NATIONAL WETLAND ATLAS:

MAHARASHTRA

Sponsored by

Ministry of Environment and Forests

Government of India

Space Applications centre
Indian Space Research Organisation
Ahmedabad – 380 015

This publication deals with the updated database and status of wetlands, compiled in Atlas format. Increasing concern about how our wetlands are being influenced has led to formulation of a project entitled “National Wetland Inventory and Assessment (NWIA)” to create an updated database of the wetlands of India. The wetlands are categorised under 19 classes and mapped using satellite remote sensing data from Indian Remote Sensing Satellite: IRS P6- LISS III sensor. The results are organised at 1: 50, 000 scales at district, state and topographic map sheet (Survey of India reference) level using Geographic Information System (GIS). This publication is a part of this national work and deals with the wetland status of a particular State/Union Territory of India, through text, statistical tables, satellite images, maps and ground photographs.

The atlas comprises wetland information arranged into nine sections. How the NWIA project work has been executed highlighted in the first six sections viz: Introduction, NWIA project, Study area, Data used, Methodology, and Accuracy. This is the first time that high resolution digital remote sensing data has been used to map and decipher the status of the wetlands at national scale. The methodology highlights how the four spectral bands of LISS III data (green, red, near infra red and short wave infra red) have been used to derive various indices and decipher information regarding water spread, turbidity and aquatic vegetation. Since, the aim was to generate a GIS compatible database, details of the standards of database are also highlighted in the methodology.

The results and finding are organised in three sections; viz: Maps and Statistics, Major wetland types, and Important Wetlands of the area. The Maps and Statistics are shown for state and district level. It gives details of what type of wetlands exists in the area, how many numbers in each type, their area estimates in hectare. Since, the hydrology of wetlands are influenced by monsoon performance, extent of water spread and their turbidity (qualitative) in wet and dry season (post-monsoon and pre-monsoon period) are also given. Similarly the status of aquatic vegetation (mainly floating and emergent types) in two seasons is also accounted for. Status of small wetlands are also accounted as numbers and depicted in maps as points. Wetland map also show important ancillary information like roads/rail, relevant habitations. False Colour Composite (FCC) of the satellite image used (any one season) is shown along with the derived wetland map to give a feeling of manifestation of wetlands in remote sensing data and synoptic view of the area. The status of some of the important wetlands like Ramsar sites, National Parks are shown with recent field photographs.

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NATIONAL WETLAND ATLAS

Maharashtra

Sponsored by
Ministry of Environment and Forests, Government of India

As a part of the project on National Wetland Inventory and Assessment (NWIA)

May 2010

Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

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जयराम रमेश
JAIRAM RAMESH

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MESSAGE

It gives me great pleasure to introduce this Atlas, the latest in a series, prepared by Space Applications Centre, Ahmedabad in connection with the National Wetland Inventory and Assessment Project.

This Atlas maps and catalogues information on Wetlands across India using the latest in satellite imaging, one of the first of its kind. Wetlands are areas of land critical ecological significance that support a large variety of plant and animal species adapted to fluctuating water levels. Their identification and protection becomes very important.

Utility-wise, wetlands directly and indirectly support millions of people in providing services such as food, fiber and raw materials. They play important roles in storm and flood control, in supply of clean water, along with other educational and recreational benefits. Despite these benefits, wetlands are the first target of human interference and are among the most threatened of all natural resources. Around 50% of the earth's wetlands are estimated to already have disappeared worldwide over the last hundred years through conversion to industrial, agricultural and residential purposes. Even in current scenario, when the ecosystem services provided by wetlands are better understood - degradation and conversion of wetlands continues.

Aware of their importance, the Government of India has formulated several policies and plans for the conservation and preservation of these crucial ecosystems. Realising the need of an updated geospatial data base of these natural resources as the pre-requisite for management and conservation planning, National Wetland Inventory and Assessment (NWIA) project was formulated as a joint vision of Ministry of Environment & Forestry, Govt. India, and Space Applications Centre (ISRO). I am told that the latest remote sensing data from Indian Remote Sensing satellite (IRS P6) have been used to map the wetlands. The present atlas is part of this project and highlights the results of the study state in terms of statistics of various types of wetlands, extent of water, aquatic vegetation and turbidity in pre and post monsoon period. I also note that special efforts are made to provide detailed information of important wetlands like Ramsar sites, National Parks etc.

I am certain that this Atlas will raise the bar in developing such database and will be of great use for researchers, planners, policy makers, and also members of the general public.

(Jairam Ramesh)

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FOREWORD

Wetlands defined as areas of land that are either temporarily or permanently covered by water exhibit enormous diversity according to their genesis, geographical location, water regime and chemistry. Wetlands are one of the most productive ecosystems and play crucial role in hydrological cycle. Utility wise, wetlands directly and indirectly support millions of people in providing services such as storm and flood control, clean water supply, food, fiber and raw materials, scenic beauty, educational and recreational benefits. The Millennium Ecosystem Assessment estimates conservatively that wetlands cover seven percent of the earth's surface and deliver 45% of the world's natural productivity and ecosystem services. However, the very existence of these unique resources is under threat due to developmental activities, and population pressure. This calls for a long term planning for preservation and conservation of these resources. An updated and accurate database that will support research and decision is the first step towards this. Use of advanced techniques like Satellite remote sensing, Geographic Information System (GIS) is now essential for accurate and timely spatial database of large areas. Space Applications Centre (ISRO) took up this challenging task under the project "NWIA" (National Wetland Inventory and Assessment) sponsored by Ministry of Environment & Forests. To account for numerous small yet important wetlands found in the country, mapping at 1:50,000 scales has been taken up. Two date IRS LISS III data acquired during pre and post monsoon season are used for inventory to account for wet and dry season hydrology of wetlands. The map outputs include the status of water spread, aquatic vegetation and turbidity. Ancillary layers like road/rail, habitations are also created. Very small wetlands below the mappable unit are also identified and shown points. The results are complied as Atlases of wetlands for states/Union Territories of India. This Atlas highlights results for a particular state/UT and hopes to improve our understanding of the dynamics and distribution of wetlands and their status in the area.

I congratulate the team for bringing out this informative atlas and sincerely hope that this will serve as a useful source of information to researchers, planners and general public.

January 25, 2010

(Ranganath R. Navalgund)

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This project has benefited from the wisdom of many people**.** It is a pleasure to acknowledge the contributions made by the wetland experts especially to Prof. C.K. Varshney, Former Dean, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi, Prof. A.R. Yousuf, The University of Kashmir, Srinagar, Prof. Pradeeep Shrivastava, Head, Wetland Research Centre, Barakatullah University, Bhopal, Dr. Prikshit Gautam, Director, WWF-India, Dr. S. Narendra Prasad, Salim Ali Centre for Ornithology and Nature, Coimbtore and Dr. R.K. Suri, Additional Director, Ministry of Environment and Forests, Govt. of India, New Delhi, and the database experts from ISRO who participated in the peer Review meeting to finalise the “Wetland Classification System” followed in this project

We acknowledge the positive role played by 16th SC-B (Standing Committee on Bioresources and Environment) of NNRMS (National Natural Resources Management System) meeting in formulating this project. We are extremely thankful to the members of the“Steering Committee” of the project, under the chairmanship of Dr E J James, Director – Water Institute, Karunya University, for their periodical review, critical comments and appreciation of the efforts by the project team. We are thankful to SC-B under the chairmanship of Secretary, MoEF, for periodic review of the progress of the project and guidance towards timely completion of the work. We acknowledge the valuable contributions made by Dr J K Garg, the then scientist of SAC for his active role in formulation of this project, co-authoring the procedure manual document.

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1.0 INTRODUCTION

It is increasingly realized that the planet earth is facing grave environmental problems with fast depleting natural resources and threatening the very existence of most of the ecosystems. Serious concerns are voiced among scientists, planners, sociologists, politicians, and economists to conserve and preserve the natural resources of the world. One of the constraints most frequently faced for decision making is lack of scientific data of our natural resources. Often the data are sparse or unauthentic, rarely in the form of geospatial database (map), thus open to challenges. Hence, the current emphasis of every country is to have an appropriate geospatial database of natural resources based on unambiguous scientific methods. The wetland atlas of Maharashtra, which is part of the National Wetland Atlas of India, is an attempt in this direction.

1.1 Wetlands

Wetlands are one of the crucial natural resources. Wetlands are areas of land that are either temporarily or permanently covered by water. This means that a wetland is neither truly aquatic nor terrestrial; it is possible that wetlands can be both at the same time depending on seasonal variability. Thus, wetlands exhibit enormous diversity according to their genesis, geographical location, water regime and chemistry, dominant plants and soil or sediment characteristics. Because of their transitional nature, the boundaries of wetlands are often difficult to define. Wetlands do, however, share a few attributes common to all forms. Of these, hydrological structure (the dynamics of water supply, throughput, storage and loss) is most fundamental to the nature of a wetland system. It is the presence of water for a significant period of time which is principally responsible for the development of a wetland. One of the first widely used classifications systems, devised by Cowardin *et al,* 1979, was associated to its hydrological, ecological and geological aspects, such as: marine (coastal wetlands including rock shores and coral reefs, estuarine (including deltas, tidal marshes, and mangrove swamps), lacustarine (lakes), riverine (along rivers and streams), palustarine ('marshy'- marshes, swamps and bogs). Given these characteristics, wetlands support a large variety of plant and animal species adapted to fluctuating water levels, making the wetlands of critical ecological significance. Utility wise, wetlands directly and indirectly support millions of people in providing services such as food, fiber and raw materials, storm and flood control, clean water supply, scenic beauty and educational and recreational benefits. The Millennium Ecosystem Assessment estimates conservatively that wetlands cover seven percent of the earth's surface and deliver 45% of the world's natural productivity and ecosystem services of which the benefits are estimated at $20 trillion a year (Source: www.MAweb.org). The Millennium Assessment (MA) uses the following typology to categorise ecosystem services:

Provisioning services: The resources or products provided by ecosystems, such as food, raw materials (wood), genetic resources, medicinal resources, ornamental resources (skin, shells, flowers).

Regulating services: Ecosystems maintain the essential ecological processes and life support systems, like gas and climate regulation, water supply and regulation, waste treatment, pollination, etc.

Cultural and Amenity services: Ecosystems are a source of inspiration to human culture and education throughout recreation, cultural, artistic, spiritual and historic information, Science and education.

Supporting services: Ecosystems provide habitat for flora and fauna in order to maintain biological and genetic diversity.

Despite these benefits, wetlands are the first target of human interference and are among the most threatened of all natural resources. Around 50% of the earth's wetland area is estimated to already have disappeared over the last hundred years through conversion to industrial, agricultural and residential developments. Even in current scenario, when the ecosystem services provided by wetlands are better understood - degradation and conversion of wetlands continues. This is largely due to the fact that the 'full value' of ecosystem functions is often ignored in policy-making, plans and corporate evaluations of development projects.

1.2 Mapping and Geospatial Technique

To conserve and manage wetland resources, it is important to have inventory of wetlands and their catchments. The ability to store and analyse the data is essential. Digital maps are very powerful tools to achieve this. Maps relate the feature to any given geographical location has a strong visual impact. Maps are thus essential for monitoring and quantifying change over time scale, assist in decision making. The technique used in the preparation of map started with ground survey. The Survey of India (SOI) topographical maps are the earliest true maps of India showing various land use/cover classes including wetlands. Recent years have seen advances in mapping technique to prepare maps with much more information. Of particular importance is the remote sensing and geographic information system (GIS)

technique. Remote sensing is now recognised as an essential tool for viewing, analyzing, characterizing, and making decisions about land, water and atmospheric components.

From a general perspective, remote sensing is the science of acquiring and analyzing information about objects or phenomena from a distance (Jensen, 1986; Lillesand and Keifer, 1987). Today, satellite remote sensing can be defined as the use of satellite borne sensors to observe, measure, and record the electromagnetic radiation (EMR) reflected or emitted by the earth and its environment for subsequent analysis and extraction of information. EMR sensors includes visible light, near-, mid- and far-infrared (thermal), microwave, and long-wave radio energy. The capability of multiple sources of information is unique to remote sensing. Of specific advantage is the spectral, temporal, and spatial resolution. Spectral resolution refers to the width or range of each spectral band being recorded. Since each target affects different wavelengths of incident energy differently, they are absorbed, reflected or transmitted in different proportions. Currently, there are many land resource remote sensing satellites that have sensors operating in the green, red, near infrared and short wave Infra red regions of the electromagnetic spectrum giving a definite spectral signature of various targets due to difference in radiation absorption and reflectance of targets. These sensors are of common use for land cover studies, including wetlands**.** Figure 1 shows typical spectral signature of few targets from green to SWIR region. Converted to image, in a typical false colour composite (FCC) created using NIR, red and green bands assigned as red, green and blue colour, the features become very distinct as shown in Figure 2. In FCC, the vegetation thus appears invariably red (due to high reflection in NIR from green leaves).

Since the early 1960s, several satellites with suitable sensors have been launched into orbit to observe and monitor the earth and its environment. Most early satellite sensors acquired data for meteorological purposes. The advent of earth resources satellite sensors (those with a primary objective of mapping and monitoring land cover) occurred, when the first Landsat satellite was launched in July 1972. Currently, more than a dozen orbiting satellites of various types provide data crucial to improving our knowledge of the earth's atmosphere, oceans, ice and snow, and land. Of particular interest to India is the indigenous series of satellites called Indian Remote Sensing satellites (IRS-Series). Since the launch of the first satellite IRS 1A in 1987, India has now a number of satellites providing data in multi-spectral bands with different spatial resolution. IRS P6/RESOURCESAT 1 is the current generation satellite that provides multi-spectral images in spatial resolution of 5.8 m (LISS IV), 23.5 m (LISS III) and 56m (AWiFS). Over the past few decades, Indian remote sensing data has been successfully used in various fields of natural resources (Navalgund *et al*, 2002).

Development of technologies like Geographic Information System (GIS) has enhanced the use of RS data to obtain accurate geospatial database. GIS specialises in handling related, spatially referenced data, combining mapped information with other data and acts as analytical tool for research and decision making. During the past few decades, technological advances in the field of satellite remote sensing (RS) sensors, computerized mapping techniques, global positioning system (GPS) and geographic information system (GIS) has enhanced the ability to capture more detailed and timely information about the natural resources at various scales catering to local, regional, national and global level study.

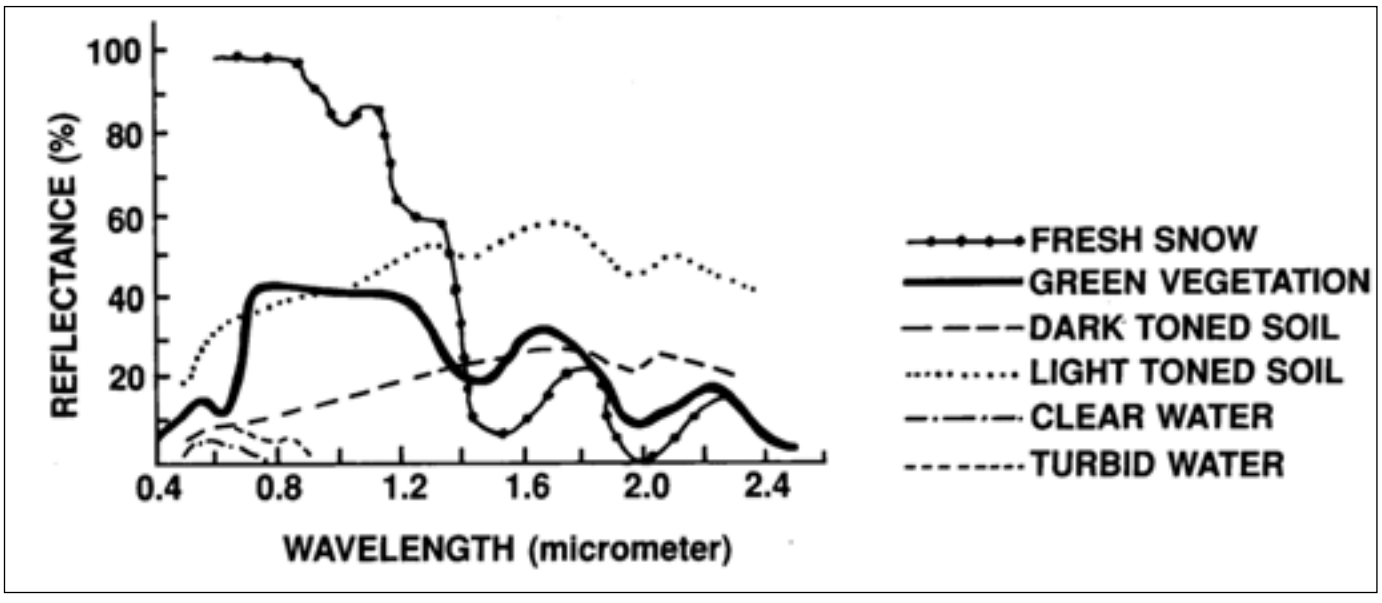
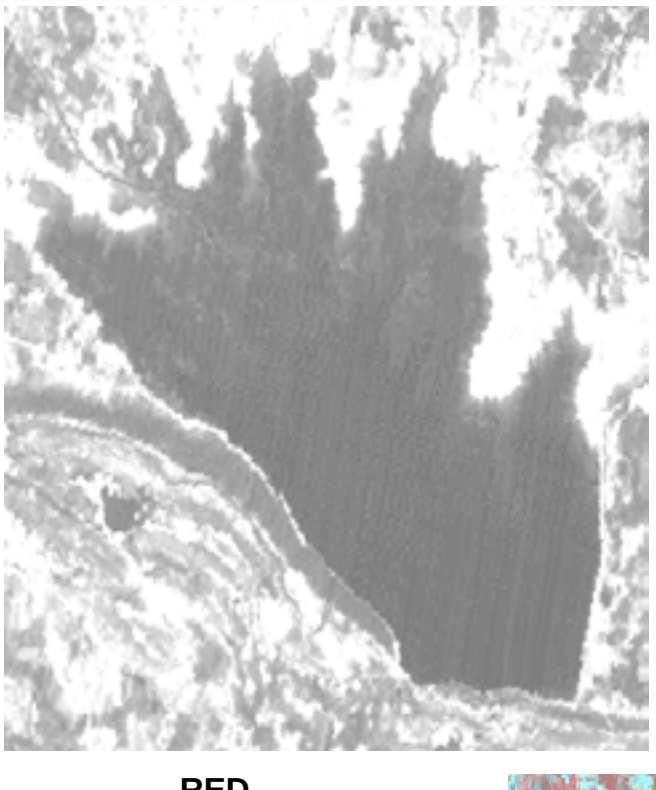
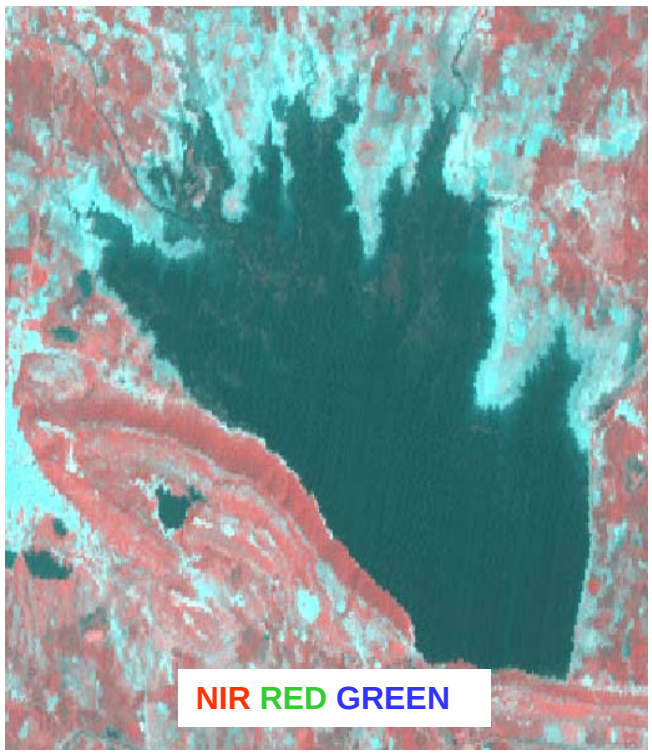
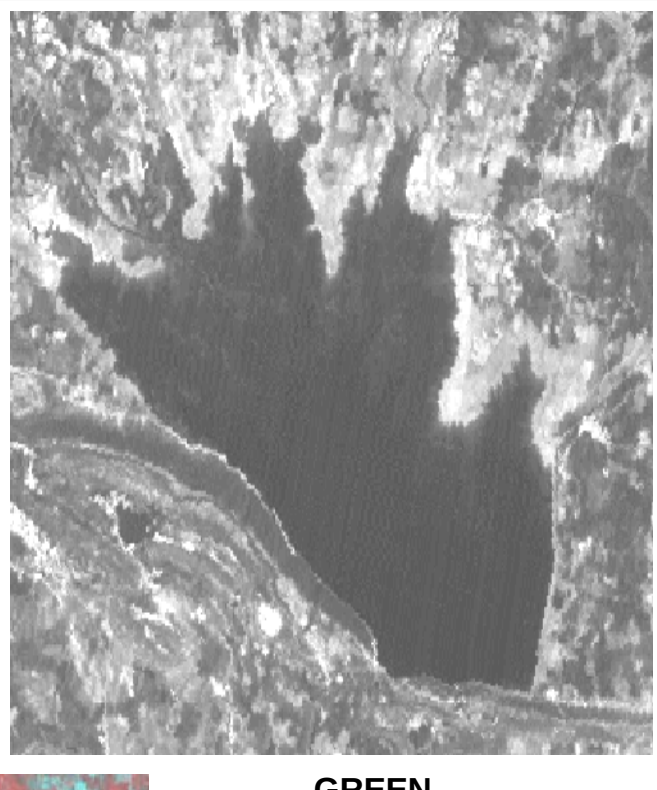


Figure 1: Spectral Signature of various targets



RED





GREEN

NIR

IRS LISS III FCC

SWIR

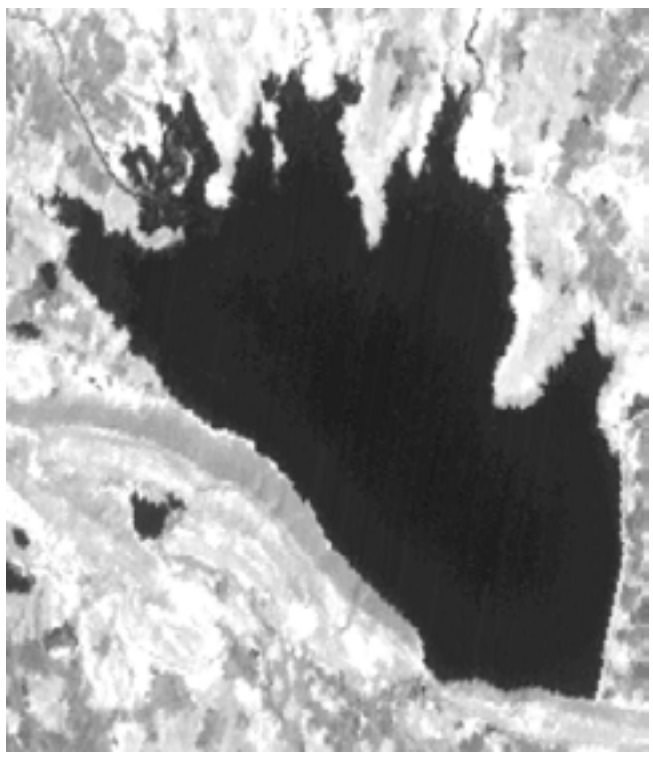


Figure 2: Various land features as they appear in four spectral bands and in a typical three band FCC.

India with its large geographical spread supports large and diverse wetland classes, some of which are unique. Wetlands, variously estimated to be occupying 1-5 per cent of geographical area of the country, support about a fifth of the known biodiversity. Like any other place in the world, there is a looming threat to the aquatic biodiversity of the Indian wetlands as they are often under a regime of unsustainable human pressures. Sustainable management of these assets therefore is highly relevant. Realising this, Govt. of India has initiated many appropriate steps in terms of policies, programmes and plans for the preservation and conservation of these ecosystems. India is a signatory to the Ramsar Convention for management of wetland, for conserving their biodiversity and wise use extending its scope to a wide variety of habitats, including rivers and lakes, coastal lagoons, mangroves, peat-lands, coral reefs, and numerous human-made wetland, such as fish and shrimp ponds, farm ponds, irrigated agricultural land, salt pans reservoirs, gravel pits, sewage farms, and canals. The Ministry of Environment and Forests has identified a number of wetlands for conservation and management under the National Wetland Conservation Programme and some financial assistance is being provided to State Governments for various conservation activities through approval of the Management Action Plans. The need to have an updated map database of wetlands that will support such actions has long been realized.

Mapping requires a standard classification system. Though there are many classification systems for wetlands in the world, the Ramsar classification system is the most preferred one. The 1971 Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat is the oldest conservation convention. It owes its name to its place of adoption in Iran. It came into being due to serious decline in populations of waterfowl (mainly ducks) and conservation of habitats of migratory waterfowl. Convention provides framework for the conservation and 'wise use' of wetland biomes. Ramsar convention is the first modern global intergovernmental treaty on conservation and wise use of natural resources (www.ramsar.org). Ramsar convention entered into force in 1975. Under the text of the Convention (Article 1.1) wetlands are defined as:

"areas of marsh, fen, peat-land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters".

In addition, the Convention (Article 2.1) provides that wetlands:

"may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands".

The first scientific mapping of wetlands of India was carried out during1992-93 by Space Applications Centre (ISRO), Ahmedabad, at the behest of the Ministry of Environment and Forests (MoEF), Govt. of India using remote sensing data from Indian Remote Sensing satellites (IRS-Series). The mapping was done at 1:250,000 scale using IRS 1A LISS-I/II data of 1992-93 timeframe under the Nation-wide Wetland Mapping Project. Since, no suitable wetland classification existed for comprehensive inventory of wetlands in the country at that time; the project used a classification system based on Ramsar Convention definition of wetlands. The classification considers all parts of a water mass including its ecotonal area as wetland. In addition, fish and shrimp ponds, saltpans, reservoirs, gravel pits were also included as wetlands. This inventory put the wetland extent (inland as well as coastal) at about 8.26 million ha (Garg *et al*, 1998). These estimates (24 categories) do not include rice/paddy fields, rivers, canals and irrigation channels.

Further updating of wetland maps of India was carried out by SAC using IRS P6/Resourcesat AWiFS data of 2004-05 at 1:250000 scale. In recent years, a conservation atlas has been brought out by Salim Ali Centre for Ornithology and Natural History (SACON, 2004), which provide basic information required by stakeholders in both wetland habitat and species conservation. Space Applications Centre has carried out many pilot projects for development of GIS based wetland information system (Patel *et al*, 2003) and Lake Information system (Singh *et al*, 2003).

2.0 NATIONAL WETLAND INVENTORY AND ASSESSMENT (NWIA) PROJECT

Realising the importance of many small wetlands that dot the Indian landscape, it has been unanimously felt that inventory of the wetlands at 1:50,000 scale is essential. The task seemed challenging in view of the vast geographic area of our country enriched with diverse wetland classes. Space Applications Centre with its experience in use of RS and GIS in the field of wetland studies, took up this challenging task. This is further strengthened by the fact that guidelines to create geospatial framework, codification scheme, data base structure etc. for natural resources survey has already been well established by the initiative of ISRO under various national level mapping projects. With this strength, the National Wetland Inventory and Assessment (NWIA) project was formulated by SAC, which was approved and funded by MoEF.

The main objectives of the project are:

- To map the wetlands on 1:50000 scale using two date (pre and post monsoon) IRS LISS III digital data following a standard wetland classification system.
- Integration of ancillary theme layers (road, rail, settlements, drainage, administrative boundaries)
- Creation of a seamless database of the states and country in GIS environment.
- Preparation of State-wise wetland atlases.

The project was initiated during 2007. The first task was to have a classification system that can be used by different types of users while amenable to database. An expert/peer group was formed and the peer review was held at SAC on June 2007 where wetland experts and database experts participated and finalized the classification system. It was agreed to follow the classification system that has been used for the earlier project of 1:250,000 scale, with slight modification. Modified National Wetland Classification system for wetland delineation and mapping comprise 19 wetland classes which are organized under a Level III hierarchical system. The definition of each wetland class and its interpretation method was finalized. The technical/procedure manual was prepared as the standard guideline for the project execution across the country (Garg and Patel, 2007). The present atlas is part of the national level data base and deals with the state of Maharashtra.

2.1 Wetland Classification System

In the present project, Modified National Wetland Classification system is used for wetland delineation and mapping comprising 19 wetland classes which are organized under a Level III hierarchical system (Table 1). Level one has two classes: inland and coastal, these are further bifurcated into two categories as: natural and man-made under which the 19 wetland classes are suitably placed. Two-date data pertaining to pre-monsoon and post-monsoon was used to confirm the classes. Wetlands put to agriculture use in any of the two dates are not included as wetland class. Definitions of wetland categories used in the project is given in Annexure-I.

2.2 Spatial Framework and GIS Database

The National Spatial Framework (NSF) has been used as the spatial framework to create the database (Anon. 2005a). The database design and creation standard suggested by NRDB/NNRMS guidelines is followed. Feature codification scheme for every input element has been worked out keeping in view the nationwide administrative as well as natural hierarchy (State-district- within the feature class for each of the theme. All data elements are given a unique name, which are self explanatory with short forms.

Following wetland layers are generated for each inland wetland:

- Wetland extent: As wetlands encompass open water, aquatic vegetation (submerged, floating and emergent), the wetland boundary should ideally include all these. Satellite image gives a clear signature of the wetland extent from the imprint of water spread over the years.

- Water spread: There are two layers representing post-monsoon and pre-monsoon water spread during the year of data acquisition.

- Aquatic vegetation spread: The presence of vegetation in wetlands provides information about its trophic condition. As is known, aquatic vegetation is of four types, viz. benthic, submerged, floating

and emergent. It is possible to delineate last two types of vegetation using optical remote sensing data. A qualitative layer pertaining to presence of vegetation is generated for each season (as manifested on pre-monsoon and post-monsoon imagery).

- Turbidity of open water: A layer pertaining to a qualitative turbidity rating is generated. Three qualitative turbidity ratings (low, medium and high) is followed for pre- and post-monsoon turbidity of lakes, reservoirs, barrages and other large wetlands.

- Small wetlands (smaller than minimum mappable unit: < 2.25 ha) are mapped as point features.

- Base layers like major road network, railway, settlements, and surface drainage are created (either from the current image or taken from other project data base).

Table 1: Wetland Classification System and coding

Wettcode*	Level I	Level II	Level III
1000	Inland Wetlands		
1100		Natural	
1101			Lakes
1102			Ox-Bow Lakes/ Cut-Off Meanders
1103			High altitude Wetlands
1104			Riverine Wetlands
1105			Waterlogged
1106			River/stream
1200		Man-made	
1201			Reservoirs/ Barrages
1202			Tanks/Ponds
1203			Waterlogged
1204			Salt pans
2000	Coastal Wetlands		
2100		Natural	
2101			Lagoons
2102			Creeks
2103			Sand/Beach
2104			Intertidal mud flats
2105			Salt Marsh
2106			Mangroves
2107			Coral Reefs
2200		Man-made	
2201			Salt pans
2202			Aquaculture ponds

* Wetland type code

3.0 STUDY AREA

The Maharashtra State occupies a prominent place in the Indian union. It is the second largest state in the country occupying nearly 10 % of the total geographical area. The State has a total geographical area of 3,07,748 km^2 extending over 800 km from East to West and 700 km from North to South, with a long coastline of 720 km all along the west. The State can be divided into two major physiographic divisions viz., the Deccan Plateau and the coastal region known as Konkan. The state is located between 16º N and 22º N latitudes and 72º E and 80º E longitudes and falls in the western part of India, along the Arabian Sea. The state of Gujarat and the Union Territories of Daman, Dadra and Nagar Haveli are to the North-West; Madhya Pradesh is to the North; Chhattisgarh to the East; Andhra Pradesh to the South-East and Karnataka, Andhra Pradesh and Goa lie to the South of Maharashtra. A 720 km long coastline stretches from Daman in the North to Goa in the South, which falls in the resource development zone called the Western Plateau and Hill Regions of India. Physical divisions of the State comprise of three parts based on its physical features, viz, Maharashtra Plateau, the Sahyadri Range and the Konkan Coastal Strip as explained below.

Maharashtra Plateau: The major physical characteristics of the state include many small plateaux and river valleys. In the north the plateau is flanked by Satpuda ranges, which run in the East-West direction in Maharashtra. The river Narmada flows along the north boundary of Maharashtra, and other major rivers like Krishna, Godavari, Bhima, Penganga-Wardha, and Tapi-Purna have carved the plateau in alternating broad river valleys and intervening highlands.

The Sahyadri Range: The Western Ghats of Maharashtra known as the ‘Sahyadri’ mountain ranges have an average elevation of 1000-1200 m above the MSL. The Sahyadri hills run parallel to the seacoast, with many offshoots branching eastwards from the main ranges (Satmala, Ajanta, Harishchandra, Balaghat and Mahadeo). The special features are the hills of Trimbakeshwar, Matheran and the Mahableshwar plateau. Its highest peak is Kalsubai at an altitude of 1650 m. Most of the rivers in Maharashtra originate in the Sahyadri and then divide to join the eastward and westward flowing rivers. These ranges are also characterised by a number of ghats, the important ones being Thal, Bor, Kumbharli, Amba, Phonda and Amboli.

The Konkan Coastal Strip: The narrow strip of coastal land between the Sahyadri and the Arabian Sea is called the Konkan coastal strip. It is barely 50 km in width; it is wider in the north and narrows down in the south. River creeks and branches of the Sahyadri, which reach right up to the coast, dissect this coastline. The important creeks in Konkan are Terekhol, Vijaydurg, Rajapuri, Raigad, Dabhol, Daramthar, Thane and Vasai. The rivers of Konkan rise from the cliffs of Sahyadri and have a short swift flow into the Arabian Sea. Some important rivers are Ulhas, Savitri, Vashishthi and Shastri.

Administrative Divisions:

Maharashtra has been divided into six divisions for administrative purposes viz. Amravati, Aurangabad, Konkan, Nagpur, Nashik, Pune Further, on socio-cultural basis, the State is divided into five regions, namely, Greater Mumbai, Marathwada (Aurangabad division), Konkan, Vidarbha (Amravati and Nagpur divisions) and Western Maharashtra (Pune and Nashik divisions) (Census, 2001; GoM 2004).

Maharashtra is covered by five hundred and three (503) 1:50,000 scale SOI topographical maps that form the spatial frame work for mapping (Figure 4).

A detail of district information followed in the atlas is given in Annexure-II.

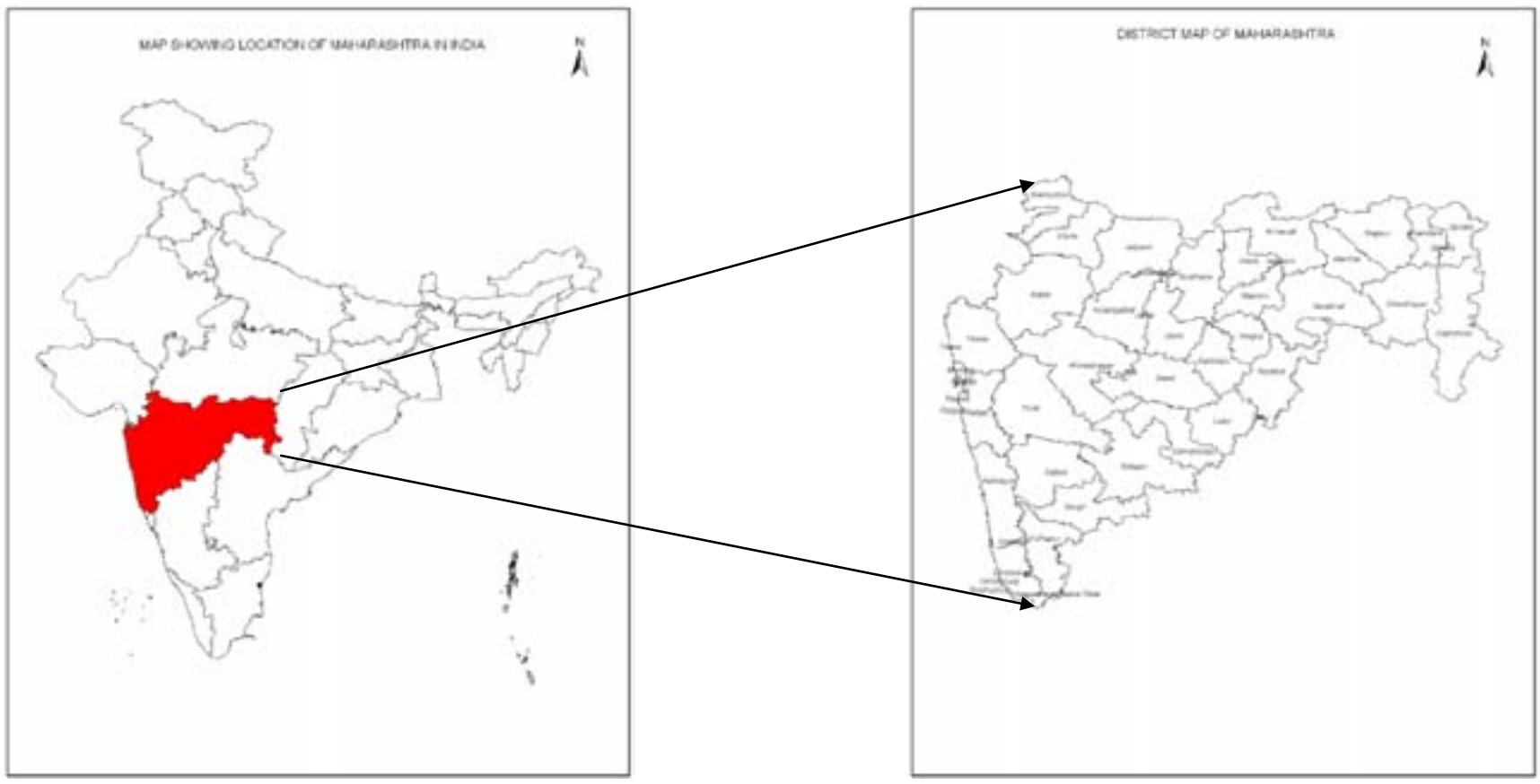


Figure 3: Location map

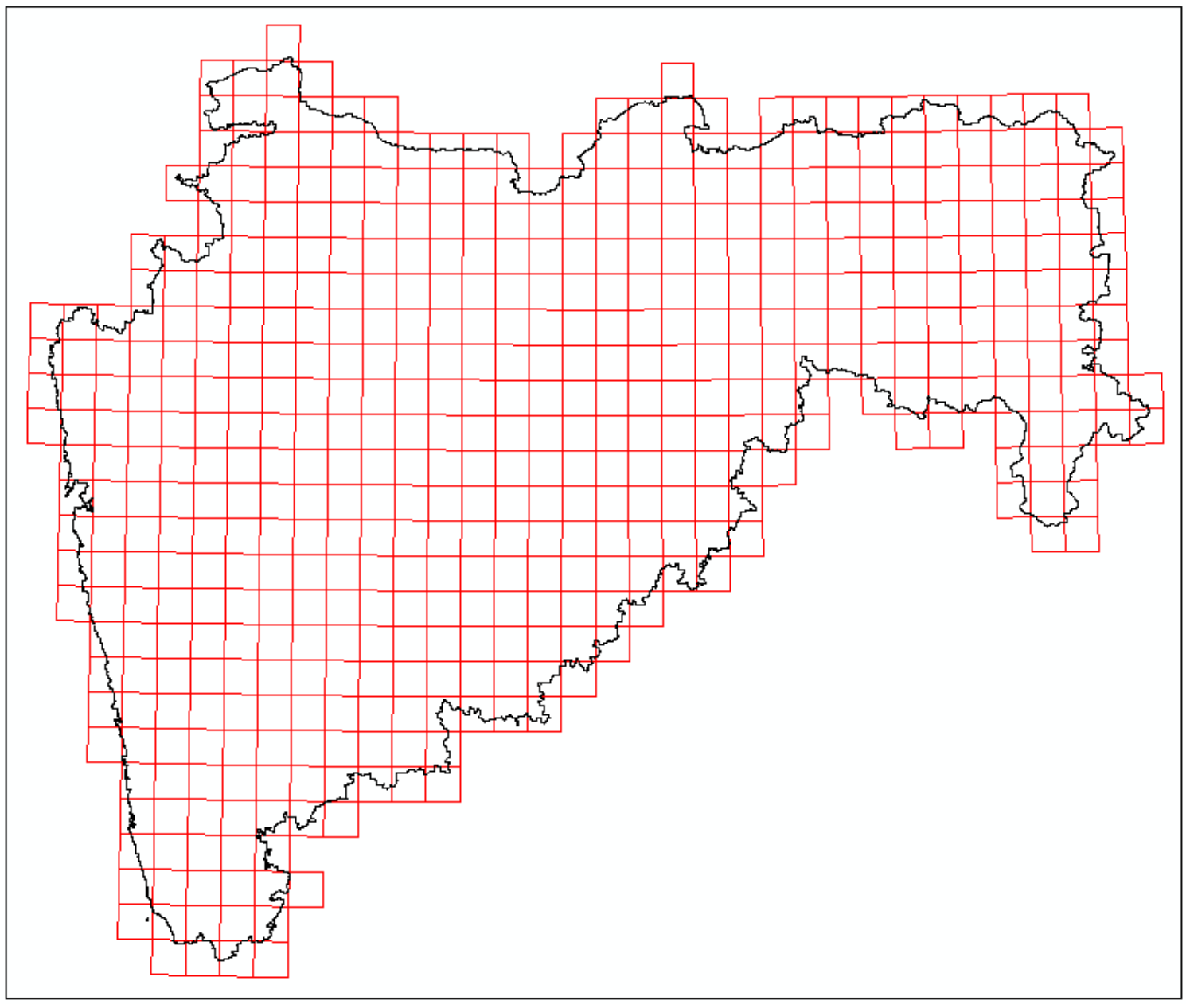


Figure 4: Spatial Framework of Maharashtra

4.0 DATA USED

4.1 Remote sensing data

IRS P6 LISS III data was used to map the wetlands. IRS P6 LISS III provide data in 4 spectral bands; green, red, Near Infra Red (NIR) and Short wave Infra Red (SWIR), with 23.5 m spatial resolution and 24 day repeat cycle. The spatial resolution is suitable for 1:50,000 scale mapping. The state of Maharashtra is covered in 33 IRS LISS III scene (Figure 5). Two date data, one acquired during March and another during January were used to capture the pre-monsoon and post-monsoon hydrological variability of the wetlands respectively (Table-2). Figure 6 shows the overview of the part of Maharashtra as seen in the LISS III FCC of post-monsoon pre-monsoon data respectively.

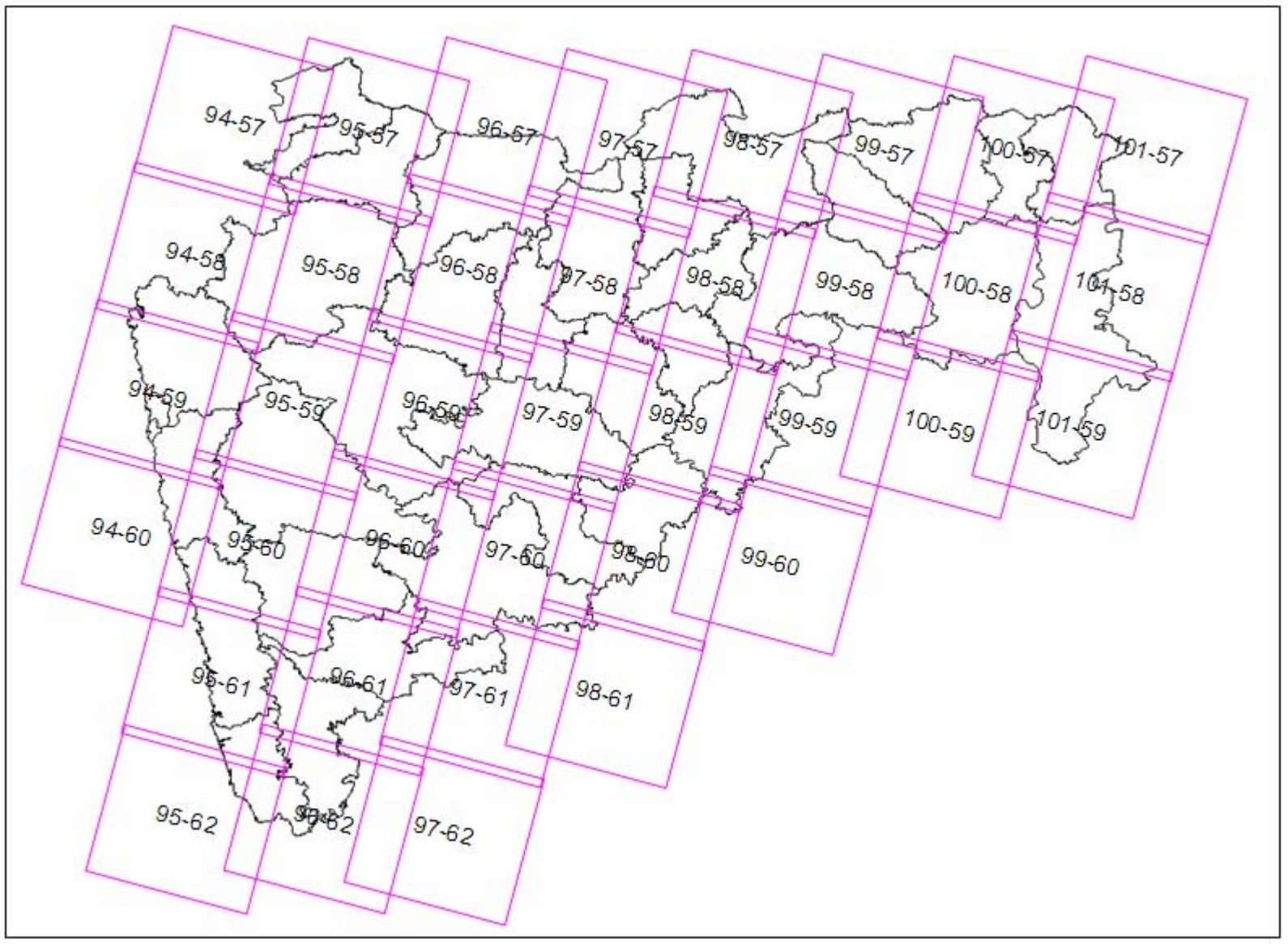


Figure 5: IRS P6 LISS-III coverage (path-row) of Maharashtra

4.2 Ground truth data

Remote sensing techniques require certain amount of field observation called “ground truth” in order to convert into meaningful information. Such work involves visiting a number of test sites, usually taking the satellite images. The location of the features is recorded using the GPS. The standard proforma as per the NWIA manual was used to record the field data. Field photographs are also taken to record the water quality (subjective), status of aquatic vegetation and water spread. All field verification work has been done during October and November 2008.

4.3 Other data

Survey of India topographical maps (SOI) were used for reference purpose. Lineage data of National Wetland Maps at 1:250,000 scale was used for reference.

Table-2: Satellite data used

Sr. No.	Sensor	Path-Row	Date of acquisition	
			Post-monsoon	Pre-monsoon
1	LISS-III	94-57	24 October 2006	9 May 2006
2	LISS-III	94-58	24 October 2006	4 May 2006
3	LISS-III	94-59	24 October 2006	2 Feb 2006 15 April 2006 10 April 2007
4	LISS-III	94-60	20 October 2006	15 April 2006
5	LISS-III	95-57	10 October 2005	20 April 2006
6	LISS-III	95-58	10 October 2005	20 April 2006
7	LISS-III	95-59	16 December 2006 10 October 2005	15 April 2007
8	LISS-III	95-60	16 December 2006 03 November 2005	15 April 2007
9	LISS-III	95-61	03 November 2005	20 April 2007
10	LISS-III	96-57	19 January 2006 27 November 2006	01 April 2006 14 May 2007
11	LISS-III	96-58	27 November 2006	27 March 2007
12	LISS-III	96-59	21 December 2006 08 November 2005	14 March 2007
13	LISS-III	96-60	08 November 2005	14 May 2007
14	LISS-III	96-61	08 November 2005	14 May 2007 25 April 2006
15	LISS-III	96-62	08 November 2005	25 April 2006
16	LISS-III	97-57	02 September 2005	25 April 2007
17	LISS-III	97-58	02 December 2006	25 April 2007
18	LISS-III	97-59	15 October 2006	25 April 2007
19	LISS-III	97-60	20 October 2005	06 April 2006 25April 2007
20	LISS-III	97-61	02 December 2007 20 October 2005	06 April 2006 25 April 2007
21	LISS-III	98-57	13 November 2006	11 April 2006
22	LISS-III	98-58	20 October 2006 07 December 2006	11 April 2006
23	LISS-III	98-59	07 December 2006	11 May 2006
24	LISS-III	98-60	07 December 2006	11 April 2006
25	LISS-III	99-57	06 October 2006	11 April 2006 15 May 2005
26	LISS-III	99-58	25 October 2006	05 May 2007
27	LISS-III	99-59	17 December 05	11 April 2007
28	LISS-III	100-57	06 October 2006	10 May 2007
29	LISS-III	100-58	04 November 2005	21 April 2006
30	LISS-III	100-59	10 January 2007	10 Jun 2007
31	LISS-III	101-57	09 November 2005	02 April 2006
32	LISS-III	101-58	14 November 2005	15 May 2007 02 April 2006
33	LISS-III	101-59	14 November 2005	15 May 2007

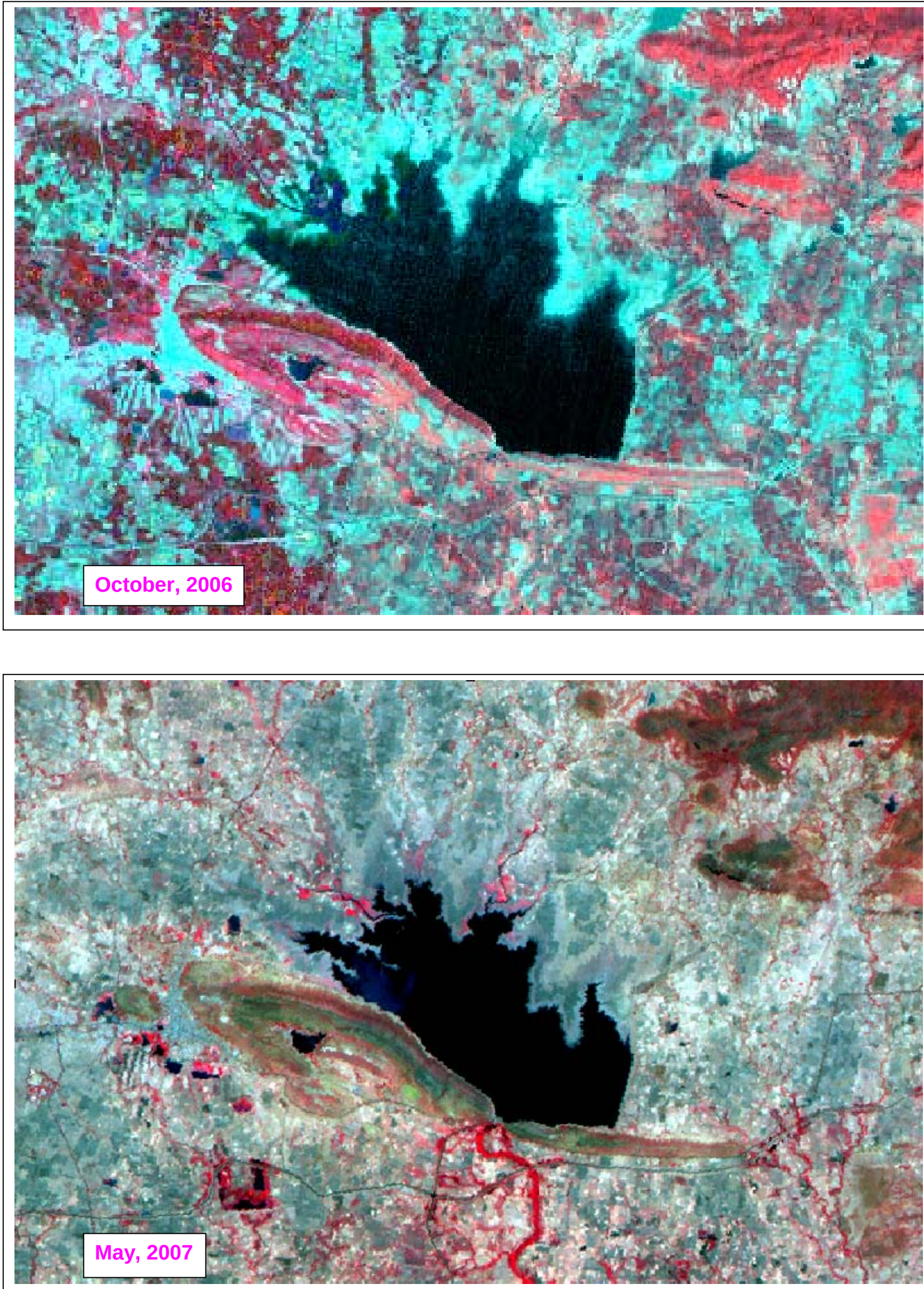


Figure 6: IRS LISS-III FCC (October 2006 and May 2007)

5.0 METHODOLOGY

The methodology to create the state level atlas of wetlands is adhered to NWIA technical guidelines and procedure manual (Garg and Patel, 2007). The overview of the steps used is shown in Figure 7. Salient features of methodology adopted are

- Generation of spatial framework in GIS environment for database creation and organisation.
- Geo-referencing of satellite data
- Identification of wetland classes as per the classification system given in NWIA Manual and mapping of the classes using a knowledge based digital classification and onscreen interpretation
- Generation of base layers (rail, road network, settlements, drainage, administrative boundaries) from satellite image and ancillary data.
- Mosaicing/edge matching to create district and state level database.
- Coding of the wetlands following the standard classification system and codification as per NWIA manual.
- Preparation of map compositions and generation of statistics
- Outputs on A3 size prints and charts for atlas.

