Draft

ENVIRONMENTAL DATA AND INFORMATION MANAGEMENT SYSTEM (EDIMS) FOR SOUTH ASIA

- Need Assessment

Submitted to

South Asia Co-operative Environment Programme (SACEP)
United Nations Environment Programme (UNEP)

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Chapter 1

Introduction

This chapter describes the background, context and objectives of this assessment.

1.1 Background and Need

Accurate, reliable and timely information is vital to effective decision-making in almost every aspect of human endeavour, whether it be undertaken by individuals, an organization or governments. It is an essential component of any effort to persuade individuals, organizations or governments to make different decisions from the ones which they might make in the absence of particular pieces of information. And it is an integral part of any attempt to hold those who make decisions accountable for the consequences of the decisions which they make. In the absence of accurate, reliable and timely information, people, organizations and governments make bad decisions; they will be unable to help or persuade others to make better decisions; and no-one will be able to ascertain whether the decision made by particular individuals, organizations or governments were the best that could have been made at the time. In the modern development planning and policy decision making process, ready and quick availability of information is a pre-requisite. Developmental planning is best guided by Environment and socio-economic data and information collected continuously over time and space. This information can provide a basis for preparing the current status, future scenarios and decision making (SACEP, 2008).

The Agenda 21 says that "in sustainable development, everyone is a user and provider of information considered in the broad sense. That includes data, information, appropriately packaged experience and knowledge. The need for information arises at all levels, from that of senior decision makers at the national and international levels to the grass-roots and individual levels". The Agenda 21 in its chapter 40 highlights two major areas of concern- the data gaps and the availability of the information. The gap in the availability, quality, coherence, standardization and accessibility of data is a common problem found in developing countries.

The South Asia State of Environment Report 2001 and National SoE Reports of South Asian countries clearly pointed out a lack of necessary data, and that the gaps in the available datasets hampered the making correct policy decisions on natural resource management in the national and regional level (SACEP, 2008).

In order to mitigate and reduce the pressure on environment, accurate, reliable and timely information is required. The absence of accurate information hampers effective decision and policy making. The information database on environment components/sectors in the form of environment statistics, text, tables and interactive maps should be compiled at one place, which will provide easy access to interactive spatial and statistical environment information.

1.2 Context

Realising the importance of Environmental Information, data and information management was identified as one of the key areas concerned in the region, in the Ninth Governing Council (GC) meeting of SACEP held at Thimphu, Bhutan in August 2005. Scattered information and data, and lack of tools, technical expertise and resources have been the limitations to provide policy briefs to decision makers. The work recommended in the Ninth GC was reiterated in the Tenth GC meeting held in Kathmandu, Nepal in January 2007. The 11th Meeting of the Governing Council of SACEP held in Jaipur, India in 2008 approved the proposal on Establishment of Environmental Data and Information Management System (EDIMS) for South Asia. UNEP was requested to support for the implementation of the proposal at the 12th Meeting of the Governing of SACEP held in Colombo, Sri Lanka in 2010.

The proposed database management system will provide updated information for SoE reporting; preparation of regional sustainable development strategies and act as the sub-regional hub to the e-KH (environmental knowledge hub) for the Asia Pacific region under the guidance of UNEP ROAP.

1.3 Overall Objective

The overall objective of this initiative is to strengthen the environmental data and information base in South Asia for improved decision-making for sustainable development (SACEP, 2008).

1.4 Specific Objectives

- Establish a Regional Environmental Data and Information Management System at the SACEP Secretariat;
- Networking existing Centers of Excellence in South Asia
- Build capacity of sub-regional and national organizations on environmental data and information management applying standard formats and methodologies, which are involved and contributed to data and information reporting;
- Assist in the development and dissemination of environmental data and information products responding to the needs of a wide variety of user groups using regional and national networks.

1.5 Inception and Training Workshop

In order to initiate the process, a two day Inception and Training Workshop on Establishment of Environmental Data and Information Management System for South Asia was held in Colombo, Sri Lanka from 9–10 February, 2012. The workshop was attended by all member countries of SACEP. It was also attended by resource persons from UNEP – Nairobi, Development Alternatives – India, UNEP-RRC.AP and National Environmental Information Management System Project of Pakistan. An outcome of the

workshop was the decision to carry out a detailed assessment to identify the information systems in different countries as well as the organizations generating relevant data. The users and their information needs at the local, national and regional levels also have to be assessed for relevant data collection.

1.6 Brief description of the assessment

The Need Assessment Report for an Environmental Data and Information System (EDIMS) for South Asia gives an overview of the data and information systems at the National (SACEP countries),Regional (relevant to South Asia) as well as Global level. The report contains a description of each database and information system – themes and indicators, type of data contained, major advantage or disadvantage – for which extensive secondary research has been undertaken by Development Alternatives. Reports, other documents and websites of existing environmental databases and information systems have been referred. Also, the institutions generating environmental data and the Governments and institutions hosting the existing information systems have been identified. The report also contains a brief description of the kinds of users availing information from the identified information systems. Through this secondary research, including review of country specific literature and country presentations made at the inception meeting at Colombo, it has been possible to identify the gaps existing at national and regional level and further analyse the need and ways for overcoming them. Towards the end of the report, recommendations for establishing the EDIMS for South Asia have been presented.

Chapter 2

Environmental Databases and Information Systems

This chapter gives an introduction to environmental databases. It identifies the institutions generating environmental data relevant to South Asia and summarizes the existing environmental information management systems.

2.1 Introduction

Statistics deals with collecting and organizing numerical information for its analysis and interpretation. It plays an important role in different spheres of human activities like industry, commerce and trade, economics, banking, natural and social sciences etc. It is helpful in the formulation of policies; bankers, insurance companies etc. make use of statistical data; and, it is also extremely useful in agricultural research.

In the recent times, statisticians are developing quantitative methods to solve environmental problems. Human beings are dependent on the environment for their development. However, anthropogenic activities are degrading the environment by putting immense pressure on the earth's carrying capacity. Statistics plays a vital role in management, analysis and dissemination of data related to complex and interrelated environmental issues. Addressing these issues requires effective use of the reliable information on environment. Environmental statistics describe the state and trends of environment, covering the media of natural environment (air and climate, water, land and soil), the biota within the media and the human settlements (OECD, 2007). They would also answer questions related to waste, noise, biodiversity, hazardous substances etc. Information is collected in various forms and is categorized into biological, physical, chemical, geological, and other themes of data to elaborate on the state and trends of the environment. Environmental database is the systematic collection of qualitative and quantitative information of environmental resources. This information will require regular updates to keep track of the changes occurring in them. A database can be called an environmental database if it fulfils the following three conditions:

1. Majority of data is environmental data.
2. A database system is used for the storage of these data.
3. The database is established as the basis for environmental queries (Baumewerd-Ahlmann and Zink 1995).

Environmental databases have various applications:

1. It helps in the analysis of current state and trends of environmental factors and would help in predicting the future trends. It acts as a pre-requisite for the 'State of Environment Reports'.

2. It will also help in environmental impact assessment. On the basis of that a decision can be taken about the implementation of a development activity in an area.
3. It is a source of dissemination of information to the general public which can help in increasing their awareness about the various environmental issues.
4. Formulation of sound policies also requires reliable and timely information. Databases can help the policy makers in this process.
5. It can also serve as a source of information for academic purposes.
6. It also helps in addressing trans-boundary issues.

Progress in the fields of information technology, geographical information systems (GIS) and remote sensing as well as database management, measuring instruments, data visualization tools has made the collection, compilation and dissemination of data a lot easier. These advances have helped in better state of environment reporting with accurate and up-to-date information. Databases also have provisions allowing users to access and download data.

