Although such data sets could support a wide variety of useful applications specific to a given locale, no single use can generally justify the cost of development;

4. In many developing countries, even well-understood environmental changes, with local causes and effects, often have very low priority with officials compared to such issues as food, health care, and the safety of the people. Global change issues and environmental concerns are often treated as rumors from more fortunate neighbors;

5. In some countries, internal struggles have resulted in civil wars or strife with neighboring states; often in these regions, there is little internal infrastructure to deal with issues that are not directly related to survival;

6. In a number of countries, the high resolution data sets needed by the world community are classified and are not permitted to leave the country in any form. In some instances where such data are exchanged with "friendly" nations, restrictive agreements can limit potential access by scientific researchers, environmental planners, resources managers, and the general public; and

7. Even in highly-developed countries where resource and environmental planning and management and scientific understanding is widespread, it is often difficult to generate the political and financial support for the correction of widely recognized environmental problems (Mooneyhan,1993).

In many developing countries, even the most basic information related to resources and the environment do not exist. In Thailand, detailed soils data exist only for lands deemed arable (rice producing) some fifty years ago. Therefore, much of the then-forested lands and all of the hilly and mountainous regions have never been the subject of a detailed soils survey. While these mountainous regions may not be economically important to commercial agriculture, they are home to millions of "Hill Tribe" peoples who practice subsistence agriculture to feed an exploding population. This "slash and burn" agriculture is now on a cycle of ten to twelve years (sometimes less), and the resulting deforestation and associated soil erosion have become major environmental problems. Soil types and erodability information, which are necessary to quantify the present condition and predict future impacts on local and regional ecosystems and/or the already marginal food supply for the growing number of "Hill Tribe" peoples, are not known. Each year, funding agencies spend millions of dollars in Thailand and numerous other countries to support hundreds of development projects that employ modern technologies to improve economic productivity, communications, education, and environmental monitoring and assessment (often using satellite remote sensing and GIS technology). None of these donors seems interested in funding a rather mundane project such as a soil survey. The result is that as of 1993, Thailand, a rather advanced, developing country, still has no detailed soils information for approximately one-third of the country.

Thailand also can serve as an example of a second type of problem that complicates the acquisition of high resolution science data sets -- the classification of certain data for "internal use" only. In Thailand today, there are detailed topographic maps at 1/50,000 that have been developed using modern techniques during the last two decades; however, these data and, in fact, all high-resolution topographic information are restricted by military classification to "internal use" only and are not available for use by the international science community for global research and applications studies.

Thailand is just one example and is, in fact, one of the more cooperative countries with respect to scientific data availability. Some of the worst-case examples are countries where entire data archives have been lost or destroyed by actions during revolution, wars, and/or civil disturbances. Examples include: Cambodia; Laos; Afghanistan; Liberia; Angola; Chad; Uganda; and Somalia. Other examples are countries in which high-resolution spatial (large scale map) information and almost all information relative to the physical and human environment has been under internal embargo for decades. These include large areas of the world that have been under communist rule for many years, such as the former USSR, Bulgaria, Romania, North Korea, the People's Republic of China, and Cuba. While the situation with respect to some of these nations seems to be improving with recent changes, it could be decades before reliable information is available for internal planning and resource development or to the world science community for global studies.

There are still other countries that have high-resolution spatial information and the freedom to release it, but simply choose not to share it with the international science community. Both India and Brazil have been in this category for a long time; however, both seem now to be relaxing their environment data/information policies somewhat following the United Nations Conference on Environment and Development (UNCED) meeting in Rio de Janeiro in 1992.

There also exist situations where a country is not constrained by either lack of resources or by data classification policies, but simply does not place a high political priority on long-term environmental investments to cause large scale science quality baseline data sets to be generated for general use. Therefore, the information is not available to either indigenous environmental planners, scientists and/or resource managers who are concerned with managing change on a site or a local scale, or to the international science community, which is concerned with change on a regional, continental, or global scale. Most of the so-called "developed countries" fall in this category. In the United States, as in most industrialized nations, large-scale, site-specific data sets are often generated for one-time studies or for the solution of a specific local problem. At present, very few of these data sets ever make their way into databases that can be accessed by the interested community at large. As a result, although much of an area may be covered, the coverage consists of data concerning different parameters compiled at different scales, or done in different time series. Therefore, the data sets that cover the area cannot be combined for larger area studies or applications. In addition, because these data most often reside in non-networked local databases (a map drawer in a planning agency or their tape rack), the data for all practical purposes are lost to the community. As a result, more money continues to be spent on the generation of site and local scale data sets than might be needed to develop science-based baseline data sets for an entire country. The loss to the community is more than just the money; many small local projects with funding levels too low to produce their own data sets are either abandoned or poorly done. The result is usually detrimental to the local environment and collectively to the global environment. In addition, large area studies (either regional or global) continue to suffer for the lack of high-resolution spatial information for: (1) baseline for model development; (2) calibration of remote measurements; and (3) verification of indices of change.

The authors are not the only individuals who recognize the lack of accurate information about our environment. Eric Rodenburg, in "Eyeless in GAIA," (1992) writes: "Those who seek data on the condition of the world's environment are often shocked by the depth of ignorance they find." The authors of International Geosphere Biosphere Programs (Turner et al, 1992) state that: "At present we are unable to answer even the most basic questions, for example: Are the world's deserts really spreading and if so why? Are population pressures extending land uses, such as agriculture or settlement to areas that cannot sustain the uses? How are deforested areas of land used, and what are the implications of these different uses for the net emissions of greenhouse gasses?"

Today, information on the status of mapping the globe is scarce and found in widely-scattered sources (e.g. United Nations, 1990; Wolf and Wingham, 1992; Townshend (ed.), 1992). From these sources, we learn that as of 1987 only 33.3 percent of the world land surface area was covered by topographic maps at a scale larger than 1:25,000 see (Figure 1). Only 56.1 percent of the world land s at 1:100,000 and 81 percent at 1:250,000. So it would appear that slow, steady progress is being made. A survey of global digital evaluation data done by Wolf and Wingham (1992) resulted in the first "...global inventory of digital, elevation data stocks of known reliability." These authors conducted a survey that they report as "...accurate over 11 percent of the Earth's surface, and shows data held for 10 percent of the Earth's surface area." The authors go on to state that, "For 11 percent of the surface area of the Earth, the status of data is known, for the remaining 89 percent the status is unknown" (Wolf and Wingham, 1992).

While a number of global scale thematic data sets have been developed for land cover, there is little agreement among primary sources and a distinct lack of information upon which to judge the accuracy of these data. Although existing sources have proven to be "useful first order delineations of land cover" (Townshend, 1992), they are basically unreliable. As seen in Figure 2 from Townshend, 1992, comparisons of these global land cover classifications for the period 1954 to 1985 show variations of as much as 100 percent in major cover types (e.g., forests) among different sources. Townshend (1992) goes on to state that the "... shortcomings of these cartographic approaches suggests the strong need to develop land cover data sets derived from remotely sensed data."

With modern technological advancements, why is there still a lack of large-scale baseline information for the land surfaces of the globe? There is a growing recognition that the environmental and/or economic conditions of nations are also factors affecting national security. The United States recently passed the Land Remote Sensing Policy Act of 1992 (Public Law 102-555), Section 2. (1) finds: "The continuous collection and use of land remote sensing data from space are of major benefit in studying and understanding human impacts on the global environment, in managing the Earth's natural resources, and in planning and conducting many other activities of scientific, economic, and social importance." While an image from a satellite is not a map, it is important to note that mapping can and is being done from satellite systems. It is significant that P.L. 102-555 puts understanding of human impacts on the global environment and management of the Earth's natural resources on a par with national security. Economic and environmental health are key factors affecting the well-being of all nations. Better environmental information is a fundamental requirement if management practices, economic well being, and environmental quality are to be improved.

Large scale, science-based spatial data/information are needed to: help improve understanding of the Earth as an integrated system; plan the wise use of the resources base of nations; and, assess and monitor environmental quality at scales from local to global. Improvements in the environmental quality of nations around the world can enhance the quality of life of and improve global economic conditions. These factors can have the effect of improving the security of all nations.

The problems associated with sustainable development and global environmental change are so critical that, in so far as practical, barriers need to be lowered to open the flow of science quality information. These barriers inhibit the improved understanding of the current status of the global resources base and the factors that affect the quality of the local and global environment. It should be noted however, that even with the barriers lowered, the production of maps is a complex and expensive task. The average cost to produce a 1:24,000 scale, 7.5 minute quadrangle in the United States map is $40,000. There are some 55,000, 1:24,000 scale maps in the conterminous United States. The cost to completely revise a 1:250,000 scale map in the United States is $20,000. There are some 470, 1:250,000 scale maps that cover the United States. There is a need for standard science quality map products on a country by country basis for the entire land surfaces of the Earth. Yet the costs associated with such an effort could run into the billions of dollars, depending on such factors as scales, thematic content and the level of accuracy desired. Developing nations, in particular (and even many developed nations) have a difficult time funding the production and or maintenance of their base cartographic products. Particularly in developing nations, there is a needto find funding mechanisms to produce geographically-referenced data from which can be derived maps and other types of geo-referenced information needed to support environmental assessment and sustainable development activities.

Conclusions

Governments engage in programs of systematic mapping and the acquisition of other types of inherently spatial information in response to a wide variety of national, regional and local needs -- military, administrative, socio-economic, and environmental. Recognizing the need for this information is not yet sufficient to generate the resources necessary to produce the maps and other spatial data needed by resource planners, managers, and the scientific community. Indexes of map coverage differentiate areas depicted according to the relative degree of importance that governments have attached to them (Platt, 1945). In general, the areas most intensively mapped are those areas of greatest interest and concern not only to governments but to society at large. Statistical summaries of spatially referenced information are also produced by most nations and are aggregated by international organizations; but here again, the care with which these data are generated are subject to the same problems associated with map data.

The technology to produce baseline data/information is generally available. Satellite sensors, global positioning systems, image processing, digital cartographic, and geographic information systems are revolutionizing mapping. The problems associated with the collection of geographically-referenced information and processing it into useful map form are by and large neither technical nor scientific. They are primarily related to governmental and institutional priorities.

The United States has endorsed the concept of a national spatial data infrastructure (NSDI) (National Research Council, 1993), and the U.S. Federal Geographic Data Committee (FGDC) is examining ways to improve this infrastructure. Environmental security and the well-being of all peoples argue that a global spatial data infrastructure and a world geographic data committee should be established and that the acquisition of core geo-referenced data sets and baseline mapping at high resolution should be pursued in every country.

To move toward the goal of creating better geo-referenced and map-based information in support of environmental assessments and sustainable development at scales from local to global, a number of specific issues must be considered:

- There are environmental assessment and sustainable development issues that are important at a country level, some of which transcend national boundaries;
- High resolution, science-quality spatial information is needed to appropriately examine the range of potential approaches to these issues;

- There is a set of baseline data/information that are required for meaningful environmental assessments and sustainable development studies; and
- Some level of cooperation that supports the development of such data sets in an internally consistent fashion across national boundaries is possible.

These issues indicate a need for action to:

- Begin to develop a set of specifications for baseline country level environmental assessment and sustainable development information; and
- Encourage international donor and environmental agencies and non-governmental organizations to work towards the production of internally consistent data sets on a country level basis;
- Study the feasibility of the establishment of a global spatial data framework where, given certain standards, various scales of thematic maps can be nested to form a complete mosaic of multi-scalar, digital coverages for the globe.

To carry this work forward, leading international intergovernmental and national aid agencies (e.g. UNEP, UNDP, the World Bank, etc.) should be encouraged to establish a committee to:

- Examine the concept of and make recommendations leading towards the development of a global spatial data framework; and
- Develop a set of specifications for the development of globally-consistent, country-level baseline data sets needed for environmental assessments and sustainable development.

Finally, every effort should be made to communicate to the public, politicians and policy makers, key agency personnel, the science community, and private industry that: (1) spatial information/maps currently needed to fully support environmental assessments and sustainable development studies are lacking in most parts of the world; (2) there is a great deal of science still to do in the collection and mapping spatially-specific, environmental development and resource management information that deserves support; and, (3) improved mapping of baseline environmental information, even with today's advanced technologies, remains a difficult task. In today's rapidly changing world, an improved understanding of the delicate balance between economic development and environmental security on both the local and global levels is essential.

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APPENDIX 5

INTERNATIONAL CASE STUDIES PRESENTATION MATERIALS

PAN-AMAZON PROJECT
PRESENTATION MATERIALS
(T. KING)

OVERHEADS FOR THE PRESENTATION AT THE INTERNATIONAL SYMPOSIUM ON CORE DATA NEEDS FOR ENVIRONMENTAL ASSESSMENT AND SUSTAINABLE DEVELOPMENT STRATEGIES

Slide 1

PANAMAZONIA PROJECT
Dr. Thelma Krug Remote Sensing Division Bangkok, 1994

Slide 2

INPE - Brief Description

National Institute for Space Research
- main civilian organization for space activities in Brazil
- staff of 1400 (800 MSc and PhD)

Areas of work:
- Space Science
- Remote Sensing
- Meteorology
- Space Engineering

Slide 3

Remote Sensing at INPE

- LANDSAT Receiving and Processing Station
  Operation since 1972
  Data from LANDSAT, SPOT, ERS-1, NOAA/AVHRR

- Remote Sensing Applications
  Research and Methodology Development
  MsC degree on Remote Sensing (since 1974)

- Image Processing and GIS
  Research and software development
  Integrated Image Processing-GIS software

Slide 4

Environment Activities at INPE

Numerical Weather Prediction Centre
NEC SX-3 supercomputer
Medium-large forecast and climate studies

China-Brazil Earth Resources Satellite
Scheduled to be launched in 1996
6 bands (3 visible, 1 NIR, 2 MIR) at 20m resolution

Brazilian Space Program
SCD-1,2,3 and SSR-1,2

Slide 5

Selected Applications

Amazonia Deforestation Mapping
Ecological Economic Zoning
Geological Mapping
Urban Water Quality

Slides 6-20

Images from Amazonia: Flora and fauna

Slide 21-23

Examples of Ecological Economical Zoning - State of Amapa

- Geological Map
- Soil Map
- Vegetation Map
- Land use
- Morphology
- Homogeneous Zoning

Slide 24

Panamazonia Project
Implementation in Brazil: December, 1991
Objective: to monitor the South American rain forest using orbital data
Countries Involved: Bolivia, Peru, Ecuador, Colombia, Venezuela, Suriname, Guyana, French Guyana
Boundary of the South America Rainforest: 7,566,725 km2

Slide 25

Map of Legal Amazon + Panamazonia countries

Slide 26 e 27

Technical Staff

. BOLIVIA
COMAT: Centro de Investigaciones de la Capacidad de Uso Mayor de la Tierra
. PERU
INRENA: Instituto Nacional de Recursos Naturales
. EQUADOR
CLIRSEN: Centro de Levantamientos Integrado de Recursos Naturales por Sensores remotos
. COLOMBIA
IGAC: Instituto Geografico Agustin Codazzi
. VENEZUELA
SAGECAN: Servicio Autonomo de Geografia y Cartografia Nacional
. GUYANA
METEOSERVICE: Hydrometeorological Service
. SURINAME
FORESTSERVICE: Suriname Forest Service
. FRENCH GUYANA
ENGREF: Ecole National du Genie Rural des Forets

Slide 28

Actions

. Discussion with all countries to delineate scope of the project
. Technical Meeting
INPE, São José dos Campos, 1991
. LANDSAT Image Distribution
270, INPE, December 1992
61, EOSAT, January 1993
2, Cotopaxi Receiving Station
. Training Course on Forest Assessment and Mapping
INPE, São José dos Campos, May, 1992
. Evaluation of Reports
Bolivia, Colombia, Venezuela, French Guyana

Slide 29

What are the key environmental assessment and sustainable development strategies facing your organization?

- Deforestation Assessment (National & Panamazonia)
  Rate of Deforestation
  Georeferenced Dataset (EOS - Global Change)

- Ecological Economic Zoning

- Multisensor Project
  Pantanal Area (LANDSAT/TM, SPOT, ERS-1, NOAA/AVHRR)

- Crop Yield Estimation

- Burnings

Slide 30

Amazonia Deforestation Mapping

Legal Amazonia: more than 5 million km2
INPE: deforestation assessment since 1988
-use of LANDSAT TM and MSS images
-comprehensive surveys (wall to wall)

Objectives
- measurement of yearly rate of deforestation
- building a geographical database

Slide 31

Coverage of the Legal Amazon Region - TM images

Slide 32

Decrease of the rate of deforestation - Graph

Slide 33

An example of a digitized chart from the Deforestation Project - one plan of information for a GIS

Slide 34

How do you rate the adequacy of data that you are currently using to respond to these challanges?

Current surveys
- manual interpretation
- 4 land covers (forest, non-forest, deforestation, water bodies)

Global change surveys and continuous monitoring
- require automatic interpretation of images
- estimation of regrowth areas

Geographical Information Systens
- vegetation map - RADAMBRASIL, 1976.
- scale: 1:1,000,000

Slide 35

What are the major issues your organization faces in acquiring and producing the data?

High incidence of cloud covered areas
- solution: radar data (ERS-1, JERS, RADARSAT)
- need of: better understanding of this kind of data
technology transfer

Insufficient classes
- regrowth (secondary vegetation)

Geographical Information Systems
- complex patterns of deforestation
- non-compatible scales

Slide 35

Cloud covered TM image

Slide 36

TM Image showing deforested areas

Slides 37 and 38

Potential of radar data to detect deforested areas
Same image as in slide 36 - JERS - SAR image
Part of the area covered in slide 36 - RADARSAT - SAR image

Slide 39 e 40

Examples of automatic segmentation and classification - a new approach for deforestation assessment

ZAMBESI PROJECT

PRESENTATION MATERIALS

(T MPOFU)

BACKGROUND

- 1985, UNEP was requested to facilitate regional cooperation.

- Environmentally Sound Management of Inland Waters (EMINWA) Programme.

- A regional Working Group of Experts undertook a diagnostic study.