Work was carried out using ERDAS Imagine, Arc/Info and Arcgis softwares.

5.1 Creation of Spatial Framework

This is the most important task as the state forms a part of the national frame work and covered in multiple map sheets. To create NWIA database, NNRMS/NRDB standards is followed and four corners of the 1:50,000 (15' x 15') grid is taken as the tics or registration points to create each map taking master grid as the reference. Spatial framework details are given in NWIA manual (Patel and Garg, 2007). The spatial framework for Maharashtra state is shown in Figure 4.

5.2 Geo-referencing of Satellite Data

In this step the raw satellite images were converted to specific map projection using geometric correction. This is done using archive geometrically corrected LISS III data (ISRO-NRC-land use / land cover project). Standard image processing software was used for geo-referencing. First one date data was registered with the archive image. The second date data was then registered with the first date data.

5.3 Mapping of Wetlands

The delineation of wetlands through image analysis forms the foundation for deriving all wetland classes and results. Consequently, a great deal of emphasis has been placed on the quality of the image Interpretation. In the present study, the mapping of wetlands was done following digital classification and onscreen visual interpretation. Wetlands were identified based on vegetation, visible hydrology and geography. There are various methods for extraction of water information from remote sensing imagery, which according to the number of bands used, are generally divided into two categories, i.e. Single-band and multi-band methods. Single-band method usually involves choosing a band from multi-spectral image to distinguish water from land by subjective threshold values. It may lead to over- or under-estimation of open water area. Multi-band method takes advantage of reflective differences of each band.

In this project, five indices known in literature that enhances various wetland characteristics were used (McFeetres, 1986; Xu Hanqiu, 2006; Lacaux *et al*, 2007; Townshend and Justice, 1986; Tucker and Sellers, 1986) as given below:

i) Normalised Difference Water Index (NDWI) = (Green-NIR) / (Green + NIR)

ii) Modified Normalised Difference Water Index (MNDWI) = (Green-MIR) / (Green + MIR)

iii) Normalised Difference Vegetation Index (NDVI) = (NIR - Red) / (NIR + Red)

iv) Normalised Difference Pond Index (NDPI) = (MIR – Green / MIR + Green)

v) Normalised Difference Turbidity Index (NDTI) = (Red – Green) / (Red + Green)

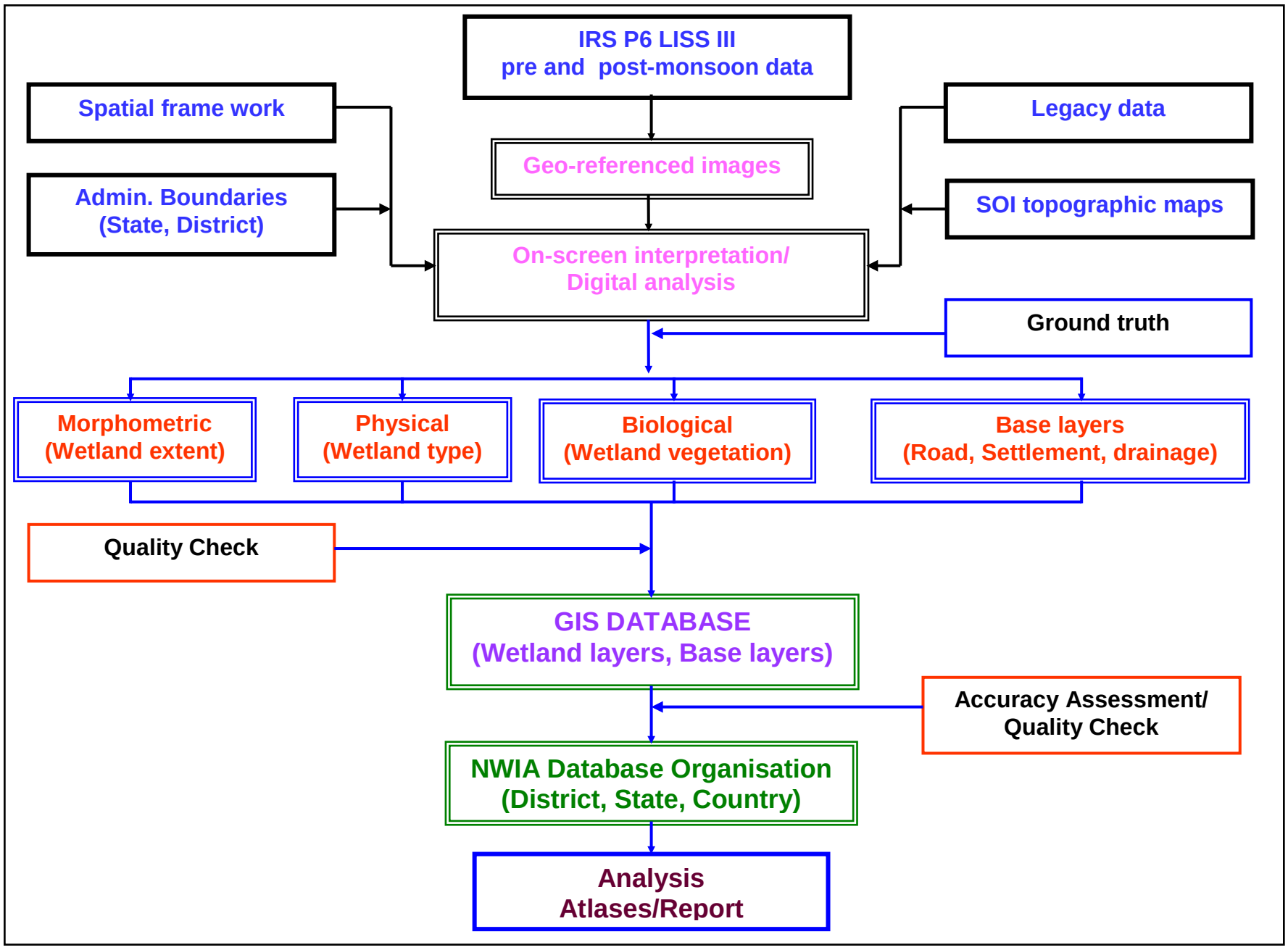


Figure 7: Flow chart of the methodology used

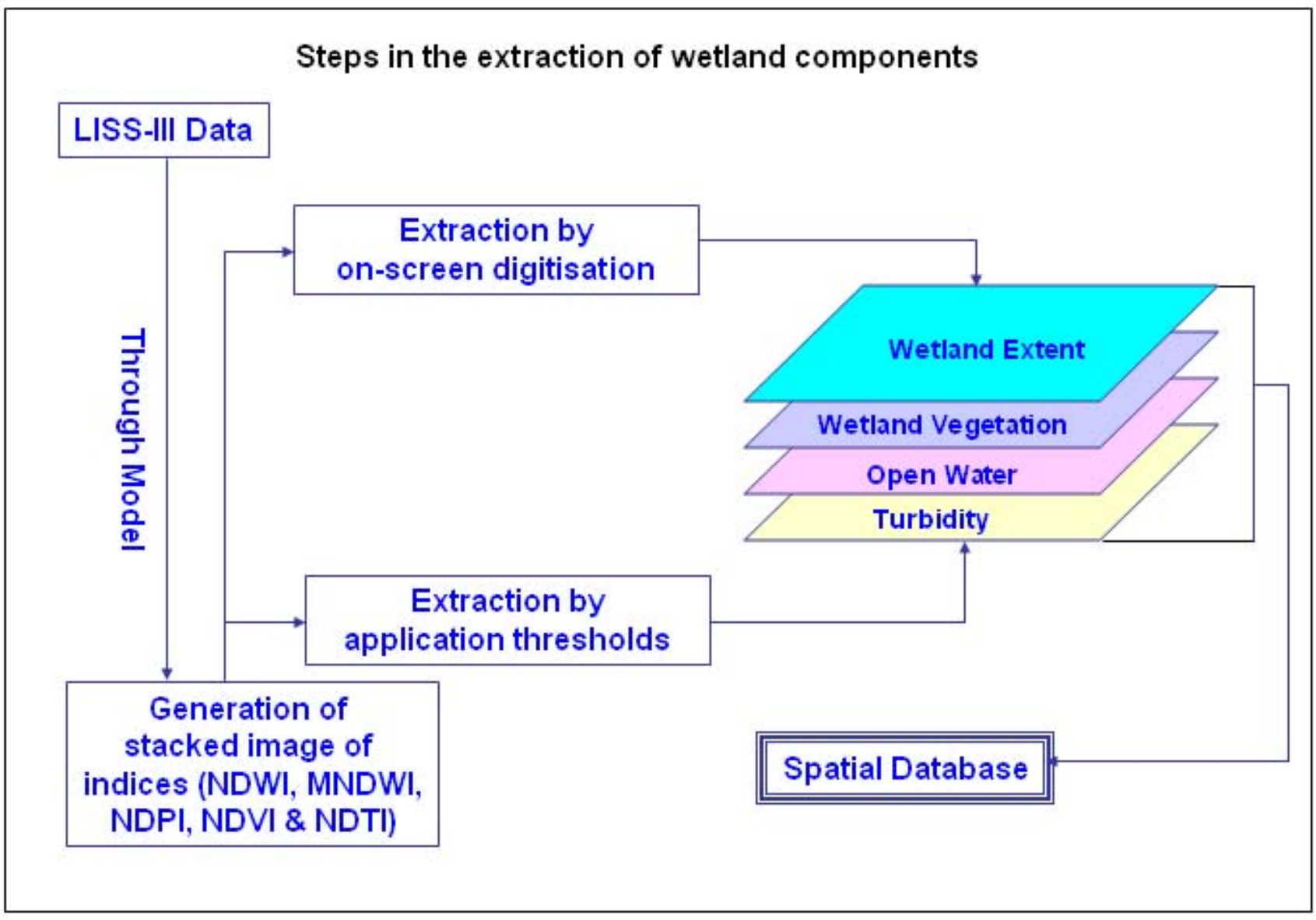


Figure 8: Steps in the extraction of wetland components

The indices were generated using standard image processing software, stacked as layers. (Figure 8). Various combinations of the indices/spectral bands were used to identify the wetland features as shown in Figure 9. The following indices were used for various layer extractions:

- Extraction of wetland extent :
  MNDWI, NDPI and NDVI image was used to extract the wetland boundary through suitable hierarchical thresholds.

- Extraction of open water :
  MNDWI was used within the wetland mask to delineate the water and no-water areas.

- Extraction of wetland vegetation :
  NDPI and NDVI image was used to generate the vegetation and no-vegetation areas within a wetland using a suitable threshold.

- Turbidity information extraction :
  NDTI and MNDWI image was used to generate qualitative turbidity level (high, moderate and low) based on signature statistics and standard deviations. In the False Colour Composite (FCC) these generally appear in different hues as given in Table-3.

Table 3: Qualitative turbidity ratings

Sr. No.	Qualitative Turbidity	Conditional criteria	Hue on False Colour Composite (FCC)
1.	Low	> $+1\sigma$	Dark blue/blackish
2.	Moderate	> -1σ to <= $+1\sigma$	Medium blue
3.	High/Bottom reflectance	<= $\mu - 1\sigma$	Light blue/whitish blue

5.4 Conversion of the raster (indices) into a vector layer

The information on wetland extent, open water extent, vegetation extent and turbidity information was converted into vector layers using region growing properties or on-screen digitization.

5.5 Generation of Reference Layers

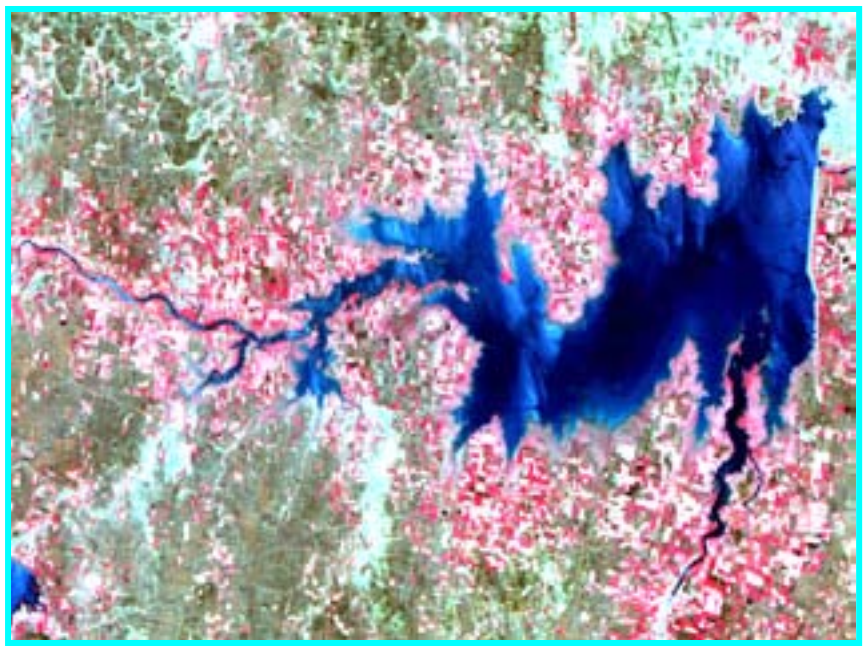
Base layers like major road network, settlements, drainage are interpreted from the current image or taken from other project data base. The administrative boundaries (district, state) are taken from the known reference data.

5.6 Coding and Attribute Scheme

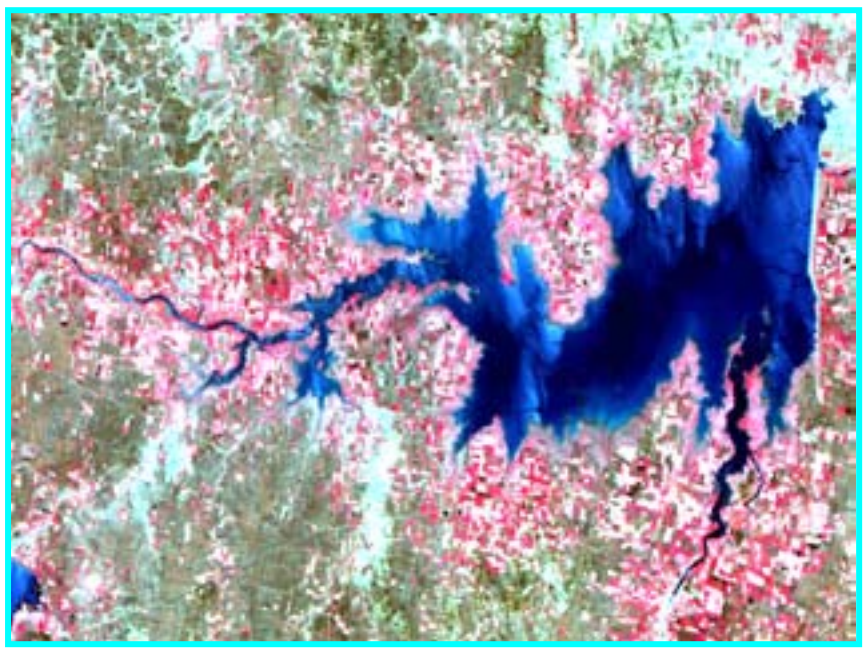
Feature codification scheme for every input element has been worked out keeping in view the nationwide administrative as well as natural hierarchy (State-district-taluka) within the feature class for each of the theme. All data elements are given a unique name/code, which are self explanatory with short forms.

5.7 Map composition and output

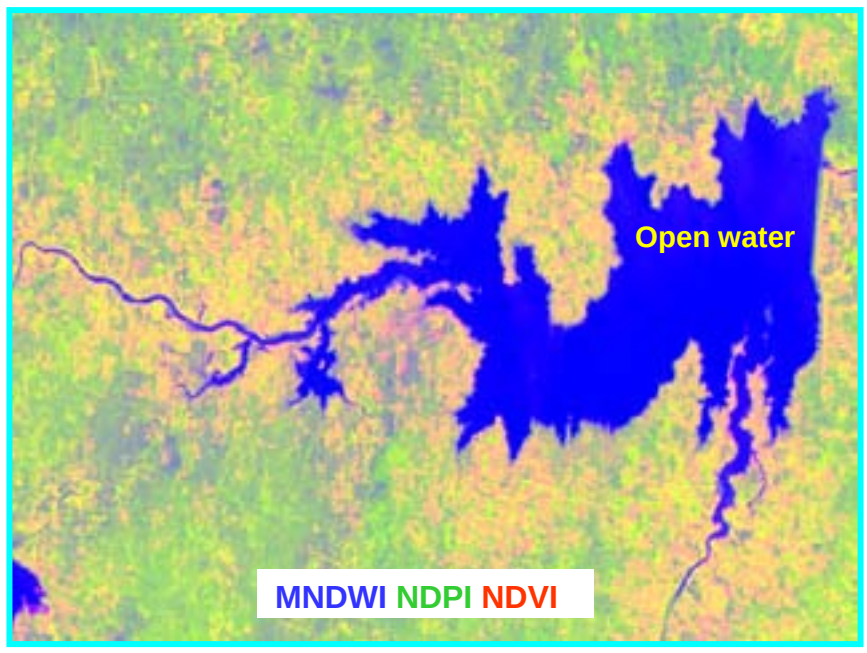
Map composition for atlas has been done at district and state level. A standard color scheme has been used for the wetland classes and other layers. The digital files are made at 1:50,000 scale. The hard copy outputs are taken in A3 size.



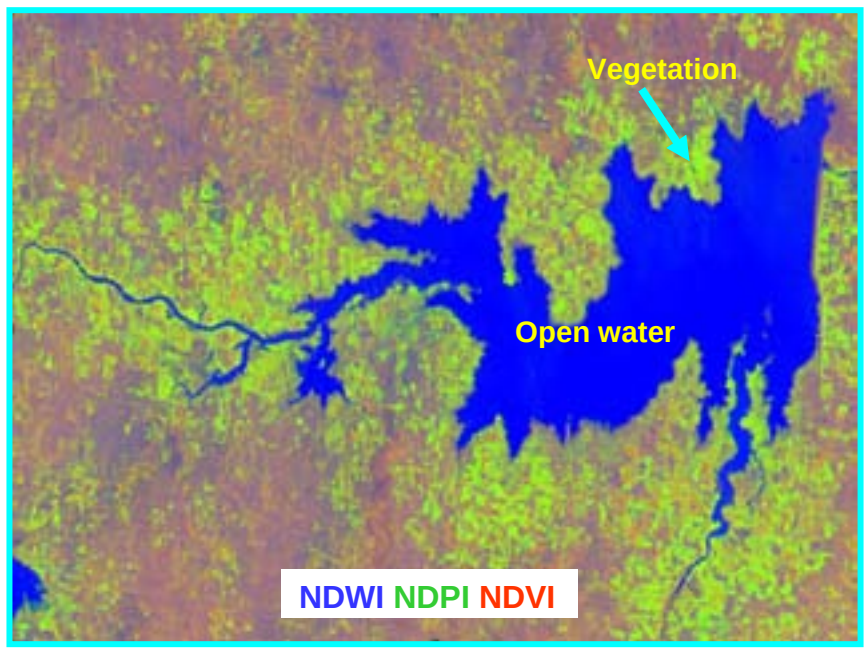
G R NIR



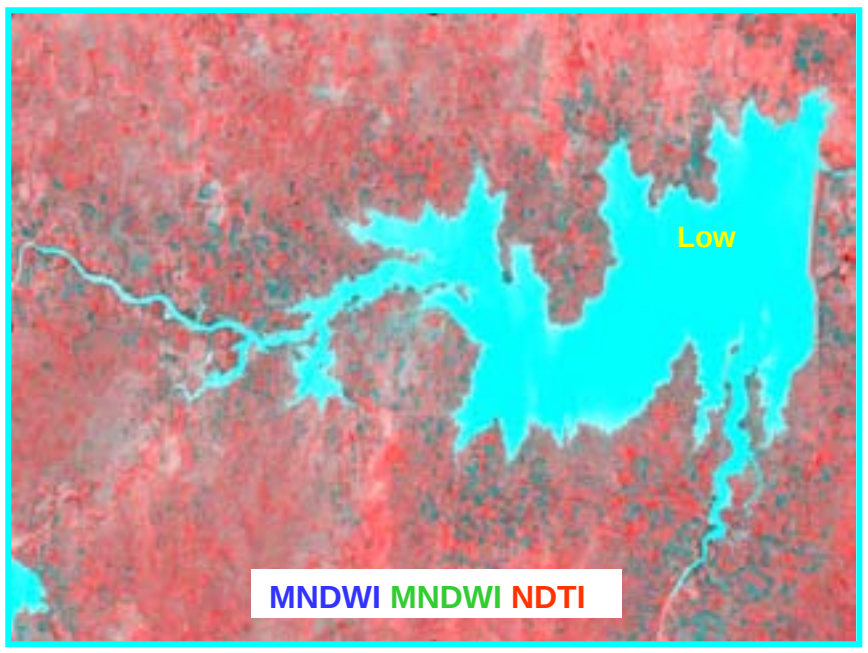
G R SWIR



Useful for wetland boundary extraction/delineation



Useful for wetland vegetation & open water features



Useful for qualitative turbidity delineation

Majalgaon Dharan,
IRS LISS III data, April 25, 2007

Figure 9: Various combinations of the indices/spectral bands used to identify wetland components

6.0 ACCURACY ASSESSMENT

A comprehensive accuracy assessment protocol has been followed for determining the quality of information derived from remotely sensed data. Accuracy assessment involves determination of thematic (classification) as well as location accuracy. In addition, GIS database(s) contents have been also evaluated for accuracy. To ensure the reliability of wetland status data, the project adhered to established quality assurance and quality control measures for data collection, analysis, verification and reporting.

This study used well established, time-tested, fully documented data collection conventions. It employed skilled and trained personnel for image interpretation, processing and digital database creation. All interpreted imagery was reviewed by technical expert team for accuracy and code. The reviewing analyst adhered to all standards, quality requirements and technical specifications and reviewed 100 percent of the work. The various stages of quality check include:

1. Image-Image Geo-referencing/Data generation
2. Reference layer preparation using NWIA post monsoon and pre-monsoon LISS-III data.
3. Wetland mapping using visual/digital interpretation techniques.
4. Geo-data base creation and organization
5. Output products.

6.1 Data verification and quality assurance of output digital data files

All digital data files were subjected to rigorous quality control inspections. Digital data verification included quality control checks that addressed the geospatial correctness, digital integrity and some cartographic aspects of the data. Implementation of quality checks ensured that the data conformed to the specified criteria, thus achieving the project objectives. There were tremendous advantages in using newer technologies to store and analyze the geographic data. The geospatial analysis capability built into this study provided a complete digital database to better assist analysis of wetland change information. All digital data files were subjected to rigorous quality control inspections. Automated checking modules incorporated in the geographic information system (Arc/GIS) were used to correct digital artifacts including polygon topology. Additional customized data inspections were made to ensure that the changes indicated at the image interpretation stage were properly executed.

MAPS AND STATISTICS

7.0 WETLANDS OF MAHARASHTRA: MAPS AND STATISTICS

Area estimates of various wetland categories for Maharashtra have been carried out using GIS layers of wetland boundary, water-spread, aquatic vegetation and turbidity. Total 23046 wetlands have been mapped at 1:50,000 scale in the State. In addition, 21668 wetlands (< 2.25 ha) have also been identified. Total wetland area estimated is 1014522 ha that is around 3.3 per cent of the geographic area. The major wetland types are Reservoir/barrages accounting for 36.29 per cent of the wetlands (368135 ha), Tank/Ponds accounting for 20.57 percent of wetland area (208669 ha), river/stream accounting for 29.54 percent of wetland area (299730 ha), creeks with 4.10 percent and mangroves with 2.98 percent of wetland area (41636 ha and 30238 ha respectively). Graphical distribution of wetland type is shown in Figure 10.

Analysis of wetland status in terms of opens water showed that post-monsoon water spread is significantly more (796834 ha) than during pre-monsoon (370357 ha). On the other hand, the area under aquatic vegetation is more during pre monsoon (84702 ha) than during post monsoon (47551 ha). The qualitative rating of turbidity of open water in the wetlands is low to moderate in both the seasons.

Table 4: Area estimates of wetlands in Maharashtra

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands – Natural**					
1	1101	Lakes/Ponds	39	9003	0.89	8760	5961
2	1102	Ox-bow lakes/ Cut-off meanders	2	15	0.00	15	12
3	1104	Riverine wetlands	1	2	0.00	2	-
4	1105	Waterlogged	35	284	0.03	219	76
5	1106	River/Stream	3501	299730	29.54	217593	47856
	1200	**Inland Wetlands -Man-made**					
6	1201	Reservoirs/Barrages	759	368135	36.29	343894	212394
7	1202	Tanks/Ponds	15845	208669	20.57	183229	71553
8	1203	Waterlogged	37	310	0.03	134	83
		Total - Inland	**20219**	**886148**	**87.35**	**753846**	**337935**
	2100	**Coastal Wetlands - Natural**					
9	2102	Creeks	162	41636	4.10	35914	25376
10	2103	Sand/Beach	400	4873	0.48	-	-
11	2104	Intertidal mud flats	752	22249	2.19	-	-
12	2105	Salt Marshes	32	614	0.06	-	-
13	2106	Mangroves	1270	30238	2.98	-	-
	2200	**Coastal Wetlands - Man-made**					
14	2201	Salt pans	205	7025	0.69	7003	7000
15	2202	Aquaculture ponds	6	71	0.01	71	46
		Total - Coastal	**2827**	**106706**	**10.52**	**42988**	**32422**
		Sub-Total	**23046**	**992854**	**97.86**	**796834**	**370357**
		Wetlands (<2.25 ha), mainly Tanks	21668	21668	2.14	-	-
		Total	**44714**	**1014522**	**100.00**	**796834**	**370357**

Area under Aquatic Vegetation	47551	84702

Area under turbidity levels		
Low	633128	202581
Moderate	139816	159856
High	23890	7920

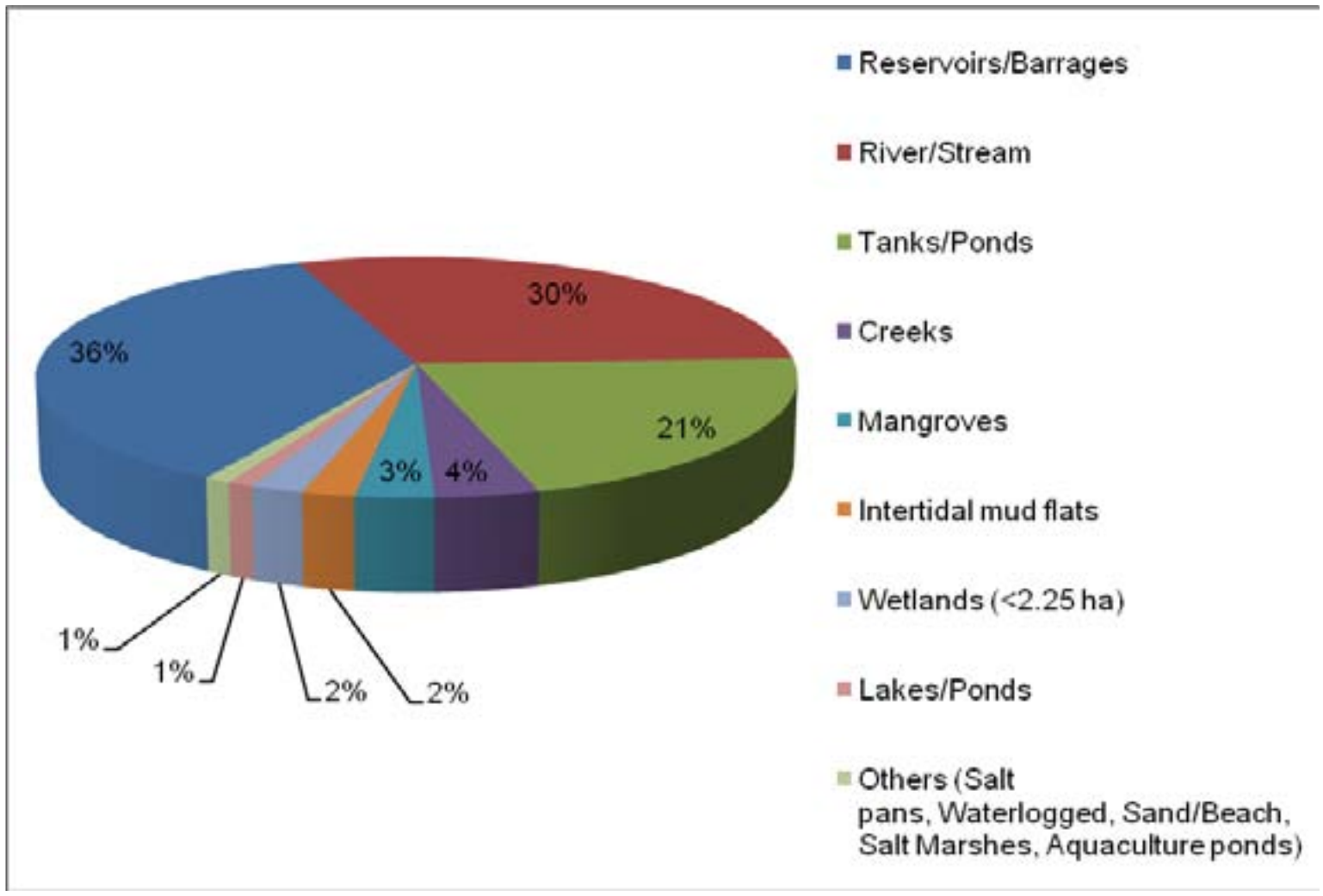


Figure 10: Type-wise wetland distribution in Maharashtra

7.1 DISTRICT-WISE WETLAND MAPS AND STATISTICS

The State has thirty five districts. The geographic area varied from 17048 sq. km (Ahmednagar) to 69 sq. km (Mumbai Urban). The wetland area in each district as per cent of total state wetland area ranged from as 0.08% (Mumbai Urban) to 6.72 % (Pune). The wetland area in the districts as per cent of geographic area varied from 24.87% (Mumbai Suburban) to 1.76 % (Buldhana). Pune, Nasik, Thane, Ahmednagar are wetland rich districts contributing more than 5.0 per cent of total wetland area of the state, followed by Chandrapur, Nagpur, Aurangabad and Raigadh districts with 4-5 per cent contribution. The district wise wetland area is given in the table -5 and Fig. 11.

District-wise distribution of wetlands in relation to rainfall zoning showed that in the high rainfall Konkan subdivision (with 7000 mm rainfall), Thane is the leading wetland district (with 5.91% area). In the assured rainfall zone of Nagpur Division and Amravati Divisions (with 1000 mm rainfall) Nagpur and Yavatmal are the wetland rich districts contributing 4.12 % and 3.37 % respectively to the state wetland area. In the scanty and rain shadow regions, Pune district is wetland rich with 6.72 per cent contribution to state wetland area. The wetland types in scanty rainfall districts are mainly man made one, with more number of Reservoirs/ barrages and Tank/pond. Gondiya district has highest concentration of small wetlands (<2.25 ha).

Wetland statistics followed by wetland map and corresponding satellite data for each district is given to have a fairly good idea about the distribution pattern and density of wetlands in the district.

Table-5: District-wise wetland area

District	Geographic Area (sq. km)	Wetland Area (ha)	% of total wetland area	% of district geographic area
Nandurbar	5055	16457	1.62	3.26
Dhule	8095	20211	1.99	2.50
Jalgaon	11765	37558	3.70	3.19
Buldhana	9661	17015	1.68	1.76
Akola	5429	11633	1.15	2.14
Washim	5155	12506	1.23	2.43
Amravati	12235	22857	2.25	1.87
Wardha	6309	15505	1.53	2.46
Nagpur	9892	41797	4.12	4.23
Bhandara	3890	20469	2.02	5.26
Gondiya	5431	32257	3.18	5.94
Gadchiroli	14412	37645	3.71	2.61
Chandrapur	11443	46948	4.63	4.10
Yavatmal	13582	34192	3.37	2.52
Nanded	10528	30508	3.01	2.90
Hingoli	4526	17701	1.74	3.91
Parbhani	6511	15601	1.54	2.40
Jalna	7718	17041	1.68	2.21
Aurangabad	10107	41724	4.11	4.13
Nasik	15539	52027	5.13	3.35
Thane	9558	59936	5.91	6.27
Mumbai suburban	534	13282	1.31	24.87
Mumbai urban	69	763	0.08	11.06
Raigad	7152	46844	4.62	6.55
Pune	15643	68137	6.72	4.36
Ahmadnagar	17048	59269	5.84	3.48
Beed	10693	31718	3.13	2.97
Latur	7157	20296	2.00	2.84
Osmanabad	7569	27027	2.66	3.57
Solapur	14895	35918	3.54	2.41
Satara	10475	39984	3.94	3.82
Ratnagiri	8208	20979	2.07	2.56
Sindhudurg	5207	13979	1.38	2.68
Kolhapur	7685	18663	1.84	2.43
Sangli	8572	16075	1.58	1.88
Total	**307748**	**1014522**	**100.00**	**3.30**

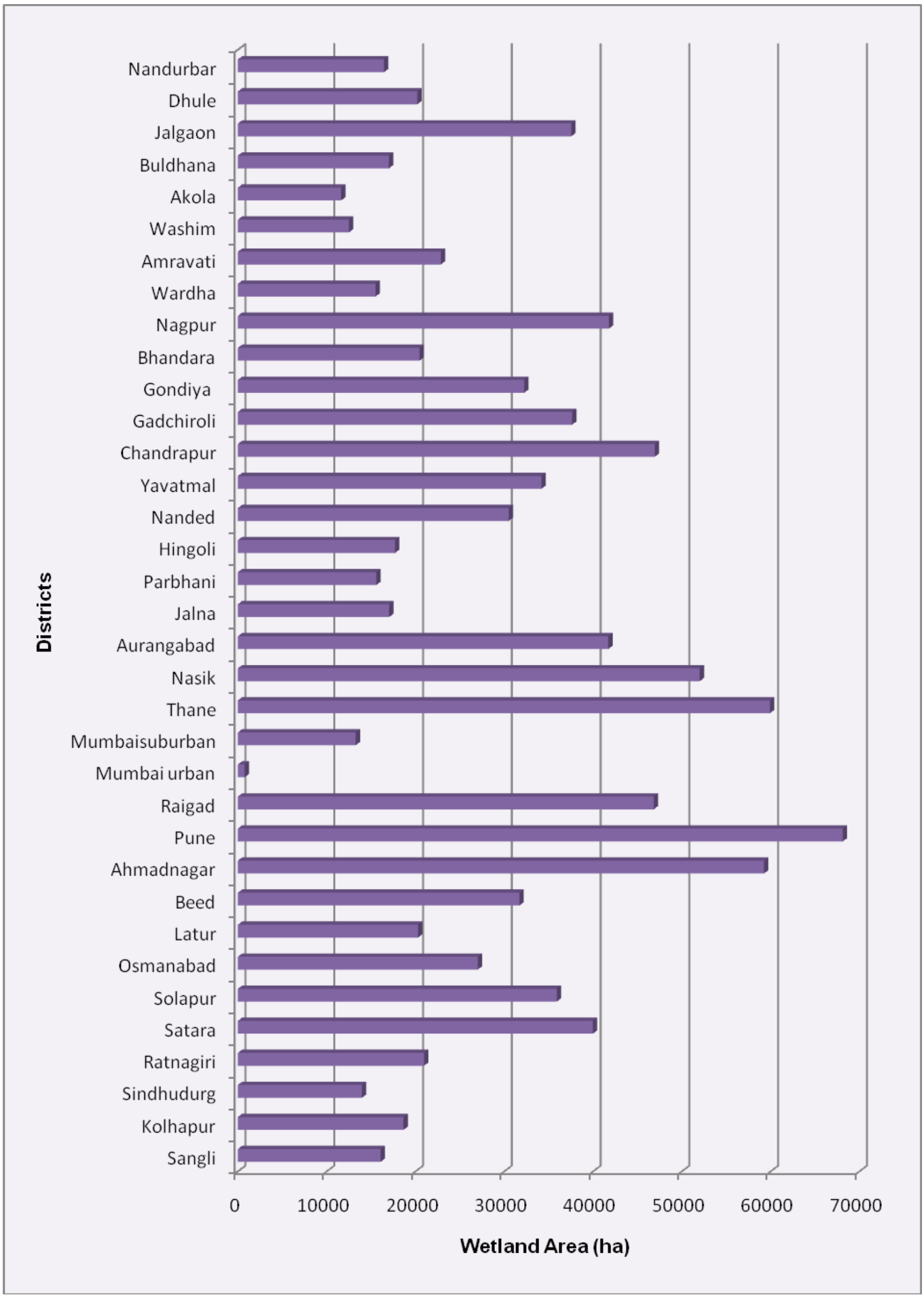


Figure 11: District-wise graphical distribution of wetlands

State : Maharashtra

WETLAND MAP

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map

0 10 20 40 60 80
Kilometers

Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

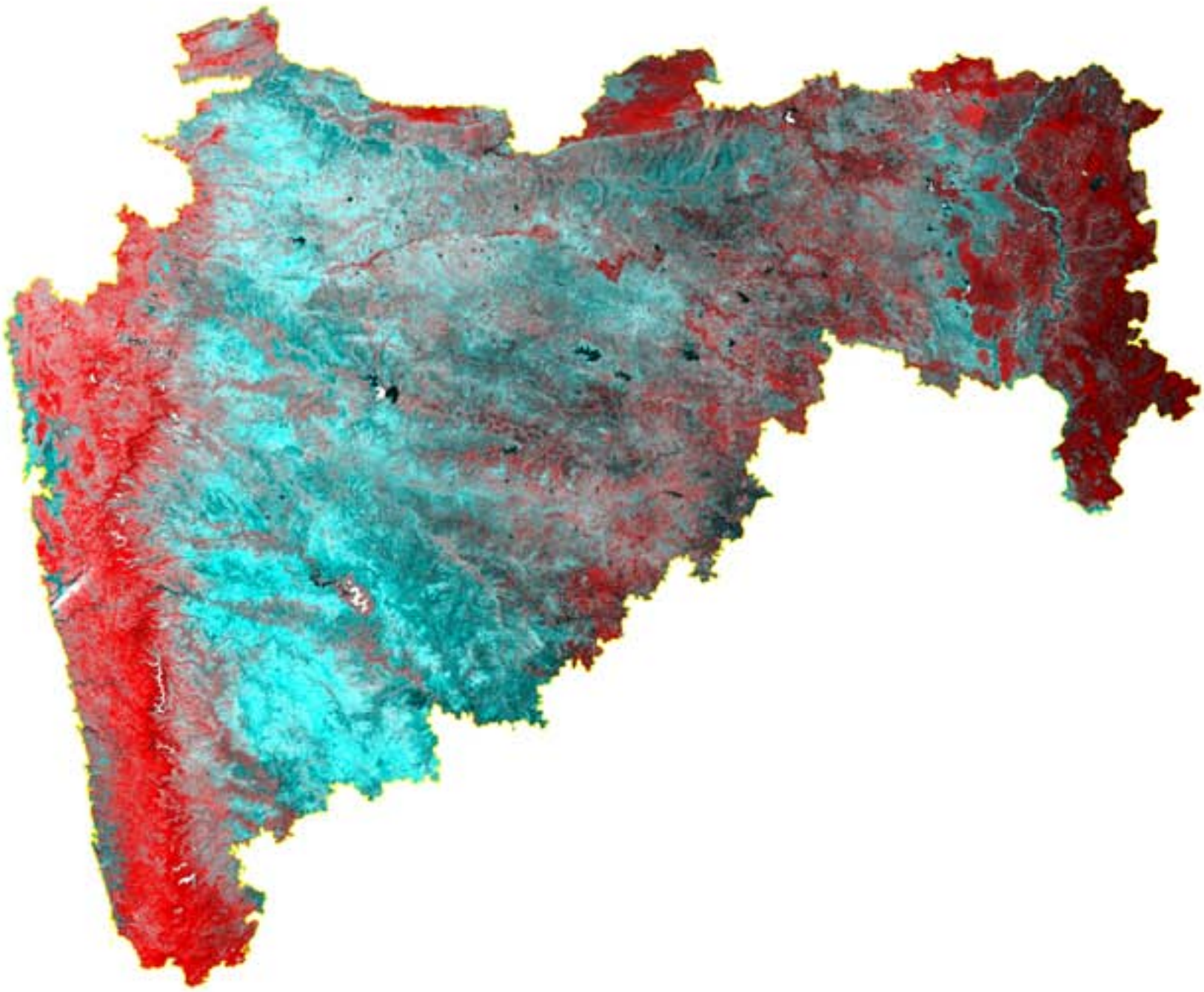
Prepared by

Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra



IRS P6 AWiFS post monsoon data (2006)

7.1.1 Nandurbar

Nandurbar district is located in the north western part of the state and lies between 20°59'58.49" and 22°1'44.66" North latitude and 73°34'32.622" & 74°46'40.976" East longitudes covering an area of about 5055 km^2. The district is bounded on the south-east by Dhule, on the north by Alirajpur and Barwani districts of Madhya Pradesh and on the west by Vadodara, Narmada and Surat districts of Gujarat. The district is divided into 6 administrative sub-units (tahsils). They are Nandurbar, Navapur, Shahada, Taloda, Akkalkua and Akrani. There are 5 towns and 947 villages in the district. According to the 2001 census, the total population of Nandurbar district 1311709.

Total 735 wetlands are mapped including 310 small wetlands (< 2.25 ha) with 16457 ha area**. R**ivers/ streams contributed 45.14% to the total wetland area. The reservoir/barrages with 6543 ha (39.76% area) is the second major wetland category, followed by tanks/ponds with 2136 ha area i.e. 12.98 %. Thus, the district is dominated by man made wetlands. Details of wetland statistics is given in Table- 6. Wetlands are more concentrated in the southern part of the district.

Open water spread of the wetlands is significantly higher in post monsoon (13382 ha) than during pre monsoon (5401 ha), indicating the rainfall dependence of the wetlands in the state. Aquatic vegetation is slightly more during pre monsoon (454 ha) than in post monsoon (310 ha). Turbidity of open water is low to moderate during post monsoon, while it is mainly moderate during pre monsoon.

Table 6: Area estimates of wetlands in Nandurbar

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1105	Waterlogged	2	29	0.18	27	2
2	1106	River/Stream	158	7428	45.14	6052	3875
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	31	6543	39.76	5550	977
4	1202	Tanks/Ponds	232	2136	12.98	1746	540
5	1203	Waterlogged	2	11	0.07	7	7
		Sub-Total	**425**	**16147**	**98.12**	**13382**	**5401**
		Wetlands (<2.25 ha), mainly Tanks	310	310	1.88	-	-
		Total	**735**	**16457**	**100.00**	**13382**	**5401**

Area under Aquatic Vegetation	310	454

Area under turbidity levels		
Low	7696	1092
Moderate	5249	4274
High	437	35

State : Maharashtra

WETLAND MAP

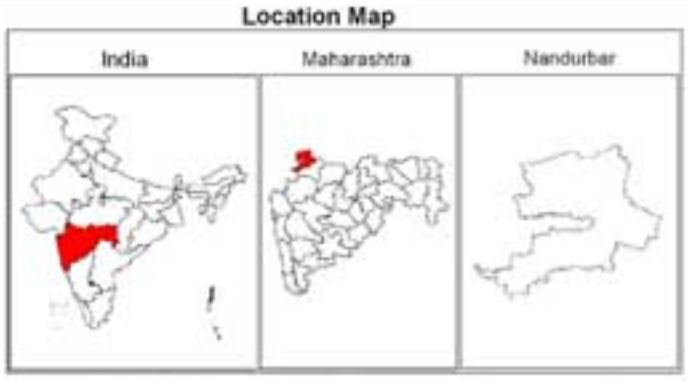
District : Nandurbar

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 5 10 20 30 40 Kilometers

Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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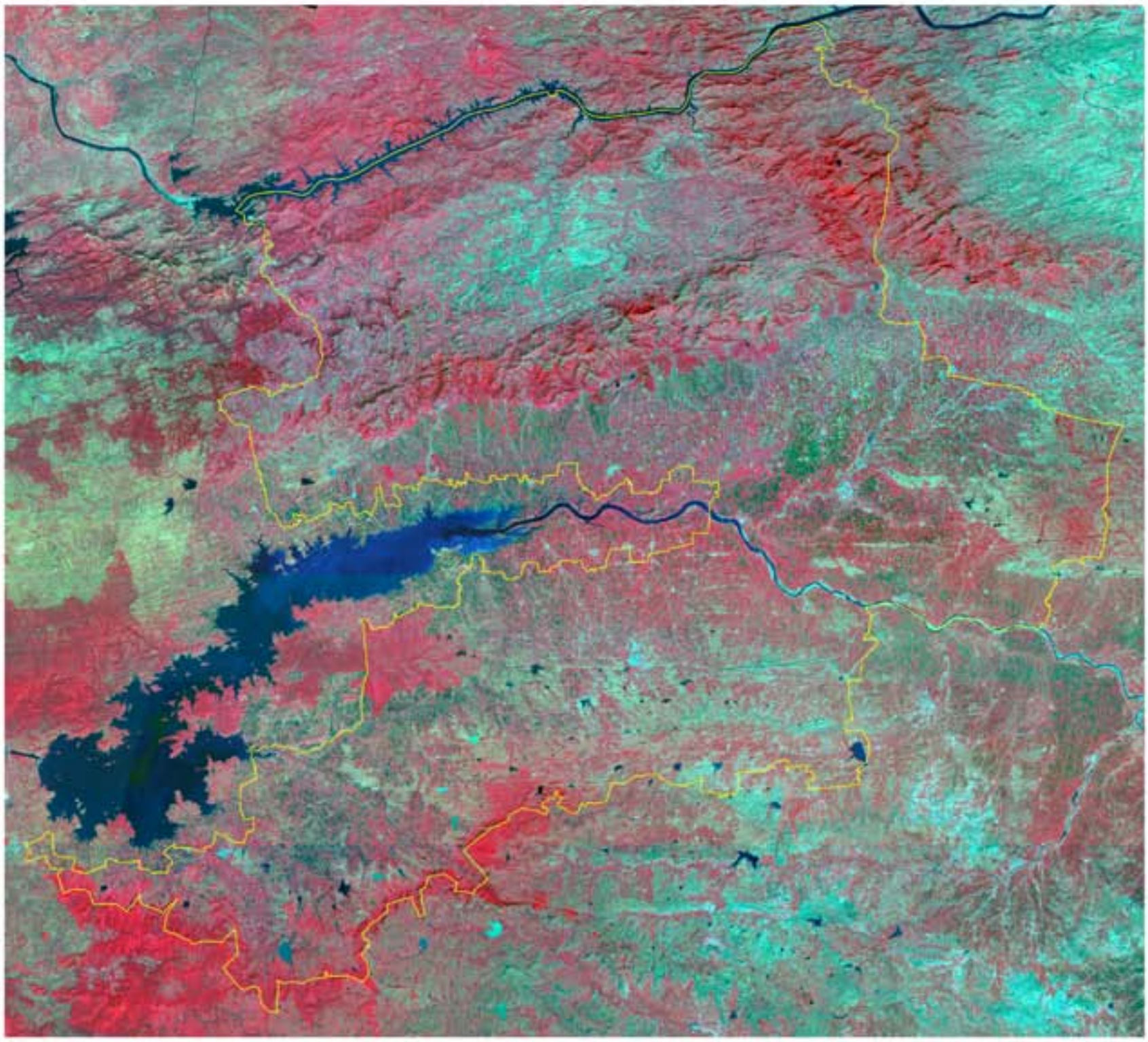
Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Nandurbar



IRS P6 LISS-III post monsoon data (2006)

7.1.2 Dhule

Dhule district is located in the north western part of the state and lies between 20°37'25" to 21°37'59" North latitude and 73°51' to 75°11'54" East longitudes covering an area of about 8095 km^2. The district is bounded on the east by Jalgaon, on the south by Nasik, on the north by Nandurbar and Madhya Pradesh. The district is divided into 4 administrative sub-units (tahsils). They are Dhule, Sakri, Shirpur and Shindkheda. There are 3 towns and 681 villages in the district. According to the 2001 census, the total population of Dhule is 1707947.

Total 1109 wetlands are mapped including 411 small wetlands (< 2.25 ha) with 20211 ha area. Rivers/ streams contributed 53.76 % to the total wetland area. The reservoir/barrages with 5001 ha (24.74 % area) is the second major wetland category, followed by tanks/ponds with 3928 ha i.e. 19.43 %. Wetlands are more concentrated in the southern part of the district. Details of area estimates of wetlands in Dhule district is shown in Table-7.

Aquatic vegetation is slightly more during pre monsoon (704 ha) than in post monsoon (350 ha). Open water spread of the wetlands is significantly higher in post monsoon (13120 ha) than during pre monsoon (3570 ha), indicating the rainfall dependence of the wetlands in the state. Turbidity of open water is low to moderate during both the seasons.