The environmental data for maintaining a database can be obtained from various sources. These sources can be categorized as follows:

1. **Primary Information:** This information can be obtained first hand by the means of surveys. Surveys can be conducted with the help of questionnaires and interviews with relevant stakeholders. Such surveys are mostly carried out by the Government and some research organizations/ institutions.
2. **Secondary Information:** Data is obtained from published and unpublished sources. Secondary sources are important as they avoid duplication of efforts in collecting the same set of data.
3. **Monitoring Data:** This refers to the factors which change temporally and spatially. Constant monitoring is required to keep track of the changes. This includes meteorological data like rainfall or temperature and pollution of air, water and noise etc.

Classification of Databases

Environmental databases are varied in their type and content. They are also found in different types of media like CD-ROM, publications and on Internet. Databases belonging to a particular medium can be grouped according to their subject into general subject databases, scientific and technical databases andbusiness and regulatory databases.

Apart from categorizing according to their media type, databases can also be classified according to the type of information they contain, e.g. databases dealing with specific information like land use data, air quality etc. Lastly, environment databases can be categorized according to the database structure and their information types. The databases are categorized into fact-based, text-based and integrated databases.

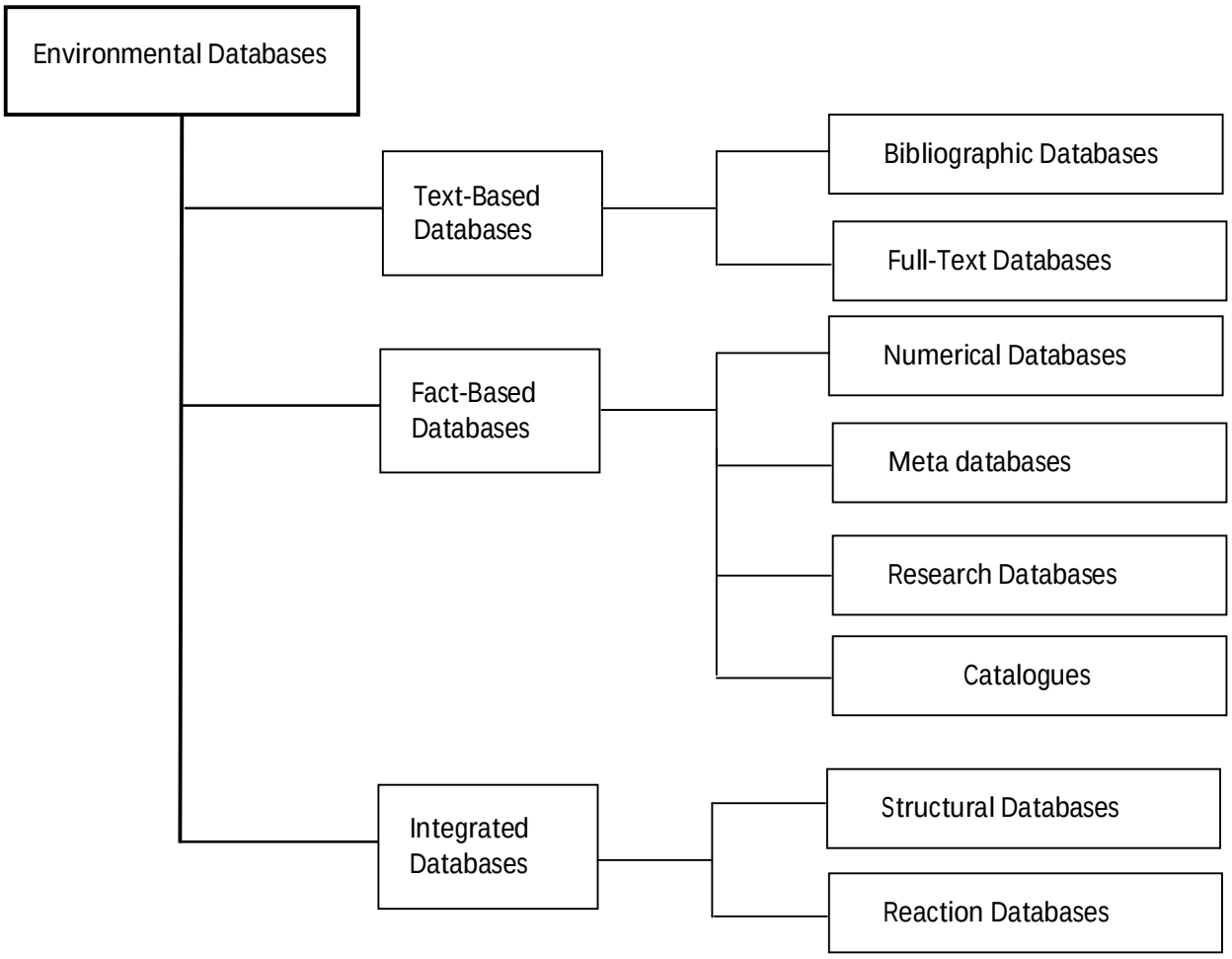


Figure 1: Types of Environmental Databases (Source: Environmental Information Databases, Kristina Voigt, GSF- National Research Center for Environment and Health, Nueherberg, Germany.
www.wiley.com/legacy/wileychi/ecc/samples/sample06.pdf)

Development of Environmental Databases and Information Systems around the World

The United Nations Environment Programme (UNEP) was created in 1972 after the Stockholm Conference on Human Environment. After its conception, UNEP prioritized the collection of data and information related to environment as an urgent task (Wallen 1997). For the effective collection and utilisation of data, UNEP along with Global Environment Monitoring System (GEMS) created INFOTERRA (International Environment Information System) by the end of 1970s. It was created as a response to an increasing world demand for accurate, quality information for environmental planning development (UNEP 1979). Around 1981-1983, UNEP developed Global Resource Information Database (GRID). GRID helps in organizing the available environmental data into credible, science-based information products. It also makes use of Geographical Information System (GIS) by integrating it with environmental data.

Another initiative after the Stockholm Conference was taken by the Economic Commission of Europe (ECE) in 1973 for the development of environment statistics. A draft programme of international work in environmental statistics was first submitted to the Statistical Commission at its eighteenth session in 1974. UN-ECE worked on developing standard environmental statistics classifications.

Agenda 21 also mentions the development of environmental information systems. It is mentioned in the article 12.7 of chapter 12, which deals with desertification. According to it, Governments at the appropriate level, with the support of relevant international and regional organizations, should:

a. Establish and/or strengthen environment information systems at the national level;
b. Strengthen national, state/provincial and local assessment and ensure cooperation/networking between existing environmental information and monitoring systems, such as Earthwatch and the Sahara and Sahel Observatory;
c. Strengthen the capacity of national institutions to analyse environmental data so that ecological changes can be monitored and environmental information obtained on a continuing basis at the national level.

Chapter 40 'Information for Decision Making' also focuses on the importance of data for sustainable development. According to it, the need for information arises at all levels, from that of senior decision-makers at the national and international levels to the grassroots and individual levels. The following two programme areas need to be implemented to ensure that decisions are based increasingly on sound information:

a. Bridging the data gap;
b. Improving information availability

Relevant international organizations should develop practical recommendations for coordinated, harmonized collection and assessment of data at the national and international levels. National and international data and information centres should set up continuous and accurate data-collection systems and make use of geographic information systems, expert systems, models and a variety of other techniques for the assessment and analysis of data. (Article 40.9)

Special emphasis should be placed on the transformation of existing information into forms more useful for decision-making and on targeting information at different user groups. Electronic and non-electronic formats should be used for this purpose. (Article 40.22)

Countries, international organizations, including organs and organizations of the United Nations system, and non-governmental organizations should exploit various initiatives for electronic links to support information sharing, to provide access to databases and other information sources, to facilitate communication for meeting broader objectives, such as the implementation of Agenda 21, to facilitate inter-governmental negotiations, to monitor conventions and efforts for sustainable development to transmit environmental alerts, and to transfer technical data. (Article 40.25)

Implementing the Agenda 21, UNEP established various databases and information systems like the GEO portal and a set of regional systems such as BALLERINA for Baltic Sea area and EIS-SSA for sub-Saharan Africa etc.

