WETLAND MAPPING AND STUDY OF TEMPORAL CHANGES IN CORRELATION WITH METEOROLOGICAL DATA FOR SOLAPUR DISTRICTS OF MAHARASHTRA USING REMOTE SENSING AND GIS TECHNIQUES

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ABSTRACT:

A wetland is an area where the soil is saturated with moisture either permanently or seasonally. Wetlands are considered the most biologically diverse of all ecosystems, a repository of various species of flora and fauna available in the area. Wetlands are directly or indirectly beneficial to human society, and are specifically valuable to people for recreational and educational activities. Mainly two types of wetland classes are present, coastal wetland and inland wetlands. Coastal wetlands are found along the coasts. They are closely linked to estuaries; though shallow coastal areas have mud flats or sand flats without vegetation. Inland wetlands are most common on floodplains along rivers and streams, in isolated depressions surrounded by dry land along the margins of lakes and ponds. Remote Sensing offers a cost effective means of identifying and monitoring wetlands over large areas on a temporal scale. In this study, we aim at providing information on characteristics of wetlands obtained from standard remote sensing techniques. The different wetland classes are mapped using pre-monsoon and post-monsoon LISS III satellite data for Solapur of Maharashtra state. Besides mapping, an attempt was made to monitor the changes in these wetlands over a time period of last 12 years and analyze the causes that have led to the current scenario in relation to meteorological data. It was found that the number of wetlands fluctuated over time. Most wetlands were delineated in post monsoon season. Some wetlands were less than 2.5 ha, were mapped as points.

1. INTRODUCTION

1.1 General Instructions

Wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface (Cowardin et al. 1979). Wetlands are defined as areas of land that are inundated for at least part of the year, leading to physico-chemical and biological conditions characteristic of shallowly flooded systems.(Watson et al. 2000). Wetlands are beneficial to the society globally, socially, economically and environmentally. Functionalities of wetlands include storage of water, recharging the groundwater, protection from storm and floods, stabilizing the shoreline, to some extent controlling the soil erosion, and retaining carbon, nutrients, sediments and pollutants, it also is a habitat for plants and other life forms.

India, with its annual rainfal1 of over 130 cm, varied topography and climatic regimes, supports and sustains diverse and unique wetland habitats. Natural wetlands in India consists of the high-altitude Himalayan lakes, followed by wetlands situated in the flood plains of the major river systems, saline and temporary wetlands of the arid and semi-arid regions, coastal wetlands such as lagoons, backwaters and estuaries, mangrove swamps, coral reefs and marine wetlands, and so on.In fact with the exception of bogs, fens and typical salt marshes, Indian wetlands cover the whole range of the ecosystem types found. In addition to the various types of natural wetlands, a large number of man-made wetlands also contribute to the faunal and floral diversity (Prasad et al.).

There are basically two types of wetland classes present, coastal and inland wetlands. Coastal wetlands are found along the coasts. They are closely linked to estuaries where sea water and fresh water mix to form an environment of varying salinities. Shallow coastal areas are un-vegetated mud flats or sand flats. Some plants, certain grasses and grass like plants, mangrove swamps, with shrubs or trees, saltpans are usually found in the coastal wetlands and have adapted to this environment.

Wetlands are important regulators of water quantity and water quality. Wetlands are known to act as hydrological buffers. For example, floodplain wetlands store water when rivers over-top their banks, reducing flood risk downstream. The value of these services may be considerable and often technical alternatives to regulate the quantity of flow are much more expensive. Wetlands not only regulate the quantity of water flow but also regulate its quality (Baker and Maltby 1995)

Wetlands are often filled in to be used by humans for everything from agriculture to parking lots, in part because the economic value of wetlands has only been recognized recently: the shrimp and fish that breed in salt water marshes are generally harvested in deeper water, for example. Humans can maximize the area of healthy, functioning wetlands by minimizing their impacts and by developing management strategies that protect, and where possible rehabilitate those ecosystems at risk. Wetlands are sometimes deliberately created to help with water reclamation.

Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors, including human disturbance. Wetlands are areas

lying along the banks of rivers and lakes and the coastal regions. As a wide range of wetland types exist, it is difficult to accurately predict whether they will continue to function as hydrological buffers for extreme events or provide other important ecological, social, and economic services. Therefore, only a general assessment of the relationships between wetlands and climate change can be given.

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There has been a need to study the co-relation between the climate changes and its impact on wetlands. This attempt will help analyse the causes of wetland area changes, changes in temperature and rainfall over years and their co-relation. The findings of this study suggest that there exist a weak relation between rainfall, temperature and the areal extent of the wetlands.

2. METHODOLOGY

2.1 Wetland Mapping

Wetland mapping has been done for 2 sets of satellite image duration, one for 1992 and the other for 2006-2007 datasets. The 1992 data set was Landsat imagery, has been classified and the wetlands have been extracted using Isodata classification along with human interpretations. The third (ancillary) data has been provided by Space Application Centre, Nagpur based on the previous wetland mapping conducted by them during the year 1992 at a scale of 1992. That data set is also considered for reference.

### 2.2 Wetland Mapping Methodology by digitization

Inventory of wetlands on 1:50,000 scale involves analysis of Resourcesat LISS III (post and pre-monsoon) data of 2006/07 or 2005/06. All the existing maps prepared under Nation-wide Wetland Mapping Project has been used as reference while doing interpretation. Base maps on 1:50,000 scale was procured/prepared for all the sates for which mapping on 1:250,000 scale was done in the first scientific inventory of wetlands in the country.

Salient features of overall methodology adopted are as under:

➢ Generation of spatial framework in GIS environment on the basis SOI graticule for database creation and organization.

➢ Digital base map procurement/preparation

➢ Procurement/generation of base layers (rail, road network, settlements (including names), drainage, administrative boundaries).

➢ Geo-referencing of satellite data

➢ Wetland map preparation from digital satellite data.

➢ Creation of a digital database for each layer as per the spatial framework.

➢ Mosaicing/edge matching of all these maps to create seamless database.

➢ Design and development of query shell for information retrieval.

➢ Preparation of map compositions and Outputs on A0 Paper and A3 size atlases.

➢ Area calculation: Area estimates of various wetlands have been completed.

2.3 Flow Chart
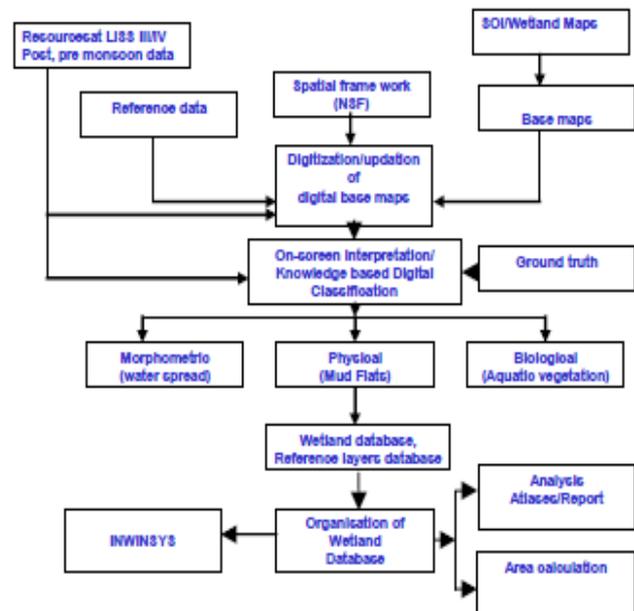
2.4 Wetland Mapping by Image Classification

The 1992 data set was Landsat imagery, has been classified and the wetlands have been extracted using Isodata classification along with human interpretations.

3. RESULTS AND DISCUSSIONS

Precipitation and temperature data was analysed for 1990 to 2008 and 1990 to 2002 respectively. It can be seen that the precipitation has decreased whereas the temperature has increased for these years.

