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

Volume I

Bangkok, Thailand, 15 - 18 November, 1994

UNEP

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

November 15-18, 1994
Bangkok, Thailand

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1. 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 of Volume 2.

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 of the results are provided in Appendices 7 and 8 of Volume 2. 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.

The responses of donor and sponsor organizations to the outcomes of the symposium are provided in Section 6.

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, national and international capacity, lack of knowledge of existence, and lack of standardization/harmonization.

Availability and accessibility were key concerns of symposium participants. Some participants have acquired core data sets from sources outside their own countries because of access restrictions. Methods to improve data exchange, including improved networks and open data policies, need to be developed. Users need efficient and effective knowledge, access, and delivery systems. Easily accessible descriptors of data type, location, structure and quality (metadata), should be developed for core data sets.

Participants noted that it is often difficult to justify the long-term costs of collecting and maintaining data. Decision makers are often surprised at the associated expense of collecting high-quality spatial (geographically referenced) data. Likewise, it is difficult to measure the benefits of such data use. Participants concluded that the assessment of benefits from use of spatial data can be done by creating a set of case studies, rather than solely through econometric studies. One approach can focus on satellite remotely-sensed data and study examples of its use. Participants also suggested that parallel case studies, combining both remote sensing and non-remote sensing data, are essential in conveying the benefits of spatial data to governments, international agencies, and the populace.

Participants also noted that many nations are not creating national-level core data sets and that, in some countries, there is no agency responsible for the creation and maintenance of some of these data sets. However, participants stressed that, as focus is drawn to a "limited and manageable" number of core data sets, it should be remembered that there are a variety of important data sets specific to a particular topic/region, such as public health, consumption patterns, or species locations, that are also needed.

Participants felt that more should be done in many nations to facilitate the funding and production of core data sets. Capacity building, education, and training were considered essential to the production, maintenance, and use of core data sets.

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 Volume 2, Appendix 1.

2. INTRODUCTION

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.

The meeting organization (see Agenda, Volume II, Appendix 2) provided for keynote and background presentations, followed by a review of the successes achieved and challenges faced in three international case studies:

- The Pan-Amazonia Project;
- The Zambezi Project; and
- The Mekong Project.

A number of UNEP programs were also reviewed; summaries of these case studies and UNEP programs are provided in Section 3.

To provide focus to the symposium, a series of panel discussions and working group sessions were established. The participants exchanged views on critical environmental assessment and sustainable development issues, core data needs, 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

Finally, to ensure that no major issues were missed, and that region-specific issues were identified, 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 individual 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 Sections 4 and 5, below. Detailed descriptions of the topical workshops are provided in Volume II, Appendix 6. Core data needs produced as a result of this process are described in the conclusions below.

The responses of donor and sponsor organizations to the outcomes of the symposium are provided in Section 6. Conclusions and recommendations stemming from the symposium are provided in Sections 7 and 8, respectively.

3. BACKGROUND

A. The United Nations Development Programme Vision -- Moving From Data to Policy

In his keynote speech, Dr. Nay Htun, Assistant Administrator and Regional Director of the United Nations Development Programme's (UNDP's) Regional Bureau for Asia and the Pacific, stated that the importance of data cannot be overemphasized. The right types of data can help improve the management of environmental resources and promote sustainable development.

Since the dawn of time, humankind has striven for better standards of living and an improved quality of life. Hunter-gathers moved to trees and then to caves, seeking a better life. This is not much different from what we are trying to do today; we want more comfort and a better quality of life. The better we can gather the right type of data, the better we will be able to make appropriate decisions to reach this goal.

The five major goals being pursued by the international community are key to improving the quality of life and living standards worldwide. Achieving these goals will eventually lead to a more harmonious and peaceful national, regional and international society.

The first goal is to alleviate and eventually eliminate poverty. Although some societies already enjoy a high standard of living, one and one-half billion people around the world still live in abject poverty. For them, potable water, for example, is a luxury they can only dream about. Is this the kind of world we should live in? We have the capability to improve global standards of living, and efforts to do so need to be undertaken at the national, regional and global level.

The second goal is to ensure jobs or, more appropriately, livelihoods, that are empowering and enabling. People's livelihoods must enable them to realize their potential. They must also be sustaining. The question is: How do we create such livelihoods?

The third major goal is to strengthen the place of women in the world. Half of the world population is made up of women, many of whom are marginalized and disenfranchised. Many do not have access to the facilities needed for development.

The fourth major goal is to achieve greater social integration and harmony. There have been outbreaks of violence all over the world, and this is unacceptable. There is an imperative need to end ethnic strife and genocide.

The fifth and final major goal is to enhance natural resources and our environmental base. We need to be able to prudently manage and conserve this capital base for the benefit of present and future generations.

It is believed that development is the major means to address these five core goals; however, traditional development paradigms have not enabled us to reach these goals, and this has cast a great shadow over these development programs. Since the industrial revolution, the major goal of development was to increase economic capital. A few decades ago, however, people began to recognize that such a single-minded pursuit was resulting in unacceptable consequences. While the attempt to increase economic capital was a legitimate pursuit, it was increasingly recognized that ecological capital must also be preserved. These two goals are not necessarily opposed to each other, but must be integrated. In fact, this integration will lead to greater sustainability.

At the Rio summit, there was recognition that improving these two capitals is still not sufficient.

There is a third component that is also important: preservation and enrichment of social capital. With these three capitals, we have three legs upon which to achieve more sustainable and stable development. The world community will meet in Copenhagen to examine how social capital can be increased.

To achieve better integration among these three types of capital (economic, ecological, and social), we need a more reliable database. With a better database, we can better monitor what is happening and establish links between economic, ecological and social capital. The availability and use of data is extremely important; however, data is expensive and must be appropriate to the question. If it is, then the data is worth the expense and is immeasurably valuable.

Our challenge is to identify the types of economic, ecological and social data necessary to help us to achieve greater sustainability. There must be certain critical, or core, data that can help us to identify changes. If we are able to identify the core data, we will be many steps ahead.

Everything in the world is linked, and we must find the critical links that will tell us what is happening economically, ecologically, and socially. We are taking our first steps in beginning to understand what the links are, but this exploration is still in its infancy.

UNDP is most interested in the outcome of this conference and we are eager to receive suggestions on what data sets we should pursue, where gaps exist, and what should be done to fill them. With this information, we can better advise governments on response options needed to address the momentous changes that are occurring -- options that will promote the sustainability of our priceless heritage for future generations.

B. Sustainable Development and Industry

Mr. David Buzzelli, co-chair of the US' President's Council on Sustainable Development and Vice President for Environment, Health and Safety of The Dow Chemical Company, presented the following overview of the roles and activities of the Commission.

The President's Council on Sustainable Development is a unique initiative to change policy and decision-making practices for environment, economy and equity in the US. The history of environmental policy in the US is an adversarial one of confrontation and litigation, and many in industry, government, and the environmental community now realize that this situation needs to change. One and a half years ago, the Clinton Administration formed the Council on Sustainable Development. The Council is a multi-state forum charged with developing a national strategy for sustainable development. Two years after its formation, it is scheduled to deliver this strategy to the President. This is no simple task and may not be completed on time, but the Council intends to define some key elements and policy recommendations for sustainable development. The Council will look at the intersections and impacts among the "three legs of the stool" -- economy, environment and equity (i.e., the social element discussed by Dr. Nay Htun).

When the Council was proposed by the President, the Administration appointed two Co-chairs: Jonathon Lasch from the environmental community and David Buzzelli from Dow. Mr. Lasch had been active in the Natural Resources Defense Council and was involved in litigation against companies like Dow. Thus, two traditional adversaries are now trying to work together to change policy. The Council is made up of eight industrial leaders, the heads of six environmental organizations, five Cabinet members and other representatives from states, ethnic groups and labor organizations in the US. This is a unique group of people never before given the opportunity to

interact in such a positive fashion. All Council meetings are public, which puts a strain on this unique relationship because it is more difficult to air disagreements and make decisions in a public forum. However, it was decided in the beginning that, if the process was to move forward and gain power, the public had to be involved. Often, members from the environmental community come to these meetings better prepared than those members from industry because, for most environmentalists, the Council is a full time job; for CEOs of companies, the Council is just another aspect of an already demanding job. Approximately 300-400 people attend each meeting and the meetings are frequently broadcast on the C-SPAN television network.

The Co-chairs realized that 25 Council members could not develop a strategy by themselves, so eight Task Forces were formed. Examples of these Task Forces include Energy Policy, Public Linkage and Education, Sustainable Communities and Natural Resources. After the formation of the Council was announced, many people wanted to be involved; thus, approximately 400 people now serve on these Task Forces. The effort to keep the Council's activities focused and to deliver policy recommendations is challenging, but we are encouraged by the changes already occurring.

The Council realizes that the US is behind much of the world in forming a strategy for sustainable development, but believes its work is a giant step forward. The Council Co-chairs are convinced that, initially, the process of forming a strategy is more important than the actual product -- for the first time, government, industry and environmental groups are working together. Ultimately, however, there is a need to deliver a product -- a framework for sustainable development and policy recommendations. Shortly after 1 January 1995, a set of goals for sustainable development for the next 20-30 years will be delivered to the President. The specific goals will be "cast back" to the present and a course forward will be plotted. The Task Forces will develop recommendations based on these goals, and in June/July 1995, the Council hopes to reach a consensus on the recommendations to be delivered to the President in October 1995. The outcome of this process will depend upon these recommendations.

Some may say that the President's Council is focused too narrowly on the US, and that we must develop a more international strategy. Although the primary focus of the Council is national, it is also examining sustainable development issues within the rest of the world and is doing its utmost to ensure that national and international strategies match.

The International Business Council for Sustainable Development is a unique group of 50 industry leaders from around the world who are dedicated to change. The focus of the Council is to determine what industry and business can do to break down barriers and move toward sustainable development. A book focusing on this subject, Changing Course was issued at the Rio conference. A second book, soon to be published, will focus on the role of financial markets and instruments in sustainable development will. Hopefully, these efforts will motivate businesses around the world to take steps toward sustainable development.

The fact that these various groups from both the environmental community and business are coming together to work toward sustainable development is a huge step forward; however, the transition to sustainable development will be the most difficult part. It can be compared to getting into a canoe -- stepping into the boat is the hardest part; once we are in the canoe, it will be easier. Today we have one foot in the canoe and one on shore, and we are struggling to figure out where we are going in terms of sustainable development.

C. UNEP Programs

Dr. Croze's presentation had two thrusts: (1) a brief description of several international programs involving environmental assessment, data analysis, and data gathering; and (2) an overview of the main frameworks currently being developed and used by UNEP's Environment Assessment Programme (EAP) for problem solving and generating policy-relevant information.

(1) International Programs

(a) Global Terrestrial Observing System

The Global Terrestrial Observing System (GTOS) is a cooperative program of UNEP, FAO, UNESCO, WMO, and ICSU aimed at providing data for governments, regional and international agencies, research scientists, and the commercial sector. The program complements the Global Climate Observing System and the Global Ocean Observing System, as well as programs and efforts of other international agencies. The major human and environmental issues addressed by GTOS are:

- Resource sustainability and natural and managed ecosystems;
- Pollution and toxicity;
- Loss of biodiversity and support to the Biodiversity Convention;
- Climate change; and
- Land cover change and degradation.

Currently, GTOS is in a start-up phase. When fully implemented, a four-tiered system of ecological ground observation sites will be established and monitored. Low level sites will be standardized and systematically distributed, and a readily available set of common data points will be collected; complex methods will be kept to a minimum. At higher level sites, a deeper set of variables will be monitored, using more rigorous methods over more extensive target areas.

(b) Consultative Group for International Agricultural Research

The Consultative Group for International Agricultural Research (CGIAR) provides a coordinating framework for 14 world-wide International Agricultural Research Centres (IARCs) involved in crop-specific research and management. A new project has been launched focusing on the use of Geographic Information Systems (GISs) and common databases in agricultural research management. Support for this project is being provided by the nation of Norway and the World Bank. Implementation will involve a number of IARCs, cooperating centres in UNEP's Global Resource Information Database (GRID) system, with GRID-Arendal (Norway) taking a lead management role.

The program has several main elements of direct interest to this conference. Of fundamental importance is the goal of harmonizing research activities throughout the Consultative Group (CG) system. In addition, common GIS tools, socioeconomic and ecological models, and minimum data sets will be established.

The data realms which have been identified as critical for this program include the following:

- Base maps (or digital data);
- Climate and population;
- Soils;
- Agricultural statistics; and
- Socioeconomic indicators

CGNET has been implemented to establish communications links between participants and will be enhanced by connectivity to UNEP's wide area network. Technology transfer to national centers will also be emphasized.

(c) Regional State of the Environment Assessments

Within UNEP's Environmental Assessment Programme, state-of-the-environment reporting will have a regional as well as sectoral focus, based on region-specific, policy-relevant information needs as defined in a series of user consultations. The reports and associated data compilations and analyses are being accomplished in strategic partnerships with UN regional commissions, such as the Economic and Social Council for Asia and the Pacific and the Economic Council for Latin America and the Caribbean; UNEP regional offices; sub-regional bodies, such as the Mekong; and UNDP, other UN agencies, and governments. The regional database compilation includes both environmental and socioeconomic data from existing sources when available. Countries are provided with access to international sources of data and meta-data as well as national data set "starters." The process will assist coordinated contributions to the Commission for Sustainable Development reporting on implementation of Agenda 21, as well as to the UNEP/EAP long term Global Environment Outlook.