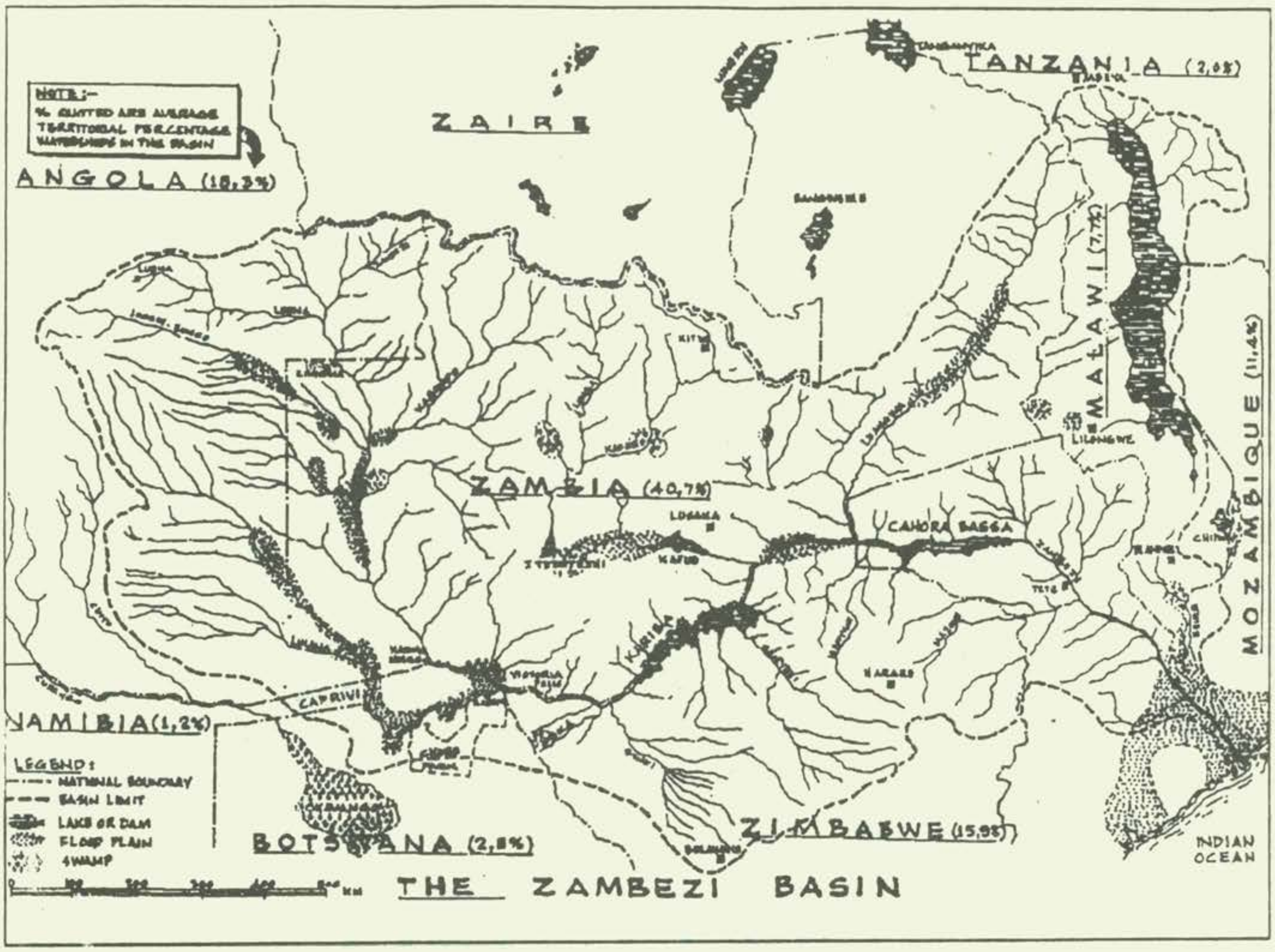

NORTH ATLANTIC OCEAN
MEDITERRANEAN SEA
Tropic of Cancer
Sudan
Ethiopian Highlands
G. of Guinea
Equator
SOUTH ATLANTIC OCEAN
East from Greenwich
INDIAN OCEAN
Madagascar
Namib Desert
Tropic of Capricorn
Kalahari
Highveld
Karoo

LOCATION

- Between 8°S and 20°S, and 16.5°E and 36°E.

- Flows 3000 km from Kalene Hills, Zambia to Indian Ocean, drawing a 13 million km^2 area where more than 25 million people lived in 1985.

- It passes through Angola, then back to Zambia and Zimbabwe, and drains areas in Angola, Botswana, Malawi, Mozambique, Namibia, and Tanzania.



Area covered by the Zambezi River Project.

OBJECTIVES OF STUDY

- **To define specific environmental problems and their impacts.**

- **To outline management goals, policies, and activities.**

STUDY FINDINGS

- Inadequate monitoring and exchange of information concerning climatic data, water quantity and quality and pollution control;

- Inadequate soil and water conservation measures and flood plain management;

- degradation of the natural resource base due to population growth and land pressure;

4c

- **Inadequate dissemination of information to the public to facilitate community participation in planning, construction, and maintenance of water supply and sanitation systems;**

- **Inadequate health education for the public;**

- **Inadequate coordination and consultation both at the national and river basin levels;**

- **Inadequate information on environmental impacts of water resources development projects such as hydropower and irrigation schemes**

Study Recommendations

- the need to deal with water and environmental management problems in a coherent, comprehensive and coordinated manner to avoid future conflicts between socio-economic development and ecological interests

Zambezi Action Plan

(ZACPLAN)

The Zambezi River Action Plan was then developed with nineteen project areas grouped into two categories.

ZACPRO 1: Up-to-date compilation of all completed, on-going and planned development projects;

ZACPRO 2: Up-to-date compilation of national and international laws related to the utilization and management of water and the environment;

ZACPRO 3: A survey of national capacities and means to respond to environmental problems;

ZACPRO 4: Development and strengthening of national research institutions and laboratories;

ZACPRO 5: Development of a basin-wide unified monitoring system related to water quality and quantity;

ZACPRO 6: Development of an integrated water management plan;

ZACPRO 7: Promotion of environmental education and public participation;

ZACPRO 8: Development of unified criteria and manuals for water engineering, planning and design.

Institutional Arrangements

- ZACPLAN was adopted by the Southern African Development Community (SADC) as a regional programme (1987)

- the Environment and Land Management Sector (ELMS) of SADC was given the responsibility to coordinate and execute ZACPLAN

- SADC ELMS is supported in this endeavour by a Water Resources Sub-Committee

Status of Implementation

Progress has rather been slow. For example

- **ZACPRO 1 and 5 have partially achieved their objectives**

- **ZACPRO 2 - an analysis of environment and water-related legislation has, with the help of UNEP, been completed. Draft Protocol due for signature in January, 1995.**

- **ZACPROs 3, 4, 7 and 8 have not been implemented due to lack of funding.**

ZACPRO 6 is being implemented in four phases. This is a Database Development Project involving the collection, storage and retrieval of hydrometeorological and water quality data. Should be completed in April, 1995. The main activities have focused on:

- **the types of data to be stored in the ZACBASE**
- **data series and station network**

- **data collection and evaluation**
- **computer configuration, hardware and software.**

It is anticipated that ZACBASE will hold information on hydrology, meteorology, water quality, sedimentation, reservoir and hydropower station characteristics.

Existing Gaps

- paucity of information remains a major constraint to effective and comprehensive planning and decision-making processes in the Zambezi river basin countries

- the need for adequate monitoring and exchange of information is still unmet

- the potential of resources to be utilized in future is unknown

- **the fragility of the ecosystem in the basin is largely based on estimation and guess work**

- **the limits of utilization in terms of achieving sustainability are unknown**

Way Forward

- Before any meaningful action can be undertaken, existing information networks and databases must be improved and new ones developed

- A continuous and systematic assessment of the main factors influencing environmental quality needs to be put in place

- a thorough understanding of the intricate linkages between development and environmental considerations should be a prerequisite if we are to achieve sustainable human development

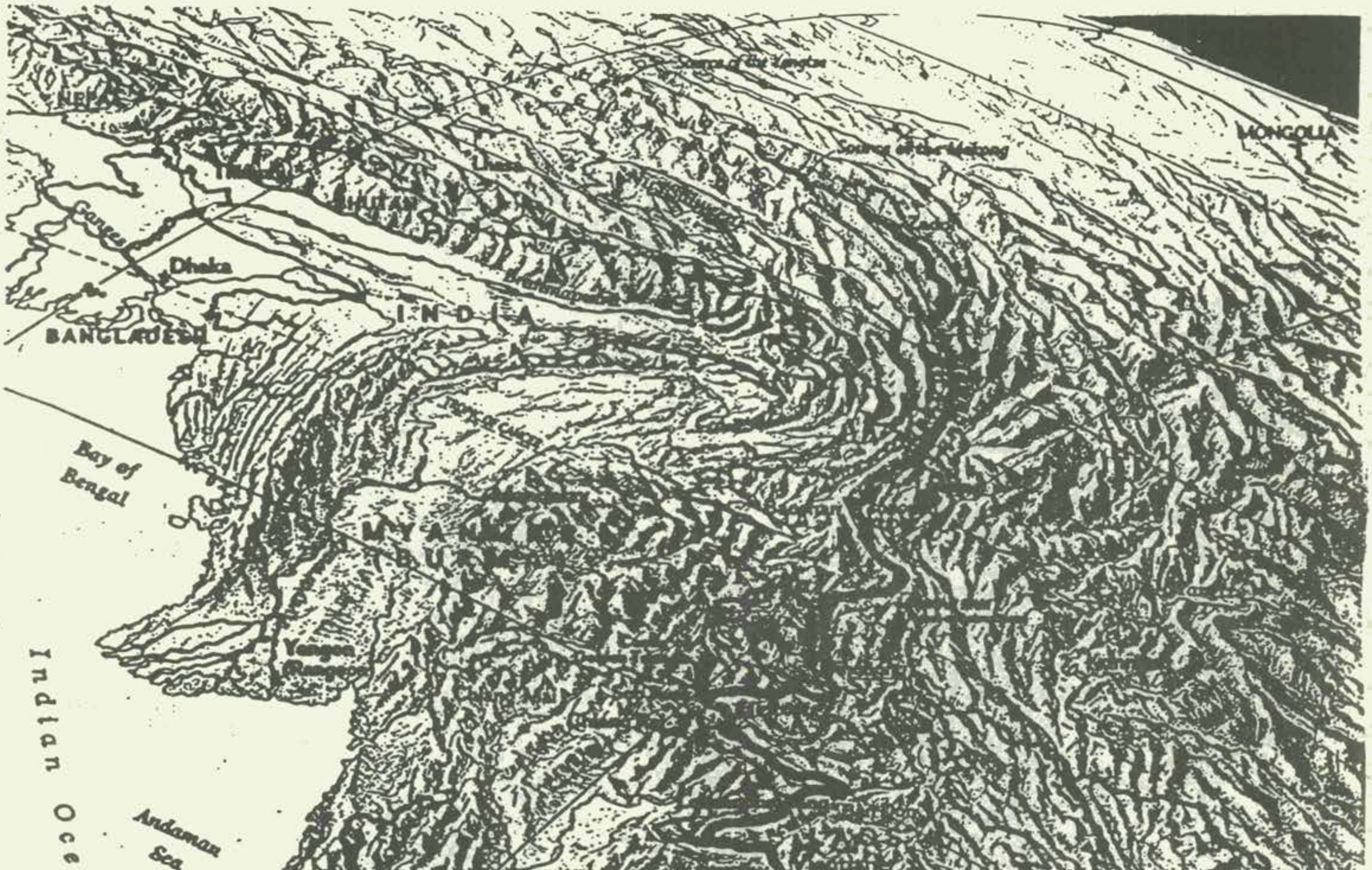
- capacity building in monitoring water quality should include improvement in the quality of laboratories and equipment.

MEKONG PROJECT

PRESENTATION MATERIALS

(L. NILSSON)

SUBJECT ....


Source of the Mekong
MONGOLIA
Ganges
Dhaka
INDIA
BANGLADESH
Bay of Bengal
MYANMAR
Yangon (Rangoon)
Indian Ocean
Andaman Sea
Chao Phraya
THAILAND
Bangkok
Hanoi
VIETNAM
Gulf of Tonkin
Hue
Da Nang
Gulf of Thailand
NORTH
U Minh forest
Ca Mau
Nam Can
Ganh Hao River
Soc Trang
Phung Hiep
Tien Giang
Ho Chi Minh City (Saigon)
South China Sea
Scale varies in this perspective.
NGS CARTOGRAPHIC DIVISION
PAINTING BY JOHN A. BONNER

FLOW CONTRIBUTIONS
[FROM NATIONAL SOURCES]

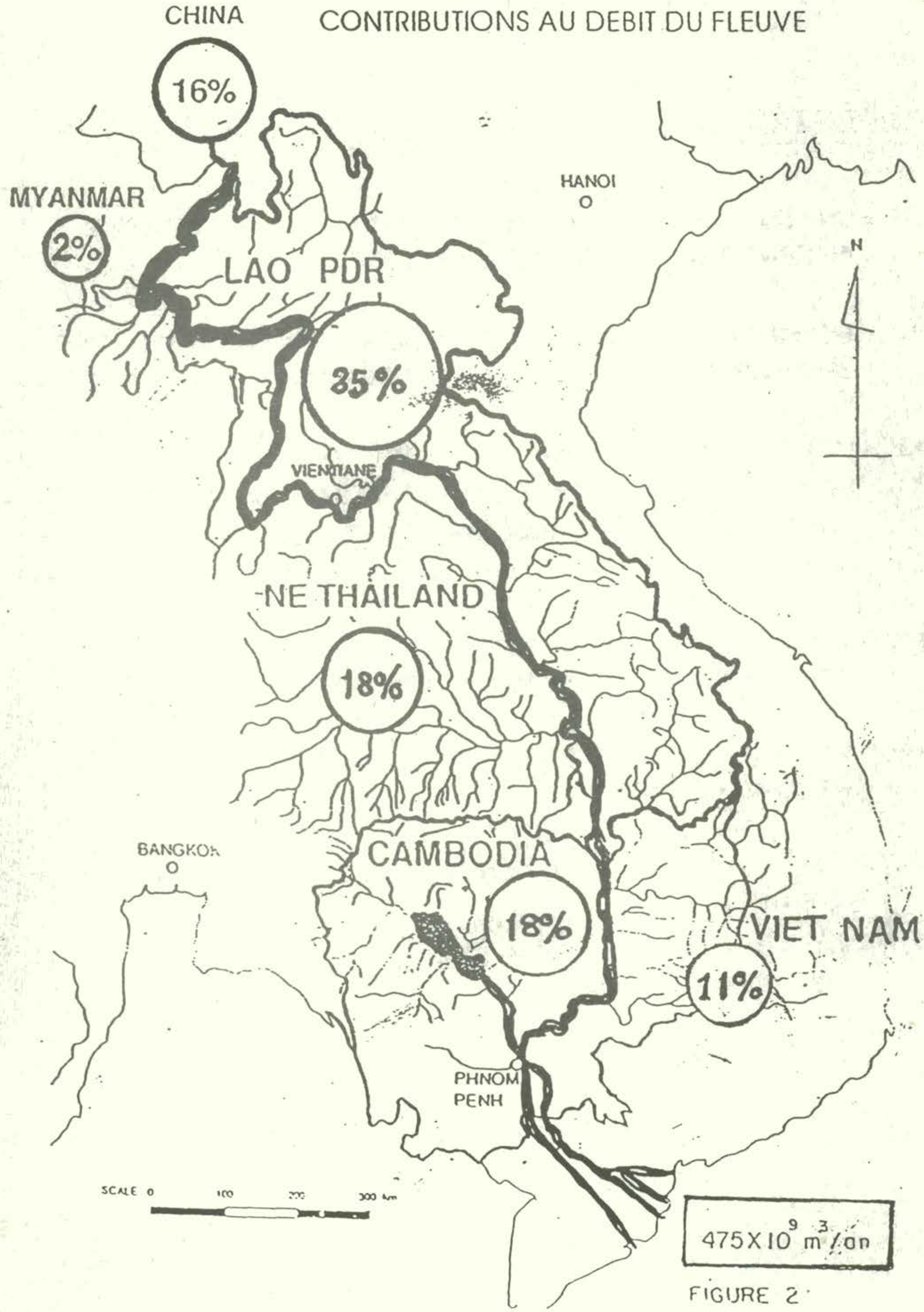


FIGURE 2

JECT ....

CONCEPTION AND CREATION OF MEKONG COMMITTEE

1949 - UNITED NATIONS PROPOSAL TO PROMOTE CO OPERATION IN INTERNATIONAL RIVER BASIN DEVELOPMENT

1951 - FEASIBILITY STUDY OF LOWER MEKONG BASIN BY ECAFE (SINCE 1974 - ESCAP) WITH CO OPERATION OF RIPARIAN COUNTRIES.

1957 - MEKONG COMMITTEE FOR CO ORDINATION OF INVESTIGATIONS OF THE LOWER MEKONG BASIN ESTABLISHED AS AUTONOMOUS INTERGOVERNMENTAL BODY UNDER THE AEGIS OF THE UNITED NATIONS

1957 - STATUTE OF THE COMMITTEE FOR THE CO ORDINATION OF INVESTIGATIONS OF THE LOWER MEKONG BASIN ADOPTED

1959 - MEKONG SECRETARIAT ESTABLISHED TO ASSIST MEKONG COMMITTEE

1970 - INDICATIVE BASIN PLAN PRODUCED BY MEKONG COMMITTEE (IBP)

1978 - INTERIM COMMITTEE FORMED, LAO PDR, THAILAND AND VIET NAM WITH SAME MANDATE AND RESPONSIBILITY

1991 - CAMBODIA PARTICIPATE

1994 - NEW FRAMEWORK OF COOPERATION ?

NOTES

MEKONG COMMITTEE

<u>DEVELOPMENT OBJECTIVE</u>

DEVELOPMENT AND MANAGEMENT

OF MEKONG WATER AND RELATED RESOURCES

FOR IMPROVED QUALITY OF LIFE AND

SUSTAINABLE DEVELOPMENT

1. POLICY AND PLANNING

- Strategic studies

2. TECHNICAL SUPPORT

- Hydrology
- Databases and modelling
- Remote sensing and mapping
- Environment

3. RESOURCES DEVELOPMENT

- Water resources and hydropower
- Irrigation and agriculture
- Watershed management and forestry
- Fisheries
- River works and transport
- Human resources development

Programme Support Activities

Table 2

Percentage of Hydropower Production Facilities
in the Lower Mekong Basin
(1990 and 2010)

Country	1990-SITUATION			2010-POTENTIAL		
	Total Capacity (MW)	Hydro Capacity (MW)	% of Total Capac.	Expected Demand (MW)	Potential Hydro (MW)	% of Demand
Cambodia	85	0	0	530	450	85
Lao PDR	190	190	100	430	14,130*/	100
Thailand	8,624	2,270	26.3	27,400	3,730	13.6
Viet Nam	2,512	1,163	46.3	9,420	7,650	81.2
Total	11,411	3,623	31.8	37,780	25,960	68.7

*/ If 97 per cent is exported to Thailand, it still accounts for only 50 per cent of demand in Thailand.