Table 7: Area estimates of wetlands in Dhule

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1105	Waterlogged	1	6	0.03	3	5
2	1106	River/Stream	209	10865	53.76	5839	820
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	28	5001	24.74	4310	2029
4	1202	Tanks/Ponds	460	3928	19.43	2968	716
		Sub-Total	**698**	**19800**	**97.97**	**13120**	**3570**
		Wetlands (<2.25 ha), mainly Tanks	411	411	2.03	-	-
		Total	**1109**	**20211**	**100.00**	**13120**	**3570**

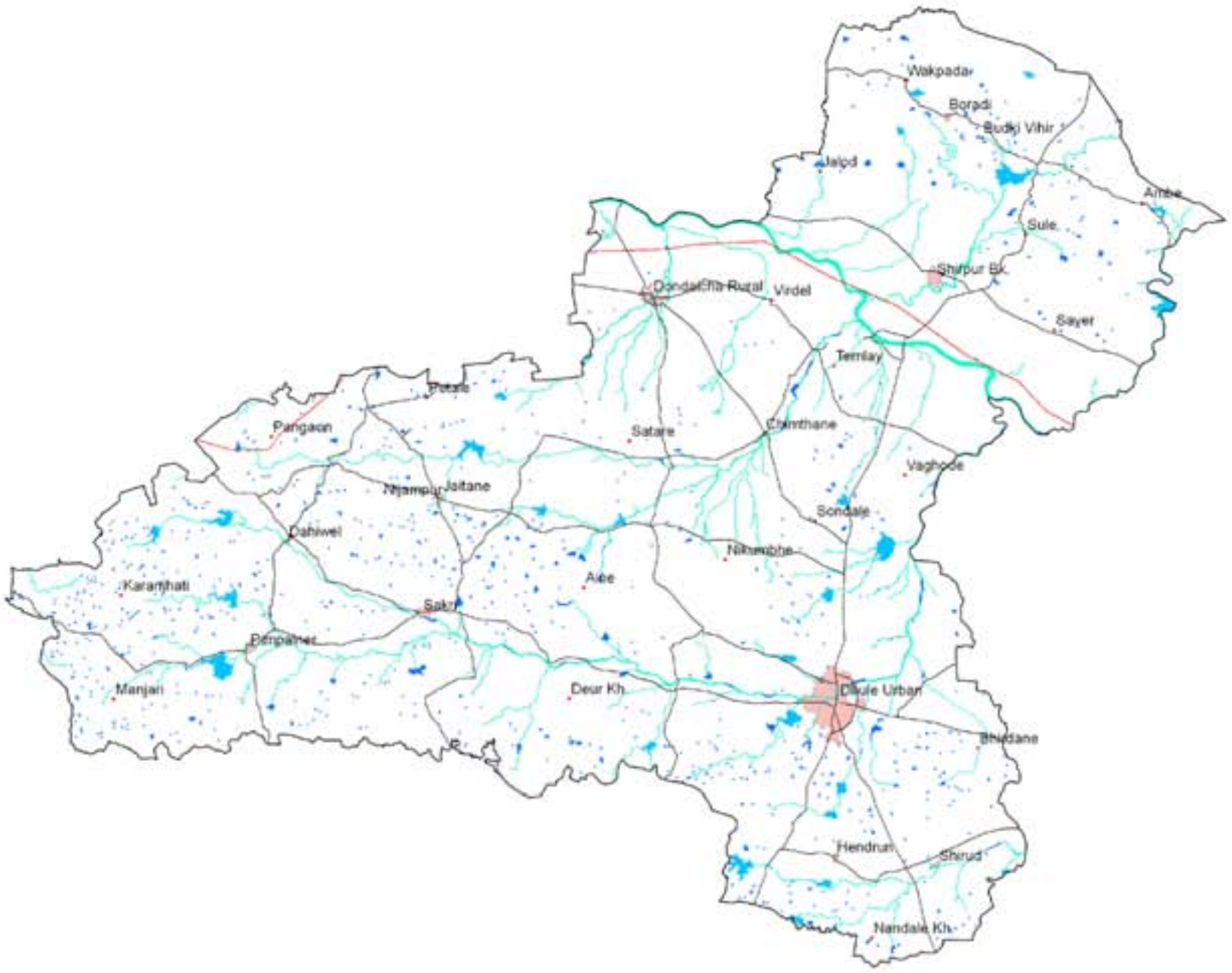
Area under Aquatic Vegetation	350	704

Area under turbidity levels		
Low	10415	1566
Moderate	2367	1886
High	338	118

State : Maharashtra

WETLAND MAP

District : Dhule



Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map

Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

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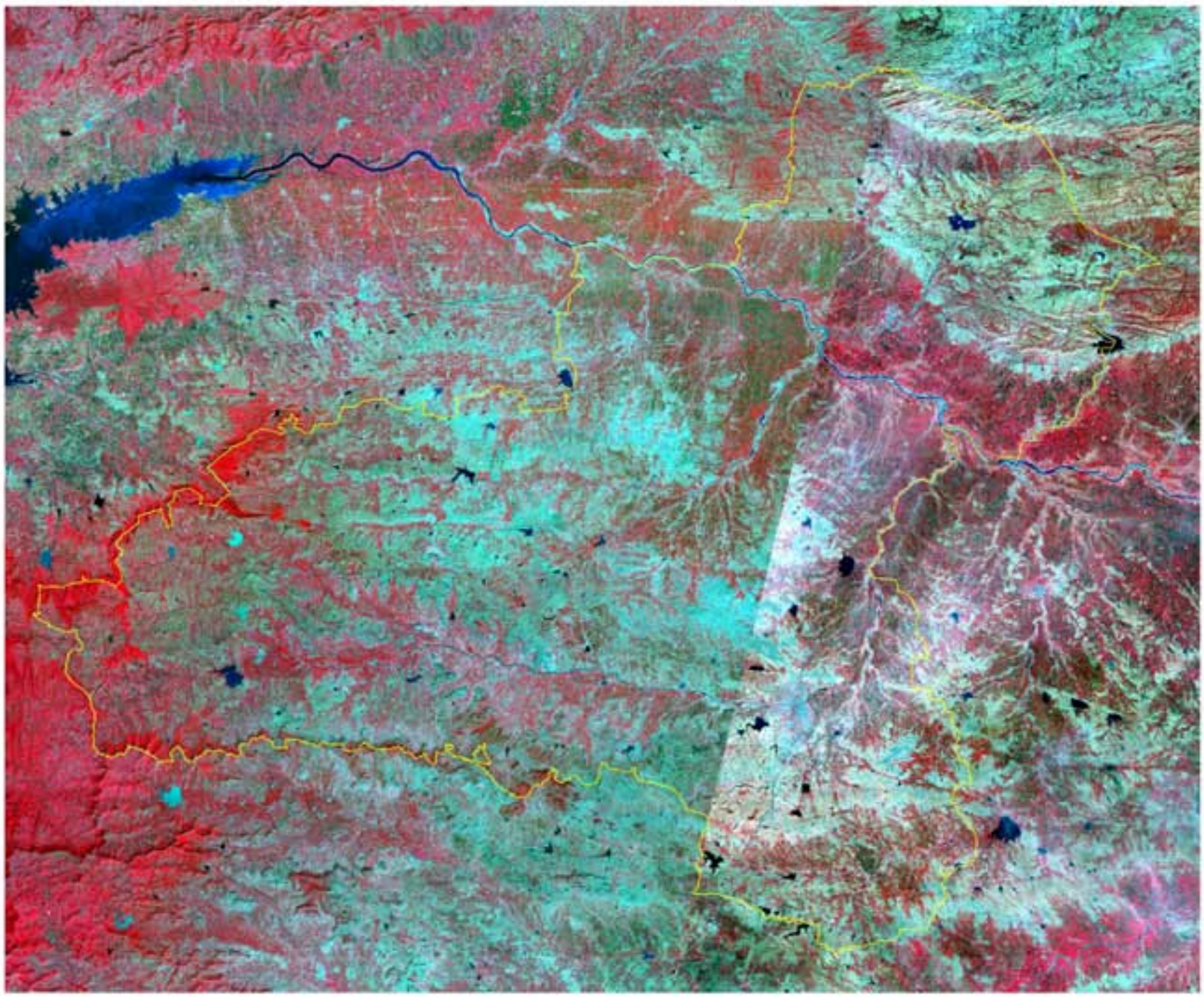
Government of India

State : Maharashtra

District : Dhule



IRS P6 LISS-III post monsoon data (2006)

7.1.3 Jalgaon

Jalgaon district is located in the northern part of the state and lies between 20^0 to 21^0 North latitude and $75^0$55' to $76^0$28' East longitudes covering an area of about 11,765 km^2. It is bounded on the southeast by Buldhana district, on the south by Aurangabad district, on the southwest by Nasik district, on the west and northwest by Dhule district of Maharashtra State and on the north and northeast by the State of Madhya Pradesh. The district is divided in fifteen administrative sub-units (tahsils). They are Jalgaon, Chopda, Yaval, Raver, Edlabad, Bhusawal, Jamner, Pachora, Chalisgaon, Bhadgaon, Parola, Erandol, Bodwad, Dharangaon and Amalner. There are 15 towns and 1519 villages in the district. According to the 2001 census, the total population of the district is 3682690.

Total 828 wetlands are mapped including 259 small wetlands (< 2.25 ha) with 37558 ha area. Rivers/ streams contributed 51.96 % to the total wetland area. The reservoir/barrages with 8961 ha (23.86 %) is the second major wetland category, followed by tanks/ponds with 8682 ha i.e. 23.12 %. Details of wetland statistics is given in Table- 8.

Aquatic vegetation is slightly more during post monsoon (2146 ha) than in pre monsoon (1978 ha). Open water spread of the wetlands is significantly higher in post monsoon (21778 ha) than during pre monsoon (9682 ha), indicating the rainfall dependence of the wetlands in the state. Turbidity of open water is mainly low in post monsoon and low to moderate during pre monsoon.

.

Table 8: Area estimates of wetlands in Jalgaon

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1105	Waterlogged	18	114	0.30	60	18
2	1106	River/Stream	87	19517	51.96	6360	2789
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	31	8961	23.86	7480	3969
4	1202	Tanks/Ponds	427	8682	23.12	7862	2903
5	1203	Waterlogged	6	25	0.07	16	3
		Sub-Total	**569**	**37299**	**99.31**	**21778**	**9682**
		Wetlands (<2.25 ha), mainly Tanks	259	259	0.69	-	-
		Total	**828**	**37558**	**100.00**	**21778**	**9682**

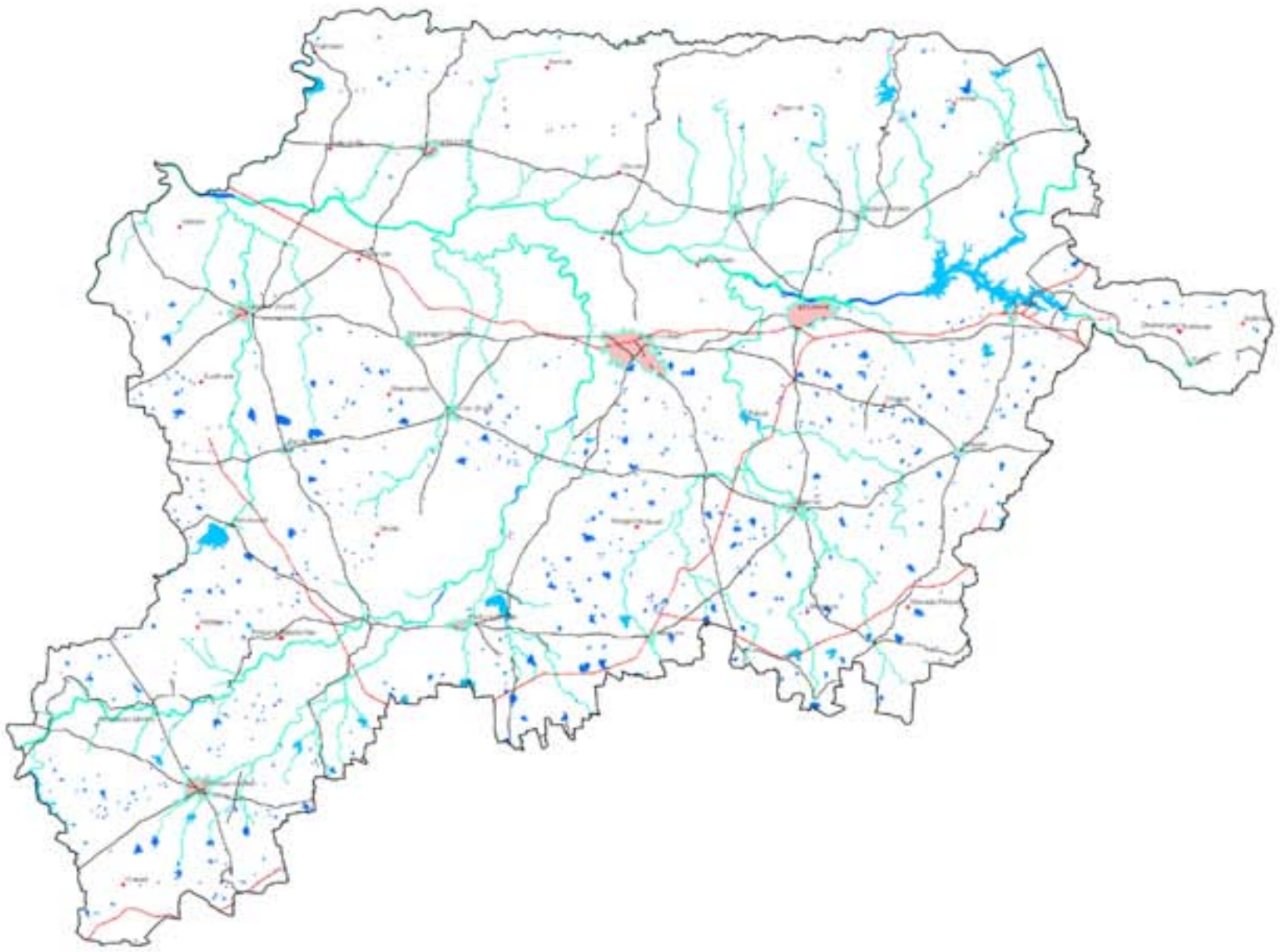
Area under Aquatic Vegetation	2146	1978

Area under turbidity levels		
Low	16334	3136
Moderate	4180	5207
High	1264	1339

State : Maharashtra

WETLAND MAP

District : Jalgaon

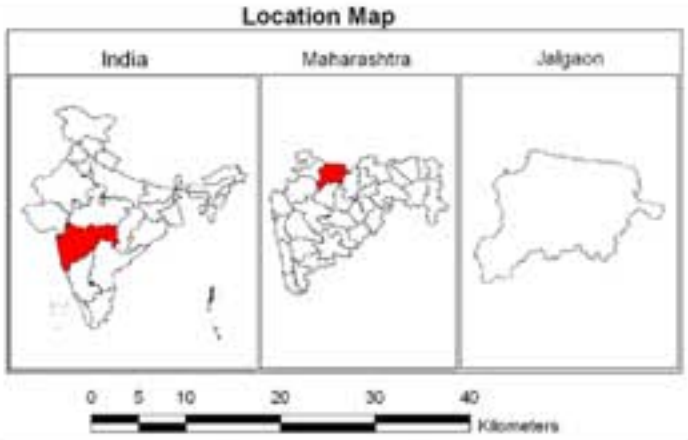


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

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State : Maharashtra

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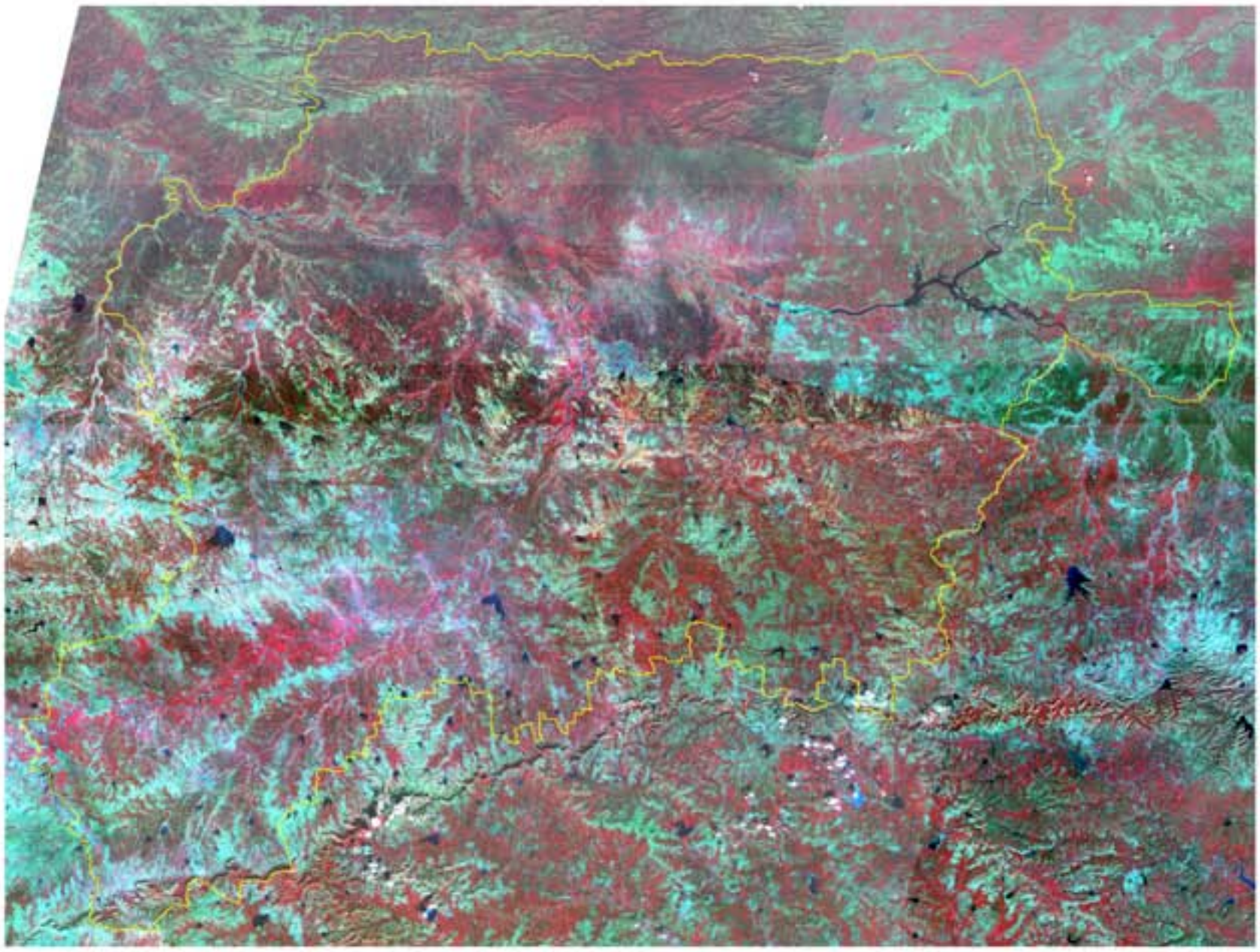


IRS P6 LISS-III post monsoon data (2006)

7.1.4 Buldhana

This district is located in the north-central parts of the State and lies between 19^0 51' to 21^0 17' North latitudes and $75^0$57' to $76^0$59' East longitudes covering an area of about 9661 km^2.The district is bounded on the north by Madhya Pradesh, on the east by Amravati and Akola districts, on the south by Jalna district and on the west by Jalna and Jalgaon districts. The district has been divided into 13 administrative sub-units (viz., tahsils) namely, Buldhana, Chikhali, Deolgaonraja, Malkapur. Nandura, Motala, Jalgaon, Jamod, Sangrampur, Khamgaon,. Shegaon,. Mehekar and Lonar. There are in all 1433 villages and 11 towns in the district. According to the 2001 census, the total population of Buldhana district is 2232480.

Total 670 wetlands are mapped including 187 small wetlands (< 2.25 ha) with 17015 ha area. The district is dominated by man made wetlands. The tanks/ponds are the major wetland type with 6661 ha area (39.15 %), followed by the reservoir/barrages with 6047 ha area (35.54 %). Rivers/ streams contribute 23.53 % of the total wetland area. Details of wetland statistics is given in Table- 9.

Aquatic vegetation is significantly more during pre monsoon (1105 ha) than in post monsoon (123 ha). Open water spread of the wetlands is significantly higher in post monsoon (15714 ha) than during pre monsoon (6506 ha), indicating the rainfall dependence of the wetlands in the state. Turbidity of open water is mainly low in both the seasons.

A special mention must be made about the Lonar Lake situated in the district. This is the only crater in basaltic rock formed by the meteoritic impact in India, ranking third largest in the world. This is a salt water lake. The Lonar Crater has a circular outline with a diameter of 1,830 m and a depth of 150 m with steep vertical slopes. The maximum elevation of the area is 669 m and the minimum is 670 m. The chemical characteristics of the lake show two distinct regions - an outer neutral (pH7) and an inner alkaline (pH11) each with its own flora and fauna. It shows high turbidity levels during pre and post monsoon seasons.

Table 9: Area estimates of wetlands in Buldhana

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	1	116	0.68	114	115
2	1106	River/Stream	76	4004	23.53	3988	240
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	24	6047	35.54	5251	3442
4	1202	Tanks/Ponds	382	6661	39.15	6361	2709
		Sub-Total	**483**	**16828**	**98.90**	**15714**	**6506**
		Wetlands (<2.25 ha), mainly Tanks	187	187	1.10	-	-
		Total	**670**	**17015**	**100.00**	**15714**	**6506**

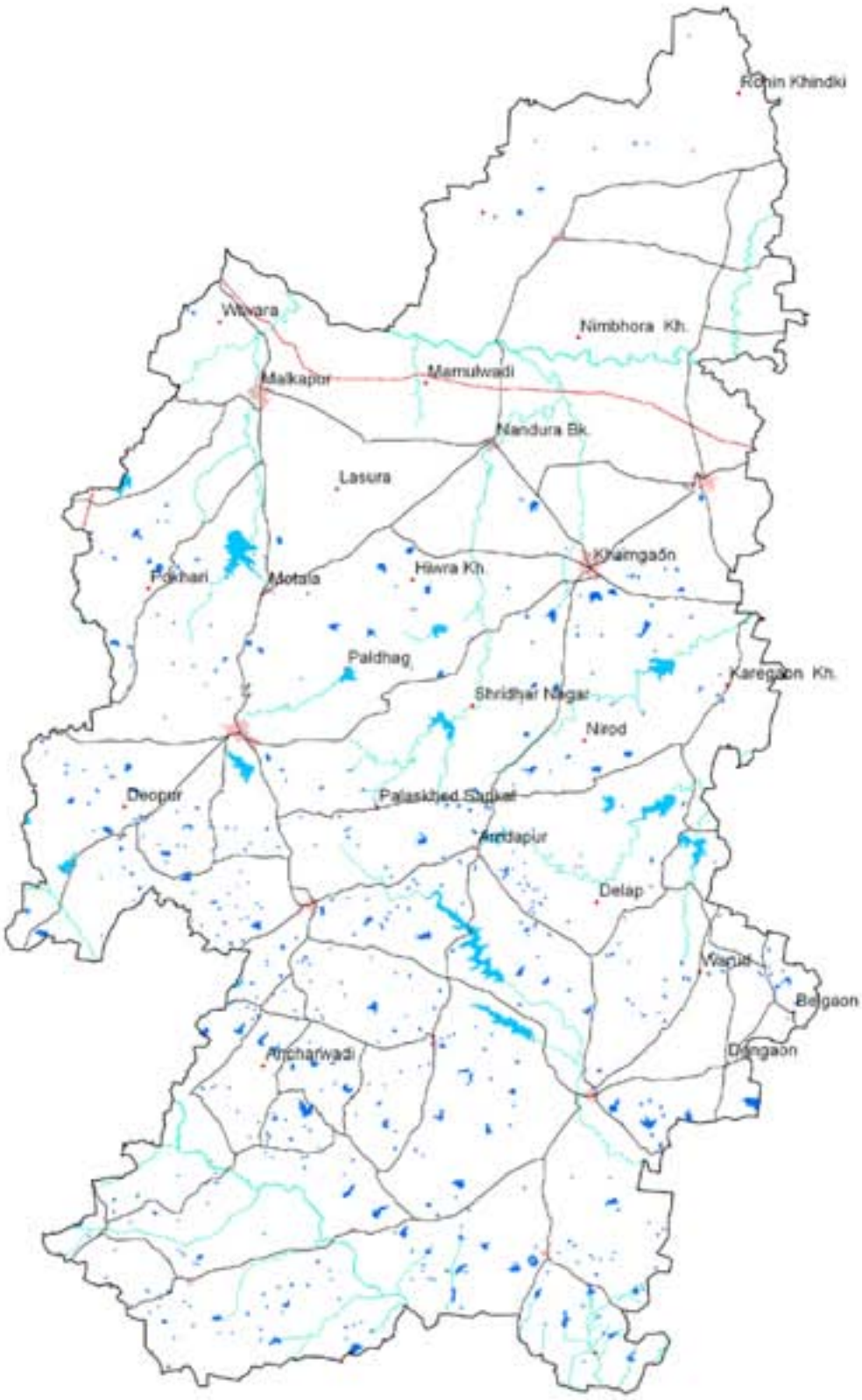
Area under Aquatic Vegetation	123	1105

Area under turbidity levels		
Low	15536	6234
Moderate	178	272
High	-	-

State : Maharashtra

WETLAND MAP

District : Buldhana

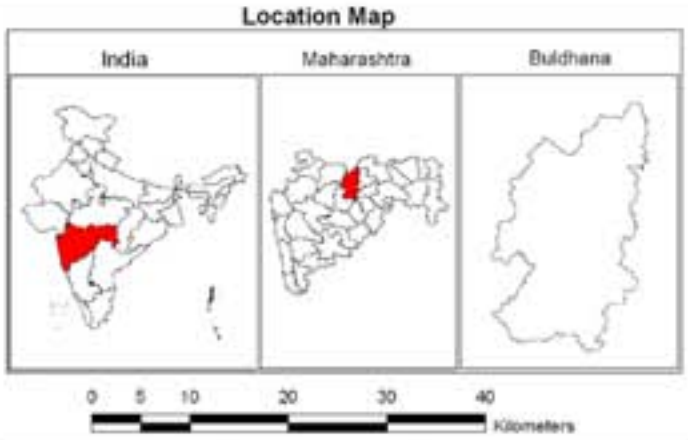


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

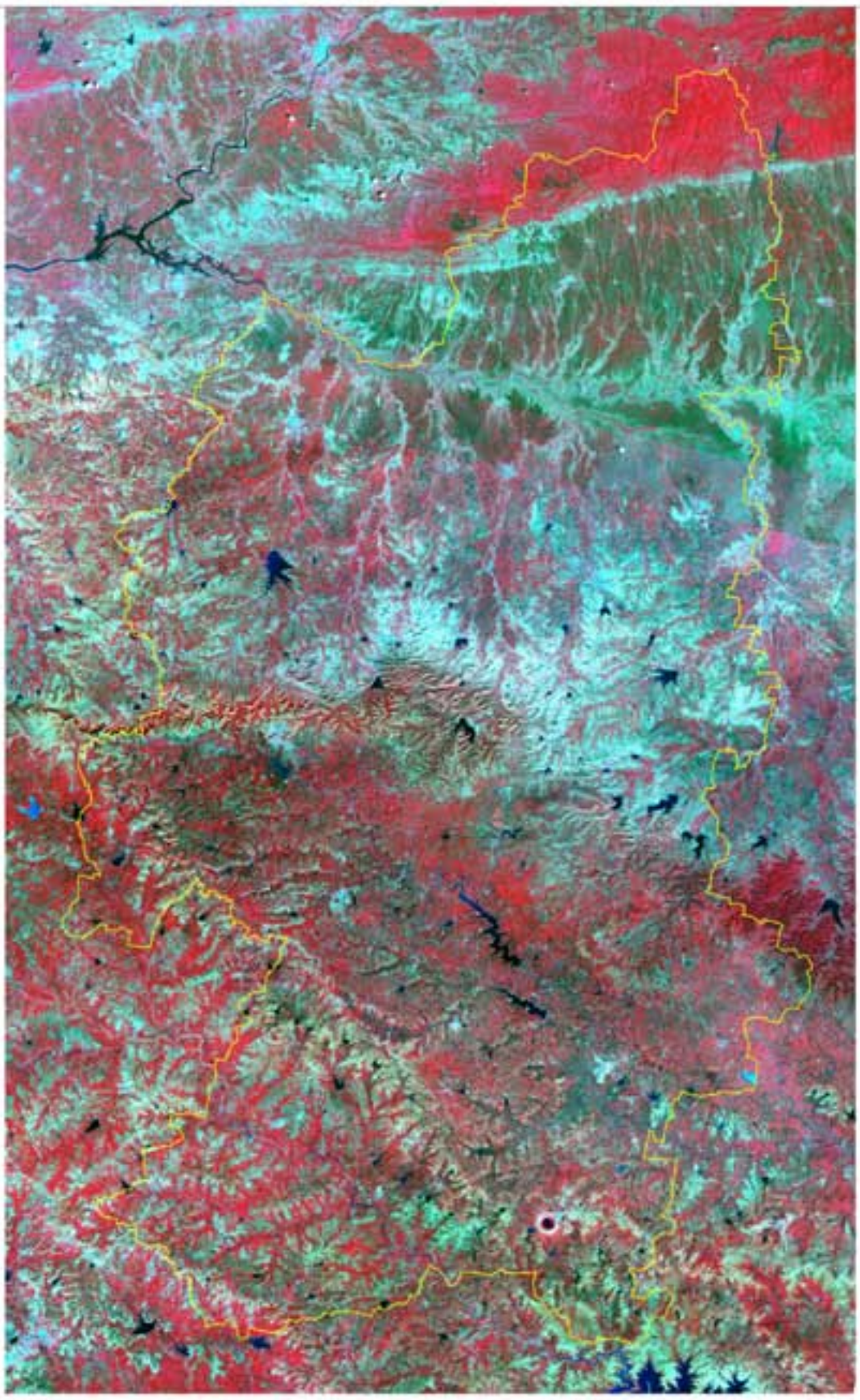
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Buldhana



IRS-P6 LISS-III Post-monsoon data(2006-2007)

7.1.5 Akola

Akola district is located in central eastern part of the district and lies between $20^0$16' to $21^0$16' North latitudes and $76^0$41' to $77^0$37' East longitudes covering an area of about 5429 km^2. The district is bounded by Amravati district on the north and east, Washim district on the south and Buldhana district on the west. The district has been subdivided into 7 administrative sub-units (i.e. tahsils) viz., Akola, Telhara, Murtijapur, Balapur, Patur, BarsiTakli and Akot. There are 986 villages and 8 towns in the district. According to the 2001 census; the total population of Akola is 1630239.

Total 366 wetlands are mapped including 172 small wetlands (< 2.25 ha) with 11633 ha area. Rivers/ streams contribute 53.74 % of the total wetland area. Reservoir/barrage is the second major wetland type with 26.0% share, followed by the tanks/ponds with 2174 ha area (18.69 %). Details of wetland statistics is given in Table- 10.

Aquatic vegetation is significantly more during pre monsoon (955 ha) than in post monsoon (75 ha). Open water spread of the wetlands is significantly higher in post monsoon (11118 ha) than during pre monsoon (2662 ha), indicating the rainfall dependence of the wetlands in the state, particularly the dryness of rivers is very prominent. Turbidity of open water is mainly low in both the seasons

Table 10: Area estimates of wetlands in Akola

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	55	6251	53.74	6266	141
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	8	3036	26.10	2874	1593
3	1202	Tanks/Ponds	131	2174	18.69	1978	928
		Sub-Total	**194**	**11461**	**98.52**	**11118**	**2662**
		Wetlands (<2.25 ha), mainly Tanks	172	172	1.48	-	-
		Total	**366**	**11633**	**100.00**	**11118**	**2662**

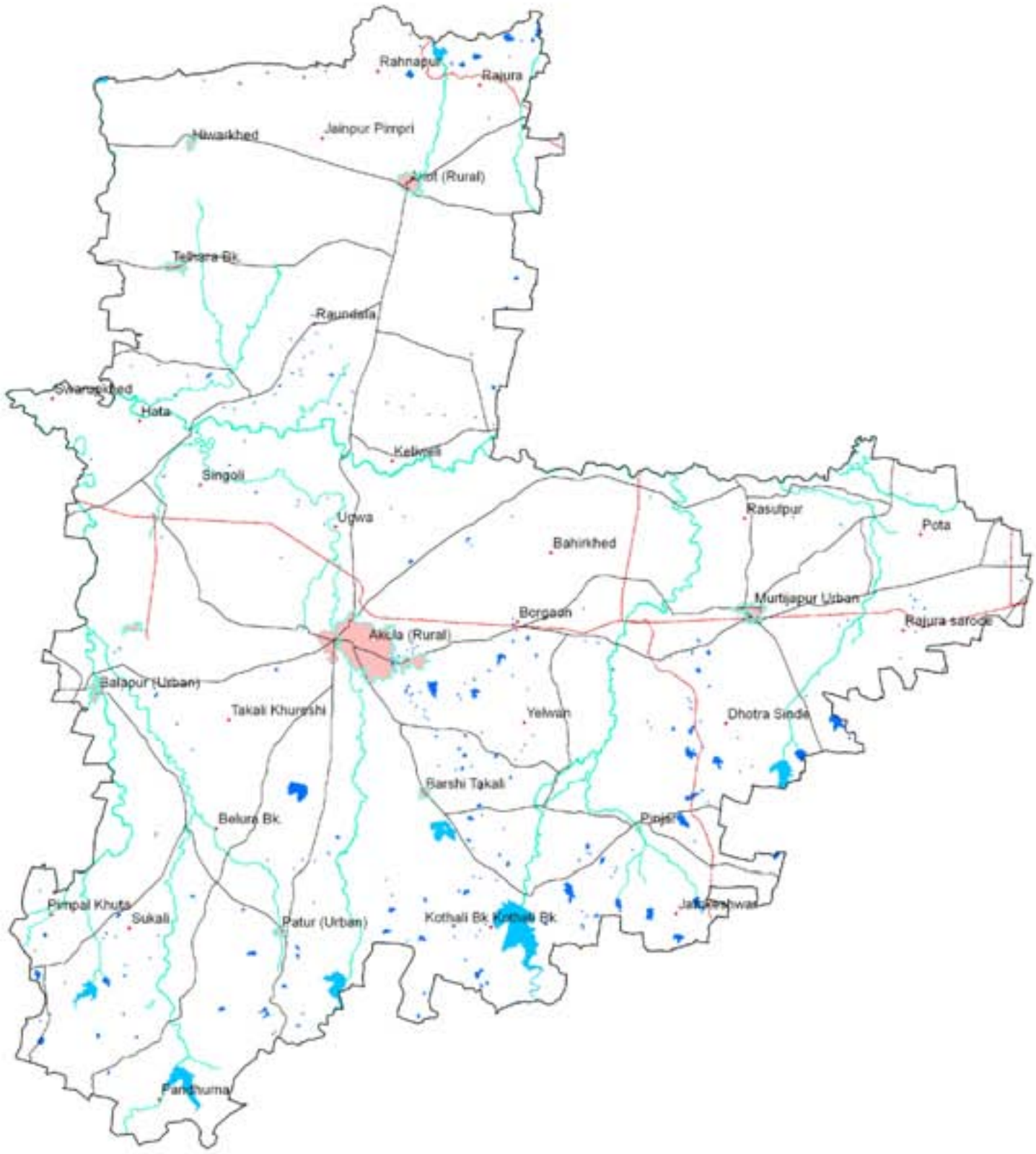
Area under Aquatic Vegetation	75	955

Area under turbidity levels		
Low	10897	2463
Moderate	205	195
High	16	4

State : Maharashtra

WETLAND MAP

District : Akola

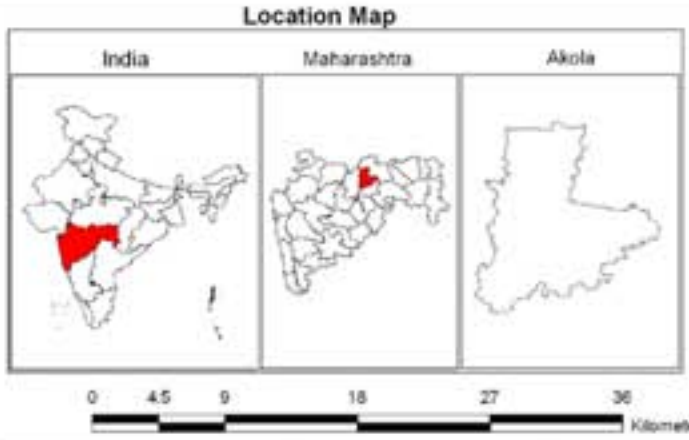


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

Space Applications Centre (ISRO), Ahmedabad
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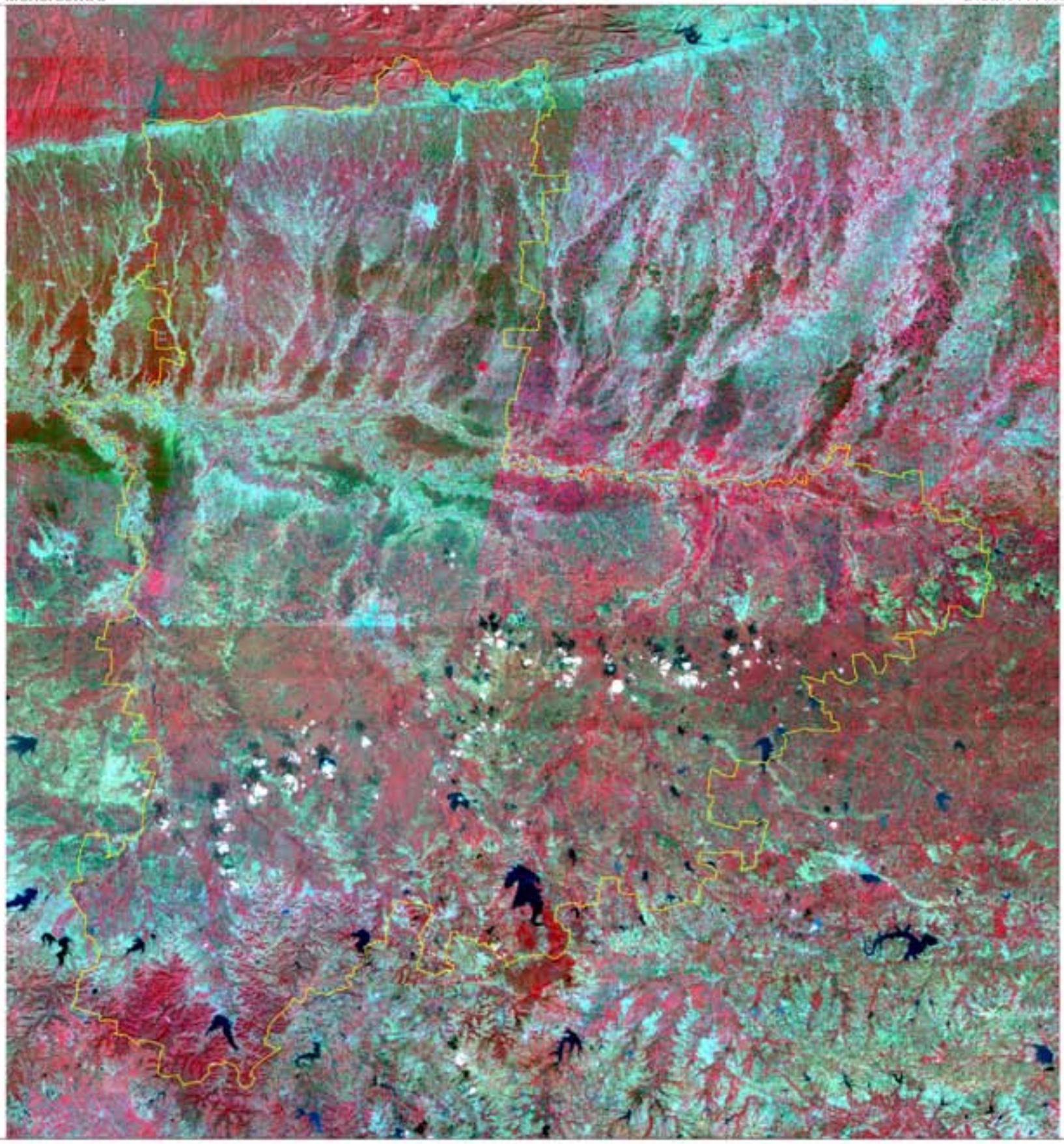
Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Akola



IRS P6 LISS-III post monsoon data (2006)

7.1.6 Washim

Washim district is located in central eastern part of the State and lies between 19^0 51' to 20^0 45' North latitudes and $76^0$36' to $77^0$41' East longitudes covering an area of about 5155 km^2. The district is bounded by Akola district on the north and Amravati on the north-east, Yavatmal district on the east and south-east, Parbhani district on the south and Buldhana district on the west. The district has been subdivided into 6 administrative sub-units (i.e. tahsils) viz., Karanja, Mangrulpir, Manora, Washim, Malegaon, and Risod. There are 789 villages and 4 towns in the district. According to the 2001 census, the total population of in Washim district is 1630239.

Total 631 wetlands are mapped including 215 small wetlands (< 2.25 ha) with 12505 ha area. The district is dominated by man made wetland types. Tank/pond is the major wetland type. There are 347 Tank/pond with 49.10% share. The reservoir/barrages contribute 2428 ha i.e. 19.41% of the wetland area. Rivers/ streams contribute 29.77 %. Details of wetland statistics is given in Table- 11.

Aquatic vegetation is more or less same during pre monsoon (255 ha) and post monsoon (254 ha). Open water spread of the wetlands is significantly higher in post monsoon (11844 ha) than during pre monsoon (4061 ha), indicating the rainfall dependence of the wetlands in the state, particularly the dryness of rivers is very prominent. Turbidity of open water is mainly low in both the seasons

Table 11: Area estimates of wetlands in Washim

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	60	3723	29.77	3749	16
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	9	2428	19.41	2309	802
3	1202	Tanks/Ponds	347	6140	49.10	5786	3243
		Sub-Total	**416**	**12291**	**98.28**	**11844**	**4061**
		Wetlands (<2.25 ha), mainly Tanks	215	215	1.72	-	-
		Total	**631**	**12506**	**100.00**	**11844**	**4061**

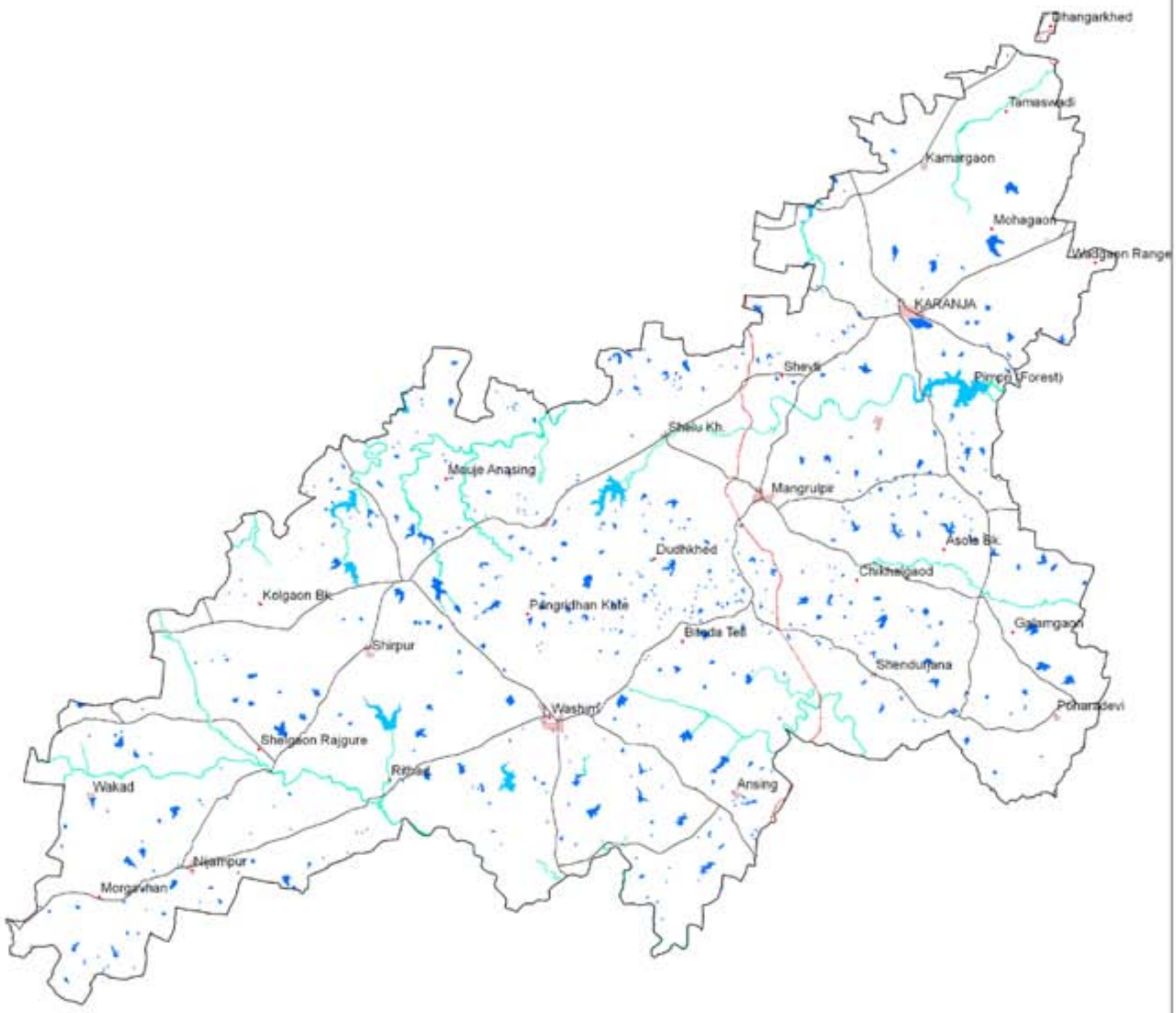
Area under Aquatic Vegetation	254	255

Area under turbidity levels		
Low	11335	3901
Moderate	488	156
High	21	4

State : Maharashtra

WETLAND MAP

District : Washim

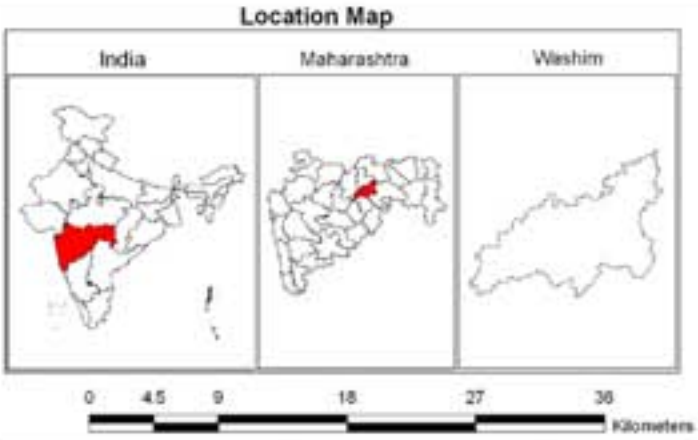


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

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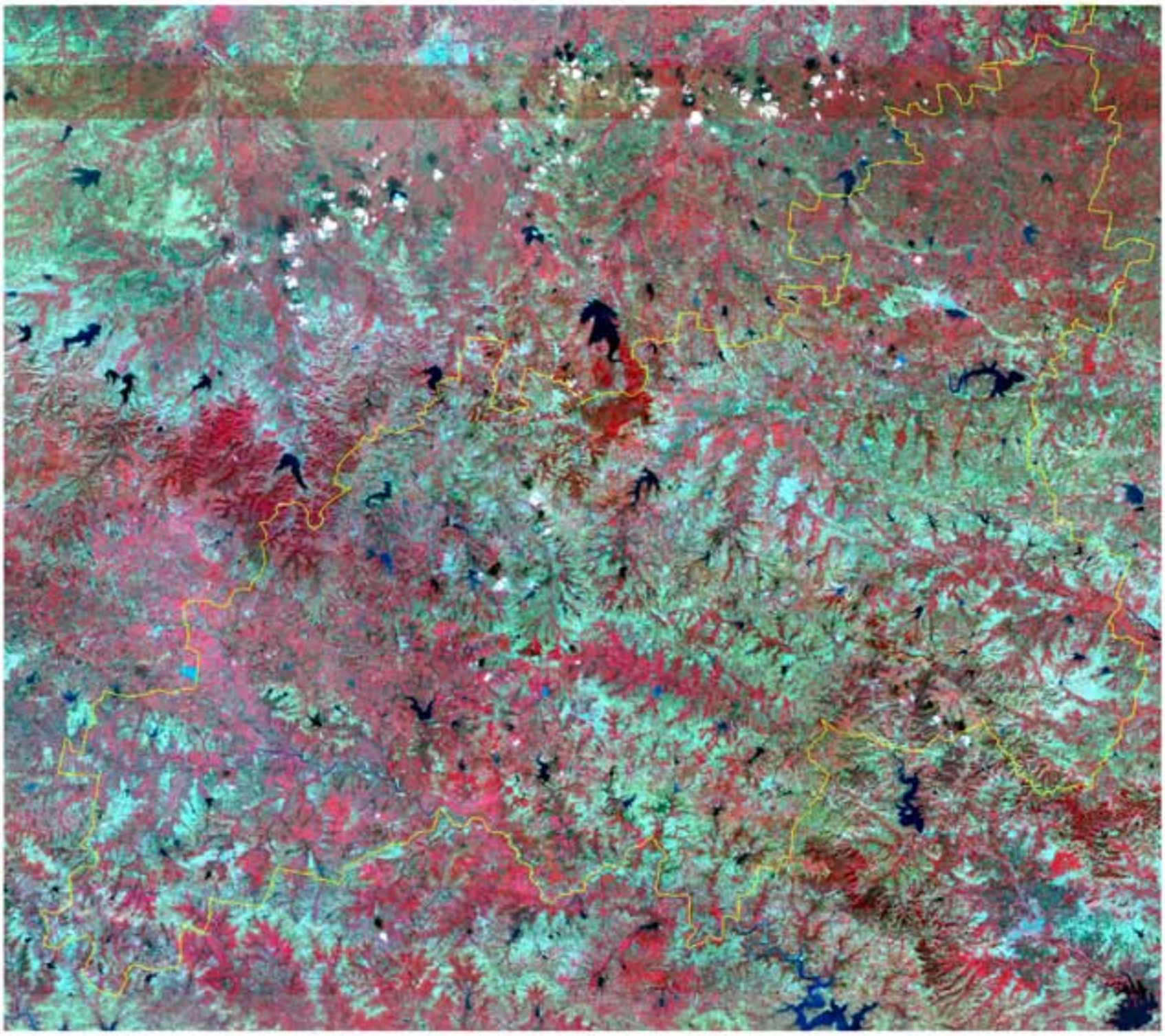
Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Washim



IRS P6 LISS-III post monsoon data (2006)

7.1.7 Amravati

Amravati district is located in the Northern parts of Maharashtra State and lies between 20^0 32' to 21^0 46' North latitudes and 76^0 37' to 78^0 27' East longitudes covering an area of about 12,235 km^2. It is bounded on the north Betul district in Madhya Pradesh, on the east by Nagpur and Wardha districts, on the south by Yavatmal and on the south-west and west by Akola and Buldhana districts of Maharashtra respectively. The district is sub-divided into 14 administrative sub-units (i.e. tahsils) viz., Amravati, Bhatkuli, Nandgaon-Khandeshwar, Achalpur, Chandur Bazar, Morshi, Warud, Chandur railway, Dhamangaon Railway, Tiwsa, Daryapur, Anjangaon, Dharni and Chikhaldara. There are 2002 villages and 11 towns in the district as per 2001 census. The total population of Amravati is 2607160.

Total 601 wetlands are mapped including 160 small wetlands (< 2.25 ha) with 22857 ha area. The district is dominated by man made wetland types. The reservoir/barrages with 7272 ha occupy 31.82 % area, followed by the tanks/ponds with 4450 ha (19.47 %). Rivers/ streams contribute 48.02 %. Details of wetland statistics is given in Table- 12.

Aquatic vegetation is significantly more during pre monsoon (1115 ha) than during post monsoon (180 ha). Open water spread of the wetlands is significantly higher in post monsoon (22651 ha) than during pre monsoon (6739 ha), indicating the rainfall dependence of the wetlands in the state, particularly the dryness of rivers is very prominent. Turbidity of open water is mainly low in both the seasons

Table 12: Area estimates of wetlands in Amravati

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	141	10975	48.02	10950	63
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	9	7272	31.82	7268	4797
3	1202	Tanks/Ponds	291	4450	19.47	4433	1879
		Sub-Total	**441**	**22697**	**99.30**	**22651**	**6739**
		Wetlands (<2.25 ha), mainly Tanks	160	160	0.70	-	-
		Total	**601**	**22857**	**100.00**	**22651**	**6739**

Area under Aquatic Vegetation	180	1115

Area under turbidity levels		
Low	21429	6129
Moderate	1204	608
High	18	2

State : Maharashtra

WETLAND MAP

District : Amravati

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map

Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

Space Applications Centre (ISRO), Ahmedabad
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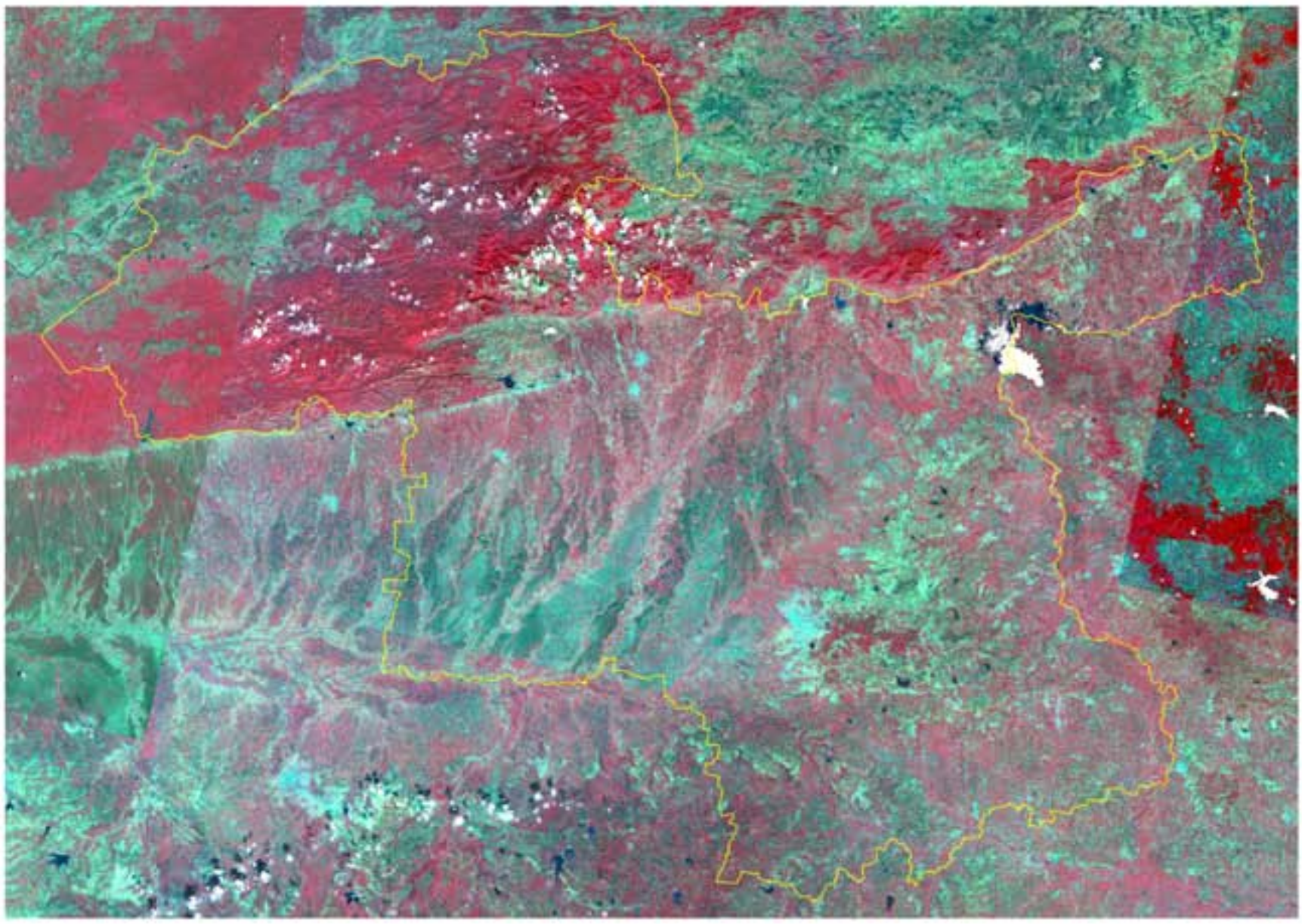
Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Amravati



IRS P6 LISS-III post monsoon data (2006)

7.1.8 Wardha

Wardha district lies between 20^0 18' to 21^0 21' North latitude and 78^0 30' to 79^0 15' East longitude covering an area of about 6,309 km^2. This district is bounded on the south and southwest by Yavatmal district, on the southeast by Chandrapur district, on the north and northeast by Nagpur and on the west by Amravati district. It is divided into eight administrative sub-units i.e., tahsils namely, Wardha, Deoli, Selu, Arvi, Ashti, Karanja, Hinganghat and Samudrapur. There are 1382 villages and 7 towns in the district.According to the 2001 census; the total population of Wardha is 1236736.

