Chapter 13

Environmental Information, Analysis, and Integration

Introduction

Decision-making on complex issues related to the environment and natural resources must be based on accurate data. The synthesis and analysis of basic environmental data yields the information that is the precondition for developing policy framework, policy design, and the plans and programs for environmental and natural resource management. Concern for environmental issues in Nepal has increased in recent years. As the population at large becomes sensitized to environmental issues, there is a growing interest in analytical data and indicators of the state of the environment. The demand for environmental information is escalating, and governments and civil society stakeholders have been the driving forces on both the supply and the demand sides. Good, reliable data on Nepal are recognized as a fundamental tool needed for development. Developing and using information and knowledge are therefore essential parts of environmental planning and management from local to national levels. The use of such information leads to greater transparency and better governance, and hence plays a crucial role in environmental management. It is the foundation upon which many analytical and decision-making processes are based, which in turn are the precursors for effective actions on the ground.

Although over the years considerable environmental data and information have been compiled by various institutions, aid projects, and individual researchers working on different projects and programs, they have been difficult to access. Data appearing in isolated reports are often dispersed, heterogeneous, and inaccessible; more often than not, they are insufficiently relevant in terms of continuity and reliability. Without an appropriate framework and mechanisms for data sharing, time and resources are wasted in duplicating efforts for data collection and management. Public and private environmental institutions and bodies in Nepal have accumulated environmental data and information on natural resources and environmental conditions. These databases lack a centralized data pool and unified standards. There is no national database integrating all the sectoral data, nor are there any data linkages that would allow sharing of the existing information.

Role of Environmental Information in Decision Making

Determining the need for environmental information is perhaps the first step towards assessing environmental conditions at local, regional, and national levels. Efforts to improve environmental conditions are based on the assumption that rational environmental planning and management results from informed decision making. Environmental information for decision making gained special attention following the Rio Earth Summit in 1992 and was further emphasized at the World Summit on Sustainable Development in 2002. The summit underlined the importance of improved availability of information on all aspects of environment and development as well as the need for improved collection and presentation of data and information for decision making. Goal 7—environmental sustainability—of the United Nations' Millennium Development Goals specifies key targets and indicators, and highlights the need to promote and use environmental data and information to tackle and monitor pressing environmental problems. Some of the targets and indicators related to Goal 7 are shown below. (More details on the Goals are provided in the Annex at the end of this book).

Target 9: Integrate the Principles of Sustainable Development into Countries' Policies and Programs and Reverse the Loss of Environmental Resources.

Indicators:

- Proportion of land area covered by forest
- Land area protected to maintain biological diversity

- Gross domestic product per unit energy use
- Carbon dioxide emission per capita

Target 10: Halve by 2015 the Proportion of People without Sustainable Access to Safe Drinking Water.

Indicator:

- Proportion of population with sustainable access to improved water sources

Target 11: Significantly Improve the Lives of at least 100 million Slum Dwellers by 2020.

Indicators:

- Proportion of people with access to improved sanitation
- Proportion of people with access to secure land tenure

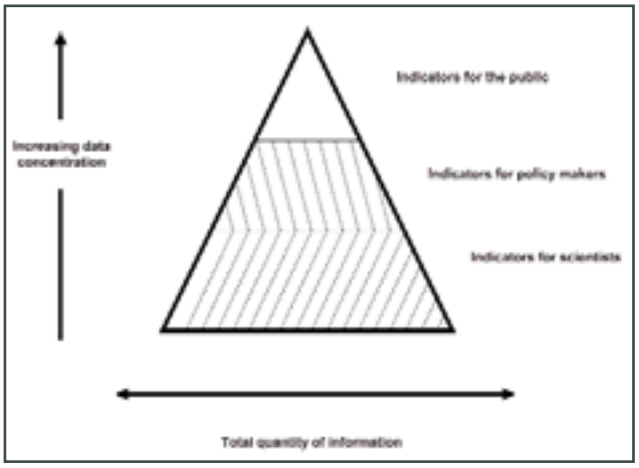
Coherent and compatible baseline data and data systems must be in place to derive the indicators described above. A United Nations Development Programme report by the Nepal Country Team in 2002 shows that Nepal's progress in meeting MDG Goal 7 has been poor and indicates that lack of data is part of the problem.

Importance of Environmental Indicators

Indicators need to be based on primary data which are the foundation for scientific analysis and decision making. An index is a composite of several indicators. Combining relevant indicators from the vast array of environmental data into a composite index reveals the evidence more convincingly than individual indicators would. Environmental indicators represent a powerful tool for communicating synoptic information on the environment to decision makers and the public. Indicators represent a bridge between the wealth of detailed information and the need for interpreted information. Environmental indicators facilitate better understanding of environmental trends and conditions at multiple levels of users—the general public, researchers and scientists, and policymakers (Figure 13.1). The packaging of environmental data into indicators will help to simplify complex issues and set precise goals, and monitor progress towards those goals.

Environmental indicators are not easy to formulate and their development is the subject of much national and international research (ICSU 2002). Environmental indicators are relatively underdeveloped compared with economic and social indicators, and there is no widely used composite index that captures the progress of environmental sustainability, similar to gross national product for economic development or the human development index.

Figure 13.1: Relationships among Indicators, Data, and Information to Meet Users' Needs



Source: After Braat, in Kurik and Verbruggen (1991)

Environmental Information Database Framework

Access to multisectoral environmental databases at multiple levels is the key to environmental assessment and monitoring. An environmental information database should integrate information from socioeconomic and biophysical sources, natural disasters, and polices and institutions. The United Nations Environment Programme (UNEP) has been advocating a framework environmental database for state of the environment reporting at the national level (Rump 1996). Embracing such a framework at the national level will help Nepal deal with environmental information (see Figure 13.2).