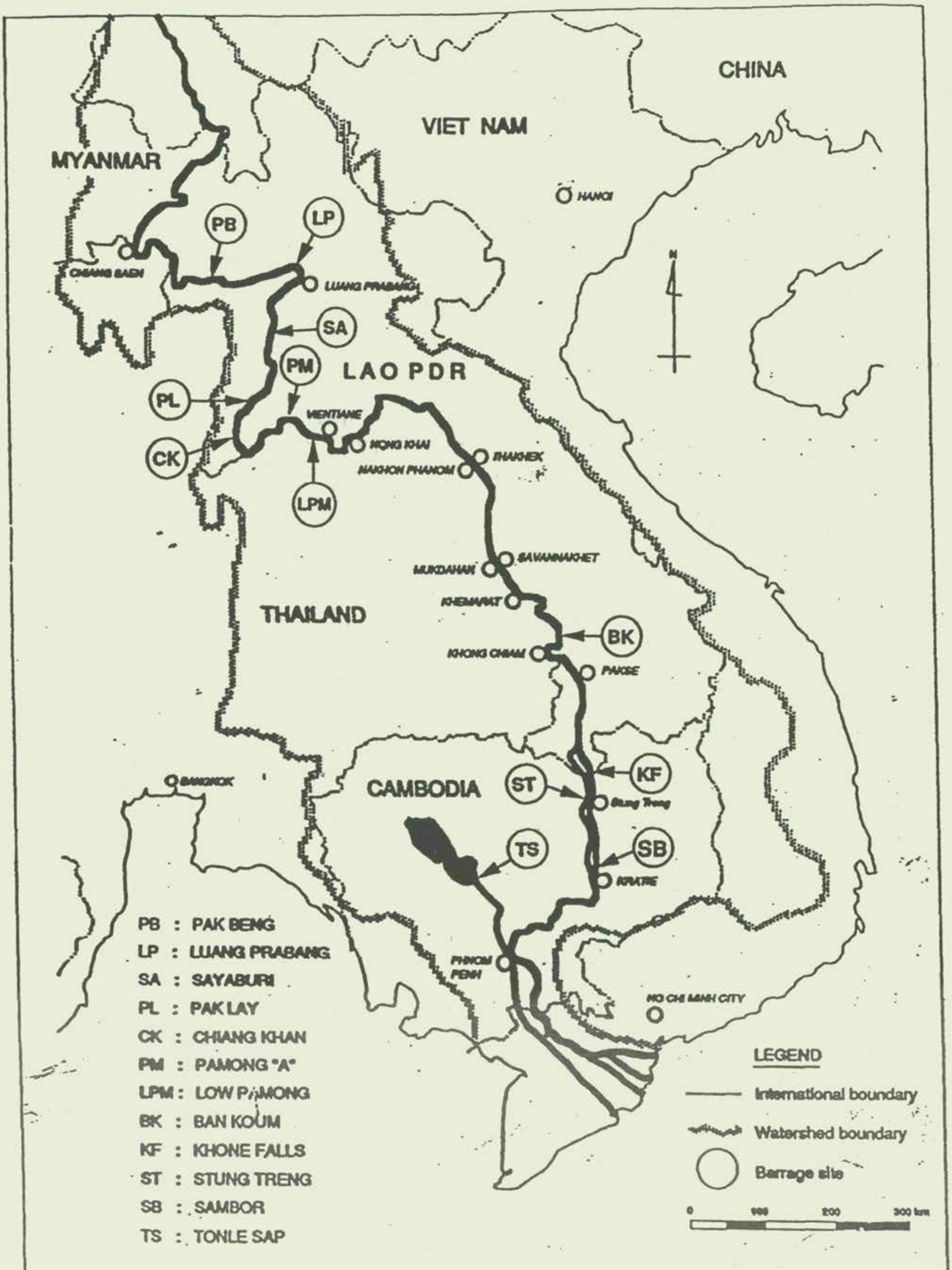
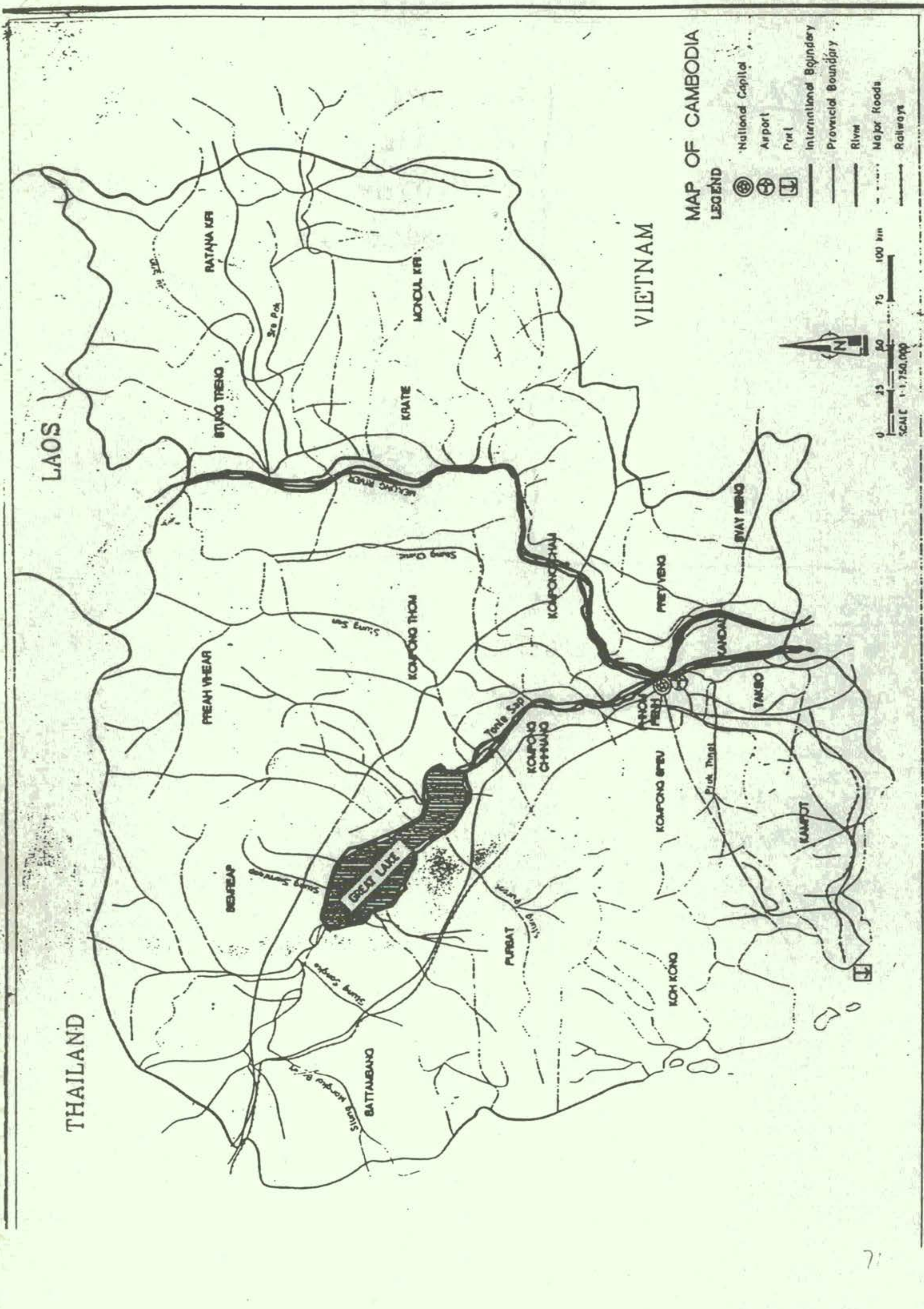


Figure S-2 LOCATIONS OF CANDIDATE SITES

MEKONG SECRETARIAT STUDY TEAM


MAP OF CAMBODIA
LEGEND
National Capital
Airport
Port
International Boundary
Provincial Boundary
River
Major Roads
Railways
SCALE 1:1,750,000
0 25 50 75 100 km
N
LAOS
THAILAND
VIETNAM
RATANA KIRI
STUNG TRENG
MONDUL KIRI
KRATIE
PREAH VIHEAR
KOMPONG THOM
KOMPONG CHAM
PREY VENG
SVAY RIENG
KANDAL
TAKEO
PHNOM PENH
KOMPONG CHHNANG
KOMPONG SPEU
KAMPOT
KOH KONG
PURSAT
BATTAMBANG
GREAT LAKE
Tonle Sap
Sre Pok
Stung Sen
Stung Sangker
Prek Thnot

DATA MAPS

I
- Fishery
- Health
- Pollution
- Socioeconomy

II
- Hydromet.
- Water quality
- Wetlands
- Topographic maps

ISSUES

- PRODUCER ~ USER
- QUALITY OF DATA
- ACCESS
- ANALYSES
- GEOGRAPHICAL DIFFERENCES
- SHORT TERM FUNDING COMITTMENTS

HYDROPOWER
- mainstream
- tributaries

- Fishery / Aquatic life
- Wetlands
- Sedimentation
- salinity
- Socioeconomy
- Health

LAND USE
- deforestation
- agriculture dev.

- Erosion
- chemical hazards
- Water flow (saline, acid soils)
- Health
- Socioeconomy

FISHERY / WETLANDS

- Water quality
- Pollution
- Biodiversity / wild life
- Socioeconomy
- :

URBANIZATION
INDUSTRIAL DEV
MINING

- Pollution
- Health

TRANSPORT
TOURISM

- Pollution
- :

UNEP PROGRAMMES

PRESENTATION MATERIALS

(H. CROZE)

International Core Data Needs

UNEP Environment Assessment Programme

UNEP

- International Case Studies: > assessment areas,
  > data needs

- International Environment Assessment Frameworks

H. Croze

International "case studies"

- Land use and degradation
- Freshwater and coastal areas
- GTOS
- CGIAR
- Regional Assessments: ESCAP, ECLAC
- Biodiverstiy Convention

Land use and degradation

- GLASOD and SOTER (UNEP/FAO/ISSS/ISRIC)
- Standardization of classification (UNEP/FAO/ITE)
- AVHRR land cover characterization (USGS/IGBP/UNEP)
- Desertification Convention

GTOS Global Terrestrial Observing System

- COMPLIMENT TO GCOS, GOOS
- UNEP, FAO, UNESCO, WMO, ICSU (? + GEF)
- USER GROUPS:

  Govt. agencies, policy/decision makers
  Reg'l, international agencies, institutions
  Research scientists
  Commercial sector

GTOS (cont'd.)

- MAJOR ISSUES:
  - Resource sustainability: natural, managed ecosystems
  - Pollution & toxicity
  - Loss of biodiversity: support to Convention
  - Climate change
  - Land degradation
- 4-TIER OBSERVATIONAL SYSTEM OF GROUND SITES
  - Lower level: few standardized, easily collected variables, systematically-distributed sample sites
  - Higher level: larger number of more complex variables, extensive target areas

- NEW PROJECT ON USE OF GIS AND COMMON DATABASES IN AG. RESEARCH MANAGEMENT
- GCIAR/TAC, IARCs, Norway, World Bank, UNEP
- MAIN ELEMENTS:
  - Harmonize activities throughout CG system
  - Common GIS tools, models
  - Minimum datasets (base, climate, population, soils, ag. stats, soc-econ. indicators)
  - Data, meta-data sharing: GRID
  - Communications: CGNET
  - Tech. transfer to NARCs

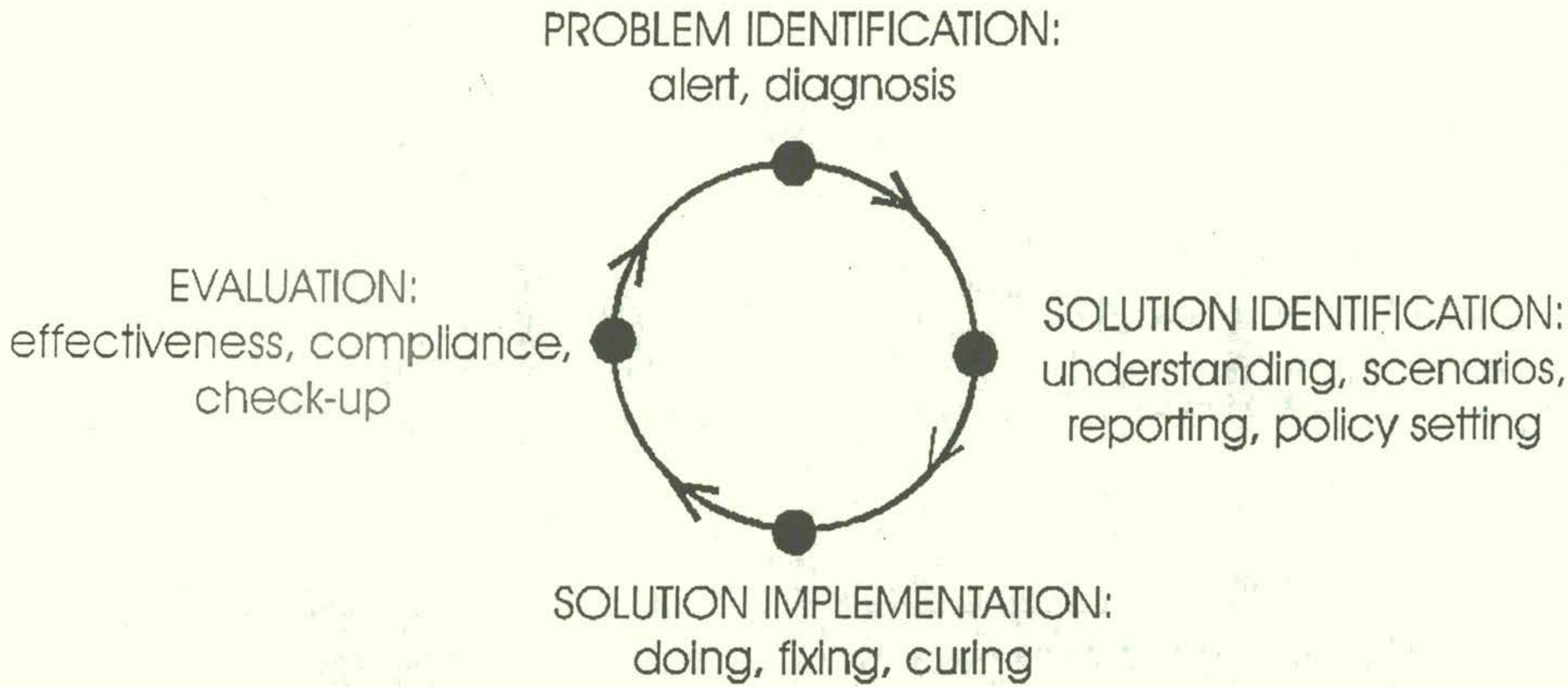
UNEP/EAP Regional SoE Assessments

- PARTNERSHIPS
  - Regional commissions: ESCAP, ECLAC;
  - UNEP Regional Offices; Sub-regional bodies
  - UNDP, other UN agencies; Governments
- USER CONSULTATIONS
- REGIONAL DATABASE COMPILATION
  - Environmental and socio-economic
  - Existing sources
- NATIONAL DATASET "STARTERS"
- COORDINATATED CONTRIBUTION TO CSD, G.E.O.

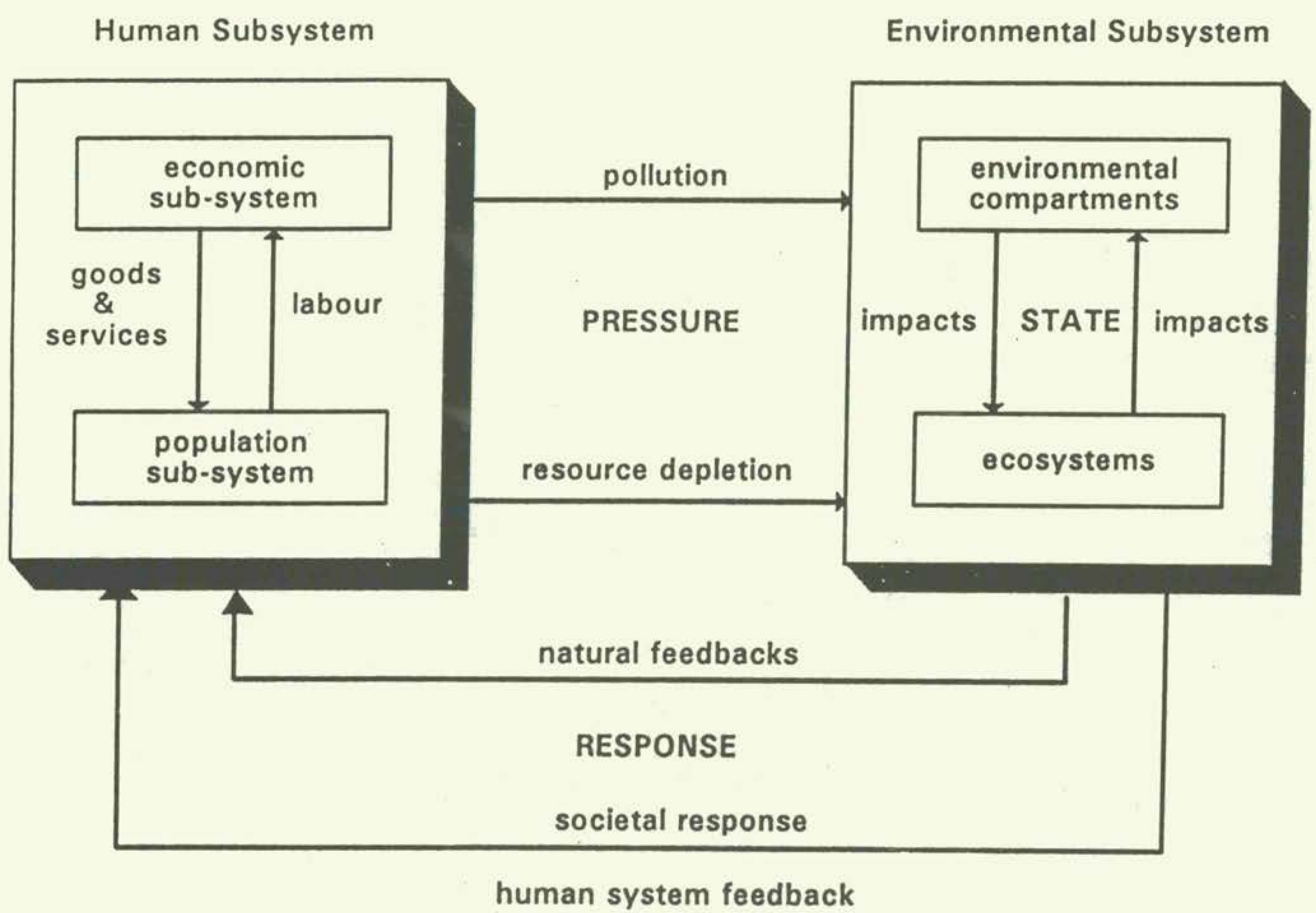
International assessment frameworks

- Policy cycle
- Environment-Development model: Pressure-State-Impact- Response
- Reporting requirements: Demand-Delivery
- Environment Indicator Hierarchy

