NEW TECHNOLOGIES FOR ENVIRONMENT, DEVELOPMENT AND DISASTERS STUDIES

Technologies like space sciences (SS), remote sensing (RS) and geographic information system (GIS) have wide applications in the natural resources management, development planning, environment studies and disaster monitoring purposes. The state-of-the-art of these modern technologies is to provide an authentic source of information for surveying, identifying, classifying, mapping and monitoring natural resources, environment and disasters in a synoptic perspective. The major fields of applications of SS, RS and GIS are[12]:

-Agriculture and vegetation
-Water resources and hydrological regime studies
-Conservation and environmental management
-Geology and mineral exploration
-Hazard monitoring and disaster mitigation
-Urban planning and industrialization
-Oceanography, marine resources and shipping
-Atmospheric and stratospheric studies
-Medical applications
-Image processing and pattern recognition
-Topographic mapping and automated cartography

Based on the focus of the present report, applications of SS-RS-GIS in the following fields are elaborated[13]:

Economic Planning

-Identify optimal sites for human settlements, schools, health facilities, hospitals, commercial enterprises, waste disposal systems.
-Identify optimal locations and necessary specifications for communication networks, power lines, water pipes and sewer systems, and plan for maintenance.
-Plan transportation routes that take factors such as population distribution, environmental vulnerability, land values, economic parameters, slope

gradients and soil suitability into account.
-Identify and correlate spatial patterns in health and diseases with chemical element distribution and pollutants.

Environmental Protection

-Assess environmental quality.
-Assess the likely impacts of proposed land uses; evaluate land acquisition priorities for conservation.
-Model the cost of alternative environmental policy options for sustainable development.
-Develop national and regional environmental regulations.

Natural Disaster Reduction

-Prepare hazard maps.
-Determine optimal locations for disaster relief centers and cyclone shelters.
-Identify populations at risks from disasters; design and implement natural disaster planning and strategies.

It may be mentioned that SS-RS-GIS has been used in the Asian countries particularly for Environmentally Sound Sustainable Development (ESSD) through integrated resource management, Global Climate Change (GCC), and Disasters Monitoring and Mitigation (DMM).

The following are more detailed descriptions of each of the above:

Environmentally Sound and Sustainable Development

The space sciences, remote sensing and geographic information system (SS-RS-GIS) has now become a tool for the holistic and integrated management of land and water resources as well as other physical and infrastructural resources. The information, when combined with conventional geopolitical and socioeconomic information/data and integrated use of SS-RS-GIS, will provide timely input for carrying out development planning, environmental protection and disaster mitigation activities. Many nations have already obtained immense benefit from this technology[14-19].

It is very difficult to attain ESSD without making a compromise, optimization of the requirements of ESSD and the environmental problems. For this purpose, SS-RS-GIS along with conventional data could play a vital role. Sustainable development of natural resources needs an understanding of the mutual interdependencies and relationships of various resources (both renewable and nonrenewable) and the identification of the ecological problems at the micro-level. These could be achieved through the following phases:

-Collection and collation of conventional data and their evaluation.

-Preparation of a set of resource maps using existing maps, satellite/space-based remote sensing data and other collateral geopolitical and socioeconomic data. The thematic maps could be of the following types:

- •surface water bodies
- •groundwater potential zones
- •potential zone for groundwater recharge
- •soil map including nature and erosion status
- •existing land use and distribution of wastelands
- •an integrated land and water resource map giving high priority areas for development of agriculture, fuel, fodder, soil conservation and afforestation.

-Development of a package of appropriate strategies to address the local resources management and environmental problems.

The completion of the above stages and their proper utilization in the national development planning will definitely help in attaining ESSD. Indian experiences for NNRMS (National Natural Resources Management System) and its applications in development planning could be profitably used by others.

Global Climate Change

The dynamics of the global environment is changing due to human intervention and other causes and effects. The impact of greenhouse gases on the world environment has become a great concern for mankind. The cause and effect of the greenhouse gases and other related phenomena have resulted in global warming and subsequent sea level rise. These will have tremendous socioeconomic consequences on the low-lying countries. SS-RS-GIS could be used for monitoring and measurement of various parameters related to GCC.

Disaster Monitoring and Mitigation

SS-RS-GIS has been extensively used for disaster monitoring and mitigation purposes. Asian countries are also developing methodologies for mapping of natural resources needed for ESSD, monitoring and management of environmental changes and disasters. All nations will greatly benefit from a regional cooperation program which would provide a mechanism for:

-Information exchange on projects/specific disciplines of common interest
-Sharing of training and infrastructural facilities and expertise
-Undertaking joint research projects of mutual interest.

