Salim Ali Centre For Ornithology & Natural History

Remote Sensing and Wetland Management

Wetland Ecosystem

Newsletter 2006

Introduction

The Salim Ali Centre for Ornithology and Natural History (SACON) brings out the second issue of SAROVAR SAURABH, an ENVIS Newsletter on wetland ecosystems, sponsored by the Ministry of Environment and Forests, Govt. of India. The major goal of the Newsletter is to share information about wetlands with various users and, to highlight conservation issues of relevance to wetland community of professionals, managers, environmentalists and other stakeholders.

This Newsletter is devoted to reporting application of remote sensing in mapping and monitoring of wetland. This deals with our ENVIS centre's on going activity on filling gaps of information and data on wetland ecosystems of India-in particular on location, distribution and aerial extent of wetlands. This information is very critical as aquatic biodiversity is the most threatened of all types of extant biodiversity. The states of Tamil Nadu and Gujarat were identified with information gap on spatial distribution of wetlands with sizes of two hectors and above. These data is extremely useful in as baseline information for comparing changes in wetland distribution and extent. The source of data for deriving wetlands is the publically available (http://glcf.umiacs.umd.edu/index.shtml) 1990 Landsat Satellite data. Wetland relevant bands of 2,3,7 were analyzed and the results were reported district-wise. Although, the information is only relating to one class, viz wetlands, it is hoped that as a base line GIS data, this data would be indeed widely used.

To make this effort worth while the editorial team of SARVAR SAURABH seeks active participation of its readers in terms of providing information, news, views, photographs and articles on issues of wetland conservation.

We welcome your feedback on the Newsletter and its contents.

Remote Sensing

Realizing the importance of wetlands in india, Ministry of Environment and Forests (Moef), Government of India, has published a directory of wetlands (1990) based on the survey carried out during 1972. However, the survey is not comprehensive and many inland wetlands and most of the coastal wetlands have not been included in the compilation. In order to fill this gap, Ministry of Environment and Forests, Govt. of india has sponsored a project to Space Application Centre (SAC) on Nation-wide Wetland Mapping for inventory and creation of a data base for conservation and management of wetlands in the country using space borne remotely sensed data from Indian Remote Sensing Satellite (IRS) 1A/1B.

SAC had mapped the wetlands at 1:2,50,000 scale in the mainland as well as in the islands, using the visual interpretation of coarse resolution satellite data. Mapping has been carried out in twelve states on 1:250,000 scale except for all NE states, Sikkim, West Bengal, Goa, Punjab, Haryana, Himachal Pradesh, Chandigarh, Delhi, Andaman & Nicobar Island, Lakshadweep, Diu, Daman, Dadra & Nagar Haveli and Pondicherry where mapping has been done at 1:50,000 scale which covered all wetlands of the size 2.25 ha and above. However, in the rest of the country, only wetlands of 56.25 ha and above in size could be mapped. It is indisputable that a vast majority of wetlands, in their number, extent and conservation importance, are below 50 ha in size (e.g. Indo-Gangetic plains and Deccan Peninsula). Yet most of these could not be captured on 1:2,50,000 scale mapping. So, an attempt has been made to locate the wetlands of below 56.25 ha, which later can be conserved based on threat status of the wetlands.

2. Methodology for mapping

Satellite data of different time periods and different resolution will be used for the present study. Initially, the ortho-rectified data from Landsat Thematic Mapper data (between 1990 to 1992) downloaded from the Global Land Cover Facility (GLCF) website. The digital image processing was carried out on WINDOWS workstation using ERDAS IMAGINE 8.6 and ARSGIS 8.0 softwares. An interactive classification approach using both supervised and visual techniques will be adopted to delineate various wetland categories viz., Lakes, Ponds, Reservoirs, Mangroves, Saltpans, other aquatic vegetation etc., of study area (Figure-1).