(d) International Convention on Biodiversity

The goals of the International Convention on Biodiversity are: conservation of biological diversity; sustainable use of individual biotic components; and fair and equitable sharing of the benefits of genetic resource utilization. Rather than provide an exhaustive listing of specific core data sets which are -- or will be -- required for carrying out this program, very broad parameters have been specified for data set requirements. The principal parameters are:

- The data must capture the variability and complexity within and between ecosystems and plant, animal, and microorganism species;
- The data sets must provide information regarding the individual components of the above environmental components, as well as genomes and genes; and
- The data sets must yield insights into those processes and activities which impact on the above ecological components.

Needed are: greater specificity in the data parameters; a data framework to provide realistic guidelines for countries; and strategic application of innovative techniques, such as gap analysis, in support of the Convention.

(2) Overview of International Frameworks for Environmental Assessment

UNEP/EAP, along with its international and regional partners and collaborating centres, is elaborating and applying a number of frameworks relevant to environmental problem-solving, assessment, and policy-setting. It is felt that such frameworks are essential to: (a) ensuring cross-sectoral integration of information, (b) providing an analytical basis for the links between environment and development, and hence (c) producing information that is policy-relevant and directly supports sound environmental decision-making and management.

A multi-stage policy cycle is defined. Generally, this cycle is considered as progressing from

problem identification to solution identification and implementation through to an evaluation stage that monitors compliance and effectiveness. Each step in the policy cycle has particular requirements for integrated data and indicators.

An important program element is the definition and implementation of a Pressure-State-Impact-Response (PSIR) model to aid in understanding complex human/environmental subsystem interactions and identifying critical cause/effects links. This approach takes into account the dynamics of the human population and economic subsystems and the pollution and resource depletion pressures which they place on the Earth's ecosystem/environmental subsystems, as well as the natural and human responses to these pressures.

In an international cooperative effort to develop environmental indicators relevant to sustainable development UNEP/EAP and such partners as the UN Department of Policy Coordination and Sustainable Development, the UN Statistical Office, the Scientific Committee for Problems of the Environment (SCOPE), The Netherlands' National Institute of Health and Environmental Protection (RIVM), and the World Resources Institute (WRI) are proposing an environmental indicator hierarchy. This program element establishes data collection and compilation reporting methodologies relevant to various levels of specificity and political requirements (with decreasing specificity and increasing synthesis) and at spatial scales ranging from local to global. Depending on the specific purposes for which they are developed, the indicators may describe a relatively simple environmental state or summarize the complex analysis of a large number of interactions. In general, policy-makers require the latter.

Finally, EAP structures reporting requirements in a demand-delivery mode, modeling information demand as a top-down, general-to-specific process. Information delivery is a reverse process. It begins with data collection through inventory and monitoring programmes, moves through regional data networks, serving statistical data and state-of-the-environment reports, aggregating to sectoral and regional assessments, with a high-level aggregation occurring in such overviews as UNEP's Global Environment Outlook for 2002.

D. Overview: Core Data Needs for Environmental Assessments and Sustainable Development

Dr. J. Estes provided an overview of the core data needs for environmental assessments and sustainable development. The material discussed here is, in some ways, a summary of the background paper written by Mr. D. Wayne Mooneyhan and Dr. Estes and sent to symposium participants (see Volume II, Appendix 4).

Complex changes are occurring in our global system that cross and touch all levels of society. Some of these changes are global, yet have local and regional impact (e.g., greenhouse gases); other changes are local or regional, with global impact (e.g., deforestation).

Issues of critical interest to the global development community include: biodiversity, consumption and production, demographics, fresh water, and poverty. Yet those who seek data on the condition of the world's environment are often shocked by the depth of ignorance they find. It is a myth that adequate maps and other types of geo-referenced information to support environmental assessments and sustainable development strategies exist and that they are up-to-date. (It is important to note that throughout this presentation, when the word "map" is used it refers to both analog and digital maps and to many other types of spatial data or geo-referenced data.)

Areas of research needs identified by global change scientists include: climate and hydrologic

systems, biogeochemical dynamics, ecological systems and dynamics, Earth system history, and human interactions. With our current data sets, we are unable to answer even the most basic questions, such as: 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 these uses?

Decision makers lack basic information to help them formulate adequate policy. Policy makers need better global information in areas such as climate change, land degradation, land use, vegetation changes, and water quality.

The type of data required depends upon the audience; policy makers want answers to questions, whereas scientists want scientific information for their research. For instance, a recent conference on early detection of global change developed a list of 105 data sets based upon what scientists, policy makers, politicians, and resource managers want. These were eventually were narrowed down and participants aggregated the data into 16 categories of information. This conference led to our realization of the need for a symposium on core data needs.

We began to see that high-resolution, science-based data sets do not exist for most of the Earth, even for developed countries. These data sets are expensive to produce and no single use can justify the cost of compiling them. But these data sets could support many other uses; for instance, with the world's population at approximately six billion, it is difficult to understand why, in the mid 1990s, we have no reliable, large-scale, global data concerning population (or, for that matter, topography, land cover or other areas).

Another key issue in this area is that of access. It's one thing to say that data exists, but what kind of access do we have to this data? Many countries still restrict access to core data sets even to their own citizens. The world is becoming a different place and data is being shared more and more; but problems still exist.

We often see statistics regarding urban population, deforestation, soil erosion, and so on. Often, these statistics paint a very grim picture. But how accurate are these estimates? Who has the base data to support or refute them?

Equally as important as the data are the models used to analyze the data. Depending upon which model is used, global land cover estimates vary greatly. Which of these models is correct to use as a baseline to measure change?

Many issues affect global data sets. These include economics, infrastructure, technology, national security, national sovereignty, political sensitivities. Better maps and many other types of geo-referenced data are required worldwide to better manage planetary resources and improve economic and environmental quality. This means we need accurate, reliable, sustained data on all aspects of our global environment

Affordability also is creating problems with respect to access. US Government civil agencies operate on an open-access, cost-of-reproduction recovery basis; however, many foreign government organizations operate on a copyright and full cost-recovery basis. Even the World Meteorological Organization (WMO), which once had free and open access to data, is now examining the possibility of establishing a pricing policy for data, and this is of real concern.

In sum, there are several common misperceptions regarding the issue of mapping. These misperceptions include the idea that the Earth is well mapped; that maps represent reality; that maps

are accurate and up-to-date; that mapping is easy and fast; that mapping is inexpensive; that cartographers know what map users need; that everyone knows how to read maps; and that satellite images are maps.

The unrecognized realities are that all maps are generalizations, all maps have inherent biases, and on all maps, distances, areas and directions must be viewed with caution. But if we are to assess the state of our environment and more towards a sustainable future, we must have maps.

Based upon Dr. Estes' presentation, the following conclusions were drawn:

- Better maps are required in support of a wide variety of spatial data users;
- Global environmental change, environmental assessment and sustainable development issues do not stop at international boundaries;
- We need to stop perpetuating the "Mapping Myth;"
- Adequate maps do not exist to support many important research and development activities in the area of land processes; and
- Mapping is neither easy nor inexpensive.

E. International Case Studies

(1) The Pan-Amazonia Project

Dr. T. Krug presented the status of the Pan-Amazonia Project.

The pan-Amazonia Project is led by the Instituto Nacional de Pesquisas Espaciais (INPE), the main civilian space organization in Brazil. INPE's activities range from space science and remote sensing and meteorology to space engineering. It recently inaugurated the Centre for Weather and Climate Forecasting, and is working with China on the construction of the China-Brazil Earth Resources Satellite (CBERS). INPE is responsible for the development and construction of the Brazilian satellites -- three for data collection (one launched in February 1993) and two remote sensing satellites.

In the remote sensing area, INPE has a receiving station in Cuiaba for Landsat, SPOT and ERS-1 data acquisition and a processing station in Cachoeira Paulista (SP). It carries out research and methodology development for diverse remote sensing applications and has offered a masters degree in remote sensing since 1974. Activities related to image processing, at the level of both research and software development, are also an important component of INPE's remote sensing activities.

Amazonia is an area of extreme importance because of its unique fauna and flora. Study of the region is fundamental in formulating sustainable development strategies to preserve its ecosystems. Several projects are being carried out in the area, including deforestation assessment using satellites and ecological economical zoning (which integrates information at several levels - morphology, vegetation, geology and land use). These projects give direction to policy makers on sustainable development. Brazil is responsible for coordinating the ecological and economical zoning of all the countries who are part of the Amazon Treaty.

The Pan-Amazonia Project was established in Brazil in 1991 to monitor the South American rain forest using satellite data. INPE has the lead on this project due to its prior experience in the deforestation assessment of the Legal Amazon, which covers an area of approximately 57% of

Brazil's national territory. The countries involved in the Pan-Amazonia Project are: Bolivia, Peru, Ecuador, Colombia, Venezuela, Surinam, Guyana and French Guyana. Technical staffs from each of these countries coordinate the activities of the Pan-Amazonia Project in their own countries.

To date, project goals have been defined, one technical meeting involving most country coordinators was held, Landsat TM data has been distributed, and training courses on forest assessment and mapping have been offered at INPE. Through training, the project aims to establish a common methodology for data analysis that will lead to compatible data from all countries. The project periodically evaluates the reports submitted by the project coordinators.

Since 1988, INPE has done annual deforestation assessments on the Legal Amazon. The first objective of this project is to provide the rate of deforestation, since this is a key issue for Brazilian policy makers. For example, in the past it was thought that Brazil was responsible for most of the tropical deforestation. From 1988-1992, the deforestation project has shown a decrease in the rate of deforestation. The results from the project, which is carried out on a wall-to-wall basis, provide quantitative information to support policy makers. However, to carry out this project yearly is very expensive. For scientific purposes, the classes investigated (forest, non-forest, deforestation, and water bodies) are insufficient. There is also a need to develop a geo-referenced data set to support studies on estimation of gas emissions. Considering that most of the deforested areas are burned (and that this process releases important trace gases in the atmosphere), it is important to characterize the vegetation units that are affected. In this respect, INPE has implemented most of the overlays generated by the project into a GIS system, so as to constitute one information plan. Other information plans (such as vegetation maps from RadarBrasil) that project at the scale of 1:1,000,000 (carried out in 1977) have also been implemented. The Pan-Amazonia project should provide a database similar to the one developed for the Brazilian Amazon project.

The current deforestation assessment project is based on visual interpretation of Landsat-TM images. The overlays generated by the project are digitized into a GIS, to constitute one layer of information. Some overlays are simple to digitize, others are more difficult, because of complex patterns of deforestation characteristics of some areas (e.g., fishbone patterns). It is necessary to develop an alternative for these complex overlays, possibly based on an automated process. Therefore, INPE has been concentrating efforts in automatic segmentation and classification of images based on neural networks, jointly with the IBM Scientific Center in Rio de Janeiro. The results are promising.

Persistent cloud cover makes useful imagery in some areas of the Amazon difficult to obtain. Additionally, the deforestation assessment is carried out using images from approximately the same period every year (July, August and September), and this contributes to the difficulty in obtaining information over some areas covered by the project. INPE is searching for alternatives, one of which is the use of radar data. This data is being studied not only for deforestation assessment, but also for potential mineral prospecting purposes, water studies, and general land use.

Another problem is the difficulty in training people. Often, after training, the technicians move to another institution without ensuring the adequate transfer of technology to other people. In addition, some countries in the Pan-Amazonia project lack the hardware necessary to carry out activities in their own countries, and for those with this capability, non-standardization of a software for digital image processing is often a problem. It is important to train people for the Pan-Amazonia Project on a more permanent basis, but it is difficult to ensure funding to do this.

The Food and Agricultural Organization (FAO) is the organization responsible for worldwide

deforestation assessment. The challenge of this worldwide assessment is to compile information obtained from different methodologies in different countries. Present discussions focus on formulating one common methodology to carry out these assessments aimed at finding the precise rate of deforestation.

It is important to focus attention on the development of a geo-referenced database for deforestation assessment, which still lacks relevant information. Digital processing may provide information more quickly.

Dr. D. Rhind (UK) pointed out that not only do we need to know the sources and characteristics of raw data, but we also need the processing procedures of different partners. For example, in Europe, it was found that the greatest rate of change in many data types, e.g., in June/July mean temperatures, occurred at national boundaries. Dr. Krug agreed that it is difficult to assess the reliability of the data and, therefore, the quality of the end product.

Dr. B. Rock (GLOBE) noted that Landsat data is already digitized and did not understand why the Pan-Amazonia Project would digitize images again introduce and additional potential sources of error. Dr. Krug replied that the project uses Landsat photographs and overlays done on an annual basis for four classes: forest, non-forest, deforestation, and water bodies. After this information is available, it is digitized to assess the rate of deforestation for each year. The project is now evaluating whether the use of digital information (instead of photographic images) should be used. The results from each process (visual interpretation and digital) are presently being compared.

Dr. J. M. Scott noted that the biodiversity-oriented Geographic Analysis Program (GAP) faces the same problems in its analysis process, and so has entered into a partnership with other agencies for a joint purchase and pre-processing of Landsat images. In this way, many processing issues are common and this helps in their analysis. This same process may help the Pan-Amazonia Project. Dr. Krug thought that such partnership might help, but noted that some countries involved lack the hardware and software to support this kind of activity. The project has been trying to get countries to work with INPE for longer periods of time, but this is no easy task.