De Martoons aridity index (De Martonne, 1926) was calculated to see the orrelation between precipitation and temperature. It was found that the aridity is reducing which indicates that the water level is increasing in the area.
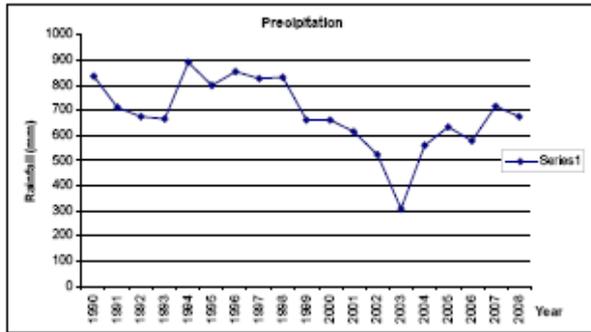
3.1 Rainfall and temperature data

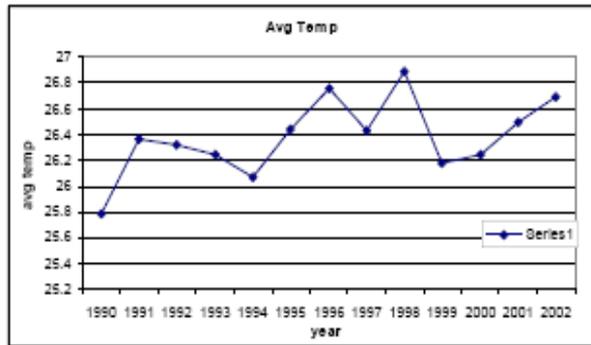Figure 1. Precipitation for Solapur District from 1990 to 2008

Figure 2. Average Temperature for Solapur District from 1990 to 2002
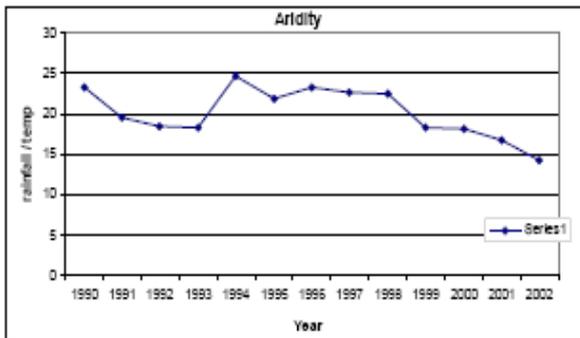
3.2 Aridity

Figure 3. Aridity Calculation

The areal extent calculated for the April images was done on 1:50,000 scale. The area was found to be 40,875.44 Ha. There were several wetland types viz: *Inland Natural:* Lakes, Ox-Bow Lake/Cut of Meander, High altitude Wetlands, Reverine Wetlands, Waterlogged,River / Stream; *Inland Manmade:* Reservoir, Tanks/Ponds, Waterlogged, Salt pans; *Coastal Natural:* Lagoons,

Creeks, Sand/Beach, Intertidal Mud Flats, Salt Marsh, Mangroves, Coral Reefs; *Coastal Manmade:* Salt pans, Aquaculture Ponds

Year	Total Wetland Area (Ha)	Mapping Scale	Using (data)
Apr-07	40875.44	1:50,000	IRS
1992	24512.00	1:50:000	Landsat
1992	2658.00	1:250,000	Ancillary