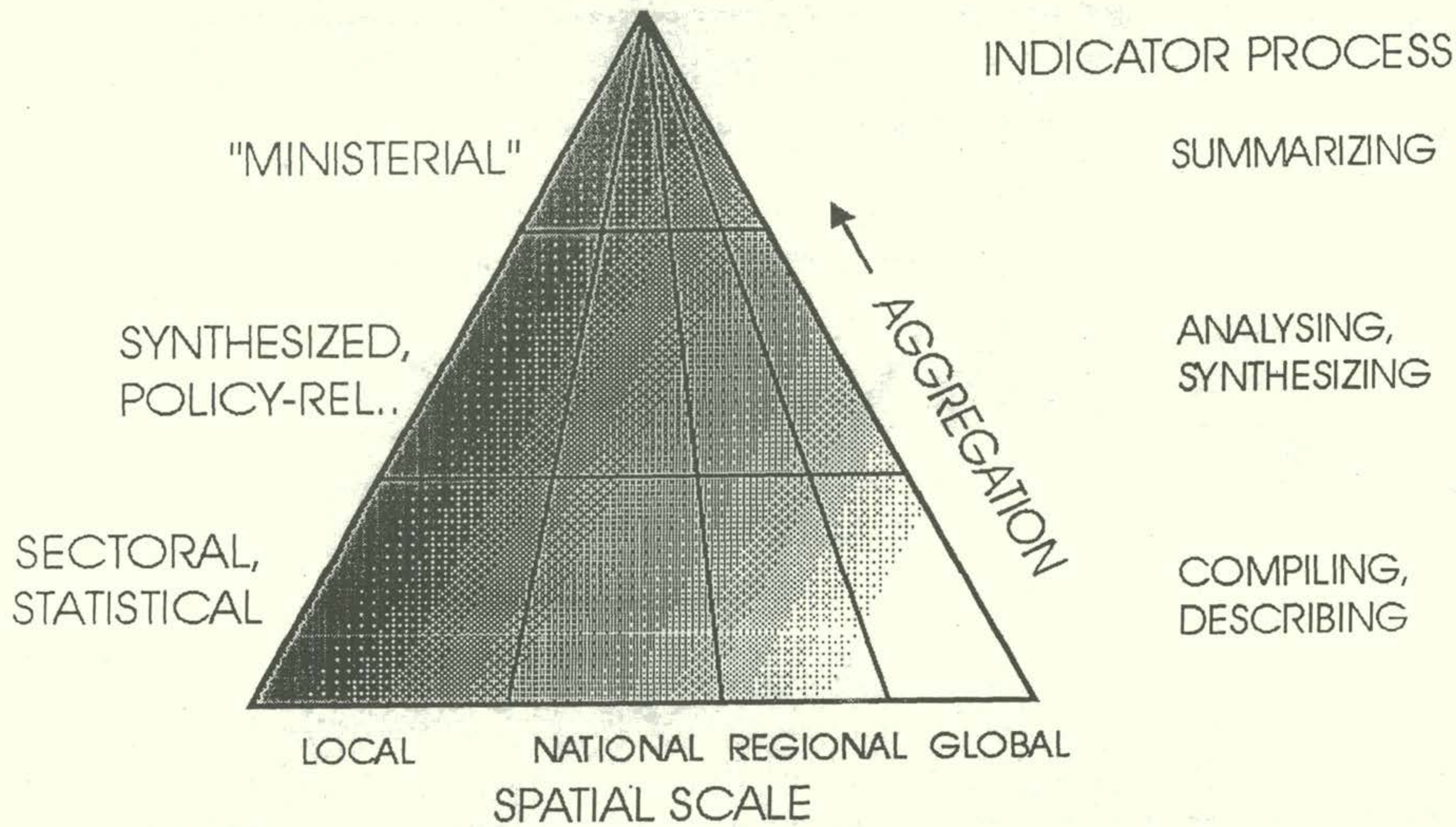
Policy cycle



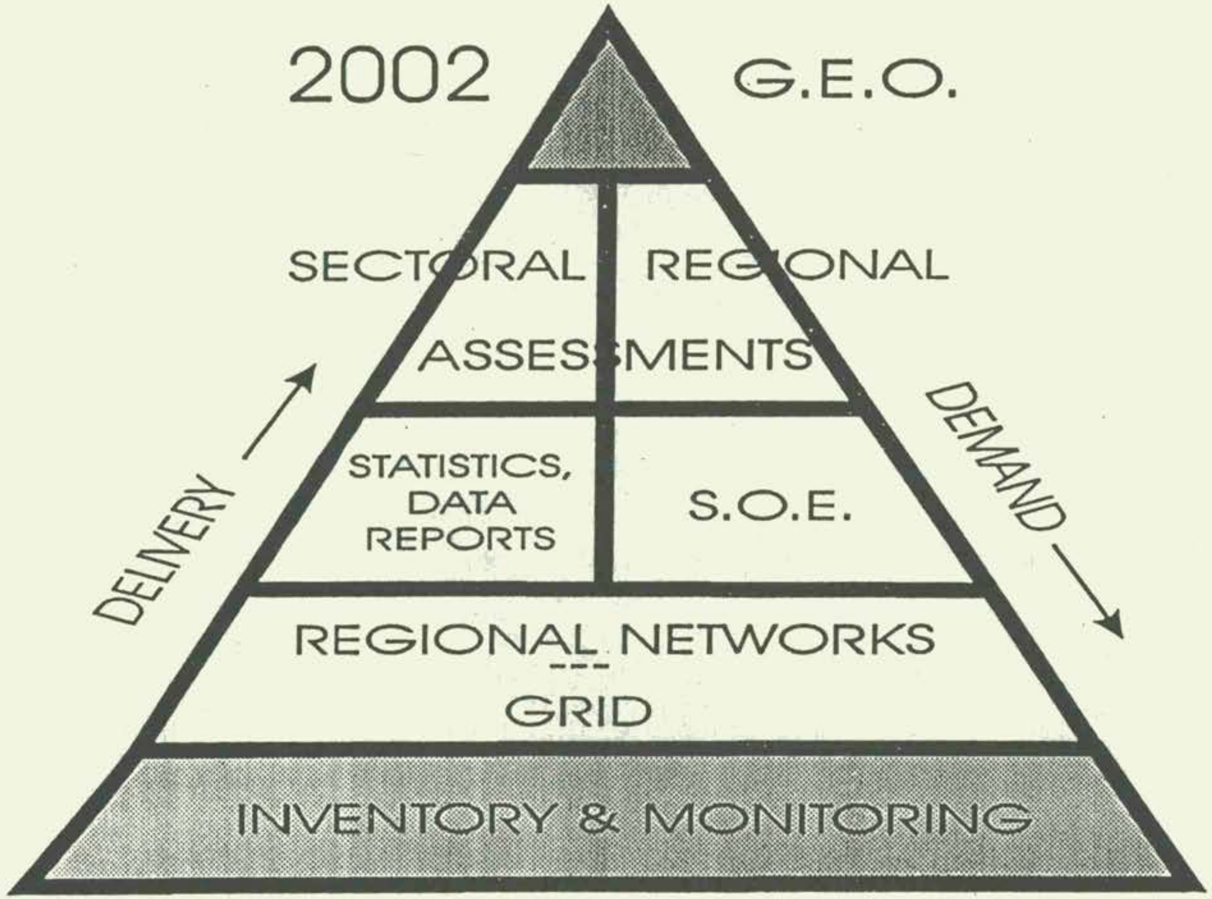
P-S-I-R Model


Human Subsystem
Environmental Subsystem
economic sub-system
goods & services
labour
population sub-system
pollution
PRESSURE
resource depletion
environmental compartments
impacts
STATE
impacts
ecosystems
natural feedbacks
RESPONSE
societal response
human system feedback

Indicator hierarchy



Reporting requirements



Biodiversity Convention

OBJECTIVES:

- Conservation of biological diversity
- Sustainable use of its components
- Fair & equitable sharing of benefits of genetic resource utilization

PARAMETERS FOR DATA REQUIREMENTS:

- Variably, complexity within & between ecosystems, species of plants, animals, micro-organisms
- Individual components of above, plus genomes and genes
- Processes and activities which impact on above

Biodiversity Convention (cont'd)

NEED:

- BOUNDARIES FOR DATA PARAMETERS AND A DATA FRAMEWORK FOR CONVENTION

  WCMC drafting guidelines for biodiversity data management

- STRATEGIC APPLICATION OF GAP ANALYSIS IN SUPPORT OF CONVENTION
- REALISTIC GUIDELINES FOR COUNTRIES

APPENDIX 6

SUMMARIES OF TOPICAL PANEL PRESENTATIONS

[See also presentation materials]

A. Land Use Change and Degradation

Tropical Deforestation
J-P Malingreau

Understanding a system of sustainable resource management requires that certain central ecological concepts be first acknowledged. Defining sustainability requires accounting of existing resources and their rates of change. Land use and land cover characteristics reflect, in a synthetic manner, the distributed resource management activities taking place on the earth's surface. Land use and land cover issues refer principally to the management of the primary productivity resource base: soils, water and atmosphere. Large variations in change dynamics across geographic and social space complicate the extrapolation of localized knowledge to larger scale applications. While they often represent a core data set for support of resource planning and management, land use and land cover changes are poorly understood, especially at large scales.

There are a number of data sets available which can be of use in this type of large area, continental or global scale analysis. These include:

- Topographic data sets (including maps of urbanized areas);
- Existing land use and land cover data sets produced to meet; mandated local, regional and national planning and science objectives;
- Vegetation maps which contain moderate levels of land use and vegetation association information related to specific tracts of land; and
- Site-specific thematic maps prepared for specific purposes (i.e. forestry maps).

A core data set that is of useful for land use and land cover analysis for sustainable development planning and management must:

- Contain categories of information of relevance;
- Be produced in a set of nestable spatial and temporal scales and resolutions;
- Support change detection , measurement and location;
- Exist in a format which is of practical use in terms of data combinations;
- Be spatially explicit (geo-referenced); and
- Be of known quality.

Keep in mind, however, that it is pointless to evaluate maps or other geo-referenced data without careful attention to the purposes for which they will be used.

Advanced Very High Resolution Radiometer (AVHRR) image data acquired by the U.S. National Oceanographic and Atmospheric Administration (NOAA) spacecraft are being used by the Commission of the European Union to monitor change in forest areas and occurrence of fires in the pantropical region of South America, Africa and Asia. For this program, these data are collected to cover the pan-tropical region, screened, preprocessed and analyzed. AVHRR data have been acquired from seven separated data receiving stations around the world and assembled into single coverages. Validation is performed using a combination of high-resolution satellite data and extensive field work. The current experience with these global data sets on vegetation area are directly applicable in the largest countries (i.e., Brazil, Indonesia, etc.). The approach could also be adjusted to the needs of frequent monitoring for change detection in other regions. Following validation, these data are compiled in a geographic information system (TFIS - Tropical Forest Information System) for analytic use, as well as application to a wide range of additional tasks.

Desertification in the Sahel

M.M. Sall

Desertification is a very important large-scale process of land use and land cover degradation occurring at various rates in several areas of the world, the largest , most important and best documented instance taking place around the southern boundary of the Sahel Desert in western and central Africa. Nine states (ranging from the Cape Verde Islands in the west to the Republic of Chad in the east) with territory included in the Sahel boundary zone have formed the Sahel Desertification Committee in order to respond to this continental-scale land use degradation.

The process of desertification in this region is influenced by a number of ecological, climatological and anthropogenic variables. The most important geographic factors are topography, soils, vegetation cover and geology. All of these characteristics vary significantly throughout the region. Rainfall amount and distribution is the key climatological factor. A well-developed pastoral economy based upon a nomadic lifestyle is present within the region and agricultural activities are present in those subregions receiving typically more than 400ml of rain per year.

Annual population growth within the region averages 2.5 percent annually, and in recent years there has been no net growth in agricultural production. The increasing human population and marginal conditions for current agricultural practices carry real potential for ecological disaster and human suffering.

In studying the region, the Committee on Desertification includes ongoing surveys of the Niger River flood plain and the Senegal River delta area. These monitoring activities are performed using satellite remote sensing image data. Particular focus is placed on the construction of hydroelectric and irrigation impoundment dams constructed on the rivers. With irrigation water available from these reservoirs, demographic pressures within the region lead to agricultural land use outside the delta areas. Current mapping of these land use changes takes place only after they have occurred. Large areas near the Senegal River delta have been abandoned due to irrigation-induced increases in soil salinity.

Through the use of satellite imagery, areas of salt intrusion into the soil and deforestation are mapped within the delta area. In addition to the satellite data, geomorphology, soils and quantitative water monitoring data are routinely used. A summary and brief qualitative evaluation of the core data sets which are used in this program are included in the following table. Overall, basic data exist, but additional data sets are required. Currently, no quantitative data on soil or water salinity or alkalinity is captured and these data are considered to be a fundamental necessity if monitoring activities are to be useful for predictive purposes.

DATA SET		AVAIL-ABILITY	ADEQU-ACY	COMPA TIBILI-TY	ACCESS -IBILITY	OBSERVATIONS
TOPOGRAPHY	NS	GOOD	GOOD	GOOD	WEAK	Significant role played by IGN in providing aerial
	RS	GOOD	GOOD	GOOD	WEAK	photos and topo maps (Nat'l Geographical Inst's)
SOILS	NS	GOOD	WEAK	GOOD	GOOD	Various pedological studies at nat'l level; at regional
	RS	GOOD	WEAK	GOOD	GOOD	level, role of ORSTOM
VEGETATION	NS	WEAK	WEAK	WEAK	GOOD	Nat'l atlases for all states of CILSS; local studies
	RS	WEAK	WEAK	WEAK	WEAK	compatibliity problem
HYDROLOGY	NS	GOOD	GOOD	GOOD	WEAK	ORSTOM and nat'l pedological services; member
	RS	GOOD	GOOD	GOOD	WEAK	states of CILSS similar policies
HUMAN	NS	GOOD	WEAK	WEAK	WEAK	Democratization problems; census and human
	RS	GOOD	WEAK	WEAK	WEAK	adequacy issues

NS - NATIONAL SCALE RS - REGIONAL SCALE

GAP Analysis - A Strategy to Combat the Loss of Biodiversity
J. M. Scott

The decline in biodiversity and the process of wildlife species extinctions is one of the most noticeable and acute consequences of land use change and degradation. I personally have field experience with eight species of birds that have become extinct during the past 25-30 years. In addition, "emergency room conservation" efforts have been and are being performed to save additional species from extinction. Typically, these crisis conservation efforts focus on a single species as it nears the extinction point and its chances of survival and re-establishment approach zero. These efforts require investments of scientific talent, monetary resources and political will vastly out of proportion to the actual number of individual animals which are affected. The multi agency program to rescue the California Condor (Gymnogpys californianus) is an excellent example of this type of program.

Adding to the difficulty of these efforts is the loss of critical ecosystems within the U.S. Some ecosystems such as the tall grass prairie and the southern long leaf pine have almost completely disappeared. We have no idea how many undescribed species were lost with the fragmentation of the ecosystems.

The process of GAP Analysis has been developed and implemented in the U.S. to complement this costly (and, at time, ineffective) single species conservation approach. Gap Analysis provides a quick overview of the distribution and conservation status of several components of biodiversity. It seeks to identify gaps (i.e. vegetation types and species that are not represented in the network of biodiversity management arenas) that may be filled through establishment of new reserves or changes in land management practices. Gap Analysis uses the distribution of actual vegetation types (mapped from satellite imagery) and vertebrate and butterfly species (plus other taxa, if data are available) as indicators of, or surragates for, biodiversity. Digital map overlays in a GIS are used to identify individual species, species-rich areas, and vegetation types that are unrepresented or underrepresented in existing biodiversity management areas. Not a substitute for a detailed biological inventory. Gap Analysis organizes existing survey information to identify areas of high biodiversity before they are further degraded.

Gap analysis is a national program in the U.S. in which the occurrence of vegetation tupes and terrestrial vertebrates (common as well as rare) in conservation areas. Currently, Gap Analysis Programs have been completed for four states. Over thirty other state programs are underway. Each state program has a minimum set of collaborating bodies. These include an Oversight Committee as well as subcommittees on data management, vegetation mapping, vertebrate modeling, coordination, and information outreach. The actual process of data compilation and analysis requires (at a minimum) a principal investigator and project leader as well as a remote sensing and GIS expert, a vegetation ecologist, a wildlife ecologist and a data manager. Gap analysis is a proactive approach to biodiversity protection whose total costs are a penny an acre.

Four data sets form the core data required for the Gap Analysis process; for the Gap analysis task, these data sets are compiled in a geographic information system for manipulation and processing.

- *Vegetation Cover* - Remote sensing data in the form of Landsat Thematic Mapper (TM) imagery is the core data set for land cover and vegetation. The United Nations Educational, Scientific and Cultural Organization (UNESCO) World Vegetation Association System is employed at the vegetation alliance or cover level as appropriate and practical. It is not possible to accurately map vegetation to the community level at statewide scales.
- *Animal Distributions* - These data are acquired in the form of museum records, wildlife habitat relationship maps, habitat documents, as well as information from other databases showing observations and species-specific accounts of habitat preferences.
- *Land Ownership* - Concentrating on publicly-owned areas, these data are becoming increasingly available in digital format.
- *Managed Areas* - Also increasingly available in digital geo-referenced databases (often publicly owned).

The process of acquisition, reformatting, geo-referencing and compiling and documenting these data can be complex and demanding of human and computer resources. The final, most difficult (and most important) task is that of a statistical assessment of thematic and locational accuracy for GIS data layers. The relationship between the data set and its representation of reality is fundamental, as it may provide an ecological context for additional, related environmental and habitat analyses.

The process of aggregating distribution data for all species (rather than just those of critical interest) and correlating wildlife distribution, vegetation cover and managed areas is an efficient and accurate methodology for deriving data on elements of biological diversity within an area. Using genetic information, issues of genetic diversity may also be addressed. These types of related applications can serve to bridge differences in geography and ecology, as well as diverse interest groups. This is reflected in the active participation in Gap Analysis Programs of state, federal and private partners and the use of Gap data in regional land-use monitoring efforts. There are a number of examples of this type of interaction. Gap program participants have cooperated with the U.S. National Parks Service in evaluating the contribution of proposed new national parks and wilderness areas to the protection of biological diversity.

Land Use/Land Cover Mapping in Uganda
F. Turyatunga

The period of the late 1970's through 1985 was one of difficulty for Uganda. After the Amin period and some years of internal conflict, many Ugandan social institutions and governmental agencies were in upheaval. The governmental offices responsible for mapping Uganda were among them. Since that time, the process of mapping the nation has resumed.

The Ugandan government had mapped its territory at a number of scales. The following table provides a brief summary of standard Uganda thematic and topographic maps in traditional use in the country.