Mr. Bakkes asked if the project had looked at changing classification to facilitate the process; Dr. Krug replied that the project will study areas of secondary vegetation using orbital data at different stages. Mr. Bakkes asked if a change in classification will help the project in using different methods and speed up the process; Dr. Krug noted that some alternative must be found to speed the process of information acquisition.

(2) The Zambezi Project

Dr. T. Mpofu described the Zambezi Project.

The Zambezi River Basin is shared by eight countries: Angola, Botswana, Malawi, Mozambique, Namibia, Zambia, Zimbabwe and Tanzania (see Figure 1). The basin rises from the Kalene Hills in Zambia, flows through Angola, then back to Zambia and Zimbabwe. The Zambezi flows eastward for about 3000 km. from its source on the Central African Plateau to the Indian Ocean. Together with its tributaries, the Zambezi drains an area of about 13,000,000 km^2. The Basin is home to more than 25 million people (1987). Cooperation among the countries is essential to preserving the natural resources of the Basin.

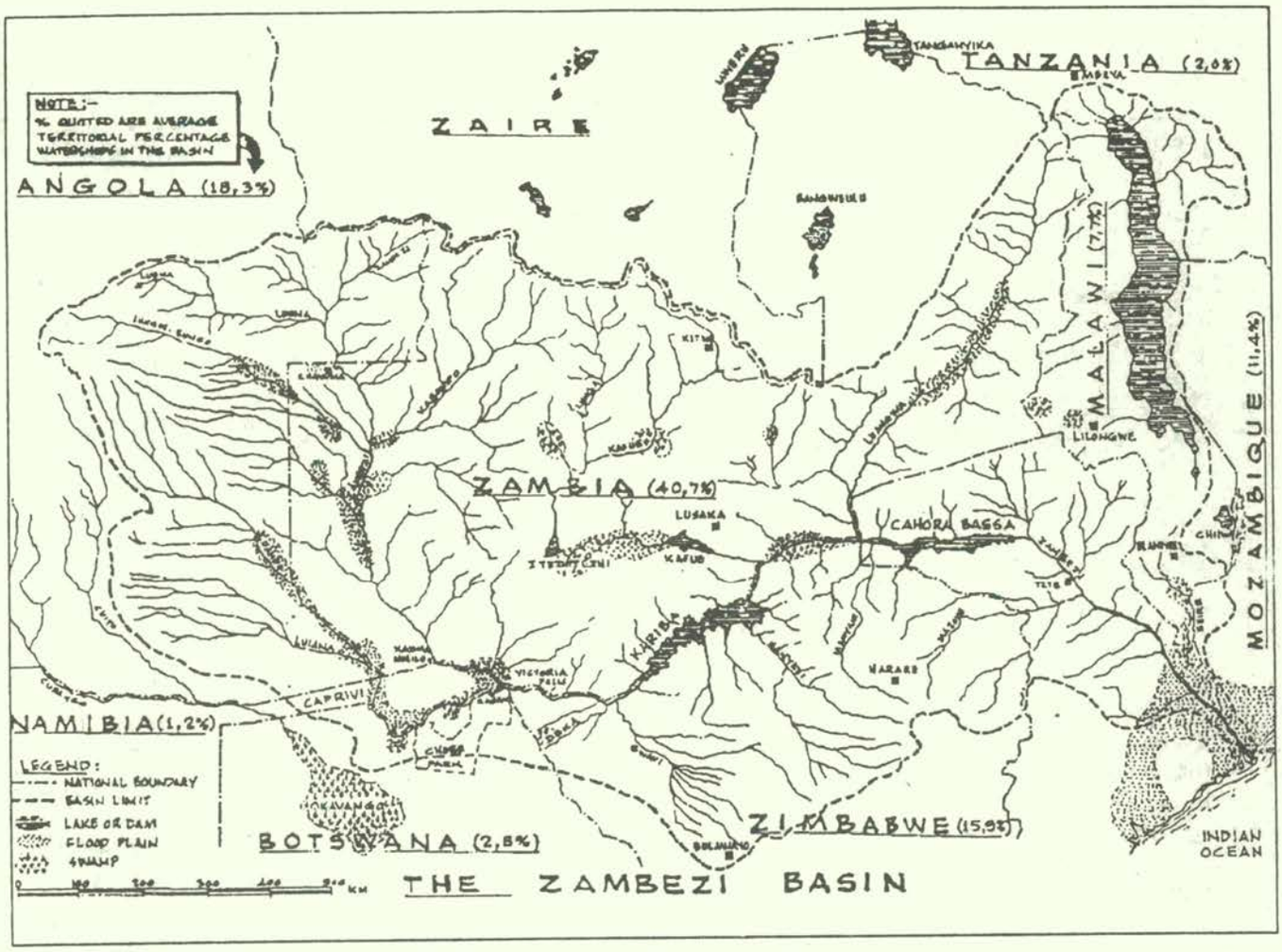

Figure 1: The Zambezi River Basin

In 1985, the countries of the region requested assistance from UNEP to facilitate regional cooperation. From this initial request grew the Environmentally Sound Management of Inland Waters (ENINWA) Programme. In support of the ENINWA Programme, a regional working group of experts undertook a diagnostic study of the needs and requirements for regional cooperation. The objectives of the study were to define specific environmental problems and their impact and to outline the required management goals, policies and activities needed to correct these problems. The group concluded that there is:

- 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;
- 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; and
- Inadequate information on the environmental impact of water resources development projects such as hydropower and irrigation schemes.

The group further concluded that there is an important need to deal with water and environmental management problems in a coherent, comprehensive and coordinated manner in order to avoid future conflicts between socioeconomic development and ecological interests. The Zambezi Action Plan (ZACPLAN) was then developed to address the inadequacies of the status quo. The plan consisted of 19 project areas, grouped into two categories, and identified as a ZACPRO 1 through 8. These projects, or recommendations, were considered to be of the first priority. Each of the major ZACPRO recommendations is described below.

- ZACPRO 1: Produce an up-to-date compilation of all completed, on-going and planned development projects in the basin;
- ZACPRO 2: Produce an up-to-date compilation of national and international laws related to the use and management of water and the environment;
- ZACPRO 3: Conduct a survey of national capacities and a means to respond to environmental problems;
- ZACPRO 4: Develop and strengthen the national research institutions and laboratories;
- ZACPRO 5: Develop a basin-wide, unified monitoring system related to water quality and quantity;
- ZACPRO 6: Develop an integrated water management plan;
- ZACPRO 7: Promote environmental education and public participation; and

- ZACPRO 8: Develop unified criteria and manuals for water engineering, planning, and design.

To further strengthen the coordination of, and commitment to, the ZACPLAN, the group also recommended certain institutional arrangements. In 1987, ZACPLAN was adopted by the Southern African Development Community (SADC) as a regional program. The Environment and Land Management Sector (ELMS) of SADC was given the responsibility of coordinating and executing ZACPLAN; SADC ELMS, in turn, formed a Water Resources Subcommittee to further support this endeavor.

Implementation of the ZACPRO recommendations has been rather slow. For instance, ZACPRO 1 and 5 have only partially achieved their objectives. ZACPRO 3, 4, 7 and 8 have not been implemented due to a lack of funding, although some of the recommendations have been covered in general terms, such as public education for the management of all natural resources (as opposed to basin-specific education programs). One success story is ZACPRO 2. With the help of UNEP, an analysis of the environment and water-related legislation has been completed and a protocol for the use of shared water resources was developed out of the analysis. In January 1995, the draft protocol will be ready for signature by the countries sharing the basin.

ZACPRO 6 is the main focus of the entire project. This recommendation was given special consideration as a database development project involving the collection, storage and retrieval of hydrometeorological and water quality data. ZACPRO 6 is being implemented in four phases or focuses: the types of data to be stored in the ZACBASE; the data series and station network requirements; the data collection and evaluation requirements; and the required computer configuration, including hardware and software. Phase I, an analysis of the types of data to be stored, will be completed by April, 1995. It is anticipated that ZACBASE will hold information on hydrology, meteorology, water quality, sedimentation, and reservoir and hydropower station characteristics.

Despite the recommendations from the study and the best efforts to implement the recommendations, gaps remain. The 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 still exists and the potential of resources to be used in the future is unknown. Due to the lack of information, the fragility of the ecosystem in the basin is largely based on estimation and guess work. For instance, the actual annual rate of deforestation is still unknown. Without information on the status of the environment, economy, and social frameworks, it is difficult to understand what limits of use are required in order to achieve sustainability.

Before any meaningful action can be undertaken, existing information networks and databases must be improved and new ones developed. Access and availability to good information varies greatly from country to country. A continuous and systematic assessment of the main factors influencing environmental quality needs to be put in place and a thorough understanding of the intricate links between development and environmental considerations should be a prerequisite if we are to achieve sustainable human development. Furthermore, capacity building in monitoring water quality should include improvement in the quality of laboratories and equipment. Sustainable development, if managed, can only be achieved on the basis of the information obtained about the aspects of human needs, ecological considerations, and economic concerns.

In response to a question from Dr. Scott, Dr. Mpofu noted that areas such as transportation, energy, irrigation, and tourism, among others, were being considered to assess their contribution

to sustainable development in the Zambezi River Basin countries. Dr. Kelleher noted that many data sets focus on water quality; however, in thin soil regions, such as Australia and the Zambezi River Basin, the critical factor is the rate of loss of soil versus the generation of soil. For instance, in Australia, the loss of soil is 10,000 times greater than the generation. This information should be a critical factor in any core data set. Dr. Mpofu responded that one-third of the Zambezi River Basin area is covered with Kalahari sands, the loss of which can be exacerbated by a lack of adequate vegetative cover. Fifty tons of soil is lost annually in some parts of Zimbabwe. This loss is definitely greater than the rate of generation. He added that it is important to the region to have information on soil loss versus generation in order to make decisions, but that there are gaps in the existing information concerning this issue.

(3) The Mekong Project

Mr. L. Nilsson described the Mekong Project.

The Mekong River is more than 4000 km in length. Its source is in Tibet and it runs through China, Laos, Thailand, Cambodia, and the delta area in Vietnam. To date, studies undertaken by the Mekong Project have focused on the lower basin.

In general, while some of the tributaries might have some minor problems, the quality of the water in the Mekong is good, and there are no severe environmental problems. Sustainable development is a possibility. However, with the strain on resources that rapid development and population growth is bringing, planning is necessary.

In the last few years, awareness of Mekong river environmental issues has increased. All the countries surrounding the Mekong are participating in river studies, and are giving administrative and financial support. There are differences, however, in these countries' individual developmental priorities and environmental concerns.

The Mekong Committee was a four-country intergovernmental organization created in 1957 by the UN to coordinate activities in the Mekong basin. The Mekong Secretariat was established in 1959. The Committee's activity plan for the region has been revised several times. Cambodia, which dropped out of the organization in 1975, rejoined in 1991. Since 1992, revision of the group's mandate has been under discussion. It is hoped that agreement will be reached soon on how to achieve sustainable use of water resources in this area in the future.

Throughout the years, a great deal of data has been collected for national as well as regional projects. The overall work being done by the Mekong Project can be illustrated by three examples of recent studies -- in hydropower, fisheries, and floods.

Hydropower studies have been a focus of the program since the 1950s. Presently, less than 20% of Mekong Project funding goes to this area of study. The total hydropower capacity of the Mekong basin's surrounding area is, at present, around 11,000 MW per year. Potential for production and consumption of hydropower varies by country. In Laos, for example, there is great potential for increased production of hydropower. In Thailand, very little potential is left. If all potential production were achieved, it would supply 60% of the area's needs by the year 2010. The mutually beneficial export of hydropower from excess to deficit countries is a possibility for the future.

The run-of-river hydropower study involved twelve cites selected from the lower Mekong basin. While these cites are certainly affected by events occurring upstream, such as the transportation of

sediments, the Mekong Project does not have specific information on these forces. There were several conclusions from this hydropower study; in general, it was found that there would be social and environmental costs from the creation of reservoirs.

Fisheries studies undertaken by the project indicate that further studies are needed to determine the impacts of Mekong River projects; however, a sound and reliable database is needed to measure these impacts.

Regarding issues of public health: while there are concerns about the existence of certain diseases in two cites chosen near Cambodia, there is still little known about the effects of water resources development on public health.

The Mekong Project has concluded that there are three areas in which needed information does not exist: fisheries, wetlands and health. In some cases, the only source of basic information for specific projects is second- and third-hand information. As a result, study conclusions are often uncertain.

Flooding is another area in which insufficient data has been a problem. Flooding, frequently of disastrous proportions, has been a serious problem in the region, harming crops and infrastructure. In 1970, the Mekong Secretariat began forecasting for early flood warnings. The most crucial element of this activity is obtaining accurate data. Current data is of a quality insufficient to allow accurate predictions. Certainly, more frequent data gathering is needed. In addition, the Project would like to obtain data from additional sources, such as China.

Overall, in terms of data needs and acquisition, the Project has found that it is unable to use much of the data acquired for a variety of reasons; e.g., lack of common formats and poor archive management. However, significant gaps in needed data do exist. The primary data sets needed relate to fisheries, health, pollution, and socioeconomic factors. Secondary data gaps were also identified in the areas of hydrometeorology, water quality, wetlands, and topographic maps.

One needed step in addressing data needs is to better link data acquisition to users. Efforts should be made to ensure that data is taken according to user needs. In addition, the quality of data must be checked regularly. Technical problems in the integration of data sets must also be considered. Other problems identified by the Project include geographic differences and short-term funding commitments.