The United Nations Statistical Division (UNSD) was also established under the United Nations Department of Economic and Social Affairs (DESA). UNSD developed a *Framework for the Development of Environment Statistics (FDES)* that was published in 1984. The FDES presented a systematic approach to the organization and development of environment statistics.The FDES sets out the scope of environment statistics by relating the components of the environment to information categories that are based on the recognition that environmental problems are the result of human activities and natural events reflecting a sequence of action, impact, and reaction. UNSD worked on developing conceptual frameworks, indicators and environmental-economic accounting. It embarked on data collection in 1990s. In 2012, UNSD adopted the System of Environmental Economic Accounting (SEEA) Central Framework as an international statistical standard for official statistics at its 43rd session in 2012.

Later on, Organization for Economic Cooperation and Development (OECD) and Eurostat also commenced the collection of environment statistics. Millennium Declaration also requires keeping track of the Millennium Development Goals (MDG) through indicators, thus necessitating the development of databases. Other initiatives to develop an information system include the Shared Environment Information System (SEIS) covering 53 countries including the countries in the European Environment Agency and the pan-European countries. It is a decentralised system where data is collected from governments, scientific organizations, businesses etc. and shared with all the interested parties.

2.2 Environmental databases and information systems - An Overview

The eight South Asian countries – Afghanistan, Bangladesh, Bhutan, India, Nepal, Maldives, Pakistan and Sri Lanka –carry out environmental planning and management through their Environmental Ministries/Agencies. Some of these countries have national level databases and information systems for environmental data management and some are beginning to initiate similar processes. The country-wise scenario of environmental information sources is presented below.

2.2.1 National Assessment

Afghanistan

Afghanistan has a number of sectoral ministries that focus on different environmental issues. Ministry of Energy and Water, Ministry of Agriculture, Irrigation and Livestock and Ministry of Mines-Afghanistan Geological Survey are some of the government bodies that look after the respective sectors associated with environment.

Management and protection of environment has been a very recent focus for Afghanistan. The National Environment Protection Agency (NEPA) was established in 2005. In the same year, Afghanistan's first

environmental law was drafted. NEPA is the key agency for communication and outreach for environmental information to ensure improved awareness on environmental issues.

At present, there is an Information Gateway for water sector under the Ministry of Energy and Water. It is an online library system for technical and commercial information on water and related issues in Afghanistan. A national level environment database, though, is not yet present.

Bangladesh

The primary sources of environment related information in Bangladesh are the Ministry of Environment and Forests of Bangladesh and Bangladesh Bureau of Statistics. Research and Development Institutions such as the Department of Environment, Soil Resource Development Institute have made use of information technology and geographic information systems to develop thematic databases. However, there is a gap in terms of a comprehensive national level database for environment related data.

The **Ministry of Environment and Forests** (MoEF) is the nodal agency of the Central Government of Bangladesh exclusively for the planning, promotion, coordination and overseeing the implementation of the environmental and forestry programmes. It carries out data generation and building of information systems in collaboration with the Centre of Environmental and Geographic Information Systems.
Web link: http://www.moef.gov.bd/

Bangladesh Bureau of Statistics is the centralized official statistical system of Bangladesh, producing statistical data of all the sectors of the Bangladesh economy. It produces statistics on environment and disseminates them through the Compendium of Environment Statistics of Bangladesh and the Handbook of Environment Statistics.
Web link: http://www.bbs.gov.bd/

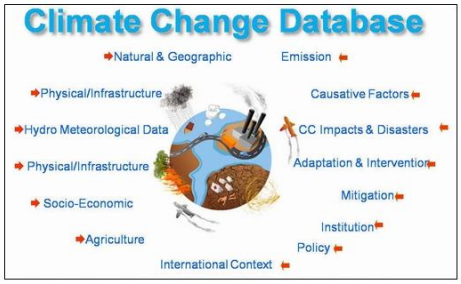
Centre for Environmental and Geographic Information Services (CEGIS), a public trust under the Ministry of Water Resources, functions as an independent centre to support management of natural resources using information technology, remote sensing and geographic information systems.

CEGIS has expertise in GIS and web-based application software and database management. It is involved in various environment related database development activities on project basis for different Government departments and institutes. Its database development projects are:-

1. Soil and Resource Information System, for Soil Resource Development Institute
2. Climate Change Database, for Department of Environment
3. GIS based application of Agriculture division, for Planning Commission
4. Integrated Coastal Resource Database, for ICZMP project
5. Soil and Land Resource Information System (SOLARIS) and its updation, for Soil Resource Development Institute
6. Generation of information for Biosafety Framework, for Department of Environment

Web link: http://www.cegisbd.com/

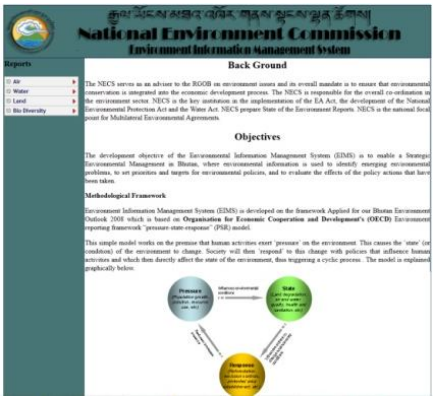
Bangladesh Agricultural Research Council of the Ministry of Agriculture has developed and maintains a number of



Database Systems for agricultural planners, researchers, extension agents and educationists of the country. These include national level spatial and non-spatial datasets on natural resources such as Climatic, hydrologic and land resources, and databases of cropping pattern, farming and forestry among others.

The Climate Change Cell of **Department of Environment** is in process of developing an updated and web enabled Climate Change Database of Bangladesh. Currently it is an offline database and supplies data upon request.

Bhutan



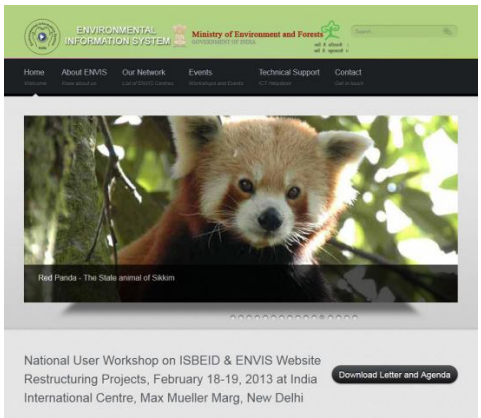
Bhutan has a centralized system for environmental data and information management, called the Environment Information Management System (EIMS).

It has been established by the **National Environment Commission** (NEC) of Bhutan, which is a high level autonomous agency of the Royal Government of Bhutan, mandated to look after all issues related to environment in Bhutan

EIMS has since long been conceptualized and initiated. At present, gaps exist in terms of data management. As part of development, the NEC is in the phase of strengthening the system. The system is being developed using the DevInfo platform and encompasses the whole DPSIR framework as used in the draft Bhutan Environment Outlook 2013.
Web Link: http://www.nec.gov.bt/eims/

India

In India, various environment databases and information systems exist, such as ISBEID, WRIS, Bhuvan. Technologies such as GIS and ICT are being increasingly used to establish thematic databases and information systems. There have been significant overall efforts, yet the use of the systems is delimited by the lack of timely data integration and updation. The organisations generating environmental data and their databases are discussed below.



The **Ministry of Environment and Forests** (MoEF) is the nodal agency in the Central Government for overseeing the implementation of India's environment and forest policies and programmes.

