International Journal Of Scientific & Engineering Research, Volume 4, Issue 12, December-2013
Issn 2229-5518

Application of Remote Sensing and Geographical Information System for Natural Resource Management

Dr. A. K. Sinha

Abstract-India is a large and prosperous country with rich natural resources and extensive variability in terrain characteristics and associated eco-system. The Country frequently faces natural calamities such as drought, floods and earthquake, besides locale – specific hazards of industrial emissions and pollutants, epidemics, hailstorms, fires, etc. The drought continues to remain the major factor of uncertainty and affects vast areas. Natural Resources especially land and water are the two most vital resources for agricultural development in the country. These resources are under tremendous stress due to the ever increasing biotic pressure. The rapid economic growth and urbanization have reduced the per capita availability of land and water over the decades. The quality of soil and water is really alarming. The resources are deteriorating due to uncontrolled industrial effluents and sewage. There is gradual depletion of water table. Today, Indian agriculture faces numerous challenges with rapidly changing business environment, globalization, climate change, uncertainty of monsoon; poor support from rural banking etc. Volatility of agricultural commodities price discourages needed investment in agriculture for development due to increased financial risks and uncertainty for farmers and traders. These issues which occur often, though confronted and managed, lack proper planning, organization and implementation strategy. Such situation can certainly be improved if cause and effect relationships are analysed and understood properly for gearing up the administration and the infrastructure for drawing appropriate action plan. This calls for a critical evaluation of the existing situation in terms of the natural resources status and its spatial distribution in relation to socio–economic conditions. In order to assess the implications of occurrence of natural hazards & control resources degradation, to increase the productivity, profitability and sustainability of agriculture, one needs critical analysis of the situation for which an information base is essential. Such information base should comprise both spatial and non spatial data related to natural resources, infrastructure and the associated socio-economic parameters. Further, creation of computerized data base adds a new dimension to the dissemination of information through networking for the free flow of data and information exchange for speeding up implementation programs and their monitoring.

Index Terms- economic growth, Natural resources, productivity, profitability, socio-economic growth, sustainability

1 INTRODUCTION

Considering the global changes and challenges facing the agriculture, the effective and efficient use of geospatial technology i.e. Remote Sensing, Geographic Information System (GIS) , Global Positioning System (GPS) technology will be required to understand the impact of growing population, inadequate infrastructure, dwindling natural resources and to developing user centric solutions. Satellite data can be effectively used for mapping and monitoring the flood inundated areas, flood damage assessment, flood hazard zoning and post flood survey of rivers configuration and protection works. Remote sensing can also be used as early warning of drought conditions will help in planning the strategy such as target potential ground water sites for taking up well digging programs and other soil conservation measures.

- *Dr.A.K.Sinha, Vice President, Scanpoint Geomatics Ltd, Nagpur, (Former Director – MRSAC, Nagpur & Retd. Scientist – RRSC, ISRO, Nagpur)*
- *Corresponding Author : aksinha@scanpointgeomatics.com*

2 ROLE OF REMOTE SENSING

Remote Sensing provides most significant reliable and updated information on natural resources. With the availability of a very high resolution of satellite data, the scope and application of remotely sensed data in combination with geographic information system has proved to be immensely useful in development of micro level planning, implementation and monitoring the degradation problems as well as reclamation efforts from at different levels. Remote sensing provides a synoptic and repetitive coverage which helps in monitoring the events during the time of occurrence and assists in damage assessment monitoring and provide base for relief operations. It is also a cost and time effective method of generating a database in the absence of detailed information related to natural phenomenon. Remote sensing and GIS can be used in drought relief management such as early warnings of drought conditions and to plan out the strategy to organise the relief work. Satellite data are also

International Journal Of Scientific & Engineering Research, Volume 4, Issue 12, December-2013
Issn 2229-5518

useful to target potential ground water sites for taking up well digging programs.

3 ROLE OF GEOGRAPHIC INFORMATION SYSTEM

Geographic information system application in natural resource management are now widely recognised. GIS has enhanced the scope and analytic power of traditional mapping and monitoring the event. GIS being the powerful tool has the capabilities to handle huge spatial and non-spatial data sets and integrated approach of analysis gives the clue to the potential areas once mapped and possible measure can be adopted to control and manage. The application GIS range from simple data query system to complex analysis and decision support system. The various maps and satellite data are combined to stimulate the interaction of complex natural phenomena for understanding the impact of extensive human activities on the global change. The condition of the earth surface, atmosphere and sub surface over the time can be examined by feeding satellite data in GIS.