MAP SERIES / USE	SCALE
World	1:1,000,000
National Thematic	1:250,000
Topographic	1:50,000
Town Maps	1:2,000 - 1:12,500

Most Ugandan maps were compiled by the use of aerial photographs acquired during the 1950's and 1960's. During the internal conflict, regional map offices were looted or destroyed, national mapping agencies were inoperative, protected areas had been violated and the national mapping infrastructure had been greatly eroded. In fact, seven different mapped estimates existed for the actual size of Uganda's approximately 236,00 sq.km. area.

In an effort to produce a national land use and land cover map for Uganda, various projects attempted to update data in their areas of interest; however, this effort was found to be unsatisfactory. As a response to this unsatisfactory situation, a national land use and land cover mapping effort was undertaken in 1991 through a National Biomass Study in the Department of Forestry. Along with this, the same raw data was used to update the 1:50,000 scale topographic mapsets (change detection) through the National Mapping Agency.

The core data set for this effort was Landsat Multispectral Scanner (MSS) satellite imagery. These data were acquired through a $600,000 grant from the United Nations Development Program (UNDP). The National Biomass Study was supported by the Norwegian Agency for International Development (NORAD).

No crosswalk table was created to establish continuity of classification systems between the 1960's series maps and the newly updated series; thus, there was no methodology for comparing thematic map elements between the map sets. The expense of this mapping effort was substantial for Uganda, a country dealing with other acute issues simultaneously. Dedicating human, technical and financial resources to this task implies that sacrifices had to be made in other important areas. Finally, as everywhere else, the competition among political and economic interests had to be accomodated.

We found that MSS imagery was inadequate for use in local planning. However, the data proved adequate for land use and land cover mapping at the national scale. Unfortunately, these improved maps were not compatible with the previous land use and land cover map series; this is an important lesson for future projects of this type.

It is impossible for the Ugandan government to commit the monetary resources to maintain and continue updating their base map series despite the acute need for these data for use in monitoring land use change and degradation.

The updated topographic maps are available through the national map sales office on the basis of limited incremental cost recovery ($1-5 per 1:50,000 scale sheet). The land use and land cover maps will soon be available on an incremental cost recovery basis to be decided by the government.

B. Fresh Water and Coastal Zone Management

Fresh Water
J. Tundisi

Most of the tropical region of South America is dominated by rivers, associated flood plains, wetlands and shallow lakes. In these river systems, many reservoirs were built up. Reservoirs have a cumulative impact upon the areas in which they are located. By the very nature of their impact, they require an integrated impact assessment and management plan; therefore, reservoirs are an important focal point in South America. In support of this requirement, the Center for Water Resources and Applied Ecology at the University of São Paulo (São Carlos Campus, Brazil) has studied reservoirs in the La Plata Basin for the last 25 years. During this time three major rivers have been identified as critical to the region and one most probably a good example for other regions when considering the need for core data: the concept of the watershed as a tool for research, management and planning, the La Plata Basin network on water resources management and the value of long term studies. This discussion begins with a look at the watershed issues: a recent survey by ILECC (International Lake Environment Committee) has identified five major impacts in the watersheds: siltation, eutrophication, decrease of water level, toxicity, and acidification.

Population increase, invasion of the global economy and industrialization all lead to over-use of land, including non-sustainable agriculture, over-grazing and deforestation, and the over-use of water. These economic and social pressures contribute to five major problems to the watershed. Over-use of water leads to a decline of the water level and a decrease of water volume. Also associated with population increase and industrialization are problems with eutrophication and acidification. Each of these impacts contributes to the extinction of indigenous fauna and flora, which means a loss of biological diversity and damage to fisheries. Decreasing water resources, disturbed surface transportation and water quality degradation also result. The La Plata River Basin, like many watersheds, has suffered all five impacts, mainly due to population increase, industrialization, large scale agricultural development, with a considerable loss of the aquatic system to provide multiple services to the human population.

A contributing factor to the watershed problems is dam construction; Brazil has many dams, and they affect several systems, including economic, social and, of course, ecological. In order to study the effects of dams on the watershed, four main topics need to be considered: the geological and climatological properties, the immunological properties, the water properties and the anthropogenic impacts.

The understanding of these relationships is a complex matter. It is necessary to know the watershed impacts to the aquatic system and the transfer functions from the terrestrial to the aquatic system. This is a dynamic relationship that clearly needs more data. Also, it is necessary to know the response of the ecosystem, the communities, the populations and the organisms to the inputs from the watershed. There are several ways to measure this, and data collection should be directed to this. It is important to know, and to define, the ecosystem health and how this can be related to the human health. This is still a debatable problem, and there is a need for an effort to collect more data and consolidate the Ecosystem Health concept. If we are to understand the responses of the aquatic and ecological systems to inputs and impacts, these data are required.

The second issue that is critical, and is given as an example on water resources management, is the La Plata Network. The key here is to include all the users as members of a team working to ensure the health and management of the region. Several studies have examined this issue, taking a dam as the focal point and including scientists, managers, government representatives, etc. in the discussion and preparation process. Three items have been singled out: seminars to discuss the dam and the watershed; integration and inter calibration of the methodologies and preparation of technical and scientific personnel; and decentralization of monitoring efforts to ensure a consistent provision of data and integration of the information (i.e., monitoring nitrogen and phosphorus and its relation to GNP in certain regions).

The final issue deals with the need for the acquisition of continuous, long-term data measuring both quantitative and qualitative water systems. There are only a few examples of long-term data and even this data tends to focus only on quantitative measurements. For example, there is continuous data for reservoirs on water flux but nothing on the reservoir water quality. Quantity and quality must go hand-in-hand in order to get a complete picture of the problems affecting the reservoirs, rivers, lakes, wetlands.

Proper management of the watersheds cannot occur unless all the users are informed about all the issues critical to the region and the aquatic systems. Such long-term pilot programmes are fundamental for gathering data, assessing the aquatic ecosystem changes as a result of watershed uses, and, most important, anticipating future problems.

Coastal Zone Management
J. C. Pernetta

One cannot hope to manage an ecosystem; the best one can do is manage the human interactions relative to that ecosystem. This is an axiom whose time has come. In order to manage the human interaction, information on the state of the environment and the natural processes is needed. Feedback between people and the environment is crucial for someone who must, despite efforts to plan 20 to 30 years into the future, manage instant problems. Types of internal or intrinsic problems include resource depletion and environmental degradation and loss leading to competition for space (both land and water) and conflicts and interference between competing uses. External forces also play a role in the management of coastal zones - the manager must have access to the information outside the coastal zone when the impacts of one of these external forces plays havoc within the zone. Fresh water and sediment flux to near-shore areas (damming, deforestation, and over-grazing in catchments) and nutrient and pollutant inputs (70% of marine pollution derives from land-based sources often at a distance from the coast) represent the distance effects on local areas.

The coastal zone, broadly defined as the domain from 200 m above to 200 m below sea level, is an important area of the world. Approximately 60% of the human population and two-thirds of the world's cities are located in the coastal zone.[1] The coastal ocean accounts for 8% of the ocean surface, <0.5% of the ocean volume, between 18 and 33% of global ocean production, 80% of the

[1] This percentage is an estimate based inappropriately on political boundaries of census areas/units and not the more appropriate geographical boundaries of coastal areas.

global organic matter burial, 90% of the global sedimentary mineralisation, 75-90% of the global sink of suspended river load and its associated elements and pollutants and in excess of 50% of the present day global carbonate deposition. Management of the coastal zone has global implications. Three different levels of organization manage the resources: the local community, the national and regional community and the international community. Coordination is often difficult, particularly in the case of living resources that move between areas of different management jurisdiction.

Coastal zone management process problems include a lack of environmental information and/or models of coastal problems and processes (the data exists in an unusable format or is inaccessible to the user); a lack of expertise in integrated coastal zone management; a shortage of resources both financial and technical; a lack of environmentally sound technology; a lack of public awareness of the causes and scope of the problems; inappropriate organization of management structures; and inappropriate allocation of management and regulation responsibilities. Furthermore, the coastal zones are not well understood and neither are the data needs required to address the aforementioned problems.

The components of the assessment and analysis of the coastal area in terms of planning include problem definition, assessment and analysis, current and future issues, formulation of elements and components, adoption, implementation and monitoring and evaluation. This planning is made possible by the collection of information. Information about resources and resource distribution, uses (i.e., what is the intensity of use?), environmental effects (current stresses), socioeconomic conditions (the social context in which current consumption, etc. is taking place) and finally, the legal institutional administrative conditions (the framework) is synthesized to understand the conflicts and compatabilities of the coastal zone usage and to analyze the issues and options.

Anthropogenic drivers of coastal change are intense because that is where the majority of people reside, resulting in comparatively high population densities. Rates of growth in coastal populations are usually greater than rates of growth in inland areas due to migration of permanent residents. Most international tourism is coastal and 90% of the land-based pollution enters the oceans from coastal areas. Much of the fertile agricultural land in tropical countries is coastal; hence, land use and cover change are most intense in coastal margins. On continental scales, the rates of sediment flux are now considerably reduced, due to dam construction and large-scale irrigation schemes, and the anthropogenic flux of dissolved nutrients from land to coastal ocean is now equal to, and in some areas greatly in excess of, the natural flux.

These information and data management trends can be summarized as: an increased need for integrated natural and social sciences research on the "change" in coastal systems; and increased investment in "system" modeling and coupling of natural and social sciences models (e.g., longer term predictions of risk assessment from sea- or land-based flooding); and increased interest from "managers and decision makers" in predictions, including scenario building and risk analysis. These trends will eventually lead to the need for higher density and temporal spread of *in situ*, long-term observations from the coastal zone, a search for synoptic or analogue signals which integrate system response to change, greater computing capacity, and more broadly trained scientists versus more narrowly trained specialists. All of this is necessary if we are to make the necessary links between the economic, ecological and social frame works of the decision-making process. We cannot make these links without more knowledge about the drivers.

Global Fresh Water Quality
V. Tsirkunov

It is well known that water is the integrating factor between land, ocean and atmospheric interactions; it is essential to ecologically sustainable development. Fresh water information includes hydrological, biological, chemical and physical data, together with metadata and ancillary data.

Information needs are functions of environmental, sociological, economic, political and other factors. Major fresh water quality issues of the global scale are presented on the figure taken from "Water Quality Assessment," WHO/UNEP/UNESCO publication. The sequence of water quality issues arising in developed countries is also shown. Developed countries can address those problems one after another, but developing countries have to deal with them all at once.

Beginning in the 1970's, water quality management focused on chemical analysis using ambient fixed stations and effluents to determine the water quality for surface, marine and estuarine water columns in municipal and industrial sources. During the late 70's and early 80's, improved chemical analysis, including biological monitoring, intensive surveys and special studies, was used to study sediments, benthic organisms and fish tissue. The late 80's through 1990 further improved chemical analysis. Introduction of new analytical tests, lower detection levels, ecosystem surveys and rapid bioassessment methods such as toxicity testing improved the results from the different sampling matrices. Ecosystem analysis also began. The early 90's have seen the integration of environmental data from multiple sources and the use of existing monitoring data in program planning and priority setting as ecosystem analysis has matured. We have transitioned from fairly simple chemical data analysis to multimedia risk management for air, ground water, drinking water and soil.

Most of the data is still collected on routine national monitoring networks. Two examples of routine monitoring networks for data generation follow. The 1994 French National Basin Network consists of 1,082 sampling sites, 946 of which are sampled yearly. The minimum permitted annual sampling frequency for these sites is 8, the most frequent is 12, while some sites are sampled 18 to 24 times a year, according to special evaluation purposes. A set of compulsory parameters is defined at the national level for every sampling site: rate of flow (gauging or interpolation); basic water composition parameters (temperature, pH, conductivity, suspended solids, etc.); biological indicators; and suspended active chlorophyll during spring and summer in eutrophicated areas. At selected sites (chosen by basin authorities among the whole set of basin sites), metals and organic micropollutants are measured according to common techniques. Measurements are conducted on water, suspended solids, sediments and aquatic mosses. Parameters may be determined according to local choice, including three determined by European directives, the North Sea protection conference, French pesticides surveys, and specific research made in each basin. The French Network is successful because it allows for the flexibility needed to make decisions.

The Russian system of ambient water quality monitoring is based on the following principles: comprehensiveness and regularity of observations, coordination of the time of their conductance with typical hydrological phases and measurement of parameters using unified methods. The system is based upon the network of fixed stations located at water bodies both in the areas of considerable anthropogenic impact and unpolluted locations. The network of Roshydromet (the Agency receiving most of the data on the quality of water bodies) consists of 1,892 sites including 2,604 cross-sections located at 1,326 water bodies. The observation sites are subdivided into 4 categories, including the economic significance of a water body; water quality, size, and volume and water flow, as well as other factors. The network currently includes 12 first category sites, 40 second category sites, 709 third category sites and 1,131 fourth category sites. Observations of inland surface water pollution are based on physical and chemical (all sites) and hydrological parameters (about 10% of sites) with simultaneous measurement of hydrological parameters. Observations at the sites are conducted according to certain programs depending on the site category. Sampling based on an obligatory standard program is usually carried out at all sites in major hydrological phases 4 times a year for lakes and reservoirs and 6-7 times a year for streams and rivers. Monthly, decadal and daily sampling according to the reduced list of parameters is added correspondingly to the sites of the third, second and first categories. The Russian network was good in the 70s and 80s, however, during the 90s, the data quality is suspect and has been deteriorating due to a lack of sufficient funds.

Examples of national (NAWQA, EMAP) and international (GEMS/Water) water quality monitoring programs were briefly described. Evaluation of water quality monitoring systems was very active during the last 10-15 years in developed countries. These systems became more purpose-oriented, flexible, multiple compartment and based on different approaches (fixed stations, synoptic surveys, detailed studies, etc.). This is a general approach for identifying environmental indicators. It requires (1) consideration of the public values or endpoints (which drive policy) and the potential stresses (at which the policy is directed), and (2) knowledge of the interactions between chemical, physical and biological processes. For instance, the Environmental Monitoring and Assessment Program in the U.S. is planning to use, for purposes of assessing inland surface waters, the trophic state index, sedimentary diatom assemblage, zoo plankton assemblage, macro invertebrate assemblage, fish assemblage and the semiaquatic wildlife assemblage (birds) as candidate response indicators. It uses the physical habitat quality, chemical habitat quality, sediment toxicity, chemical contaminants in fish, chemical contaminants in sediments and biomarkers as candidate exposure and habitat indicators. Land use and land cover, human and livestock population density, atmospheric emission and deposition, use of chemicals, pollutant loadings, flow and channel modification, lake level and shoreline modification, introduced species and stocking and harvesting records serve as the candidate stressor indicators. It is important for the world to continue using synoptic surveys rather than fixed-station monitoring for the critical issues facing water quality.

Most of the world lacks the data needed to make informed water quality assessment decisions. Developing countries lack the resources needed to address their problems. For these countries, the synoptic approach to water quality assessment is more appropriate in comparison with the traditional fixed-station approach.

The World Meteorological Organization (WMO) Regional Workshop on Advances in Monitoring, held in Vienna in March, 1994 addressed several questions with regards to monitoring:

- What minimum physical, chemical, biological and socio-economic information is required to plan and manage water resources?
- What minimum data are needed to produce the required information?
- How do we effectively produce the required information from the data?

As to the first question, the two broadest objectives are the protection of human and aquatic health; thus, the minimum information needs are: (1) the quantity of water in space and time; (2) the basic indicators of physical and chemical quality and changes over time, including stage, turbidity, water temperature, specific conductance and dissolved oxygen, and perhaps pH and ammonia; and (3) the biological information on sanitary quality, toxicity, and biological integrity. Minimum information needs for water resource assessment do not require laboratory measurement of chemical variables. For more detailed assessment objectives, chemical measurements of such things as nutrients, trace elements and pesticides will be required. However, simple assumptions and methods should be employed whenever they will meet the defined information needs (i.e., the measurement of turbidity instead of a costly measurement of suspended sediment concentrations).

As to the second question, two additional categories of data are required for the effective use of water resource data: (1) Metadata to characterize the quantity and quality data. Metadata are stored in the computer database along with the water resource data and include date of collection, why the resource data were collected, field method used, laboratory method used, sample handling technique and quality control data for the field and laboratory (most present databases do not store this information); and (2) Ancillary data on natural and human factors that effect water quality, including data on climate, geology and soils; pollutant discharges; nutrient and pesticide application rates for agriculture and residential use, number of livestock, etc.; and socio-economic factors including population density, land use and land cover, etc. and their rate of change.

As to the final question, two issues are covered: database structure and the most useful types of products for use by the public managers and decision-makers. New software is needed to make the water resource databases of agencies transparent to each other and to enable resource data to be efficiently interpreted in the context of socio-economic conditions. All new databases should be constructed with the open structural architecture to facilitate cross reference and use. As to the types of products, simple colored maps and graphics showing current conditions in relation to resource goals and showing the changes with time are the most useful information products.

Coastal Zone Management, Great Barrier Reef
G. Kelleher

The Great Barrier Reef Marine Park, an area of approximately 350,000 sq. km, generates more than $1 billion dollars a year mostly in tourism and travel-related income. The primary challenge of the Great Barrier Reef Marine Park Authority is to allow for development both in the Great Barrier Reef and outside it without allowing progressive degradation of the Reef ecosystem. This challenge requires consideration of social and economic, as well as biophysical, issues . Data collection and scientific assessment should address the following elements:

- The health of the Great Barrier Reef as a large marine ecosystem depends primarily on water quality. Most of the threat to the maintenance of water quality standards comes from run-off from the mainland. The three principal parameters are the levels of nitrates and phosphates and turbidity associated with suspended sediments. Most of these constituents arise from broad area pastoral activity, with a significant proportion from crop lands and a minor proportion from coastal cities. Heavy metals, toxic chemicals including pesticides and herbicides are not a significant problem. Coral reef health is already being affected by nitrates, phosphates and suspended sediments in inshore reefs. Erosion is a major problem. Occasional, infrequent monitoring is insufficient because most sediment washout events are of a short duration (usually a week or less). The challenge is to at least maintain the existing water quality. At issue is whether this can be done in ways which are acceptable technically, socially and economically.

- The long-term effects of commercial and recreational fishing, particularly bottom trawling, are not known. One thing is clear - 5/6 of what is caught is tossed overboard dead. Only 1/6 of what is captured is put to good use. This ratio has a huge effect on the environment and the human activity associated with bottom trawling is critical. Bottom trawling doesn't just remove some fish from the area, it changes habitats. Permits are required to do anything new in the Great Barrier Reef and all zoning decisions take into account the effects of trawling. But gaps remain; for instance, does trawling lead to long term changes in the ecosystem, and if so, what are those changes? Can the ecosystem sustain itself under these challenges? Can the required changes to trawling activity be achieved technically, socially and economically?

- Coastal development, including clearing of mangroves, destruction and degradation of wetlands and estuaries, is another concern. Questions remain as to the effect on the health and productivity of the Great Barrier Reef and whether coastal development can be adequately controlled.