The Environmental Information System (ENVIS) is a primary initiative of the MoEF to have information and data on environmental parameters. Focus of ENVIS is on providing

environmental information to decision makers, policy planners, scientists and engineers, research workers, etc. ENVIS is a decentralized system with a network of distributed subject oriented Centres. The objective is to ensure integration of national efforts in environmental information collection, collation, storage, retrieval and dissemination to all concerned. At present, there are 67 ENVIS Centres of which 39 are subject-specific and 28 focused on state/ UT related issues.
Web link: http://envis.nic.in/

Under the aegis of MoEF, Government of India has initiated an application called Indian State Level Basic Environmental Information Database (ISBEID) to utilize the strengths of Web Geographic Information System (GIS) for dissemination of information related to various Environment related areas. ISBEID is a centralized web based Environmental Information system for efficient management of spatial/non spatial information on various environmental areas through Interactive maps that are capable of handling various GIS operations. The non-spatial data can be regularly updated by various ENVIS nodes with password security.
Web link: http://isbeid.gov.in/

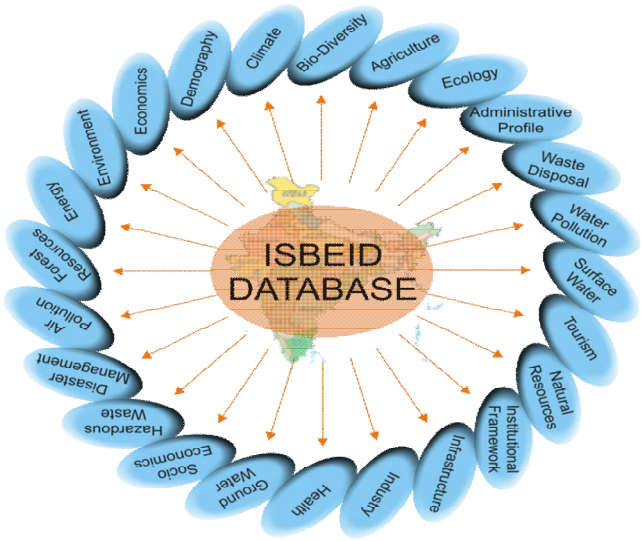
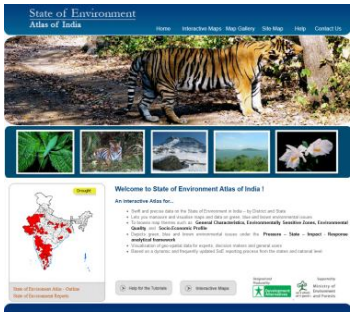


Figure 2. List of themes in ISBEID

A State of Environment (SoE) Atlas – India has been developed by Development Alternatives for MoEF, as an interactive Atlas for maps and data on green, blue and brown environmental issues to indicate the status of environment. It contains GIS based maps under the categories of General Characteristics, Environmentally Sensitive Zones, Environmental Quality, and Socio-Economic Profile, along with brief write-ups on various sections and captures priority issues in the

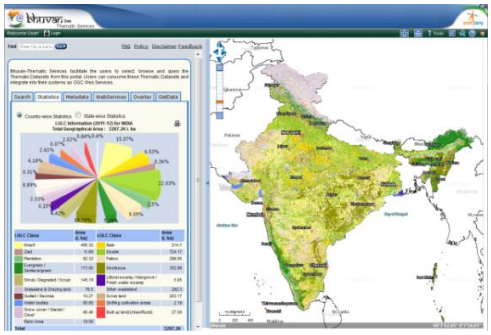


Pressure-State-Impact-Response framework. It has been created as a web based as well as desktop application.
Web link: http://www.soeatlas.org/default.aspx

The **Ministry of Statistics and Programme Implementation** (MOSPI) compiles the national environmental statistics and publishes the Compendium of Environment Statistics. The Compendium of Environment Statistics 2011 is the twelfth edition of its series, which initially commenced in 1997. Apart from this, it has also published the annual Energy Statistics report.

In order to improve spatial data management practices for better resource management, the Government of India has established a national infrastructure termed as the **National Spatial Data Infrastructure** (NSDI). It is a gateway of spatial data being generated by various agencies and includes the India Geo-portal. NSDI has developed and maintained a digital collection of spatial data as well as metadata pertaining to environmental and cultural phenomena in tune with the international standards of ISO and OGC (NSDI 2009).
Web link: https://nsdiindia.gov.in/nsdi/nsdiportal/index.jsp

National Remote Sensing Centre is the pioneer organization in India for aerial and satellite data acquisition, processing, mapping and data supply. It has been a major force in adoption of geo-spatial technologies in the country. NRSC has established a geo-portal called Bhuvan.



Bhuvan provides data and image visualization through WebGIS services. It showcases Indian Remote Sensing Satellite imagery along with value-added spatial information pertaining to land, weather and disasters. While the GIS thematic information and value-added products are freely available to Government officials and departments, general users have access to the database in the form of visualization and snapshots.
Web link: http://bhuvan.nrsc.gov.in/bhuvan_links.php

The **Central Water Commission** of the Ministry of Water Resources, in collaboration with Indian Space Research Organisation, has established an information portal on water resources of India called the Water Resources Information System, India-WRIS Web GIS. India-WRIS provides data on India's water resources along with allied natural resources in a GIS framework for monitoring and planning purposes and Integrated Water Resources Management.

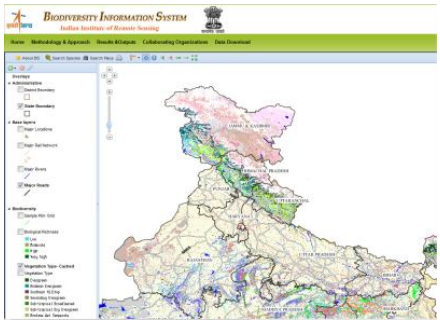
The data is collected from the concerned State Government departments, CWC offices and Government of India departments. It contains information on 12 themes- surface water, ground water, hydro-met, water quality, snow cover/glacier, inter-basin transfer links and water tourism among others. The database for some of these is still

underway.

The India-WRIS Mobile App gives the smart phone users access to information about water resources specific to the current geographic location of the user, such as proximity to a resource, tourist spots etc.
Web Link: http://www.india-wris.nrsc.gov.in/

Soil and Land Use Survey of India of the Ministry of Agriculture is an apex institution in the country for providing detailed scientific database on soil and land characteristics for planning and implementation of soil and water conservation in the watershed programme.

SLUSI maintains a digital National Database on soil and land resources of the country. The database contains a Soil Information System for priority watersheds, spatial data for all catchments and a State-wise Micro-watershed Atlas of India, all as GIS-based Web Services. It is also expected to soon provide a digital Watershed Atlas of India.
Web Link: http://slusi.dacnet.nic.in/



The **Department of Biotechnology** and **Department of Space** have jointly launched a Biodiversity Information System. It contains a species database and a large amount of spatial information on various facets of biodiversity for entire India for the purpose of prioritization, conservation and bio-prospecting. The information system was launched in 2012 and its development is under progress.
Web Link: http://bis.iirs.gov.in/

The **Forest Survey of India,** under the MoEF, has released an interactive geo-portal on forests, in collaboration with National Spatial Data Infrastructure (NSDI) for the purpose of monitoring the status of forests in India and the forest conservation initiatives of the government. It also publishes the Indian State of Forest Report every two years.
Web link: http://117.239.115.45/FCM2011/

Nepal

Currently, there is an absence of any organised environmental database or information system in Nepal. This can be attributed to a lack of resources (human and financial), institutional set-up and access to training. Environmental data is primarily available from the Ministry of Environment along with other institutions which are responsible for environmental monitoring, and the Central Bureau of Statistics which prepares an annual report on Environment Statistics of Nepal (Pantha, R. & Kunwar N. B., 2012)

Pakistan

Pakistan is emerging with its National Environment Information Management System. NEIMS has been in the pipeline for a long while, and is expected to be complete and launched soon.

National Environment Information Management System (NEIMS) has been established by the Government of Pakistan for the purpose of creating a sectoral and inter-sectoral database of existing environmental information in the country. The website of NEIMS carries the outline and structure of the information system. Data integration however is yet to commence.

Web link: http://neims.com.pk/index.php

Pakistan Bureau of Statistics compiles environment statistics and brings out a Compendium on Environment Statistics of Pakistan. The most recent Compendium was released in 2010. This publication provides environment statistics compiled through secondary sources, presented in the light of socio-economic activities, natural events and environmental impacts.