In response to a question concerning specific work the Mekong Project may have done on coastal problems and how the Project has worked with coastal zone managers on these problems, Dr. Nilsson replied that the Mekong Project works with a variety of organizations in the region on issues related to the Mekong including mainstream and tributaries. The group has no mandate, however, related to the sea.

A member of the audience noted that the Mekong Project's activities are focused only on the lower basin. Assuming that there is a similar organization for the upper basin, how do the two organizations work together? Dr. Nilsson stated that there are informal ties between the groups. In addition, there is contact through international organizations such as UNEP.

Sympathy was expressed for the short-term funding situation of the Mekong Project (and other projects). All agreed that the situation is a difficult one, and that the ability to sustain such projects is limited.

4. ISSUES, NEEDS AND CORE DATA SETS FROM A TOPICAL PERSPECTIVE

Five topical panels were assembled to discuss critical environmental management and sustainable development issues, core data sets, and suggestions in the following five 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

Each panel consisted of three to five participants, with each providing a formal presentation. The opportunity for discussions and questions for the panel experts was also provided. Detailed summaries of these panel presentations and discussions are provided in Volume II, Appendix 6. Panel membership is detailed in the prefatory pages of this report.

In addition, each of the topical panels participated in workshops to prepare suggestions in response to the following questions:

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

The following paragraphs provide a synopsis of the outcomes of the topical panel discussions and a summary of needs and suggestions stemming from the workshops. During the topical panel discussions, two additional issues were highlighted: capacity building, education, and training; and intellectual property rights. These issues are also summarized below under the heading Other Topics (paragraph F).

A. Land Use Change and Degradation

Tropical Deforestation: Dr. Jean-Paul Malingreau (Joint Research Center, MTV, Institute for Remote Sensing Applications, Commission of European Communities) made the fundamental point that an understanding of a system of sustainable resource management requires that certain central ecological concepts first be acknowledged. Defining sustainability requires an 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, i.e., 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 are 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. Among the highest priorities are:

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

To be useful for land use and land cover analysis for sustainable development planning and management, a core data set must:

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

One fundamental point is that it is useless to evaluate maps or other geo-referenced data without careful attention to the purposes for which they will be used. See Appendix 6 for a more complete description of Dr. Malingreau's application of these principles in his work on tropical deforestation.

Desertification in the Sahel Region: Professor M. M. Sall (Department of Geography, University of Dakar) presented a description of the significance of desertification in understanding land cover change. Desertification is a very important large-scale process occurring at various rates in several areas in the world, the largest and best documented instance taking place around the southern boundary of the Sahel Desert in western and central Africa. The process of desertification in this region is influenced by a number of ecological, climatological and anthropogenic variables, including 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 large-scale human suffering. Core data sets are one of the most important tools for managing the development process in such conditions. The following is a summary of the most important core data sets for the region, along with a ranking of their quality, availability, and ease of access.

	Availability	Adequacy	Compatibility	Accessibility
Topography:				
	NS good	good	good	weak
	RS good	good	good	weak
Soils:				
	NS good	weak	good	good
	RS good	weak	good	good
Vegetation:				
	NS weak	weak	weak	good
	RS weak	weak	weak	weak
Hydrology:				
	NS good	good	good	weak
	RS good	good	good	weak
Human:				
	NS good	weak	weak	weak
	RS good	weak	weak	weak

See Appendix 6 of Volume II for a more complete description of use of data in responding to desertification in the Sahelian region.

GAP Analysis - A Strategy to Combat the Loss of Biodiversity: Dr. James M. Scott (Director, Idaho Fish and Wildlife Cooperative Unit) presented an overview of the GAP Analysis technique for preserving biodiversity. The loss of critical ecosystems and the related 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, leading to "emergency room conservation" efforts to save acutely threatened 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.

The process of GAP Analysis has been developed and implemented in the US. as a response to this costly (and, at time, ineffective) single species conservation approach. In summary, the idea is to systematically locate and map occurrences of rare, threatened or endangered species and then correlate these observations with the established preserve or management areas (and detect the spatial gaps between these two variables). Four data sets form the core data required for the Gap Analysis process. For the Gap analysis task, these data sets are compiled into the following 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 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 state-wide 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, georeferencing and compiling and documenting these data can be complex and demanding of both 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. See Appendix 6 of Volume 2 for a more complete description of the application of this technique.

Land Use/Land Cover Mapping in Uganda: Mr. Frank Turyatunga (Program Manager, National Environment Information Centre (NEIC) of Uganda) gave an overview of land use and land cover mapping in Uganda. The period of the late 1970's through 1985 was one of difficulty for Uganda, with many social institutions and governmental agencies in upheaval, including the governmental offices responsible for mapping. Since that time, the process of mapping the nation has resumed in the face of substantial difficulties. For instance, seven different mapped estimates existed for the actual size of Uganda's approximately 236,00 sq.km. area.

In the past, the Ugandan government mapped its territory at a number of scales. The following provides a brief summary of standard Uganda thematic and topographic maps in traditional use in Uganda:

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

In an effort to produce an up-to-date, national land use and land cover map for Uganda, a number of efforts have been undertaken using both in situ and remotely sensed data. Unfortunately, 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. This has reduced the usefulness of the map data for analyzing changes over time. The expense of this mapping effort was substantial for Uganda, a country dealing with other acute issues. Dedicating human, technical and financial resources to this task necessitates that sacrifices be made in other important areas. Finally (as is the case everywhere else), competition among political and economic interests had to be accommodated.

It is currently impossible for the Ugandan government to commit the money needed 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 that have been produced 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.

Minimum Core Data Sets Required: Land use change information includes both basic geophysical

measurements and higher level data products derived from other, more basic data sets, such as topography, soils type, hydrology, and vegetation indices. Meaningful information on land use change is best produced through the use of a hierarchical combination of different data sets, including both in situ and remotely-sensed geophysical and ecological measurements and socioeconomic data (such as population density, population growth rates, and land ownership) into higher-level products. Such data products are most effective and usable for both technical and policy purposes when geo-referenced and spatially displayed; however, differences in classification schemes, sampling strategies, standards, and software are significant difficulties in assembling land use information at all scales, from local to global.

Necessary core data sets and some of their potential sources for use in hierarchical analysis include the following, roughly classified according to the temporal scales on which significant changes are expected to occur:

Long-term Changes (Greater than 50 years)

Topography Data (Maps, Digital Terrain Data)

Medium-term Changes (10-20 years)

Administrative/Political Boundaries (Cadastral Maps, Digital Line Data, Digital Chart of the World)
Managed/Protected Areas (Thematic Maps, Digital Databases)
Soil (Regional/National Maps)
Land Tenure Data (Local/Regional/National Databases)
Infrastructure Data (Thematic Maps, Digital Line Data)

Short-term Changes (Less than 5 years)

Land Use/Land Cover Data (Derived data set, source data [remote sensing])
Hydrology Data (Topographic Maps, Digital Line data)
Economic Data (Census, Regional/National/International Agencies)
Demographic Data (Census, Statistical Sampling)
Natural Disaster Data (Forest Fire Maps, Seismic, Volcanological and Meteorological Data sets)

Since land cover change is a continuous process, it is necessary to update data sources on a regular basis. As regular updating of all relevant data is prohibitively expensive, a mix of monitoring with sampling and change detection strategies must be developed to allow a focus on areas where significant change is occurring, thus making the most efficient possible use of limited resources.

The inclusion of socioeconomic data in the study of land use change is fundamental. Factors such as land ownership and tenure, governmental administrative structures (parish, county, district, etc.), infrastructure patterns, and commodity prices all influence patterns and trends of human land-use, such as agriculture and mining, which are among the most important forces in land cover change. In some cases, actions by other species, both natural (elephants) and human-introduced (livestock) also have significant effects on land cover that should be measured. Land use "degradation" implies an evaluation of land cover and/or land use changes based on a specific perspective.

Data Availability: Much of the basic global-scale data (particularly data from satellite remote sensing) relevant to studies of land use are generated and updated on a regular basis in a few developed nations. Nevertheless, data production and availability varies widely by type and region, and it is often true that users cannot obtain the data they need or effectively use the data they obtain. Different users have significantly different needs in terms of resolution and timeliness of acquisition. There is potential for significant improvement in data accessibility, compatibility, and comparability through establishment of a framework approach that would permit more effective combination and use of local, national and regional scale data sets. Vast improvements in metadata, including information on formats, standards and methodologies, is required for the creation of a usable framework.

Policies and organizational mechanisms supporting the open access to environmental data are necessary for both sustainable development and environmental research; however, open data policies are not sufficient in and of themselves. In order to improve the distribution of data, more attention to finding solutions to the technical problems of data access is required.

The role of regional organizations, such as the CILSS for the Sahel region in Africa, for improving access to data and contributing to the hierarchical framework approach outlined above must be underlined. In CILSS, a national committee consisting of all relevant organizations aggregates the data from within a country, thus contributing to the consolidation and sharing of all data relevant to the issue. This national committee then contributes the data to the Institute for the Sahel, which aggregates and makes available the regional data.

Building National Capacity: The capacity for collection and analysis of the data necessary for creating usable land use information is widespread; the major problem is sustaining this capacity over the long-term. Typically, donor agency efforts have focused on short-term data collection and gathering in support of defined development projects. Donor agencies should work more effectively with national governments to ensure that investments in capacity building are maintained so as to ensure the greatest possible human and ecological return from aid expenditures. When feasible, project-level (local) data production should be undertaken in such a way as to permit data to be used in the hierarchical scaling described above, just as global and regional data production should be scalable to the National level.

Suggestions:

(1) A framework for the combination (aggregation and disaggregation) of local, national, regional and global land use data must be developed. Data standards, formats and metadata are fundamental elements of this approach.

(2) Open access to environmental data is necessary for sustainable development and environmental research; however, data policies must be accompanied by solutions to the technical problems of data accessibility. Recent technological advances negate the need for restricting certain types of data. The advantages of sharing data at the national, regional and global levels must be made more explicit. This raises critical issues of government/military security classification and commercial copyright laws limiting access to data required for increased environmental understanding and more effective management of development efforts.

B. Fresh Water and Coastal Zone Management

Water is an integrating factor between land, ocean, and atmospheric interactions, and is critical to ecologically sustainable development. Management of any resources or environment such as fresh water and coastal zone is dependent upon data and information relating to the physical, chemical and biological resource base; the relationship between people's activities and changes in the resource base and hence the production of planning scenarios; and models of future conditions. Management requires a sound database which integrates natural environmental and socioeconomic data based on appropriate spatial and temporal distributions and resolutions.

Fresh water is the fundamental resource for human development. Assessment is required of the elements of the fresh water system (e.g., hydrological cycle, supply and demand, and the impacts of human use). To quantify the components of the system, data concerning river basin characteristics, hydrology, water quality, and the socioeconomic conditions of use are all required.

There is a significant need to use the watershed concept as a basis for data acquisition and management. Three issues are of special importance: 1) watershed impacts on the aquatic ecosystems and ecosystem response; 2) development of a water resources monitoring network adequate for sound water management; and 3) acquisition of continuous, long-term data measuring both the quantity and quality of water systems. The La Plata River Basin can be used as a good example for the analysis of the needs for core data sets and international networks and cooperation.

During the last 10-15 years, a number of changes have been introduced in developed countries in water quality monitoring systems, which became more flexible, purpose-oriented and multi-compartmental. Panel participants presented examples of data collected on national (Canada, France, Russia) and international (GEMS/Water) monitoring networks and programs (NAWQA, EMAP, etc.).

To facilitate global assessments, UNEP has sponsored development of a simulation model (AQUA), based on the Pressure-State-Impact-Response model, which has specified certain data fields. Remote sensing data may have an important role in water quality assessment.

A number of problems are associated with dam construction and reservoir formation. Reservoirs can be used as representative focal points for water quality assessments in South America and other regions of the planet where there is a concentration of such artificial ecosystems.

Developing countries lack resources to conduct comprehensive, broad-scale assessments of water quality and quantity. New, less costly approaches (e.g., synoptic surveys) for data acquisition in developing countries are urgently needed.

It was recognized that recommendations on core data needs for water quality assessment and management made in recent international forums (e.g., WMO/WHO/UNEP Workshop in Bratislava, August 1991, WMO Regional Workshop in Vienna, March, 1994) should be taken into account. Figure 1 is included as an example of this type of data; Figure 2 presents a matrix of issues of environmental and management concern for 18 marine regions.