Table 1: Wetland area and the data used to generate the areal extent

The 1992 image shows areal extent of 24,000 Ha at 1:50,000 scale. This could be because of the wetland classes that have been included in the 2007 study is far more extensive than the classified image. Here only the waterbodies such as reservoirs, lakes, tanks and rivers have been classified. The 1992 ancillary data was obtained from SAC, Nagpur. It shows an areal extent of 2658 Ha. This mapping was done at a scale of 1:250,000. The scale is another reason for the less area covered by the wetlands. The classes used for the mapping is also not known hence the areal extent of the ancillary data cannot be commented.
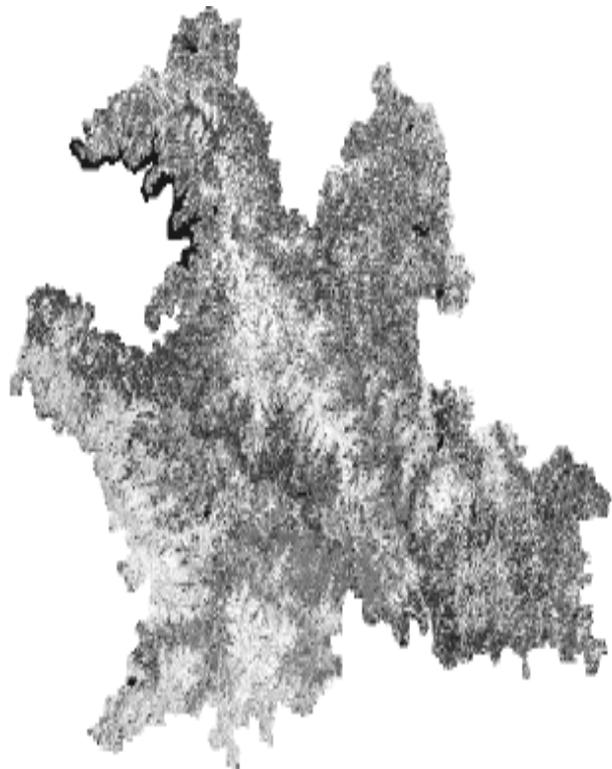
3.3 Outputs

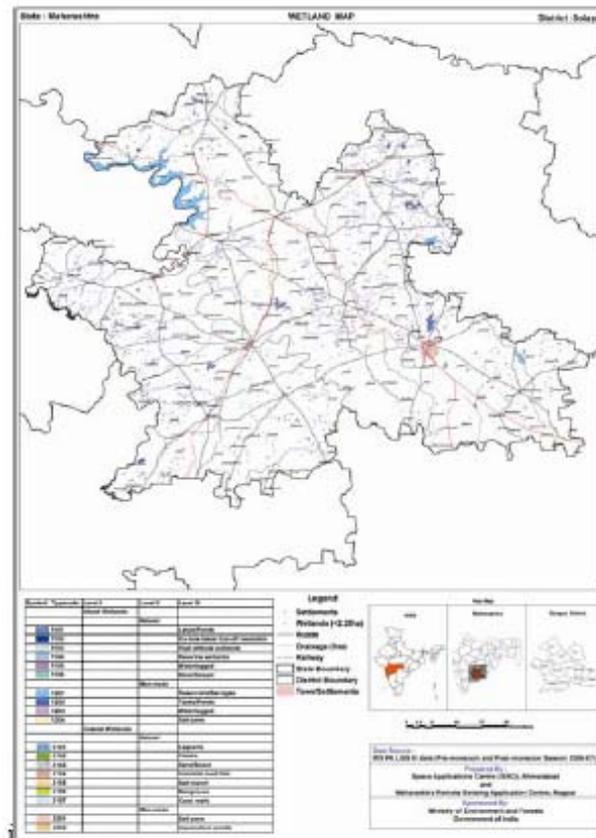Figure 4. classified image of Solapur (1992 year)

Figure 4. Solapur Wetland map Generated by Digitizing the April 2007 Satellite Images

CONCLUSION

The study shows that the wetland area has increased. Based on the type of mapping technique that has been used, i.e. the digitization of wetland for 2007 and the image classification technique used for 1992 dataset. The aridity index calculated shows a lower trend which indicates that there is an increase in water in the area which the analysis support to a certain extent. It can also be calculated that the two techniques will give different areal extent as the image classification has certain limitations. It is difficult to classify certain wetland types using the classification technique. Whereas the digitization technique is time consuming, but is far more accurate.

ACKNOWLEDGEMENTS

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