Republic of Maldives

Maldives faces severe environmental damage due to rapid economic growth and at the same time suffers from lack of adequate data on status of environment for planning and research.

The sources of environmental information are limited to the annual Statistical Yearbook of Maldives released by the **Department of National Planning** and the State of Environment Reports produced by the **Ministry of Environment and Energy**. Due to a number of constraints of line departments, only the most important environmental statistics are collected (ESCAP). Complete absence of environmental information pertaining to issues such as chemical and toxicology hinders not just evaluation and state of the issue but also assessment of risks (Ministry of Environment and Energy, 2011).

The lack of a centralized information system poses a major challenge. However, **National GIS Database** establishment work is underway as part of the Maldives Environment Management Project (MEMP) (Zuhair, M. H. & Azhar, H., 2012).

Sri Lanka

Establishment of environment data and information and its management through technology is at a very nascent stage in Sri Lanka. Digital data and maps on important themes are available with the Ministry of Environment and Renewable Energy; however a national environment database needs to be established.

The Ministry of Environment and Renewable Energy is the national focal point for environment related matters in Sri Lanka. In Sri Lanka, there is a considerable amount of information related to environment.

However, this information is scattered among the various agencies ranging from the Ministry of Environment and Renewable Energy, the Central Environment Authority to the Ministry of Defense, Ministry of Agriculture and many others. In addition there are also non-governmental organizations which have environmental information. The major issue related to environmental related information management in Sri Lanka s consolidation of this information into a centralized system and enable access to it by the relevant stakeholders. The Ministry of Environment and Renewable Energy necessitates the establishment of an environmental information system.

An information system for farmers in Sri Lanka is the Agriculture Information Management System (AgMIS). The **Ministry of Agriculture** of Sri Lanka maintains and operates the system. It contains information on commercially cultivated food crops, production, yield forecast and the contact details of farmers and officers involved. The database also assists government officers and policy makers in decision-making in the food crop sector.

Web link: http://www.agridept.gov.lk/index.php/en/farmer-database

2.2.2 Regional Assessment

South Asia Co-operative Environment Programme (SACEP) is an inter-governmental organization formed by the governments of South Asia to promote and support protection, management and enhancement of the environment in the region. SACEP member countries are Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.
One of its initiatives, South Asia Environmental and Natural Resources Information Centre (SENRIC) has been involved in training, data management activities, assessments and reports. It has produced State of Environment reports of the SACEP countries and South Asia regional State of the Environment reports. These publications serve as important documents containing data and information on the environment of the region and are available on the website of SACEP.
Web link: http://www.sacep.org/html/senric_main.htm

A web based portal for disaster related information in South Asia is the South Asia Disaster Knowledge Network (SADKN). The purpose of the network-cum-geoportal, developed by the **South Asian Association for Regional Cooperation (SAARC)** in partnership with the national governments of South Asia region and a number of knowledge based institutions and launched in 2011, is to organise information on disaster management and connect organizations, communities and individuals to share knowledge and experience to build disaster preparedness in South Asia. The South Asian countries included are Afghanistan, Bangladesh, India, Kyrgyzstan, Maldives, Nepal, Pakistan and Sri Lanka. The SADKN has been supported by the United Nations International Strategy for Disaster Reduction with financial assistance from Global Facility for Disaster Reduction and Recovery of the World Bank.
Web link: http://saarc-sadkn.org/

Another information management portal established by the SAARC is the South Asia Digital Vulnerability Atlas (SADVA). SADVA is a web GIS based Atlas for providing information pertaining to vulnerability of the South Asian countries to disasters through maps on hazard zones, demographic spread and vulnerability and risk indices.
Weblink: http://saarc-dva.org/

The Mountain Environment and Natural Resources' Information System (MENRIS) Division of ICIMOD is an important resource centre for geo- spatial information and resources on Hindu Kush Himalayas. The **International Centre for Integrated Mountain Development (ICIMOD)** is a regional inter-governmental learning and knowledge sharing centre serving the eight regional member countries of the Hindu Kush Himalayas in Asia – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan.

MENRIS maintains the Mountain Geo-Portal for providing information on regional issues. The Geo-Portal has an online GIS database of HKH through which it provides open and free access to data on themes of Climate, Disaster and Natural Hazard, Land Cover Land Use, Ecosystem and Biodiversity, Water and Cryosphere and also Socio-economy and Livelihoods. It has other thematic portals such as the HKH HYCOS Regional Flood Information System, Indus Portal, HKH Conservation Portal, which is a regional repository of biodiversity and conservation related information, and SERVIR Himalaya, which is a regional visualization and monitoring system and a joint venture by the National Aeronautics and Space Agency (NASA) and the US Agency for International Development.
Weblink: http://www.icimod.org/

UNEP's Environmental Knowledge Hub (eKH) aims to build a virtual storehouse of information about the environment in the Asia and Pacific region and serve as a decentralized knowledge network enhancing regional cooperation and public participation in decision-making and actions for environmental management.

eKH is an online portal and provides data and information on four core themes- Air, Biodiversity, Land and Water. Information is presented in the form of various publications and other resources, and country profiles.
Web link: http://www.ekh.unep.org/?q=front_page

The **United Nations Economic and Social Commission for Asia and the Pacific** (UNESCAP) is an organization of the United Nations for development in the Asia-Pacific region.

ESCAP maintains an online database of country level secondary data including environmental indicators pertaining to air pollution, energy consumption and supply, water use and withdrawal, and forests and protected areas, as well as indicators on natural disasters. It provides aggregate data for the world and major geographic regions and sub-regions of ESCAP countries.
Web link: http://www.unescap.org/stat/data/

Asian Development Bank (ADB), a multilateral development finance institution in the Asia and Pacific region, has a central statistical database called the Statistical Database System (SDBS) that stores economic and social data for its developing member countries. Some datasets are available free-of-cost while others need to be purchased. The environmental indicators included in SDBS pertain to land use, flora and fauna, biodiversity, air pollution and energy. However, the data for Afghanistan, Bhutan, Bangladesh, India, Pakistan, Sri Lanka and Maldives is limited.
Web link: https://sdbs.adb.org/sdbs/index.jsp

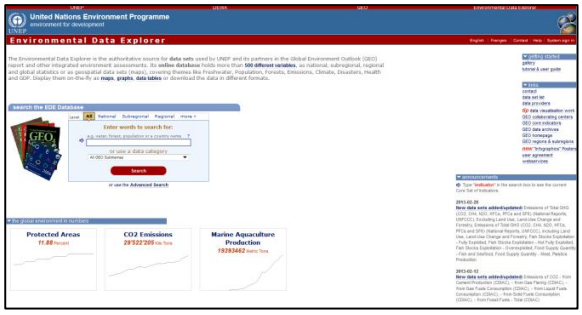
2.2.3 Global Assessment

The **United Nations Environment Programme** (UNEP) has established large platforms for information-sharing such as the GEO data portal and UNEP-Live.

UNEP-Live has been initiated with a view to keep track of the state of world environment and make information easily accessible. The prototype was developed with support from ESRI and launched in 2012. It is modelled around the Eye on Earth platform of the European Environment Agency (EEA) and aims to report the State of Environment as a dynamic process, assembling time series data, indicators and other resources and enabling interpretation and analysis.
Weblink: http://www.uneplive.org/uneplive/catalog/main/home.page

GEO Data Portal - UNEP Environmental Data Explorer is an online portal for data sets used by UNEP and its partners in the Global Environment Outlook (GEO) report and other integrated environment assessments. It offers more than 1400 datasets and 500 variables as national, regional, sub regional and global statistics or as geospatial datasets including temporal data.

The datasets are broadly divided into categories of Climate change, Disaster and conflicts, Ecosystem management, Environmental governance, Harmful substances and hazardous waste, Resource efficiency and General- which contains watershed boundaries and data on motor vehicles in use, among others. It has a separate page dedicated to the Asia and Pacific region. Some datasets in the portal are restricted while others are freely available.