Total 396 wetlands are mapped including 161 small wetlands (< 2.25 ha) with 15505 ha area. The district is dominated by man made wetland types. The reservoir/barrages with 6953 ha occupy 44.84 % area, followed by the tanks/ponds with 3460 ha (22.32 %). Rivers/ streams contribute 31.80 %. Details of wetland statistics is given in Table- 13.

Aquatic vegetation is significantly more during pre monsoon (1398 ha) than during post monsoon (85 ha). Open water spread of the wetlands is significantly higher in post monsoon (14831 ha) than during pre monsoon (5097 ha). Dryness of rivers during pre monsoon is very prominent. Turbidity of open water is mainly low in post monsoon, while ranged from low to moderate during pre monsoon.

Table 13: Area estimates of wetlands in Wardha

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	89	4931	31.80	4811	497
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	5	6953	44.84	6832	3691
3	1202	Tanks/Ponds	141	3460	22.32	3188	909
		Sub-Total	**235**	**15344**	**98.96**	**14831**	**5097**
		Wetlands (<2.25 ha), mainly Tanks	161	161	1.04	-	-
		Total	**396**	**15505**	**100.00**	**14831**	**5097**

Area under Aquatic Vegetation	85	1398

Area under turbidity levels		
Low	12230	3746
Moderate	2529	1290
High	72	61

State : Maharashtra

WETLAND MAP

District : Wardha

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map

0 5 10 20 30 40 Kilometers

Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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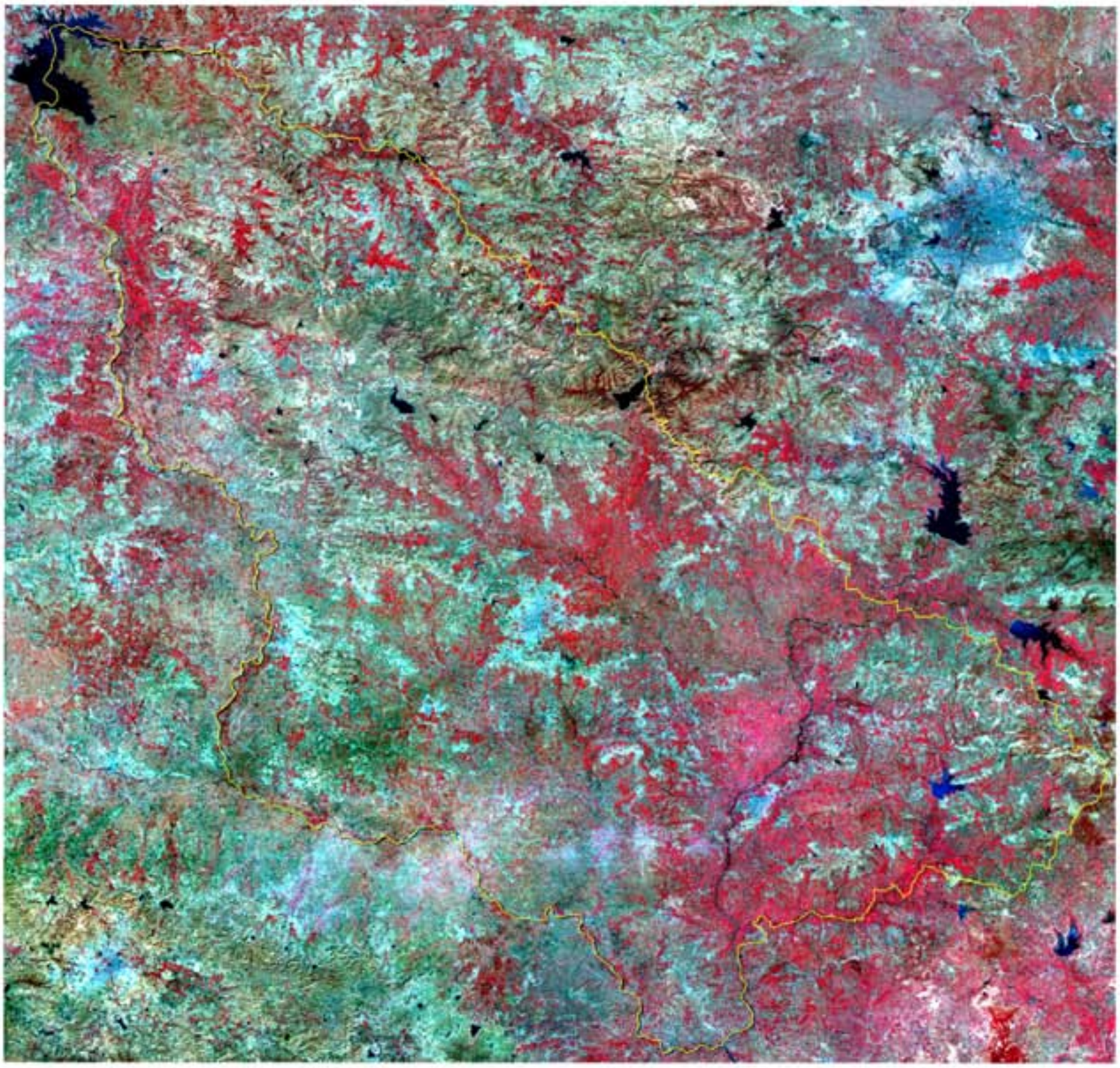
Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Wardha



IRS P6 LISS-III post monsoon data (2006)

7.1.9 Nagpur

Nagpur district, the second capital of Maharashtra is located in the eastern part of the State of Maharashtra and lies between 20^0 30'and 21^0 45' North latitude and 78^0 15' and 79^0 40' East longitude covering an area of about 9864 km^2. It is bounded on the north by Chindwada district of Madhya Pradesh, on the east by Bhandara, on the South by Chandrapur and on the west by Wardha and Amravati district of Maharashtra. The district has been divided into 14 Administrative Sub-units (tahsils). They are Nagpur, Nagpur (Rural),Kamptee, Hingna, Katol, Narkhed, Saoner, Kalmeshwar, Ramtek, Parseoni, Mauda, Umrer, Kuhi and Bhiwapur. There are 1869 villages and 29 towns in the district. According to the 2001 census, the population of Nagpur district is 4067637.

Total 1053 wetlands are mapped including 335 small wetlands (< 2.25 ha) with 41791 ha area. The district is dominated by man made wetland types. The tank/pond is the major wetland type. There are 601 Tank/pond mapped with 17920 ha area (42.87%). The reservoir/barrages with 11420 ha area occupy 27.32 %. Rivers/ streams contribute 24.68 %. Details of wetland statistics is given in Table- 14.

Aquatic vegetation is significantly more during pre monsoon (5727 ha) than during post monsoon (854 ha). Open water spread of the wetlands is significantly higher in post monsoon (34361 ha) than during pre monsoon (14984 ha), indicating the rainfall dependence of the wetlands in the state, particularly the dryness of rivers is very prominent. Turbidity of open water is mainly low to moderate in both the seasons

Table 14: Area estimates of wetlands in Nagpur

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	1	1805	4.32	1755	1005
2	1106	River/Stream	112	10317	24.68	5435	148
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	5	11420	27.32	10986	6692
4	1202	Tanks/Ponds	601	17920	42.87	16185	7139
		Sub-Total	**719**	**41462**	**99.20**	**34361**	**14984**
		Wetlands (<2.25 ha), mainly Tanks	335	335	0.80	-	-
		Total	**1054**	**41797**	**100.00**	**34361**	**14984**

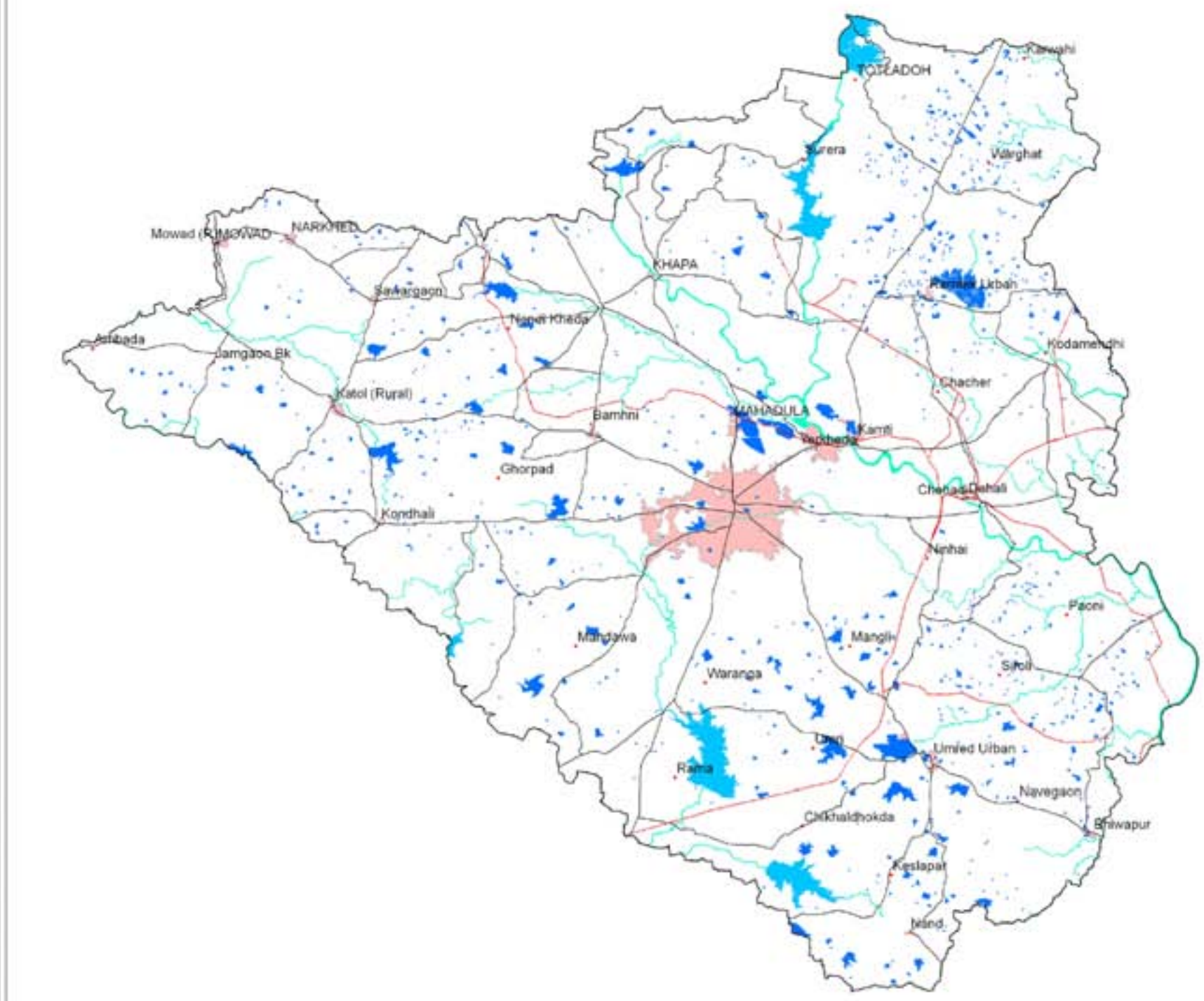
Area under Aquatic Vegetation	854	5727

Area under turbidity levels		
Low	20420	10828
Moderate	12121	3202
High	1820	954

State : Maharashtra

WETLAND MAP

District : Nagpur

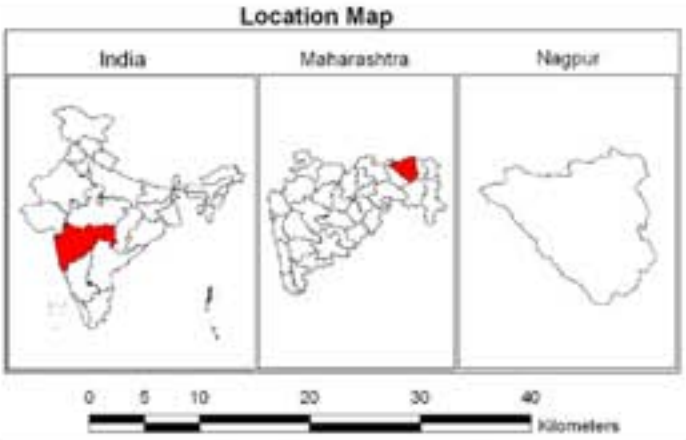


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

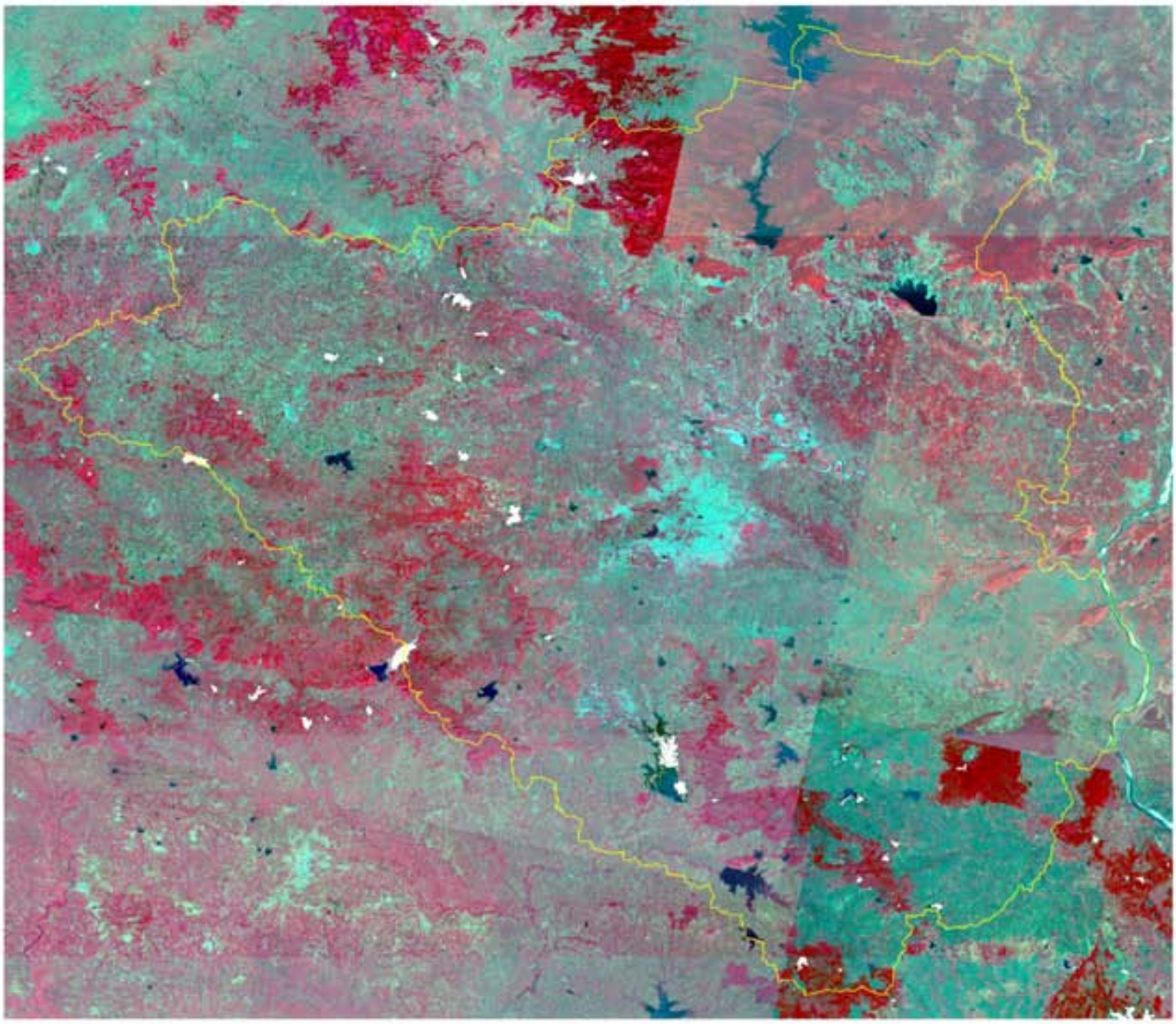
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Nagpur



IRS P6 LISS-III post monsoon data (2006)

7.1.10 Bhandara

The district of Bhandara in the North-Eastern extreme of the Nagpur division of Maharashtra State lies between 20° 39' to 21° 38' north latitudes and 79° 27' to 80° 42' east longitudes covering an area of about 3890 km^2 . The district is bounded by the Balaghat district of Madhya Pradesh in the north, the Gondiya district in the east, Chandrapur district in the south and Nagpur district in the west. The river Wainganga and its tributaries Bagh and Bavantari rivers, form the northern boundary of the district. The district has 7 tahsils. Bhandara district is situated to the north east of Maharashtra and is considered as rice bowl of the state. It, along with adjoining Gondiya district (which has been carved out of Bhandara), have innumerable water tanks known as 'malguzari ' tanks for paddy cultivation. Bhandara is also rich in mineral reserves and manganese, chromite, iron ore, copper, corundum, pyriphylite etc., are found.

Total 1518 wetlands are mapped including 477 small wetlands (< 2.25 ha) with 20469 ha area. The district is dominated by man made wetland types. The tank/pond is the major wetland type. There are 697 Tank/pond mapped with 8889 ha area (43.43%). The reservoir/barrages with 1523 ha area occupy 7.44 %. Rivers/ streams contribute 46.80 %. Details of wetland statistics is given in Table- 15.

Aquatic vegetation is significantly more during pre monsoon (831 ha) than during post monsoon (84 ha). Open water spread of the wetlands is significantly higher in post monsoon (13223 ha) than during pre monsoon (2899 ha), indicating the rainfall dependence of the wetlands in the state, particularly the dryness of rivers is very prominent. Turbidity of open water is mainly low during post monsoon and moderate during pre monsoon.

Table 15: Area estimates of wetlands in Bhandara

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	335	9580	46.80	4028	582
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	9	1523	7.44	1438	680
3	1202	Tanks/Ponds	697	8889	43.43	7757	1637
		Sub-Total	**1041**	**19992**	**97.67**	**13223**	**2899**
		Wetlands (<2.25 ha), mainly Tanks	477	477	2.33	-	-
		Total	**1518**	**20469**	**100.00**	**13223**	**2899**

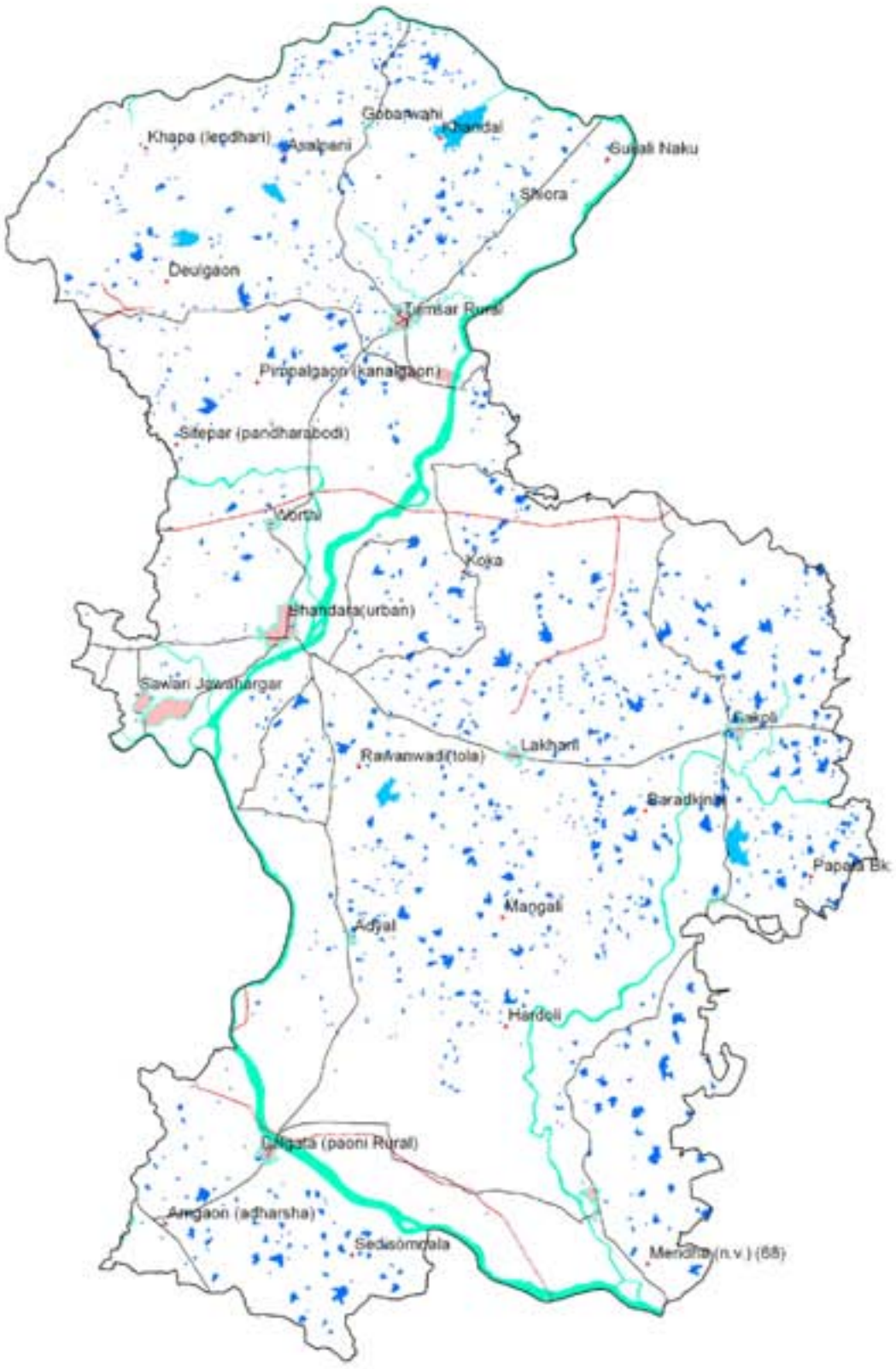
Area under Aquatic Vegetation	84	831

Area under turbidity levels		
Low	8921	705
Moderate	3533	1965
High	769	229

State : Maharashtra

WETLAND MAP

District : Bhandara

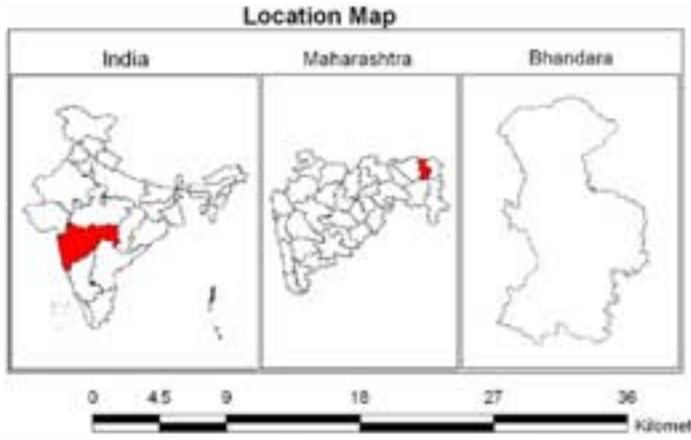


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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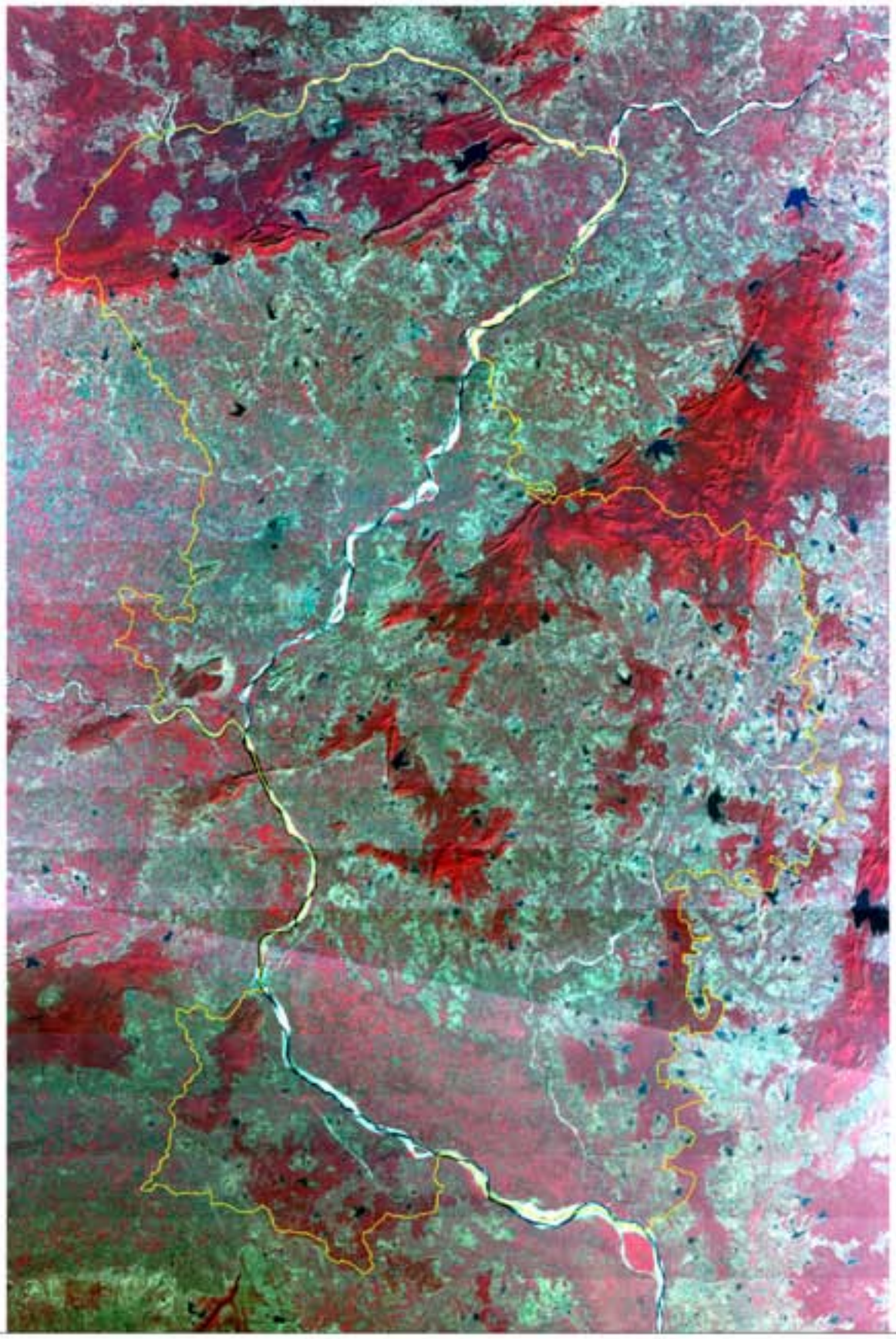
Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Bhandara



IRS P6 LISS-III post monsoon data (2006)

7.1.11 Gondiya

The district of Gondiya in the North-Eastern extreme of the Nagpur division of Maharashtra State lies between 20° 39' 22'' to 21° 38' 35" north latitudes and 79° 47' 32'' to 80° 41' 12'' east longitudes covering an area of about 5431 km^2. The district is bounded by the Balaghat district of Madhya Pradesh in the north, the Rajnandgaon district of Chhatisgargh in the east, Chandrapur district in the south and Bhandara district in the west. The river Wainganga and its tributaries Bagh, Pangoli and Bavantari rivers, form the northern boundary of the district. The district has 8 tahsils. Along with adjoining Gondiya district (which has been carved out of Bhandara), have innumerable water tanks known as 'malguzari 'tanks for paddy cultivation. Gondiya is also rich in mineral reserves and manganese, Sillimenite, iron ore, quartz, sand, corundum, pyriphylite etc., is found. According to the 2001 census, the population of Gondyia is 1200707.

Total 5884 wetlands are mapped including 4600 small wetlands (< 2.25 ha) with 32257 ha area. The district is dominated by man made wetland types. The reservoir/barrages with 13526 ha contribute 41.93 %, followed by Tank/pond type. There are 1098 Tank/pond mapped with 10365 ha (32.13%). River/stream occupies 11. 67% area. This is the district with highest concentration of small wetlands (area < 2.25 ha). Details of wetland statistics is given in Table- 16.

Aquatic vegetation is slightly more during pre monsoon (520 ha) than during post monsoon (224 ha). Open water spread of the wetlands is significantly higher in post monsoon (18540 ha) than during pre monsoon (7811 ha), indicating the rainfall dependence of the wetlands in the state, particularly the dryness of rivers is very prominent. Turbidity of open water is mainly low during post monsoon and moderate during pre monsoon.

Table 16: Area estimates of wetlands in Gondiya

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	164	3766	11.67	2577	47
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	22	13526	41.93	10221	6350
3	1202	Tanks/Ponds	1098	10365	32.13	5742	1414
		Sub-Total	**1284**	**27657**	**85.74**	**18540**	**7811**
		Wetlands (<2.25 ha), mainly Tanks	4600	4600	14.26	-	-
		Total	**5884**	**32257**	**100.00**	**18540**	**7811**

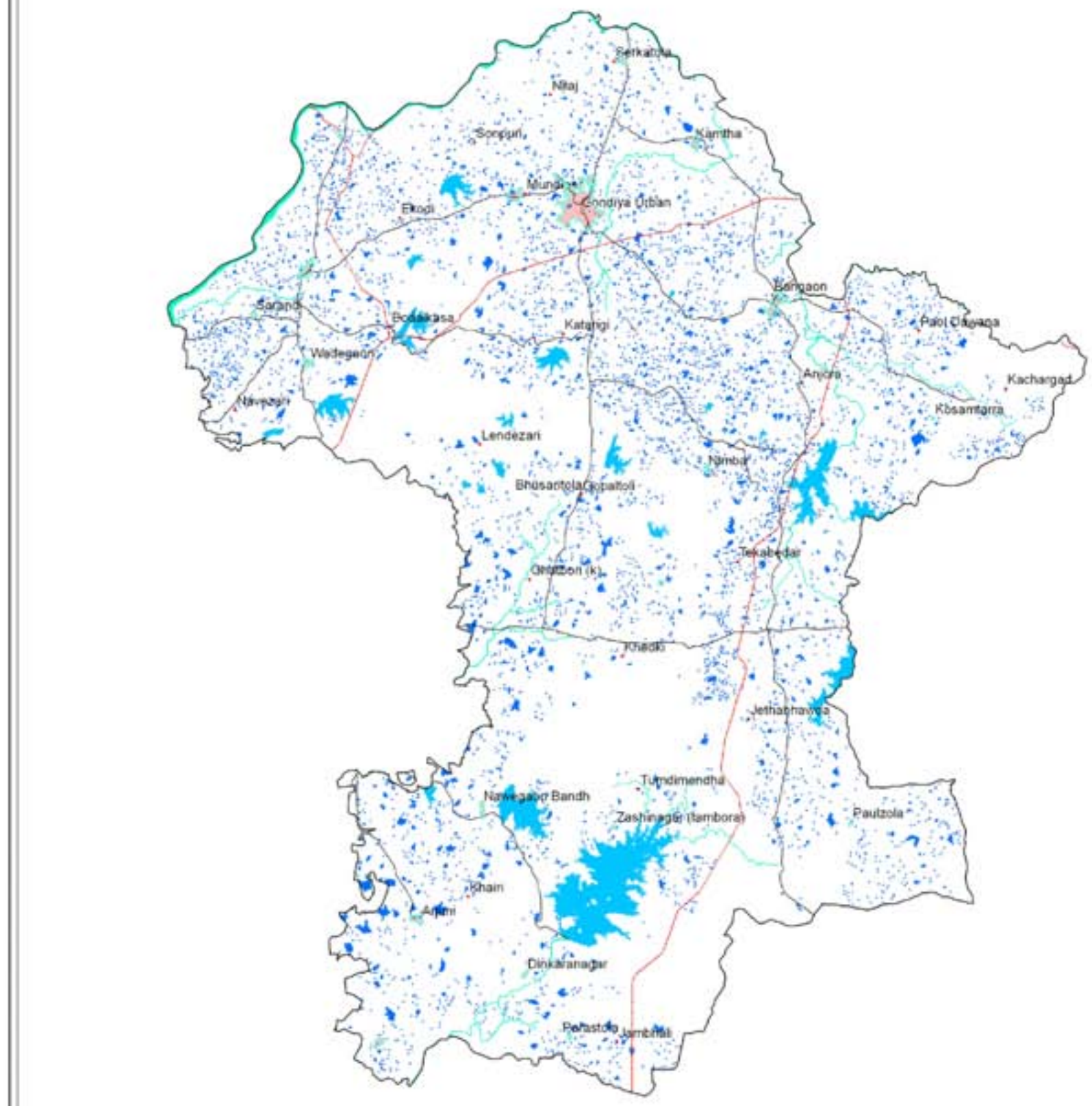
Area under Aquatic Vegetation	224	520

Area under turbidity levels		
Low	14050	1464
Moderate	3020	5977
High	1470	370

State : Maharashtra

WETLAND MAP

District : Gondiya



Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map

0 4.5 9 18 27 36 Kilometers

Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

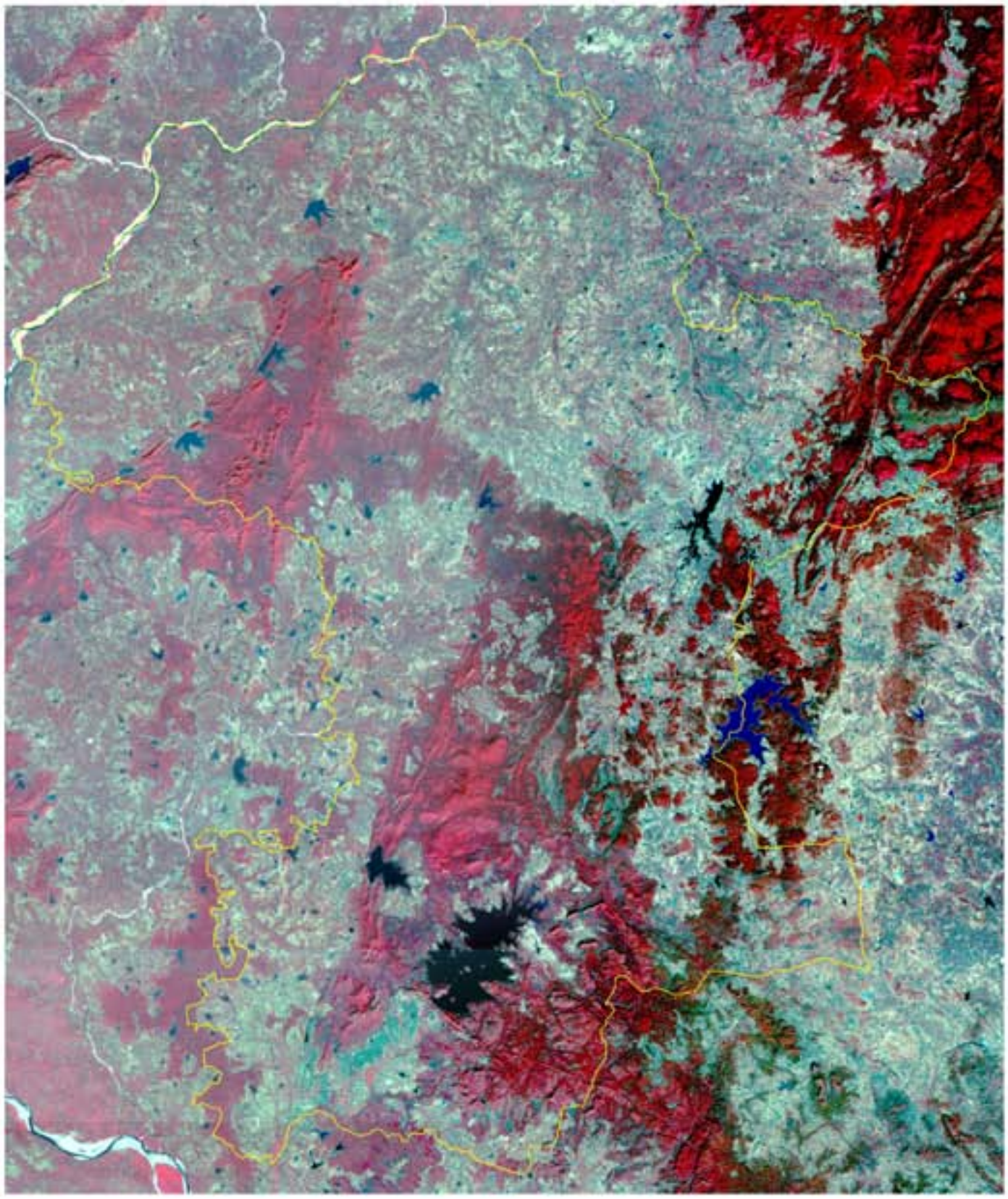
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Gondiya



IRS P6 LISS-III post monsoon data (2006)

7.1.12 Gadchiroli

Gadchiroli is located in the Southeastern part of the State of Maharashtra and lies between 18^0 18'to 20^0 20' North latitude and 79^0 45' to 80^0 54' East longitude covering an area of about 14412 km^2. The district was formed Chandrapur district. It is bounded on the north by Bhandara district on the east by Rajnandgaon and Bastar districts of Chhatisgarh, on the South by Karimnagar and Adilabad districts of Andhra Pradesh and on the West by Chandrapur district. Wainganga and Pranhita rivers form the entire western boundary of the district separately it from the Chandrapur district. The district has been divided into 12 Administrative Sub-units (tahsils) namely Gadchiroli, Chamorshi, Dhanora, Kurkheda, Armori, Sironcha, Aheri, Desaiganj, Korchi, Mulchera, Bhamragad and Etappli. There are 2 towns and 1679 villages in the district. According to the 2001 census, the total population of Gadchiroli is 970294.

Total 27604 wetlands are mapped including 1413 small wetlands (< 2.25 ha) with 37645 ha area. Rivers/ streams are the major wetland type with 74.15 % area. The tanks/ponds is the second major wetland type with 6967 ha area (18.51%), followed by the reservoir/barrages (3.59%). Details of wetland statistics is given in Table- 17.

Aquatic vegetation is slightly more during pre monsoon (931 ha) than during post monsoon (572 ha). Open water spread of the wetlands is significantly higher in post monsoon (24244 ha) than during pre monsoon (5301 ha), indicating the rainfall dependence of the wetlands in the state, particularly the dryness of rivers is very prominent. Turbidity of open water is mainly low during both the seasons.

Table 17: Area estimates of wetlands in Gadchiroli

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	558	27914	74.15	17715	2193
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	2	1351	3.59	317	443
3	1202	Tanks/Ponds	787	6967	18.51	6212	2665
		Sub-Total	**1347**	**36232**	**96.25**	**24244**	**5301**
		Wetlands (<2.25 ha), mainly Tanks	1413	1413	3.75	-	-
		Total	**2760**	**37645**	**100.00**	**24244**	**5301**

Area under Aquatic Vegetation	572	931

Area under turbidity levels		
Low	22311	1888
Moderate	1169	2760
High	764	653

State : Maharashtra

WETLAND MAP

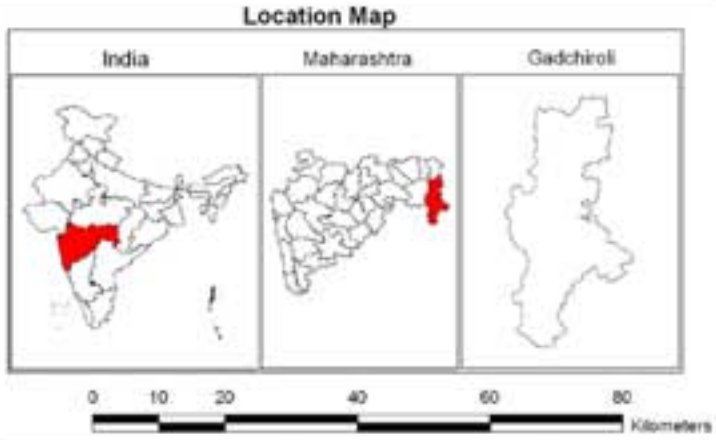
District : Gadchiroli

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

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Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Gadchiroli

IRS P6 LISS-III post monsoon data (2006)

7.1.13 Chandrapur

Chandrapur district is located in the eastern part of the Maharashtra State and lies between $78^0$48' to $79^0$59' East latitudes and $19^0$27' to $20^0$43' North longitudes, covering an area of about 11443 km^2. The district is bounded by Nagpur, Bhandara and Wardha districts on the north, Gadchiroli district on the east, Yavatmal district on the west and Adilabad district of Andhra Pradesh on the south. The eastern boundary is demarcated by the Wainganga river, the western boundary by the Wardha river and the southern boundary by Wainganga river and Manikgarh hills. This district is divided into 4 Sub Divisions, having 15 Talukas. There are 14 towns and 1791 villages. .According to the 2001 census, the demographic features observed in Chandrapur district is 20711014.

Total 1750 wetlands are mapped including 496 small wetlands (< 2.25 ha) with 46948 ha area. The district is dominated by man made wetland types. The Tank/pond with 17244 ha area contributes 36.84%, while, Reservoir/barrage contribute 20.62 %. Rivers/ streams occupy 41.48 % area. Details of wetland statistics is given in Table- 18.

Aquatic vegetation is significantly more during pre monsoon (4130 ha) than during post monsoon (804 ha). Open water spread of the wetlands is significantly higher in post monsoon (42105 ha) than during pre monsoon (15950 ha), indicating the rainfall dependence of the wetlands in the state, particularly the dryness of rivers is very prominent. Turbidity of open water is mainly low during post monsoon while it ranged from low to moderate during pre monsoon.

Table 18: Area estimates of wetlands in Chandrapur

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	114	19472	41.48	17322	3337
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	8	9683	20.62	9381	5929
3	1202	Tanks/Ponds	1132	17297	36.84	15442	6684
		Sub-Total	**1254**	**46452**	**98.94**	**42145**	**15950**
		Wetlands (<2.25 ha), mainly Tanks	496	496	1.06	-	-
		Total	**1750**	**46948**	**100.00**	**42145**	**15950**

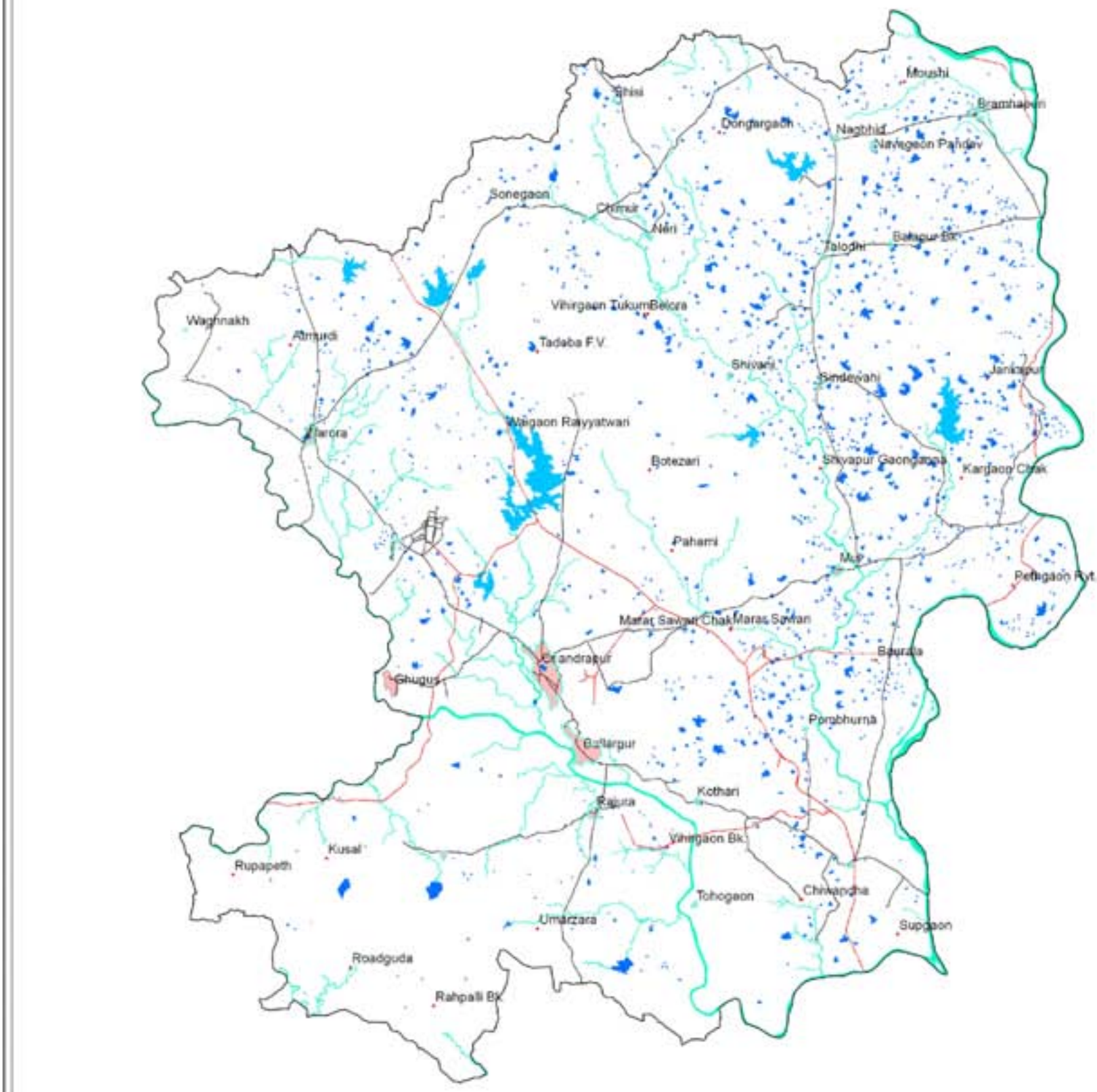
Area under Aquatic Vegetation	804	4130

Area under turbidity levels		
Low	35453	5530
Moderate	5377	9453
High	1315	967

State : Maharashtra

WETLAND MAP

District : Chandrapur



Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map

Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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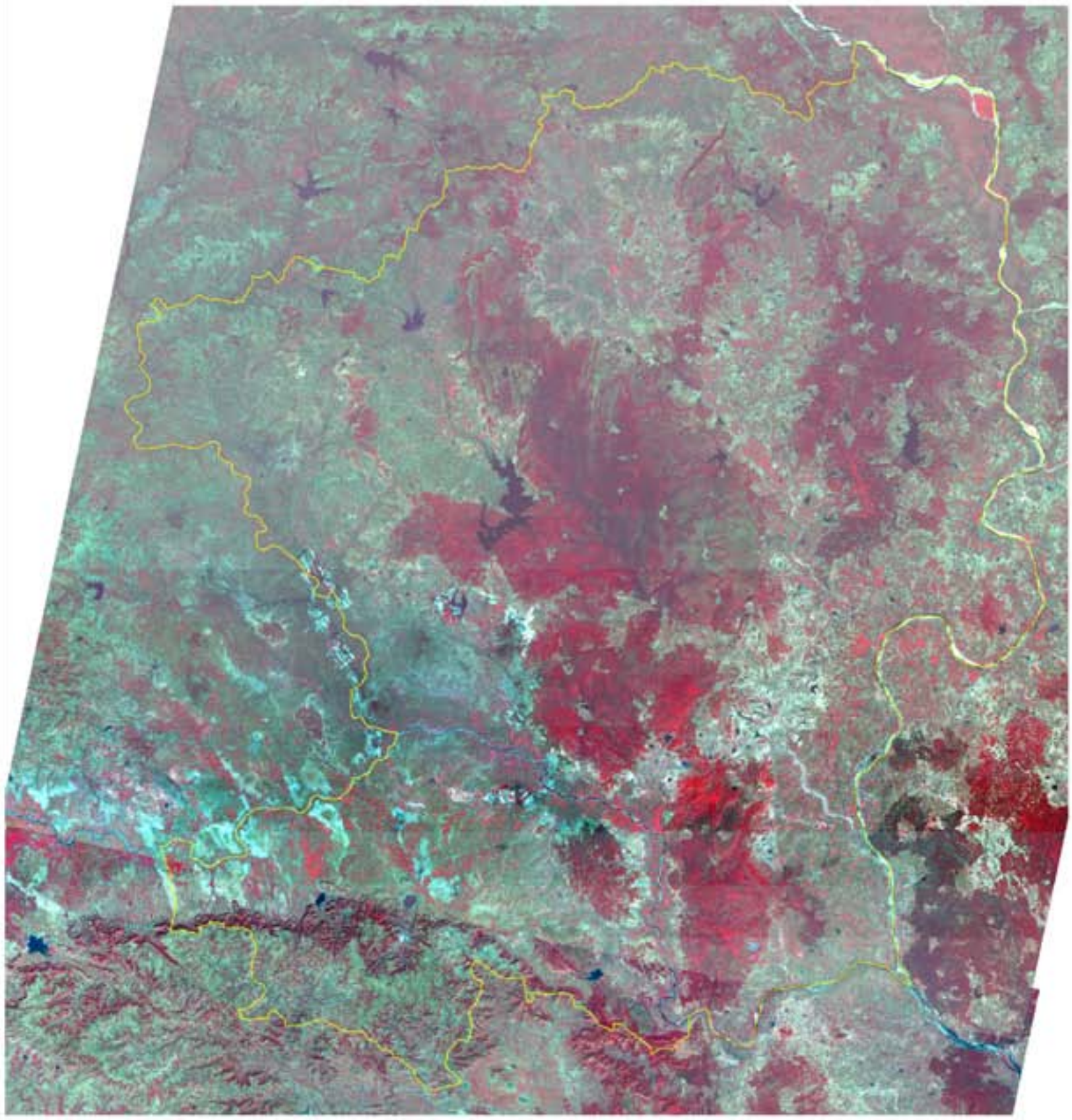
State : Maharashtra

District : Chandrapur



IRS P6 LISS-III post monsoon data (2006)

7.1.14 Yavatmal

Yavatmal district is located in eastern part of the State and lies between 19^0 26' to 20^0 42' North latitude and 77^0 18' to 79^0 98' East longitude covering an area of about 13582 km^2. It is bounded on the north and northeast by Amravati and Wardha districts, on the east by Chandrapur, on the south by Nanded district and Adilabad district of Andhra Pradesh and on the west and south-west by Akola and Parbhani districts. The Wardha and the Penganga rivers have demarcated the district boundaries on the eastern and southern sides respectively. The district has been subdivided into 16 sub-units (tahsils) viz., Darwha, Pusad, Yavatmal, Kelapur, Digras, Vani, Ner, Babhulgaon, Mahagaon, Umarkhed, Ralegaon, Ghatanji, Maregaon ,Kalamb, Zari Zamni and Arni. There are 2130 villages and 13 towns in the district. According to the 2001 census, the total population of Yavatmal district is 2458271.

Total 797 wetlands are mapped including 212 small wetlands (< 2.25 ha) with 34192 ha area. The district is dominated by man made wetland types. Reservoir/barrage is the major wetland type. There are 7 Reservoir/barrage mapped with 13250 ha area (38.75%). There are 440 Tank/pond mapped with 33.10% area. Rivers/ streams occupy 27.53 % area. Details of wetland statistics is given in Table- 19.

Aquatic vegetation is slightly more during pre monsoon (2936 ha) than during post monsoon (812ha). Open water spread of the wetlands is significantly higher in post monsoon (32303 ha) than during pre monsoon (13786 ha), indicating the rainfall dependence of the wetlands in the state, particularly the dryness of rivers is very prominent. Turbidity of open water is mainly low during post monsoon, while ranged from low to moderate during pre monsoon.