BANGLADESH EXPERIENCES

Bangladesh is a disaster-prone country with a high population density (about 800 persons per square kilometer). Her peculiar geographic location and morphological conditions make her vulnerable to disasters. The flat topography, rapid runoff, effects of the confluence of major rivers, drainage congestion, funnel-shaped and shallow Bay of Bengal causing high windstorms and storm surges are major factors for the occurrences of disasters. High population density, higher frequency and intensity of disasters and weaker industrial base are some of the salient characteristics of Bangladesh. Major disasters of Bangladesh are floods, droughts, windstorms (cyclones/tornadoes), storm surges, etc., which occur frequently causing immense loss of life and severe property damage.

In spite of these, the government and people of Bangladesh are struggling hard to survive and improve the quality of life of the people by taking some appropriate steps as follows:

-Development of appropriate forecasting and monitoring system of disasters in Bangladesh.

-Establishment of space sciences, RS-GIS and other associated facilities which are effectively used for environment and disaster monitoring and mitigation purposes.

-Formulation and promulgation of National Environment Policy (1992) and Action Programs[20].

-Preparation of National Conservation Strategy (NCS) and National Environment Management Action Plan (NEMAP) and their implementation through phases.

-Mandatory Environment Impact Assessment (EIA) of development projects, particular attention being given to the Flood Action Plan (FAP) project under implementation.

-Environmental Quality Standard (EQS) and Industrial Guidelines related to environmental parameters being in the final stage of preparation.

-Creation of awareness and training of concerned officials in phases which

are in progress.

-Regional and international collaboration for improving the environment.

With this background information the major themes and issues of disasters, environment and development are addressed as follows:

-Human resources development in the field is within the framework of short-term and long-term training programs of the country and all-out efforts are being made in this respect. International support and cooperation are also required for this purpose.

-Status of disasters and environmental understanding/thinking/assessment in the country and its impact are encouraging. The National Planning Commission, Ministry of Environment and Forest, Department of Environment (DOE) and other concerned ministries/agencies are taking appropriate steps for the environmental components in their development efforts. UN/ESCAP and Asian Development Bank are making studies, surveys, assessments, etc., on regional aspects of the environment.

-EIA's are mandatory for development projects and continuous monitoring is also done. Out of 26 components of FAP, one component is for overall environment impact assessment. Similar other mandatory approaches for EIA are being implemented in the country.

Bangladesh is a developing country with numerous problems of over-population, poverty, complex socioeconomic structure, low-level industrial base, resource constraints, lack of appropriate infrastructures and institutional facilities, dearth of trained manpower, etc. These problems are complicated and compounded by the occurrences of frequent disasters, impeding the overall socioeconomic development of the country. To cite a few examples, on average, the Annual Development Program (ADP) of Bangladesh is around US$1.5-2.0 billion in various sectors like agriculture, water resources, health, education, industry, infrastructure (transport, utility systems and related items), social welfare, etc. In addition to the loss of valuable human lives and immense suffering of the people, the damage caused by disasters in terms of physical properties and infrastructures is US$1.0 billion (1970 cyclone), US$2.4 billion (1988 flood), US$1.4 billion (1991 cyclone), etc. It is estimated that the total economic loss due to disasters in Bangladesh from 1947 to 1991 is US$ 25 billion. Relief, rehabilitation and reconstruction activities after disasters require huge resources and time, affecting the overall development of the country. As such, disasters and development act in a vicious cycle of destruction and reconstruction with a net result of hindering the socioeconomic development of the country. It may be further mentioned that after any disaster both quantifiable and unquantifiable environmental degradation and ecological imbalance occur. Thus, the efforts of improving the quality of life of the people and attaining ESSD are being frustrated. It is felt that when disasters occur, in addition to the short-term measures of providing relief and essential items,

more attention should be given to the effects of impending disasters which should be integrated in the long-term development planning and programming in the country.

The occurrences of severe cyclones and devastating floods are inevitable and so are the ferocity and vagaries of nature. These cannot be stopped, but preparedness and appropriate mitigation techniques could help a lot in terms of reducing loss of life, and damage to physical property and infrastructures. Believing in the philosophy of "Live with disasters", the following important disaster mitigation tools should be developed:

-Improved forecasting and monitoring techniques.

-Identification of high risk regions and dissemination of information to the public.

-Increasing awareness about disasters of policymakers and others through the mass media.

-Preventive measures - short-term and long-term - including structural engineering practices and nonstructural policy interventions.

-Integration of disasters in development planning.

Floods, a perennial source of havoc (Central Area of Dhaka City, 1988)
Source: Citizen's Response - A Journal of Life Resource and Culture, Jan-Mar 1993