Web link: http://geodata.grid.unep.ch/

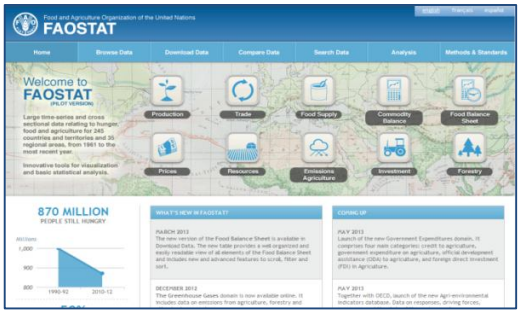
Food and Agriculture Organization of the United Nations also serves as a knowledge network. It creates and maintains several statistical data on food, agriculture and natural resources. The important environment-related databases maintained by FAO include:

i. **Agro-MAPS:** It is a global spatial database on agriculture parameters and is available as an interactive website.

ii. **AQUASTAT:** It is a global information system providing data on water and agriculture, with emphasis on developing countries.

iii. **CountrySTAT:** It is a national statistical information system on food and agriculture.

iv. **FAOSTAT:** It is the FAO statistical database, containing time-series on agriculture, nutrition, fisheries, forestry and food aid.



v. **Fishery and Aquaculture Statistics:**It provides fishery and aquaculture data on capture and consumption, available as 50 year time series.

vi. **Forestry Country Profiles:** It provides information on forests and forestry for over 200 countries and regions of the world.

vii. **Global Livestock Production and Health Atlas (GLiPHA):**It provides an overview of spatial and temporal variation of quantitative information related to animal production and health.

viii. **TERRASTAT:**It houses databases and information systems containing data on soil and land.

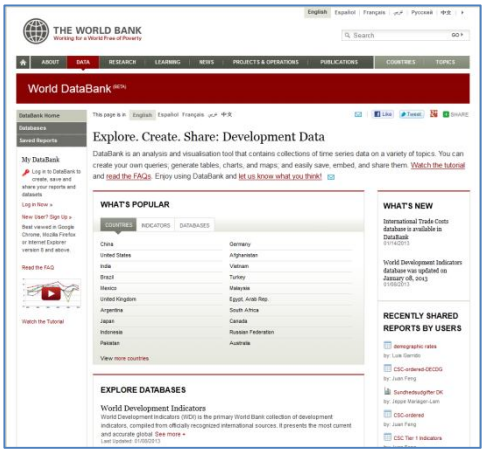
Web link: http://www.fao.org/corp/statistics/en/

Table 1: Some of the important characteristics of FAO databases vis-à-vis eight South Asian countries India, Pakistan, Maldives, Bangladesh, Bhutan, Nepal, Afghanistan and Sri Lanka

Database	Agro-MAPS	AQUASTAT	CountrySTAT	FAOSTAT	Fishery and Aquaculture Statistics	Forestry Country Profiles	Global Livestock Production and Health Atlas (GLiPHA)	TERRASTAT
Core themes/data	- Area Harvested - Production - Yield	- Land use and population - Water use, by sector and by source - Climate and water resources - Irrigation and drainage development - Environment and health	Data only from Bhutan among the seven South Asian countries available - food statistics - agriculture statistics	- Trade - Food Balance Sheet - Food Supply - Foresty - Investment - Population - Prices - Production - Resources - Commodity Balance	- Global Fishery Production - Global Aquaculture Production - Global Capture Production - Consumption of fish and fishery products - Others	-Species - Forest area Statistics - Growing Stock Statistics -Planted Forests -Disturbance Statistics	- Human Demographics -Land -Livestock Population -LivestockProduction	- Land use and land cover - Land resources - Soil quality and properties - Global terrain
Time	varies	varies	varies	varies	1976-2009	varies. Latest available data is of 2005	varies	varies
Scale	National and Subnational Level	National and regional Level	National and Subnational Level	National Level	National Level	National Level	National Level	Global, national and regional level
Data Format	- Geospatial data - Tabular data - Online query	- Geospatial data - Tabular data - Online query	-Tabular -Online query	- Geospatial data - Tabular data - Online query	- Geospatial data - Tabular data - Online query	-Tabular -Online query	- Geospatial data - Tabular data - Online query	- Geospatial data - Maps - Statistics
Link	http://kids.fao.org/agromaps/	http://www.fao.org/nr/water/aquastat/main/index.stm	http://www.fao.org/economic/ess/countrystat/en/	http://faostat3.fao.org/home/index.html	http://www.fao.org/fishery/statistics/en	http://www.fao.org/forestry/country/en/	http://kids.fao.org/gliphа/	http://www.fao.org/nr/aboutnr/nrl/en/

World Bank

World Bank maintains an online databaseconsisting of indicators on various topics ranging from Health, Agricultural and Rural Development and Poverty to topics like Energy and Mining, Climate Change and Environment.



The indicators in Environment section coverforests, biodiversity, emissions and pollution, whereas climate systems, exposure to climate impacts, greenhouse gas emissions and energy use are covered in Climate Change section. The website has the provision of online viewing and comparative analysis of data, both region-wise and country-wise.

The following table providesan overview of data availability vis-à-vis the eight South Asian countries.
Web link: http://databank.worldbank.org/data/home.aspx

United Nations Statistical Division

The United Nations Statistical Division (UNSD)launchedUNdatain order to provide free access to global statistics and educate users about the importance of statistics for policy and decision making and to assist member countries in strengthening their data dissemination capabilities.
UNdata is an Internet based data access system to the United Nations databases. It makes available (through a single access window) all the statistical databases of the United Nations collected over the years since the establishmentof the organization. The information system allows query-based searches, viewing country profiles and accessing tabular data and numerous glossaries. It covers a wide range of themes including Agriculture, Energy, Environment as well as the Millennium Development Goals indicators.

Three Environment databases are contained in the UNdata:

i. Environment Statistics Database, UNSD: This database contains data related to water, particularly freshwater, groundwater and precipitation, and waste (municipal waste and hazardous waste).

ii. Greenhouse Gas Inventory Data, United Nations Framework Convention on Climate Change (UNFCC): This database carries information on emission of various greenhouse gases.

iii. World Meteorological Organization Standard Normals, World Meteorological Organization (WMO):It contains nearly 70 meteorological indicators/variables such as radiation, precipitation, temperature, wind and other weather-related phenomena.

Although a large number of indicators are present in the databases, distinct data gaps still exist for several countries. There is a lack of data on the eight South Asian countries.
Web link: http://data.un.org/In close collaboration with other agencies and organizations, the UNSD also coordinates the preparation of data analysis to assess progress made towards the United Nations Millennium Development Goals Indicators (MDGs) and maintains the database containing the data series related to the selected indicators. The assessment of progress is carried out periodically and the database is compiled and presented online on the UNSD website, the latest compilation being MDGInfo 2012. MDGInfo is an online information system, providing statistics to the users through querying of the database and presenting the data in tables, graphs and maps. The statistics cover the region of Southern Asia and Developing regions as well as the other countries in the region.

The statistics presented in the database are sourced from statistical organizations in the Government of the countries and wherever data is not available or submitted to UNSD, modeled data is substituted in progress tracking.

Besides the current status of progress, country and regional snapshots are also present. The snapshots present a summary and analysis of the progress made since 1990 towards the MDGs at country and regional levels.
Web link: http://mdgs.un.org/unsd/mdg/

Chapter 3

Environmental Data and Information Management System – Users' Assessment

This chapter identifies the different users of environmental data and their needs.

There are various stakeholders of environmental data and information systems like government departments and policy-makers, non-governmental organizations and private sectors, scientists and research organizations, and individual researchers. Environment is a complex and inter-connected field, connecting various fields like meteorology, energy, biodiversity, urban development, economic growth etc. The users of the environmental information systems can be categorized as follows:

1. **Government Departments**: Environmental information plays a vital role not only in formulating environmental management policies but also in the decision making process aimed at environmental protection and improvement of environment for sustaining good quality of life for the living beings. Apart from procuring accurate data for sound policy making, data is also required to monitor the impacts of environment policies and programmes. Various government departments require high quality environmental, scientific and social data for environmental assessments. Departments include central ministries, state ministries and Union Territories, and pollution control boards.