Table 19: Area estimates of wetlands in Yavatmal

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	138	9413	27.53	8909	1458
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	7	13250	38.75	13062	7602
3	1202	Tanks/Ponds	440	11317	33.10	10332	4726
		Sub-Total	**585**	**33980**	**99.38**	**32303**	**13786**
		Wetlands (<2.25 ha), mainly Tanks	212	212	0.62	-	-
		Total	**797**	**34192**	**100.00**	**32303**	**13786**

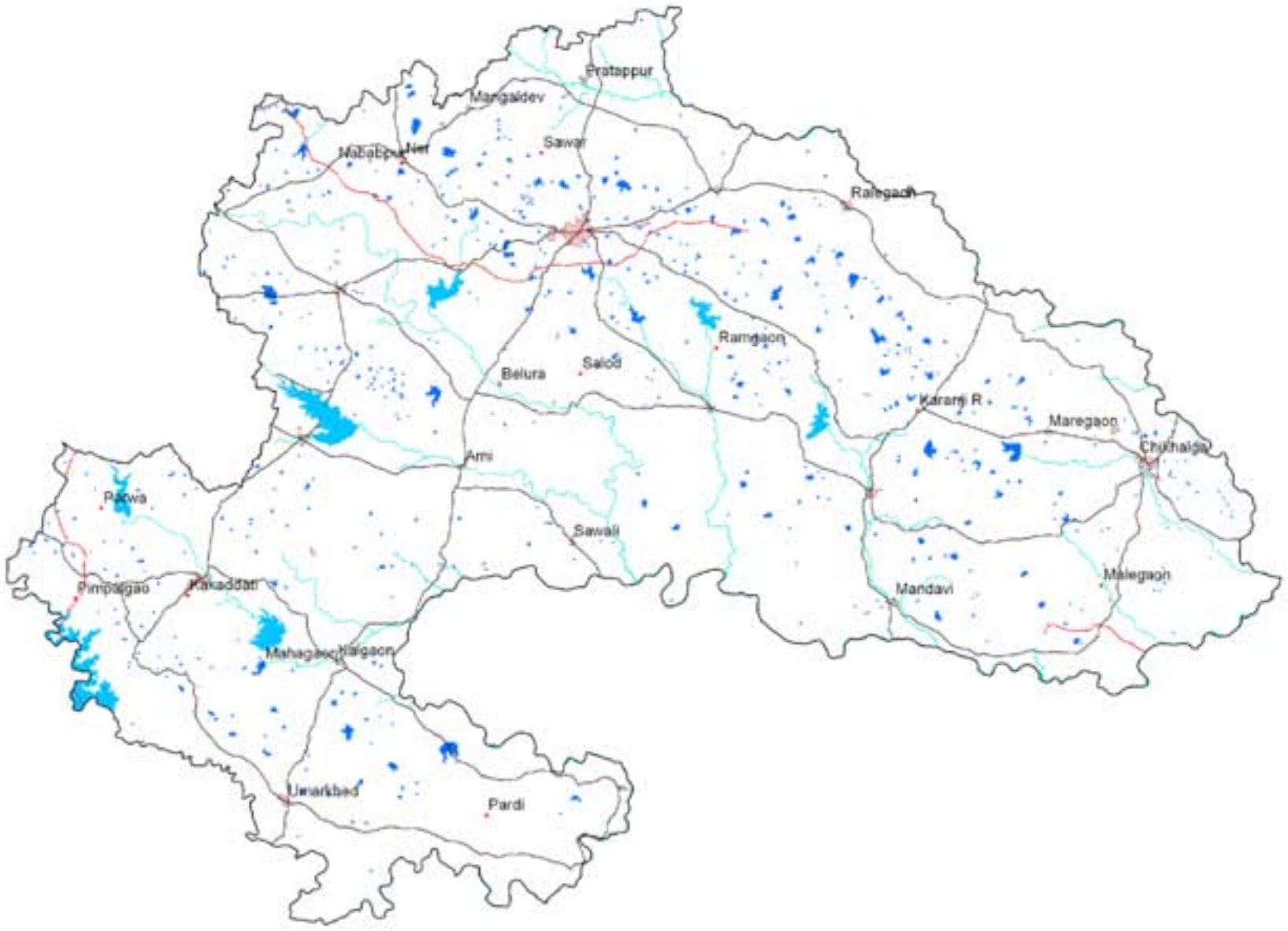
Area under Aquatic Vegetation	812	2936

Area under turbidity levels		
Low	31286	9607
Moderate	970	4141
High	47	38

State : Maharashtra

WETLAND MAP

District : Yavatmal

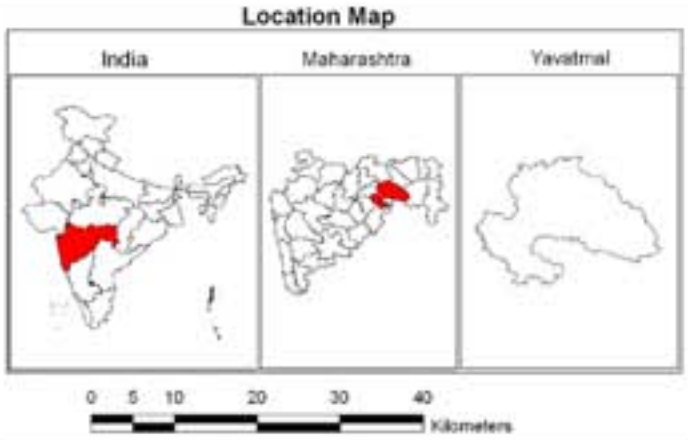


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

Space Applications Centre (ISRO), Ahmedabad
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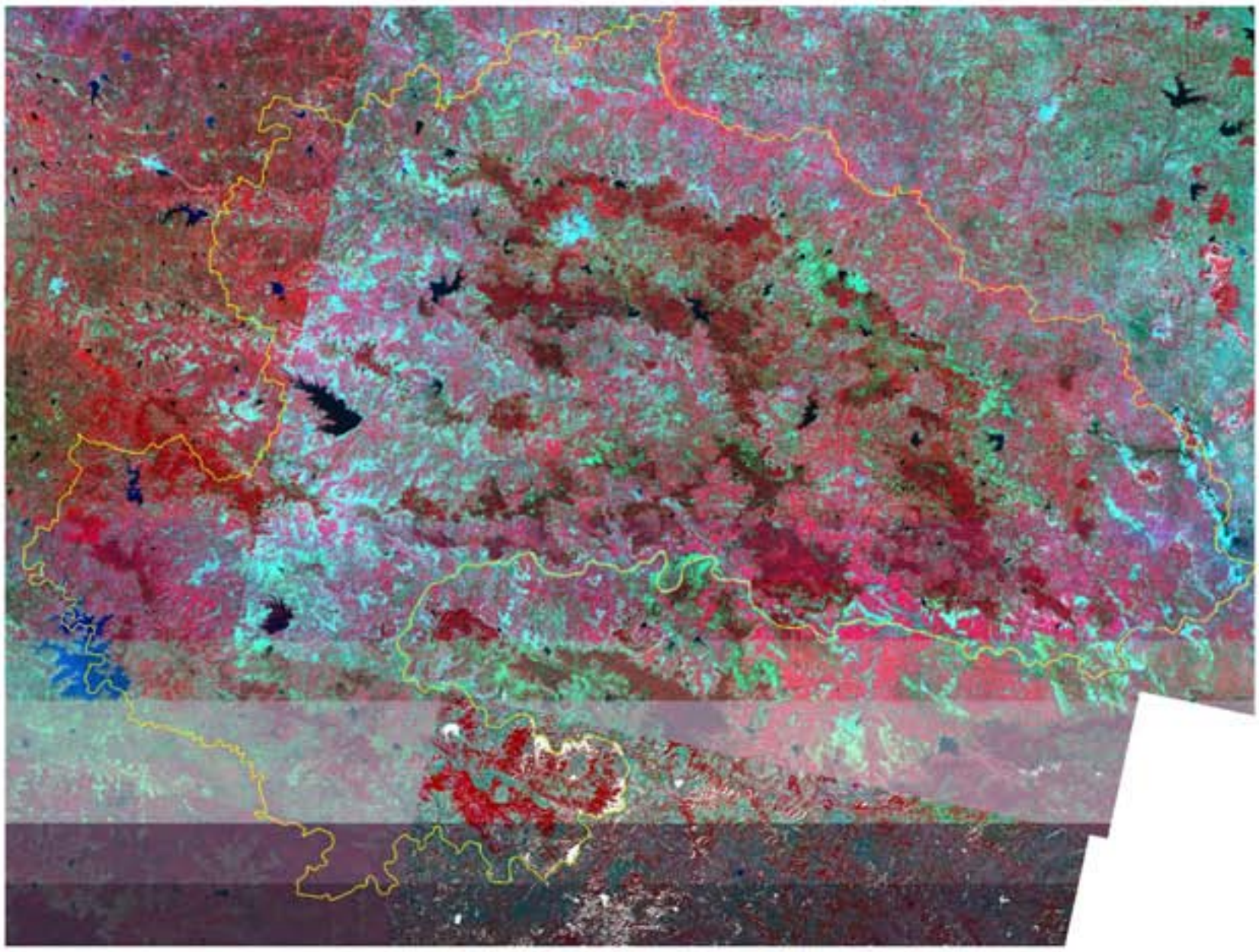
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Yavatmal



IRS P6 LISS-III post monsoon data (2006)

7.1.15 Nanded

Nanded district is one of the districts of Marathwada region of Maharashtra State. It is located in the southeastern part of the state. The district lies between 18^0 15' to 19^0 55' North latitudes and 77^0 to 78^0 25' East longitudes covering an area of about 10528 km^2. It is bounded on the north by Yavatmal district, on the southeast by Latur district, on the northwest by Parbhani district of Maharashtra State., on the east and southeast by Adilabad and Nizambdin districts of Andhra Pradesh district of Maharashtra State On the east and southesast byh Adi9labad and Nizamabad districts of Andhra Pradesh and on the south by Bidar district of Karnataka State. The district is divided into 8 administrative subunits (tahsils) namely Nanded, Hadgaon, Kinwat, Bhokar. There are 8 towns and 1586 villages in the district. According to the 2001 census, the population of Nanded district 2876259.

Total 1072 wetlands are mapped including 440 small wetlands (< 2.25 ha) with 30508 ha area. Rivers/ streams occupy 57.21 % area. There are 395 Tank/pond mapped with 25.22% area. There are 12 Reservoir/barrage mapped with 4913 ha area (16.10%). Details of wetland statistics is given in Table- 20.

Aquatic vegetation is slightly more during pre monsoon (2673 ha) than during post monsoon (1559 ha). Open water spread of the wetlands is significantly higher in post monsoon (26935 ha) than during pre monsoon (8311 ha), indicating the rainfall dependence of the wetlands in the state, particularly the dryness of rivers is very prominent. Turbidity of open water is mainly low during post monsoon, while ranged from low to moderate during pre monsoon.

Table 20: Area estimates of wetlands in Nanded

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	223	17455	57.21	16739	2034
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	12	4913	16.10	4254	3340
3	1202	Tanks/Ponds	395	7693	25.22	5936	2937
4	1203	Waterlogged	2	7	0.02	6	-
		Sub-Total	**632**	**30068**	**98.56**	**26935**	**8311**
		Wetlands (<2.25 ha), mainly Tanks	440	440	1.44	-	-
		Total	**1072**	**30508**	**100.00**	**26935**	**8311**

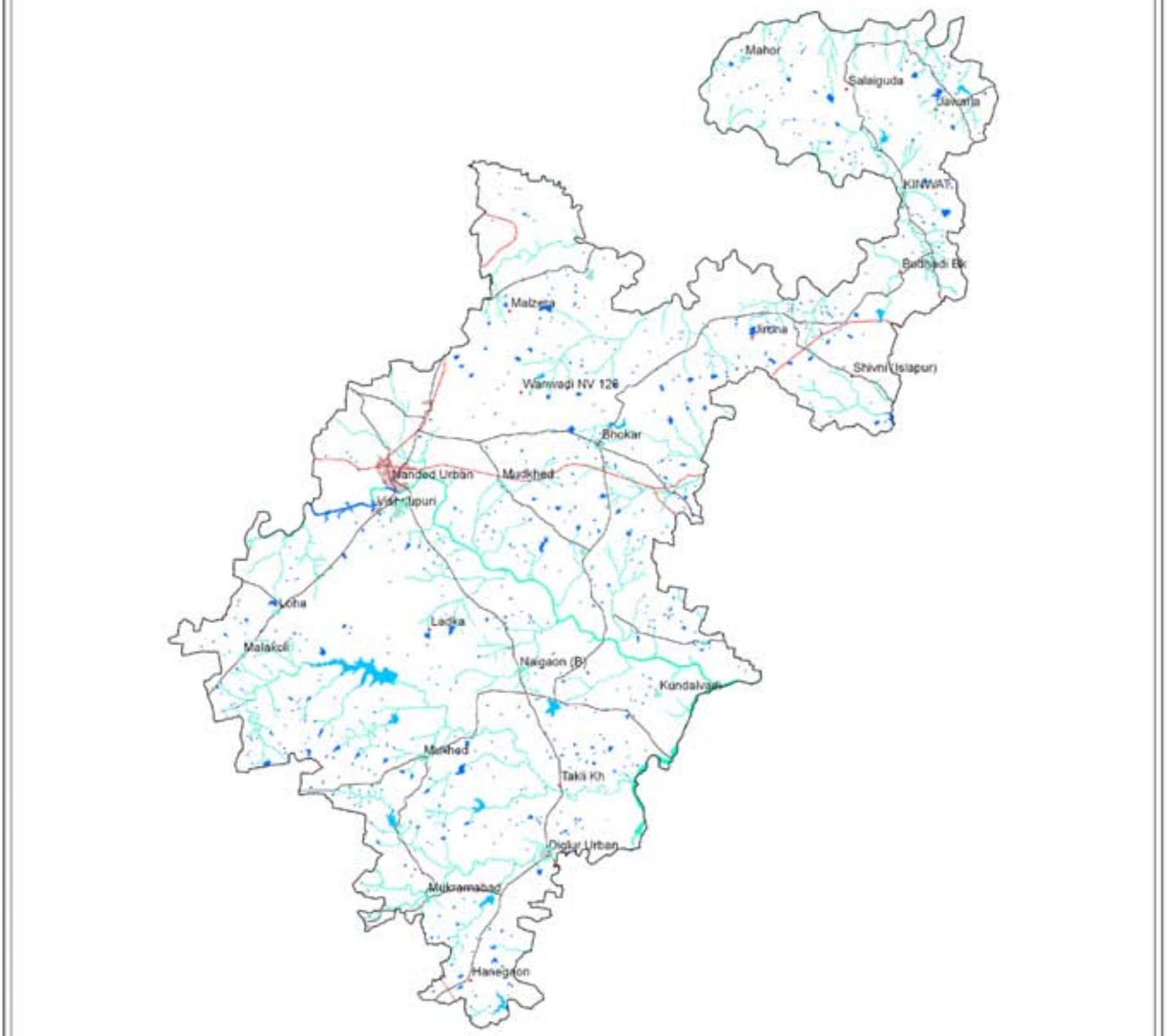
Area under Aquatic Vegetation	1559	2673

Area under turbidity levels		
Low	24859	3224
Moderate	1815	4833
High	261	254

State : Maharashtra

WETLAND MAP

District : Nanded

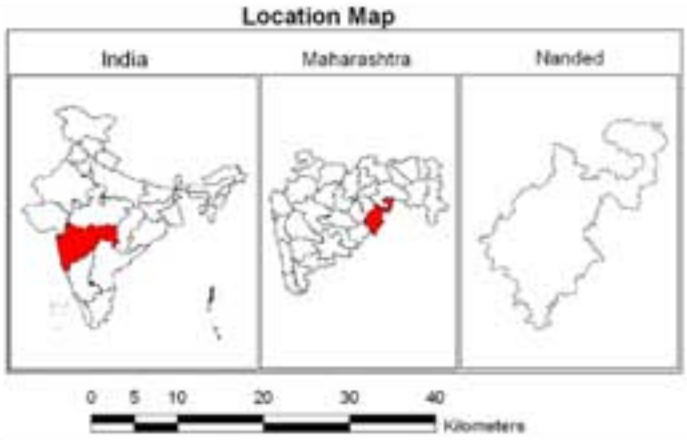


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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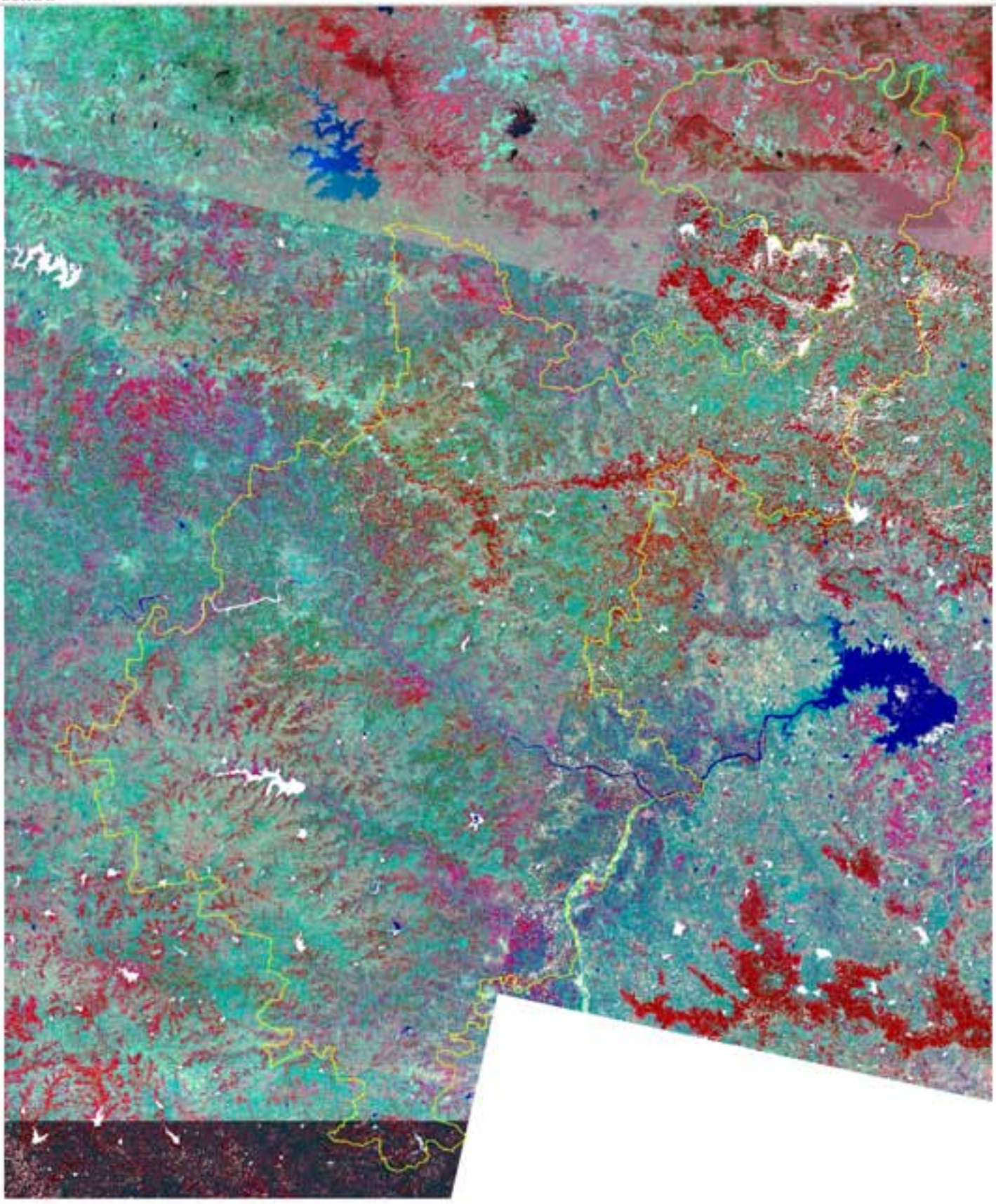
Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Nanded



IRS P6 LISS-III post monsoon data (2006)

7.1.16 Hingoli

Hingoli district is located in the central part of the State of Maharashtra and lies between 19°12'23" to 20°01'11" North latitudes and 76°30'35" to 77°29'13" East longitudes. The district covers an area of about 4526 km^2. It is bounded on the north by Washim and Buldhana districts, on the east by Nanded and Yeotmal districts, on the south by Nanded and Parbhani district and on the west by Parbhani district. The district is divided into 5 Administrative Sub-units (tahsils) namely Hingoli, Sengaon, Aundha, Basmath and Kalamnuri. Hingoli town is the district headquarters. There are 710 villages and 4 towns in the district. According to the 2001 census, the total population of Hingoli district is 987160.

Total 306 wetlands are mapped including 134 small wetlands (< 2.25 ha) with 17701 ha area. The district is dominated by man made wetland type. Reservoir/barrage is the major wetland with 81.01% area. Total 25 such wetland types are mapped with 14339 ha area. Total 80 Tank/pond are mapped with 5.80% area. Rivers/ streams occupy 12.41 % area. Details of wetland statistics is given in Table- 21.

Aquatic vegetation is more during pre monsoon (1401 ha) than during post monsoon (111 ha). Open water spread of the wetlands is significantly higher in post monsoon (17002 ha) than during pre monsoon (8076 ha), indicating the rainfall dependence of the wetlands in the state, particularly the dryness of rivers and reservoirs is very prominent. Turbidity of open water is mainly low during post monsoon, while ranged from low to moderate during pre monsoon.

Table 21: Area estimates of wetlands in Hingoli

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1105	Waterlogged	1	5	0.03	5	6
2	1106	River/Stream	66	2197	12.41	1734	74
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	25	14339	81.01	14267	7039
4	1202	Tanks/Ponds	80	1026	5.80	996	957
		Sub-Total	**172**	**17567**	**99.24**	**17002**	**8076**
		Wetlands (<2.25 ha), mainly Tanks	134	134	0.76	-	-
		Total	**306**	**17701**	**100.00**	**17002**	**8076**

Area under Aquatic Vegetation	111	1401

Area under turbidity levels		
Low	16650	5473
Moderate	320	2563
High	32	40

State : Maharashtra

WETLAND MAP

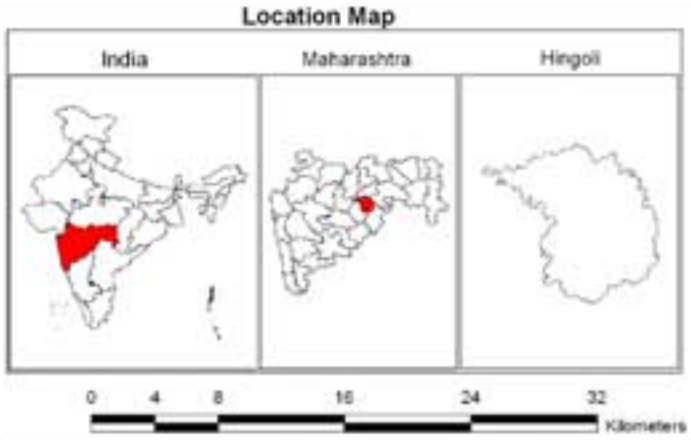
District : Hingoli

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

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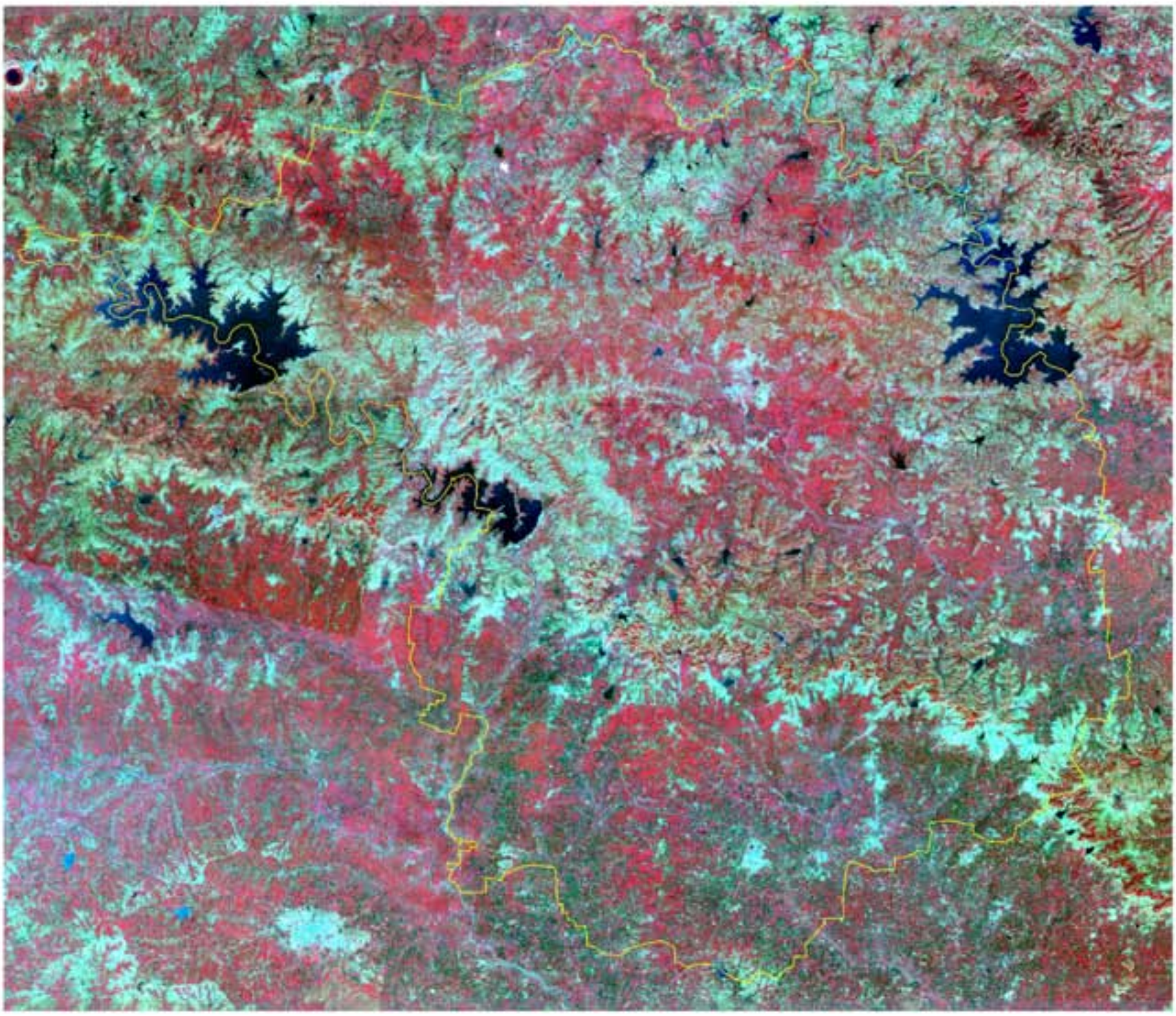
Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Hingoli



IRS P6 LISS-III post monsoon data (2006)

7.1.17 Parbhani

Parbhani district is located in the central part of the State of Maharashtra and lies between 18°44'48" N to19°49'39"N North latitudes and 76°12'12" E to 77°11'34" E East longitudes. The district covers an area of about 6511 km^2. It is bounded on the north by Buldhana and Hingoli districts, on the east by Nanded and Hingoli districts, on the south by Beed and Latur district and on the west by Jalna district. The district is divided into 9 Administrative Sub-units (tahsils) namely Parbhani, Jintur, Selu, Manwat, Sonpeth, Gangakhed, Palam, Purna and Pathari. Parbhani town is the district headquarters. There are 841 villages and 8 towns in the district. According to the 2001 census, the total population of Parbhani district 1527715.

Total 276 wetlands are mapped including 142 small wetlands (< 2.25 ha) with 15601 ha area. The district is dominated by man made wetland type. Reservoir/barrage is the major wetland with 46.72 % area. Total 19 such wetland types are mapped with 7289 ha area. Total 78 Tank/pond are mapped with 9.88% area. Rivers/ streams occupy 42.43 % area. Details of wetland statistics is given in Table- 22.

Aquatic vegetation is more during pre monsoon (1421 ha) than during post monsoon (103 ha). Open water spread of the reservoir/ barrage and tank/pond wetlands is more in post monsoon than during pre monsoon. However, in case of rivers, the reverse is observed. Turbidity of open water is mainly low during post monsoon, while ranged from low to moderate during pre monsoon.

Table 22: Area estimates of wetlands in Parbhani

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1105	Waterlogged	1	4	0.03	4	0
2	1106	River/Stream	34	6619	42.43	461	1609
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	19	7289	46.72	7391	4294
4	1202	Tanks/Ponds	78	1541	9.88	1333	568
5	1203	Waterlogged	2	6	0.04	6	0
		Sub-Total	**134**	**15459**	**99.09**	**9195**	**6471**
		Wetlands (<2.25 ha), mainly Tanks	142	142	0.91	-	-
		Total	**276**	**15601**	**100.00**	**9195**	**6471**

Area under Aquatic Vegetation	103	1421

Area under turbidity levels		
Low	8682	4021
Moderate	425	2162
High	88	288

State : Maharashtra

WETLAND MAP

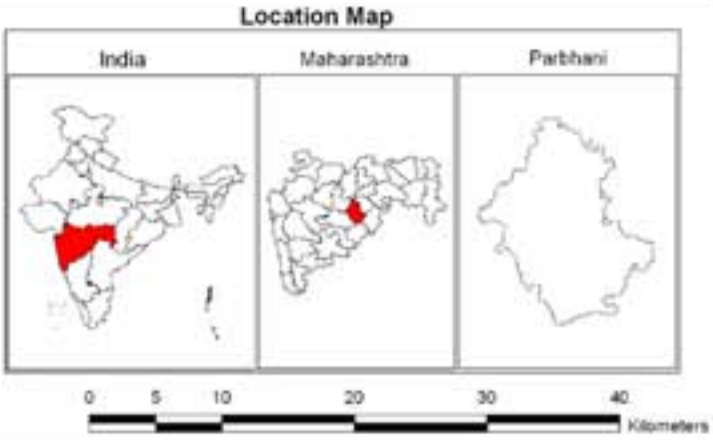
District : Parbhani

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

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Sponsored by

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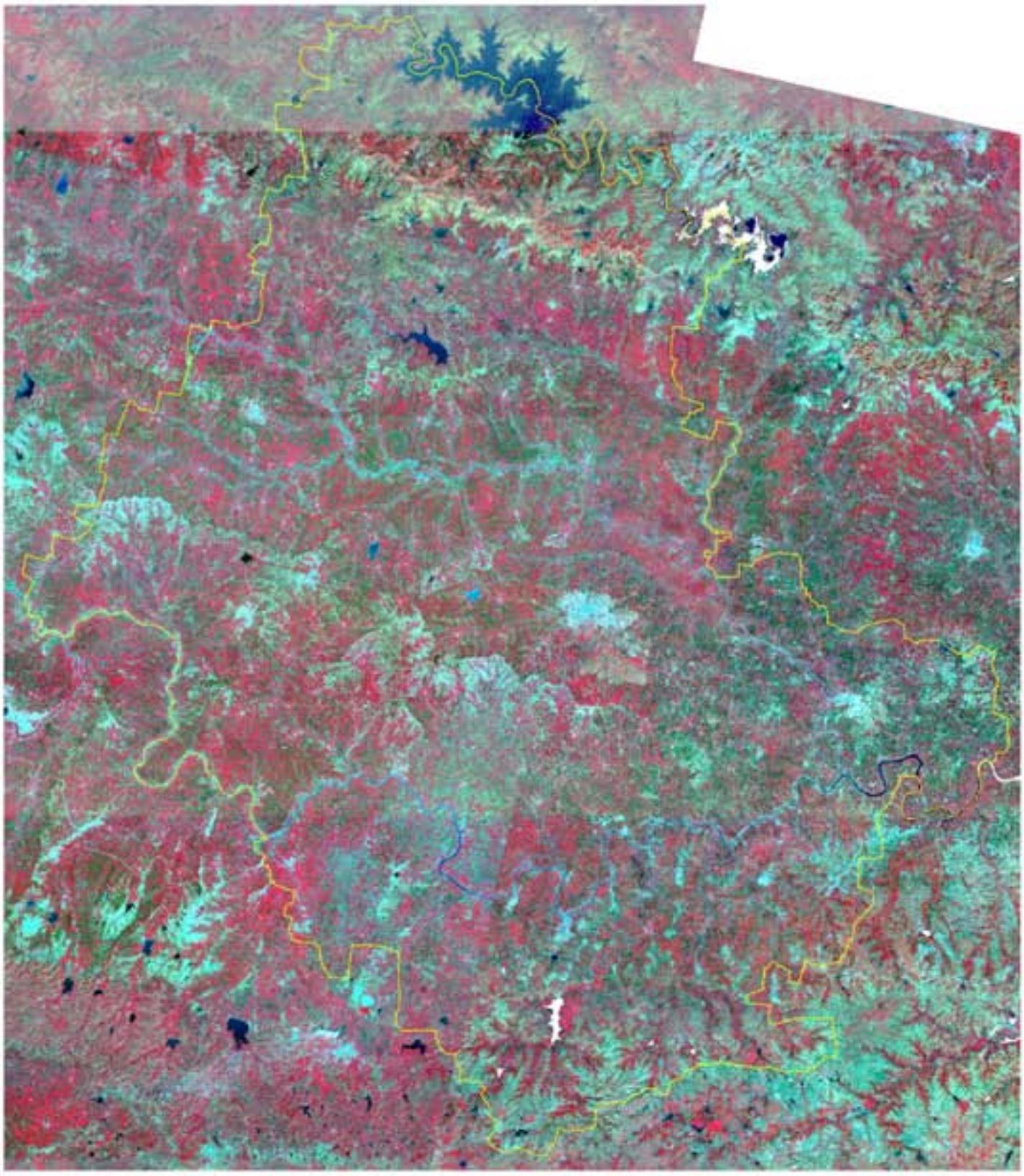
Government of India

State : Maharashtra

District : Parbhani



IRS P6 LISS-III post monsoon data (2006)

7.1.18 Jalna

Jalna district is located in the central part of the Maharashtra State and lies between 19^0 01' to 20^0 03' north latitude and $74^0$40' to $76^0$40' east longitudes covering an area of about 7718 km^2. It is bounded on the north by Jalgaon district, on the east by Parbhani and Buldhana districts, on the south by Beed and on the west by Aurangabad district of Maharashtra State. The district is divided into eight administrative sub-units (tahsils). There are four towns and 971 villages in the district, as per 2001 Census. The total population of the district is 1612980.

Total 1015 wetlands are mapped including 505 small wetlands (< 2.25 ha) with 17401 ha area. The district is dominated by man made wetland type. Total 47 reservoir/barrage are mapped with 6355 ha area (37.29%). Total 423 Tank/pond are mapped with 19.58% area. Rivers/ streams occupy 40.17 % area. Details of wetland statistics is given in Table- 23.

Aquatic vegetation is more during pre monsoon (1489 ha) than during post monsoon (59 ha). Open water spread wetlands is more in post monsoon (12178 ha) than during pre monsoon (4400 ha). Turbidity of open water is low to moderate in both the seasons.

Table 23: Area estimates of wetlands in Jalna

Area in ha

Sr. No.	Wettcode	Wetland Category	Numbe of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	40	6845	40.17	2596	255
2	**1200**	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	47	6355	37.29	6223	3578
4	1202	Tanks/Ponds	423	3336	19.58	3359	567
		Sub-Total	**510**	**16536**	**97.04**	**12178**	**4400**
		Wetlands (<2.25 ha), mainly Tanks	505	505	2.96	-	-
		Total	**1015**	**17041**	**100.00**	**12178**	**4400**

Area under Aquatic Vegetation	59	1489

Area under turbidity levels		
Low	8005	2416
Moderate	3925	1942
High	248	42

State : Maharashtra

WETLAND MAP

District : Jalna

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
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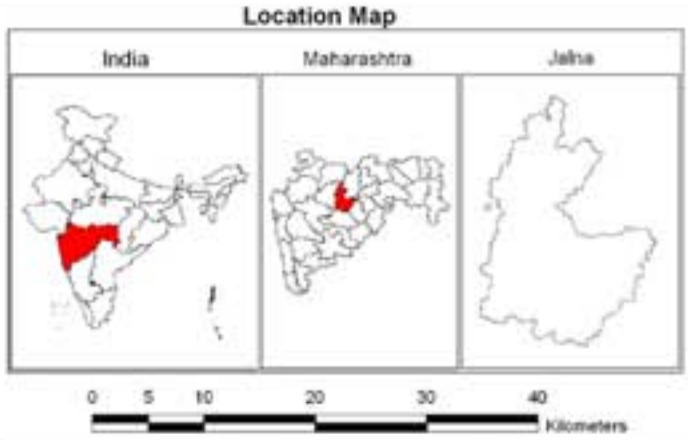
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

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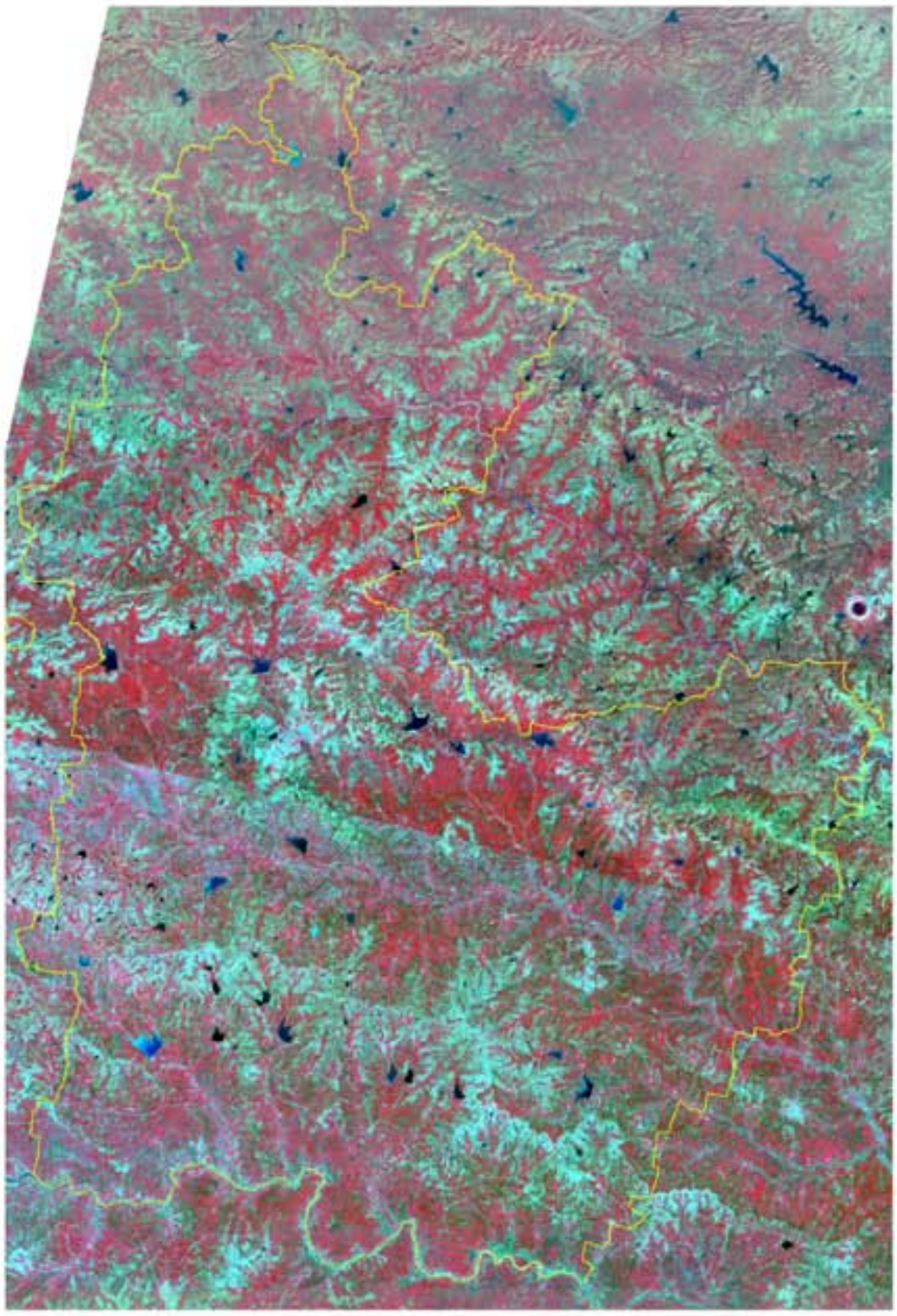
State : Maharashtra

District : Jalna



IRS P6 LISS-III post monsoon data (2006)

7.1.19 Aurangabad

Aurangabad district is located in the central part of the Maharashtra State and lies between 19^0 to 20^0 North latitudes and 74^0 to 76^0 East longitudes covering an area of about 10,107 km^2. It is bounded on the north by Jalgaon district, on the east by Jalna district, on the south by Beed and Ahmadnagar districts and on the west by Nasik and Ahmadnagar districts. The district is divided into 9 Administrative subunits (tahsils). There are 9 towns and 1344 villages in the district. According to the 2001 census, the total population of Aurangabad is 2897013.

Total 1668 wetlands are mapped including 586 small wetlands (< 2.25 ha) with 41724 ha area. The district is dominated by man made wetland type. Reservoir/barrage is the major wetland type with 74.33 % area. Total 168 such wetland types are mapped with 31015 ha area. Total 823 Tank/pond are mapped with 11.54% area. Rivers/ streams occupy 12.47 % area. Details of wetland statistics is given in Table- 24.

Aquatic vegetation is more during pre monsoon (3401 ha) than during post monsoon (252 ha). Open water spread of wetlands is more in post monsoon (37913 ha) than during pre monsoon (20030 ha). Turbidity of open water is mainly low to moderate in both the seasons.

Table 24: Area estimates of wetlands in Aurangabad

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1105	Waterlogged	7	106	0.25	100	28
2	1106	River/Stream	84	5203	12.47	3737	277
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	168	31015	74.33	29860	19173
4	1202	Tanks/Ponds	823	4814	11.54	4216	552
		Sub-Total	**1082**	**41138**	**98.60**	**37913**	**20030**
		Wetlands (<2.25 ha), mainly Tanks	586	586	1.40	-	-
		Total	**1668**	**41724**	**100.00**	**37913**	**20030**

Area under Aquatic Vegetation	252	3401

Area under turbidity levels		
Low	27039	16680
Moderate	7860	3350
High	3014	-

State : Maharashtra

WETLAND MAP

District : Aurangabad

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
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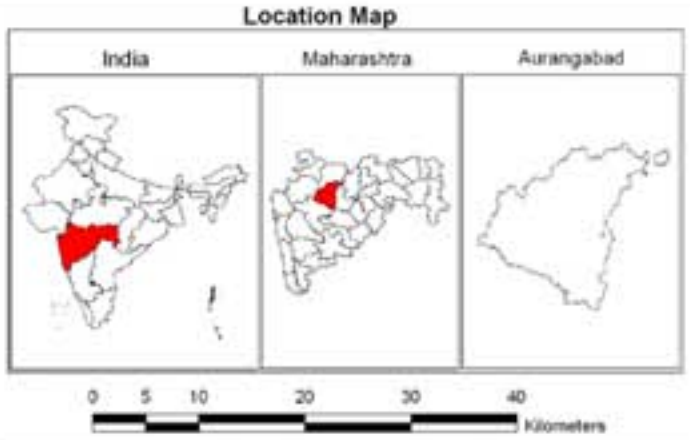
- International Boundary

Location Map



Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

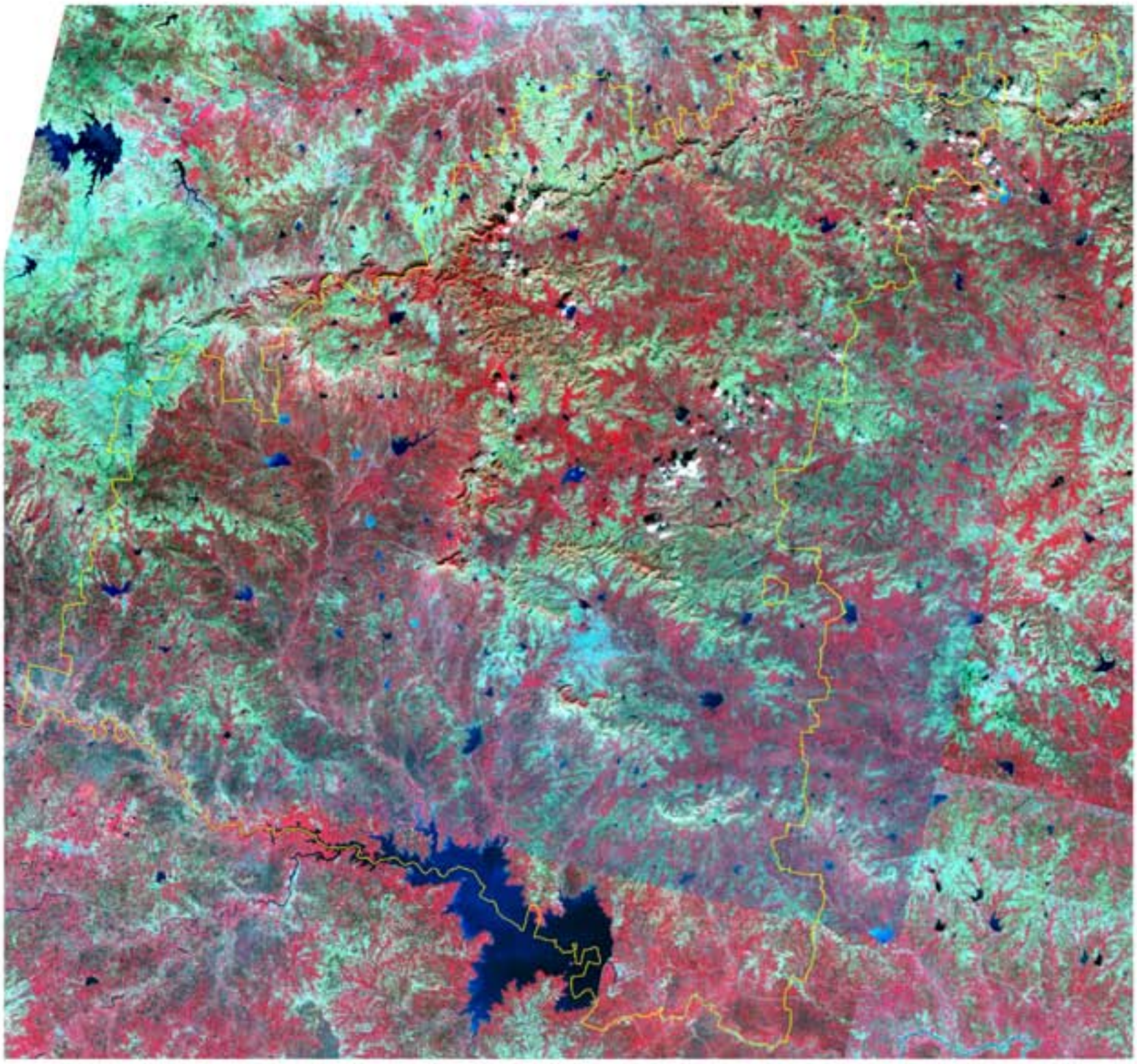
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Aurangabad



IRS-P6 LISS-III Post-monsoon data(2006-2007)

7.1.20 Nasik

Nasik district is located in the northwestern part of the Maharashtra State and lies between 19^0 33' to 20^0 53' North latitudes and 73^0 16' to 75^0 16' East longitudes covering an area of about 15539 sq.km. The district is bounded on the north by Dhule, on the east and northeast by Jalgaon, on the south east by Aurangabad and Ahmadnagar, on the southwest by Thane district of Maharashtra State and on the northwest by Dung and Surat districts of Gujrath State. The district is divided in to fifteen administrative sub-units (tahsils). There are 18 towns and 1929 villages in the district. According to the 2001 census, the total population of Nashik district 4993796.

Total 4013 wetlands are mapped including 2593 small wetlands (< 2.25 ha) with 52027 ha area. The district is dominated by man-made wetland type. Reservoir/barrage is the major wetland category which contributes 53% wetland area. Total 42 such wetland types are mapped with 27675 ha area. Total 1033 Tank/pond are mapped with 17.0% area. Rivers/ streams occupy 25.0 % area. Details of wetland statistics is given in Table-25.

Aquatic vegetation is more during post monsoon (834 ha) than during pre monsoon (564 ha). Open water spread of wetlands is significantly more in post monsoon (44151 ha) than during pre monsoon (18096 ha). Turbidity of open water is mainly low to moderate during post monsoon, while mainly moderate during pre monsoon.

Table 25: Area estimates of wetlands in Nasik

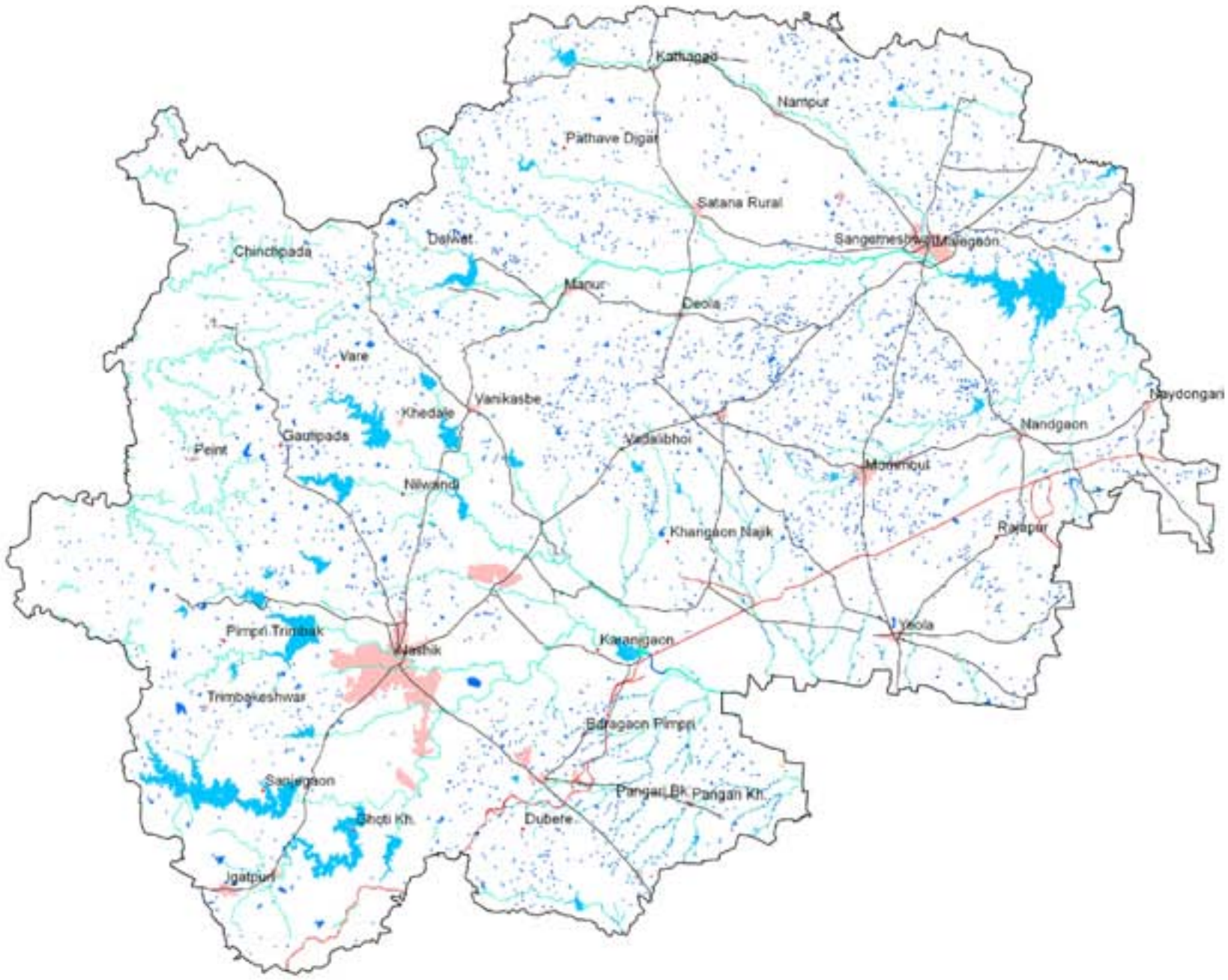
Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	343	13081	25	8351	859
	1200	Inland Wetlands -Man-made					
2	1201	Reservoirs/Barrages	42	27675	53	27246	15236
3	1202	Tanks/Ponds	1033	8653	17	8529	2001
		Total - Inland	**1418**	**49409**	**94.97**	**44126**	**18096**
	2200	**Coastal Wetlands - Man-made**					
4	2202	Aquaculture ponds	2	25	0.05	25	-
		Total - Coastal	**2**	**25**	**0.05**	**25**	**-**
		Sub-Total	**1420**	**49434**	**95.02**	**44151**	**18096**
		Wetlands (<2.25 ha), mainly Tanks	2593	2593	4.98	-	-
		Total	**4013**	**52027**	**100.00**	**44151**	**18096**
		Area under Aquatic Vegetation				834	564
		Area under turbidity levels					
		Low				23925	1005
		Moderate				11745	16760
		High				8481	331

State : Maharashtra

WETLAND MAP

District : Nasik



Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map

Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

Space Applications Centre (ISRO), Ahmedabad
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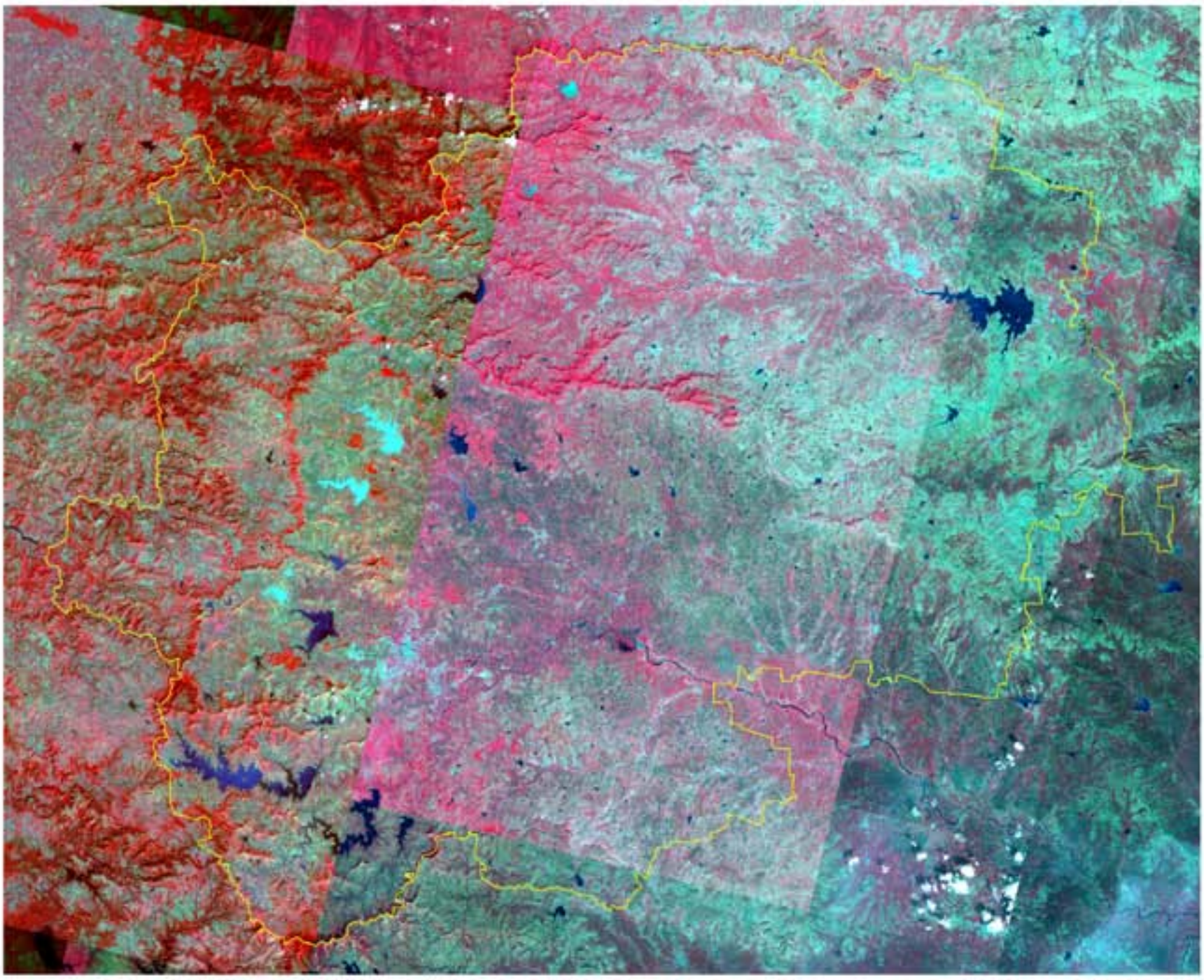
Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Nasik



IRS P6 LISS-III post monsoon data (2006)

7.1.21 Thane

Thane district is one of the coastal districts of Maharashtra and is in the northern part of Kokan division. It lies between 18^0 42' and 20^0 20' north latitudes and $72^0$45' and $73^0$48' east longitudes covering an area of about 9558 km^2. It is bounded on the west by Arabian Sea on the north by Gujrath state, on the northeast by Nashik district, on the east by Ahmadnagar district, on the southeast by Pune district, on the south by Raigad district and on the southwest by Bombay. The district has been sub-divided into fifteen administrative sub-units (tahsils). They are Thane, Ulhasnagar, Murbad, Shahapur, Kalyan, Bhiwandi, Vasai, Palghar, Vada, Mokhada, Jawahar, Dahanu, Ambarnath, Vikramgad and Talasari. There are 37 towns and 1748 villages in the district. The total population of Thane district is 8131849.

