18

Applications of Geoinformatics in Fisheries and Natural Resource Management

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Geoinformatics is the art, science or technology dealing with the acquisition, storage, processing production, presentation and dissemination of spatial data or the geoinformation. Geoinformatics has been extensively used in almost all the fields of study, be it natural sciences, social sciences, archaeology, surveying, marketing etc. and you name any field of study for that matter. It shows the importance of Geoinformatics in the present world. Geographic information system (GIS) is the platform on which spatial data is collected, stored, analysed and the information is extracted. The strength of GIS is its ability to integrate data from different sources and carryout spatial analysis to arrive at meaningful conclusions which otherwise would not be possible.

We use geoinformatics for locating the potential fishing zones (PFZ), identifying and monitoring of different marine habitats, mangrove areas, oceanic variables like sea surface temperature (SST), ocean colour (chlorophyll a content), ocean currents etc. which otherwise would not be possible to collect information from such a vast area.

Geographic information system (GIS) is a tool for making and using spatial information and it is mainly concerned with location of the features as well as properties/attributes of those features. It helps us gather, analyse and visualize spatial data for different purposes. A GIS quantifies the locations of features by recording their coordinates which are the numbers that describe the position of these features on Earth. The uniqueness of GIS is its ability to do spatial analysis. GIS helps us analyse the spatial relationships and interactions. Sometimes, GIS proves to be the only way to solve spatially-related problems and it is one of the most important tools that aid in decision making process. GIS basically helps to answer three questions; How much of what is where? What is the shape and extent of it? Has it changed over time?

Globally, on an average, GIS tools save billions of dollars annually in the delivery of goods and services through proper route planning.GIS regularly help in the day-to-day management of many natural and man-made resources, including sewer, water, power, and transportation networks. GIS help us identify and address environmental problems by providing crucial information on where problems occur and who are affected by them. It also helps us identify the source, location and extent of adverse environmental impacts. GIS enable us to devise practical plans for monitoring, managing, and mitigating environmental damage. Human impacts on the environment, conflicts in resource use, concerns about pollution, and precautions to protect public health have spurred a strong societal push for the adoption of GIS.

GIS is composed of hardware, software, data, humans and a set of organizational protocols. The selection and purchase of hardware and software is often the easiest and quickest step in the development of a GIS. Data collection and organization, personnel development and the establishment of protocols for GIS use are often more difficult and time consuming endeavours. A fast computer, large data storage capacities and a highquality, large display form the hardware foundation of most GIS. GIS software provides the tools to manage, analyse, and effectively display and disseminate spatial information. GIS as a technology is based on geographic information science and is supported by the disciplines like geography, surveying, engineering, space science, computer science, cartography, statistics etc.

In GIS, we handle thespatial and attribute data sets. Spatial data describes the absolute and relative location of geographic features while the attribute data describes characteristics of the spatial features. These characteristics can be quantitative and/or qualitative in nature. Attribute data is also referred to as tabular data. Vector and raster are two different ways of representing spatial data. Raster data is made up of pixels (or cells), and each pixel has an associated value. A digital photograph is a simple example of a raster dataset where each pixel value corresponds to a particular colour. In GIS, the pixel values may represent elevation above/below sea level, or chemical concentrations, or rainfall etc. The key point is that all of this data is represented as a grid of (usually square) cells. Vector data consists of points, lines, and polygons. The individual pointsare stored as pairs of (x, y) co-ordinates. The points may be joined in a particular order to create lines, or joined into closed rings to create polygons, but all vector data fundamentally consists of lists of co-ordinates that define vertices, together with rules to determine whether and how those vertices are joined.

As with many other systems, GIS basically works on the principle of '*GIGO*' that is *garbage in garbage out*. Hence the quality of data that you feed into GIS is very important and it determines the quality of the end products. But, when used wisely, GIS can help us live healthier, wealthier, and safer lives.
Two examples of the applications of geoinformatics on is given below.

