CHAPTER 4
REMOTE SENSING AND GIS APPLICATIONS

4.1 INTRODUCTION

The importance of remote sensing and its wide range of applications in the study of various ocean parameters, features, processes and in the exploration and exploitation of various marine resources have been recognized around the globe. In India, the Indian Remote Sensing Satellites IRS 1A and 1B have earlier provided excellent data which were used in various coastal and marine studies. The recent IRS satellites, IRS 1C, 1D and P4 with their improved spatial resolutions, spectral range and increased repetitive coverages are also providing significant information for ocean and coastal related studies. Further remote sensing integrated with geographical information system(GIS) has emerged as the latest tool in information system development for natural resources management.

Ocean related studies have been affected to a great extent in the past by lack of data. Collection of data over oceans and coastal region by conventional methods such as sample collection and in situ measurements by ships is costly and time consuming. A satellite platform with its synoptic view and capability to give spatially continuous data on a repetitive basis is ideal for the study of oceans. The availability of satellite data has led to several studies such as measurements of physical properties of the sea with respect to space and time, ocean circulation, sea surface temperature (SST), topography, primary productivity zones, oil slicks, coastal pollution, salinity and marine geology and geomorphology, shoreline changes, coastal wetland mapping, coastal landuse/ landcover, etc.

Satellite imagery gives a synoptic view of the coast and provides sequential images at intervals of time, and hence it is possible to observe and measure changes along the coast. Satellite imagery provides a useful tool for studying the coastline on a systematic basis and to identify areas of potential erosion and accretion. In addition to

monitoring erosion, which is a main task in shoreline, operations relevant to shoreline management that can be supported and improved by GIS technologies.

4.2 Changes in shape of the Lake

The changes in the configuration of the lake are brought out from the maps report published by Vaz and Banerjee (1997). The collected maps were scanned and digitized, using IDIRISIW2 GIS software. The changes were observed for the period from 1700, 1750, 1803, 1861 and 1988. During the earlier period, the lake was not bifurcated by the road leading to SHAR. Both the side of the lake was experiencing good mix up with the two inlet openings. The present day Kalangi river is flowing in East-West direction. At the central part of the lake and the lake, area is also double. In the present day lake of 1988, show shallow lake in the northern side of the SHAR-Sullurpet metal road. Northern part of the lake is almost dried may be due to tectonic upliftment and siltation by the rivers. Kalangi river presently flowing on the NW side of the lake. The lake area is reduced from almost 490 sq,km to 281 sq.km from 1750 to 1998. Half of the lake is dried and became shallow may be due to siltation, pollution and upliftment. The results of the changes in the shape of the lake are given in the following Figures 4.1a-d.

4.3 Landuse/Landcover changes:

Land use and land cover changes play a pivotal role in global environmental change. It contributes significantly to earth atmosphere interactions and biodiversity loss, which is a major factor playing a driving role for the sustainability of an ecosystem. The increasing urbanization and industrialization are placing considerable stress on the demand for land use for development purposes in many parts of our country. This leads to diversion of fertile lands to non-farm uses, particularly around growing urban centers. The increasing hazards of environmental pollution are also laying considerable stress on demand for land for good forest cover. Information on existing land use/land cover, its spatial distribution and change are essential prerequisite for planning (Dhinwa et al., 1992). Remote sensing, because of its synoptic viewing and repetitive coverage,

emerged as an efficient and powerful tool in providing reliable information on various natural resources on land use/land cover dynamics (Sharma et al., 1989, Roy et al., 1991). The change in land use/land cover due to natural and human activities can be observed using current and past remotely sensed data (Luong., 1993). Land use and land cover change is critically linked to the interaction of natural and human influences on environmental change. The changes in the state of biosphere and biogeochemical cycles are driven by heterogeneous changes in land use and continuation of those uses (Turner, 1995). Land use and land cover patterns particularly in developing countries are changing rapidly due to large pressure from the growing population, increased demand of food, fodder and fuel wood combined with industrial developmental activity. Planning for development of natural resources without endangering the environment is a crucial issue, the world is facing today (Kachwaha, 1985; Sharma et al., 1989; Khorram and John., 1991). The present study was taken up to monitor changes in land use over a period of time and to evaluate socio-economic conditions in the light of land use changes.

