Importance of Remote Sensing Satellite Technology for Aquatic Resource Management

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ABSTRACT

One of the foremost basic types of information utilized in field work is space information with few specific targets. There are various types of information which that fall within space information; such as information concerning soil topography, land use for fisheries, social infrastructure, climate and manufacturing infrastructure. All of this information must be appropriately gathered, in accordance with the objectives of a study or research. Remote sensing and geographic information systems (GIS) are among the many useful means for gathering and analyzing such information. Using aerial photography and satellite image obtained through remote sensing, it is possible to gather information covering wide geographic areas; such as information about natural resources or information about the environment. For example, natural resources can play a vital role for culture and breeding ground for many freshwater and marine water fishes. In addition, if these methods are used in conjunction with field work or by rearranging existing data, more detailed space information can be collected. Positioning data is attached to this collected information and it can then be analyzed using a geographic information system (GIS). A GIS is both a database of space information and a tool for its analysis. For example, analysis of existing shoal for a particular fish can lead to information used to predict natural disasters.

INTRODUCTION

Over the past three and half decades, India has achieved significant progress in space technology and applications for monitoring and management of natural resources. These satellites are capable to provide remote sensing imageries for application on natural resource management, disaster management, sustainable development of natural resources and cartographic application at cadastral level. Geographical Information System (GIS) are computer-based system that efficiently store, retrieve, manipulate, analyze and display spatial data according to user specifications. GIS is used as a decision support system involving integration of spatially referenced data in a problem-solving environment. GIS is integrated with remote sensing system in order to realize the full potential of both systems. Global positioning system (GPS) are device for determine the own position of the object on the earth surface. GIS technology, marine RS and fisheries monitoring methods provided a set of data and tools for the management of fishing fleets and fisheries resources in the various EEZs. Satellite Remote Sensing (SRS) of the marine environment has become instrumental in ecology for environmental monitoring and impact assessment, and it is a promising tool for conservation issues. In the context of an Ecosystem Approach to Fisheries Management (EAFM), global, daily, systematic, high-resolution images obtained from satellites provide a good data source for incorporating habitat considerations into marine fish population dynamics. SRS measurements are the basis for a large set of indicators describing the oceanographic conditions that determine preferred habitats for feeding, spawning, maturation and predator avoidance. The physical and biological properties of pelagic, demarsal and benthic habitats influence the distribution and abundance of fish populations through environmental constraints on prey availability, the survival of larvae and migration (Chassot *et al.*, 2011). Remote sensing from satellites has revolutionized our view of the surface of planet Earth, on land, in the atmosphere and in the sea. As well as the many scientific advances made possible from these sensors, the data they provide have been applied operationally for weather forecasting and military planning. Therefore, it would be of utmost value if they could also provide operational information useful for the sustainable management of ecosystems.

GIS Software

Digital image processing performed on computer system using standard software like ERDAS imagine, Integrated Land and Water Information System (ILWIS), map information and View IDRSI etc. ILWIS is a decision support system with image processing capabilities developed by the international institute for aero space survey and earth Science, Netherlands. In ILWIS, number of operations performed for map preparation namely addition, subtraction, cross, overate etc.

Fisheries internet based applications

1) Australian Marine Spatial Information System (AMSIS)
2) National Oceanic and Atmospheric Administration (NOAA)
3) Coral Reef Watch
4) Ocean Biogeographic Information System (OBIS)
5) GISFish
6) Great Lakes GIS (GLGIS)
7) Newfoundland and Labrador Aquaculture Geographic Information System
8) Reefbase
9) Coastal Resource Information Management System
10) Ocean Management Internet Mapping Application (OMIMA)
11) Underwater GIS Data Models

India has extensively used remote sensing for developmental projects such as irrigation and

water resource management, agriculture, extraction of mineral resources, environmental monitoring, disaster management etc. and continues to do through the regional remote sensing service centers (RRSSCs) at Bangalore, Nagpur, Jodhpur, Dehradun and Kharagpur and the 22 states remote sensing application centres. All these states have carried out either detailed or partial mapping of land, waste land, grass land, wet land, soil and vegetation cover.

For water resource management in aquaculture, hydro-geomorphological and flood mapping & delineation of ground water potential zones have carried out by majority of the states. Important projects among these are sriramsagar project and Srisailam Right, Branch Canal Project (Andra Pradesh), the ganga, the gandak river configuration project (Bihar), the Yamuna River course study and satellite inventory of Bhakhra Irrigation System (Haryana) and Watershed Atlas Project and Pushkar Sarovar Desiltation (Rajasthan). Utter Pradesh has undertaken flood inundation mapping and assessment of dynamics of migratory trends of rivers like the Ghaghra for locating sites for construction of bridges. Remote sensing technology's (RST) importance in fisheries can be best understood from the fact that the national wheat production forecast in 1996-97 was possible through multi-date WIFS data. Many states have taken advantage in different projects for the estimation of production estimation (CAPE) project of capture fisheries. Orissa has made use of marine remote sensing information system (MARSIS) for determining potential fishing zone delineation lines off Bay of Bengal. RST has revolution and eased the extraction of mineral resources, the driving forces in a modern society. For instance, UP and RST for mining targeting of base metals and strategic minerals in the Himalayas. Karnataka has used it for ornamental stone outcrop mapping in Chamarajnagar taluk.