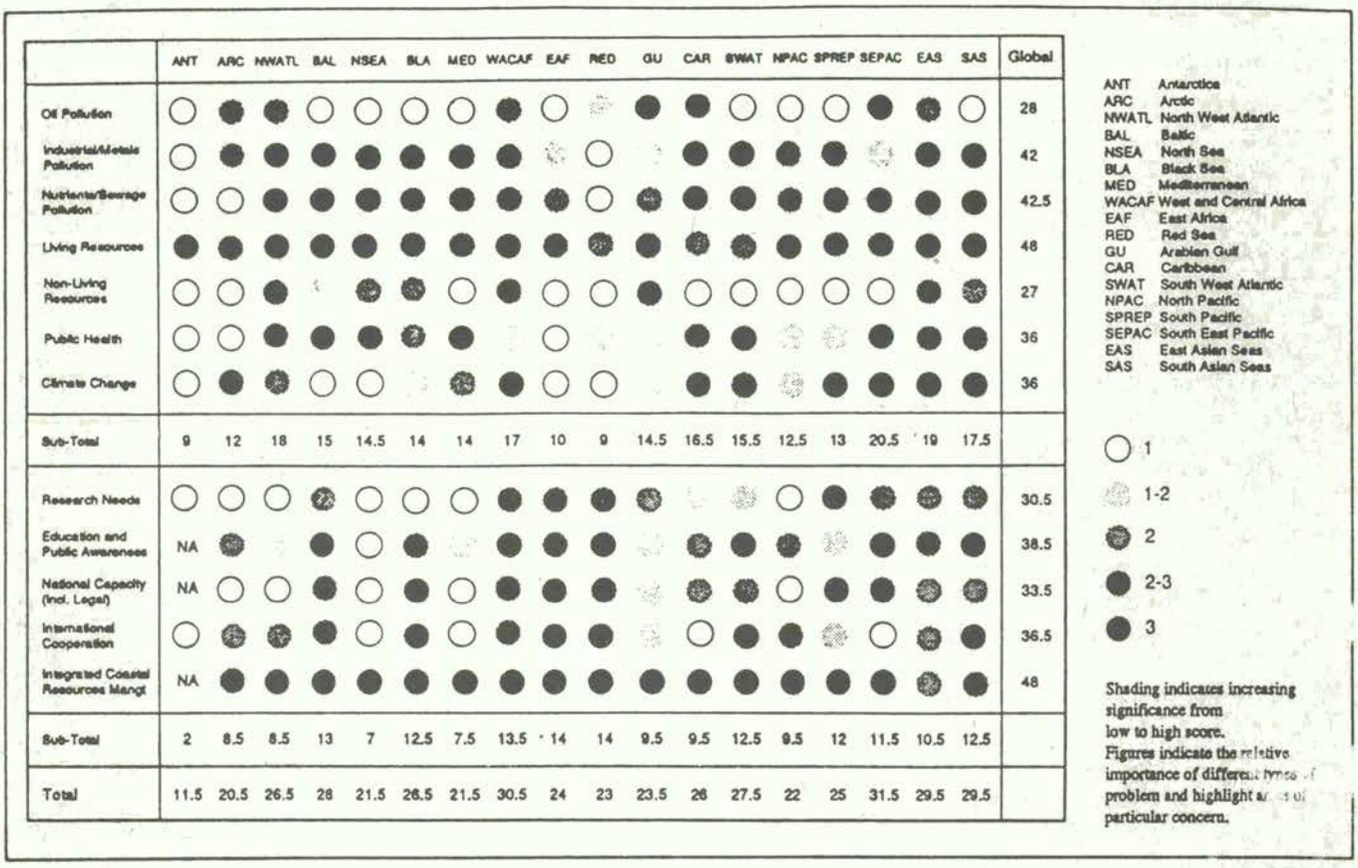

Figure 2: Principal Issues of Environmental and Management Concern for 18 Marine Regions

The coastal zone supports more than 60% of the world's human population. The problem of competition for limited resources is particularly severe in this zone, making integrated coastal zone management a necessity. Such management requires core data covering both land and sea.

The Great Barrier Reef Marine Park provides an example of a large marine ecosystem managed by a single authority that must reconcile the demands of tourism, recreation and fishing, coastal development, mariculture and the rights of indigenous people. There are some areas of inadequacy in the data available for this purpose, particularly in relation to the effects of land use and human activities occurring at a distance from the Reef itself.

SUGGESTIONS

Coastal Zones

The working group felt that the list of principal issues for each of the 18 marine regions of the world as prepared by Dr. J. Pernetta, et al, 1992, basically serves the purpose (Figure 2). The additional issues are coastal erosion and the impacts of introduced organisms.

As to the data, the most important are: river discharge (flow, sediments and dissolved matter), tides regime, and bathimetry of the first 10 meters. The set of data on land use and land cover must be extended under water.

Fresh Water

The members of the working group strongly believe that water is the most important resource for development. Because water has a powerful integrating capacity over major issues and processes, the integrated watershed management approach is the appropriate course of strategy.

Out of the multitude of water and water-related data, water quantity is of the highest priority. All other related data hinges upon water quantity data. Water quantity and quality data must go together. A short list of the main water quality parameters is: dissolved oxygen, specific conductance, pH, turbidity and temperature. The working group stressed the high value of long-term series of data. The high importance of meteorological data was also emphasized.

The working group expressed concern over the decline in development of the observational networks in LDCs, particularly in Africa.

The members of the working group considered it important to recall that water management inevitably brings a host of environmental problems that are different in different natural settings (e.g., soil salinization, erosion or eutrophication); to address them one needs specific and separate sets of data in each case.

The participants perceived a dire lack of solid information on fresh water management data, such as water withdrawal, losses of water, effluents of various kinds, water pricing, etc.

The working group members expressed their support for establishing the global monitoring systems: the Global Climate Observing System, Global Ocean Observing System, and Global Terrestrial Observing System.

C. Sustainable Use of Natural Resources

This session dealt with issues of global resource consumption, core data availability in southern Africa, and core data needs for environmental models. Natural resource management is a key global issue because of its importance in global food supplies, particularly in third world countries where subsistence agriculture and fisheries are a major input into human well being. The management of the savannas as well as the tropical rain forests are also key resources in relation to the management of global carbon and CO^2 emissions.

Many natural resource management issues, from rain forests to fisheries and the management of emissions, are either regional or global issues. In these cases, consistent core data sets are an essential requirement for effective management of the resources. The core data sets are used both for natural resource planning as well as global monitoring and education purposes and, therefore, provide for multiple benefits at the national, regional, and global levels.

Dr. Rodenburg noted that, at the global level, trends such as imbalances in consumption between north and south as well as trends in the use of fossil fuels are reasonably well documented, but information on the renewable resources such as soil, water, forests and fisheries is extremely limited. As an example of a developing portion of the world, southern Africa, although having reasonably good information on topography and climate, lacks sufficient information at the provincial level for adequate environmental assessments or sustainable development planning. This is particularly apparent at a time when most countries are reexamining their planning in response to Agenda 21, or political changes.

In the Asia and Pacific Region, significant progress has been made by UNEP, together with partners in developing a framework for the implementation of Agenda 21 and modern technologie such as GIS and remote sensing offer exciting opportunities for implementation of environmental programmes. However significant work is still needed in areas such as the coordination and harmonization of data, capacity building, and better coordination of data collection efforts within the region.

Minimum Core Data Sets:

This group approached the definition of core data needed for ensuring sustainable development through a number of stages. Those were:

(1) The definition of what areas of natural resources were to be included. These were defined as:
- Forests
- Biodiversity
- Fossil fuels
- Fisheries
- Minerals
- Grasslands/savannas
- Surface and ground water
- Soil
- Air
- Landscape (this was treated, as in the mainland Europe way, as a partly cultural concept)

(2) The definition of generic questions which decision makers might ask:
- How much of this exists?
- What is its geographical distribution?
- How is it changing over time?
- What is its current use?
- What can we do with it in a sustainable fashion?

It was recognized that a further generic question would be asked: How valuable is it? But this was not factored into the group's conclusions because the question was regarded as involving a back-end process that required prior definition of the value metric and one which might also include strategic and political judgments.

We explicitly defined the decision-makers as those working within a country, employed by national governments, and those in international aid bodies. A crucial decision made by the group was on the level of detail required for such sub-national planning. Highly generalized (and sometimes inaccurate and biased) data (represented, for example, by the Digital Chart of the World(?)) was not believed to be acceptable. In general, our requirements could best be met by data at a detail and quality analogous to 1:250,000 scale mapping.

(3) The definition of all the data needed for answering the generic questions in regard to the natural resources previously identified. This resulted in Annex A, below.

(4) The extraction from the total data list in Annex A of core data sets produced the list in Annex B.

ANNEX A

DATA CATEGORY	DATA SET	AVAIL-ABILITY	ACCESSI-BILITY	GAPS
Forests	Land cover *,#			
	Land use *,#			
	Vegetation structure *,#			
	Vegetation types *,#			
	Soil form & condition *,#			
	Rainfall *,#			
	Elevation			
	Temperature *,#			
	Productivity/dynamics *,#			
	Harvesting/use *,#			
	Population *,#			
	Pollution *,#			
	Infrastructure *,#			
	ECOLOGY OF SPECIES			

ANNEX A (Cont'd)

DATA CATEGORY	DATA SET	AVAILA-BILITY	ACCESSI-BILITY	GAPS
Biodiversity	Land cover*			
	Land use *			
	Vegetation structure *			
	Vegetation types *			
	Soil form and condition *			
	Rainfall *			
	Elevation			
	Temperature *			
	Productivity/dynamics *			
	Harvesting/use *			
	Population *			
	Pollution *			
	Infrastructure *			
	Protected areas			
	Species distribution			
	Ecology of species			
Fisheries	Pollution (nutrient, toxic..)			
	Ocean currents			
	Ocean temperature			
	Human pressures incl no. of people-technique			
	Productivity & harvesting			
	Coastal zone wetland distribution & health			
Fossil fuels	Reserves (where, how much, quality, nature)			
	Production			
	Infrastructure			
	Demand and consumption			
	Environmental consequences			
Minerals	Reserves (where, how much, quality, nature)			
	Recycling			

* These data are required over time to determine changes.
\# Changes in state data also needed.

ANNEX B

DATA CATEGORY	DATA SET (SCALE)	AVAILA-BILITY	ACCESSI-BILITY	BARRIERS	GAPS
Land Cover*	1:250,000			Incompatibilities between existing data sets in collection methodology and classifications. Cost of production. No official organization charged with collecting it in many countries.	
Land Use*	1:250,000	1	1	Same as those of land cover	
Vegetation*	1:250,000	1-3	3		
Geology*	1:250,000	2	3-4	Private data sets already exist which are in some respects better than the public domain ones.	
Soil*	1:250,000	1-2	2-3	Soter project is having great problems creating them at 1:1 million scale	
Topography*	1:50,000	3	>2-5	Security considerations constrain ready availability of this in many countries.	KNOWN
Climate/weather *	1 KM Resolution	2-3	5	Few at this detail?	
Population*	Admin districts	3-4	3-4	For many areas these data are relatively inaccurate and/or out of date. The geographical resolution of migration data is typically much coarser. Inaccuracy. Migration	Coarse Resolution
Hydrology*	1:250,000	1-4	3		
Physical Infrastructure *	1:50,000	3	2		

SCALE: 0 = bad; 5 = perfect

* These data are required over time to determine changes.

Based upon discussion, the following suggestions were put forth:

(1) The barriers to creating the core data sets are institutional, financial and policy-related (e.g., leading to the need for different classifications in existing land use data sets in different countries) as well as technical. Our planning must take cognizance of that.

(2) Relatively high-resolution data is required in our scenario of data use. Relatively-low resolution data may be worse than useless because of errors propagated (e.g., from linking together data generalized by different methods).

(3) The meteorological model may be an appropriate one for building global data sets to

common specifications and for creating capacity in different countries across the globe. We commend it on this basis but are aware that it will be less easy to make work where official agencies with responsibility for creating national versions of the data (e.g., land use, land cover) do not exist and where there is little or no obvious incentive to collaborate internationally and expend scarce national resources (e.g., in the case of soils?).

(4) If these data sets are to be realized, it is essential that the UN agencies use all possible leverage with national governments to devote any additional funding required to harmonize and integrate their data.

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

There were four presentations in the session on human health, pollution, hazardous waste management, and natural and environmental disasters. The focus was largely on case studies - in Eastern Europe, Mexico and India - and the recent WHO initiative on integrating health and environment concerns in national planning for sustainable development (now involving 12 countries). The GLOBE (Global Learning and Observations to Benefit the Environment) Program, an international environmental education initiative proposed by Vice President Gore of the United States, was also outlined. This is seen as an important way of improving environmental awareness, and includes the collection of scientific data by pre-college students which could contribute significant core ground truth measurements in support of environmental and global change research activities.

The availability of high-quality data greatly affects the quality of research. 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 United Nations Economic Commission for Europe (UNECE). Landsat Thematic Mapper (TM) data coupled with detailed forest stand ground truth data, have been extremely useful in mapping forest damage due to air pollution and loss in the Czech Republic, Poland and the former East Germany. This spectral coverage (extending into the short wave length infrared) provided by TM has proven to be of great value in the detection and quantification of forest damage and decline. Using these core data sets, the loss of 52% of forest cover present in 1972 was documented by 1989 for the Krusne Hory region of the Czech Republic.

The future of the Landsat program is still in doubt, causing major difficulties to scientists dependent upon the data. In various parts of the world, there is no extensive spatial coverage, because of cloud cover, lack of ground receiving stations, or military prohibitions. Although the aging Landsat TM sensors will be replaced by future systems (the Indian Remote Sensing - IRS system), issues of lack of data continuity due to different spectral band combinations and spatial resolutions will limit their usefulness as a means of monitoring forest conditions. Another challenge facing scientists is the increasing costs of data; as a result, access to Landsat TM data is becoming a major limitation to carrying out environmental research, and future access to a major source of land cover information is in jeopardy.

Human health is difficult to assess. Although there are different definitions of health, a working definition could be the absence of disease. The type and prevalence of diseases differ between industrialized and developing countries. The need for timely, useful data is more acute in the second group, where infectious diseases require more frequent and fresh data for their control. Remote Sensing (RS) and Geographic Information System (GIS) technology, based on landscape epidemiology, could provide these.