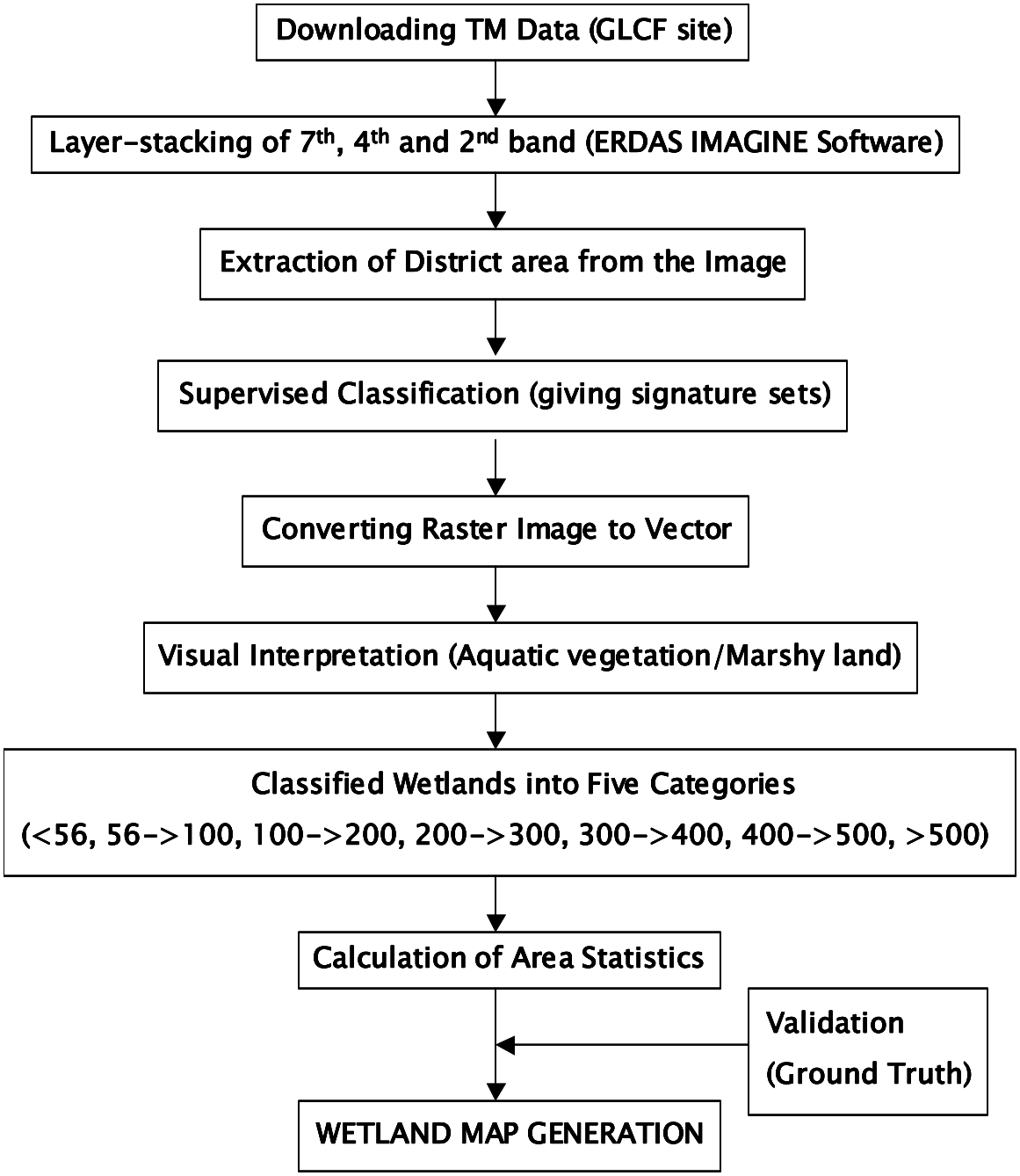

Figure-1: Methodology for delineation of wetlands using Remote Sensing and GIS

3. Selection of bands for extraction of water bodies

Landsat TM provides a reasonably quick and cost-effective means for mapping wetlands. Landsat satellites have 7 bands (Table-1). The first 3 channels are visible bands. Channel 4 (near infrared) is the most effective band for monitoring vegetation differences. The

signals from channels 5 and 7 (mid infrared) are related to soil moisture content of the surface. Channel 6 (thermal) has lower resolution (120m). Typically TM bands 4, 3, 2 can be combined to make FCC where band 4 represents Red, band 3 Green and band 2 Blue. The two Mid-IR bands (bands 5 and 7) are useful for vegetation and soil moisture studies. For the present study bands 2 (0.52 – 0.6), 4 (0.76 – 0.9), 7 (2.08 – 2.35) are proved to be beneficial in delineating wetlands along with their aquatic vegetation.