- Another element is mariculture and how much development can occur without degrading the reef - release of nutrients, clearing of mangroves and the threat of disease are the major concerns.

- The rights of indigenous people, following the formal recognition of the rights of the people in Australian legislation, means the authority has to face the immense challenge of maintaining those rights and involving the indigenous people in an integrated way in the scientific study and management of the reef.

The adequacy of data is also a major concern for the area. Data related to receiving water standards are probably adequate. Data are inadequate in relation to the effects of nutrients and suspended sediments on corals and on the ecosystem as a whole and to the scope for reducing nutrients and suspended sediment run-off from the mainland through changed farming practices. Data on the level of fishing are probably adequate; however, data are inadequate on ecological effects of bottom trawling and line and net fishing. Data on the rate of development are probably adequate too. Data are inadequate relating to the ecological effects of the destruction of wetlands, the removal of mangroves and the degradation of estuaries. Data on nutrient effects of the mariculture projects in the Reef are adequate as a result of a full monitoring program. Data on disease or toxic chemical effects are inadequate. Data on the demography of reef users, economic and financial issues of reef resources, attitudes, perceptions and behavior of reef users are not available for the Reef specifically; they are only available for the region.

The major issues in acquiring the missing data include the cost and time involved in carrying out scientific studies necessary to assess the ecological effects of these developments (the major issue) and the cost of carrying out regular monitoring. Actually, monitoring is being adequately addressed at this time.

Long-term studies over large spatial and temporal scales are necessary to determine natural variability and any human induced changes and their significance. Suitable methodology is not always available and needs to be developed first. Currently, every area is re-zoned every 7 years. This results in an inverse GAP analysis of the available data. It is critical that the scientists, managers and users work together for the monitoring, management, research and interpretation of the data. Involvement of all of these groups may slow the process, but it does give them the sense of ownership in the project that is required to ensure a healthy Reef, with users of the Reef voluntarily complying with zoning plans and codes of practice.

Global Fresh Water Assessment
H. Croze

Within the UNEP Environment Assessment Programme, there are four areas relevant to the issue of fresh water: UN Global Fresh Water Assessment, a focus on river basins, conflict and strategic rivalry, and indicators.

Global assessment is a perennial requirement of UN Earth watch (reiterated in Stockholm, Dublin, UNCED, Noordwijk, etc.) The UN Commission for Sustainable Development put UNEP at the head of a list of UN agencies that need to work together to produce a global, comprehensive fresh water assessment. A group of international experts convened by UNEP in September 1994 reiterated the need for a global comprehensive assessment to deal with both water quantity (and long term sustainability) and quality, including human health aspects. The main causes of problems in both areas are due to human pressures in both the hydrological cycle as well as in geographical space. A river-basin approach is required to make the global assessment operationally-relevant, and the application of the P-S-I-R (pressure, state, impact, response) model (see below) is necessary to make the assessment policy-relevant. A list of data needs relevant to the assessment has been developed.

In order to facilitate global assessment, a simulation model called AQUA is being developed by RIVM. The AQUA model distinguishes four subsystems: responses, pressures, water system and impacts. The dynamics of the water system change as a consequence of certain pressures. Changes in the dynamic system result in certain impacts. These impacts may give rise to certain responses by users and management. The model uses several data sets based on monthly or yearly averages, preferably with a long historical series, and river basin or country aggregates. The data sets, not all of which are meant as time series, are as follows:

- River basin characteristics and general information, including total area and areas of different land cover types (forest, grassland, desert, wetland, rainfed and irrigated agriculture, human area); temperatures; population number; and agricultural and industrial production and gross national product, specifically by sector.

- Hydrological data, including fresh water stocks (surface water, ground water, fossil ground water); precipitation; river discharges; ground and surface water-flow lag times; artificial reservoirs (volumes, extra evaporation); ground water level decline; and sea level rise.

- Water quality data including concentrations per substance (nutrients, heavy metals, pesticides, organic micropollutants) and per fresh water type (ground water, surface water) and the distribution of fresh water stock over different qualities of storage suitable for aquatic life, domestic water supply and irrigation or industrial water supply.

- Socio-economic data, including water withdrawals per sector (such as households, agriculture and industry), distribution between public and private supply and per source (ground water, surface water, possibly also fossil ground water, rain water and sea water for desalination); water consumption percentages (losses by evaporation) per sector (households, agriculture and industry); water use efficiencies per sector (households, agriculture and industry); price and income elasticities of water demand, hydroelectric generation; data on coastal or delta area possibly flooded; investment and operation and maintenance costs of the water supply; other water-related costs and legislation on water use or pollution.

Model-based assessments like the one described here for the global level aim at aggregation, synthesis and analysis of data relevant to policy and ecology. The approach is useful for identifying critical regions of the world and the data needs to assess the status of the regions and for developing policy options. And unless the critical data needs are met, the policy options remain clouded.

A river basin focus can help make a global assessment operationally relevant. The sum of all assessments in turn should equal a global assessment. It serves as the basis for policy formation using the PSIR (pressure-state-impact-response) structure to bridge the gap between the human/socio-economic sub-system and the environment-ecological sub-system, identify critical links and thereby develop policy-relevant information for decision-makers. Such information should be used to adapt policy for changing behavior, as appropriate; only in this way can the impacts on ecosystems be altered.

Data management problems include *disaggregation* (how to break down the typically aggregated socioeconomic data into spatial density distributions relevant to river basins) and *aggregation* (how to extrapolate from water quality point samples to entire basins).

Remote sensing and digital mapping show considerable promise in support of river-basin based assessments. For example, the potential use of the DCW (Digital Chart of the World) may in some areas provide better data on river basin extent (to be verified). The use of remote sensing for water quality assessment relevant data is being studied in order to determine the limits of detail and the nature of parameters that can be detected.

Conflict and strategic rivalry between basin-sharing states may be influenced by the degree of scarcity of water including per-capita availability, the extent of sharedness, and the ease of access to alternative sources (after Gleock); this is an important emerging issue that calls for using environmental information on shared resources.

Indicators in the PSIR framework also play an important role in global assessments. Three types of aggregated indices that encompass the evaluative frame work for water policy analysis (see annex) have been proposed. These indices link to the AQUA simulation model and allow for the user to choose an appropriate level of aggregation.

QUESTIONS/COMMENTS:

Comment - Rhind: the quality of the aforementioned sort of mapping is appalling. The generalization of materials to needs could cause up to a 30% error.

Golubev, Summation

There is an integrating capacity of water and it is helpful in putting together other data sets. In water management, there is a great need for a number of data sets compiled in other sectors (e.g., land cover/land use, basic socio-economic data, etc.).

The number one issue is the water quantity. Data are needed to better assess the quality and to better define the water management issues.

C. Sustainable Use of Natural Resources

Global Resource Consumption and Depletion
E. Rodenburg

Consumption of the world's natural resources is a key issue today. There is a fear that consumption of renewable resources is proceeding at unsustainable rates, and that the Northern countries are depriving their Southern neighbors of their fair share of the Earth's resources. There is further concern that the costs of overconsumption to the environment will be unaffordable.

Disparities in consumption between the North and South are mirrored by the amount of environmental destruction caused by each region. Consumption practices by the poor, however, can also lead to environmental degradation. Hopefully, alleviating poverty will reduce the pressure to degrade local resources for survival.

Many are hopeful that it will be possible to change our practices to meet the legitimate material aspirations of the people in the South without suffering further future environmental degradation and resource depletion. This will be a difficult task, in part because we lack information adequately describing our current condition and what brought us here. Specifically, information on consumption and the effects of consumption on the environment is necessary for us to adequately manage our resources and create a sustainable future.

Global consumption of non-renewable resources is accelerating. Consumption of two key metals, aluminum and copper, for example, has risen dramatically over the last three decades, resulting in serious environmental consequences.

The good news is that aluminum and copper are recyclable and are recycled in large amounts. As a result, we are increasingly able to get the same performance from lesser amounts of such materials and to replace old materials with new. Substitutes and more efficient uses of bauxite and copper ore, to name two important examples, will extend the world's supply to meet the demands of the foreseeable future.

The increasing rates of consumption of almost all subsoil minerals will not be constrained by available resources in the near and long term; however, the consumption will have real environmental consequences, making them unsustainable.

Fossil fuels are a similar example, except that they are not recyclable. Again, there are severe environmental costs to the exploration, production, transport, refining, and combustion of fossil fuels. Northern countries are the greatest consumers of these fuels and bear the greatest responsibility for these environmental effects. Demands for a better quality life in the South, though, also imply increased energy use. Despite the fact that higher prices, more exploration, and better technology will increase the level of global fossil fuel reserves, we know that these are finite. Oil production is expected to peak by the year 2018, and gas production will peak by the year 2030. Shortfalls in oil production of these will be made up by increasing consumption of coal. This will result in accelerated degradation of the environment.

In sum, the global supply of non-renewable resources also appears to be sufficient at present. Limits on consumption of these resources, however, will likely come from their effect on the environment.

World renewable resources, such as soil, water, forests, and fisheries, are better referred to as "fragile" resources. In many cases, these resources are declining rapidly. Our information about the supply, condition, and consumption of these resources is extremely limited. One reason that renewable resources are poorly documented is that they are not commercialized. In contrast, world knowledge of non-renewable resources is far superior. This is largely because of their critical economic importance.

While much information is available on commercial fishing, for example, we have very little information on the harvest of uncommercialized fisheries or waste. If we had such data, we might find that the total true harvests far exceed the estimated maximum sustainable yield.

There is a similar dichotomy in our understanding of forests and woodlands. We do know that total forest area has declined drastically; however, we do not have sufficient information on the extent and condition of forests, how much wood is harvested informally or illegally, or how much forest land is being converted, for example.

Freshwater is another important renewable resource about which we have limited information. Freshwater is rarely commercialized. While we know that consumption is increasing drastically, we have limited information on consumption, use, quality and supply.

In relation to soils, we have good information related to commercialized food production, but very little about erosion and soil degradation.

Fuel wood is the cause of important environmental degradation around the world, yet what we know about it is based on very poor data.

In conclusion, periodic collection of high quality data on relevant topics is an essential management tool. Policy makers must have access to basic data in order to make important decisions for our planet. Too often, the data sets we use to understand the conditions and trends of environmentally relevant variables are of poor quality.

Information on non-renewable resources is widely available because these resources are economically important to both governments and the private sector. In contrast, information on renewable resources, which are only partially commercialized, is spotty. Still, in the medium and long term, it is the renewable resources that should concern us most.

Discussion:

The group expressed an interest in how we get from where we are now to having reasonable access to needed data. Dr. Rodenburg stressed the need for good sample surveys as a way to get important information which is adequate for many planning purposes. Again, a key problem in getting some of this data is that there is no economic pressure to collect it.

In response to a question on where we stand on making assessments of environmental degradation, Dr. Rodenburg stated that while efforts are being made in this regard, we are not yet close to having the full picture.

Core Resource Data Availability in Southern Africa
D. MacDevette

South Africa and Mozambique are in a process of national reconstruction and development planning. Although these programmes focus on meeting basic human needs, they do involve comprehensive provincial and national projects that offer an opportunity to incorporate sustainable development guidelines within the planning process. Other countries within the region are reexamining at both national and regional development planning in the context of Agenda 21; therefore, a unique opportunity exists to incorporate environmentally sustainable development principles within the development planning process.

These planning processes require, among others, information on: the state of the environment, including human well-being; and environmental potential and environmental constraints. The overall need for better quality data has been driven by: democratization and the need for better access to data by communities, the capabilities of GIS technology, the need to share project costs, requirements for data by regional projects such as SADC and IGADD. In addition, international agencies, global scientific programs, international conventions and aid agencies require better data and are prepared to finance information activities.

Much of the new data being collected in the region is at the project or ministry level, which often leads to the collection of non-standard data that cannot be used for national or regional work. Initiatives to commercialize the management of certain core data sets such as geology and soils has led to restrictions in the availability of the data, particularly in South Africa.

Inappropriate use of the information technologies, such as GIS and remote sensing, has consumed significant amounts of both human and financial resources and lead to very few high-quality data sets in relation to the monies invested. There is also a general lack of appreciation, at the national and regional level, of the importance and value of accurate and timely information and, therefore, very few policy initiatives in this respect.

For natural resource management, core data is required in the following areas: topography, water quantity and quality, climate data, land cover data, land use data, forest resource and biomass data, vegetation data, fauna and flora species distribution data, geomorphology and soils data and biodiversity data. Much data is available on human welfare and the state of the environment in general national terms, and in cases where it is mapped (not often), it is usually at scales of 1:1,000,000 or smaller. Where data is available at a larger scale or even where available for the region, such as vegetation data, the data sets were collected in different formats and using different classification systems, and thus cannot be easily compared.

In examining the availability of data for development planning purposes at the 1:250 000 to 1:50 000 levels, very little current data is available for the region, with the notable exceptions of climatic and topographical data. Therefore, insufficient data exists at a scale of 1:250 000 in all countries for effective planning and monitoring of sustainable development. Significant progress has however been made in a number of areas and particularly in countries like Botswana, Zimbabwe and South Africa, but countries such as Angola and Mozambique require significant assistance to regain the most basic levels of data. Coordinating initiatives such as the SADC Environmental Information initiative and the Program on Environmental Information System for Sub-Saharan Africa should continue to be supported in order to promote and support the development of the core data sets in the region.

Discussion:

The discussion centered around the accuracy and use to which the data can be put. It was noted that ground water data is an important requirement and that neither SADC as a whole nor countries like South Africa had prioritized the core data sets, although this would be done within a year in both cases. The issue of data quality was raised and it was noted that it is not yet a major issue in the region due to the need to merely obtain digital data.

Core Data Needs for Environmental Models
S. Shrestha

INTRODUCTION: Five topics are covered in this presentation. In the presentations yesterday, the need for frameworks and models with data was discussed. There is also a need for coordination, data harmonization, and standardization mechanisms. The presentation represents the results of consultations that have been held with 38 Governments, 6 sub-regional organizations, and 10 regional institutions. A clear shift has occurred on emphasis by UNEP's Environment Assessment

Programme ((EAP) to begin to address the needs of the countries in the Asia and the Pacific Region (AP).

FRAMEWORK FOR INFORMED DECISION MAKING: Chapter 40 of Agenda 21 addresses the need for the use of data and information. UNEP's EAP has developed a framework for the implementation of this chapter in consultation with governments and partner institutions of the AP Region. In the environment context, at the decision-making level, we need regular State-of-the-Environment reporting, assistance to legislation, and action plans. At the information level, there is a need to look at emerging issues, indicators and indices. At the data level, there is a need to move from the traditional sectoral approach towards integrating biophysical with the socio-economic. The tools we have for multi-sectoral analysis to move from the data level to the information level are Geographic Information System (GIS) and Remote Sensing (RS). The tool suggested for reporting at the decision-making level is expert systems. On the institution side, there is a need to move from a centralized approach to a decentralized. There is a need to network the key users and producers of data and provide multi-sectoral analysis capability at institutions such as planning commissions or environment agencies. This is a framework that has gained wide acceptance in the AP Region.

MAJOR ISSUES IN THE SOUTH ASIA REGION: One of the ways in which we might begin to address the core data needs is to examine the major environment and development issues. As an example, the South Asia sub-region has been taken. Consultation show the major issues faced by governments include: deforestation, desertification, land degradation, fresh water resources, marine pollution, population growth, salinization, waste disposal, and natural disasters. The countries in the South Asia sub-region include Afghanistan, Bangladesh, Bhutan, India, Iran, Maldives, Nepal, Pakistan, and Sri Lanka.

DEFORESTATION DATA MODEL: For each of the issues, a model to arrest or address the issue could be developed to see what data layers are needed for analysis and informed decision making. Deforestation is one example; it is an issue of concern to all the governments of the sub-region except perhaps Maldives. The consequences of deforestation include: desertification, degradation, erosion of biodiversity, sedimentation, air pollution, depletion of energy resources, land slides and flood hazards. There is a need to analyze the pressure on the forests. The minimum core data needed are population, land use, trade, and infrastructure.

MINIMUM CORE DATA NEEDS: Deforestation model is an example of deriving the core data needs by addressing the major issues of concern. In the AP Region, through consultations, similar exercises of models have been reviewed for all the major issues. The results show that the minimum core data needs include: on the biophysical side, geology, soils, topography, hydrology; and on the socio-economic side, demography, infrastructure, administrative boundary, and land use.

COORDINATION HARMONIZATION STANDARDIZATION MECHANISM: There is a strong need to only examine frameworks, data models but also coordination mechanism for harmonization and standardization. It has been suggested to look at national, sub-regional, and regional levels for the Asia and the Pacific Region. At the national level, a decentralized network of key users and producers on a compatible platform is needed. At the sub-regional level, there is a need to compliment the efforts of existing inter-governmental bodies. In the AP Region, these bodies include: ASEAN-Association of South East Nations; ICIMOD - the International Centre for Integrated Mountain Development; Mekong- The Interim Mekong Committee; SACEP-South Asia Cooperation on Environment Programme; SPREP-South Pacific Regional Environment Programme. At the regional level the Regional Environment and Natural Resources Information Centre (RENRIC) is being established by UNEP in close collaboration with Asian Development

Bank, UNDP, ESCAP and other bilateral and multi-lateral agencies. RENRIC is being developed as a regional resource centre for networking in the AP Region, data repository, clearing house, dissemination, coordination for use of data in informed decision making. There is a need to minimize duplication of effort at the national, sub-regional and regional levels. The scales suggested through consultations are: 1:50,000 at the national level; 1:250,000 at the sub-regional level; and 1:1 million scale at the regional level. There are needs of both expertise and expertise as well as access to data. These needs might be addressed through capacity building, including training and provision for hardware and software. The needs of access to data could be addressed through national Internet gateways, scanning technology to provide existing data in digital form, and satellite data to update the existing data in digital form. The international community must begin to address these needs of the less-developed countries and to examine a 'bottoms-up' approach while considering the needs of global data sets.

D. Human Health, Pollution, Waste Management, and Natural and Environmental Disasters

The upsurge of communicable diseases in the last decade in context of the environment and development is a matter of serious concern. Seen globally, some diseases stand out most prominently. Acquired Immunodeficiency Syndrome (AIDS) has become pandemic in approximately a decade. AIDS is now causing the spread of tuberculosis, an opportunistic infection which has become resistant to tuberculine drugs and difficult to treat. Malaria at one time considered under effective control in most countries of the world, has returned with vengeance outside Africa South of the Sahara. The parasite has become resistant to the anti-malarial and the vector to the insecticides, and the spread of malaria is aided and abetted by man-made environmental changes creating habitats favorable for the proliferation of mosquitoes. Aedes aegypti and Aedes albopictus, the vectors of dengue fever (DF) and dengue hemohragic fever (DHF), have spread to all continents of the world. Until the 1970s, DF and DHF were confined to urban areas, but with the introduction of rural water supplies, Aedes mosquitoes have entered rural areas bringing dengue epidemics. Filaria is entering new areas as the breeding of vector Culex quinquefasciatus is facilitated by water stagnation and lack of adequate drainage. Schistosomiasis is spreading with the construction of big dams providing opportunities for the snails to breed profusely in new habitats. Human behavior and environmental changes are therefore helping in the return of diseases in more virulent forms, and becoming refractory to control in most endemic countries of the world.