Two examples -- the study of sleeping sickness and its vectors in Central Africa in relations to vegetation variation, and the prediction of malaria vector abundance in villages of Southern Mexico by estimation of land use coverage around these villages -- warrant further studies to show the potential use of RS and GIS technology in these areas.

The availability of core data can help reduce or eliminate mosquitoes (Anopheles minimus) and the diseases they transmit. For example, the capital of India was to be established in Delhi in 1917. The site selected was in north Delhi, a low-lying, water bogged area. The Director of the Malaria Institute of India rejected the site and suggested constructing the new capital in Raisina Ridge, an area well drained for up to 5 miles. At that time, core data on the topography and dynamics of malaria transmission was available and applied in the selection of the site for Delhi. Core data on the drainage cuts and seepage during the Sarda Canal construction in Nainital district (UP) in late 1930s was used to prevent mosquito breeding. Similarly, in 1939, core data on drainage and dispersal of mosquitoes was applied to establish malaria-free zones and roads during the second world war in the worst areas of malaria transmission among the jungles of Assam. DDT spraying in the 1940s for the control of malaria changed this scenario. Core data is available and can be generated and applied to prevent mosquito breeding, but political and economic considerations and the lack of understanding about the transmission of malaria have resulted in some societies ignoring the application of core data in regard to mosquitogenic and malariogenic conditions, resulting in the spread of malaria and other vector-borne diseases on a sustained basis. There a innumerable examples in India of enhanced receptivity to malaria in the irrigation and industrial projects, agriculture, forestry, urbanization and other developmental activities.

Some existing environmental health data sets are available, including the WHO/UNEP Global Environmental Monitoring Programme (GEMS). GEMS consists of four component monitoring activities -- GEMS Air, GEMS Water, GEMS Food, and GEMS HEAL (Human Exposure Assessment Location) -- that examine total human exposures to environmental contaminants. GEMS has operated in many countries for some years, and has produced useful data on existing environments in those countries. All four of the components of GEMS have recently been analyzed, and extensions/improvements to them have been suggested. Appropriate quality assurance procedures for the data is a matter requiring special attention.

In general, however, the availability of good environmental health data sets is sparse. Although case studies are useful, it is difficult to aggregate the situation to a global scale. In many parts of the world, the prevalence of diseases related to environmental degradation is not well known, both in terms of the incidence and distribution. A methodology for linking health and environment data to better understand the health effects of environmental pollution is required.

A particular need is the production of core environmental health data sets for use in economic development, environmental planning and resource management; this includes environmental health impact assessment. It must be recognized that sustainable development is a multi-disciplinary topic, and includes health concerns. Table x summarizes the important core data sets and provides the working group's overall assessment of the status of the data (1=poor; 5=very good). Factors incorporated into rankings by participants: include both the availability and accessibility of these data sets.

CORE DATA SETS	RANKINGS
Human Health	
1. Population Parameters / Demographics	4
2. Disease Prevalence	1-5
3. Primary Health Care Coverage:	
Health services: Institutional and Private	4
Traditional	2
4. Disease control activities	4
5. Health Planning/Geography (environmental characteristics)	2-4
Pollution	
1. Population Parameters/Demographics	4
2. Prevalence of Pollution-Related Diseases	2
3. Environmental Monitoring Data and laws	1-5
4. Land use/land cover	2-4
5. Economic Component/Energy Activity: Industry/Transportation	2-4
6. Pesticides/toxic/chemical contaminants	2-4
Waste	
1. Population Parameters/Demographics	4
2. Per-capita waste production	2
3. Treatment/Reuse/Recycling	4-5
4. Prevalence of Waste-Related Diseases	2
5. Land use/Land Cover	2-4
Natural/Environmental Disasters	
1. Population Parameters/Demographics	4
2. Geo attributes including land use/land cover/prevalence and propensity	2-4
3. Preparedness, including health-related preparedness and education	1-4
4. Communication/transportation warning and response infrastructure	1-5
5. Health Data sets: --Post Disaster	4
--"Real-time Monitoring"	1-2

E. Food and Energy for an Increasing Population

The group felt that any set of core data must be viewed in the context of the users' need for the data; therefore, the group identified the possible policy objectives for pursuance of which the data set may be used, and thereafter set upon the task of listing the data requirements for environmental assessment and sustainable development with reference to such policy objectives.

Food: An expanding population requires an expanding food supply, though this requirement may vary from region to region and from country to country. As land stock is limited, it is necessary to improve productivity through more intensive cultivation in order to expand food supplies. This, in turn, involves the issue of sustainability of food production at high levels for any length of time.

Viewed against this, the possible policy objectives for which the data set may be required are:

(1) Land Use Planning, both at the local and national level;
(2) Food Production Management and Planning;
(3) Scope of agricultural commodity exports/imports with concomitant international implications; and
(4) Technological development and planning.

The data set that is necessary against each of this broad group of policy requirements has been listed. Some of the items listed will overlap with listings by other groups, but this is unavoidable when constructing a set of data requirements for pursuing a policy objective.

For Land Use Planning, agroclimatic zone data, in detail, is necessary. While data from the topographic maps would be extremely useful, the changes that have taken place in availability and use pattern of land over time would be essential for assessing of the situation and framing action.

In respect to Food Production Management and Planning, a host of data ranging from population dynamics through agricultural statistics to food balance and consumption pattern is required. As management of food production for an expanding population will be a key task for the world community, both spatial and temporal data, in detail, is necessary to help the managers and planners.

The policy objective of Scope of Agricultural Commodity Exports/Imports will require data relating to global food balance and global trade, information relating to markets and other allied items. Both agricultural commodity exports and imports form an important part of international trade and the data set could aim at bringing out implications in this regard.

Regarding Technology Development and Transfer, data requirements relate to cultivars availability/livestock breeds, irrigation technology, use of agrochemicals and biomass and agricultural implements for food production and food processing. Technology will play a very important role in augmenting food supply for an expanding population.

The questions relating to availability, adequacy, accessibility, capacity building, etc. were discussed in the Group. It was felt that availability and adequacy of data vary greatly from country to country and from item to item within a country. The barriers include high cost, classification of information, level of training and literacy. Facilitation, training and fund are necessary to fill the current gaps. To build national and international capacity, it is imperative that full and frequent exchanges of data take place.

Energy: The policy objectives for which a core data set may be relevant are:

(1) Optimum exploitation of domestic energy resources;
(2) Efficient use of energy;
(3) Adequate availability of energy; and
(4) Environment friendly supply and use of energy.

The first objective will require detailed resource inventory for energy resources, including renewable energy technologies and biomass. Detailed production statistics for each form of energy be required.

The data set for efficient use of energy will include current conversion efficiency and specific

energy consumption in the production and use of energy. A cross-section data in this regard will help determine the present level of efficiency and give an indication about areas in which new initiatives are possible. The cost of production and supply of energy will also be relevant.

Adequate availability of energy for all economic activities will require data relating to consumption, demand-supply balance and transportation/transmission network.

Regarding an environment-friendly supply and use of energy, this data set can aim at bringing out the impact of energy production and use on land (agriculture), air, water and health. The emission factors and the effluent discharge levels will be necessary in this context. As use of energy is one of the most important factors causing environmental problems, a data set bringing out these implications will be extremely important.

Regarding other questions relating to availability, etc., basic data about resources, production, consumption, transportation/transmission network, prices, etc. are available and accessible; however, sometimes basin information is classified. Not fully available now are efficiency and environment coefficients. Reliable data about use-pattern of biomass is also unavailable. Some sample surveys may be necessary in these regards to obtain accurate information. As for food, full and frequent exchanges of data are necessary to help build national and international capacity.

A list of specific core data requirements under each set of policy objectives for Food and Energy is provided below.

Food:

Policy Requirements:

Expanding population needs an expanding food supply. As land stock is limited, more intensive cultivation is needed. The policy requirements are:

1. Land use planning (local/national);
2. Food production management and planning (national);
3. Scope of agricultural/commodity exports/imports (international); and
4. Technology development and planning.

Minimum Core Data Sets:

1. Land Use Planning
   - Agroclimatic zone data - crop patterns, soil, rainfall, terrain, etc.
   - Topographic map data
   - Land use change data

2. Food Production Management And Planning
   - Population data (growth rate; immigration/emigration; internal movements and displacements)
   - Marketing infrastructure statistics (# miles of highway, railroads, etc.)
   - Agriculture statistics (area/crop patterns); livestock/fisheries/forests
   - Food balance (production/consumption/export/import)
   - Per-capita consumption of different food items (e.g., cereals, meats, vegetables, etc.) - Nutritional status data

3. Scope of Agricultural Commodity Exports/Imports and International and National Food/Trade Policies
   - Crop yield production data
   - Consumption data
   - Market information data (price/futures/shipping costs)
   - Global food balance

4. Technology Development and Transfer
   - Cultivar availability/livestock breeds
   - Irrigation technology by type and area (potential)
   - Per-hectare use of agrochemicals by type
   - Biomass availability and use
   - Agricultural implements for production and processing

Data Availability: Availability of data varies from country to country.

Data Accessibility: Limited.

Barriers to Data Availability and Accessibility: Cost prohibitions, classified information, lack of trained staff, format, and literacy level.

Gaps in Data: Resolution of data, frequency of data collection, and quality of data.

What is Needed to Fill the Gaps: Facilitation, training and money.

Building National and International Capacity: Build up the Internet (better communication) and free exchange of data.

Energy:

Policy Requirements:

1. Exploitation of Energy Resources (maximum possible production of energy from domestic resources)
2. Efficient Use of Energy
3. Adequate Availability for All Economic Activities
4. Environment-friendly Supply and Use of Energy

Minimum Core Data Sets:

1. Exploitation of Energy Resources (maximum possible production of energy from domestic resources)
   - Resource Inventory (fossil fuels, hydropower, nuclear, wind, oceans, biomass, etc.)
   - Production Statistics

2. Efficient Use of Energy
   - Conversion Efficiency
   - Specific Energy Consumption
     - Transport
     - Agriculture

- Industry
- Domestic

- Cost

3. Adequate Availability for All Economic Activities
   - Per capita energy consumption by type
   - Sectoral availability
   - Energy demand/supply balance
   - Transportation/transmission and energy distribution networks
   - Unit cost of supply by type

4. Environment-friendly supply and use of energy
   - Emission factors for production and use of energy
   - Effluent discharge
   - Radiation levels
   - Global carbon balance
   - Impact on land, health, air and water

F. Other Issues

During the topical panel discussions, two additional issues were highlighted: capacity building, education and training; and intellectual property rights. These issues are discussed in the following paragraphs.

(1) Capacity Building, Education and Training

Dr. Rock, of the GLOBE Program, drew attention to the importance of capacity building, education, and training, areas of need that span each of the topics addressed. The technical and multi-faceted nature of environmental data sets require that potential users of these data be well informed about the significance of the issues and the use of the products. In many cases, the use community can benefit directly from access to an appropriate infrastructure (hardware/software) that allows analysis of the data and interpretation of products such as environmental assessments and proposed sustainable development strategies. The effective use of both data sets and infrastructure will require a significant effort in the areas of capacity building, education, and technical training and support.

A strong education component must be developed, one that not only raises environmental awareness in the user community, but also provides technical training in the use of appropriate hardware and software systems that allow the users to compile and maintain data (data entry and management), analyze data (statistical analysis), and display data in graphic forms (data processing and visualization). Through such capacity building/educational activities, core data sets can be converted by the user into meaningful products essential for policy formulation and decision making. The use of a coordinated, multinational approach to transboundary problems, joint data purchases, harmonized data analysis and display methods, and uniform interpretation of the results will facilitate a cost-effective information exchange and dissemination among participating countries.

Access to critically needed core ground truth data sets (meteorological parameters such as temperature, precipitation, wind speed and wind direction; water quality and quantity; and land

cover/land use parameters such as biomass, biodiversity and seasonal patterns of change) are not currently provided in many countries of the world. A coordinated environmental education program, designed to train teachers and their students to gather appropriate core data sets, using calibrated equipment, standard protocols, at predetermined times, could be developed to address this gap in the availability to such data sets. With the proper educational materials and training programs, pre-college students from around the world could provide the global change/environmental research community with meaningful core data available from no other source.

(2) Intellectual Property Rights

Dr. Rhind identified intellectual property rights as an important cross-cutting issue with respect to data availability and use. He noted that the traditional Western approach to science has been based on the publication of research results and dissemination at minimal or no cost of scientific data. In addition, governments have committed themselves to various treaties and protocols, the ends of which, at least implicitly, can only be achieved through international data sharing. Agenda 21 is one such example.

In recent years, however, a growing number of nations have begun to treat data collected by the nation-state as a type of commodity to be bought, sold and traded; intensifying international competition has fostered this view. The mechanism by which this trade is facilitated is through the intellectual property rights held by the data owner. These rights vary greatly from nation to nation, especially where environmental data, held in computer form, are concerned. As a result, there is growing tension between the free availability of data for scientific and international development purposes and real or potential national economic gain. Specific examples include growing international disagreement about charging for meteorological, topographic and hydrographic data, and for certain types of satellite imagery.

This situation is likely to be an important constraint on any programme that assembles from existing sources the core data needed to support environmental assessment and sustainable development strategies. These constraints will differ greatly in different parts of the world, for different core data sets and at different geographical resolutions, but solving this problem is a political, not a technical, matter and one in which the UN must play a key role.