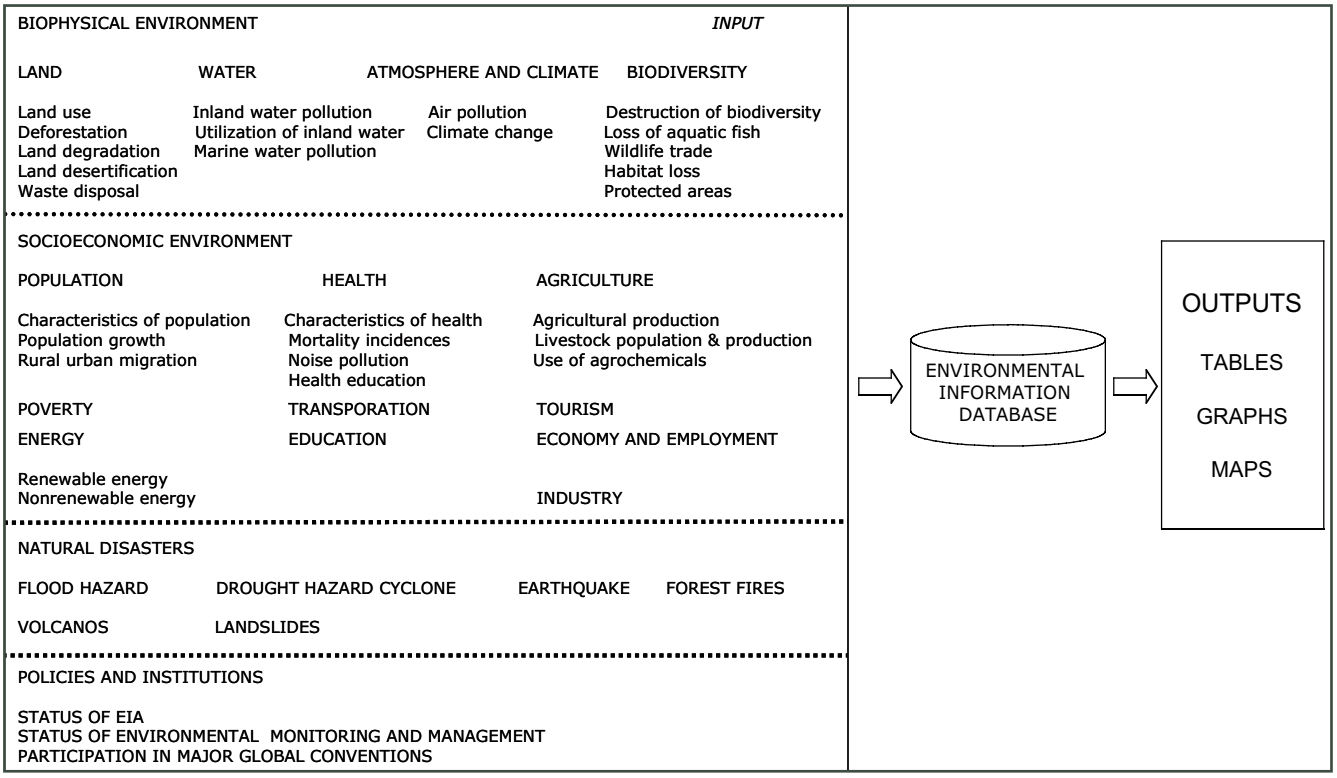
Issues Related to Environmental Information

Needs for environmental data and information are determined by specific environmental problems. Some critical questions regarding environmental data and information are:

(i) What are the pressing environmental problems?
(ii) What are the data needs?
(iii) What are the data gaps?
(iv) What are the institutional mechanisms to support the data and information?

Environmental data and information are multidisciplinary and integrative in nature, measuring human activities and natural events that affect the environment. There needs to be a

Figure 13.2: Framework for an Environmental Information Database



Source: UNEP/EAP-AP—State of the Environment Data Collection and Reporting Training for South Asia (unpublished).

continuous process to survey and monitor both quantitative and qualitative assessment of the resources base or environmental conditions. Specific environmental problems require assessment of existing data structure and identification of data gaps. Proper institutional mechanisms allow sharing of data and information and will fill the data gaps. A concept of "information infrastructure" is emerging in which information is seen as infrastructure like telecommunications or road infrastructure. Information infrastructure related to the environment can be seen as a broad policy, technical, financial, and institutional framework to promote and use environmental information. An information infrastructure on the environment will be the key to managing environmental problems. Such an information infrastructure on environment will facilitate integrating environmental concerns into economic development, tracking environmental changes and managing the environment, and promoting environmental awareness to the public.

Core Environmental Information

Almost all environmental problems share common information needs. These include basic descriptions of such things as topography, land use/land cover, infrastructure, and demography (human activity) that are common information denominators (UNEP and UNDP 1994). Such details can be considered the core environmental information that will facilitate better understanding within the context of the environmental problem (local, regional, and national) in its fullest sense. The specific type of environmental and natural resources information, however, will be dictated by the nature of the development interventions for which it is designed.

Development of core environmental datasets is often labor and technology intensive, and they are expensive to produce and update (UNEP and UNDP 1994). These core datasets provide a wide variety of uses specific to a given location; for instance, land use information is needed to address many environmental problems, but often no single use can justify the cost of development. Focusing on environmental assessment and sustainable development strategies, a broad-based symposium organized by UNEP and UNDP identified ten high-priority core environmental datasets that are central to many types of studies related to environmental assessment. These are: land use and cover, demographics, hydrology, infrastructure, climatology, topography, economy, soils, air quality, and water quality.

In Nepal, many different government agencies have mandates to generate and maintain core information, but the availability of information varies from theme to theme and data gaps persist.

Time Series Information

Generally two types of information are needed: the first is the baseline condition and the second is monitoring data to determine changes from baseline conditions. Developing monitoring networks often requires considerable investment in infrastructure; for example, investments in monitoring instruments or computer networks. For a developing country like Nepal, such investments are difficult and their use needs to be carefully evaluated in terms of costs and benefits in relation to policy objectives and programs. They should provide reliable, harmonized, and comparable environmental information for monitoring purposes.

In Nepal, monitoring information is often hard to obtain and difficult to compile due to lack of systematic data collection and monitoring systems. The monitoring of natural resources is particularly important, since that sector makes major contributions to the economy. Other environmental problems requiring monitoring include air quality in Kathmandu Valley and other major urban centers. This problem has been aggravated by heavy migration of people to urban centers due to the prevailing insurgency, although exact figures are unavailable.