Environmental Pollution in Eastern Europe and the GLOBE Program
B. Rock

Dr. Rock discussed two areas: forest decline and air pollution effects in Eastern Europe, and the Global Learning and Observations to Benefit the Environment (GLOBE) Program - an international environmental education program designed for pre-college students being developed in Washington, DC.

The availability of good quality data greatly affects the quality of research resulting from the use of the data. An example of an effective joint research project involving quality data is the Large Area Operational Experiment (LAOE) for Monitoring Forest Damage Using Satellite Data sponsored by UNEP and the UN Economic Commission for Europe. Landsat Thematic Mapper (TM) data have been extremely helpful in mapping forest damage and loss for three countries in Eastern Europe: the Czech Republic, Poland and the former East Germany. As a result of combining TM data analysis with detailed forest inventory ground truth provided by foresters in each country, it has been determined that, between 1975 and 1985, large areas of these forests have gone from forested conditions to conditions where forests are dead or dying.

Landsat TM data is uniquely valuable for detecting forest damage for the following reasons:

1. The TM remote sensing system on board Landsats 4 and 5 provide the environmental research community with a UNIQUE environmental monitoring tool for detecting a range of forest damage levels (low, moderate and high).

2. The UNIQUE spectral capabilities provided by the Landsat 4 and 5 TM are especially effective in detecting, mapping and monitoring forest decline damage thought to be due to air pollutants, including acid rain, ozone, and toxic metals as well as forest damage due to toxic waste disposal.

3. Other satellite sensors such as the Landsat Multispectral Scanner (MSS), the Advanced Very High Resolution Radiometer (AVHRR) onboard NOAA "weather" satellites, and the French Systeme Pour d'Observation de la Terre (SPOT) do not provide the extended spectral coverage of TM, coverage needed to detect forest decline damage.

4. Continuous data acquisition by TM is required for the data to be used as a monitoring tool, especially when the dynamic response of vegetation is to be used as an indication of global change.

Landsat TM has extended spectral coverage in the Short Wave Infrared (SWIR) not available on other satellites in orbit. These SWIR bands, in combination with near infrared (NIR) bands, allow scientists to monitor with accuracy and precision various levels of damage within a forest (although not the causes of such damage). For example, between 1972 and 1989, Krusne Hory forest cover in the Czech Republic declined to 48% of the 1972 baseline. Furthermore, by combining core data sets such as topographic data in digital form with Landsat thematic data, scientists are able to determine the zone of elevation where most damage has occurred. In this case, 601-1000M is the highest area of damage. An intensive reforestation program has started in the Krusne Hory and TM is being used to monitor the program's progress.

The future of the Landsat program is still in doubt, causing major challenges to scientists who depend upon the data. One major challenge scientists are facing is the aging of Landsat satellites currently in orbit - Landsats 4 and 5. Landsat 6 failed to reach orbit. Because of their age and associated costs, Landsats 4 and 5 are no longer acquiring data on a routine basis, which scientists require. Without Landsat data, the scientific community will not be able to detect, map, and monitor forest damage in the future.

In various parts of the world there is not extensive TM spatial coverage because of cloud cover, lack of ground receiving stations, or military prohibitions. Another challenge facing scientists is the increasing costs of the data (currently, approximately $4,000 per scene). As a result, access to data representing world-wide coverage is becoming a limitation to conducting environmental research.

Some foreign systems may replace Landsat, specifically the Indian Remote Sensing (IRS) satellite system; however, the IRS system would not be as effective as Landsat. IRS does not offer the same extended spectral coverage and does not have as extensive coverage of the Earth as Landsat, due to acquisition of data only on demand.

Dr. Rock echoed the concern of several speakers in the Conference for the need for harmonization in terms of categorizing forest damage and harmonizing ground truth collection methods. The Czech Republic and Germany have taken a major step toward this direction in their agreement to use each other's systems for assessing levels of forest damage in individual tree stands in the Krusne Hory and the Erzgebirge regions of the two countries.

One way to improve the scientific community's access to high quality ground truth is through the GLOBE Program. GLOBE will train pre-college (kindergarten through 12th grade) students to collect ground truth data while educating young people about the environment. Initiated by Vice President Gore, GLOBE will involve a worldwide network of K-12 students to make a core set of environmentally important observations at or near their schools, report their data to a GLOBE data processing facility, receive and use global images created from data collected by the worldwide network of GLOBE schools and study environmental topics in their classroom. The goal of the GLOBE program is to have over 200 schools involved worldwide by Earth Day (April 22) 1995. Half of these schools will be in foreign countries, and the number will increase to thousands of schools by Earth Day 2000. School selection will be up to individual countries intending to participate in the GLOBE program.

In conclusion, there are several core data needs required for assessing forest damage in Eastern Europe:

1. Baseline satellite data sets for all land surfaces readily available to the scientific community;

2. Routine data acquisition of these satellite data sets (rather than only on demand);

3. Data acquired by systems using TM band combination (SWIR/NIR data critical);

4. Data acquired at highest spatial resolution possible (10M minimum resolution);

5. Standardized/harmonized ground truth data (biometrics, species types, damage classification, etc.) must be acquired for selected study sites distributed worldwide;

6. Create a limited number of study sites along environmental gradients in order to monitor change-over-time at a number of levels (ground, aerial photography, satellite data); and

7. Student-generated ground truth data for school sites available at the Anderson level 2 or higher (via the GLOBE program) will make a significant contribution in many areas of environmental study.

Questions from the audience:

Is 10-meter spatial coverage a realistic request and, if one were to get such coverage, how would one store it?

Dr. Rock believes it is important to "aim high" in terms of requests for ideal data needs. Dr. Lawless pointed out that technology continually improves and the storage of such data is really not a problem. Access to such data would provide future scientists with a baseline on which to base their analyses of future conditions.

Another member of the audience asked if we now have an obligation to move away from "just in case" data collection and request only core data sets necessary now or in the future.

Dr. Lawless replied that policy makers need to see actual benefits from the expense of the acquisition of data. Dr. Rock pointed out that, in 1989, there was an attempt in the U.S. Congress to turn off Landsat sensors. The scientific community took steps to educate the policy makers of the many benefits they were receiving from Landsat and Congress reversed its decision.

Human Health Data Needs and Availability in Mexico
M. Rodriquez

Health is difficult to define. A good definition for health could be the well-being of individuals in a population and the satisfaction of its needs and amenities. A population's needs and amenities are different for industrialized and developing countries and are difficult to assess. For purposes of study, health is defined as the absence of disease.

Diseases can be classified into the following categories: chronic/degenerative, neoplastic, accidents, malnutrition and infectious diseases (virus, bacteria, parasitic, air-borne, water/soil-borne and vector-borne). The first three categories are found more in industrialized countries, while the last two categories are more common in developing countries. Data required for the health care of both groups is different. Chronic disorders could be assessed using longitudinal data, and do not require frequent data. On the other hand, the prevention of vector-borne infectious diseases requires fresh and freshly-processed data. Environmental conditions determine the co-existence of the disease agent, animal reservoirs and humans and therefore, the presence of disease. Remote sensing can help detect these vectors and their interactions. Since health is connected to the environment, it is possible to use remote sensing and the Geographic Information System (GIS) to study health.

Two examples are presented of the use of remote sensing on the study of vector-borne diseases. In Africa, the seasonal variation of forests in Sierra Leone was studied to determine the presence of vectors of sleeping sickness. It was found that the distribution of disease varied with soil temperature and rain forests. Now work is underway to determine what will happen with global warming.

In Mexico, malaria is prevalent along both coasts. The malaria control program in Mexico is limited by inadequate time to prevent the spread of the disease and the infrequency of insecticide spraying. The disease also goes through cycles of low and high incidence. The difficulty is in reaching areas where the disease is prevalent. To control the disease, one needs to know where the disease occurs.

In the Global Monitoring and Disease Prediction Program, a joint program between NASA and Mexico, remote sensing was used to determine mosquito abundance based on landscape variability around villages. Landsat data identified 11 different types of land coverage and a correlation between landscape and mosquitoes was found to be 90% accurate in predicting where mosquitoes will be found and thus, malaria incidence. These two examples indicate the possibility of using remotely-sensed data and GIS techniques for the study of vector-borne diseases providing data for prediction and to provide control programs with timely, useful data sets. Limitations on data include data accuracy, geo-referencing, costs and technology transfer. The data needs are elevation, temperature and rainfall, human migrations and biological data. There is also a need to have rapid detection of outbreaks of the disease.

Human Health Data in India
V. Sharma

V. Sharma provided some examples of the importance of core data application in various sectors of the economy in India.

IRRIGATION SECTOR

1. The current malaria epidemic in Western Rajasthan is the result of unhealthy conditions created by the construction of the Indira Gandhi canal. The command area of the canal lies in four districts, where vast areas have become water-logged, providing opportunities for Anopheles culiafacias to breed. Water logging is the result of hard pan in this area preventing water percolation. This core data was ignored in the construction of the canal; as a result, the area has become endemic for malaria.

2. The Sardar Sarovar Project in Gujarat is still under construction, but in the areas already completed, receding waters in ponds provide opportunities for An. culicifacies and An fluviatilis to breed. Already in the neighboring villages, there is ten-fold increase in malaria and a rise in P falciparium, and Malaria has become a serious health problem, killing people. Core data to prevent malariogenic conditions were available but not used due to lack of proper understanding about the disease.

3. Lack of a data base on drainage cuts delayed the construction of Sarda Canal Projects, Banbasa, District Nanital, Uttar Pradesh.

The opening of Ganga canal in 1854 brought malaria havoc in the command area. In low-lying command areas, the process of desertification started. Sub-soil water level started rising on permanent basis, resulting in salt formation on the surface. The productive agricultural land had to be abandoned. At that time, core data on such adverse impact of irrigation on agricultural land were not available. In those days, there was no malaria control as the transmission by mosquitoes was not even discovered. Malaria was rampant throughout the India-gangetic plains, killing people and adversely affecting all aspects of human life and development.

The erstwhile Oudh province (comprised of 12 districts viä., Lucknow, Unnao, Rai Bareilly, Sitapur, Hardoi, Kheri, Faizabad, Gonda, Bahraich, Sultanpur, Pratapgarh, and Barabanki) in the state of Uttar Pradesh lies between the Gaghra river in the North and the Ganges in the South. This vast region had been experiencing famines, particularly during 1897-98 and 1907-08. To eliminate the vagaries of the monsoons and provide irrigation, the British government drew up an irrigation scheme to harness the waters of the Sarda river in Banbasa. The Sarda Canal Project was sanctioned in 1931, but work could not be started, first due to World War I, and then because of a lack of information on drainage cuts to prevent water-logging in the proposed command area (this was considered an essential requirement after the opening of the Ganga canal in 1854). The construction of Sarda canal was taken up in 1920 and completed in 1929. The total length of the canal is 2,880 Kms and the combined length of drains is 2,880 Kms. The command area is nearly 7 million acres. The Banbasa head works had created seepages due to the barrage, which was unavoidable. Vast marshy areas were a threat to the health of the people of that area. To overcome this problem in the marshy areas in Banbasa, sub-soil seepage canals were constructed to prevent water stagnation and formation of marshes.

Industrial Sector

1. The National Thermal Power Corporation (NTPC), Dadri is located in Ghaziabad district (UP) about 40 Kms southwest of Delhi. NTPC produces 1,200 MW power. The area under the NTPC is 2,200 acre. In 1988, when the work started, there were 7,000 workers; the population has now increased to 12,000. Malaria is a major problem, and control efforts by the NTPC have failed in containing it. NTPC became operational in 1989, and malaria APIs for the years that followed were: 1990, API-332; 1991, API-149; and 1992, API-194. There have been deaths due to malaria, and there is no hope for any improvement in the situation. P. falciparum is on the increase

and there are reports of drug resistance, and a morbid fear in all employees of contracting malaria. Mosquito nuisance is also enormous, the bulk of which is Culex quinquefasciatus and the man-hour density varies between 113 and 339. Vector Anopheles culicifacies breeds all over and maintains man-hour densities between 33 and 93.

Initial selection of the site for the NTPC was wrong, as the two criteria for site selection, i.e., location near Delhi and nominal price of land guided the site selection. There was no consideration for "healthy site" at the time of site selection; in fact, this area should have been declared unfit for industrialization because of the following characteristic features.

This is a command area of the upper ganga canal. Parts of the command area are low-lying and this particular portion of land is bowl-shaped. Sub-soil water is very shallow, and rain water stagnates for extended periods due to lack of percolation. Until the Ganga canal was brought in for irrigation, this fertile land was considered good agricultural land, but had to be abandoned later due to desertification as a result of irrigation. The land was available for the asking and given away cheap to the NTPC. Construction activities created a large number of mosquito production areas. Imported labor from endemic states like Orissa, Bihar and West Bengal provided an infection reservoir thus setting up a chain of transmission. Unlined canal, seepages, weed growth and poor maintenance of the surface water has compounded the problem. The cost of malaria control operations is Rs. 1 million annually, and if losses due to malaria are taken into consideration, the annual loss due to malaria may be as high as Rs. 5 to 10 million. A malaria situation of this nature cannot be tackled with spraying or anti-larval methods; an engineering solution must be found to improve drainage and reduce sub-soil water level as an initial remedial action to control malaria.

2. The Visakhapatanam Steel Plant (VSP), Visakhapatanam, Andhra Pradesh: Land for VSP required the resettlement of 24 impact villages. The site selected was foot hills with water seepage, puddle formation and production of the important vectors An. culicifacies and An. fluviatilis. The VSP villages were moved from healthy area to one with high receptivity to malaria. The impact village population, since their resettlement, are experiencing intense malaria transmission, and deaths due to malaria are common. In the VSP itself, tropical aggregation of labor in a haphazard manner near water bodies, the creation of borrow pits to build shelters and wells dug for drinking water created ideal breeding ground for An culicifacies. Malaria in this otherwise healthy area multiplied and assumed epidemic proportions, not amenable to control. In 1988, of 45,000 population, there were 9,199 malaria cases (2,695 Pf), and this situation has not shown any improvement during the construction phase of the VSP.

URBAN SETTLEMENT

1. In India, urban malaria has assumed serious proportions. In some cities, malaria is a serious health problem and there is no easy solution to control or even contain malaria. In the past, a data base on the breeding habitats of Anopheles stephensi resulted in the planning of malaria control in urban areas. The classical example is malaria control by Bombay in Covell in 1928. Malaria is back in Bombay, with a vengeance. Covell collected core data on two items viz., biology of the immatures of An. stephensi, and enumeration of An. stephensi breeding habitats. This resulted in: (a) the formation of by-laws which were implemented rigidly to make people accountable for the control of mosquito breeding in their buildings; (b) development of scientific methods of the control of An. stephensi breeding; and (c) a system of field monitoring of interventions that ensured 100% coverage of mosquito breeding habitats. Wherever this strategy was followed, positive results of malaria control were forthcoming. Malaria was well under control in Bombay until about 4 years ago when the implementation of the by-laws was relaxed due to poor field operations. Unfortunately, this lesson was not followed elsewhere in the country, except

occasionally in some towns for brief periods. As a result, malaria has emerged as a major public health problem in the country.

2. In 1917, Delhi was selected as the capital of India, the site selected was north Delhi. At that time all plans had to be approved by the Director of the Malaria Institute of India (MII). Dr. Hodgson, then Director of MII, had access to core data on malaria receptivity in Delhi. He rejected the site on the ground of its high receptivity to malaria. Vast land in that area was water-logged and lacked adequate provisions for drainage. Instead the site recommended was the Raisina ridge, the present location of New Delhi. This area had natural drainage for up to 5 miles on all sides, and to avoid water stagnation beyond this area, drains were laid to discharge runoff into the river. We have no such example today and, in fact, the rejected site has now been colonized due to population pressure. Thanks to DDT and our continued dependence on residual insecticides, we now have in these areas perennial malaria transmission refractory to control.

FOREST

After the entry of Japan into World War II and the invasion of Malaya and Burma (now Myanmar), land communication had to be established immediately with the army in Burma for supplies and for its withdrawal in to India. The shorter route passing through the jungles was selected. The line of communication and base camp had to be guarded from malaria. Malaria transmission was so intense that, during the rainy season in 1942, over 90 percent of the labor working in the large railway construction project at Rangapahar near Manipur road were infected with malaria and all work had to stop. In Assam, attention was focused on the preferential breeding sites of An. minims, such as springs, seepages and streams which were canalized and subjected to weekly control by the malariol. These measures were not enough, and a large drainage of the base camps and roads had to be undertaken to prevent troops from contracting malaria. Malaria was effectively controlled in specified areas and these places were known as "harbours." Drainage integrated with vector control and weekly chemotherapy eliminated indigenous transmission in the harbors and on the line of communication so that the troops could move without fear of contracting malaria. In contrast, Japanese troops did not and could not prevent malaria onslaught and this was one factor in the defeat of the Japanese forces. At that time, core data on the vector breeding habitats in relation to drainage was not available. This data base was generated and drainage was applied with meticulous precision to control mosquito breeding.

CORE DATA REQUIREMENTS

The following core data is required to prevent mosquitogenic and malariogenic conditions in areas under development:

1. Meteorological data for transmission potential;
2. Epidemiological data for receptivity and vulnerability;
3. Vector(s) and their biology, particularly dispersal, feeding and resting behavior and breeding habitats;
4. Health services, type and outreach to the local population;
5. In irrigation projects: (a) Upstream: quarrying and borrowing area, seepages and humidity levels, (b) Downstream: riverbed structure, creation of swamps and marshy land; affects on fisheries; loss of occupational opportunities, (c) Conveyance: Banking stretches to estimate seepages; lining requirement of the canal, and (d) Command area: drainage of excessive irrigation, storm water and flood drainage; soil irrigability and cropping patterns; and settlement and rehabitation;
6. Industrial Sector: Topographical features, industrial and domestic water requirement, tropical aggregation of labor, resettlement and rehabitation of oustees;

7. Urban Settlements: water requirement and its conveyance, management and storage practices; liquid and solid waste disposal, water table and core data on planned development; and
8. Forestry Sector: Deforestation, aforestatoin and forest fringe areas, economic activities like tea gardens, coffee plantations, mining, logging, etc., and tribal settlements and their socioeconomic and cultural activities.