5. ISSUES, NEEDS, AND CORE DATA SETS FROM A REGIONAL PERSPECTIVE

Working groups of participants organized by region met to discuss core data needs and priorities. At the end of this session, each regional working group presented a list of identified, prioritized data needs to the full symposium. The prioritized data needs were then aggregated to identify common, cross-cutting data sets, as described in paragraph G below.

A. Latin America

The group began discussions by characterizing some of the general features of the region (Latin America) that were common to most countries, some of which are: (1) the existence of only two languages (Portuguese and Spanish) despite its vast geographical area; (2) the similarity of cultural backgrounds (Iberic colonization); and (3) the sharing of large river systems, such as the Orinoco, Amazon, and Paraná. The discussions then progressed to the core data needs issue. Initially, some time was devoted to a general overview of the common problems shared by most (if not all) Latin American countries, which were identified as the following: biodiversity, population, health, economy, land use/land cover, and urbanization. Other problems emerged during the discussions, such as the trend to economic integration in the region (Nafta, Mercosul) and several common social problems related to environment and development (poverty, health, migration, job opportunities, education, income).

The discussion made it obvious that Latin America still has areas of very high biodiversity and areas of very low diversity. For example, countries such as Costa Rica are realizing the economic and social value of biodiversity.

Later in the discussion, the term "economy" was changed to "economic integration region". These common markets will have a great impact in the region (environmental impact, development, social problems).

Considerable discussion time was dedicated to the problem of land use/land cover, these being fundamental problems and priority issues for the entire group. Vast areas of Latin America have vast areas with good natural vegetation cover; on the other hand, large areas are completely depleted of natural vegetation, being intensively used for agricultural activities and large-scale urban areas. In addition, inadequate land use is creating several environmental problems with impacts on surface and ground water quality. Soil losses and soil toxicity are two important problems from a qualitative, as well as a quantitative, point of view.

Issues of health, education and job opportunities were all merged into one larger issue termed "human resources," because Latin America has to cope with the increasing demands of population growth, economic changes and rising levels of poverty.

When considering the availability and reliability of data, the group concluded that the issues of population and economy may be better off because statistics are routinely compiled by different countries, while for most of the other issues, the data are scattered, scanty, or simply non-existent.

Core issues and data sets for the Latin American region were identified as follows:

(1) Biodiversity
- Population Density Impacts
- Land Use/Land Cover
- Deforestation
- Water Supply
- Species Value

(2) Water Resources (Fresh/Marine)
- Hydrology
- Deforestation
- Water Quality
- Surface / Ground Water
- Land Use/ Land Cover
- Population (Density)
- Waste Disposal
- Biomass
- Eutrophication

(3) Population Dynamics
- Migration
- Birth/Mortality
- Age/Sex Distribution
- Geographic Distribution

(4) Global Change
- Deforestation
- Biomass
- Biodiversity
- Hydrology
- Climate
- Pollution
- Land Use/ Land Cover
- Human Health
- Ecosystem Health
- Wildlife Health

(5) Land Degradation
- Land Cover/Land Use
- Population
- Soils
- Productivity
- Hydrology
- Deforestation
- Climate
- Pollution

(6) Human Resources
- Health
- Education
- Income Equity
- Opportunities
- Population

(7) Pollution And Contamination
- Population
- Land Use/Land Cover
- Industry
- Transportation Waste Disposal
- Pesticide Use Soils

(8) Economic Integration
- Population
- Human Resources
- Financial Resources
- Trade

8 Issues; 29 Individual Data Sets

Core Data Sets:
- Land Use/Land Cover (5)
- Population (4)
- Deforestation (4)
- Pollution (4)
- Climate (3)
- Soils (3)
- Hydrology (3)

B. Asia and the Pacific

The group from the Asia and the Pacific Region discussed at length the characteristics, major issues, and core data needs of the region. The points below represent the major points discussed:

(1) The region consists of 31 million square kilometers, comprising 23 percent of the Earth's land mass and about 800 million below the poverty level out of a total of 56 percent of the world population;

(2) The region has diverse cultures and traditions. The member countries vary from small island states to large country continents;

(3) The region's countries range from industrialized to some of the World's poorest nations. The region is experiencing rapid economic growth;

(4) Small island states in the region should be considered separately with regard to issues as well as data needs; and

(5) Agriculture, health (including communicable diseases), and poverty are the issues discussed.

Environmental Issues of the Region: The group considered the major issues compiled and circulated by the Chair. The group decided to prioritize the high number of issues in the region to six. The group agreed to advance the following six issues: natural disasters; deforestation; desertification; inland/marine water pollution and availability; urbanization; and population dynamics.

Core Data Needs: The group considered at length the many data variables that will be needed to address the major issues identified above and decided upon the following as the basic core data needs of the region: basic data from topographical maps, land use/land cover/vegetation, hydrology, political boundaries, and population including data on economy.

The group agreed that the above data should be available in digital form, and that it would be desirable to have time series data looking as far back in time as possible.

C. Africa

Africa is a diverse region, ranging from conflict-stricken, poorly-developed economies to more rapidly growing and stable economies; however, in discussion, we found remarkable similarities among the priority issues faced by the countries in the region. In war-torn areas such as Angola, Rwanda and Somalia, peace and national reconstruction are obviously the highest priority issues. The issue of diseases which have a major impact in the region, such as AIDS, malaria and cholera, were included under the heading of socioeconomic development.

The importance of the three pillars of sustainable development (social, economic, and ecological), were hotly debated. It was agreed that all three were interdependent and important. In discussion regarding data availability, it was felt that in a number of countries, data regarding the country was more freely available elsewhere (such as in New York, Washington, and London) than in the countries themselves. This was a matter for concern and should be considered when addressing the issue of data availability as well as capacity building in those countries.

It was felt that the group had not been able to adequately sell the benefits arising from the use of core data to governments and communities; as a result, many of the data collection and management projects are still funded from donor funds. The issue of sustaining these operations is, therefore, a matter of great concern.

Another concern is data accuracy. Although population data is generally freely available for most countries, there are often more than one set of conflicting estimates and, in some cases, estimates are known to be up to 300% out.

The success of regional exercises involving the coordination and use of data from a number of countries was illustrated by the work being done by IGADD, in which data from a number of countries is used successfully for drought monitoring and food security planning, and is readily available for other uses.

One of the key issues identified is the capacity of the natural resources. First, this involves the state of the environment, such as the area and condition of the forest and water resources. Second, this refers to the carrying capacity or capacity of the environment to assimilate certain pollutants (such as the critical loads approach in relation to air pollution) and includes issues of stability and resilience of resources in relation to disturbance or use.

Major Issues: In a brainstorming session, the following issues were identified:

(1) Providing for basic human needs, including housing, health needs and food;
(2) Poverty;
(3) Social and economic development
    - Sustainable use of natural resources
    - Improvement of human welfare (i.e., health, water, food, sanitation, settlements);
(4) Communication, transportation;
(5) Capacity of resources - what is the capacity of the environment to produce (could include the state of environment)?
(6) Toxic Waste;
(7) Social conflicts/conflict resolution;
(8) Drought and desertification, famine;
(9) Refugees;
(10) Population Growth;
(11) Disease (i.e., malaria, AIDS, etc.); and
(12) Debt burden.

Priority Issues: The major issues were grouped into broader categories and prioritized as follows:

(1) Social and economic development (includes poverty)
    - Sustainable use of natural resources
    - Sustainable economic development
    - Improvement of human welfare (i.e., health, water, food, sanitation, settlements, managing population growth);
(2) Capacity of resources - what is the capacity of the environment to produce (could include state of environment)?;
(3) Debt burden;
(4) Drought and desertification, famine;
(5) Social Conflicts-conflict resolution;

(6) Communication, transportation;
(7) Refugees; and
(8) Toxic Waste.

Availability of Core Data: The status of core data was rated on a scale of 1 (low) to 5 (high) for the high priority data sets as follows:

ISSUES	CORE DATA			
	Exist	Accessibility	Accuracy	Up to Date
Social and Economic Development	3	3	3	4
Knowledge About Capacity of Resources	3	3	1	2
Debt Burden	5	5	5	5
Drought, Famine, Desertification	2	4	2	3

D. Middle East, Eastern Europe, and Former Soviet Union

During deliberations, the regional panel on the Middle East, Eastern Europe, and the Former Soviet Union (FSU) decided that the countries of the Middle East face issues and possess needs very different from the countries of Eastern Europe and the FSU. For this reason, the panel assumed a dual perspective, giving separate attention to the Middle East, and Eastern Europe/the FSU.

(1) Middle East

In the wake of peace efforts and reconciliation taking place in the Middle East, countries of the area will have to re-shape their development plans and accommodate themselves for the new era which is expected to entail better living standards and new resource allocations. Long periods of war , hostilities, animosities, and military expenditures hampered the economic and social process in most of these countries, not excluding adverse environmental conditions. In preparation of building a new Middle East with all the reforms it entails, many core data sets will be required to sustain future development plans.

Yet, it is only natural to start tackling the most immediate and pressing issues that can foster economic and social reforms, paying special attention to environmental preservation and resources conservation. Although most of these countries share many common features, including topography, climate, culture and history, they also face common problems, such as water shortages, desertification, unemployment, health, and the lack of financial resources. Hence, a regional approach to solving many of these outstanding issues must be emphasized.

(2) Eastern Europe and Former Soviet Union

This territory (Russia, the Ukraine, Belarus, the Baltic States, Poland, the Czech Republic, Slovakia, Bulgaria, Hungary and Romania) has many environmental problems in common, most

of which are traceable to the previous political regime. The southern, new states of the Former Soviet Union (FSU) are border cases, their problems stemming from both the previous political situation and their geographic location. The latter states have a number of environmental problems (e.g., water availability) in common with Middle Eastern countries.

The main environmental problems have been clustered in large groups consisting, in turn, of specific problems . The main clusters are:

(a) Pollution of the environment;
(b) Problems of natural resources use;
(c) Problems related to water resources management; and
(d) The worldwide importance of the environmental problems due to the sheer size of the territory.

The data on air, water, and soils pollution are available; the monitoring systems work. However, the monitoring systems are currently in serious need of maintenance .

The data sets on industrial wastes and radioactive contamination are incomplete and need improvement.

There are no coordinated data sets on renewable natural resources. There is an urgent need to establish a unified format and approach on the basis of which one could put together partially existing sectoral data sets (e.g., forests, soils, etc.).

There are no data sets on water resources management, and this hinders the efficiency of water management.

Minimum Core Data Sets: The main environmental problems, clustered into large groups, are:

(1) Pollution of the environment:
- Air
- Water
- Soils
- Industrial wastes
- Radioactive contamination

(2) Inefficient use of natural resources:
- Soils and land
- Forest
- Fisheries
- Oil and gas

(3) Problems related to water resources management:
- Inefficient use of water resources
- Irrigation-related problems (salinization of soils, water-logging, etc.)
- Water reservoirs
- Special case of catastrophic dimension - the Aral Sea and its Basin

(4) The world-wide significance of the environmental problems in the FSU and Eastern Europe due to the size of the territory.

E. Western Europe and North America

Taken as a region, North America and Western Europe include the most technologically advanced and highly educated societies. The quality of life is high, as are for expectations for future generations to enjoy the same quality of life. A low birth rate, advanced environmental legislation and enforcement, and a vocal population characterize these societies where an individual's health is controlled to a large extent by age and lifestyle rather than environmental pollution.

While clean air and water are important expectations/rights in an advanced society, these issues are generally under control. Higher priority issues include energy supply/use/consumption and their resulting by-products, such as greenhouse gases; waste management; agricultural problems including soil loss, soil, ground water and surface water degradation; and water management issues. Water quantity is a highly charged issue in areas in the southwestern United States. Habitat loss and biodiversity have become rallying points for environmentalists. Species loss, particularly endangered species, has successfully been used to halt development or further habitat destruction.

Management of our energy resources, waste streams, agricultural lands, and habitats depends on timely and accurate monitoring and spatial data. We need monitoring data for air and water pollutants to describe current conditions and trends; and current topographic/hydrographic maps as well as land cover/land use and soils maps to make land management and planning decisions. We need to know energy sources and sinks, emission coefficients, as well as consumption and production statistics to provide for currents and future energy needs of an industrialized society.

In general, most of the above databases are available, although they may be inadequate when applied to specific purposes. Long-term databases are "spotty," because the environmental priorities are constantly shifting and monitoring networks are costly. Accessibility to data also is another function of national policy. Satellite data is becoming increasingly important, but its associated costs for processing, hardware, and training requirements have limited its accessibility.

Key Issues:

(1) Waste management (large amount of waste generated)
(2) Energy supply/consumption (large energy consumption)
(3) Agricultural problems
(4) High expectations/awareness (created high expectations, now must answer questions)
(5) Donor status (need information to set priorities)
(6) Preservation of quality of life (employment, etc.)

Key Data Sets:

(1) Topography and hydrography
(2) Hydrology and meteorology
(3) Land cover/use and soils (political, administrative)
(4) Boundaries and owners
(5) Demography (includes amount, age, sex, health, etc.)
(6) Transportation and Communication (infrastructure)
(7) Energy production/consumption
(8) Species (selected, not sure what type of information needed)

(9) State of environment parameters (water, air quality, etc.)

Data Constraints:

(1) Data exists everywhere (not perfect or complete, but adequate)
(2) Adequacy depends on purpose
(3) Long term databases are "spotty" (need long term databases)
(4) Worst data - waste information and fisheries statistics
(5.) Access to data varies by policy (depends partly on who you are and how much you can pay, as well as variations in policy)

(Cost was omitted from the data needs here because this working group felt that this region does not have a significant spatial dimension.)