Information Scale

Environmental planning and management are often influenced by particular geographic conditions and require spatial (map) information on natural resources, including major hydrology, topography, soil characteristics, and human activities. Scale of information suggests the amount of generalization that has taken place in compiling a map. The scale of maps is a critical but often overlooked factor for environmental assessment and monitoring. In Nepal, most maps are at different scales and have different coordinate systems, making it difficult to make overlays and integrate them into a common geographic information system (GIS) platform (Shrestha and Pradhan 1999). Data related to environmental problems requiring large-scale maps are unavailable or difficult to compile. Satellite technology (remote sensing imagery) is an alternative source for such information, but often associated with high costs, and its uses are limited due to lack of adequate technical expertise.

Institutional issues

Because resources and environmental information tends to be sector specific, institutional considerations surround information collection, processing, and dissemination. Because baseline data is commonly unavailable, database development is often carried out on a project basis with little focus on the generic uses of the data, leading to duplication of effort and data redundancy (Shrestha and Pradhan 1999). Seemingly comparable data generated by different agencies may in practice be incompatible as a result of differences in data format, reporting schedules, or the ultimate purpose for which the data were collected. Further, due to poor understanding of the processes involved and weak technical capabilities, datasets are often of low quality and lack standards. Little attention is paid to sharing data. An institutional mechanism is needed to encourage coherence while allowing for participation by a variety of institutions involved in environmental issues, taking into account their own specific needs and the need for a national vision. This institutional mechanism should aim for cost-effectiveness in funding and allocation of resources, and for policy relevance of the information. Such an institutional mechanism is yet to be seen in Nepal, though there is increasing awareness among professionals and scientists of the need for it.

Data Quality

Since baseline data will likely be used by many users, they must be of the highest quality. Sensitivity testing should be carried out, and each ministry and agency should reassess data quality standards and the data's ability to address their purpose. Generally, quality assessment procedures are weak in Nepal (ICIMOD and UNEP 2001) and the user communities must make do with the information that is available.

Data Standards and Metadata

Data standards ensure the quality of data and effective data interchange. No comprehensive environmental data standards have been developed in Nepal except for some specific application domains (ICIMOD and UNEP 2001).

Metadata is a process of documenting existing databases that provides information about data for access and use by the user community. Metadata is intended to provide as much information as possible about the data, its history, use, quality, and other associated information to the users. Such documentation of data or creation of a metadatabase has not been done in Nepal due to lack of know-how and standards, which will make future use of data difficult.

Status of Environmental Data and Information in Nepal

There is a need for a strong information base on all aspects of Nepal's environment and natural resources; this must be collected systematically from

decentralized multisectoral environmental agencies or institutions, analyzed, and presented in a timely manner. In Nepal, environmental data and information are collected by many sectoral agencies, and tend to remain with the agencies that generated them. As explained and illustrated in previous chapters of this book, a wide variety of sources are used for data collection. Although access to environmental information among government institutions is theoretically unrestricted, there is no clear, established mechanism to promote access to and circulation of environmental information. In practice, various publications and reports circulate among the agencies, but each agency tends to manage its own data sources and publications without much coordination or exchange of information about what is produced. As a result, needed information cannot be compiled quickly for multisectoral analysis of environmental issues. The following section highlights the status of environmental data and information in Nepal.

Data from the State of the Environment Nepal

The State of the Environment Nepal study was undertaken jointly by the Ministry of Population and Environment (MOPE), UNEP, and the International Center for Integrated Mountain Develoment (ICIMOD) in 1999 as part of an environmental assessment of Nepal and to contribute to UNEP's Global Environment Outlook initiative. The report (UNEP 2001) highlighted the major environmental issues of Nepal in five categories: forest depletion, soil degradation, air pollution, water quality, and solid waste management. The study aimed to set in motion a data collection and updating mechanism and process to support regular state of the environment reporting.

The study quoted 64 different sources identified during its efforts to compile information and derive indicators. Major sources of data were annual reports of the ministries and departments concerned, reports of the Central Bureau of Statistics (CBS), papers published in national and international journals, unpublished official records, and informal discussions with the experts and heads of the organizations and departments. Table 13.1a,b summarizes the different types of datasets collected for the report and the sources from which they were obtained.

Data on Environmental Impact Assessment

Performance of environmental impact assessments (EIA) was initiated in Nepal in the mid-1980s. Attempts towards institutionalizing EIAs include the National EIA Guidelines 1993 and EIA Guidelines for Forestry and Industry Sectors 1995. EIA guidelines for other sectors such as water resources, roads, mining, and urban development have been drafted. Integration of EIA through legal measures has also been initiated through the Environment Protection Act 1996 and Environment Protection Regulations 1997 (amended 1999). The Nepal State of the Environment study listed 44 different nongovernment organizations (NGOs) and 20 different consulting firms used to undertake different EIAs in Nepal. Many of these EIAs depend on secondary sources of information and in some cases primary data collection. EIAs are mostly carried out independent of each other and there is very little sharing of data and information and lessons learned.

Environmental Statistics

Besides collecting and processing social and economic data, CBS also collects and publishes data related to agriculture, fisheries, and forestry, and the environment. CBS regularly compiles and publishes environment statistics for Nepal prepared under the Framework for the Development of Environment Statistics (CBS 2004). The statistics relate to flora and fauna, atmosphere, water and sanitation, land and soil, and human settlement.

Under the framework, CBS relates these components to social and economic activities; natural events; environmental impacts of activities and events; response to environmental impacts; and inventories, stocks, and background conditions.

Data Collected by Government Organizations and Others

The Ministry of Agriculture and Cooperatives has an Agricultural Statistics Division that regularly publishes comprehensive statistical information on agriculture and related variables in its publication Statistical Information on Nepalese Agriculture (ADB 2004). The data released are advance estimates of district statistics on cereal crops, cash crops, pulses, livestock, poultry, fishery, and horticulture. Its statistical functions are limited to producing forecast data of crop area, agricultural production, and other agricultural statistics. CBS also carries out an agricultural census, and the differences between CBS and the Ministry of Agriculture and Cooperatives data must be evaluated and reconciled. Despite extensive data collection, there are considerable gaps in national estimates in terms of sources, desired frequency, and desired level of geographic disaggregation.