The major issues in acquiring core data are:

1. Classified data is inaccessible
2. In restricted entry areas, core data cannot be generated (also in the disturbed areas);
3. Intersectoral communication is often poor and data sharing is difficult;
4. Core data may be old and needs updating;
5. The cost of acquiring core data may be high;
6. Rapid environmental degradation requires frequent updating of core dat;
7. Lack of uniform procedure of data collection; and
8. Information on the source of core data availability is poor.

Environmental Health Data - WHO
K. Rolfe

Dr. Rolfe covered three areas: An existing environmental health data system;, a major WHO initiative since the UNCED Conference; and data needs in environmental health

<u>Existing Environment Health Data System</u>

The Global Environmental Monitoring System (GEMS), run in association with UNEP, consists of four components: GEMS Air, GEMS Water, GEMS Food and GEMS Human Exposure Assessment Location (HEAL). These four programs have produced a large amount of useful data on existing environments in many countries.

Until now, GEMS has been limited to two types of pollutants: sulfur oxides and particulate matter. But other pollutants need to be considered, especially those associated with motor vehicles in urban areas. There is also a need for quality assurance procedures.

GEMS Water has conducted a great deal of water quality monitoring, including part of the Mekong Project, discussed previously.

GEMS Food investigates the presence of various contaminants in food, such as pesticides.

GEMS HEAL began with only 3 types of pollutants and is now expanding. It examines total exposure in terms of air, water and food in certain populations.

<u>Major WHO Initiative Since UNCED</u>

Following UNCED, WHO carried out a detailed assessment of its involvement in Agenda 21. A Global Strategy for Health and the Environment has been prepared. As recommended by the Director General's Council on the Earth Summit Action Programme for Health and Environment as the top priority for action, a major initiative has commenced (with support from UNDP) on the incorporation of health and environmental considerations into national planning for sustainable development.

The initiative began in 1993 with six countries: Ghana, Jordan, Nepal, Guatemala, Lithuania, and the Philippines. It recently expanded to Sri Lanka, Barbados, Vietnam, Ivory Coast. In the next few months, it will add Guinea, Bissau and Iran. The gathering of good environmental health data sets are an important component of the initiative.

The scope of work differs from country to country; however, the following common terms of reference were prepared for implementing the initiative in the participating countries. The objectives are to:

1. Gain greater involvement of the health and environment sectors in national planning for sustainable development;

2. Provide sectoral inputs into national plans for sustainable development dealing with health and environment, including identification of their capacity-building requirements for health and the environment, and

3. Provide an assessment of the extent to which health and environment issues are incorporated into national plans for sustainable development and how this may be improved.

I ıvironmental Health Data

Key Challenges:

1. To facilitate the integration of health and environmental concerns into development planning processes. This requires policy makers to look at potential health impacts of developmental projects before they are allowed to proceed; and

2. To secure adequate recognition of the potential health impact of development projects (including environmental health impact assessment)

Adequacy of Data:

1. For some countries, data is available and mechanisms/systems are in place;

2. For other countries, however, data is inadequate and hence there is a need for local studies to obtain it.

Major Issues:

1. The need for a recognition that sustainable development is a multi-disciplinary topic, and includes health concerns;

2. The requirement to have appropriate coordinating mechanisms and arrangements at all levels of government; and

3. The building up of capabilities, including awareness-building on the part of decision-makers.

Questions:

What would be suitable for areas of further consideration to meet the needs of more focused data? Specifically, what is an acceptable spatial scale when addressing data needs?

Dr. Rolfe referred to various WHO epidemiological studies on the impacts on human health of environmental degradation. In most cases, the focus is more local than national, and more national than global. However, the human health implications of global issues, such as ozone layer depletion and climate change, are also extremely important.

Dr. Rhind pointed out that health questions have another dimension. The whole story is not just spatial needs but individual data as well as longitudinal data.

Dr. Rock suggested we could use schools to contribute data every week on the health of students.

E. Food and Energy for an Increasing Population

Early Warning and Food Information in Africa
S. Zziwa

The Early Warning and Food Information System (EWFIS), IGADD, was created in 1986, and has a membership of seven eastern Africa countries: Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan and Uganda. Its current focus is environmental protection and food security. In the area of food security, IGADD has implemented two projects: a U.S. $ 1.5M remote sensing project funded by Japan, which ended in December 1993, and the main EWFIS project, funded by Italy (U.S. $ 6M), which will end in December 1994. Steps are being taken to find further funding for the remote sensing project, while Italy may try to fund an extension of the project to a second phase.

The main food security challenges are guaranteeing an adequate food supply and sustained access to it by the entire population. The objectives of the EWFIS project are to increase the capacity of national institutions to handle early warning data and to strengthen the capacity of the IGADD Secretariat to carry out sub-regional early warning. Presently, there is not a consistent approach to food security early warning. The EWFIS project would like to produce a common methodology, create necessary databases, improve data transmission, train staff and disseminate food information outputs.

The EWFIS project has spent a substantial amount of resources on methodology development. Formats have been created for standardized data handling and software needed to analyze the data have been developed. It is necessary to build the capacity to process the data and distribute the results. In the area of communications, the EWFIS project has provided links from the field to centers of operation and between capitals and the IGADD Headquarters by SSB radio, facsimile and other means. A system is also in place to transmit digital (binary format) data by radio. In the future, EWFIS hopes to increase communication, especially by use of the Internet. The EWFIS project has trained many people at national institutions; however, there is a problem with staff turnover and the resultant need to frequently train new people. The project publishes five newsletters.

In examining the indicators for food security monitoring, there is not a single variables that can reliably measure security conditions. Hence, indicators used should be chosen from the entire length of the food chain. The minimum data sets selected for food security monitoring are: (a) traditional data (most commonly used in early warning monitoring) including rainfall, remote sensing images, prices of main staple crops and livestock, and anthropometry for children under the age of five; 2) additional data (for improved monitoring of trends) including minimum and maximum temperatures, wind speed, relative humidity, sunshine hours, remote sensing image statistics, the Consumer Price Index, morbidity of childhood diseases and anthropometry for mothers; 3) contextual data (for better interpretation of trends) including basic agronomic data and socioeconomic data; and 4) data for food balance analysis including agricultural statistics, imports, exports, food reserves and the number of people needing food aid.

EWFIS project emphasizes working with existing data, as means of minimizing costs and ensuring the sustainability of the system. However, data collection and methodology of existing data need to be improved. In food monitoring, data accuracy is not overly emphasized because rough figures for larger areas of population are adequate.

Generally, the data for food security monitoring is available and accessible, but has poor spatial coverage, is not long term and has missing values. The limitations and constraints of the EWFIS are the cost of the program, quality of the data and weak national institutions that need a lot of support.

Discussion
A dangerous trend is developing in Africa -- staple (traditional) crops are being substituted by non-traditional (food) cash crops, which contributes to food shortage and is exacerbated by improved infrastructure. This leads areas that were initially self-sufficient to sell all their food and results in localized famines.

Southern Africa has a similar sub-regional food monitoring system in place and it might be useful to exchange results. There is a need improve the food situation both regionally and in smaller units (nationally). However, in EWFIS, when activities were expanded to support a greater number of countries, there was a funding shortfall -- more money will be needed to focus on national units. In addition, it is sometimes difficult for representatives from different countries to meet together and coordinate activities.

It is very difficult in Africa to forecast food production and decide whether to import or export grain. While remote sensing data would help in making decisions, there needs to be more comprehensive coverage in terms of spatial distribution of meteorological stations. The EWFIS project is trying to assist countries in setting up and/or upgrading these stations. Other forms of communication of information are also necessary. However, most countries lack the proper mechanisms to coordinate the collection and distribution of this information.

Core Data Neets for Agriculture in Bangladesh
Z. Karim

There are many gaps in the agricultural database in Bangladesh. Much of the data needs updating, including the following.

Topography and soil data -- the data is more than twenty years old. Polders and embankments have altered topographical features. Extensive irrigation has been developed -- this requires soil quality evaluation. Following the floods of 1987 and 1988, the physiographic situation has changed and the land resources data base needs to be updated.

Flood data -- there is a need for early warning of floods, land type classification by seasons, flood damage data and data on salinity and tidal surges.

The amount of arable land in Bangladesh has been classified into five major land types: highlands, medium highlands 1, medium highlands 2, medium lowlands and lowlands. Over the last 15 years, a database of land classification has been built. Soil classification is confused because different systems have worked on the data. It is essential that classification of land and soil be uniform. In addition, a climatic database that includes rainfall, temperatures, radiation, etc. has to be built up.

Over the past several years, Bangladesh has experienced both floods and droughts -- this has a great effect on agriculture and on the population in the flood plains.

Water resources -- there is a need for quantification of the dry season, water quality data and sedimentation.

Crop phenological data -- there is a need for a minimum data set for different models. In addition, basic crop physiological data is needed for the modern crops now grown in the country..

Environmental safe limits for agro-chemicals -- there is a need for data on heavy metals in fertilizers, pesticides, soils, etc.

As far as data quality is concerned, better collection and storage methods must be found. The data also needs to be standardized and coordinated. Building even a minimum data set is difficult because the right types of data must be included and the system of development of the database varies. In addition, the quality of data is unknown because of the lack of standardization. For standardization of data coordinated efforts are needed. This requires trained staffs and creation of facilities at the national level.

Energy in India
P. Sengupta

Approximately forty percent of total energy consumption in India is non-commercial energy (biomass), i.e., fuel wood, animal wastes and agricultural residues. Sixty percent of energy consumption is from coal, oil, gas and electricity. Industry accounts for the largest share of consumption; but agriculture's share is increasing.

There are data gaps in studying biomass consumption: the actual amount (quantum) of use, pattern of use and effect on deforestation and desertification. For example, it is not known what effect the future availability of fuel wood will have on the environment because estimates of annual fuel wood consumption vary and the amount of fuel wood available is not known. However, appropriate sample studies can be undertaken to determine the sustainability of present use patterns and solutions to future problems. Field studies on deforestation to look at quantum and patterns have also been undertaken, but solutions may not emerge from database of this information.

In looking at figures for the percentage of energy consumption, the general trend is that industrial and agricultural consumption have risen over the past forty years. A larger consumption of energy by agriculture is envisioned because to meet food requirements in India, the land needs to be used more intensively. More data from satellite imagery is needed to study this situation. It will also help to determine the impact of agriculture and increasing energy consumption on natural resources, thus helping to decide how to use these natural resources.

Many forms of commercial and non-commercial energy are used in agriculture, both directly and indirectly. For example, electricity and petroleum (commercial energy sources) are used indirectly in fertilizers, pesticides and post harvest processing. Animal and labor (non-commercial sources) are used directly in land preparation, interculture, irrigation and harvesting. In order to build an adequate database for agricultural energy consumption, the following data is required: current use and recharge pattern of ground water to determine sustainable exploitation; impact of fertilizers and pesticides on ground water qualities; and remote sensing data and other means to assess changes in agricultural patterns in each agro-climatic region to determine the social, economic and environmental impacts. Presently, the impact of agriculture and increasing energy consumption on soil quality and ground water is understood only to a limited extent Crop patterns and market situations are also changing and difficult to determine. It is difficult to pinpoint the data needed to study the competitive use of energy in agriculture.

The data requirements for energy consumption in the urban transportation sector are: rate of growth of different types of vehicles; pattern of passenger kilometer transportation; and pollution co-efficients. This sector will be increasingly emphasized in the future. The organization of urban areas, the use of energy in those areas and the living conditions are also of great concern in India.

In terms of the type of commercial energy sources in India, the use of coal is declining, while final consumption of oil, gas and electricity are rising. However, coal is still the main fuel for power generation in the country, and the environmental impact of coal mining is a matter of concern.

APPENDIX 7

AGGREGATED CORE DATA SETS

AGGREGATED "PRIORITY" CORE DATA

CORE DATA TYPES	LUC&D	FW/CZM	HH/P/HWM	SUNR	F/E/FEP
LU/LC	X	X	X	X	X
DEMOGRAPHICS	X		X	X	X
HYDROLOGY	X	X	X	X	
INFRASTRUCTURE	X		X	X	X
CLIMATOLOGY	X	X	X	X	X
HYDRO/TOPO	X		X	X	X
ECONOMY	X	X	X		
SOILS	X	X		X	X
WATER/AIR QUALITY		X	X	X	
WATER QUANTITY		X	X	X	
RECYCLING			X	X(?)	X
EMM/EFF/RAD		?	?		?
POLLUTION		X	X	X(?)	
GROUND WATER		X	X	X	X
OCEAN TEMPERATURE		X		X(?)	X
AGRICULTURAL PRACTICES			X(?)		X

SOURCE: SYMPOSIUM STEERING COMMITTEE AS DISCUSSED IN PLENARY AT SYMPOSIUM

"?" and "X(?)" indicate areas where questions of definition were raised and discussed with respect to the inclusion or exclusion of a data type by a specific panel, "X(?)" indicates inclusion, "?" indicates exclusion.

"Priority" Core Data Sets

- Land Use/Land Cover
- Demographics
- Hydrology
- Infrastructure
- Climatology
- Topography
- Economy
- Soils
- Air Quality
- Water Quality

SOURCE: SYMPOSIUM PARTICIPANTS, RESULT OF PLENARY DECISIONS

APPENDIX 8

ENUMERATED CORE DATA SETS

ENUMERATION OF IDENTIFIED CORE DATA NEEDS

CORE DATA TYPES	LUC&D	FW/CZM	HH/P/HWM	SUNR	F/E/FEP
LU/LC	X	X	X	X	X
TOPOGRAPHY	X		X	X	X
SOIL	X			X	X
MGMT/PRO AREA	X			X	
HYDROLOGY	X	X	X	X	
ECONOMY	X	X	X		
LAND TENURE/CAD	X				
DEMOGRAPHICS	X	X	X	X	X
ADMIN/POL BDRY	X			X	
INFRASTRUCTURE	X		X	X	X
NATURAL DISASTER	X		X		
WATER QUANTITY		X	X	X	
WATER QUALITY		X	X	X	
HYDROGEOLOGY		X			
METEOROLOGY		X	X	X	X
TIDE DATA		X			
RIVER DISCHARGE		X			
USE (LAND/CZ)		X			
HABITAT TYPE/VEG		X		X	
BATHYMETRY		X			
WATER MGT. ISSUES		X		X	
DISEASE PREV			X		
HEALTH SERV. INF			X		
DISEASE CONTROL			X		
AIR/WTR/CHEM CON			X	X	
WASTE PRODUCTION			X		
RECYCLING			X	X	X
AGRIC STATS.					X
FOOD BAL (NAT/GL)					X
PER CAP CONSUMP					X
CROP YIELD					X
CROP MARKET					X
CULTIVAR AVAIL.					X
PRODUCTION TECH.					X
AGROCHEM/ PESTICIDE USE			X		X
BIOMASS AVAIL				X	X
ENERGY RES. INV				X	X
ENERGY PROD.STATS				X	X
ENERGY CONV. EFF				X	X
SECT ENERGY CONS.				X	X

ENUMERATION OF IDENTIFIED CORE DATA NEEDS (Cont'd)

CORE DATA TYPES	LUC&D	FW/CZM	HH/P/HWM	SUN R	F/E/FEP
PEST CONTROL/MGT.			X		X
ENERGY COST				X	X
SECTOR AVAIL				X	X
ENERSUP/DEM BAL				X	X
EMM/EFF/RAD		X	X		X
GEOLOGY				X	
COST UTIL. POLL.				X	
SPECIES DIST.			X	X	
SPECIES ECOLOGY			X	X	
POLLUTION		X	X	X	
HARVESTING/USE				X	
OCEAN CURRENTS		X		X	
OCEAN TEMP		X		X	
MINERAL RES				X	
ENV/HUMAN CONS.			X	X	
POLL. ABSOR. CAP.				X	
ECOLOGY REQ.			X	X	
AGRI. PRACTICES			X	X	X
SOIL FERTILITY				X	X
GROUND WATER		X	X	X	X
SOIL DEGRADATION				X	X
AIR CHEMISTRY				X	
AIR PARTICULATES				X	
COSTS OF ENVIR. PROTECTION				X	
EPID. OF DISEASE			X		X
VECTOR BIOLOGY			X		

APPENDIX 8

GLOSSARY OF TERMS FOR CORE DATA SETS

Climatology - includes meteorologic records, charts, and statistics

Demographics - includes census, birth/death, and migration information

Economy - includes consumption and production and supply and demand statistics

Hydrology - includes information on water location, quantity, and flows

Infrastructure - includes cadastral and land tenure records, transportation, communication, and energy flow networks

Soils - includes fertility, acidity, and loss/formation relationships

Topography - includes hypsography, hydrography, and political administrative boundaries

Water and Air Quality - includes information on point and non-point source pollution and particulates

APPENDIX 9

LIST OF ACRONYMS

AVHRR	Advanced Very High Resolution Radiometer
CBERS	China-Brazil Earth Resources Satellite
CDC	Center for Disease Control
CG	Consultative Group
CGIAR	Consultive Group for International Agricultural Research
CGNET	Consultative Group for Networking
DANIDA	Danish Agency for International Development
DF	Dengue Fever
DHF	Dengue Hemohragic Fever
EAP	Environmental Assessment Programme
ELMS	Environmental and Land Management Sector
ENINWA	Environmentally Sound Management of Inland Waters
EPA	Environmental Protection Agency
EWFIS	Early Warning and Food Information System
FAO	Food and Agricultural Organization
FSU	Former Soviet Union
GAP	Geographic Analysis Program
GEMS	Global Environmental Monitoring Programme
GIS	Geographic Information System
GLOBE	Global Learning and Observation to Benefit the Environment
GRID	Global Resource Information Database
GTOS	Global Terrestrial Observing System
HEAL	Human Exposure Assessment Location
IARC	International Agriculture Research Center
IARC	International Agricultural Research Centre
ICIMOD	International Center for Integrated Mountain Development
ICSU	International Council of Scientific Unions
IGADD	Intergovernmental Authority on Drought and Development
INPE	Instituto Nacional de Pesquisas Espaciais
IRS	Indian Remote Sensing
LAEO	Large Area Operational Experiment
MII	Malaria Institute of India
MSS	Multispectral Scanner
NASA	National Aeronautics and Space Administration
NIR	Near Infrared
NOAA	National Oceanographic and Atmospheric Administration
NORAD	Norwegian Agency for International Development
PSIR	Pressure-State-Impact-Response
RIVM	National Institute of Health and Environmental Protection (The Netherlands)
SADC	Southern African Development Community
SCOPE	Scientific Committee of Problems of the Environment
SPOT	Systeme Pour d'Observation de la Terre
SWIR	Short Wave Infrared
TFIS	Tropical Forest Information System
TM	Thematic Mapper
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development

USGS....................................United States Geological Survey
USRA....................................Universities Space Research Association
WHO.....................................World Health Organization
WMO.....................................World Meteorological Organization
WRI......................................World Resources Institute
ZACPLAN...............................Zambezi Action Plan
ZACPRO.................................Zambezi Action Project

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