   Central Ministries/Nodal Agencies:

   a. Afghanistan:
      - Ministry of Energy and Water
      - Ministry of Mines
      - Ministry of Agriculture

   b. Bangladesh:
      - Ministry of Environment and Forests
      - Ministry of Agriculture
      - Ministry of Food
      - Ministry of Power, Energy and Mineral Resources

   c. Bhutan:
      - National Environment Commission

   d. India:
      - Ministry of Environment and Forests
      - Ministry of Agriculture
      - Ministry of Water Resources
      - Ministry of New and Renewable Energy
      - Ministry of Drinking Water Supply and Sanitation
      - Ministry of Power

   e. The Republic of Maldives:
      - Ministry of Environment, Energy and Water

- Ministries of Fisheries, Agriculture and Marine Resources

f. Nepal:
   - Ministry of Environment
   - Ministry of Energy

g. Pakistan
   - Ministry of Climate Change
   - Ministry of Petroleum and Natural Resources
   - Ministry of Water and Power

h. Sri Lanka:
   - Ministry of Environment
   - Ministry of Irrigation and Water Resources Management
   - Ministry of Power and Energy

Other ministries that utilize environmental data include the Industries department, Planning Commission, urban development, disaster management etc.

Apart from these ministries, there are various agencies that generate and utilize environmental data.

- National Environment Protection Agency, Afghanistan
- National Environment Commission, Royal Government of Bhutan
- Central Pollution Control Board and State Pollution Control Boards, India
- Environment Protection Agency, Maldives
- Environment Protection Agency, Pakistan
- Central Environment Authority, Sri Lanka

2. **Civil Society and Non-Governmental Organizations:** The term civil society is generally used to classify persons, institutions, and organizations that have a goal of advancing or expressing a common purpose through ideas, actions and demands on the government (Cohen and Arato, 1992). Civil society encompasses a range of members, including individuals and academic institutions to non-governmental organizations (NGOs). NGOs are groups of individuals organized for a myriad of reasons that engage human aspirations and imagination. They can be set up to advocate a particular cause such as human rights, or to carry out programmes on the ground, such as disaster relief. They can have membership ranging from local to global (Charnovitz, 1997). NGOs play a crucial role in tackling the environmental issues at the ground level. They are functioning in various sectors like sustainable development, poverty alleviation, protection of forest resources etc. United Nations endorsed the need to collaborate with NGOs, especially in environmental negotiations (Weiss, 1999). The role of NGOs can be divided into the following areas:
   - Information Dissemination
   - Policy development consultation
   - Policy implementation
   - Assessment and monitoring
   - Mobilization of public opinion
   - Delivering technical expertise on a variety of topics

It is evident that the NGOs entail the use of information systems to obtain precise data to perform the above-mentioned functions in a satisfactory manner and help achieve sustainability and protect the environment. A few examples of NGOs working in the South Asia region are World Wildlife Fund for Nature (WWF), Greenpeace, Aga Khan Foundation, and Practical Action among many others.

3. **Academics and Scientific Community:** This group includes research organizations, scientists and individual researchers. The role of the scientific community is to develop knowledge and technology to promote a sustainable and environment-friendly growth. Science has helped the society and the government to shift its focus from economic growth to sustainable growth. Scientific information is essential to identify an environmental problem, its nature and its causes. A qualitative and quantitative prediction of the impacts, both environment and social, also requires the attention of scientific community. Finally, this group also has a role in developing alternate mitigation and adaptation measures. For this, scientists need to browse through information systems for data collection, analysis and presentation.

Apart from the above categorization, users of environmental data and information systems can also be classified according to the various sectors requiring data and information.

- Agriculture
- Biodiversity
- Natural resource management
- Meteorology
- Conventional and non-conventional sources of energy
- Waste management
- Water, sanitation and hygiene
- Glacier monitoring studies
- Environmental health

This list is not exhaustive but only indicative of the various inter-connected fields.

Chapter 4

Recommendations

This chapter suggests institutional, technical and financial options which could be considered to establish an Environmental Data and Information Management System for South Asia.

Based on the secondary research and analysis, it is evident that there is a need to establish the EDIMS for some of the countries as these countries do not have a comprehensive information system on environment and at the same time, strengthen the existing environmental Information System. It has been observed that countries like India have a very well developed EDIMS, such as India's Environmental Information System (ENVIS), which is a de-centralized network of institutions generating data/information on various environmental themes. Some countries have developed an EDIMS, such as Pakistan, which has the National Environmental Information Management System (NEIMS) and is in the process of strengthening the system with data and information. Bhutan has initiated the development of Environmental Information Management System (EIMS) which is still in the conceptualization phase by National Environment Commission. The EIMS is based on the Bhutan Environment Outlook (BEO) framework. The system needs to be strengthened. In all the other countries, there is no comprehensive EDIMS and these countries need to conceptualize and establish, although there are agencies that are generating, collecting and collating data/information on environment indicators.

At the regional level, there is no EDIMS currently for South Asia, although there are platforms such as the Environment Knowledge Hub for Asia and Pacific, GEO data portal, UNEP LIVE which has been conceptualized and is functional. In all these platforms, there has been a sub-regional module on South Asia for which some data/information is available. One of the key gaps in these existing systems is the availability of data/information in a standard format. These existing systems could be strengthened for South Asia or a new system can be designed.

It is therefore concluded that, there is a need to establish EDIMS for South Asia, having data/information in a standard format on the priority environmental issues which have been identified through the consultative process.

Following are some of the options suggested for establishing an Environmental Data and Information Management System for South Asia. **Technical Options**

1. ***Design and development of the web pages (front and landing)***
   Design and development of front and navigational pages along with the database architecture. This includes designing of the user interface, administrative panel as well as the backend application. The existing national platforms, such as the NEIMS, EIMS and ISBEID and the regional platforms would be kept in view while undertaking technical design of the EDIMS.

2. ***Development of a common data format/template for member countries which will facilitate data sharing***

   The environmental parameters and indicators to be included in the database of the information system need to be identified first. A template will be created for collecting the data from the countries. The template would enable uniform and easy data collection. The template already developed by UNEP for collecting the data can be taken. Development Alternatives is collecting data as per the template as part of the development of South Asia Environment Outlook 2013. UNEP's template can be further modified for the EDIMS based on the data collection templates of the existing country level environmental information systems as per the requirement, and the combined template can be used for data collection with the member countries.

3. ***Data collection, collation and analysis***

   Compilation and analysis of environmental data requires understanding of environmental concepts. This forms an important part of the development process of the Environmental Data and Information Management System as the effectiveness of the system relies on it. The collected data would be collated based on the Pressure-State-Impact-Response (PSIR) framework of the OECD.

4. ***Integrating Geographic Information System (GIS) interface***

   Depicting environmental data through GIS will be an effective method of dissemination of information. GIS maps can be prepared as per the PSIR framework adopted in analysis of data, with separate maps indicating Causes and Impacts. Knowledge of GIS software and techniques and experience in developing GIS based applications would be essential for incorporating GIS capability in to the information system.

5. ***EDIMS Hosting and Management***

   Once the information system is created, its maintenance and management would be a continuing process. SACEP would host the EDIMS and also manage the system. The management would include updation and maintenance of the EDIMS with data/information, integrating SoE reports and other related information.

   An agency would be hired for designing and developing the EDIMS. The focal points from the member countries would be involved in designing and developing the EDIMS. The roles and responsibilities of the hired agency will be detailed out in the Terms of Reference (as a separate exercise).

   Broad responsibilities of the **Hired Agency** would be as follows:

   - Data compilation and analysis
   - MIS/GIS database design and module design
   - Design and development of the user interface including front end and back end coding;
   - Training and capacity building support for management of the EDIMS

SACEP Secretariat

- Finalisation of data collection template with country Agencies/Ministries
- Overseeing the progress and activities of the hired Agency
- Management of EDIMS after its development, for which support will be offered by the Agency in the terms of capacity building and training.