Table.1. Characteristics of Landsat TM sensor.

Channel	Wavelength (µm)	Band	Resolution (m)
1	0.45-0.52	Blue	30 x 30
2	0.52-0.60	Green	30 x 30
3	0.63-0.69	Red	30 x 30
4	0.76-0.90	Near IR	30 x 30
5	1.55-1.75	Mid IR	30 x 30
6	2.08-2.35	Mid IR	30 x 30
7	10.4-12.5	Thermal	120 x 120

4. Classification

Classification of the image has been carried out digitally keeping all wetland classification system in mind. Special care was taken to classify marshy and swampy areas, as these constitute important components of the wetlands. The classification process is conducted using the supervised classification technique based on known `training' sites of various wetland classes. The supervised classification technique uses the Maximum Likelihood Classifier (MLC) algorithm and MLC assumes Gaussian distribution of data. The classification process involves grouping the unclassified pixels in a satellite image into different specified classes basing on probability. Pixels are assigned to their most likely classes basing on highest probability values. The supervised classification method was performed using ERDAS Imagine image processing software package. The final classified raster image was vectorized to convert the data into GIS domain. The GIS software used is ARC INFO. To ensure maximum accuracy further visual interpretation of wetlands was followed in certain areas where the water bodies were covered with aquatic vegetation. The attribute data are managed by Microsoft Excel software. Wetland area were categorized into 5 classes as < 56 ha, 56 - <100 ha, 100 - < 200 ha, 200 - < 300ha, 300 - < 400 ha, 400 - <500ha and > 500 ha.

We had concluded the Gujarat and Tamil Nadu state wetland mapping using LANDSAT imageries. The results were shown below.

5. Results

The wetland area statistics pertaining to different wetland categories is shown in Table 1 & 2 and Figure-2.

Table - 1 clearly indicates that high proportion of wetland area is covered in Kachch district (79%) alone and remaining districts show low percent of area under wetland category. Especially districts like Bharuch, Jamnagar, Kachch, Rajkot and Surendernagar showed wetland area > 500 ha, covering inland as well as coastal wetlands.

SAC reported an overall area of 27,17,468.75 ha and considered the wetland area > 56 ha. But in the present study we have considered wetlands greater than 2 ha and overall area reported is 30,23,917.76. The difference is area statistics is about > 3 lakhs compared with SAC, and even it should be more.

The under estimation is the area statistics is due to the low interpretation of large wetlands which are covered with aquatic vegetation. The digital classification allowed in classifying only the water reflected surface and failed to classify the wetlands with vegetation, which to certain extent is done by visual method. Some of the classes interpreted by SAC, could not be interpreted due to the variation in the time period of procured satellite data. Sac estimations are based on two data sets of post and pre monsoon, which is lacking in the present study.

Distribution of wetland area in 19 districts of Gujarat state is also done. The graphical representation of wetland areas in Amreli and Ahmedabad districts are shown in Figure 4, 6 & 8.

The final output wetland maps of different district are done with adding road, rail, drainage and important location points using ARCGIS software. The wetland map of two districts (Amreli and Ahmedabad) is shown in figure 3, 5 & 7.

The wetland area statistics of Tamil Nadu pertaining to different wetland categories is shown in Table 2.

Distribution of wetland area in 30 districts of Tamil Nadu state is also done. The final output wetland maps of different district are done with adding road, rail, drainage and important location points using ARCGIS software. The wetland map of two districts (Ariyalur and Chennai) is shown in figure 9 & 10.