The Ministry of Forest and Soil Conservation compiles statistics related to forest and the environ-

Table 13.1a: Different Datasets Collected for the Nepal State of the Environment Report

Topic	Sources (Table 13.1b)	Topic	Sources (Table 13.1b)
Land: Deforestation	18, 10, 5, 43, 4, 23	Poverty	30, 4, 44, 41, 16, 37, 31
Land: Land Degradation	45, 18, 21, 5, 7, 23	Health	18, 4, 41, 2, 6, 45, 17, 13, 36, 31
Land: Land Desertification	18, 2, 5, 25, 45	Industry	4, 14
Land: Land Use	18, 2, 5, 14, 30, 12,	Agriculture	2, 18, 4, 19, 35
Land: Waste Disposal	18, 45, 4, 11	Tourism—International/Internal	18, 4, 32
Water: Inland Water Pollution	45, 38, 20	Transportation	18, 4, 45, 15
Water: Utilization of Inland Water	9, 18, 2, 43, 9, 45, 33, 34	Energy	4, 43, 18
Atmosphere and Climate: Air Pollution	45, 43, 18, 25, 22, 9, 15	Natural Disaster	18, 21
Atmosphere and Climate: Climate Change	9	Economy and Employment	18, 4, 30
Biodiversity	18, 7, 45	Policies and Institutions	24, 29,
Biodiversity: Loss of Aquatic fish	2, 18, 27, 4, 45	Policies and Institutions: Status of EIA	7
Biodiversity: Wild Life Trade	4, 15, 45	Policies and Institutions	
Biodiversity: Habitat	26, 7, 5	Signatories in Major Global Conventions	
Biodiversity: Protected Areas	28, 18, 45	Emerging Environmental Issues	
Population	18, 7, 36, 42, 40, 4, 1		
Education	18, 3, 4, 42, 41, 39, 40, 6, 30		

EIA = environmental impact assessment
Source: ICIMOD and UNEP (2001)

Table 13.1b: Key to Dataset Sources

Number	Source	Number	Source
1.	Ministry of Local Development	24.	Krishna Engineering Consultant
2.	Ministry of Agriculture	25.	Kathmandu Valley Vehicular Emission Control Programme
3.	Ministry of Education and Culture	26.	Land Resources Mapping Project
4.	Ministry of Finance	27.	National Account of Nepal 1998 CBS/HMG:35 pond+river
5.	Ministry of Forest and Soil Conservation	28.	National Biodiversity Action Plan HMG
6.	Ministry of Health	29.	Nepal Bureau of Standards and Metrology
7.	Ministry of Population and Environment	30.	National Planning Commission
8.	Ministry of Water Resources	31.	Nepal Rastra Bank
9.	Department of Hydrology and Meteorology	32.	Nepal Tourism Board
10.	Department of National Parks and Wild Life Conservation	33.	Nepal Water Supply Corporation
11.	Department of Agriculture	34.	People and Resource Dynamics Watershed Project
12.	Department of Forest	35.	Pesticide data from records
13.	Department of Health	36.	REGHED, Health Statistics of Nepal
14.	Department of Mines and Geology	37.	Rural Water Supply and Sanitation Project
15.	Department of Transport Management	38.	SMEC, Stanley International Ltd.
16.	Department of Water Supply and Sewerage	39.	Tribhuwan University
17.	Bir Hospital	40.	United Nations Environment Programme
18.	Central Bureau of Statistics	41.	United Nations Development Programme
19.	Cotton Development Board	42.	World Bank
20.	CEMAT	43.	Water and Energy Commission Secretariat
21.	Disaster Prevention Technical Center	44.	World Health Organization
22.	Environment and Public Health Organisation	45.	Individuals
23.	International Centre for Integrated Mountain Development		

Source: ICIMOD and UNEP (2001)

ment. The data are collected regularly from district and regional forestry offices through observation, total counting, and measurement, and the disaggregation is district, regional, and ecological. The forest resources inventory is based on standardized statistical methods, and sample errors, standard errors, and variation coefficients are computed. An Asian Development Bank (ADB) technical assistance report (ADB 2004) recommends that MOFSC strengthen its capability in coordinating the production of important statistics on forestry and the environment to be able to fill the current data gaps.

The CBS and the Department of Health Services of the Ministry of Health are the two major sources of health and environment related statistics. The Department of Health Services has an integrated health management information system that aims to encourage bottom-up planning from community level to national level. About 400 indicators are collected every month and about 100 derived from different reports. The indicators monitored concern child health, reproductive health (safe motherhood and family planning), and disease control. Despite many social surveys being conducted, ADB (2004) points out considerable data gaps as well as the necessity to allocate responsibilities for generating such data to avoid duplication of functions.

In addition, a number of other organizations including research institutes, universities, NGOs, and individual researchers collect data and information in their areas of specialization as indicated in Table 13.1.

Existing Environmental Information

Collecting, compiling, and harmonizing information from different sources are often difficult tasks. Furthermore, collecting environmental data from secondary sources or descriptive data has proven to be a daunting task in Nepal. The past study on the State of the Environment Nepal and the present study are good examples and share the same experience. Except for data found in reports, reliable data are very difficult to obtain and many institutions lack the proper data handling capability. The problems include the fact that sources of environmental data and information are generally diverse and incoherent; the marked unwillingness on the part of most of the institutions and individuals to share data and information; and a lack of the data standardization and consistency that would make them usable under a common platform—often there are simply no data available.

Circulation of environmental information should be stimulated at the national level. Issues emanating from the present institutional context need to be addressed to improve the environmental data and information available in Nepal.

Integration and Analysis of Environmental Information

The information required for environmental assessment and monitoring covers a wide spectrum. There is an increasing need for better integration of environmental concerns into decisions that can affect the environment in major economic and human activities such as energy, industry, transport, agriculture, and tourism. Information on the natural resources base and environment is essential. Information on human activities impacting the environment, emission of pollutants, natural events, and human responses to environmental changes is equally important for assessing the ecosystem as a whole.