On the environmental front, many states have carried out eco-system, land degradation and vegetation studies using remote sensing data. Andra Pradesh and Karnataka have respectively carried out environmental impact analysis of bauxite mining in the Eastern Ghats. Maharashtra has prepared erosion status maps for several talukas in Western Ghats for soil conservation measures. Orissa has done environmental monitoring of Chilka lagoon. Punjab has used RS data making an Atlas for sitting pollution industries to avoid contamination in water bodies.

Coinciding with the country's Golden Jubilee of Independence, the launch of IRS-ID is a great step in self- reliance in space and use of research and development in high technology areas for rural development. The country has already curved a niche in civilian use of remote sensing satellite through its earlier spacecraft in IRS series with the imageries being sold world-wide. The success of the fourth PSLV flight would enable India to join the select band of countries launching satellite in middle earth orbit, raising the countries stock considerably higher.

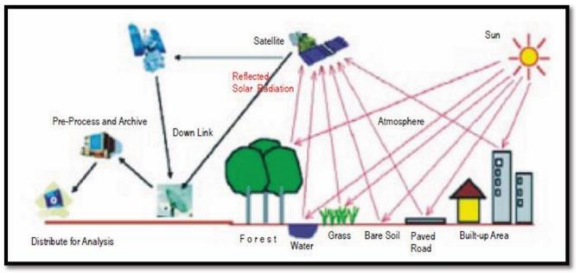

Figure 1: Process of Satellite Remote Sensing

Modern Remote Sensing Technology versus Conventional Aerial Photography

The use of different and extended portions of the electromagnetic spectrum, development in sensor technology, different platforms for remote sensing (spacecraft, in addition to aircraft), emphasize on the use of spectral information as compared to spatial information, advancement in image processing and enhancement techniques, and automated image analysis in addition to manual interpretation are points for comparison of conventional aerial photography with modern remote sensing system.

During early half of twentieth century, aerial photos were used in military surveys and topographical mapping. Main advantage of aerial photos has been the high spatial resolution with fine details and therefore they are still used for mapping at large scale such as in route surveys, town planning, construction project surveying, cadastral mapping etc. Modern remote sensing system provide satellite images suitable for medium scale mapping used in natural resources surveys and monitoring such as forestry, geology, watershed management etc. However the future generation satellites are going to provide much high-resolution images for more versatile applications.

Table 1: Milestones in the History of Satellite Remote Sensing

1800	Discovery of Infrared by Sir W. Herschel
1839	Beginning of Practice of Photography
1847	Infrared Spectrum Shown by J.B.L. Foucault
1859	Photography from Balloons
1873	Theory of Electromagnetic Spectrum by J.C. Maxwell
1909	Photography from Airplanes
1916	World War I: Aerial Reconnaissance
1935	Development of Radar in Germany
1940	WW II: Applications of Non-Visible Part of EMS
1950	Military Research and Development
1959	First Space Photograph of the Earth (Explorer-6)
1960	First TIROS Meteorological Satellite Launched
1970	Skylab Remote Sensing Observations from Space
1972	Launch Landsat-1 (ERTS-1) : MSS Sensor
1972	Rapid Advances in Digital Image Processing
1982	Launch of Landsat 4 : New Generation of Landsat Sensors: TM
1986	French Commercial Earth Observation Satellite SPOT
1986	Development Hyper-spectral Sensors
1990	Development High Resolution Space borne Systems First Commercial Developments in Remote Sensing
1998	Towards Cheap One-Goal Satellite Missions
1999	Launch EOS : NASA Earth Observing Mission
1999	Launch of IKONOS, very high spatial resolution sensor system

Application of Remote Sensing and GIS in fisheries like, identification and stock enhancement areas. Some scientist identified locating fish shoals and fishing grounds, analyzed effects of trawl gear on soft bottom habitat. The identification of MPAs are becoming a popular tool in fisheries management to present overexploitation of fish stocks, conserve biodiversity and to reduce by-catch of non targeted species. Management of Cephalopod fishery and enhancement of Shrimp Fisheries were done by GIS.

Whereas remote sensing systems are powerful tools for the collection of the classified spatial data, the GISs are powerful tools for the management and analysis of spatial data. Remote sensing systems produce large volumes of spatial data, which can be handled only by efficient geographic handling and processing system that will transform these data into usable information. Most of the GIS utilize maps as their primary source of spatial data and remote sensing systems produce such spatial data in the form of maps. These complex maps are generally utilized for visual search and retrieval by the interpreter but when the same data are digitized, these can be best handled by GIS.

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