Table - 1 Distribution of wetland Categories in Gujarat State (Area in Ha)

S.No	Districts	< 56	56 -<100	100 -<200	200 -<300	300 -< 400	400 -<500	>=500	Total	% of Area
1	Amreli	747.14	690.82	775.05	1196.20	703.04	14814.82	---	18927.07	0.63
2	Ahmadabad	6411.45	1776.57	3169.28	1298.94	15052.57	---	---	27708.80	0.92
3	Banaskantha	3180.89	1055.39	1109.40	1464.63	8594.08	---	---	15404.40	0.51
4	Bharuch	2488.40	1023.64	2186.57	1406.78	2365.24	447.61	60412.40	70330.64	2.33
5	Bhavnagar	1247.85	755.39	1689.51	1197.93	2128.45	62384.09	---	69403.22	2.30
6	Gandhinagar	354.83	---	---	---	---	---	---	354.83	0.01
7	Jamnagar	1673.06	1256.28	2577.19	3863.75	1826.80	880.10	95123.53	107200.70	3.55
8	Junagadh	691.09	1380.67	1754.99	1534.91	15210.42	---	---	20572.08	0.68
9	Kheda	9495.46	3342.93	3919.39	2487.09	24926.63	---	---	44171.50	1.46
10	Kachch	8061.12	5548.58	7178.52	5986.94	5166.99	3142.69	2372702.43	2407787.26	79.62
11	Mahesana	2061.58	1639.18	---	---	---	---	---	3700.76	0.12
12	Panchmahals	7839.25	1349.88	1169.65	22470.65	---	---	---	32829.42	1.09
13	Rajkot	2908.69	1498.48	2843.61	1250.41	1400.89	1471.42	15770.84	27144.35	0.90
14	Sabarkanth	4704.62	661.20	442.34	14623.80	---	---	---	20431.97	0.68
15	Surat	1952.69	806.85	1480.46	1221.75	1029.01	70624.71	---	77115.46	2.55
16	Surendranagar	6192.94	1816.76	2039.57	2027.08	1036.95	922.95	14021.45	28057.71	0.93
17	Thedang	1238.18	---	---	---	---	---	---	1238.18	0.04
18	Valsad	1250.12	487.81	1501.10	1386.06	1421.32	28664.90	---	34711.32	1.15
19	Vadodara	2215.19	524.85	1631.04	1196.02	11261.00	---	---	16828.10	0.56
	Total Area								**3023917.76**	100

Table - 2 Wet land Categories in Tamil Nadu state (Area in Ha)