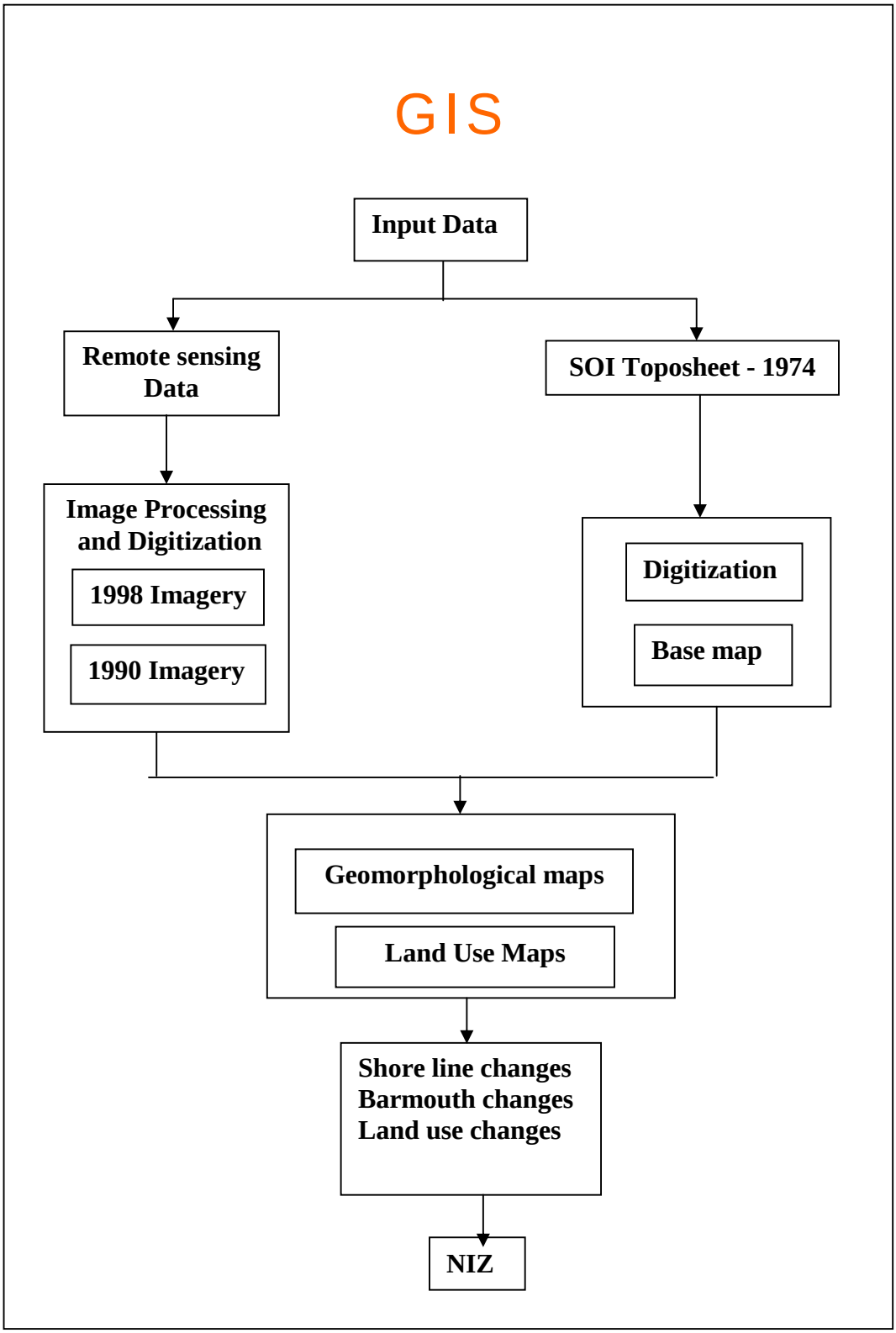
Pulicat lake is under stress due to the developmental activity such as urbanization and industrialization from the southern side of the lake apart from Sriharikota Rocket Launching Station which is present on the eastern side of the lake. All these development leads to changes in the land use condition of the lake and the fringing regions. The study on land use change and its impact to the lake ecosystem during the past 25 years will be useful for making the future management plans for preserving one of the largest bioreserve in our country and sustaining its livelihood supporting functions.