Careful integration of environmental data into social and economic dimensions is increasingly recognized as vital for scientific understanding and societal decision making (Maclaren et al. 1994). This has a number of implications for the collection, management, and use of information, including the necessity of synthesizing and presenting scientific and technical information in readable, usable form, and of displaying the links between environmental and socioeconomic issues. Such integration can be fostered by proper institutional mechanisms as well as by using modern analytical tools and decision-support systems, which will support better understanding of environmental trends and conditions and help develop and implement policies, plans, and actions. The following section describes the use of such modern scientific tools.

Geographic Information Systems (GIS)

Environmental problems have distinct spatial and temporal dimensions. From an operational standpoint, data must be referenced geographically. Decisions related to the environment, protection of biodiversity, environmental damage due to natural hazards, urban growth, and so on need information through space and time. Due to the very high variability in topography and ecological characteristics, Nepal poses challenges in compiling and analyzing such information.

Advanced information communication technology, GIS, and space technology represent a new generation of tools for scientific analysis. Myriads of these tools are converging and are now available to quantify, model, document, and disseminate information on key environmental and natural resources conditions and trends. The information thus generated is readily understood by policymakers and the public. GIS technology is

relevant due to its multidisciplinary nature that allows integrating divergent sources of data, spatial modeling, and visual presentation; using such tools calls for close collaboration among many sectors. Availability, accessibility, and affordability of geographically referenced information at multiple scales, and the capacity to use modern decision support system tools are crucial to investigating key environmental problems.

Importance of Spatial Information

Information portrayed in maps is an essential tool for assessing the state of the environment (UNEP and UNDP 1994). From a spatial context, the analysis of environmental conditions and trends can be presented by administrative boundary, environmental units such as watersheds, or eco-regions. As socioeconomic data are based on the administrative units, it is convenient to map environmental impacts due to human activities in these units. The ecological framework approach demands better understanding of natural processes, and a natural resource based approach using watersheds or eco-regions is suitable for environment assessment. Such analyses can be accomplished through the use of GIS (Bajracharya 2000).

Many spatial data are considered core environmental information such as topography, land use, ecology, drainage networks, geology, infrastructure, and so on. In Nepal, such information is reasonably well developed but needs regular updating. Figure 13.3 provides examples of these types of information layers prepared by ICIMOD's Mountain Environment and Natural Resources Information Systems (MENRIS) program using data from various government sources.

ICIMOD and CBS have also carried out extensive mapping of socioeconomic indicators and trends using census information, which included health and environment information; an example is shown in Figure 13.4.

Environmental GIS Applications

Through its MENRIS program, ICIMOD has adopted a strategic approach to promoting and using GIS for environmental and natural resources management for mountain areas among its member countries. Figure 13.5 shows typical examples of some of these environmental applications in Nepal; they demonstrate the potential for using GIS.

Remote Sensing

Remote sensing (RS) observations from satellites provide data on the earth in a spatial format. The last decade witnessed unprecedented growth and

Figure 13.3: Examples of Information Layers for Nepal prepared using data from Government Sources

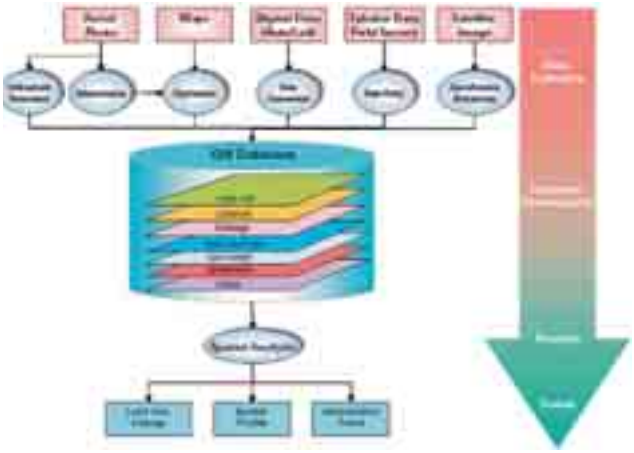
Source: Mountain GIS Portal (www.icimod-gis.net) MENRIS, ICIMOD.

Figure 13.4: Mapping of Socioeconomic Indicators Using Census Information – Sources of Drinking Water

Source: ICIMOD (2003)

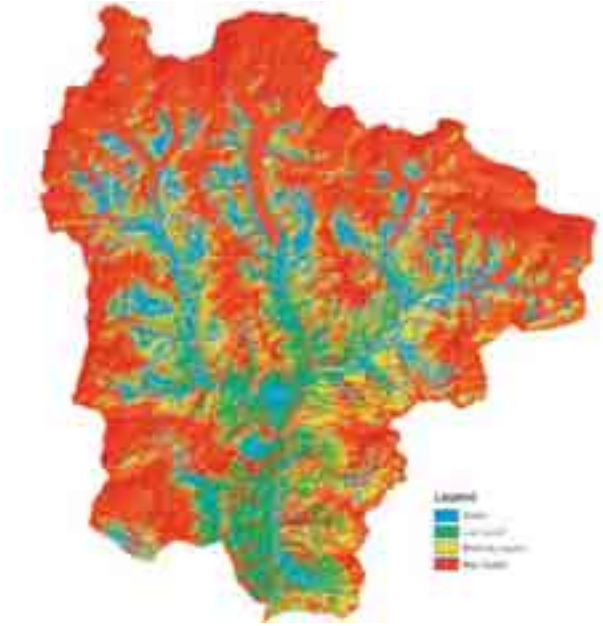
Figure 13.5: Examples of Environmental Applications of GIS

a) GIS in Urban Environmental Planning



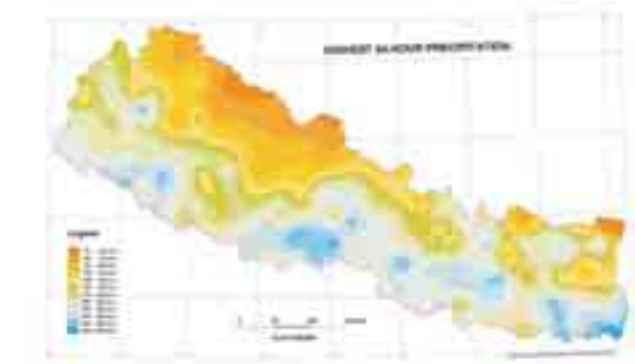
Source: Shrestha t al. (2003)

b) Hazard Map of Sagarmatha National Park
(Criteria based on lithology, slope, and land cover)