F. Common Regional Issues, Needs, and Core Data Sets

Dr. Rhind interpreted the results of the regional panels and presented a preliminary aggregation of priority regional issues and common core data sets needed (Tables I, II and III). He observed that the regional perspective ignores the global commons (e.g., the oceans and poles). He noted that the initial analysis revealed that the outcomes of the regional panels' deliberations reflected, to an extent, the background of the people present in the group and how each group interpreted the instructions that were to guide their deliberations. He also observed that: in general, regional problems and information needs are often regarded as more important than global data; the results indicated that economic, demographic, and social data are vitally important to environmental assessments and sustainable development; high-quality data is vital; and finally, although time-series data was considered very important, it rarely exists. He added that there appeared to be a need for geographically-detailed data, for national planning and aid-to-development projects, that there are unlikely sources of data (e.g., the military), and that national variations in data ownership policies were barriers to assembling wide-area databases. He concluded that there were multiple and diverse regional policy needs and that it was very difficult to match those needs with available data.

There was extended discussion of Dr. Rhind's initial analysis and it was agreed that it would be refined and further aggregated during the next day and a half of the symposium to arrive at cross-cutting issues and core data needs. Tabular summaries of Dr. Rhind's analysis follow.

TABLE I

COMMON MAJOR ISSUES

ISSUES	NA/W.EUR	ME/E. EUR	AFRICA	ASIA/PAC	L. AMER.
Social and economic development (including poverty relief)	X	?	X	?	X
Sustainability in use of natural resources		X	X	X	X
Pollution of some type/waste management	X	X	X	X	X
Water quality and availability		X	X	X	X
- Toxic waste management	X		X		
- Land degradation		X	X	X	X
Natural disasters (desertification, earthquakes)		X	X	X	
Population moves (migration, refugees)	?	X	X	?	X
Human resource development		X		X	X
Agriculture and provision of food	X	X	X	X	?
Human health				•	
Biodiversity	?			•	X
Urbanization/industrialization		X	?	X	
Human conflicts, lack of regional collaboration		•	X		
Transport and communications			X		
Global change issues					
a. Physical environment					X
b. Economic/trade	•		X	?	X
Communicating with/persuading/responding to citizens	X				
Need for information on other regions/countries	X				

KEY: X = Direct
• = Indirect
? = Areas for Which the Editorial Committee had Significant Concern as to Why the Issue had not been Highlighted by Regional Panel Members.

TABLE II

PRIORITY ISSUES TO BE ADDRESSED IN DIFFERENT REGIONS

N. America/ W. Europe	M. East/ E. Europe	Africa	Asia/Pacific	L. America
Considerable within-area variation e.g., Mexico/US./Greece/ Germany	Really two separate areas: M. East and adjacent former Soviet Republics/Russia and E. Europe	Happy with region?	Should consider as 2 parts: Island states/mainland states	Greater homogeneity through common culture
1. Waste Mgt.	1. Pollution of all Types	1. Social & Economic Dev. - sustainable use of nat. resources - economic development for country - improve human welfare	1. Natural Disasters	1. Biodiversity
2. Energy Supply/ Consumption	2. Misuse of Natural Resources	2. Know Resource Capacity (Human & Natural	2. Deforestation	2. Water Resources
3. Agricultural Problems	3. Water Quantity and Quality	3. Define & Obviate the Debt Burden	3. Desertification	3. Population Dynamics
4. Preserve & Enhance Quality of Life	4. Natural Disasters	4. Drought, famine, desertification	4. Agriculture	4. Global Changes in Natural Environment and Human Health
5. Highly Aware & Articulate Populations	5. Desertification	5. Transport and Communication	5. Water Pollution (Freshwater & Marine)	5. Land Degradation
6. Donor Status - relationships with rest of world and need information on others to set priorities	6. Food Quality and Quantity	6. Toxic Waste Management	6. Population Dynamics	6. Human Resources
	1. Illiteracy 2. Desertification 3. Limited Renewable Network Resources 4. Urbanization 5. Migration Problems 6. Resource sharing between states 7. Lack of regional collaboration in problem solving 8. Need to import food	7. Conflicts	Some of these are important for island states	7. Pollution/ Contamination
		8. Migrations/ Refugees		8. Economic Integration

TABLE III

CORE DATA NEEDS AS A CONSEQUENCE OF THE PRIORITY ISSUES

ISSUES	N Am/ W. Eur.	E EU/ME	Africa	Asia/Pacific	Lat. Am.
1. The Framework - topography, geodesy, hydrography --Satellite Data	X	X X	X	X	•
2. Political, Administrative Framework	X	•	•	X	•
3. Land Cover/Use (& Vegetation)	X	X	X	X	X
4. Soils and Geology (& Geomorphology)	X	X	X	X	X
5. Hydrology, Meteorology	X	X	X	X	X
6. Population Characteristics (and its distribution & migration)	X	X	X	X	X
7. Land/Air/Sea Capacity	X				•
8. Transport and Communications, Infrastructure	X		X		X
9. Energy Production/Consumption	X				
10. Economic, Induct. & Agric. Statistics at Nat'l & Internat'l (Sub- nat'l) Levels	X		X		X
11. Human Health at Personal Dev. Measures (e.g. Income, Educ., Consumption)		X	X		X
12. Biodiversity	•		•	X	X
13. Coastal Zone Data (Integrated)	•			X	•

X = DIRECT
• = INDIRECT

6. RESPONSES TO THE SYMPOSIUM BY DONORS AND SPONSORS

A. Asian Development Bank

Dr. Lohani, Assistant Chief of the Office of the Environment, spoke on the activities undertaken by the Bank of the Region relating to core data needs for environmental assessment and sustainable development programs. Dr. Lohani stated that the Asian Development Bank considers environment as one of its major agendas; at present, 20 percent of the Bank's investments and technical assistant grants are used for environmental-oriented projects. He also spoke about how the Bank collects, uses and supports data information-related programs in the region; including data/information relating to (1) specific projects (e.g., in conducting environmental impact assessment of the projects); (2) planning, designing and implementing environmental projects; (3) country-related activities (e.g., state-of-the-environment and national reporting requirements); (4) ground-level programs (e.g., the Bank's work with the International Center for Integrated Mountain Development (ICIMOD), UN/GRID, and the planned GIS/Remote Sensing work in the Greater Mekong Subregion (Laos, Cambodia, China, Thailand, Vietnam, and Myanmar) and the acid rain transboundary project; and (5) data on a global level, such as the Bank's climate change project for 13 countries on emissions and sinks of greenhouse gases.

He also stated that the Bank is committed to supporting environmental information projects and will be working with key regional partners such as the UNEP EAP. The Bank will support programs on capacity building and technology transfer, as well as demonstrative projects for regional and subregional cooperation.

B. US Agency for International Development and Danish Agency for International Development

Dr. Gale provided a joint statement on behalf of the US Agency for International Development (USAID) and the Danish Agency for International Development (DANIDA).

Dr. Gale stated that this symposium could not have come at a more opportune time, as nations around the world are increasing their efforts to protect the environment and develop sustainable development strategies; the symposium is right on target and the timing is right on schedule. UNDP/UNEP, the symposium steering committee, and all invitees should be highly commended for taking on this bold challenge. As active participants and observers at this international symposium, we have been extremely impressed with the dedication, energy, and enthusiasm of all workshop members from across the globe.

There is a clear and pressing need for more information about the environment. This data is needed for many purposes, including national planning, regional and global assessments, program and strategy impact measures -- as well as preventing and mitigating national disasters. Other important needs are sure to emerge as issues are discussed over these past four days; many data gaps exist. In part, this reflects the relative "newness" of environmental science assessment, ongoing debates about environmental theory and the shear breadth of environmental issues -- not to mention the initial, tepid response of many citizens worldwide to environmental degradation. As a consequence, many nations and their developmental partners (multilateral banks, bilateral donors, non-governmental organizations, etc.) alike may have under-invested in environmental data collection and analysis. We see this symposium as a very important first step in moving ahead on this front by raising the overall awareness about what is needed and re-focusing donor attention more closely on the needs of developing countries.

Having baseline environmental data, identifying critical indicators, building host country data collection and analysis capacities are all essential. At the same time, resources from all sources to support environmental measurement are finite. Also, many developmental partners are being asked to more accurately "show" the impact of environmental investments. Limited funding and greater accountability are likely to be the realities of the 1990's; in this regard, we encourage symposium members to set priorities and narrow their focus, where possible, to identify "manageable" core data sets -- capable of addressing several sectors as well as specific projects.

Host countries and developmental partners, working in a participatory manner, should take steps to further strengthen and interrelate worldwide capacities for environmental measurement and sustainable development. The donors specifically recommend that:

- Sustainability be seen in its broadest dimension -- social and economic as well as environmental;
- To ensure for a long life when donor support ends, efforts be made to strike a balance between "indigenous" data collection methodologies and those developed elsewhere;
- Additional thought be given to the "quality" and "timeliness" of needed data which may differ significantly between developing and developed countries;
- Review ongoing donor "field experiments," which seek to understand the most effective and viable environmental resource information and monitoring systems.
- "Interim indicators" of institutional capacity be considered as part of any core data set since this has been a major thrust of donor assistance.

Dr. Gale concluded by thanking the attendees for giving USAID and DANIDA the opportunity to participate and comment.

C. UNEP

Dr. Croze noted that UNEP has three primary roles: environmental assessment, environmental policy setting, and environmental management support. He explained that environmental support is provided in the form of economic, legal or technological tools to support the development of environmentally sound policies for sustainable development tools, such as computer hardware and software, to help shape environmentally sound and sustainable development practices. He recalled that two main outcomes of UNCED were calls to improve access to policy-relevant information and to enhance the capacity of developing countries to use the information. He explained that it is critical to engage users in activities that strive to increase the effectiveness of environmental information for decision making. Dr. Croze also noted that cost sharing is a necessary part of the process, given that resources are limited.

Dr. Croze also reviewed the context within which UNEP activities, in partnership with other international bodies, are carried out. He explained that the process engages international, regional, and national bodies to develop environmental action plans that are as consistent and coherent as possible. Key users are involved in activities which build upon existing institutions and efforts. Duplication is minimized, and there is an awareness of and focus on national needs. He noted that this symposium should be viewed within the wider international context of ongoing programmes

for improving information for decision making and that, as the process continues, the output of the symposium would be a useful input both to sectorial assessments and regional users' consultations.

D. UNDP

Dr. Estes conveyed comments on behalf of Dr. Nay Htun and conveyed Dr. Htun's sincere regrets for his absence during the closing session (urgent matters made it necessary for him to leave early). He asked that Dr. Estes convey to the attendees, on his behalf, the thanks and appreciation of UNDP for their attendance at this important symposium. He thoroughly enjoyed the time he spent with the attendees and was impressed by the lively discussion and enthusiasm with which the participants addressed the topic of core data needs. He assured the participants that he and UNDP are very interested in the status and accessibility of core data sets and he looks forward with anticipation to the report of this symposium.

7. CONCLUSIONS

The five panels identified a total of 66 core data sets; a list of these data sets and the panels that identified them can be found in Volume II, Appendices 7 and 8. Based upon plenary discussion, a core of 16 data sets was aggregated from the total. After clarification of terminology, this list was further aggregated into 10 high-priority core data sets central to the conduct of many types of studies that produce environmental assessment information and sustainable development strategies.

These ten priority core data sets are:

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

A glossary containing the participants' definitions of what these data sets include can be found in Volume II, Appendix 9.

Having identified these data sets as priority core data sets, the participants then agreed that ways must be found to develop, maintain, and make openly accessible core data. The participants also concluded that:

- These core data sets are essential for environmental assessments and sustainable development strategies;
- For many countries, adequate representations of these types of data do not exist;
- 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; and
- A variety of factors restrict the availability, accessibility and use of core data sets, including costs, national security/sovereignty, national and international capacity, lack of knowledge of existence, and lack of standardization/harmonization.

8. RECOMMENDATIONS

Based upon the above conclusions, 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. (This recommendation was submitted by the steering committee and endorsed by the body of symposium participants.)
- UN agencies and donor organizations should influence national bodies to provide local funding for the creation and maintenance of core data sets by:
  - Developing funding policies and mechanisms that encourage national organizations to acquire and provide core data sets; and
  - Encouraging national organizations to 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;
  - Conduct surveys over the next 18 to 24 months to document the status of core data sets;
  - Recognize existing differences in national policies on government-provided data, but work towards 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 our knowledge of existing data bases; and
  - Work toward the development of guidelines for standardization/harmonization of core data within the next 12 months.

In addition to these recommendations, participants felt that more should be done to publicize the fact that the creation and maintenance of core data are essential to our ability to assess the status of the environment and develop resources, both human and natural, in a sustainable fashion. Participants also felt that UNEP and UNDP should evaluate, on a case-by-case basis, the need to fund the creation of national- and regional-specific data sets key to understanding significant environmental assessment and sustainable development issues. It was also recommended that international assistance projects should incorporate strong capacity building, education and training components that enhance the basic skills of users and the use of the data products, and facilitate information exchange between producers and users. Where possible, a coordinated approach to such projects should be encouraged so that multinational data purchases and technical assistance

facilitate the most cost-effective and productive use of data sets and resources available.

Finally, participants recommended that an international symposium be held to address how core data sets can be applied to policy formulation and decision-making.

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