4.4 Methodology

The study region falls in toposheets 66 C/1&5, 2&6, 3, 4, 7 and 8. It is located between 13º26’ and 13º43’N latitude and 80º03’ and 80º18’E longitudes, lying almost parallel to the Bay of Bengal. Base maps were prepared from the 1974 survey of India toposheets in 1:50,000 scale. Maps were digitized using digitizer board with the support of ARC/INFO software package. Digitized polygons were rectified and cleaned using ARC/INFO for further processes. Land use classifications were made using the

established standards. Satellite data of IRS 1A for 1990 and IRS 1D for 1998 were processed and geo-coded with the control points. Different thematic layers of land use categories were digitized visually on screen using ERDAS imagine software using different band combinations. Major thematic polygons digitized were agricultural land, fallow land; lake water spread region, forestland, settlements, mud flats etc. Areas were calculated for the different land use categories using ARC view GIS package for doing change detection analyses. Change detection for the period between 1974, 1990 and 1998 were carried out and discussed in detail below.

Figure 4.2 Methodology for RS and GIS Study



4.5 Results

The results from the change detection analyses of the Land use/Land cover of Pulicat Lake brought out from the Satellite imagery of 1990 and 1998 and the base map of 1974 are given in Table 4.1. Natural changes due to the upliftment with respect to NE-SW trending lineament in central part of the Pulicat Lake leads to the shallowness of the northern part of the Lake has been discussed in detail from the isotopic record of the core samples by Vaz and Banerjee (1997).

The Pulicat Lake is rich in fish and prawn resources and nearly 50,000 fishermans are living in fringes of the lake. Due to the construction of Sriharikota Rocket Launching Station in northeast side of the lake regions, fisherman villages on the eastern side along Sriharikota Island were rehabilitated to other places for security reasons. This has altered the settlement pattern of the villages near Gunankuppam and Lighthouse kuppam of Pulicat Lake. Buckingam canal which is running parallel to the coast along the sand spit on eastern side of Pulicat Lake which was earlier used as a water way for transporting materials in water way from Vaizag to Chennai and further south, now become almost unused and silted up in some places due to the shifting of villages. The natural littoral transport process along the coastal regions leads to change in bar mouth region during the past 25 year. The different land use patterns were going on in the Pulicat Lake and surrounding regions. The changes in land use pattern were given in the Figure 4.3 a-c.

Changes in Agriculture

Intense paddy cultivation is seen in the southern and western side of the Pulicat in Ponneri Tk of Tamil Nadu. Major cultivation crop is Paddy as the regions has numerous water tanks available to support the cultivation pattern. Two rivers namely Kalangi and Arani bring water during the monsoon season, which supports the agriculture in this region. The fringes of island regions in the central part of the Lake Irakkam and Venadu are highly utilized for agriculture. Small shallow tanks support irrigation water for the agriculture. Changes in the cultivable area during the three-decade period are given in the

Table 4.1. Due to the developmental activity such as SIPCOT industrial estate in Gummidipundi and small scale industrial developments leads to occupation of agricultural land and the population pressure is also playing a major role in the reduction of agricultural land and it is being converted mostly into settlements region. Some of the agriculture lands in the southern side of Pulicat along the Channel is converted to aquafarms. In 1974, data (Table 4.1) is given as plantation which includes cropped land and fallow land covering 1044 sq.km. of the study region. For 1990 and 1998 the classification is made to differentiate fallow land and cropped land from the imageries by changing the band combination. Calculated area comes around 855 sq.km during 1990 which is further reduced to 803 sq.km. during 1998.