S.No	Districts	< 56	56 -<100	100 -<200	200 -<300	300 -< 400	400 -<500	>=500	Total	Sq Km	% of Area
1	Ariyalur	1076.71	219.86	---	284.94	---	409.43	2691.85	4682.79	46.83	2.2
2	Chennai	209.63	---	330.9	205	---	---	---	745.53	7.46	0.3
3	Coimbatore	1043.83	328.73	545.37	579.86	---	422.44	772.65	3692.88	36.93	1.7
4	Cuddalore	1653.34	618.41	608.39	1286.81	693.1	459.94	4211.54	9531.53	95.32	4.4
5	Dharmapuri	4009.46	694.24	629.14	254.46	---	---	4068.11	9655.41	96.55	4.5
6	Dindigul	1078.04	284.79	668.86	---	371.98	---	---	2403.67	24.04	1.1
7	Erode	920.6	298.43	---	---	357.07	434.71	3363.12	5373.93	53.74	2.5
8	Kanchipuram	6516.52	696.31	551.74	562.34	667.13	414.99	3530.13	12939.16	129.39	6.0
9	Kanyakumari	2714.62	439.81	495.41	716.02	389.89	493.09	612.14	5860.98	58.61	2.7
10	Karur	1039.36	764.37	425.59	534.12	---	---	---	2763.44	27.63	1.3
11	Madurai	1011.68	226.75	294.85	---	---	---	1271.54	2804.82	28.05	1.3
12	Nagapattinam	3824.15	1902.06	2117.02	1328.35	2099.33	1261.32	19674.36	32206.59	322.07	15.0
13	Namakkal	560.72	---	290.12	---	---	---	630.42	1481.26	14.81	0.7
14	Nilgiri	147.19	90.72	154.02	551.31	665.38	401.75	---	2010.37	20.10	0.9
15	Perambur	489.88	78.64	---	---	---	---	---	568.52	5.69	0.3
16	Pudukotai	10285.27	1959.9	1572.48	714.08	---	---	---	14531.73	145.32	6.8
17	Ramanthpuram	7925.59	3705.94	4603.58	2705.25	667.07	---	4644.18	24251.61	242.52	11.3
18	Salem	746.07	416.89	404.44	---	---	409.74	7309.03	9286.17	92.86	4.3
19	Sivganga	6008.31	980.66	404.07	---	---	---	---	7393.04	73.93	3.4
20	Tanjavur	5510.06	528.04	839.92	1218.16	---	---	---	8096.18	80.96	3.8
21	Teni	69.97	---	---	---	---	---	---	69.97	0.70	0.0
22	Tiruchinapalli	1799.08	356.96	---	200.82	---	---	---	2356.86	23.57	1.1
23	Tiruneveli	4342.1	1525.89	1387.83	205.73	---	---	648.59	8110.14	81.10	3.8
24	Tiruvalur	2353.5	888.98	330.09	639.91	324.44	---	5619.52	10156.44	101.56	4.7
25	Tiruvannamalai	2120.57	280.42	136.61	---	---	---	1306.91	3844.51	38.45	1.8
26	Tiruvanur	460.83	93.51	---	248.48	---	---	---	802.82	8.03	0.4
27	Tutikorin	2795.11	992.73	1921.04	960.77	1407.84	417.91	10049.68	18545.08	185.45	8.7
28	Vellore	366.7	---	---	---	---	---	---	366.7	3.67	0.2
29	Villupuram	1531.42	124.89	124.05	---	---	---	2212.42	3992.78	39.93	1.9
30	Virudnagar	3681.46	1200.15	414.44	509.78	---	---	---	5805.83	58.06	2.7
	TOTAL	**76291.77**	**19698.08**	**19249.96**	**13706.19**	**7643.23**	**5125.32**	**72616.19**	**214330.74**	**2143.31**	100.0