Source: MENRIS, ICIMOD.

c) Climatic Atlas Mapping



Source: MENRIS, ICIMOD.

development in earth observation techniques. The trend is continuing, and remote sensing techniques are proving to be more cost effective than ground-based ones. RS data have benefits from the synoptic view and large area coverage, which help in obtaining a "bird's eye-view" of the features. Remotely sensed data have a huge potential for providing time series data on environmental conditions of dynamically changing resource bases. The availability of RS data in a temporal domain (as short as 3–20 day intervals) provides a new dimension to spatial information processing and monitoring of earth features. Furthermore, in recent years high-resolution satellite data have provided a greater degree of spatial and temporal variations than ever before. Global positioning system (GPS) technology has revolutionized surveying and mapping. The increasing availability of public domain datasets from RS techniques, the declining trend in the cost of computer hardware, the exponential increases in computing power and the expansion of the Internet, and increased user-friendliness of software are other welcome developments. These developments create a suitable context for using remote sensing for environmental monitoring. The recent release (June 2005) of the GoogleEarth product (http://earth.google.com) has allowed ordinary Internet users to view interactively a 3-D globe based on satellite imagery.

In the present context, remotely sensed data provide a means to integrate the information required to assess and monitor ecosystem sustainability. Virtually all modern map products derive considerable information from remote sensing. Recent developments in space technology suggest that the future will bring a wide variety of products for environmental monitoring and assessment. The recent UNEP Atlas "One Planet Many People" used satellite imagery extensively to assess and monitor the earth's environment (UNEP 2005).

ICIMOD has been promoting the use of RS in the greater Himalayan region and applying RS techniques to various environmental problems; some typical examples drawn from Nepal are shown in Figures 13.6.

Environmental Decision Support Systems

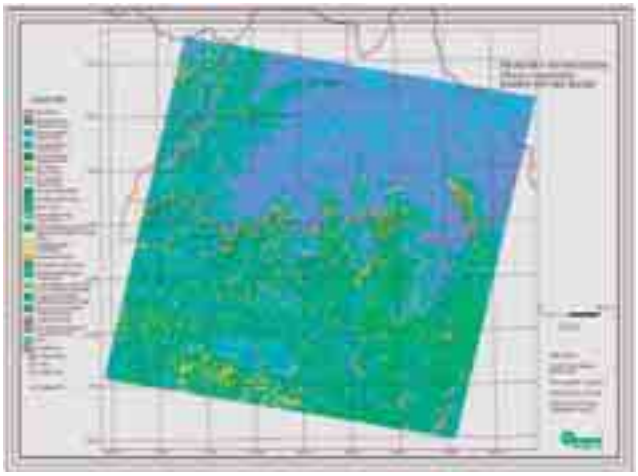
Environmental databases coupled with information systems and decision support systems are central to achieving a successful transition from the traditional (sectoral) environment and natural resources management to an integrated, holistic approach to development because of their integrative quality (linking biophysical and socioeconomic information)

Figure 13.6: Examples of Applications of Remote Sensing in Environmental Studies

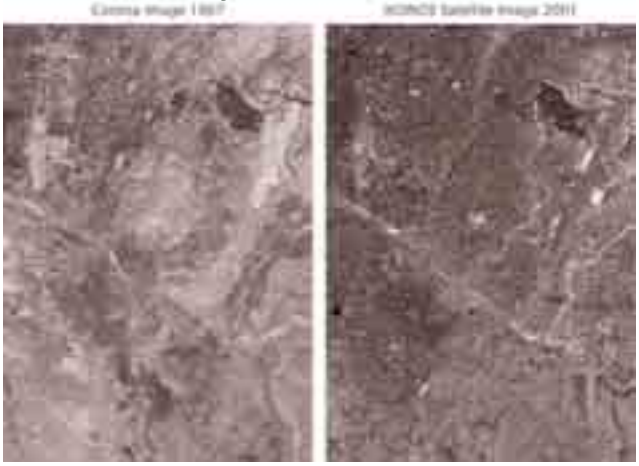
(Source: Mountain GIS Portal ICIMOD)

a) Mosaics of Natural View and Geocover of Nepal

b) Biodiversity Mapping Using Remote Sensing



c) Kathmandu Valley—Urban Growth (1967–2001)



and their location-based property (addressing relationships among places at local to national levels). Figure 13.7 illustrates the framework for environment and natural resources information and decision support systems adopted by the MENRIS program at ICIMOD for sustainable mountain development in the Hindu Kush-Himalayan region.

This framework is based on building the capacity of local and national partners, and creating an environmental information network. The framework provides a mechanism to assimilate both biophysical and socioeconomic information at multiple levels through an organized environmental and natural resources information network of local and national partner institutions. The framework defines the aggregation of geo-referenced environmental information with accepted international standards at local and national levels to give rise to integrated environmental databases. The databases serve as a foundation upon which analytical and decision making processes are based. The spatial modeling tools combined with thematic expert knowledge on priority environmental issues will help to analyze and model key components of the mountain environment such as biodiversity, climate change, snow and glaciers, land use and land cover, and infrastructure development. Ultimately, the framework is aimed at contributing to an increased knowledge base for environmental information and to decision-support systems.

The main functions of such an information and decision-support system are to facilitate access to environmental information and data sharing; promote the integration and harmonization of data through the use of GIS, the Internet, and related tools; and indicate alternative scenarios through scientific analysis of priority environmental issues.