Changes in Forests

Changes in areal extent of forests are clearly seen (Table 4.1). Forest area has increased in recent times in the Sriharikota Island regions of Pulicat Lake. After the commencement of SHAR during 1975 the villages in the near by Sriharikota Islands were rehabilitated for the security purposes. The shifting of villages from island and restrictions by SHAR activity had indirectly paved way for the increasing reserve forest area in the island regions. Since the Pulicat Lake is a birds sanctuary it needs good forest cover for the birds to rest. But overall assessment of coastal plantation of the study region show reduction in forest cover due to developmental activity in the south near Kattupalli and reduction in inland forests where coastal plantation has reduced from 171 sq.km in 1974 to 144 sq.km in 1990 to 131 sq.km in 1998. Total forest area reduced has from 412 sq.km to 163 sq.km.

Changes in settlements

The change in the settlements area is given in Table 4.1. In total around one lakh people are living in the surrounding villages of the lake. Most of the settlements depend directly or indirectly on lake. Settlements have increased in recent years due to the development in Ponneri and Gummidipundi Taluk and SHAR activity in Sullurpet. Total

settlement area has increased from 78 sq.km in 1974, 318 sq.km in1990 to 334 sq.km in1998.

Changes in Lake water spread regions

Total lake area is reduced from 291 sq.km in 1974, 261 sq.km in 1990 to 254 sq.km in 1998. This reduction in lake region is due to the lowering of water level and encroachments from the land side. The reduced lake regions are converted to salt pan activity in the northern part and also converted into sandy regions in the southern side of the lake.

Changes in Salt Pan and Sand regions of the lake

The changes in saltpan and sandy areas show increasing trend from 1974 to 1998. Saltpan activity has increased due to shallowness of the lake region in the north. It increased from 15 sq. km in 1974 to 31 sq.km 1998. The sandy areas which are occurring adjacent to mudflats in the lake has increased from 93 sq.km in 1974 to 147 sq.km in 1998 (Table 4.1).

Table 4.1 Land Use Changes in the Study Area Between 1974 and 1998

S.No.	Classification	Area (Sq. Km) in the Year		
		1974	1990	1998
1	Canal	2.78	5.77	5.97
2	Coastal Plantation	171.67	144.49	122.20
3	Lake Water Spread	291.02	261.81	251.62
4	Lake Channel	11.30	16.13	16.84
5	Lake Part	2.50	2.10	2.96
6	Mud flats	41.24	43.08	41.85
7	Open Scrub	64.57	68.12	70.20
8	Plantation	1044.50	--	--
9	Cropped Land	--	544.62	411.36
10	Fallow Land	--	356.57	451.84
11	Reserve Forest	41.24	34.15	16.35
12	River	28.73	32.10	25.18
13	Salt Pans	15.68	23.44	33.02
14	Sand	93.51	149.79	147.12
15	Settlements	78.41	201.24	282.73
16	Irrigation Tanks	142.65	145.62	149.90
17	SHAR Centre	--	3.11	3.00
18	Mangrove Swamps	2.34	--	--