The wetland mapping shows that rivers/ streams contribute 17.83% the total wetland area. The reservoir/barrages contribute 7928 ha i.e. 13.23% to the wetland area. The tanks/ponds contribute 2427 ha i.e. 4.05 %. The creeks contribute a major 11992 ha i.e., 20.01% other coastal wetlands like sand/beaches contribute 541 ha (0.9 %), Salt marshes 70 ha (0.12%), mangroves 7062 ha (11.78%). A salt pan which is a commercial activity occupies 7.14 % of the total wetland area. The total area under wetland is 59936 ha with the water bodies less than the minimum mappable unit contributing to 1091 ha to the wetland area. Thane is also one of the districts having the most wetlands in Maharashtra. Aquatic vegetation is seen in both the seasons and changes from 7408 ha in post-monsoon to 8446 ha during pre-monsoon specially as the water bodies shrink considerably during pre-monsoon. Turbidity ranges from low to high and the shift in turbidity levels can be compared with the area under low turbidity level changing from 22661 ha to 5157 ha. Moderate turbidity level changes from 11913 ha to 15160 ha during pre-monsoon. Similarly the high turbidity level changes from 5 ha during post monsoon to 1426 ha during pre-monsoon. The presence of water bodies with moderate and high turbidity is due to presence of water bodies along ridges and the turbidity of the creeks.

Table 26: Area estimates of wetlands in Thane

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	3	1980	3.30	1947	1397
2	1106	River/Stream	87	10684	17.83	10900	2982
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	17	7928	13.23	7913	4632
4	1202	Tanks/Ponds	212	2427	4.05	2114	1126
		Total - Inland	**319**	**23019**	**38.41**	**22874**	**10137**
	2100	**Coastal Wetlands - Natural**					
5	2102	Creeks	23	11992	20.01	7433	7331
6	2103	Sand/Beach	34	541	0.90	-	-
7	2104	Intertidal mud flats	126	11884	19.83	-	-
8	2105	Salt Marshes	4	70	0.12	-	-
9	2106	Mangroves	192	7062	11.78	-	-
10	2107	Coral Reefs	0	0	0.00	-	-
	2200	**Coastal Wetlands - Man-made**					
11	2201	Salt pans	106	4277	7.14	4272	4275
		Total - Coastal	**485**	**35826**	**59.77**	**11705**	**11606**
		Sub-Total	**804**	**58845**	**98.18**	**34579**	**21743**
		Wetlands (<2.25 ha), mainly Tanks	1091	1091	1.82	-	-
		Total	**1895**	**59936**	**100.00**	**34579**	**21743**

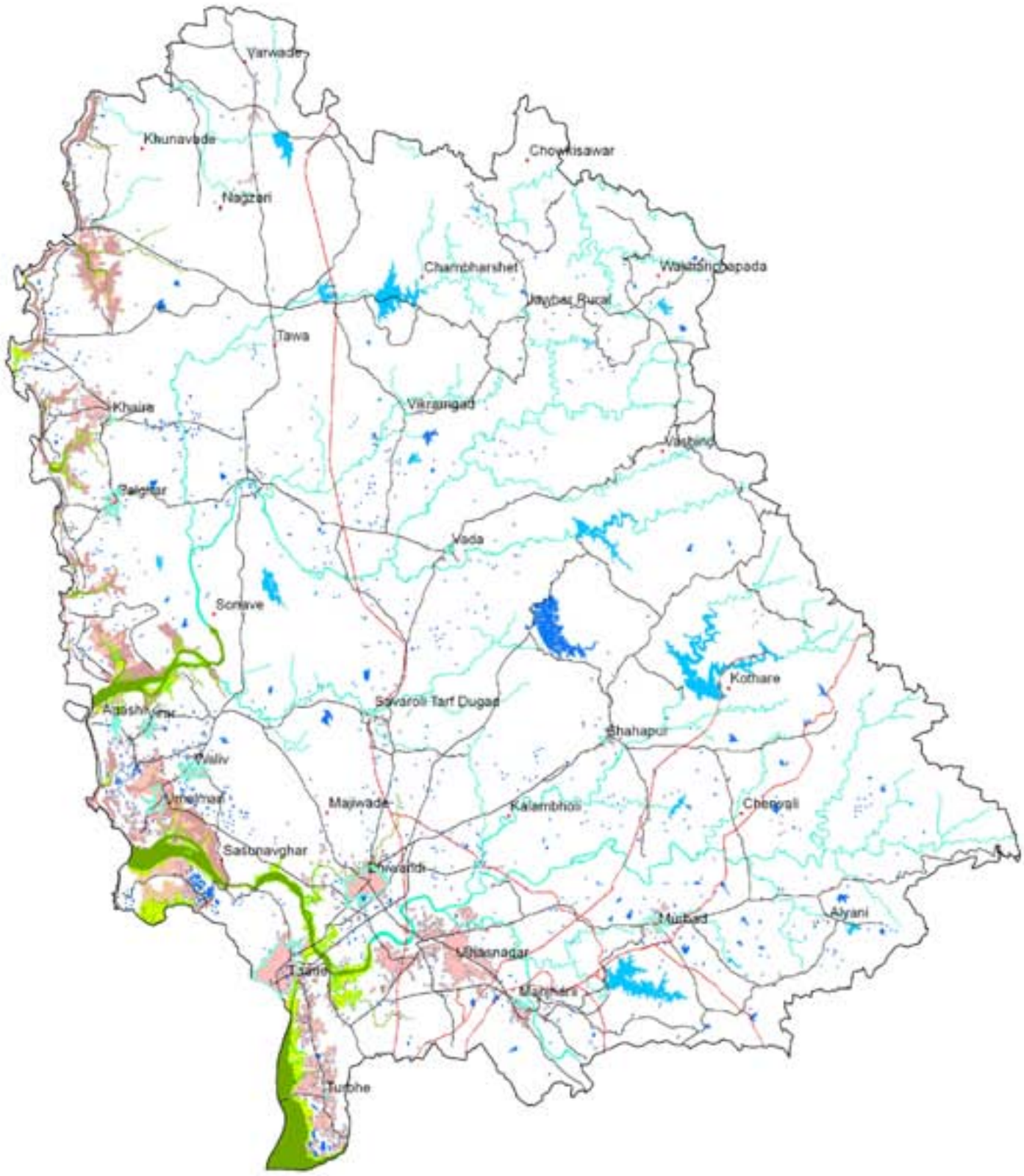
Area under Aquatic Vegetation	7408	8446

Area under turbidity levels		
Low	22661	5157
Moderate	11913	15160
High	5	1426

State : Maharashtra

WETLAND MAP

District : Thane

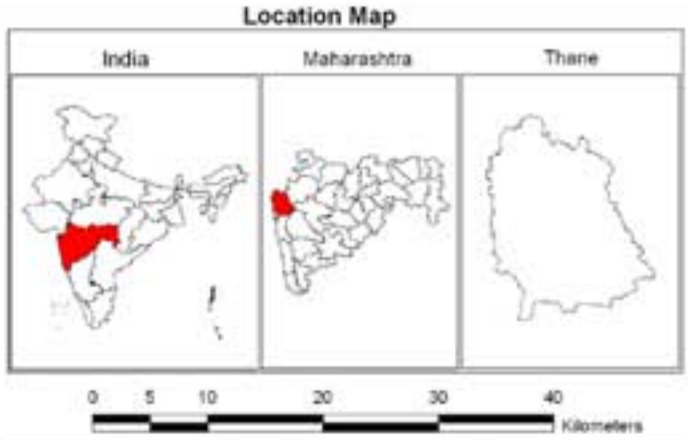


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

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Prepared by

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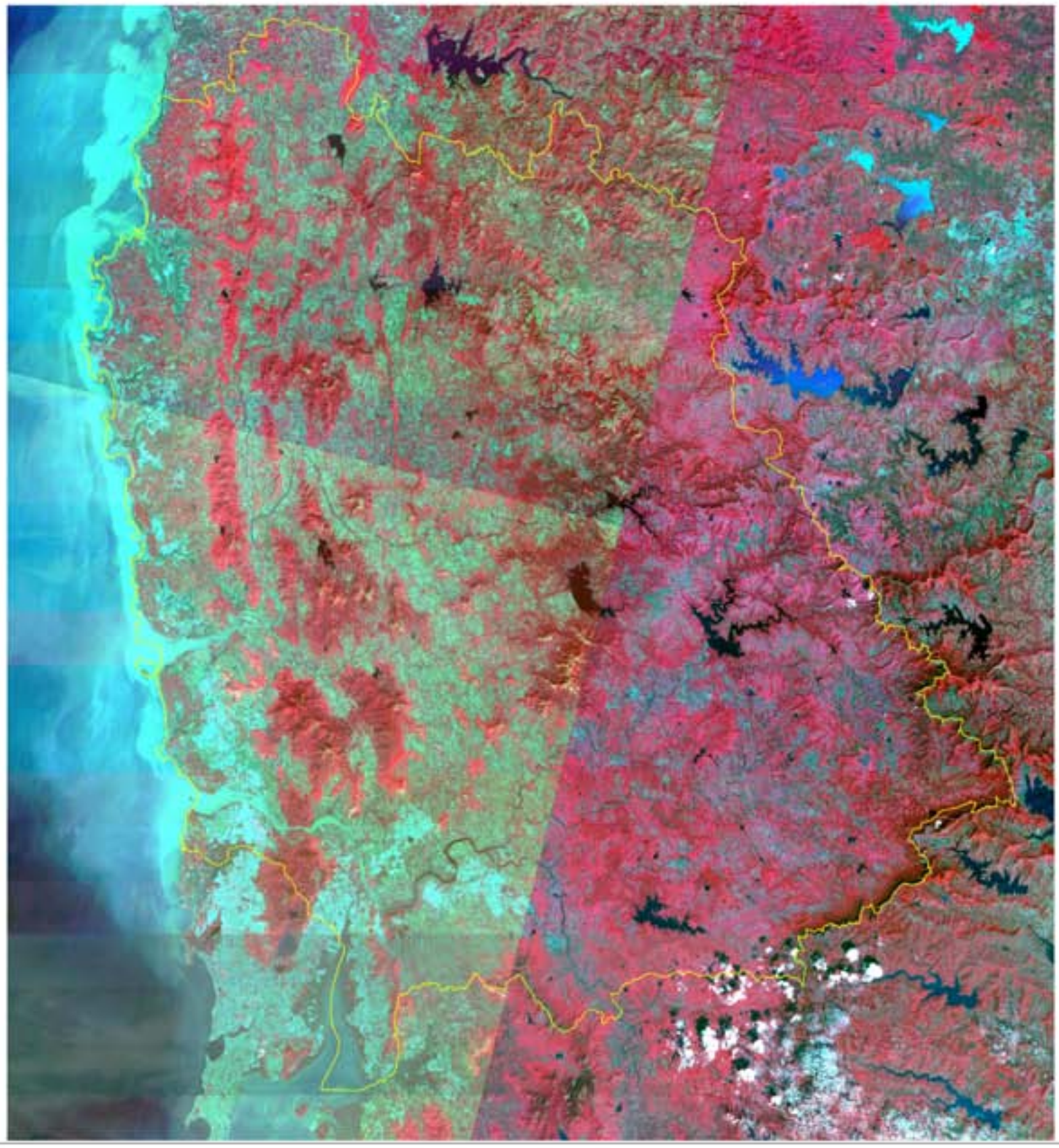
Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Thane



IRS P6 LISS-III post monsoon data (2006)

7.1.22 Mumbai Suburban

Greater Mumbai Metropolitan area or Brihan Mumbai Municipal Corporation (BMC) area is divided in two revenue districts viz Mumbai Urban (city) District and Mumbai suburban District.

Mumbai suburban district is one of the coastal districts of Maharashtra. Geographic area of the district is 534 km^2. The Mumbai Suburban district has been sub-divided into three administrative sub-units (tahsils).These are Andheri, Kurla, and Borivali. According to the 2001 census, the total population of Mumbai Sub-urban is 8640419. The detail of the wetland categories is given in the Table 27.

The wetland category the rivers/tanks contribute 18 ha (0.14 %) the creeks contribute a major 4177 ha i.e., 31.45%. Other coastal wetlands like sand/beaches contribute 240 ha (1.81%), mud flats contribute 1260 ha (9.46 %) Salt marshes 514 ha (3.87 %), mangroves 5459 ha (41.10%) Salt pans which is a commercial activity occupies 842 ha (6.34 %) of the total wetland area. The total area under wetland is 13282 ha. As the maximum aquatic vegetation is mangroves hardly any change is seen during the pre and post monsoon season. Similarly there is not much change in the turbidity levels which varies from low to moderate.

Table 27: Area estimates of wetlands in Mumbai suburban

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	4	719	5.41	706	645
2	1106	River/Stream	3	18	0.14	18	-
	1200	**Inland Wetlands -Man-made**					
3	1202	Tanks/Ponds	45	53	0.40	53	53
		Total - Inland	**52**	**790**	**5.95**	**777**	**698**
	2100	**Coastal Wetlands - Natural**					
4	2102	Creeks	24	4177	31.45	4180	4182
5	2103	Sand/Beach	28	240	1.81	-	-
6	2104	Intertidal mud flats	164	1260	9.49	-	-
7	2105	Salt Marshes	25	514	3.87	-	-
8	2106	Mangroves	106	5459	41.10	-	-
	2200	**Coastal Wetlands - Man-made**					
9	2201	Salt pans	13	842	6.34	823	823
		Total - Coastal	**360**	**12492**	**94.05**	**5003**	**5005**
		Sub-Total	**412**	**13282**	**100.00**	**5780**	**5703**
		Wetlands (<2.25 ha), mainly Tanks	-	-	0.00	-	-
		Total	**412**	**13282**	**100.00**	**5780**	**5703**

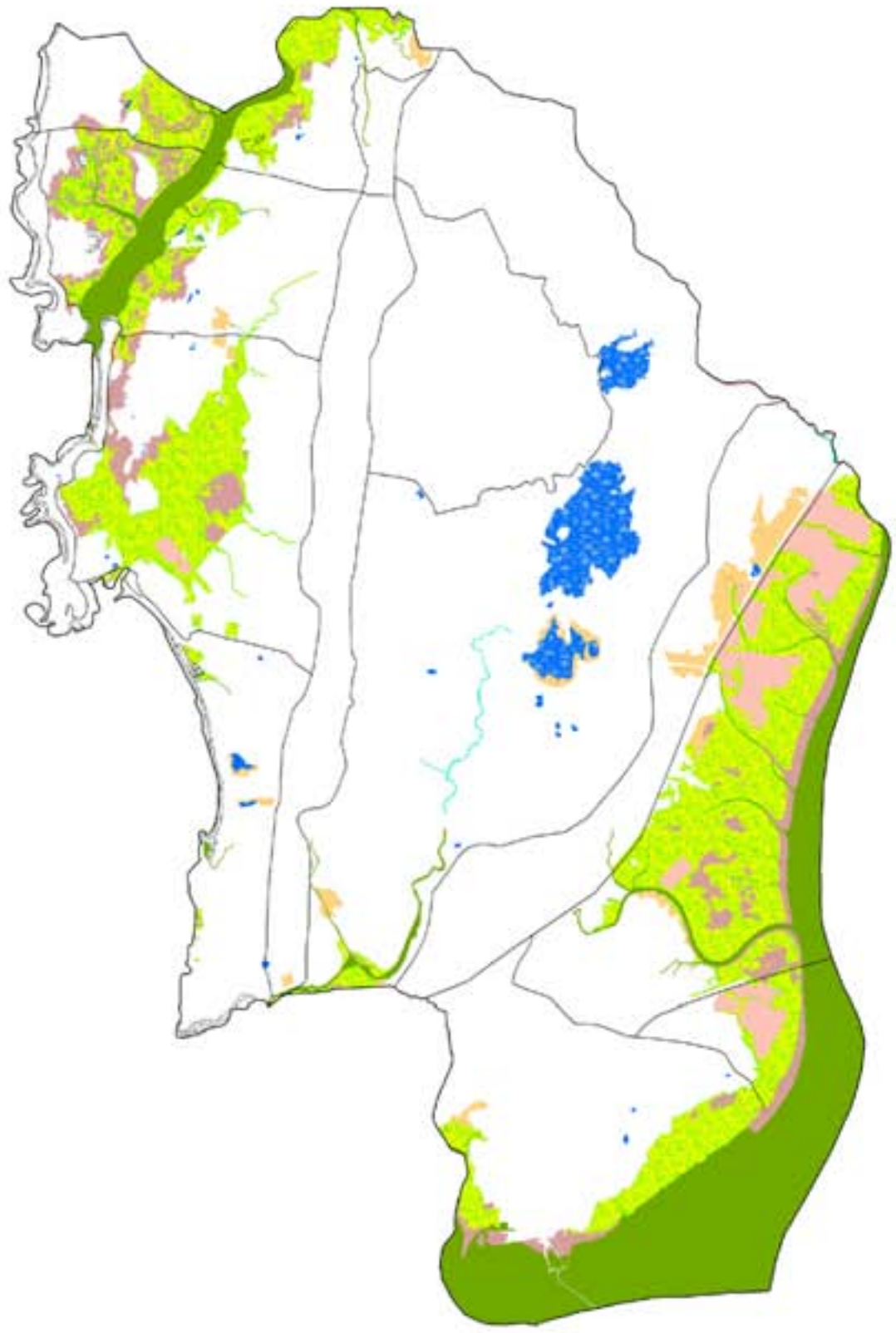
Area under Aquatic Vegetation	6221	5534

Area under turbidity levels		
Low	777	691
Moderate	5003	5012
High	-	-

State : Maharashtra

WETLAND MAP

District : Mumbai Suburban

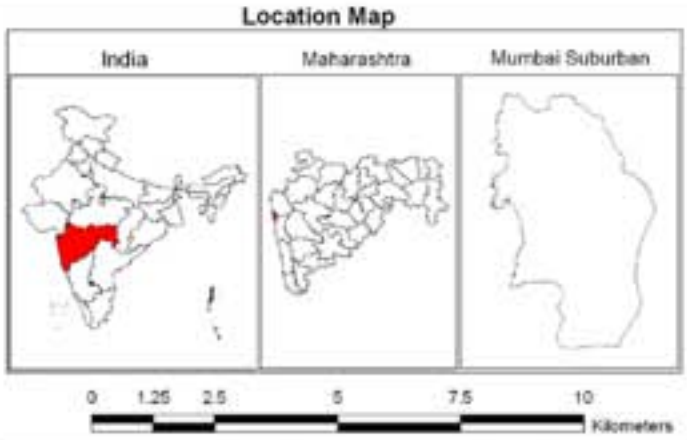


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



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Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Mumbai Suburban

IRS P6 LISS-III post monsoon data (2006)

7.1.23 Mumbai Urban

Greater Mumbai Metropolitan area or Brihan Mumbai Municipal Corporation (BMC) area is divided in two revenue districts viz Mumbai Urban (city) District and Mumbai suburban District. Greater Mumbai of Maharashtra is entirely urban.

Mumbai Urban district is one of the coastal districts of Maharashtra. Geographic area of Mumbai Urban is 69 km^2.

Tanks/ponds contribute 28 ha i.e. 3.67 %. The creeks contribute a major 280 ha i.e., 36.70% other coastal wetlands like sand/beaches contribute 79 ha (10.35 %), mud flats contribute 8 ha (1.05 %) Salt marshes 30 ha (0.3.93%), mangroves 257 ha (33.68%).Salt pans which is a commercial activity occupies 81 ha (10.62 %) of the total wetland area. The total area under wetland is 763 ha

Table 28: Area estimates of wetlands in Mumbai urban

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1200	**Inland Wetlands -Man-made**					
1	1202	Tanks/Ponds	5	28	3.67	28	28
		Total - Inland	**5**	**28**	**3.67**	**28**	**28**
	2100	**Coastal Wetlands - Natural**					
2	2102	Creeks	12	280	36.70	269	269
	2200	**Coastal Wetlands - Man-made**					
3	2201	Salt pans	1	81	10.62	81	81
		Total - Coastal	**58**	**735**	**96.33**	**350**	**350**
		Sub-Total	**63**	**763**	**100.00**	**378**	**378**
		Wetlands (<2.25 ha), mainly Tanks	-	-	0.00	-	-
		Total	**63**	**763**	**100.00**	**378**	**378**

Area under Aquatic Vegetation	285	285

Area under turbidity levels		
Low	28	28
Moderate	350	350
High	-	-

State : Maharashtra

WETLAND MAP

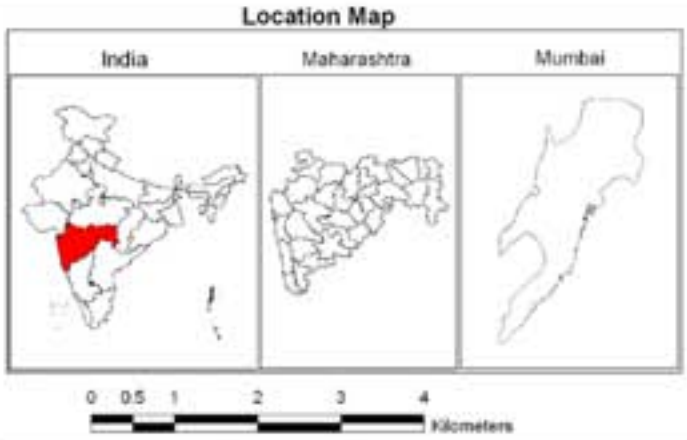
District : Mumbai

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



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Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Mumbai

IRS P6 LISS-III post monsoon data (2006)

7.1.24 Raigarh

Raigarh district is one of the coastal districts of Maharashtra and lies between 17^0 51' to $19^0$8' north latitudes and 72^0 51' to 73^0 40' east longitudes covering an area of about 7152 km^2. The district is bounded on the west by the Arabian Sea, on the south by Ratnagiri, on the southeast by Satara, on the east by Pune, on the north by Thane and on the northwest by Bombay.

The district has been sub-divided into 15 sub-units (tahsils). They are Alibag, Uran, Panvel, Karjat, Khalapur, Pen, Sudhagad, Roha, Mangaon, Mahad, Poladpur, Mhasla, Shrivardhan, Tala and Murud. There are 26 towns and 1919 villages in the district.According to the 2001 census, the total population of Raigarh district 22,07,929.

Rivers/ streams contribute 15.18% to the total wetland area. The reservoir/barrages contribute 1897 ha i.e. 4.05 % to the wetland area. The tanks/ponds contribute 1713 ha i.e. 3.66 %. The creeks contribute a major 11992 ha i.e., 20.01%. Other coastal wetlands like sand/beaches contribute 541 ha (0.9 %), Salt marshes 70 ha 13482 ha (28.78 %), mangroves 13124 ha (28.02 %). A salt pan which is a commercial activity occupies 3.86 % of the total wetland area. The total area under wetland is 46844 ha with the water bodies less than the minimum mappable unit contributing to 399 ha to the wetland area. Raigarh, along with Pune and Thane, is also one of the districts having the most wetlands in Maharashtra. Aquatic vegetation is seen in both the seasons and is 13124 ha in post-monsoon as well as during pre-monsoon. Turbidity ranges from low to moderate and the shift in turbidity levels can be compared with the area under low turbidity level changing from 8010 ha to 351 ha. Moderate turbidity level changes from 16024 ha to 17530 ha during pre-monsoon. The presence of water bodies with moderate turbidity is due to presence of water bodies along ridges and the turbidity of the creeks.

Table 29: Area estimates of wetlands in Raigarh

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
1	**1100**	**Inland Wetlands - Natural**					
2	1106	River/Stream	104	7110	15.18	6190	1663
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	7	1897	4.05	1825	1625
4	1202	Tanks/Ponds	129	1713	3.66	1586	967
		Total - Inland	**240**	**10720**	**22.88**	**9601**	**4255**
5	**2100**	**Coastal Wetlands - Natural**					
6	2102	Creeks	92	13482	28.78	12626	11819
7	2103	Sand/Beach	48	977	2.09	-	-
8	2104	Intertidal mud flats	303	6415	13.69	-	-
9	2106	Mangroves	680	13124	28.02	-	-
	2200	**Coastal Wetlands - Man-made**					
10	2201	Salt pans	77	1806	3.86	1807	1807
		Total - Coastal	**1200**	**35804**	**76.43**	**14433**	**13626**
		Sub-Total	**1440**	**46524**	**99.32**	**24034**	**17881**
		Wetlands (<2.25 ha), mainly Tanks	320	320	0.68	-	-
		Total	**1760**	**46844**	**100.00**	**24034**	**17881**

Area under Aquatic Vegetation	13124	13124

Area under turbidity levels		
Low	8010	351
Moderate	16024	17530
High	-	-

State : Maharashtra

WETLAND MAP

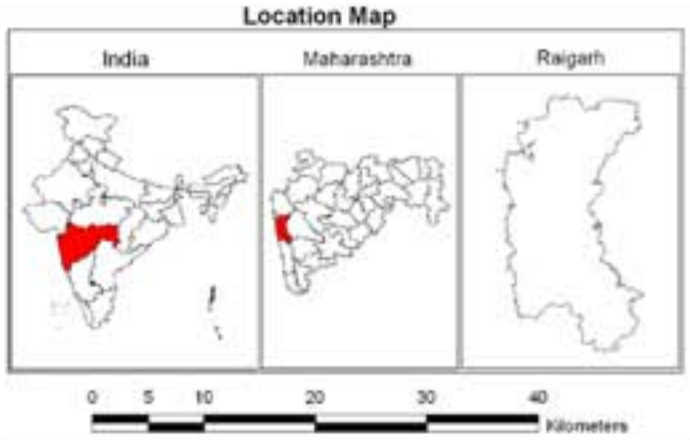
District : Raigarh

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

Space Applications Centre (ISRO), Ahmedabad
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Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Raigarh

IRS P6 LISS-III post monsoon data (2006)

7.1.25 Pune

Pune district is located in the western parts of the State and lies between 17^0 5' to 19^0 2' north latitude and 73^0 2' to 75^0 1' east longitudes covering an area of about 15643 km^2. The district is bounded on the North and East by Ahmadnagar, on the south by Satara, on the west by Raigad on the southeast by Solapur and on the Northwest by thane district of Maharashtra State.

The district is divided into fourteen administrative sub-units (tahsils). They are Pune, Haveli, Ambegaon, Junner, Shirur, Daund, Indapur, Baramati, Purandhar, Bhor, Velhe, Mulshi, Khed and Mawal. There are 25 towns and 1866 villages in the district. According to the 2001 census, the total population of Pune district is 7232555.

The wetland mapping shows that rivers/ streams contribute 19.28% to the total wetland area. The reservoir/barrages contribute a major share of 48339 ha i.e. 70.94 % to the wetland area. Pune has the maximum area under wetland. The tanks/ponds contribute 6314 ha i.e. 9.27 %. The total area under wetland is 68137 ha with the water bodies less than the minimum mappable unit contributing to 348 ha to the wetland area. Aquatic vegetation is seen in both the seasons and changes from 1898 ha in post-monsoon to 1840 ha during pre-monsoon. Wetlands shrink considerably during pre-monsoon. Turbidity ranges from low to high and the shift in turbidity levels can be compared with the area under low turbidity level changing from 61047 ha to 33127 ha. .Moderate turbidity level changes from 3392 ha to 6853 ha during pre-monsoon. Similarly the high turbidity level changes from 68 ha during post monsoon to 2 ha during pre-monsoon. The presence of water bodies with moderate and high turbidity is due to presence of water bodies along ridges.

Table 30: Area estimates of wetlands in Pune

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	76	13136	19.28	12950	4347
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	41	48339	70.94	46247	32045
3	1202	Tanks/Ponds	531	6314	9.27	5310	3590
		Sub-Total	**648**	**67789**	**99.49**	**64507**	**39982**
		Wetlands (<2.25 ha), mainly Tanks	348	348	0.51	-	-
		Total	**996**	**68137**	**100.00**	**64507**	**39982**

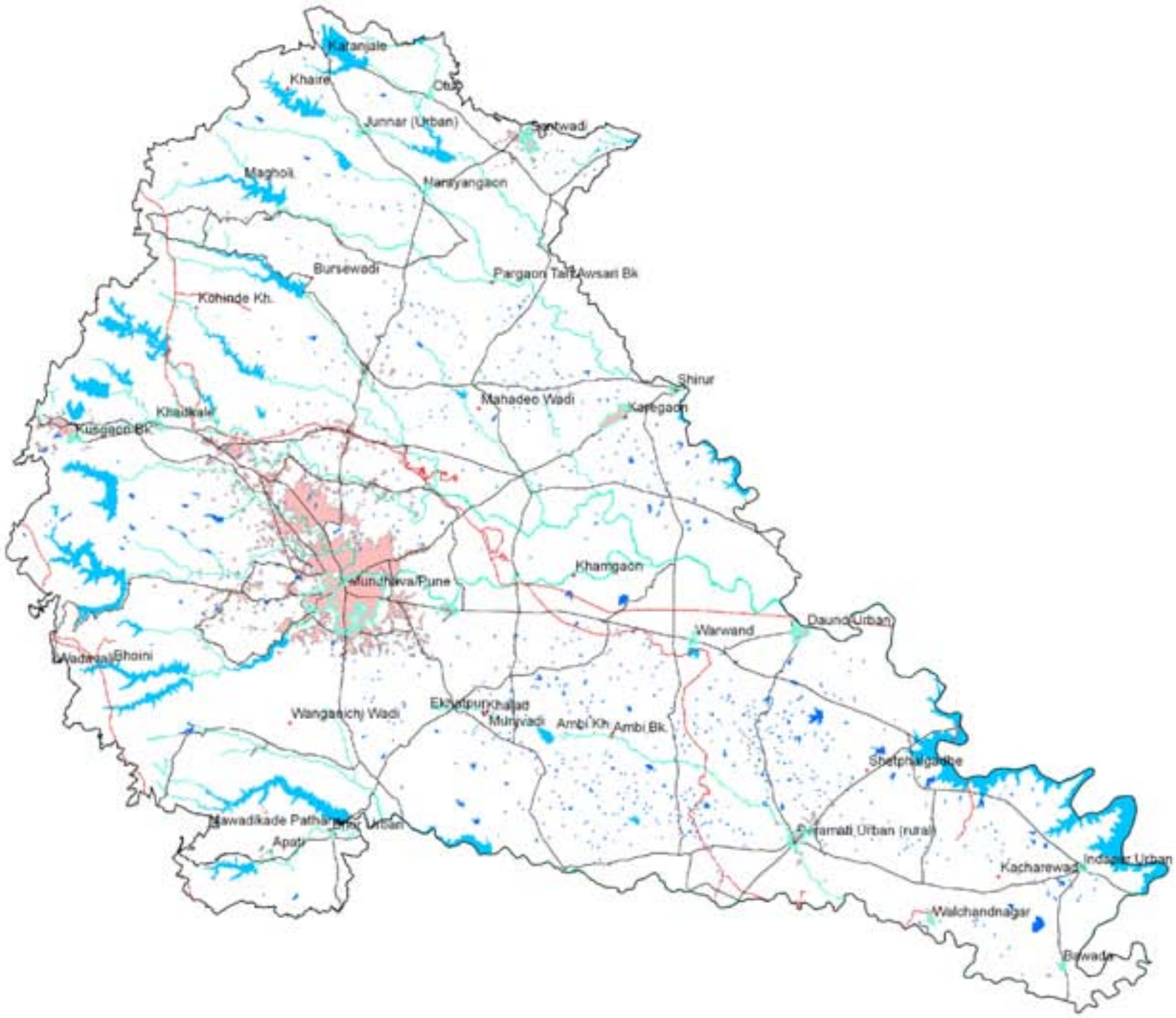
Area under Aquatic Vegetation	1898	1840

Area under turbidity levels		
Low	61047	33127
Moderate	3392	6853
High	68	2

State : Maharashtra

WETLAND MAP

District : Pune

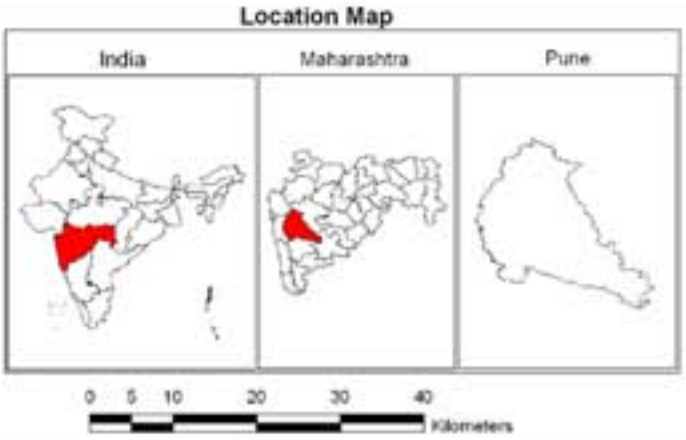


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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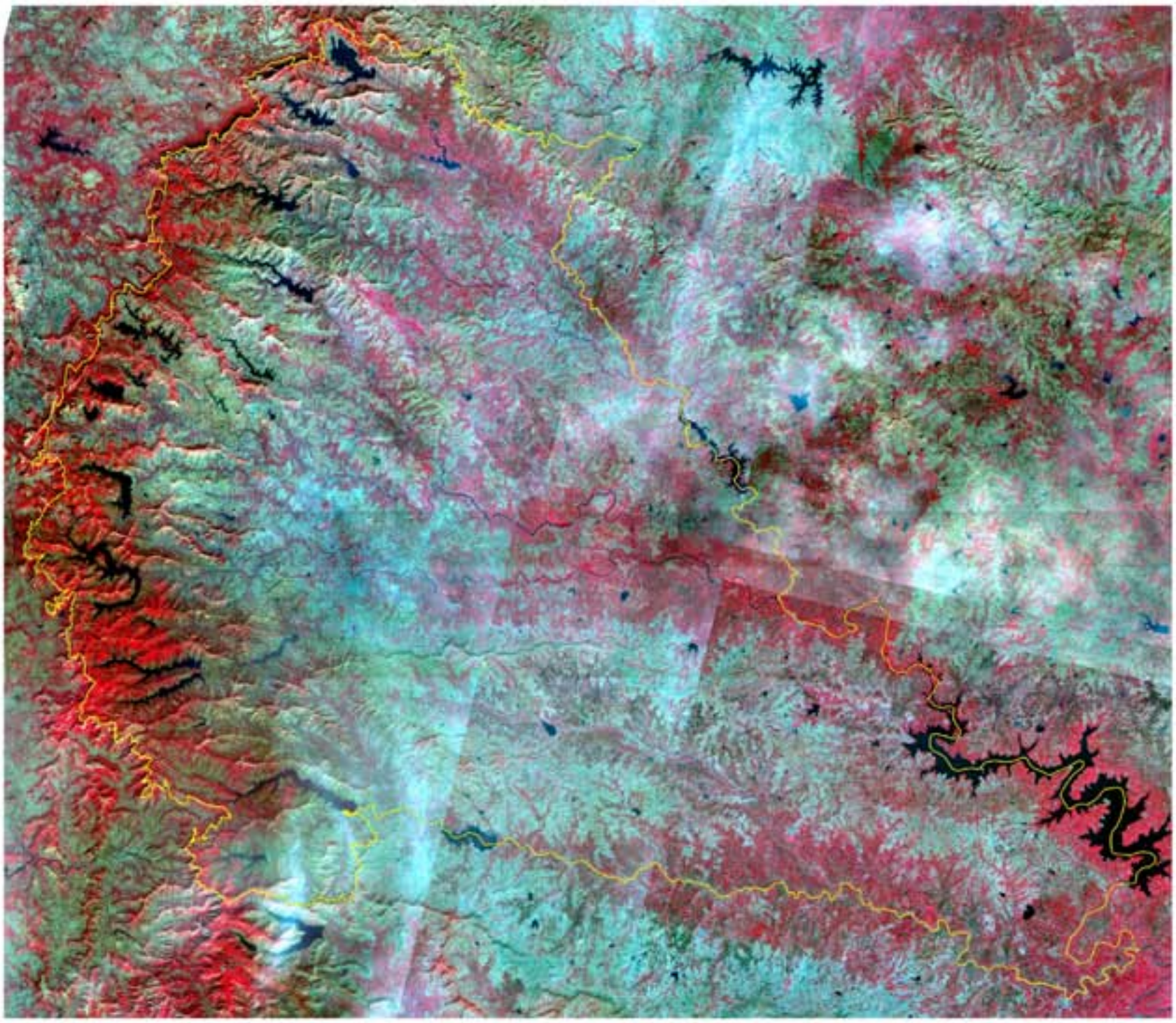
Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Pune



IRS P6 LISS-III post monsoon data (2006)

7.1.26 Ahmadnagar

Ahmednagar district is located in the central part of the state and lies between 18^0 02' to 19^0 09' north latitudes and 73^0 09' to 75^0 05' east longitudes covering an area of about 17,048 km^2. The district is bounded on the north by Nashik and Aurangabad on the east by Beed, on the south by Solapur and on the west by Thane and Pune district of Maharashtra State.

The district is divided into fourteen administrative sub-units (tahsils), namely, Ahmadnagar, Parner, Pathardi, Shevgaon, Karjat, Shrigonda, Jamkhed, Shrirampur, Nevasa, Rahuri, Akole, Sangamner, Rahata and Kopergaon. There are 18 towns and 1587 villages in the district.

According to the 2001 census the population of Ahmadnagar district 4040642

Analysis of the satellite data reveled that there are 18 reservoir/barrages and 795 tanks. The total area under wetland is 59269 ha. Reservoir/barrages contribute to 54.90 % and 17.07 % of wetland area. The post monsoon and pre monsoon open water contribute to 46476 ha and 23225 ha respectively. The contribution due to river/stream is 15333 ha and water logged area contributes to a minimal 20 ha. The aquatic vegetation during the pre-monsoon and post-monsoon period were mapped and have been found to be 444 ha and 5148 ha respectively. Varied levels of turbidity was mapped for the water bodies and found to be 39834 ha for low turbidity, 6328 ha for moderate turbidity and 314 ha for high turbidity for post-monsoon. 18623 ha and 4602 ha were mapped for the pre-monsoon period.

Table 31: Area estimates of wetlands in Ahmadnagar

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	619	15333	25.87	6546	1008
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	18	32540	54.90	30615	19016
3	1202	Tanks/Ponds	795	10118	17.07	9298	3186
4	1203	Waterlogged	2	20	0.03	17	15
		Sub-Total	**1434**	**58011**	**97.88**	**46476**	**23225**
		Wetlands (<2.25 ha), mainly Tanks	1258	1258	2.12	-	-
		Total	**2692**	**59269**	**100.00**	**46476**	**23225**

Area under Aquatic Vegetation	444	5148

Area under turbidity levels		
Low	39834	18623
Moderate	6328	4602
High	314	-

State : Maharashtra

WETLAND MAP

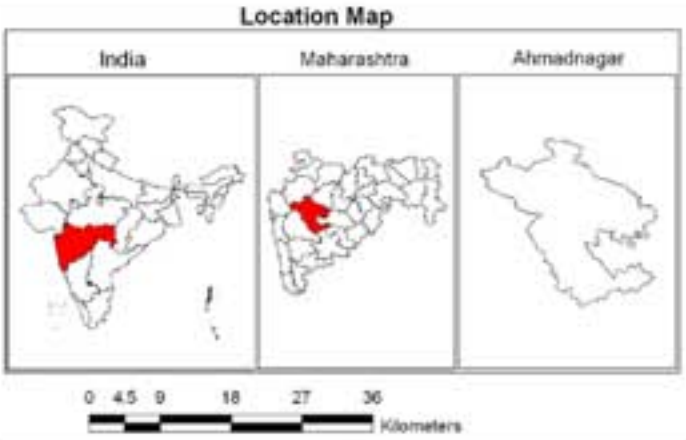
District : Ahmadnagar

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

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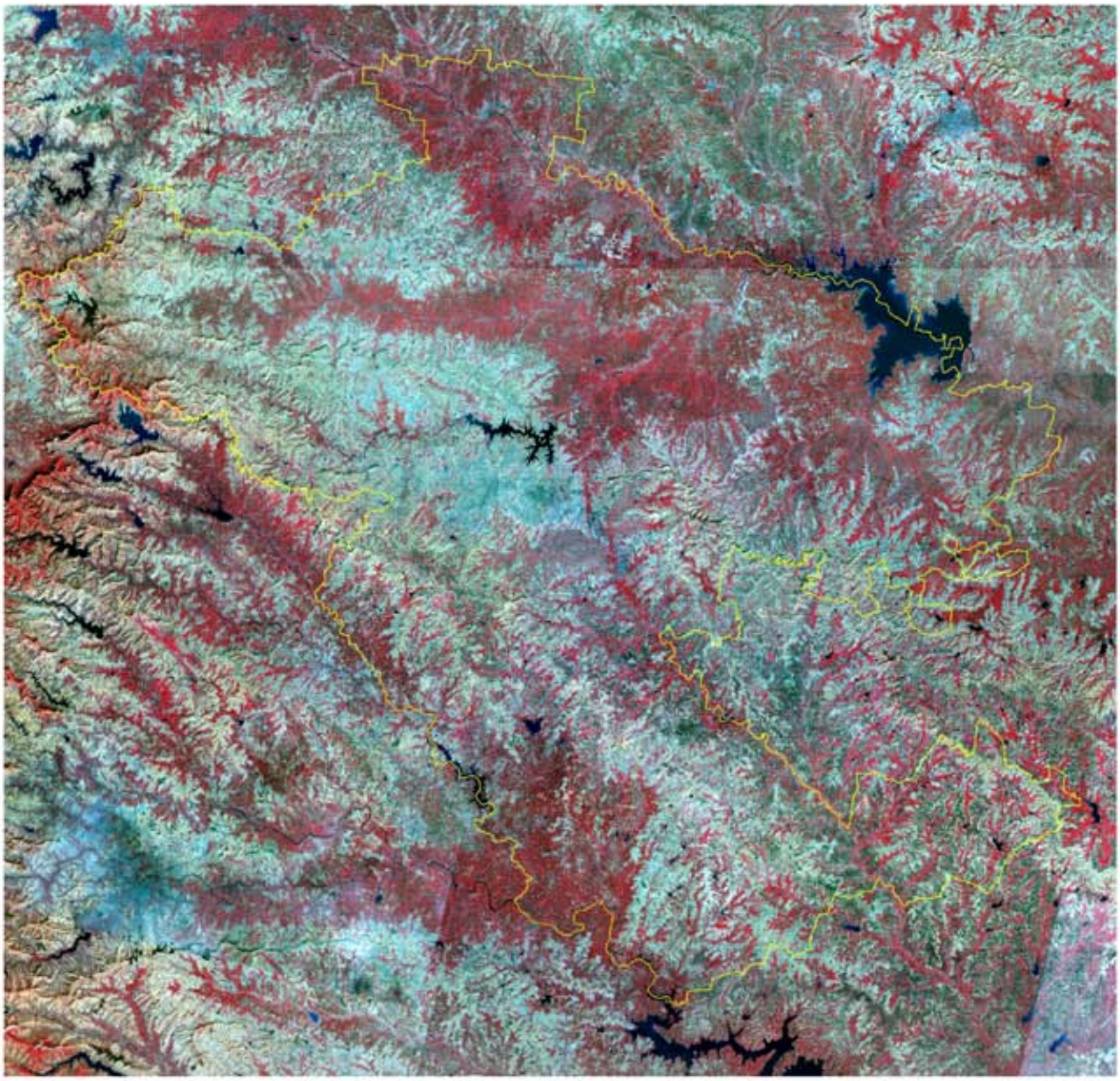
Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Ahmadnagar



IRS P6 LISS-III post monsoon data (2006)

7.1.27 Beed

Beed district is located almost at the center of the State of Maharashtra and lies between 18^0 32' to 19^0 26' North latitudes and 74^0 48' to 76^0 44' East longitudes covering an area of about 10693 km^2. It is bounded by Aurangabad and Jalna districts on the east by Parbhani and Latur districts, on the south by Osmanabad and Ahmadnagar and on the west by Ahmadnagar district of Maharashtra State.

The district is divided into 11 administrative sub-units (i.e. tahsils) viz., Beed, Gevrai, Majalgaon, Ambejogai, Kaij, Patoda, Shirur-Kasar, Dharur, Wadwani, Parli and Ashti. There are 6 towns and 1365 villages in the district as per the 2001 census. According to the 2001 census, the total population of Beed district is 2161250.

Rivers/ streams contribute to 23.79% of the total wetland area. The reservoir/barrages are the biggest contributor to the wetland area with 12630 ha i.e. 39.82 % .The tanks/ponds contribute to 10728 ha i.e. 33.82 %. The total area under wetland is 31718 ha with the water bodies less than the minimum mappable unit contributing to 780 ha to the wetland area. Aquatic vegetation is seen in both the pre-monsoon and post-monsoon season. Turbidity levels ranging from low to moderate to high are seen both during the pre-monsoon and post –monsoon period. The high sedimentation can be seen due to the location of many water bodies along the ridge line.