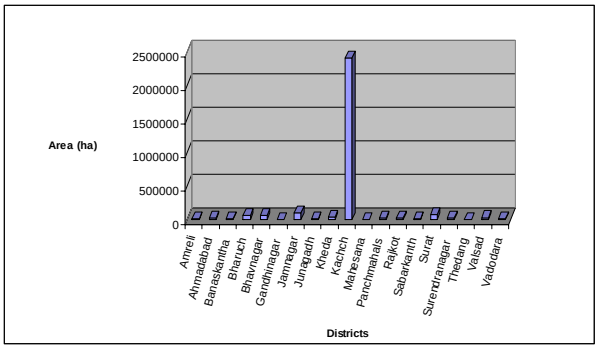

Figure-2:
Wetland area in different districts of Gujarat State

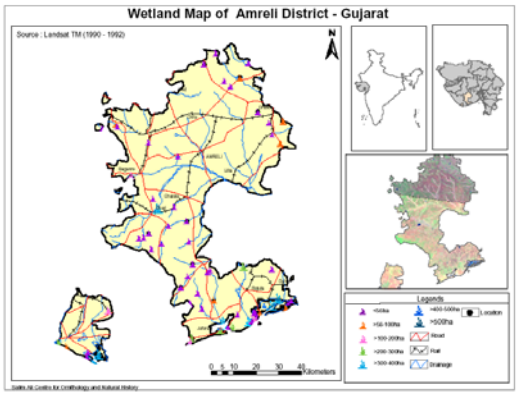

Figure-3:
Wetland map of Amreli district, Gujarat

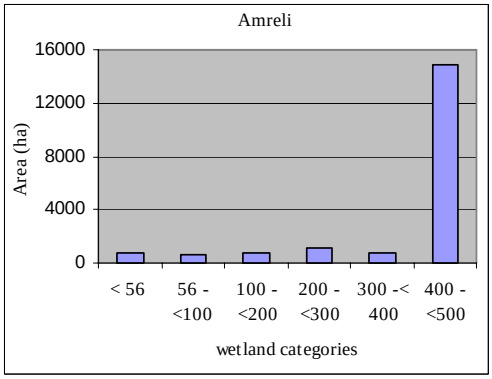

Figure-4:
Wetland area distribution in Amreli district, Gujarat

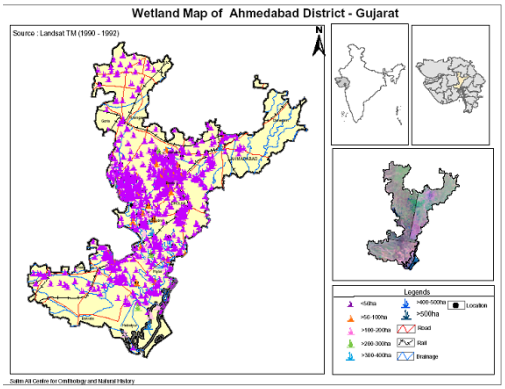

Figure-5:
Wetland map of Ahmedabad district, Gujarat

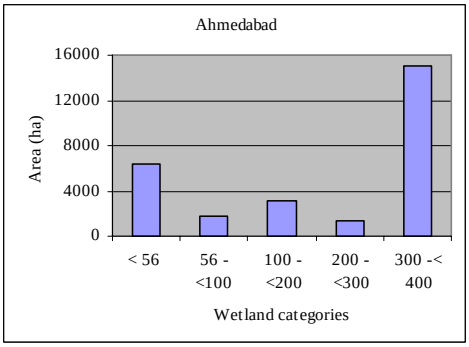

Figure-6:
Wetland area distribution in Ahmedabad district, Gujarat

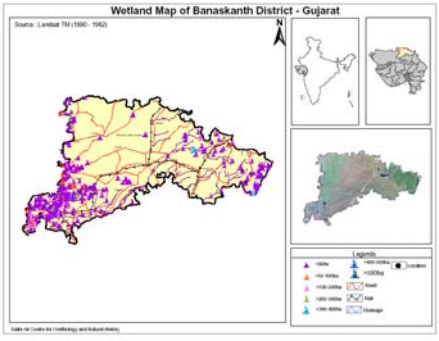

Figure-7:
Wetland map of Banaskanth district, Gujarat

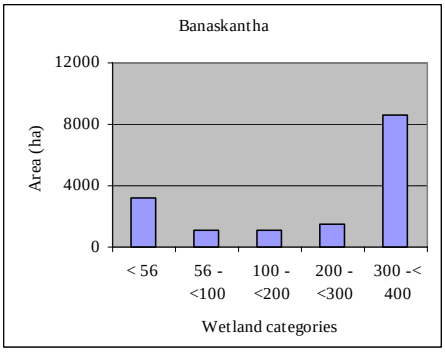

Figure-8:
Wetland area distribution in Banaskanth district, Gujarat

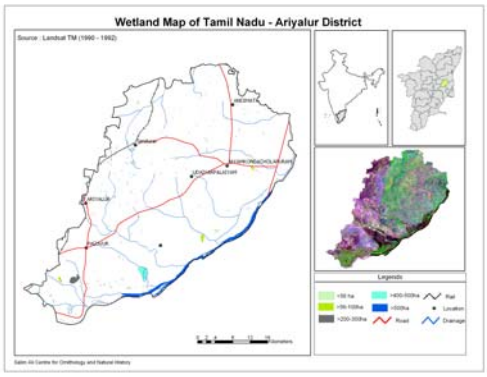

Figure-9:
Wetland map of Ariyalur district, Tamil Nadu

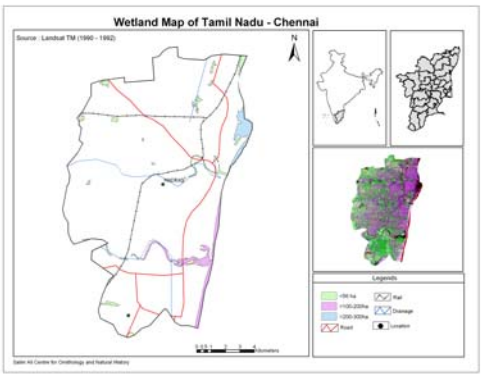

Figure-10:
Wetland map of Chennai district, Tamil Nadu

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