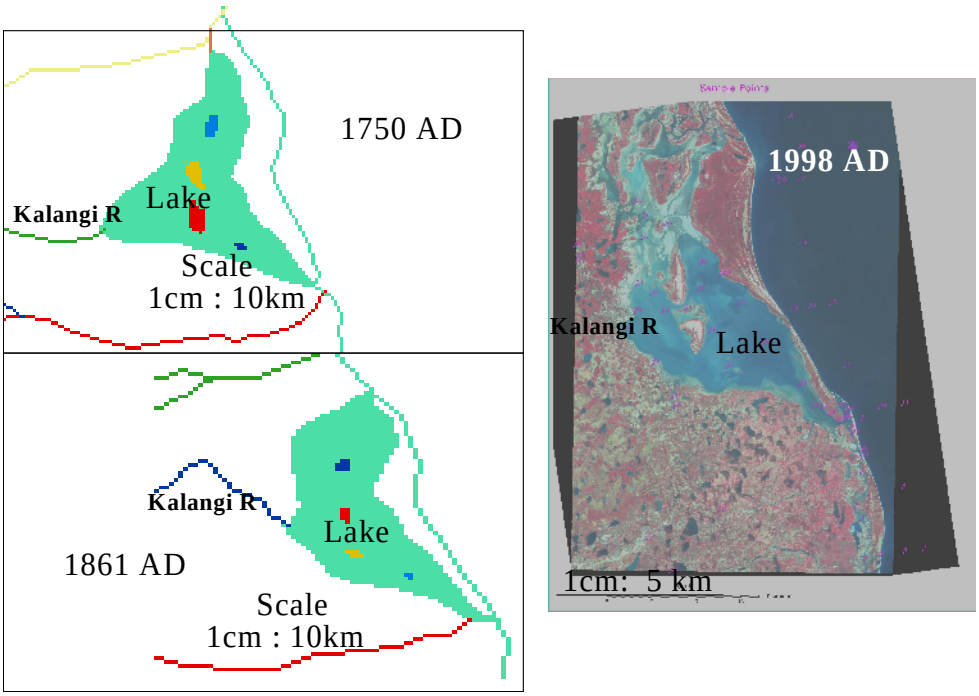


Figure 4.1 Changes in the Configuration of Pulicat Lake