Table 32: Area estimates of wetlands in Beed

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	2	12	0.04	12	5
2	1102	Ox-bow lakes/ Cut-off meanders	1	3	0.01	3	-
3	1106	River/Stream	116	7547	23.79	4396	530
	1200	**Inland Wetlands -Man-made**					
4	1201	Reservoirs/Barrages	20	12630	39.82	12520	7454
5	1202	Tanks/Ponds	733	10728	33.82	9966	3741
6	1203	Waterlogged	1	18	0.06	18	10
		Sub-Total	**873**	**30938**	**97.54**	**26915**	**11740**
		Wetlands (<2.25 ha), mainly Tanks	780	780	2.46	-	-
		Total	**1653**	**31718**	**100.00**	**26915**	**11740**

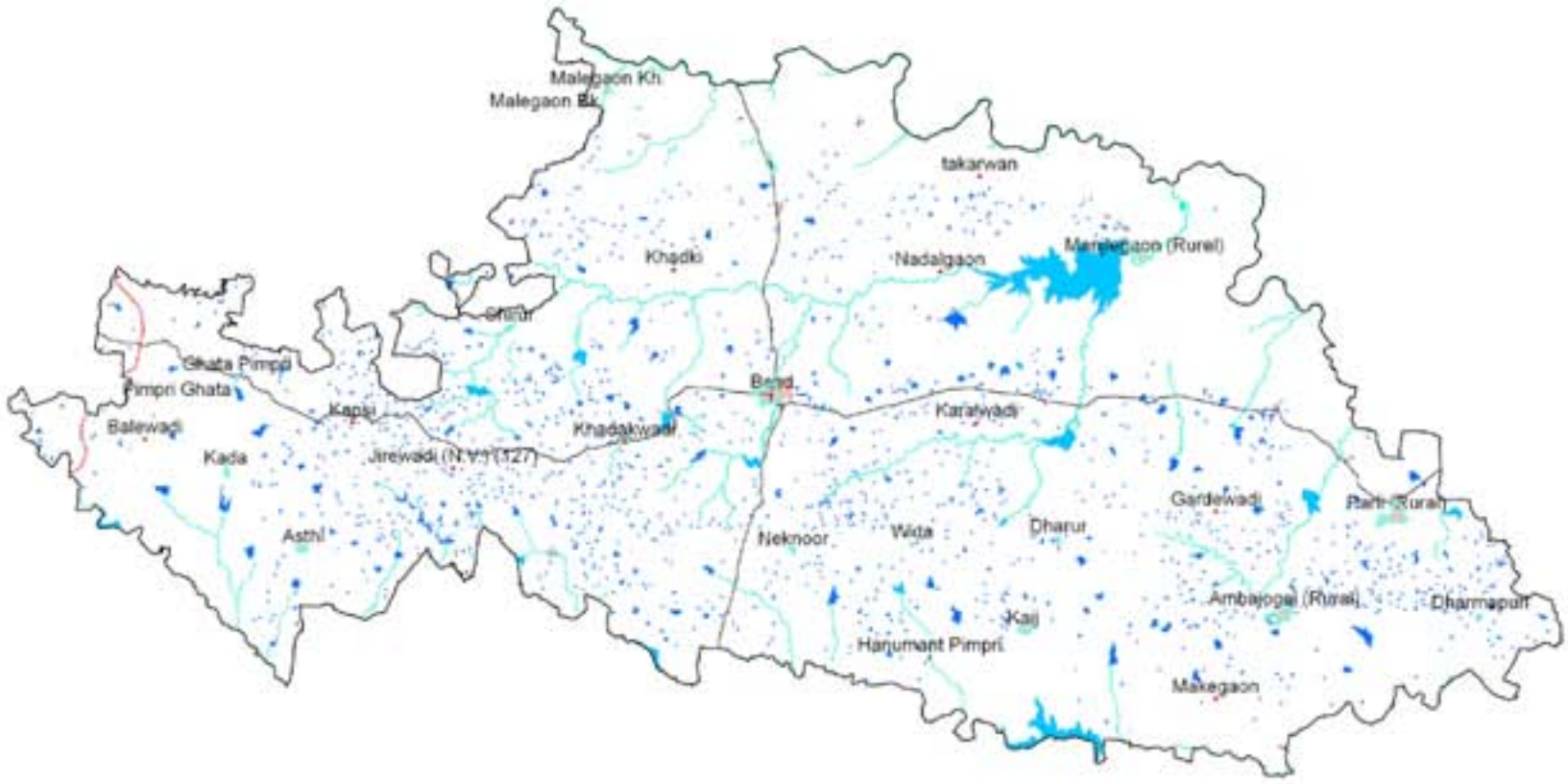
Area under Aquatic Vegetation	327	4106

Area under turbidity levels		
Low	23509	3236
Moderate	2566	8475
High	840	29

State : Maharashtra

WETLAND MAP

District : Beed



Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map

0 5 10 20 30 40
Kilometers

Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

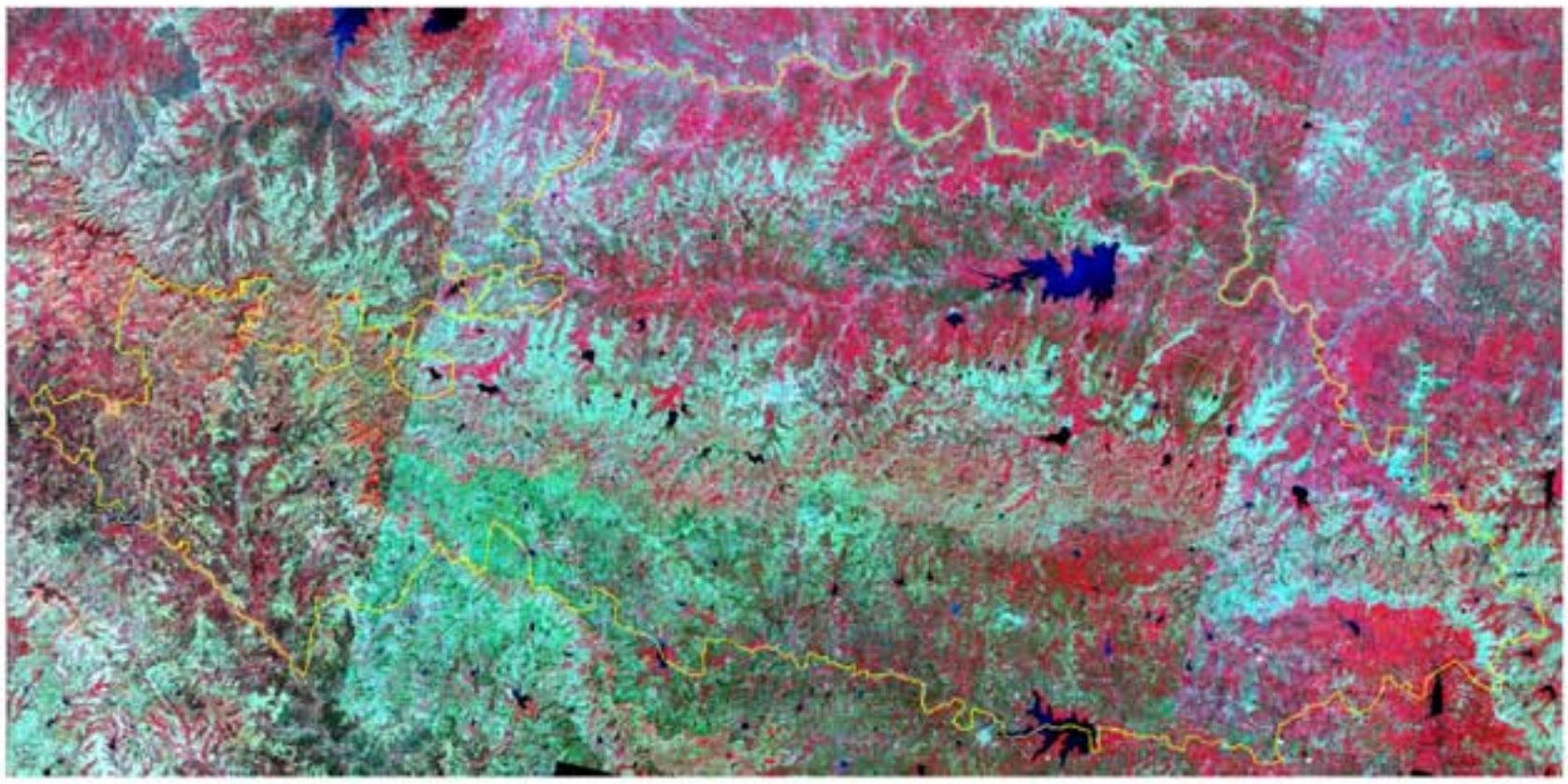
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Beed



IRS P6 LISS-III Post-monsoon data (2006)

7.1.28 Latur

Latur district is located in the southeastern part of the State and lies between 18^0 05' to 18^0 45' North latitude and 76^0 25' to 77^0 25' East longitude covering an area of about 7157 sq.km. It is bounded on the west and south by Osmanabad on the northwest by Beed, on the north by Parbhani district, on the northeast by Nanded district of Maharashtra and on the eastern side by Bidar district of Karnataka State. The district was formed on the 16th Aug, 1982. Previously it was a part of Osmanabad district.

The district is subdivide into ten administrative sub-units (tahsils) viz., Latur, Ahmadpur, Udgir, Nilanga, Renapur, Deoni, Chakur, Shirur-Anantpal, Jalkot and Ausa. There are 5 towns and 944 villages in the district. According to the 2001 census, the total population of Latur district 2080285.

Rivers/ streams contribute to 23.44% of the total wetland area. The reservoir/barrages contribute 5810 ha i.e. 28.63 % to the wetland area. The tanks/ponds contribute a mere 9440 ha i.e. 46.51%. The total area under wetland is 20296 ha with the water bodies less than the minimum mappable unit contributing to 289 ha to the wetland area. Aquatic vegetation is seen in both the seasons and changes from 1486 ha in post-monsoon to 851 ha during pre-monsoon. . Turbidity ranges from low to high and the shift in turbidity levels can be compared with the area under low turbidity level changing from 13763 ha to 6244 ha. Moderate turbidity level changes from 3818 ha to 1809 ha during pre-monsoon. Similarly the high turbidity level changes from 336 ha during post monsoon to 247 ha during pre-monsoon.

Table 33: Area estimates of wetlands in Latur

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	29	4757	23.44	4200	416
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	14	5810	28.63	5055	3580
3	1202	Tanks/Ponds	715	9440	46.51	8662	4304
		Sub-Total	**758**	**20007**	**98.58**	**17917**	**8300**
		Wetlands (<2.25 ha), mainly Tanks	289	289	1.42	-	-
		Total	**1047**	**20296**	**100.00**	**17917**	**8300**

Area under Aquatic Vegetation	1486	851

Area under turbidity levels		
Low	13763	6244
Moderate	3818	1809
High	336	247

State : Maharashtra

WETLAND MAP

District : Latur

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map

0 5 10 20 30 40 Kilometers

Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

Space Applications Centre (ISRO), Ahmedabad
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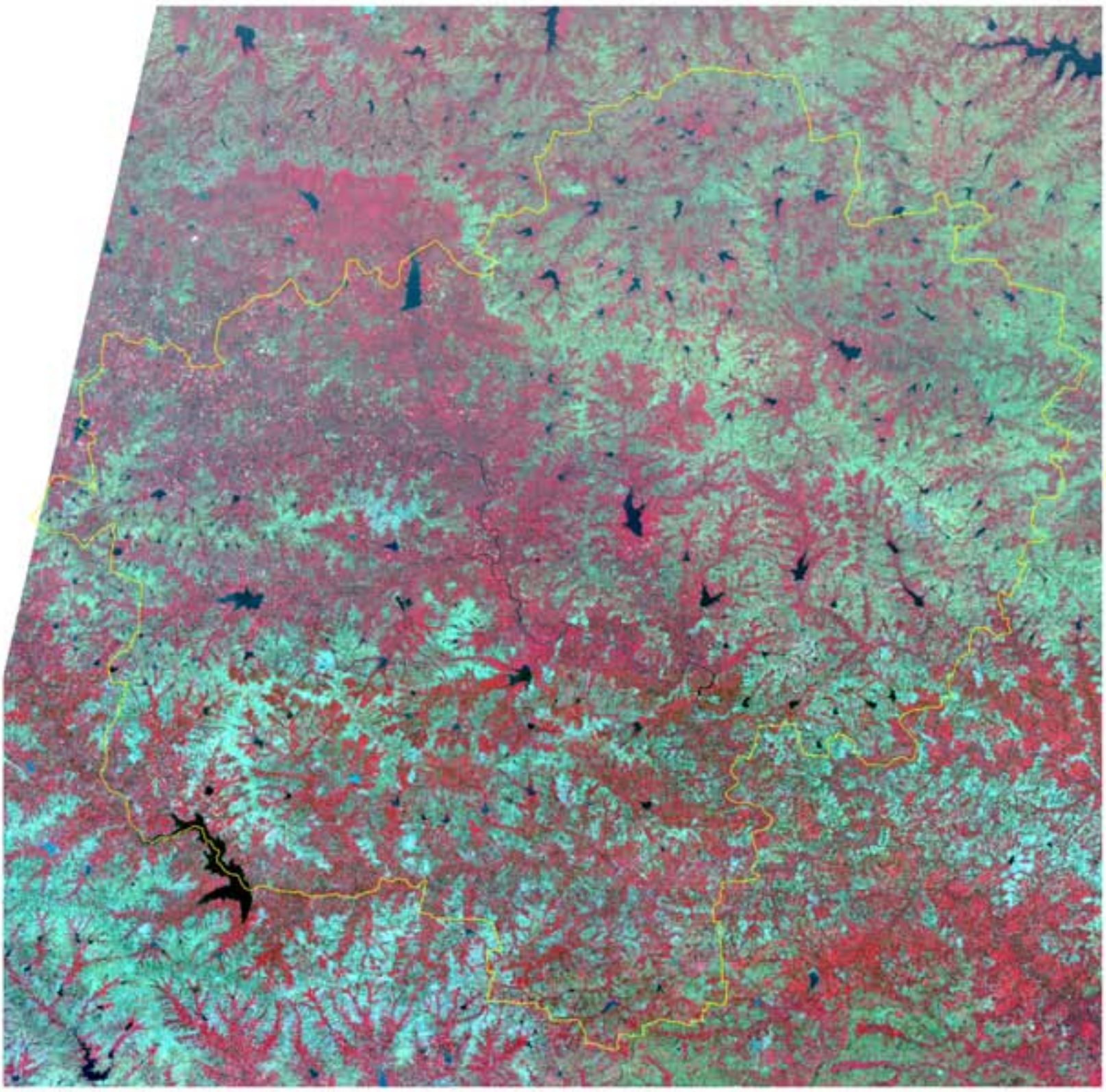
Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Latur



IRS P6 LISS-III post monsoon data (2006)

7.1.29 Osmanabad

The district of Osmanabad falling in the Marathwada Region of Central Maharashtra is the southernmost district in Aurangabad division. The district has geographical area of 7569 km^2. The district accounts for roughly 2.4% of the total geogrphical area of the State. It is bounded in the north by Beed district, in the east by Latur district, in the south by Solapur and in the west Ahmednagar districts and on the southeast by Bidar and Gulbarga district of Karnataka State. The district is divided into 8 administrative sub-units (tahsils) namely Osmanabad, Tuljapur, Umerga, Kalamb, Parenda, Bhoom, Washi and Lohara. According to the 2001 census, the total population of Osmanabad district 1486586.

Rivers/ streams contribute 9.32% to the total wetland area. The reservoir/barrages contribute a major share of 12617 ha i.e. 46.68% to the wetland area. The tanks/ponds contribute 11092 ha i.e. 41.04%. The total area under wetland is 27027 ha with the water bodies less than the minimum mappable unit contributing to 653 ha to the wetland area. Aquatic vegetation is seen in both the seasons and changes from 715 ha in post-monsoon to 3292 ha during pre-monsoon specially as the water bodies shrink considerably during pre-monsoon .Turbidity ranges from low to high and the shift in turbidity levels can be compared with the area under low turbidity level changing from 16433 ha to 4888 ha.

Moderate turbidity level changes from 5829 ha to 4493 ha during pre-monsoon. Similarly the high turbidity level changes from 1056 ha during post monsoon to 68 ha during pre-monsoon. The presence of water bodies with moderate and high turbidity is due to presence of water bodies along ridges.

Table 34: Area estimates of wetlands in Osmanabad

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1106	River/Stream	129	2519	9.32	2439	143
	1200	**Inland Wetlands -Man-made**					
2	1201	Reservoirs/Barrages	32	12617	46.68	11429	6602
3	1202	Tanks/Ponds	846	11092	41.04	9408	2704
4	1203	Waterlogged	2	146	0.54	42	0
		Sub-Total	**1009**	**26374**	**97.58**	**23318**	**9449**
		Wetlands (<2.25 ha), mainly Tanks	653	653	2.42	-	-
		Total	**1662**	**27027**	**100.00**	**23318**	**9449**

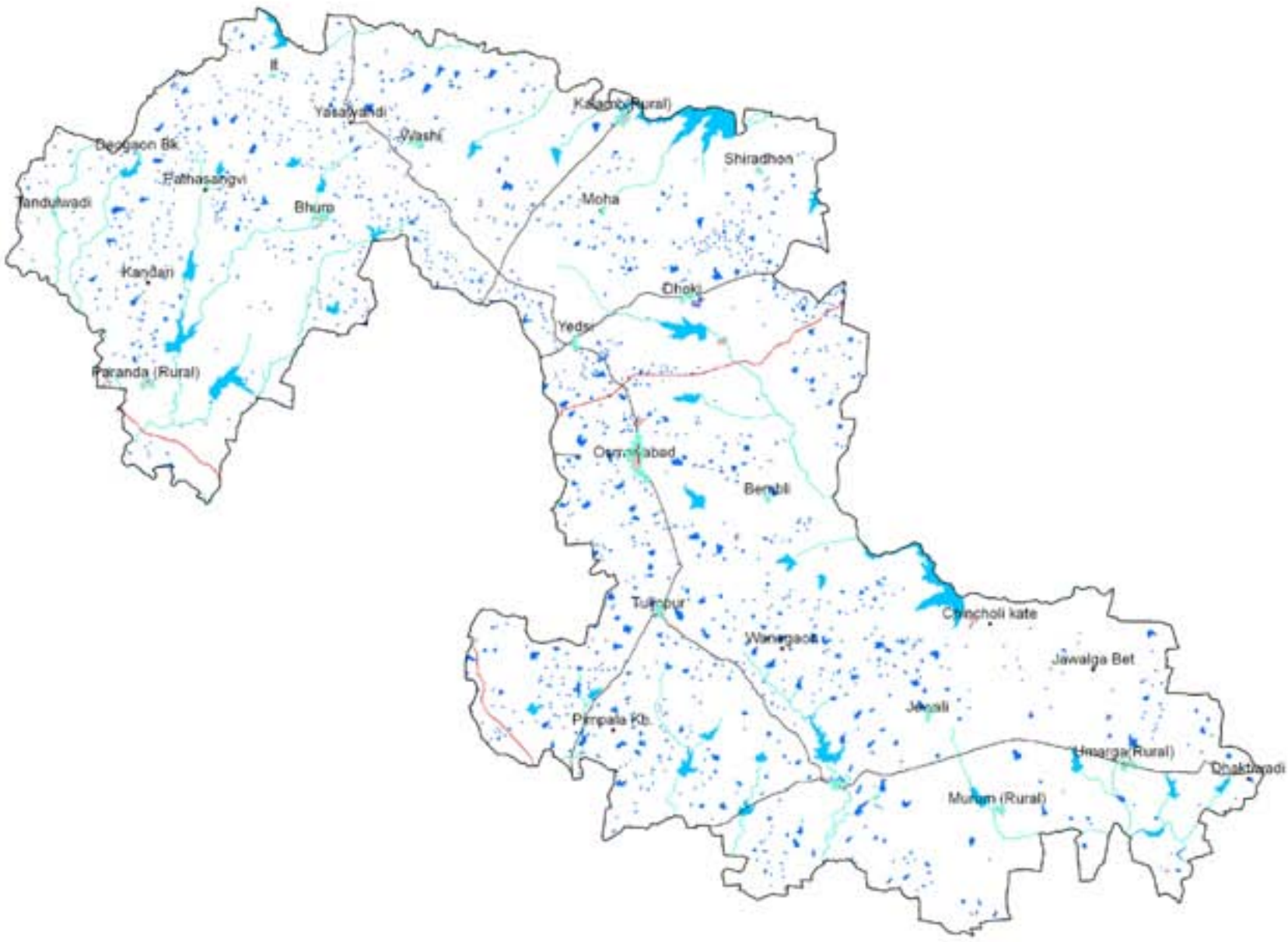
Area under Aquatic Vegetation	715	3292

Area under turbidity levels		
Low	16433	4888
Moderate	5829	4493
High	1056	68

State : Maharashtra

WETLAND MAP

District : Osmanabad

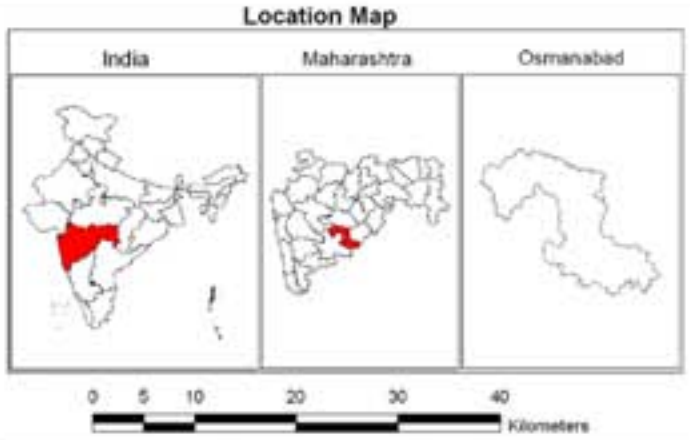


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

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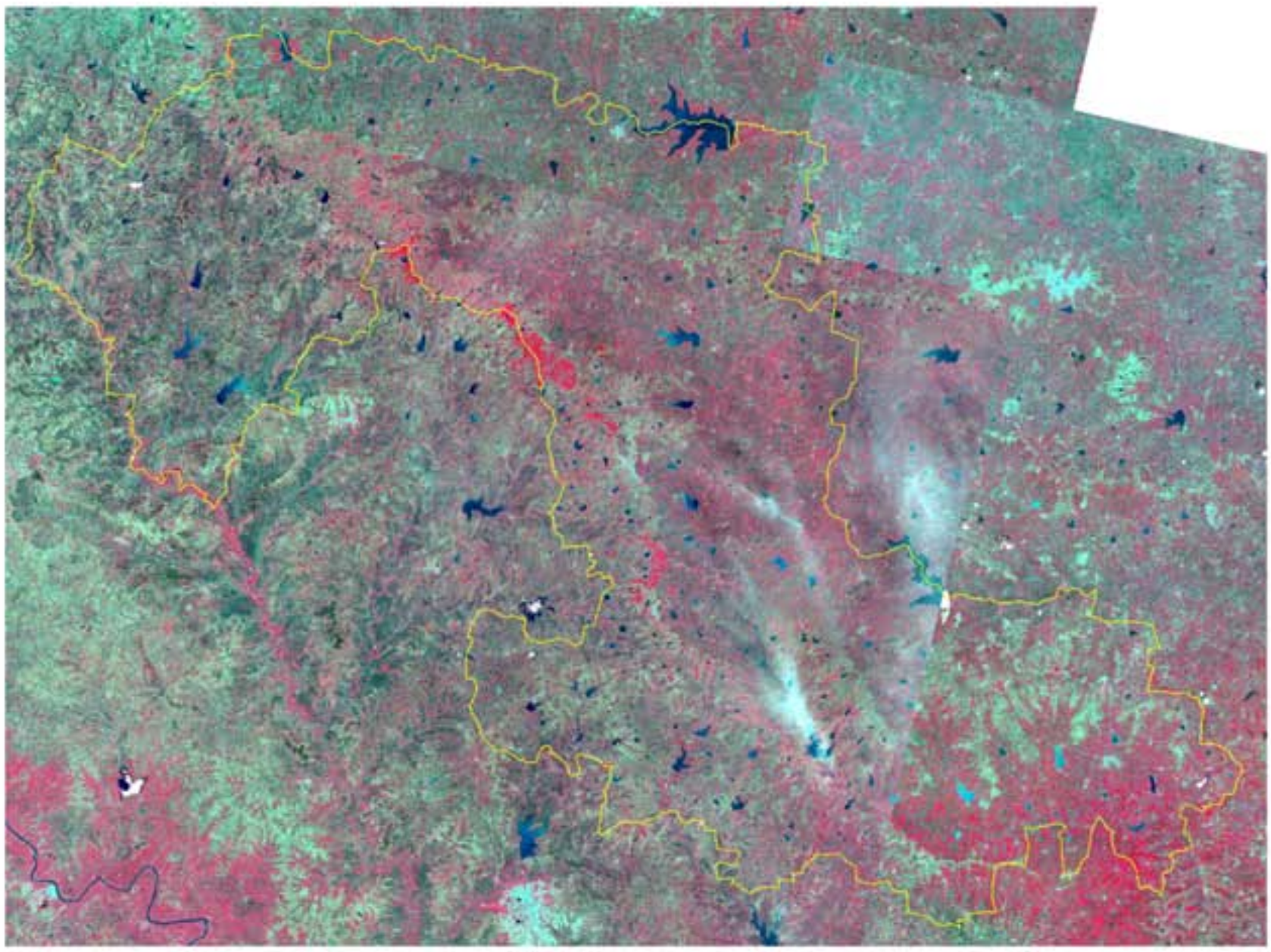
State : Maharashtra

District : Osmanabad



IRS-P6 LISS-III Post-monsoon data(2006-2007)

7.1.30 Solapur

The district is located in the southern parts of the State and lies between 17^0 10' to 18^0 32' north latitude and 74^0 42' to 76^0 15' east longitudes covering an area of about 14,895 km^2. It is bounded on the north by Ahmadnagar and Osmanabad, on the east by Osmanabad, on the west by Pune and Satara, and on the south by Sangli district and Karnataka State.

The district is divided into eleven administrative sub-units (tahsils). They are north Solapur, south Solapur, Barshi, Akkalkot, Mohol, Mangalvedha, Pandharpur, Songale, Malshiras, Karmala and Madha. There are 10 towns and 1150 villages in the district. According to the 2001 census, the total population of Solapur district 3849543.

Rivers/ streams contribute 21.53% to the total wetland area. The reservoir/barrages cover 49.75 % wetland area. The tanks/ponds contribute 5137 ha i.e. 14.30%. The total area under wetland is 35062 ha excluding wetlands less than minimum mapable unit (856 ha). Aquatic vegetation is seen in both the seasons and changes from 593 ha in post-monsoon to 1999 ha during pre-monsoon. Turbidity ranges from low to high and the shift in turbidity levels can be compared with the area under low turbidity level changing from 31019 ha to 16006 ha. Moderate turbidity level changes from 1107 ha to 4947 ha during pre-monsoon. Similarly the high turbidity level changes from 579 ha during post monsoon to 117 ha during pre-monsoon. The presence of water bodies with moderate and high turbidity is due to presence of water bodies along ridges. Many water conservation structures have been taken up in Solapur as a part of watershed development and social forestry activity and hence have large number of water bodies. The ujjani dam is specially prone to high turbidity due to the presence of industrial effluents from MIDC in Pune and Solapur.

Table 35: Area estimates of wetlands in Solapur

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	17	4325	12.04	4182	2768
2	1106	River/Stream	95	7732	21.53	6149	4483
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	51	17868	49.75	17574	12694
4	1202	Tanks/Ponds	636	5137	14.30	4800	1125
		Sub-Total	**799**	**35062**	**97.62**	**32705**	**21070**
		Wetlands (<2.25 ha), mainly Tanks	856	856	2.38	-	-
		Total	**1655**	**35918**	**100.00**	**32705**	**21070**

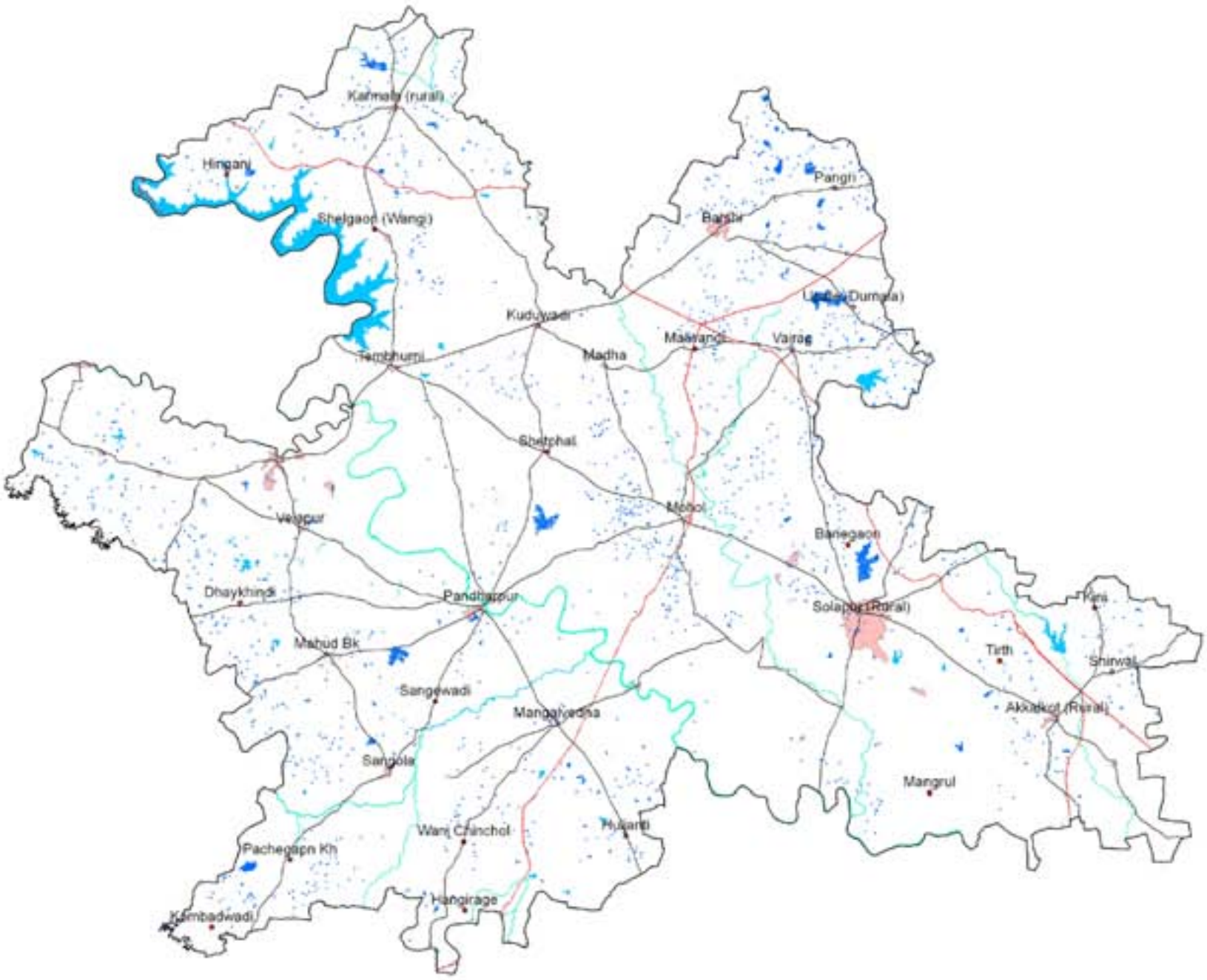
Area under Aquatic Vegetation	593	1999

Area under turbidity levels		
Low	31019	16006
Moderate	1107	4947
High	579	117

State : Maharashtra

WETLAND MAP

District : Solapur

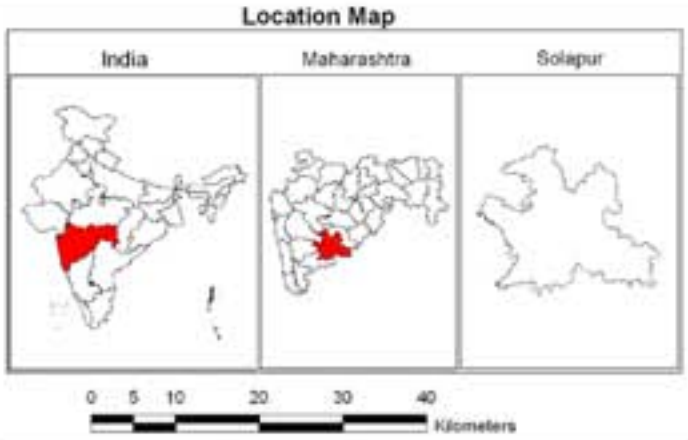


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

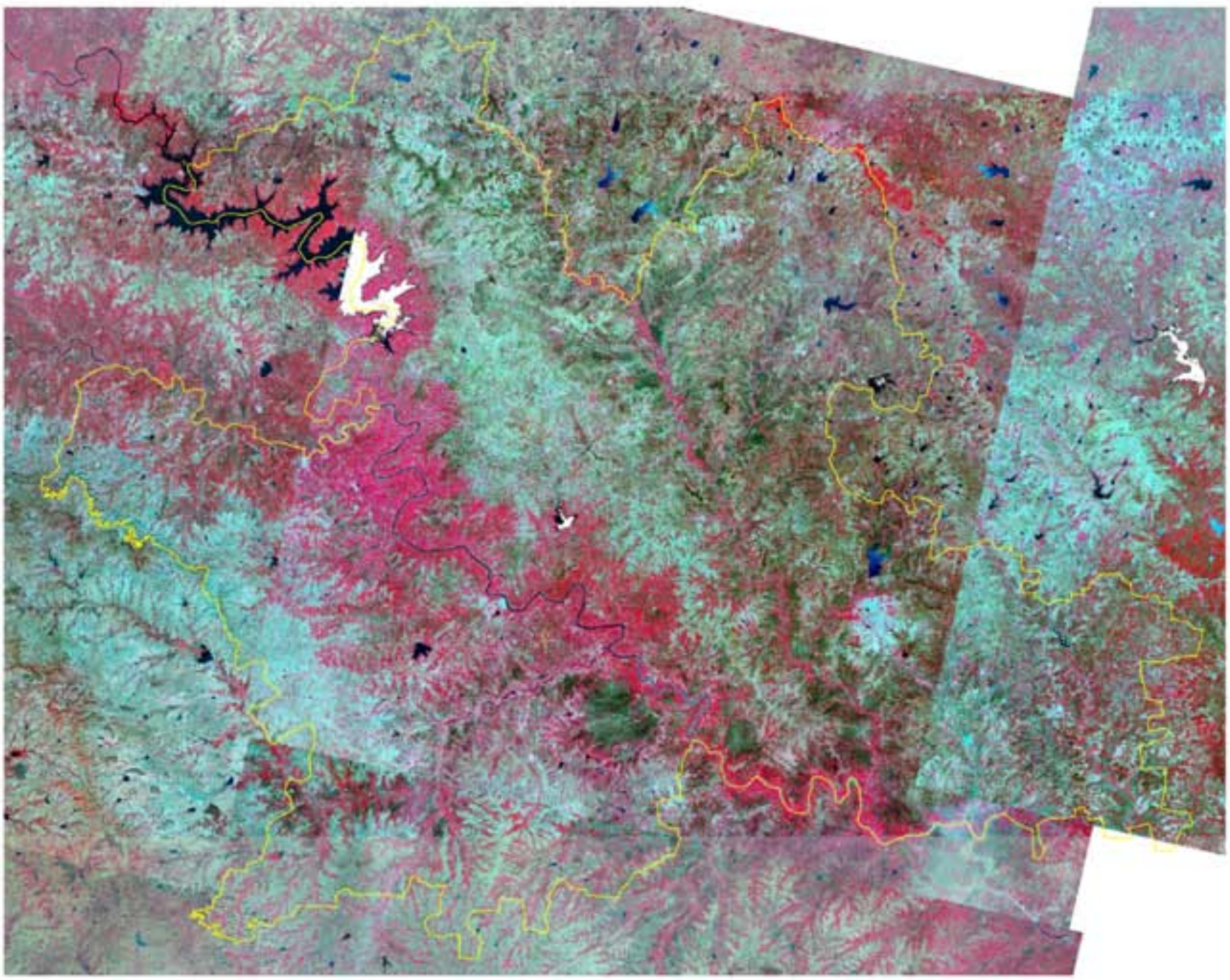
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Solapur



IRS P6 LISS-III post monsoon data (2006)

7.1.31 Satara

Satara district is located in the South Western parts of the State and lies between 17^0 05' to 18^0 11' north latitude and 73^0 31' to 74^0 54' east longitudes covering an area of about 10,475 km^2. Pune bound it on the north, on the south by Sangli, on the west by Ratnagiri, on the northwest by Raigad and on the east by Solapur district of Maharashtra State.

The district is divided into eleven administrative sub-units (tahsils). They are Satara, Wai, Khandala, Koregaon, Phaltan, Man, Khatav, Karad, Patan, Jaoli and Mahableshwar. There are 15 towns and 1739 villages in the district. According to the 2001 census, the total population of Satara district is 2808994.

Rivers/ streams contribute 26.19 % to the total wetland area. The reservoir/barrages contribute a large percent 23503 ha i.e. 58.78 % to the wetland area. The tanks/ponds contribute 5213 ha i.e. 13.04 %. Waterlogged patches having area of 34 ha and contributing 0.09 % to wetlnds is also seen. The total area under wetland is 39984 ha with the water bodies less than the minimum mappable unit contributing to 749 ha to the wetland area. Aquatic vegetation is seen in both the seasons and changes from 874 ha in post-monsoon to 1587 ha during pre-monsoon specially as the water bodies shrink considerably during pre-monsoon .Turbidity ranges from low to high and the shift in turbidity levels can be compared with the area under low turbidity level changing from 35350 ha to 13936 ha. Moderate turbidity level changes from 139 ha to 1597 ha during pre-monsoon. Similarly the high turbidity level changes from 136 ha during post monsoon to 6 ha during pre-monsoon. The presence of water bodies with moderate and high turbidity is due to presence of water bodies along ridges.

Table 36: Area estimates of wetlands in Satara

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	3	12	0.03	10	4
2	1104	Reverine wetlands	1	2	0.01	2	-
3	1106	River/Stream	145	10471	26.19	11356	1499
	1200	**Inland Wetlands -Man-made**					
4	1201	Reservoirs/Barrages	41	23503	58.78	20723	13141
5	1202	Tanks/Ponds	707	5213	13.04	3517	890
6	1203	Waterlogged	10	34	0.09	17	5
		Sub-Total	**907**	**39235**	**98.13**	**35625**	**15539**
		Wetlands (<2.25 ha), mainly Tanks	749	749	1.87	-	-
		Total	**1656**	**39984**	**100.00**	**35625**	**15539**

Area under Aquatic Vegetation	874	1587

Area under turbidity levels		
Low	35350	13936
Moderate	139	1597
High	136	6

State : Maharashtra

WETLAND MAP

District : Satara

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map

Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

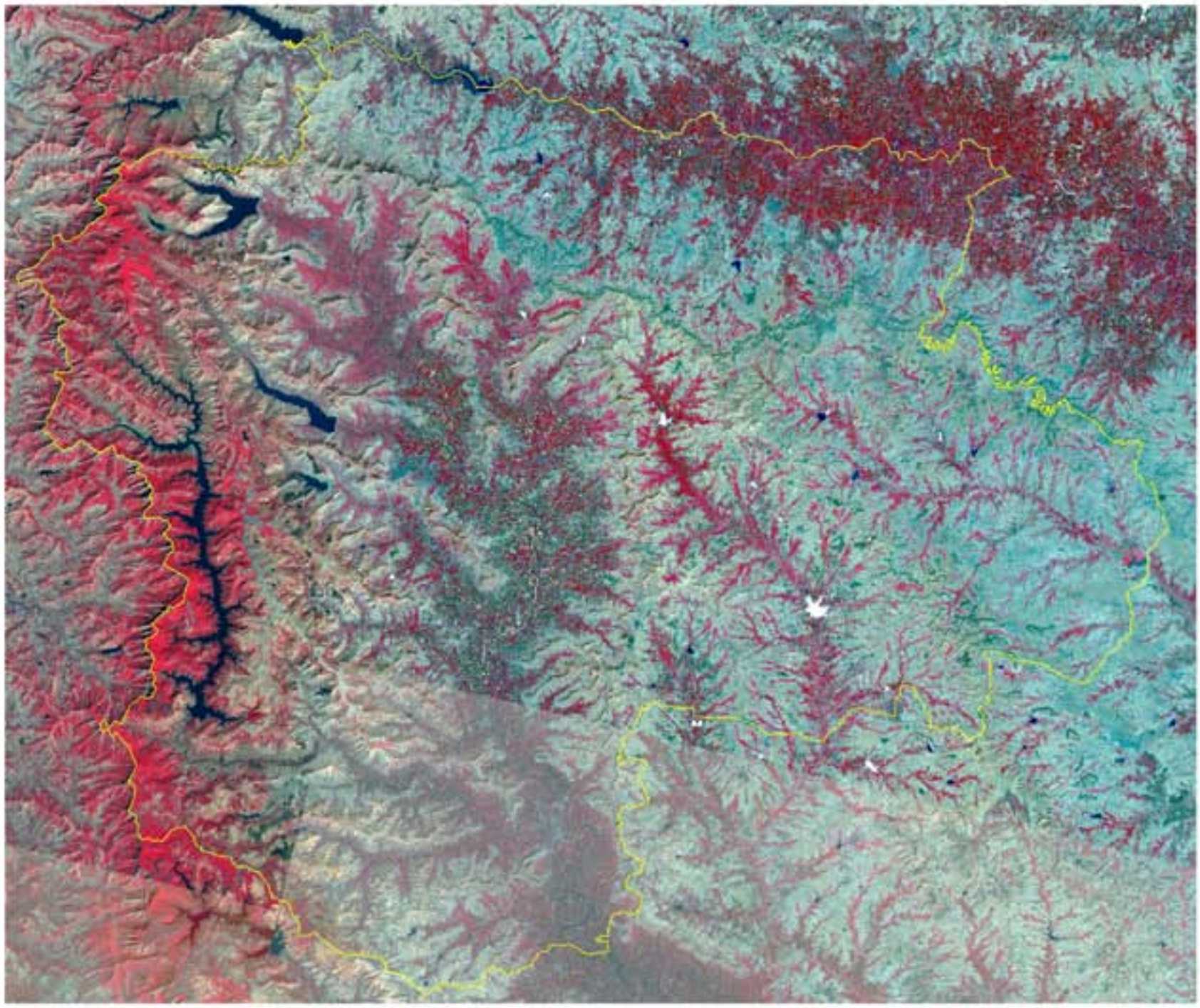
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Satara



IRS-P6 LISS-III Post-monsoon data(2006-2007)

7.1.32 Ratnagiri

Ratnagiri is one of the coastal districts of Maharashtra. It is located in the western extremity of the /state in the Konkan region and lies between 16^0 30' to 18^0 04' north latitudes and 73^0 02' to 73^0 52' east longitudes covering an area of about 8208 km^2. The district is bounded on the west Arabian Sea, on the south by Sindhudurg district on the east by Kolhapur, Sangli, Satara districts and on the north by Raigad district of Mahrashtra State. The district is sub-divided into nine administrative sub-units (tahsils). There are 10 towns and 1543 villages in the district. According to the 2001 census, the total population of Ratnagiri district is 1696777.

Total 771 wetlands are mapped in the district including 16 small wetlands (<2.25 ha), with total wetlands area of 20979 ha. The coastal wetlands dominated the district. The major wetland type is the creeks contributing 34.09 %. The other coastal wetland types are sand/beaches with1955 ha (9.32 %), mud flats with 1767 ha (8.42 %), and mangroves with 3381 ha (16.12%). Aqua-culture ponds contribute which is a commercial activity occupies 46 ha (0.22%) of the total wetland area. Details of wetland statistics is shown in Table- 37.

The rivers/stream is the major in land wetland type with 4769 ha (22.73 %), followed by Tanks/ponds (5.42%). There are 7 reservoirs/ barrages with 755 ha (3.60 %). Aqua-culture ponds contribute which is a commercial activity occupies 46 ha (0.22%) of the total wetland area.

As the aquatic vegetation is mainly the mangroves, hardly any change is observed during the pre and post monsoon season. The open water spread of wetlands is more during post monsoon than pre monsoon. The turbidity of water is mainly moderate in both the seasons.

Table 37: Area estimates of wetlands in Ratnagiri

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1105	Waterlogged	1	3	0.01	3	3
2	1106	River/Stream	85	4769	22.73	2087	5355
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	7	755	3.60	699	521
4	1202	Tanks/Ponds	61	1136	5.41	998	689
		Total - Inland	**154**	**6663**	**31.76**	**3787**	**6568**
	2100	**Coastal Wetlands - Natural**					
5	2102	Creeks	94	7151	34.09	6906	1383
6	2103	Sand/Beach	205	1955	9.32	-	-
7	2104	Intertidal mud flats	104	1767	8.42	-	-
8	2105	Salt Marshes	0	0	0.00	-	-
9	2106	Mangroves	194	3381	16.12	-	-
	2200	**Coastal Wetlands - Man-made**					
10	2202	Aquaculture ponds	4	46	0.22	46	46
		Total - Coastal	**601**	**14300**	**68.16**	**6952**	**1429**
		Sub-Total	**755**	**20963**	**99.92**	**10739**	**7997**
		Wetlands (<2.25 ha), mainly Tanks	16	16	0.08	-	-
		Total	**771**	**20979**	**100.00**	**10739**	**7997**

Area under Aquatic Vegetation	3381	3381

Area under turbidity levels		
Low	2100	16
Moderate	8635	7981
High	4	-

State : Maharashtra

WETLAND MAP

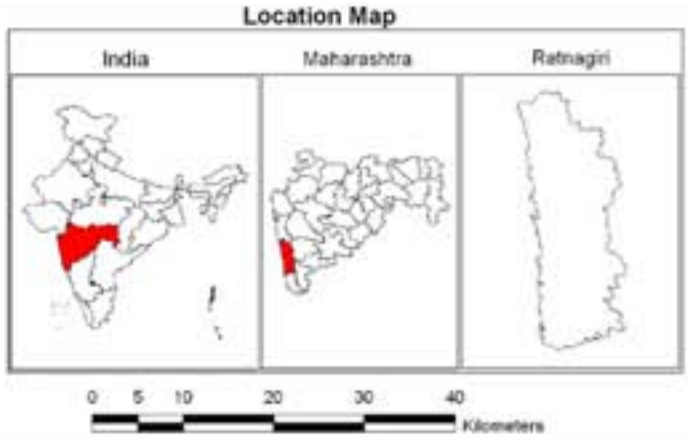
District : Ratnagiri

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

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and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Ratnagiri

IRS P6 LISS-III post monsoon data (2006)

7.1.33 Sindhudurg

The district is one of the coastal districts of Maharashtra. It is located in the southwestern extremity of the state in the Konkan region. This district was formed in the year 1981 by combining some tahsils of erstwhile Ratnagiri and Kolhapur districts. It lies between 15^0 37' to $16^0$40' north latitudes and $73^0$19' to $74^0$13' east longitudes covering an area of about 5207 km^2. The district is bounded on the west Arabian Sea, on the north by Ratnagiri district, on the east by Kolhapur districts and on the south by Goa state. The district is sub-divided into eight administrative sub-units (tahsils). Kudal is the district headquarters. There are 5 towns and 743 villages in the district. According to the 2001 census, the total population of Sindhudurg district is 868825.

Total 373 wetlands are mapped in the district including 10 small wetlands (<2.25 ha), with total wetlands area of 13979 ha. The coastal wetlands dominated the district. The major coastal wetland type is the creeks contributing 32.58% area (4554 ha). The other coastal wetland types are: sand/beach (7.73 %), mud flats (6.55 %), and mangroves (6.83 %). The rivers/stream is the major in land wetland type with 4385 ha area (31.37 %)), followed by Tanks/ponds (10.22 %). There is 1 reservoir/ barrage with 618 ha (4.42 %).
Details of wetland statistics is shown in Table- 38.

As the aquatic vegetation is mainly the mangroves, hardly any change is observed during the pre and post monsoon season. The open water spread of wetlands is more during post monsoon than pre monsoon. The turbidity of water is mainly moderate to low in post monsoon, and moderate in pre monsoon.

Table 38: Area estimates of wetlands in Sindhudurg

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1105	Waterlogged	3	14	0.10	14	14
2	1106	River/Stream	43	4385	31.37	2580	1777
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	1	618	4.42	564	386
4	1202	Tanks/Ponds	66	1428	10.22	1187	757
		Total - Inland	**113**	**6445**	**46.10**	**4345**	**2934**
	2100	**Coastal Wetlands - Natural**					
5	2102	Creeks	45	4554	32.58	4500	392
6	2103	Sand/Beach	75	1081	7.73	-	-
7	2104	Intertidal mud flats	43	915	6.55	-	-
8	2105	Salt Marshes	0	0	0.00	-	-
9	2106	Mangroves	79	955	6.83	-	-
	2200	**Coastal Wetlands - Man-made**					
10	2201	Salt pans	8	19	0.14	20	14
		Total - Coastal	**250**	**7524**	**53.82**	**4520**	**406**
		Sub-Total	**363**	**13969**	**99.93**	**8865**	**3340**
		Wetlands (<2.25 ha), mainly Tanks	10	10	0.07	-	-
		Total	**373**	**13979**	**100.00**	**8865**	**3340**

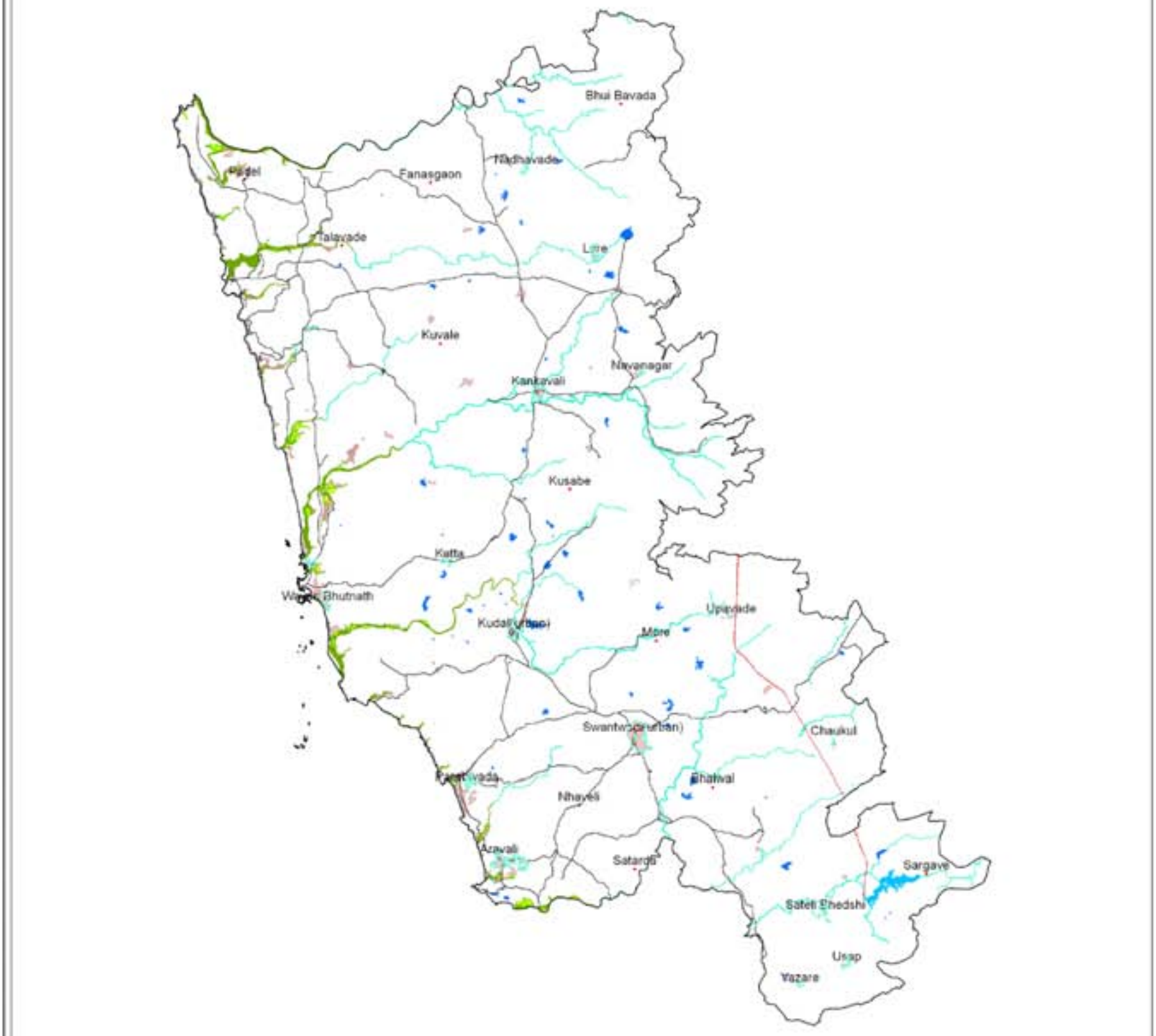
Area under Aquatic Vegetation	955	955

Area under turbidity levels		
Low	4182	870
Moderate	4637	2455
High	46	15

State : Maharashtra

WETLAND MAP

District : Sindhudurg

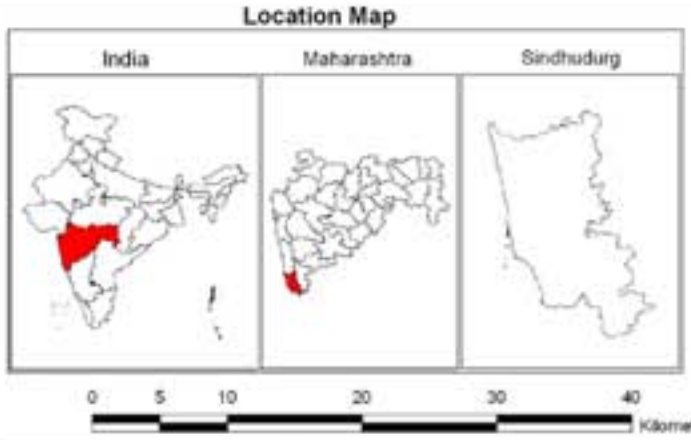


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

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Sponsored by

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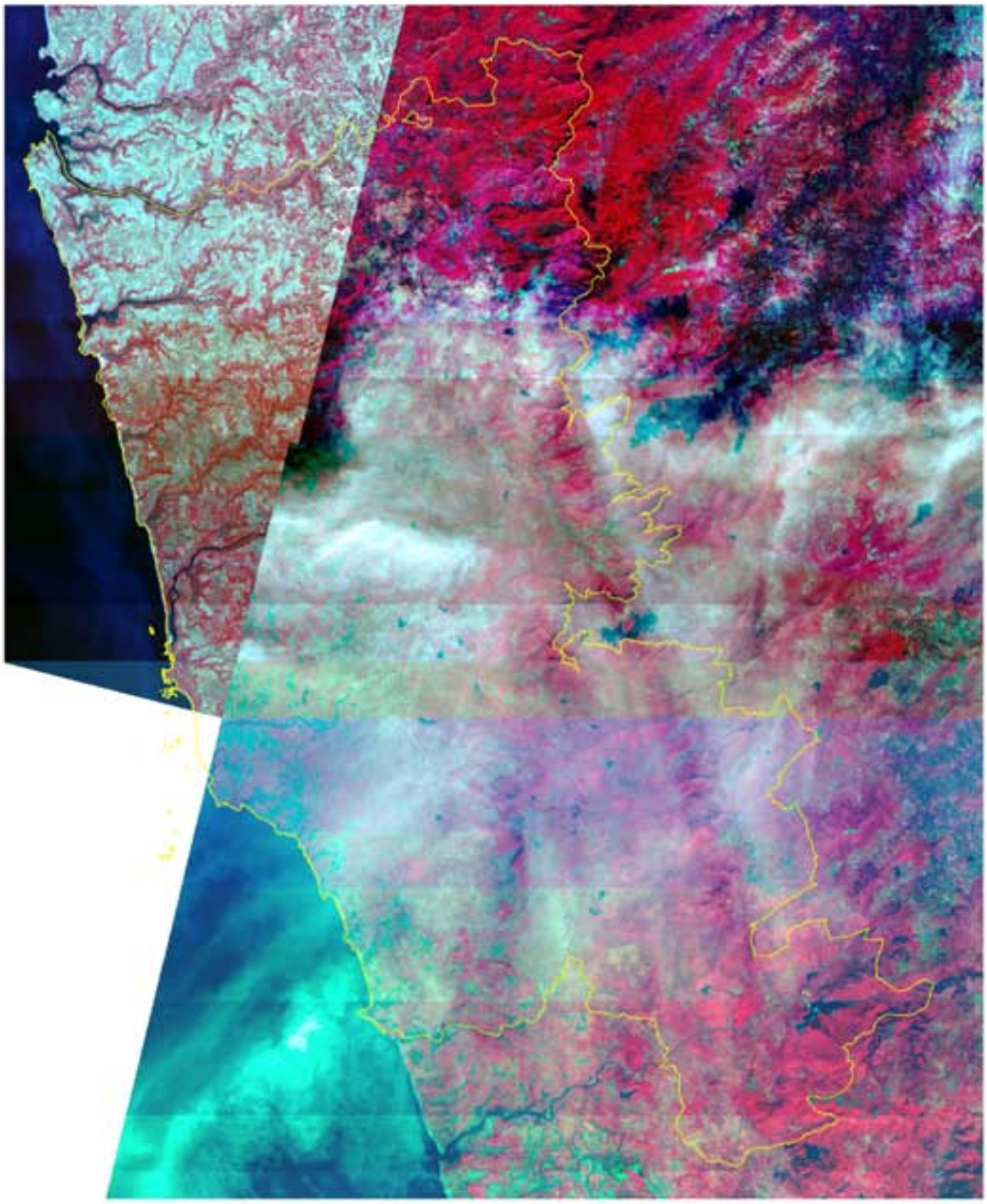
State : Maharashtra

District : Sindhudurg



IRS P6 LISS-III post monsoon data (2006)

7.1.34 Kolhapur

Kolhapur district is located in the southern part of the Maharashtra State and lies between 15^0 to 17^0 north latitudes and 73^0 to 74^0 east longitudes covering an area of about 7685 km^2. The district is bounded on the west by Ratnagiri and Sindhudurg district, on the north by Sangli district and on the east and south by Karnataka State. The district is divided into 12 administrative sub-units (tahsils). There are 12 towns and 1153 villages in the district. The total population of Kolhapur is 3523162.