UNEP

- UNEP may provide capacity building support for national and regional activities relating to the EDIMS, with support from the hired Agency.

Hosting of EDIMS

The EDIMS can be launched as an independent webpage, for which a domain name would have to be acquired, or can be linked to the SACEP website. In the initial phase, the EDIMS can be linked with the SACEP website in order to have wider outreach. Later on the EDIMS as a standalone web portal can be transferred to an independent domain. The suggested domain name for the EDIMS-South Asia can be www.edims-southasia.org.

Institutional Arrangement for Data Management

In order to institutionalize the data management process for the EDIMS, a Polycentric model is being proposed. The model rests on collaborative efforts of institutions at multiple levels. Data flow will be as follows-

- Environmental Data and Information will be provided by various National level Institutions. The Ministry of Environment/Environment Agency will act as a nodal agency for coordinating the data collection process. It will work with the National level Institutions for getting environment data/information. These would be academic institutions, research organizations, government line ministries and statistical organizations. Selection of the National Institutions will be done by the Ministry of Environment.
- The Ministry/Agency will validate data from the National Institutions of the country.
- The Ministry of Environment/Environmental Agency of the respective countries would provide the data to SACEP.

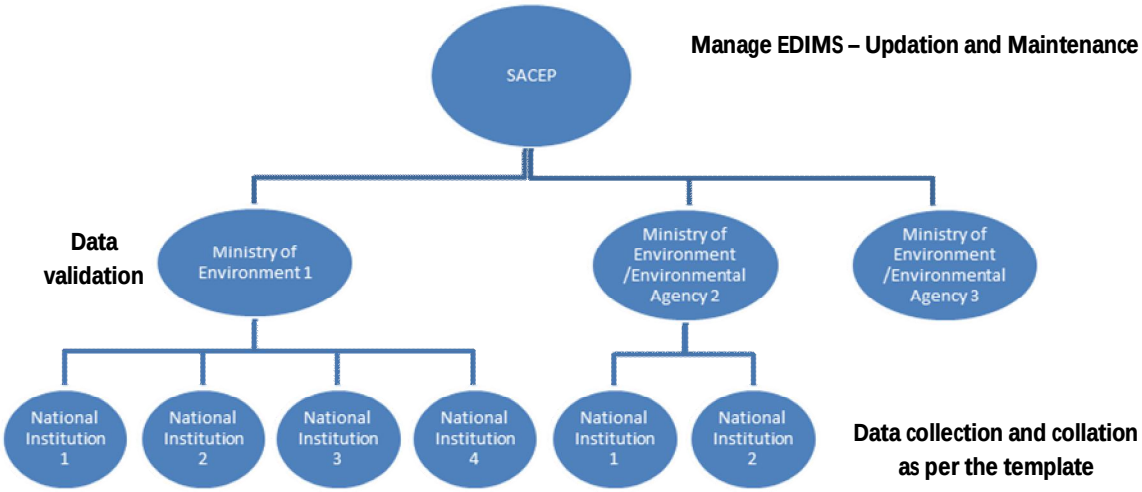


Figure 3. DATA/INFORMATION FLOW Model for EDIMS

This will be a periodic process to keep the EDIMS updated with the latest available information. Updation of the EDIMS would be carried out on a quarterly basis. For data collection and gathering, the hired Agency will build capacities of the National Institutions. Such a process would lead to regular environmental data collection and research in all the countries and would fast track the development of National environmental information systems at the same, in addition to enabling a regional information system.

Financial Option

Developing the EDIMS at the national level will require resources and it is suggested that the UNEP can work with the Ministry of Environment of the countries and mobilize the resources. Funding can also be sought from regional and global level organizations. For establishing the EDIMS for South Asia, UNEP can fund the design and development part along with the initial data collection and collation. Data collection can be part of the existing SAEO development process.

References

Baumewerd-Ahlmann, A. &Zink, L.1995.Umweltdatenbanken, eds. B. Page and L. M. Hilty, Umweltinformatik, InformatikmethodenfurUmweltschutz und Umweltforschung, 2. Auflage, Oldenbourg, Munchen, 1995, pp. 101-124.

Charnovitz, S.,1997. Two Centuries of Participation: NGOs and International Governance. *Michigan Journal of International Law*, 18(2): 183-286.

Cohen, L. & Arato, A., 1992. *Civil Society and Political Theory*. Cambridge, MA: MIT Press.

Ministry of Environment and Energy, 2011. *State of the Environment 2011*.Republic of Maldives: Ministry of Environment and Energy.

Ministry of Environment and Forests, 2011. *Report to the People on Environment and Forests 2010-11*.India: Ministry of Environment and Forests.

NSDI, 2009.*Indian NSDI: A Passionate Saga*. [online] Available at: https://nsdiindia.gov.in/nsdi/nsdiportal/images/NSDI_A_Passionate_Saga.pdf [Accessed 6 February 2013].

OECD, 2007. *Glossary of Statistical Terms*. Paris:Organisation for Economic Co-operation and Development. [online] Available at: http://stats.oecd.org/glossary [Accessed 10 January 2013].

SACEP, 2008. Proposal on Establishment of Environmental Data and Information Management System for South Asia. *Report on the 11th Meeting of the Governing Council*. Jaipur: South Asia Co-operative Environment Programme.

Pantha, R. & Kunwar N. B., 2012. Ministry of Environment, Nepal- Country Presentation. *Workshop Report on Inception and Training Workshop on Environmental Data and Information System for South Asia.* Columbo: South Asia Co-operative Environment Programme.

Zuhair, M. H. & Azhar, H., 2012. Environment Protection Agency, Republic of Maldives- Country Presentation. *Workshop Report on Inception and Training Workshop on Environmental Data and Information System for South Asia.* Columbo: South Asia Co-operative Environment Programme.

UNEP,1979. *UNEP Annual Review, 1978*. Nairobi: United Nations Environment Programme.

Wallen, C. C.,1997. *History of "Earthwatch" 1972-1995*. [online] Available at: http://www.unep.ch/earthw.html [Accessed 17 January 2013].

Weiss, T. G., 1999. *International NGOs, Global Governance and Social Policy in the UN System*.Globalism and Social Policy Programme Occasional Papers, Finland. [online] Available at: http://www.stakes.fi/gaspp/occasional%20papers/gaspp3-1999.pdf [Accessed 17 January 2013].

List of websites

www.agridept.gov.lk

www.barc.gov.bd/inf_sys_data.php

www.bbs.gov.bd

www.climatechangecell.org.bd

www.envis.nic.in

www.isbeid.gov.in

www.soeatlas.org/default.aspx

www.bis.iirs.gov.in

www.bhuvan.nrsc.gov.in/bhuvan_links.php

www.cea.lk

www.cegisbd.com

www.cpcb.nic.in

www.cwc.nic.in

www.data.worldbank.org

www.data.un.org

www.ekh.unep.org

www.icimod.org

www.eyeonearth.org

www.fao.org

www.fsi.org.in

www.india-wris.nrsc.gov.in

www.geodata.grid.unep.ch

www.geodata.rrcap.unep.org

www.unescap.org/drpad/vc/conference/bg_mv_7_sei.htm

www.hdr.undp.org

www.icimod.org

www.mdgs.un.org

www.mocc.gov.pk

www.moef.gov.bd

www.moef.gov.in

www.mospi.nic.in

www.nec.gov.bt/eims

www.neims.com.pk/index.php

www.nsdiindia.gov.in/nsdi/nsdiportal/index.jsp

www.pbs.gov.pk

www.planning.gov.mv/YearBook2011/introduction.html

www.rrcap.ait.asia

www.saarc-sadkn.org

www.saarc-dva.org

www.sacep.org

www.sdbs.adb.org/sdbs/index.jsp

www.slusi.dacnet.nic.in

www.unep.org

www.uneplive.org

www.unescap.org/stat/data