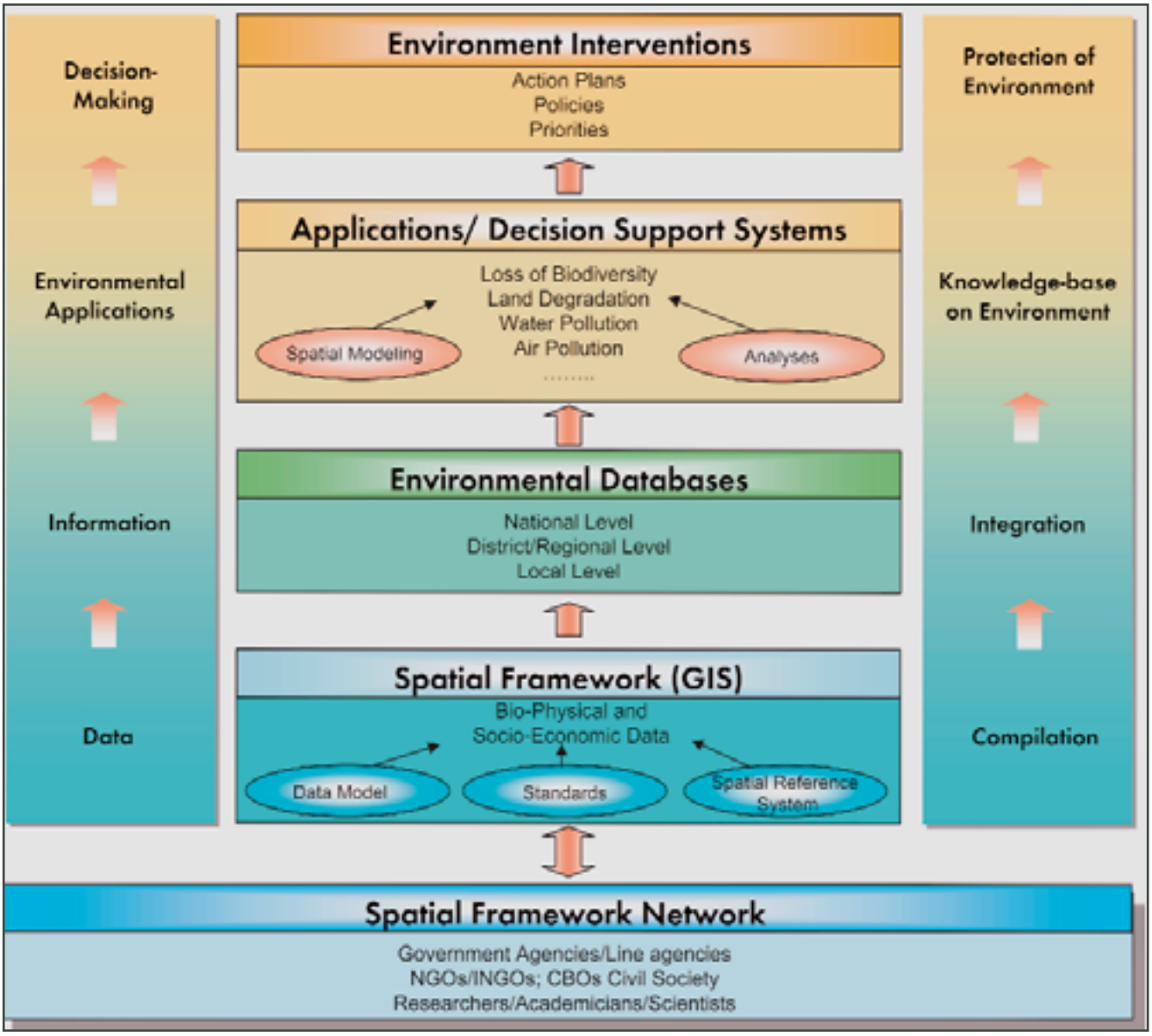
ICIMOD, together with partners, is currently developing a "Protected Areas Database Portal" of Nepal—a framework for sharing and exchanging information related to protected areas and biodiversity through the Internet with a dynamic mapping capability, and a database for a transboundary water quality monitoring network.

Conclusions: Challenges in Environmental Information

Developing countries like Nepal, where the environment is often treated as a lesser priority or even neglected, clearly face big challenges in tackling problems related to environmental information. Most often, analysts and policymakers lack the capacity to fully use environmental data and information to bear upon decision making. Some of the challenges and issues that Nepal faces in this regard are presented below:

(i) There is a general lack of awareness about what environmental information is available, and it is not easy to learn what work is being carried out at present or has been done in the past. There is neither a central record of

Figure 13.7: Framework for Environment and Natural Resources Information and Decision Support Systems