Recent developments in parcel based GIS have opened up new opportunities for planning, analysis and monitoring capabilities at the farm level. It has allowed to reach beyond the traditional land degradation mapping and monitoring efforts and to consider the relationship between various land capabilities, existing land use, socio-economic and climatic conditions, planning and policy issues. GIS facilitates integration of total range of variations and allows visualization of their interactions and spatial relationships.

4 RESOURCE DATABASE

The Generation of database comprise both spatial and non-spatial data. The spatial data consist of data on basic natural resources, such as geology, soil, geomorphology, land use / land cover, hydrogeomorphology, surface water bodies, etc, derived from remote sensing satellite imagery and drainage, relief and slope, watersheds, road network etc, derived from the maps made available from the concerned departments. In addition, non-spatial data related to socio-economic situation and collateral data about the resources would also be added to the database.

The resource database allows to understand existing resource status, their spatial distribution and association with socio-economic situation besides assisting people needs / demands. It also facilities integration and analysis for sustainable development and planning.

The satellite derived database information in combination with the ground support data is an excellent input, which can be updated from time to time. Monitoring of surface water bodies such as ponds, tanks, lakes and reservoir in terms of geographical location, water spread, volume and quality helps in identifying and monitoring drought conditions, besides effective management of surface water resources.

4.1 Cadastral Database

The cadastral database consists of spatial information of each parcel of land holding, its unique identification number and its ownership. The quantitative aspects of the land includes the geomatic dimensions, shape, area of each parcel, crop yield, location of irrigation sources, location of buildings and trees and other structures standing on the land parcel, etc. Similarly, the qualitative aspects of the land resources may be soil types, land forms; ownership details crop types, irritability status.

The scale of cadastral maps varied from 1:4000 to 1:10,000 prepared using chain or plain table survey and generally have no projection. These maps are not geo-reference hence, cannot be directly integrated and analyzed with other data sets. For effective utilization, the cadastral maps pertaining to entire state of Maharashtra have been digitized and geo-referenced using IRS PAN Satellite data following the standard specifications designed and developed. The geo-referenced cadastral maps have been mosaiced on taluka-wise basis. The information however, can be extracted for any desired administrative or natural units. The farm level planning, implementation and monitoring of development activities, cadastral level database is required.

4.3 Large Scale Mapping

The generation of spatial information on large scale is becoming an important area. The advent of high-resolution satellite images coupled with GIS and GPS technologies has made possible the generation of large-scale database. High resolution imagery (2.5 meter resolution of Cartosat-1 Stereo data, 1 m Panchromatic and 4 m multi-spectral provided by IKONOS, 0.60 m panchromatic and 2.5 m multi-spectral provided by Quick Bird, 5 m multi-spectral provided by IRS P6 LISS-IV) with high positional accuracy, revisit time 3 to 5 days and its Global Positioning System (GPS) readiness has opened possibilities of carrying out detail mapping.

4.4 Database Design and Standards

Standards and specifications are essential to facilitate the development and sharing of geospatial data and products. Standards and specifications define the requirements to ensure that all products and data prepared are consistent in accuracy, format, structures and content. Database standards are the important elements in database design. Standards enable to generate well constructed, functionally and operationally efficient database and also reduces the cost of operation. Today vast amount of data being generated from main different sources and use in different ways. There is a need for real time data updations, effective data storage and data sharing for better use.

5 UNIQUE CODIFICATIONS

The easily accessible common reference framework of Census codes are being used as a base for identification (PIN) of the villages and the parcels (Survey Nos.). The unique codes have been designed for all attribute and spatial data feature like Polygon, Line and point. The unique codification

International Journal Of Scientific & Engineering Research, Volume 4, Issue 12, December-2013
Issn 2229-5518

for the cadastral database in the digital format would facilitate the attachment of ownership revenue details (7/12 records) to each parcel of land in a GIS environment.

5.1 Quality Assurance Standards

The Quality Assurance Standards (QAS) should be rigorously followed at various level of the database generation and the reports documentation. The formats for quality checks should also be predefined for all the activities.

6 DATA INTEGRATION AND ANALYSIS

The GIS plays an important role in information management, analysis and providing the solution to planning and land management issues. The integration of the various thematic maps and attribute data and their analysis for identifying the action plan for land resources development should be carried out in GIS environment. The decision criteria is structured within the framework of resources potentials and other determinants to evolve a sustainable model. The land resources development plan depicts alternative land use practices through intensive agriculture, horticulture, agro-forestry, afforestation and silvipasture along with appropriate soil conservative measures. The GIS has a key role in implementing the soil and water conservation practices that is essential for sustainable agriculture production.

7 USES OF GIS DATABASE

In India many states and central institutions have generated the GIS database and using the geospatial technology for natural resource management, urban planning, disaster management, infrastructure planning & development, better project implementation and monitoring the development activities.