I. *Potential Fishing Zones (PFZ) Identification*

PFZ are the are the possible zones of fish aggregation indicated by satellite-derived sea surfacetemperature (SST) and chlorophyll-a (Chl-a). In 1999, Space Applications Centre (SAC), Indian Space Research Organization, Ahmedabad developed the techniques to generate the PFZ advisoriesusing SST and Chl-a data.The biological productivity is considered to be higherin regions where strong SST fronts are observed.

A front is a boundary between two distinct water masses. The water masses are defined by moving in different directions, i.e. on one side of the front the water is generally moving in one way, and on the other side of the front, the water is moving in another.The water masses on either side of a front may also have different temperatures, salinities, or densities.

In frontal regions where SST gradients are large and rapidchanges takes place in SST. The high resolution infrareddaily SST data are used to identify such regions.Apart from this, the chlorophyll data which is sensedby the satellite as ocean colour is used as a direct markerof biological productivity. Regions in which SST gradientsoccur along with a higher chlorophyll concentrationare considered to be strong potential for fishing. The figures below show the SST fronts, chlorophyll fronts and sample PFZ map.

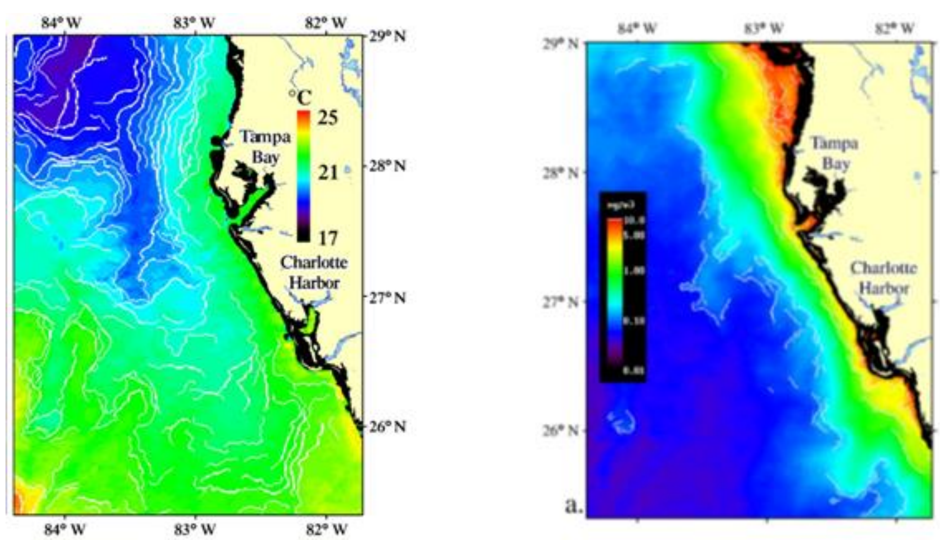

Fig 1. Satellite derived SST map showing the thermal fronts (Left) and Chlorophyll a map showing the chlorophyll fronts (Right) (Wall *et al*., 2008).