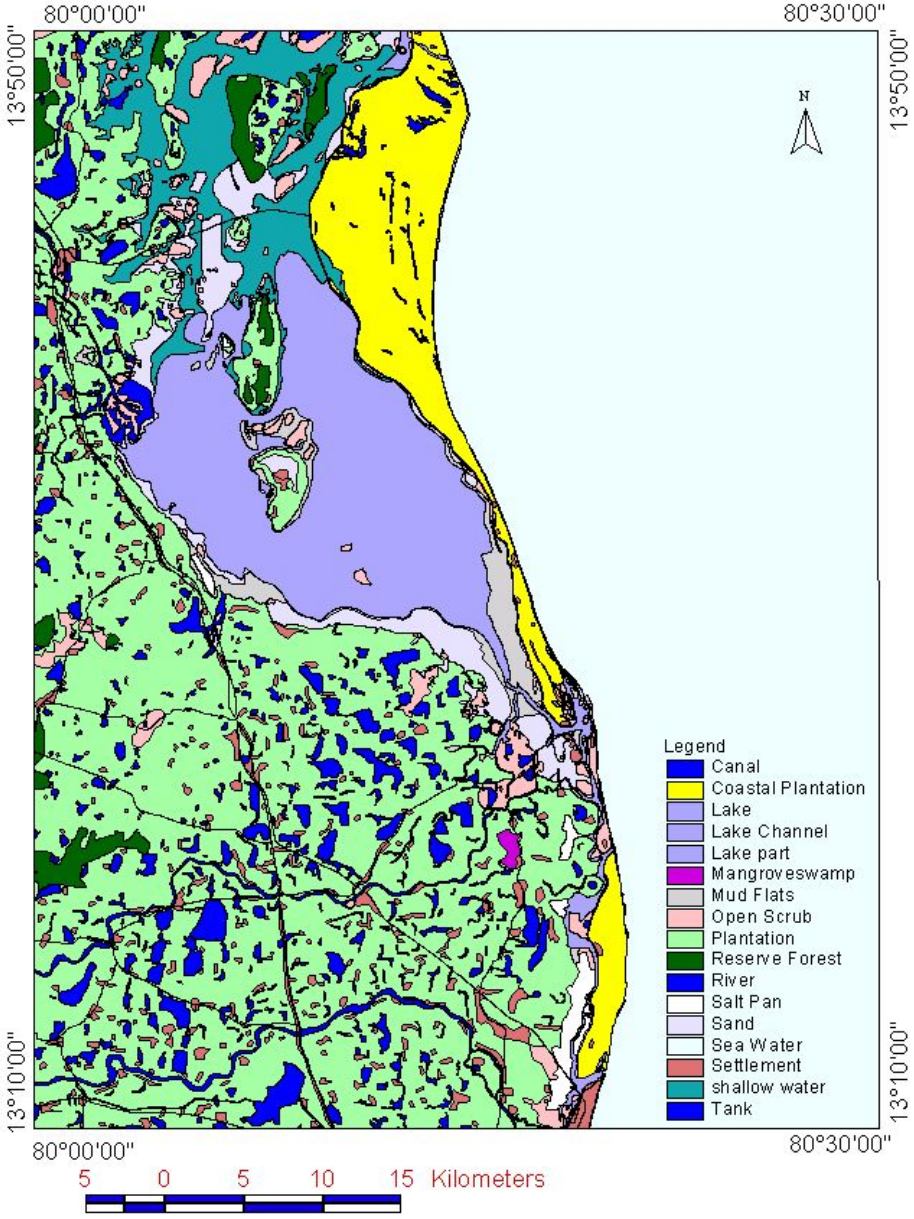


Figure 4.3 a Landuse Map for the year 1974

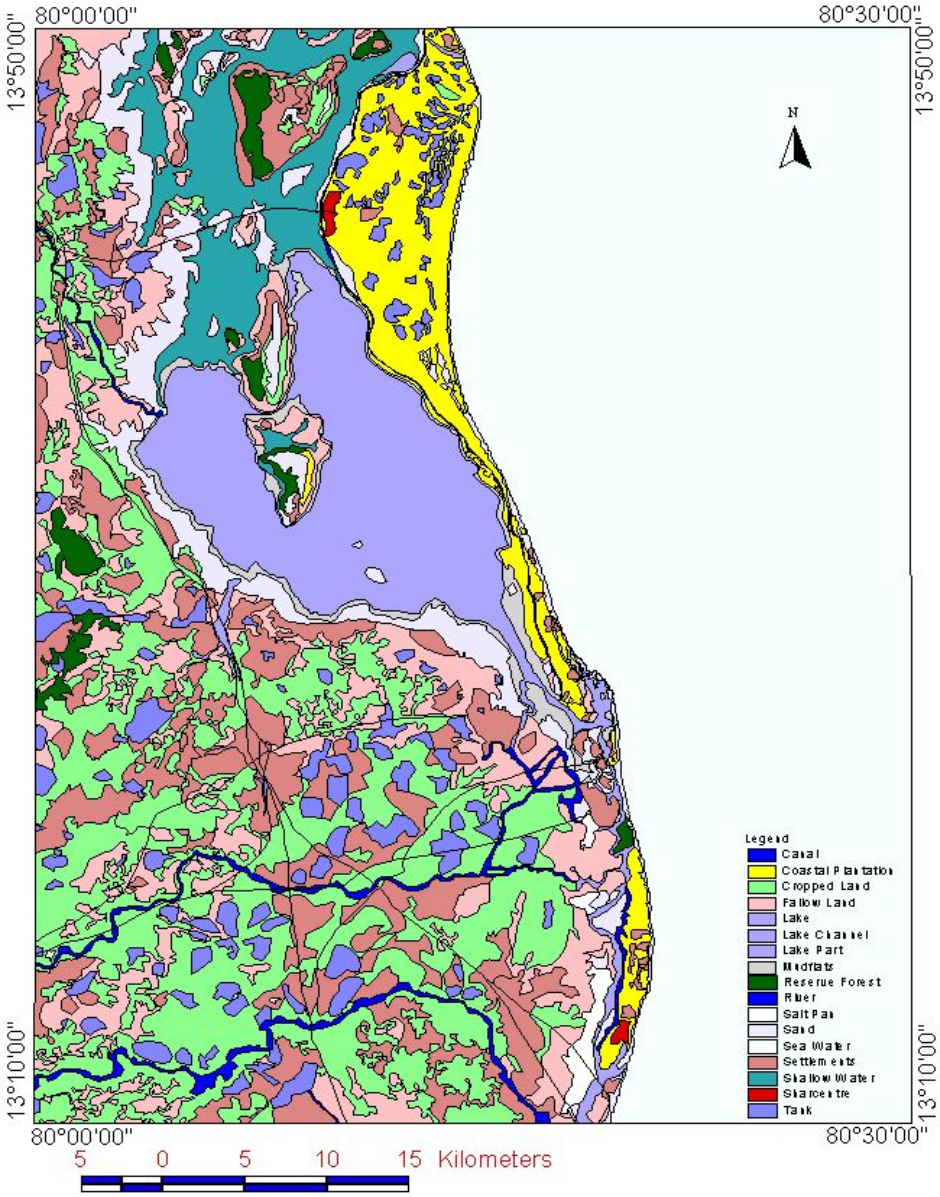