Source: ICIMOD/MENRIS Programme Brochure

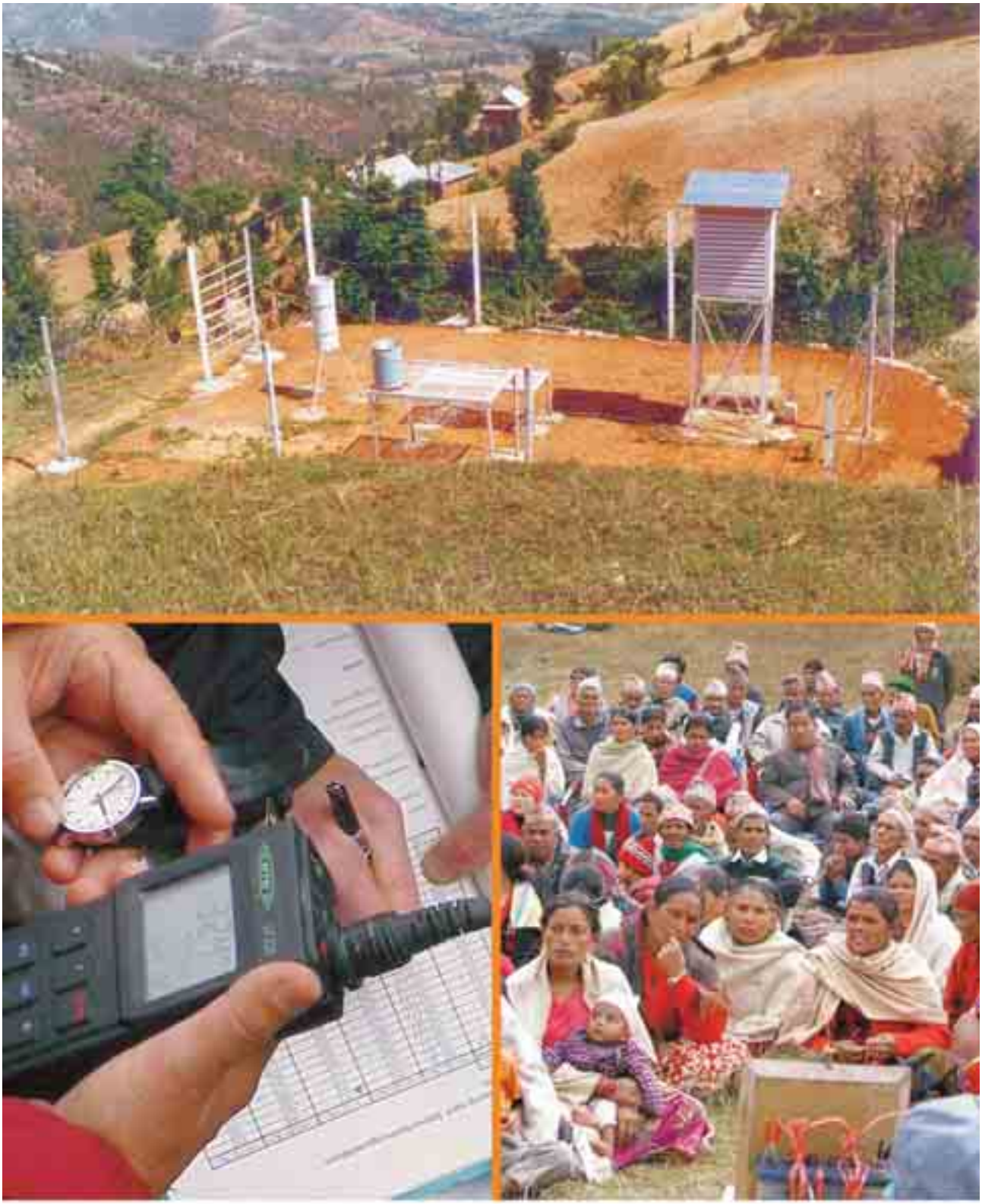
environmental information or meta-information, nor a comprehensive list of data sources, environmental publications, and reports. Often available information is communicated verbally, and little attention is paid to structuring the data in a computerized system. It is often easier for agencies to simply re-collect information.

(ii) There is no clear mandate or policy at the institutional level responsible for defining, maintaining, and updating environmental data and information. There is little or no interaction among institutions or projects, and their mandates, authorities, responsibilities, and functions often overlap.

(iii) The present level of information gathering on the environment is insufficient and important data gaps persist. There are gaps in terms of desired frequency and desired level of geographic disaggregation. Even where data are available, they remain sectoral in nature and most often incompatible across sectors, areas, and time.

(iv) Many organizations use different methods for acquiring, storing, processing, analyzing, and presenting environmental data and information. Harmonization of environmental data and information is difficult.

(v) Information networking between local and national levels remains weak, and coordination among the line agencies for effective data sharing is non-existent. The data sharing culture remains poorly developed.



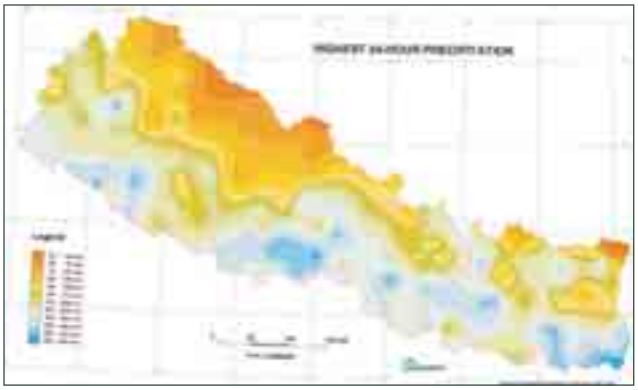
Gopal Nakarmi

Judith Dobmann

Zbigniew Mikolajuk

There are many sources of environmental information: clockwise from top-weather station; demographics; measuring water flow

(vi) Many environmental issues such as loss of biodiversity, glacier melting, soil erosion, air pollution, and flooding transcend national boundaries. It is also necessary to strengthen a sense of collective ownership and responsibility for the environmental challenges faced at the regional/global level. There is a need to pursue effective measures of regional cooperation and to establish a regional network for effective sharing and exchange of environmental information.



Unless there is a strong political will and good governance, these challenges are unlikely to be met. For this, policymakers, user communities, and data producers need to be more aware of the benefits. Tackling problems related to environmental data and information requires establishing an environment and natural resources information network to facilitate the exchange of information and strengthen appropriate policymaking capacities. A unified repository would collect all relevant databases with the participation of government, nongovernment and academic institutions, the private sector, and other stakeholders. Such a network, which would integrate data and information from decentralized providers and make them available to a multitude of users, is an important concept, and doubtless a useful one, but needs to be strictly managed to make it viable. There are several needs related to this.

(i) Initially, existing structures need to be assessed and the capacity of the different sectoral agencies reinforced to allow them to generate and analyze multisectoral environmental and natural resources data and information more easily.

(ii) Sectoral agencies need to be coordinated so that the data and information collected are systematic and conform to a consistent information structure that ensures quality and reliability.

(iii) Socioeconomic and other sectoral data and information can then be harvested to derive policy-relevant, aggregated indicators for major environmental issues at the local and national levels.

(iv) An integrated environmental decision-support system focusing on priority environmental issues can then be developed to bring together existing knowledge and help facilitate assessments, trends, and projections in the area of environmental protection.

(v) To maximize its usefulness, Nepal's central repository of information would then need to be networked and linked with different regional and international agencies and with other well-developed and managed information bases dealing with similar types of information.

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