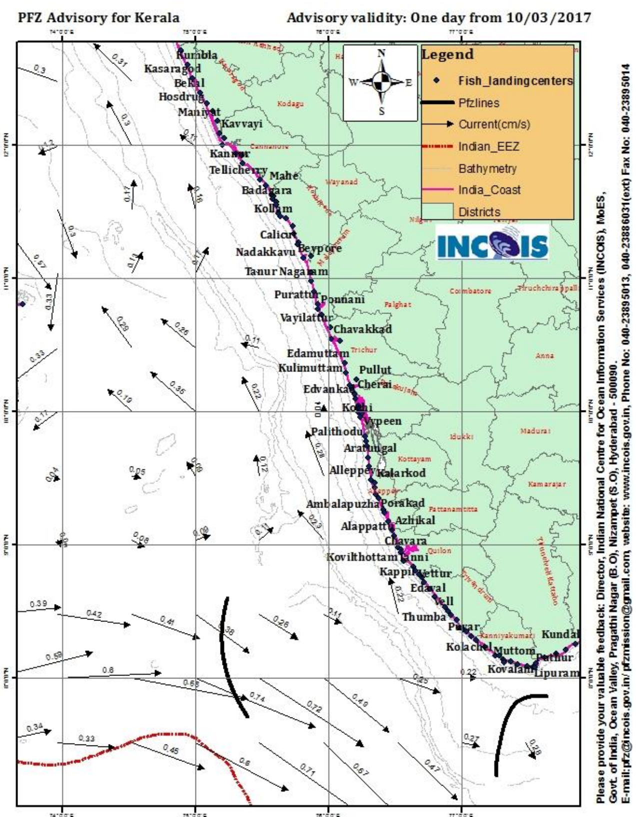

Fig 2. PFZ map of Kerala coast prepared by INCOIS, Hyderabad. The thick black curved line indicates the PFZ.

II. Monitoring the coastal habitats

The most important advantage of Remote Sensing is its synoptic view and repetitively. Due to this advantage we can use it monitor different areas of earth with comparatively less efforts. The below satellite images show how the coastal areas of Ernakulam has changed over time.

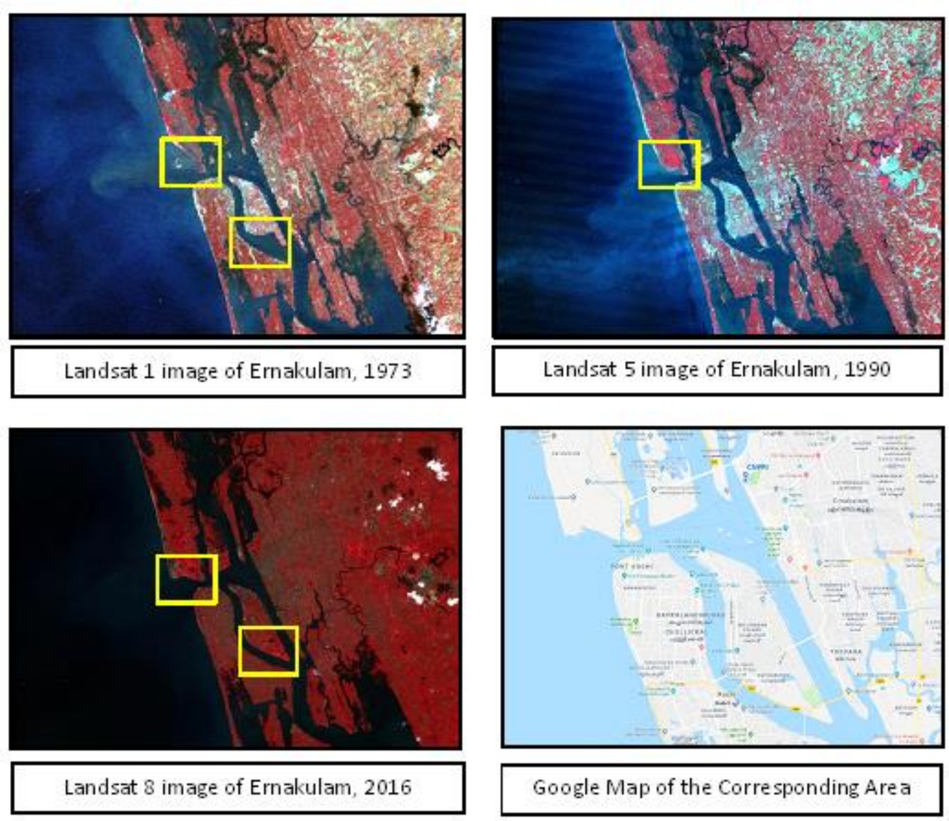

Fig 3. The three images above show the utility of satellite remote sensing in monitoring the earth surface / our environment. The yellow box indicates the areas where drastic changes had taken place.

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