Figure 4.3 b Landuse Map for the year 1990

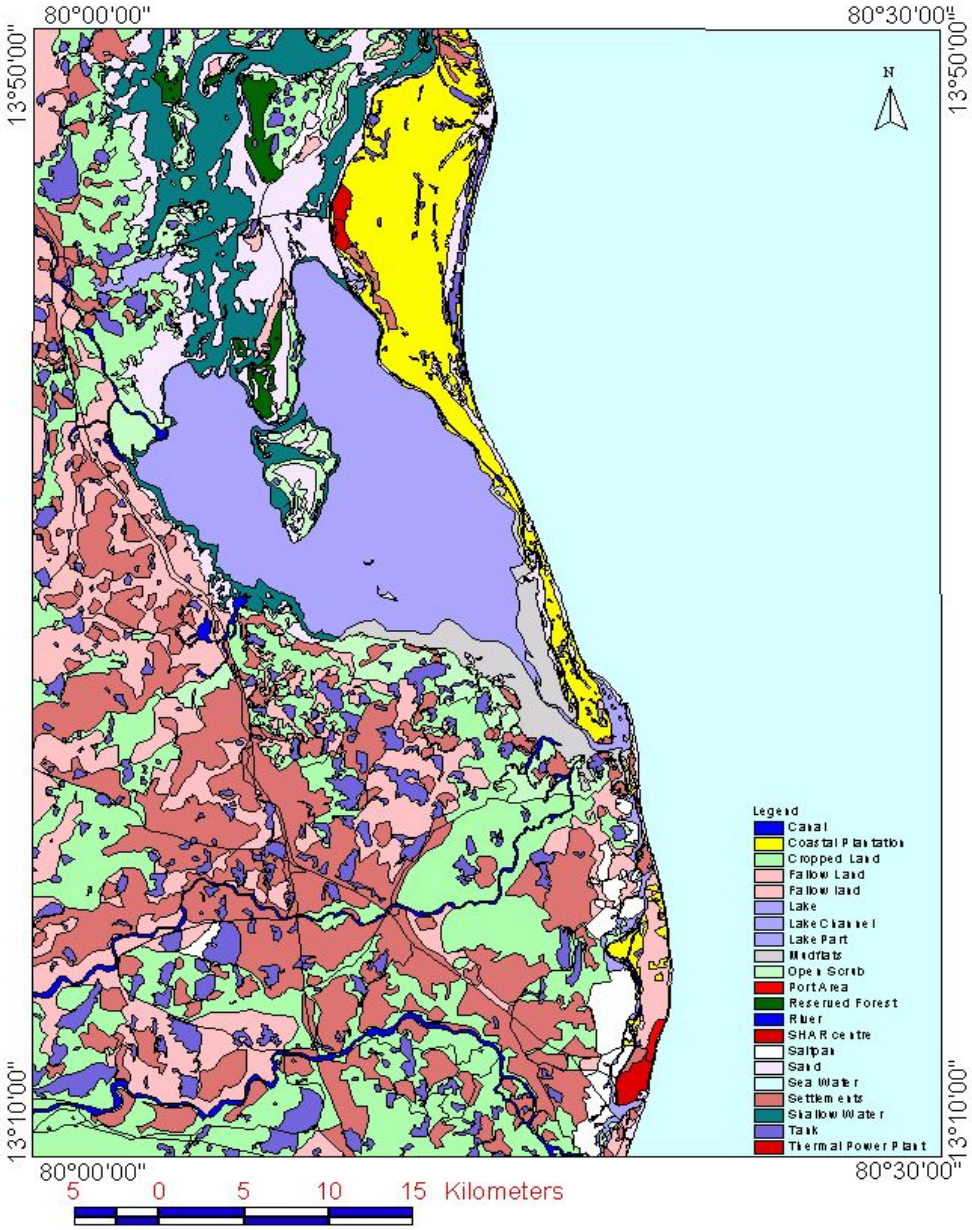


Figure 4.3 c Landuse Map for the year 1998