Total 443 wetlands are mapped in the district including 184 small wetlands (<2.25 ha), with total wetlands area of 18663 ha. In land man made wetland type dominated in the district. The reservoir/barrages are the major wetland type. Total 109 such wetland types are mapped with 13060 ha area (69.98 %). Rivers/ streams contribute 28.17 %. Total 37 Tank/pond are mapped with 147 ha area (0.79%). Details of wetland statistics is shown in Table- 39.

Aquatic vegetation is more in pre monsoon (73 ha) than in post monsoon (27 ha). The open water spread of wetlands is more during post monsoon than pre monsoon. The turbidity of water is mainly low to moderate in both the seasons.

Table 39: Area estimates of wetlands in Kolhapur

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1102	Ox-bow lakes/ Cut-off meanders	1	12	0.06	12	12
2	1105	Waterlogged	1	3	0.02	3	-
3	1106	River/Stream	111	5257	28.17	5142	1063
	1200	**Inland Wetlands -Man-made**					
4	1201	Reservoirs/Barrages	109	13060	69.98	12202	7462
5	1202	Tanks/Ponds	37	147	0.79	144	76
		Sub-Total	**259**	**18479**	**99.01**	**17503**	**8613**
		Wetlands (<2.25 ha), mainly Tanks	184	184	0.99	-	-
		Total	**443**	**18663**	**100.00**	**17503**	**8613**

Area under Aquatic Vegetation	27	73

Area under turbidity levels		
Low	16286	6768
Moderate	1211	1790
High	6	55

State : Maharashtra

WETLAND MAP

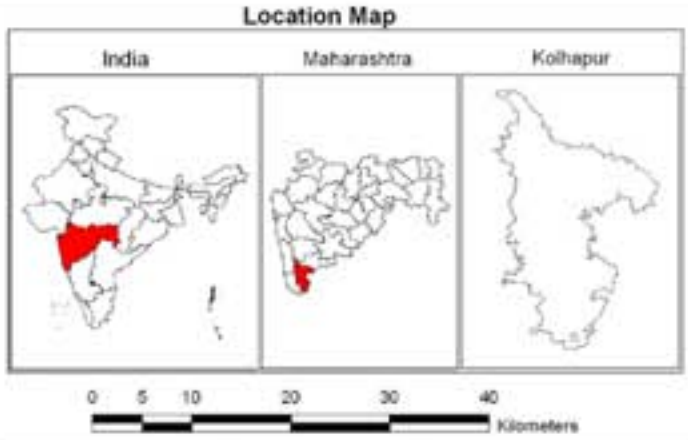
District : Kolhapur

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

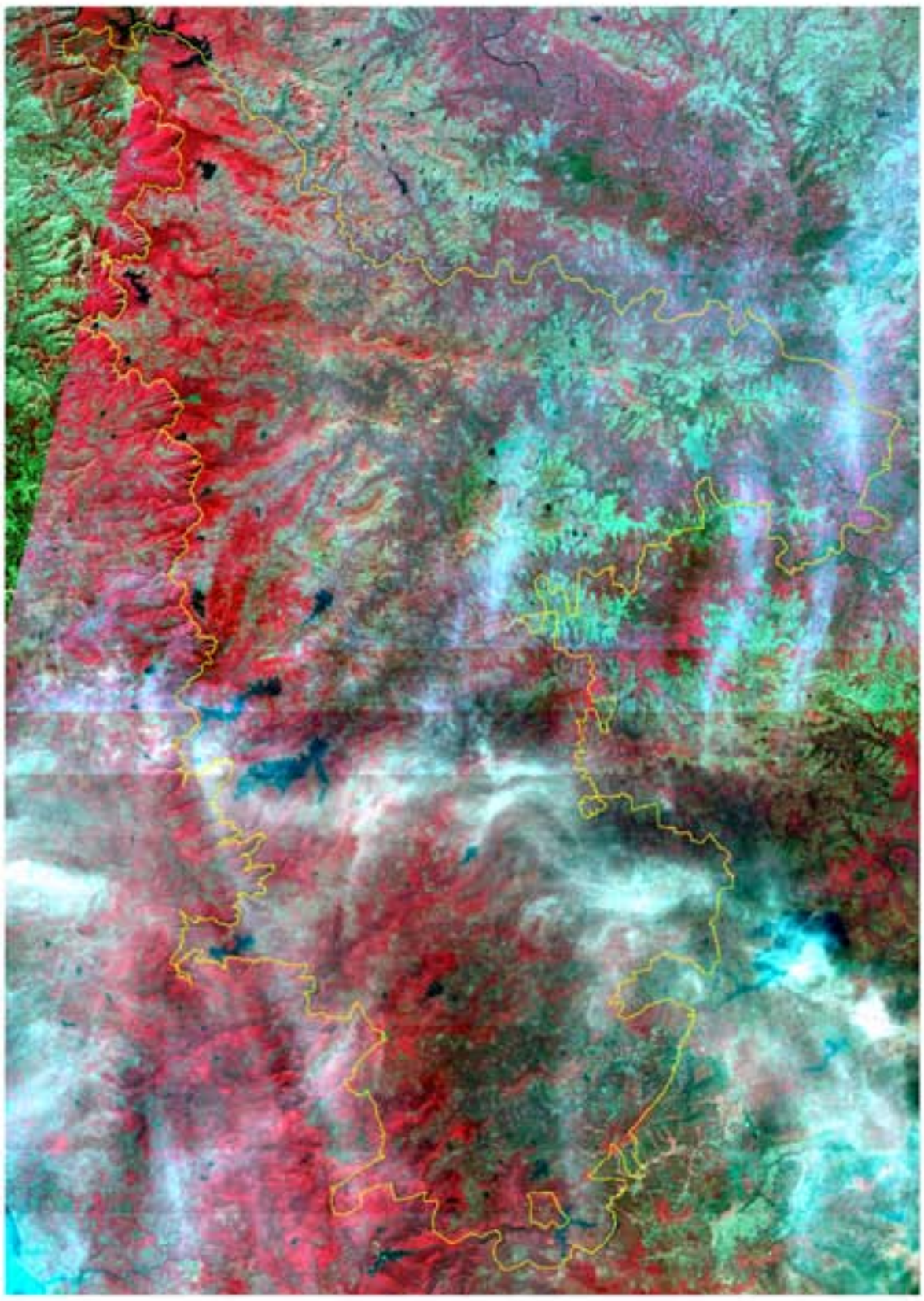
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Kolhapur



IRS P6 LISS-III post monsoon data (2006)

7.1.35 Sangli

Sangli district is located in the southern parts of the State and lies between 16^0 42' to 17^0 37' north latitude and 73^0 42' to 75^0 40' east longitudes covering an area of about 8572 km^2. It is bounded on the north by Satara and Solapur districts, on the west by Ratnagiri district, on the south by Kolhapur and on the east and south east by Bijapur district of Karnataka State. The district is divided into ten administrative sub-units (tahsils). There are 8 towns and 724 villages in the district. According to the 2001 census, the total population of the district is 2583524.

Total 1921 wetlands are mapped in the district including 1306 small wetlands (<2.25 ha), with total wetlands area of 16075 ha. Inland man made wetland type dominated in the district. Total 489 Tank/pond wetland type is mapped with 6246 ha area (38.86%). The reservoir/barrages contribute 12.38%. Rivers/ streams are the main natural wetland with 40.16% contribution. Details of wetland statistics is shown in Table- 40.

Aquatic vegetation is more in pre monsoon (93 ha) than in post monsoon (22 ha). The open water spread of wetlands is more during post monsoon than pre monsoon. The turbidity of water is mainly low in post monsoon and moderate to low in pre monsoon.

Table 40: Area estimates of wetlands in Sangli

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	8	34	0.21	34	22
2	1106	River/Stream	106	6456	40.16	5021	1276
	1200	**Inland Wetlands -Man-made**					
3	1201	Reservoirs/Barrages	2	1990	12.38	8	1580
4	1202	Tanks/Ponds	489	6246	38.86	5797	2643
5	1203	Waterlogged	10	43	0.27	5	43
		Sub-Total	**615**	**14769**	**91.88**	**10865**	**5564**
		Wetlands (<2.25 ha), mainly Tanks	1306	1306	8.12	-	-
		Total	**1921**	**16075**	**100.00**	**10865**	**5564**

Area under Aquatic Vegetation	22	93

Area under turbidity levels		
Low	10656	1532
Moderate	184	3806
High	25	226

State : Maharashtra

WETLAND MAP

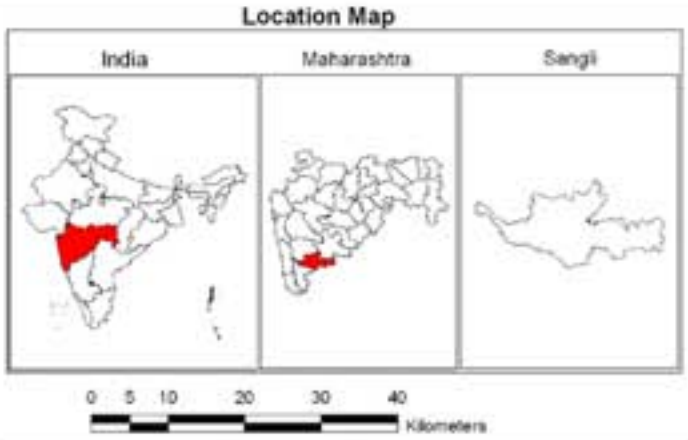
District : Sangli

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 5 10 20 30 40 Kilometers

Data Source

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared by

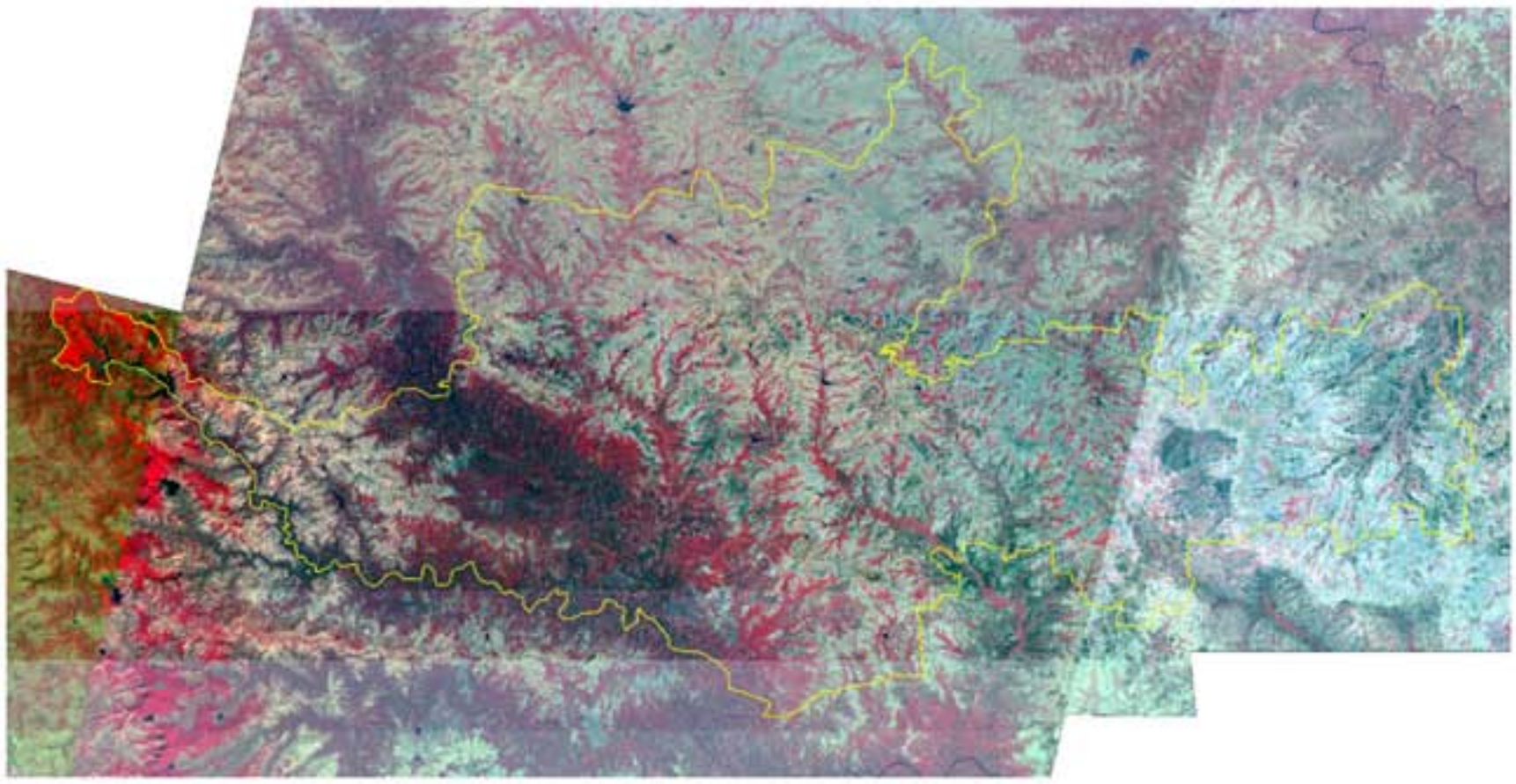
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored by

Ministry of Environment and Forests
Government of India

State : Maharashtra

District : Sangli



IRS P6 LISS-III post monsoon data (2006)

MAJOR WETLAND TYPES

8.0 MAJOR WETLAND TYPES OF MAHARASHTRA

Major wetland types observed in the state are reservoirs/barrages, rivers/stream and Tank/pond. The manifestation of these wetland types in satellite image is shown in Plate-1. Field observation of representative wetlands in the state was collected. Field photographs of the sites and observations of characteristics for some of the sites is shown in Plates 2a, 2b, 2c and 2d..

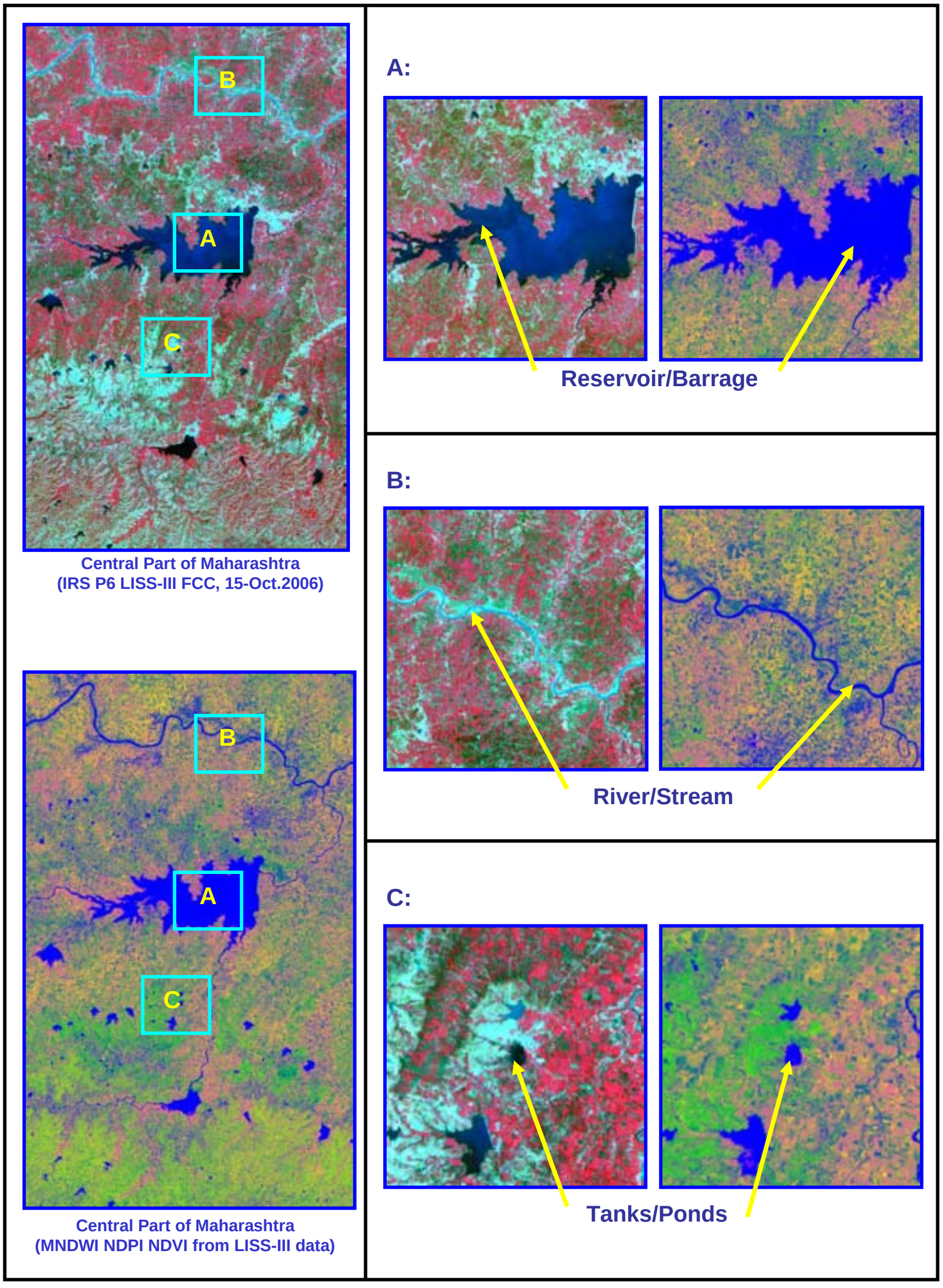
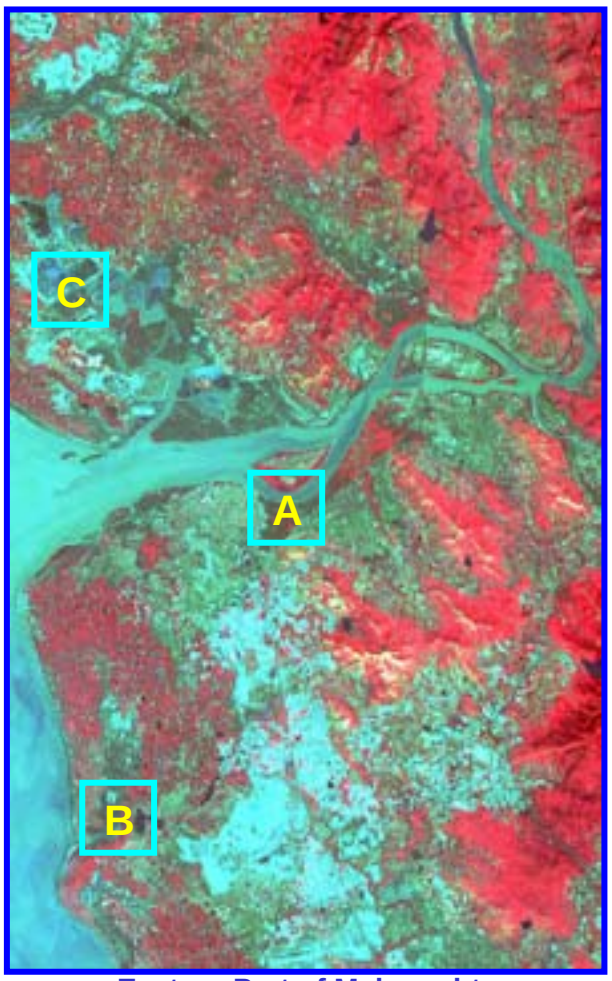
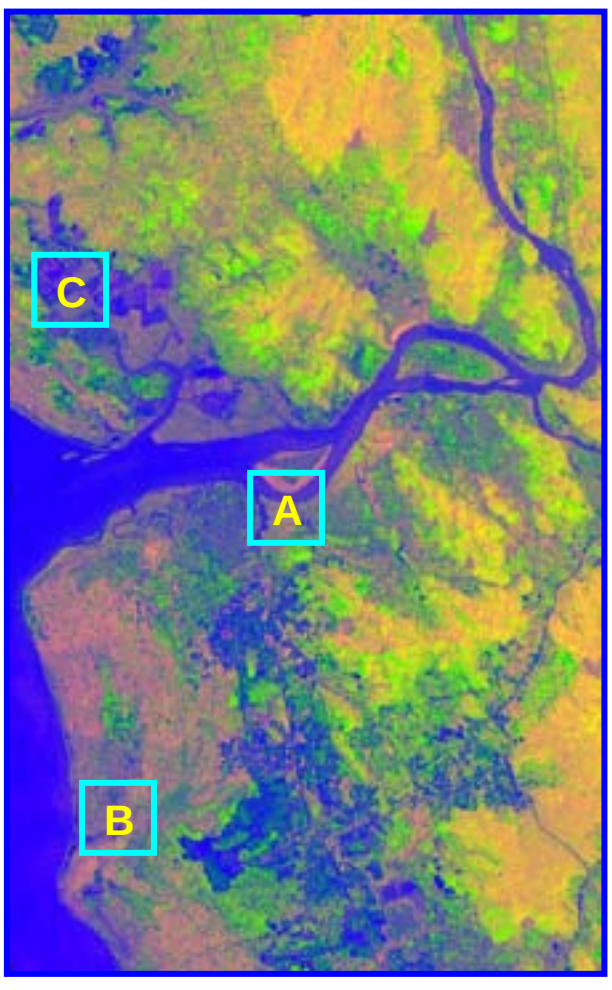


Plate – 1a: Major wetland types of Maharashtra as seen and deciphered from remote sensing data

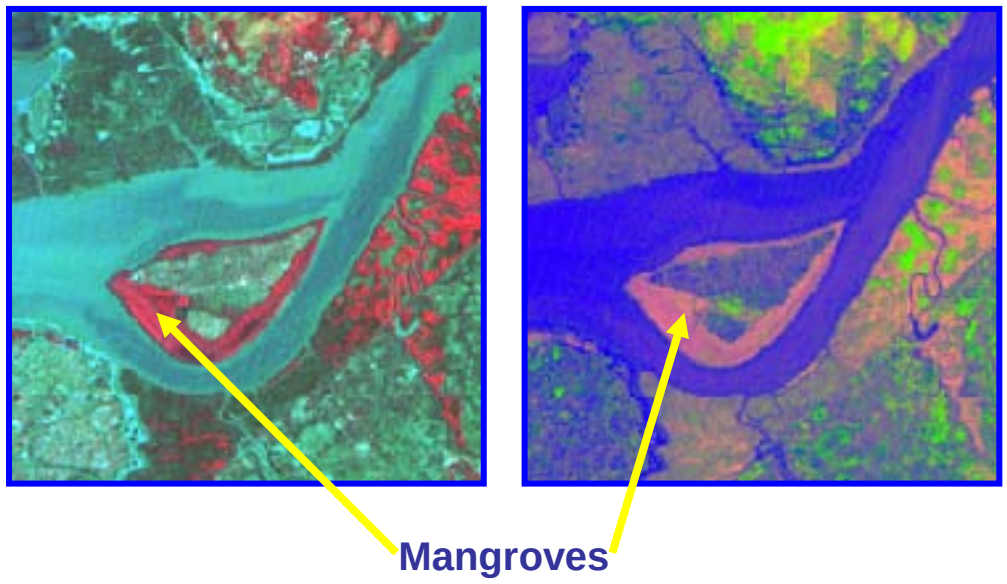


Eastern Part of Maharashtra
(IRS P6 LISS-III FCC, 2006)

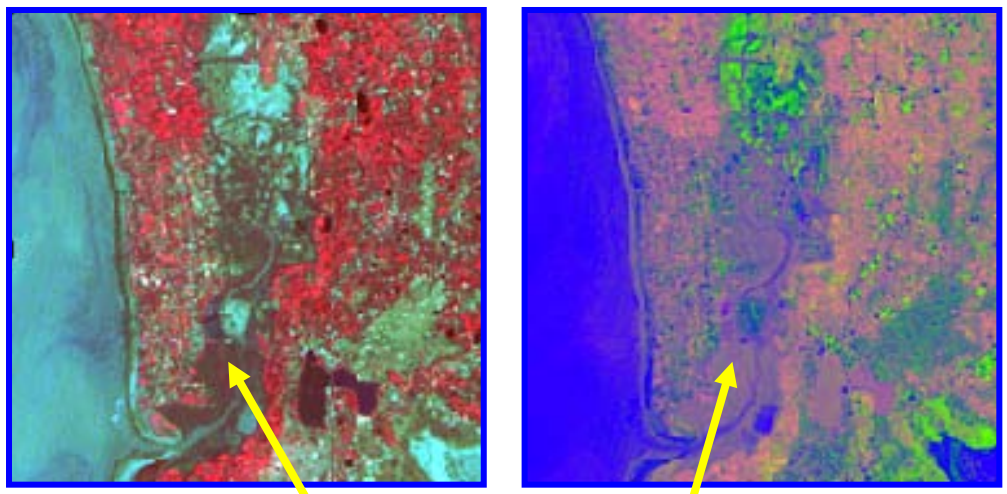


Eastern Part of Maharashtra
(MNDWI NDPI NDVI from LISS-III data)

A:



B:



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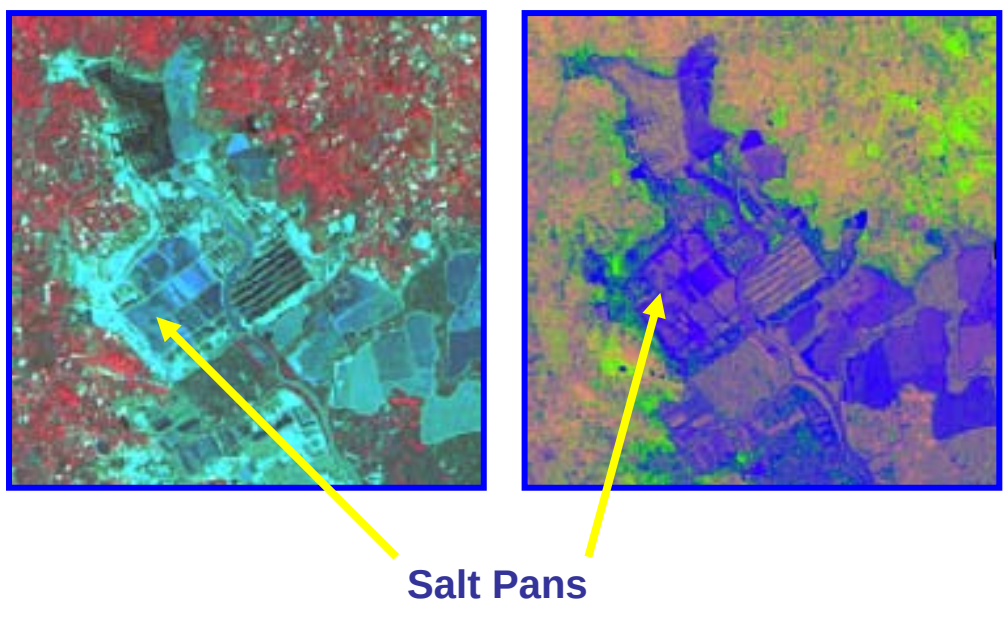


Plate – 1b: Major wetland types of Maharashtra as seen and deciphered from remote sensing data

Sr. No	Description	Field Photograph
1	**Wetland Type**: Tanks/Ponds **Location**: Longitude: 74^0 44’ 19” E Latitude : 19^0 38’ 11” N **Aquatic vegetation**: Present	
2	**Wetland Type**: Reservoir/Barrages **Location**: Longitude: 75^0 21’ 18” E Latitude : 19^0 56’ 07” N Aurangabad City : Sangvi reservoir **Aquatic vegetation**: Present	
3	**Wetland Type**: Tanks/Ponds (Cooling pond) **Location**: Longitude: 76^0 28’ 48” E Latitude : 18^0 51’ 56” N Parli Thermal Power Station	
4	**Wetland Type**: Natural Lake – Lonar (Notified Wetland) **Location**: Longitude: 76^0 30’ 28” E Latitude : 19^0 58’ 36” N **Aquatic vegetation**: Present	

Plate 2a: Field photographs and ground truth data of different wetland types in Maharashtra

Sr. No	Description	Field Photograph
5	**Wetland Type**: Reservoir/Barrages **Location**: Longitude: 79^0 47’ 57” E Latitude : 21^0 31’ 13” N Bhandara Wainganga River	
6	**Wetland Type**: River/Stream **Location**: Longitude: 78^0 48’ 42” E Latitude : 20^0 32’ 40” N Asti River **Aquatic vegetation**: Present	
7	**Wetland Type**: Reservoir/Barrages (with canal irrigation) **Location**: Longitude: 80^0 09’ 50” E Latitude : 20^0 48’ 12” N Tehsil : Arjuni Morgaon Village : Gothangaon **Aquatic vegetation**: Present	
8	**Wetland Type**: Tanks/Ponds (Notified Wetland) **Location**: Longitude: 75^0 55’ 26” E Latitude : 17^0 43’ 59” N Ekrukh tank, North of Solapur city **Aquatic vegetation**: Present	

Plate 2b: Field photographs and ground truth data of different wetland types in Maharashtra

Sr. No	Description	Field Photograph
9	**Wetland Type**: Mangroves **Location**: Longitude: 72^0 45’ 66” E Latitude : 19^0 36’ 36” N Salt Pans near Palghar	
10	**Wetland Type**: Salt Pans **Location**: Longitude: 72^0 45’ 54” E Latitude : 19^0 36’ 48” N Near Palghar	
11	**Wetland Type**: Mangroves **Location**: Longitude: 73^0 01’ 47” E Latitude : 18^0 41’ 43” N Tehsil : Pen Village : Beneghat	
12	**Wetland Type**: Sand/Beach **Location**: Longitude: 72^0 52’ 10” E Latitude : 18^0 38’ 29” N Tehsil : Alibag Village : Alibagh	

Plate 2c: Field photographs and ground truth data of different wetland types in Maharashtra

Sr. No	Description	Field Photograph
13	**Wetland Type**: Sand/Beach **Location**: Longitude: 73^0 14’ 28” E Latitude : 17^0 18’ 22” N Tehsil : Guhaghar Village : Tavasal	
14	**Wetland Type**: Creek **Location**: Longitude: 73^0 34’ 34” E Latitude : 17^0 19’ 06” N Tehsil : Guhaghar Village : Rohille	
15	**Wetland Type**: Mangroves & Creek **Location**: Longitude: 73^0 25’ 55” E Latitude : 17^0 34’ 37” N Tehsil : Chiplun Village : Ketki	
16	**Wetland Type**: Mud flat **Location**: Longitude: 73^0 28’ 50” E Latitude : 16^0 24’ 38” N Tembaval	

Plate 2d: Field photographs and ground truth data of different wetland types in Maharashtra

IMPORTANT WETLANDS OF MAHARASHTRA

9.0 IMPORTANT WETLANDS OF MAHARASHTRA

Some of the important wetlands of the state of Maharashtra are highlighted here. Major criteria identified for conservation of the wetlands were birds as recognized by the Ramsar Convention Bureau (1971, 1996). Size and economic use of the wetlands were also used. Wetland prioritization for notified wetlands in the country takes into account many parameters like hydrology, biodiversity, avifauna, fishes and socio-economic value etc. There are many notified and important wetlands in Maharashtra. Six important wetlands of the state are selected to show their status in term of morphometry and other structural components as given below:

Lonar Lake

Nathsagar Notified Wetland

Yeldari Reservoir

Nandur Madhyameshwar Tank

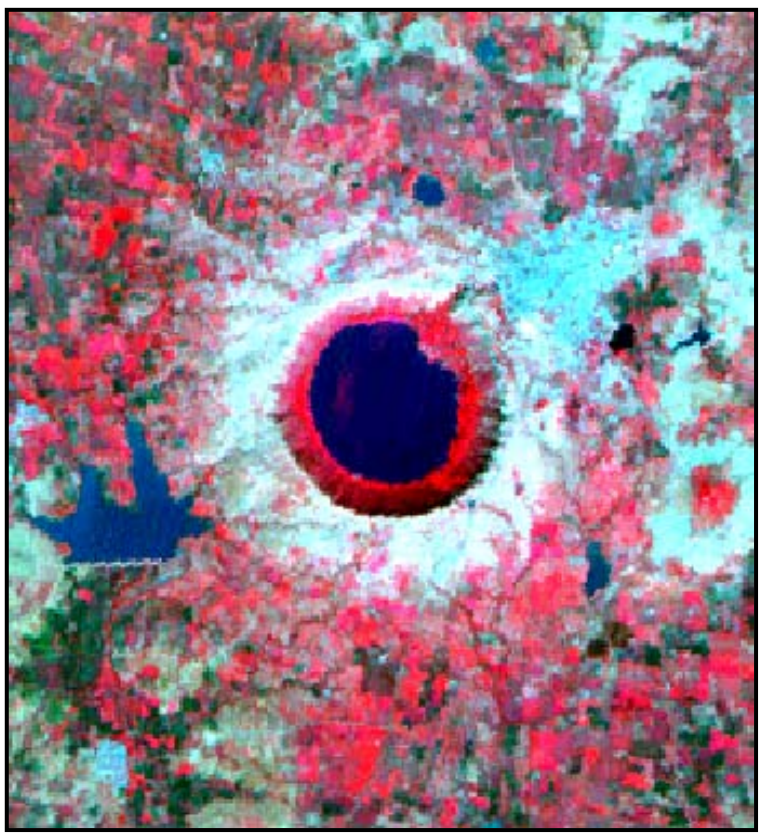
Navegaon Notified Wetland

Ujani Reservoir

Description of each of these wetlands along with the map and satellite image of 5 km buffer area of the site is given in this section. This information is vital to plan management plans to protect their biodiversity components and wiser use. Extensive field work was carried out for these wetlands to collect information on flora and fauna. A buffer of 5 km has been considered for each wetland to understand land use and satellite wetlands. These maps were given in plate 3 to 20.

9.1 Lonar Lake

Name	**Lonar Lake**
Location	Between 19^0 58'13" N and 19^0 58'57" N latitudes and 76^0 30'8" E and 76^0 30'50" E longitudes
Area	115 ha
Salient features	Lonar Lake is situated about 86 km south-west of Buldhana headquarer of the District, Maharashtra State. This is the only crater in basaltic rock formed by the meteoritic impact in India, ranking third largest in the world. This is the salt water lake. The Lonar Crater has a circular outline with a diameter of 1,830 m and a depth of 150 m with steep vertical slopes. The maximum elevation of the area is 669 m and the minimum is 670 m.
Turbidity	Low
Vegetation	Resident and migratory birds such as black-winged stilts, brahminy ducks, grebes, shell-ducks (European migrants), shovellers, teals, herons, red-wattled lapwings, rollers or blue jays, baya weavers, parakeet hoopoes, larks, tailorbirds, magpies, peacocks and robins and swallows are found on the lake. Among reptiles, the monitor lizard is reported to be prominent. The lake is also home to thousands of pea fowls, chinkara and gazelles. Rabbit, mongoose, deer, langur monkeys and snakes are also found.
Fauna	Principal vegetation of the area is of a dry deciduous type on the crater, dry bushy vegetation on the rim and slopes, moist deciduous component along the bank of perennial stream and salt tolerant vegetation along the lake shore. Among the fauna you can find custard apple, eucalyptus, lemon grass, bamboo, teak and many other trees as go down, the thick mixed deciduous forest also seen.



Post-Monsoon 2006

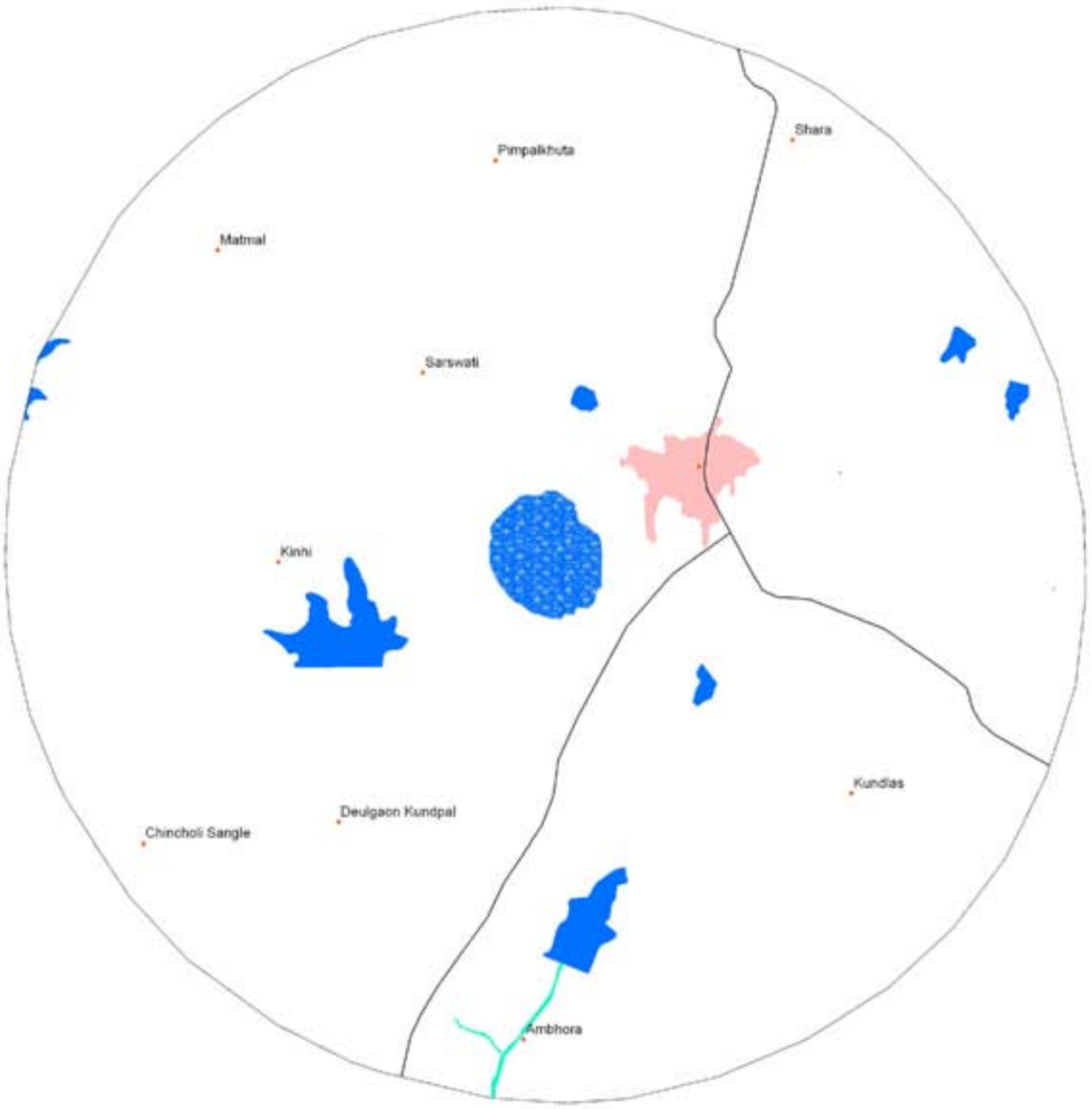
Pre-Monsoon 2007

Plate 3: Lonar Lake

State : Maharashtra

WETLAND MAP

Lonar Lake

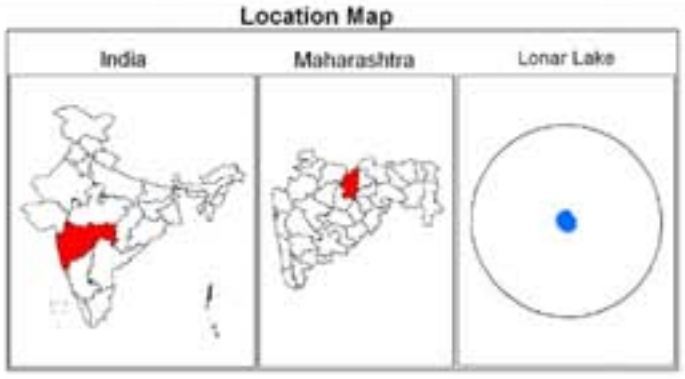


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 0.5 1 2 3 Kilometers

Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

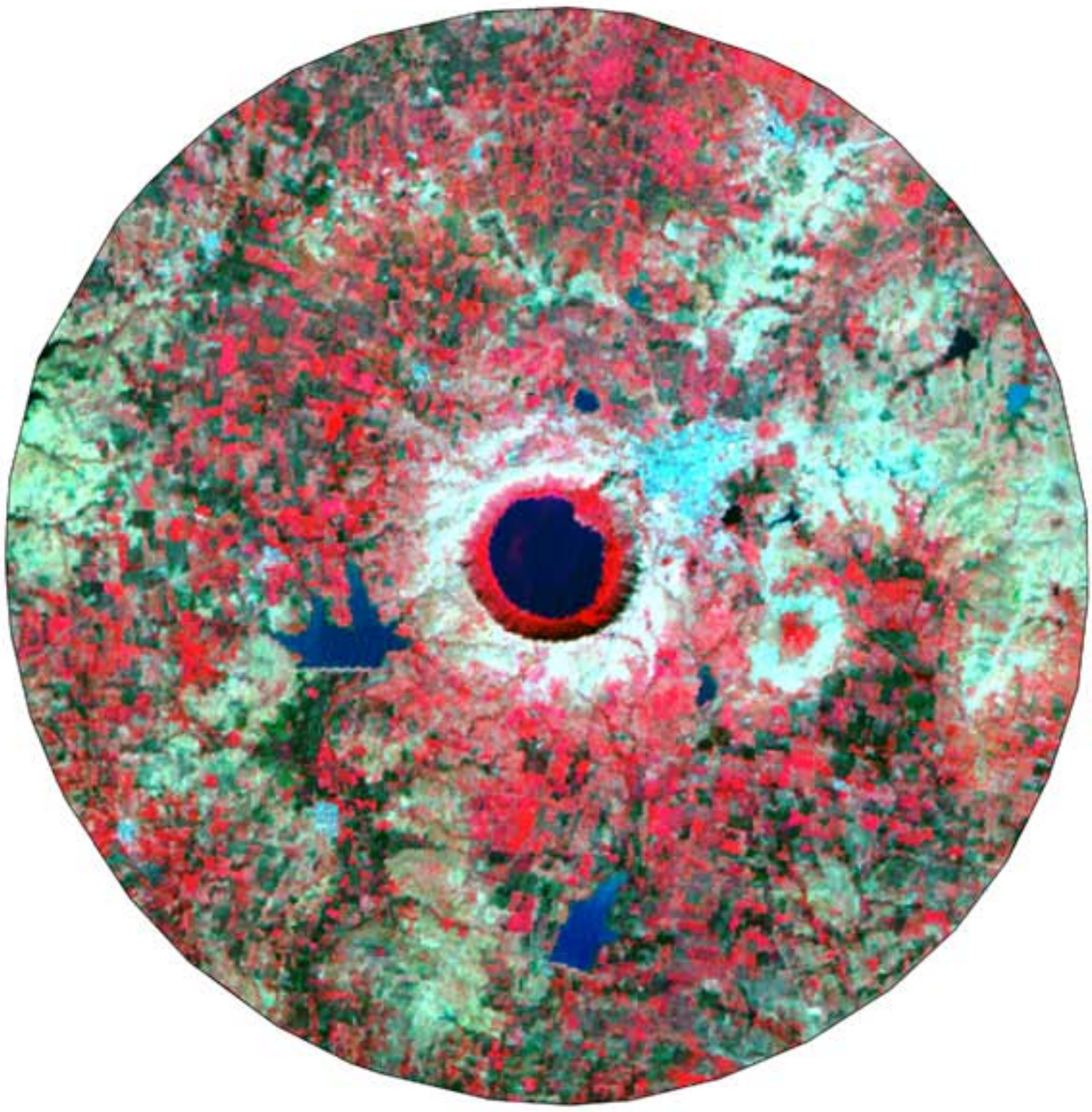
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 4: Wetland map - 5 km buffer area of Lonar Lake

State : Maharashtra

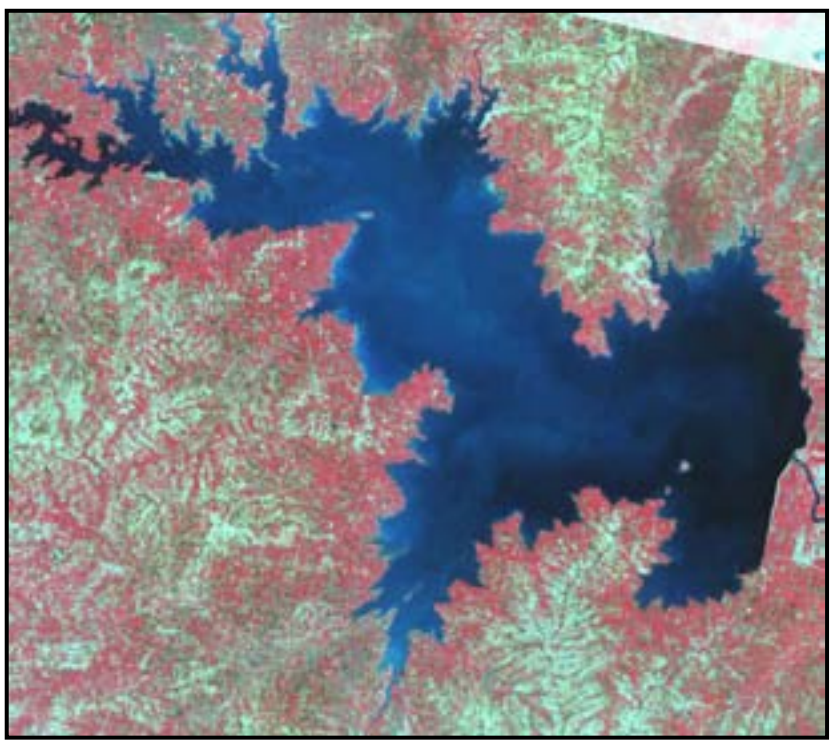
Lonar Lake



IRS-P6 LISS-III Post-monsoon data(2006-2007)

9.2 Nathsagar Notified Wetland

Name	Nathsagar Notified Wetland
Location	Between 19^0 22' N and 19^0 40' N latitudes and 74^0 52' E and 75^0 22' E longitudes
Area	18153 ha
Climate	Tropical monsoon climate
Salient features	Nathsagar reservoir is one of the major irrigation projects in Maharashtra state. It has been constructed across the river Godavari, a major river in southern India. The catchment area of Nathsagar dam is 21750 km2 and impounding gross storage of dam is 2909 million cubic meters. The submergence area of dam is 35000 ha. The maximum height of this dam is 37 meter. This project has rehabilitated 107 villages. Nathsagar is one of the largest shallow wetland habitats which was traced by the migratory birds, 10-12 years ago.
Turbidity	Low - High
Vegetation	Species of Hydrilla, Myriophyllum, and Potamogeton in the ponds, and *Carex sp*., other sedges, and grasses in the marshes. The surrounding arid steppe is dominated by *Caragana sp*.
Fauna	Due to favorable environmental factors, ample food and safeness, this habitat is at the peak in fetching the birds from November to February every year. A total of 66 species were recorded. *Some of them are Amblypharyngodon mola Muraena anguilla, Aorichthys aor Muraenesox bagio,A. seenghala Mystus armatus, Barilius bendelisis M. tengara, Branchydanio rerio, andus nandus, Catla buchanani Nemacheilus aureus, C. catla N. botia, Channa marulius Notopterus notopterus, C. orientalis Ompak bimuculatus, C. punctatus Osteobrama , himensis, Chitala chitala O. cotio, Cirrhinus cirrhosus Osteochilichthys, godavariensis, C. mrigala Pangasius pangasius, Clarius batrachus Parasilorhynchus, tentacularis, Ctenopharyngodon idellus Plotosus lineatus.Cyprinus carpio carpio Poecilia reticulate, Danio aequipinnatus, Pseudeutropinus taakree etc.*



Post-Monsoon 2006

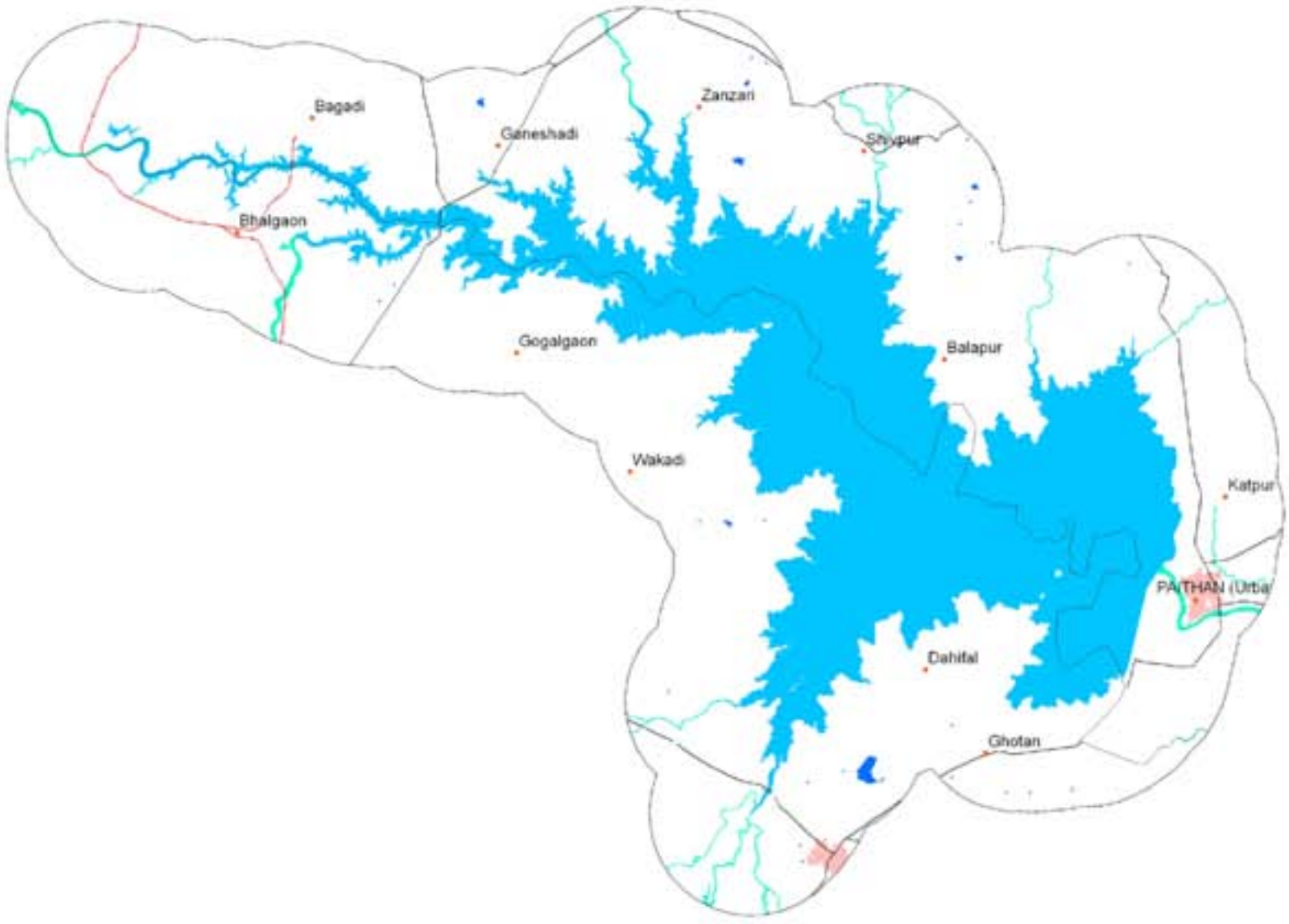
Pre-Monsoon 2007

Plate 6: Nathsagar Notified Wetland

State : Maharashtra

WETLAND MAP

Nathsagar Notified Wetland



Symbol	Typecode	Level I	Level II	Level III
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	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
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		Coastal Wetlands		
			Natural	
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	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map

0 3 6 12 18 Kilometers

Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

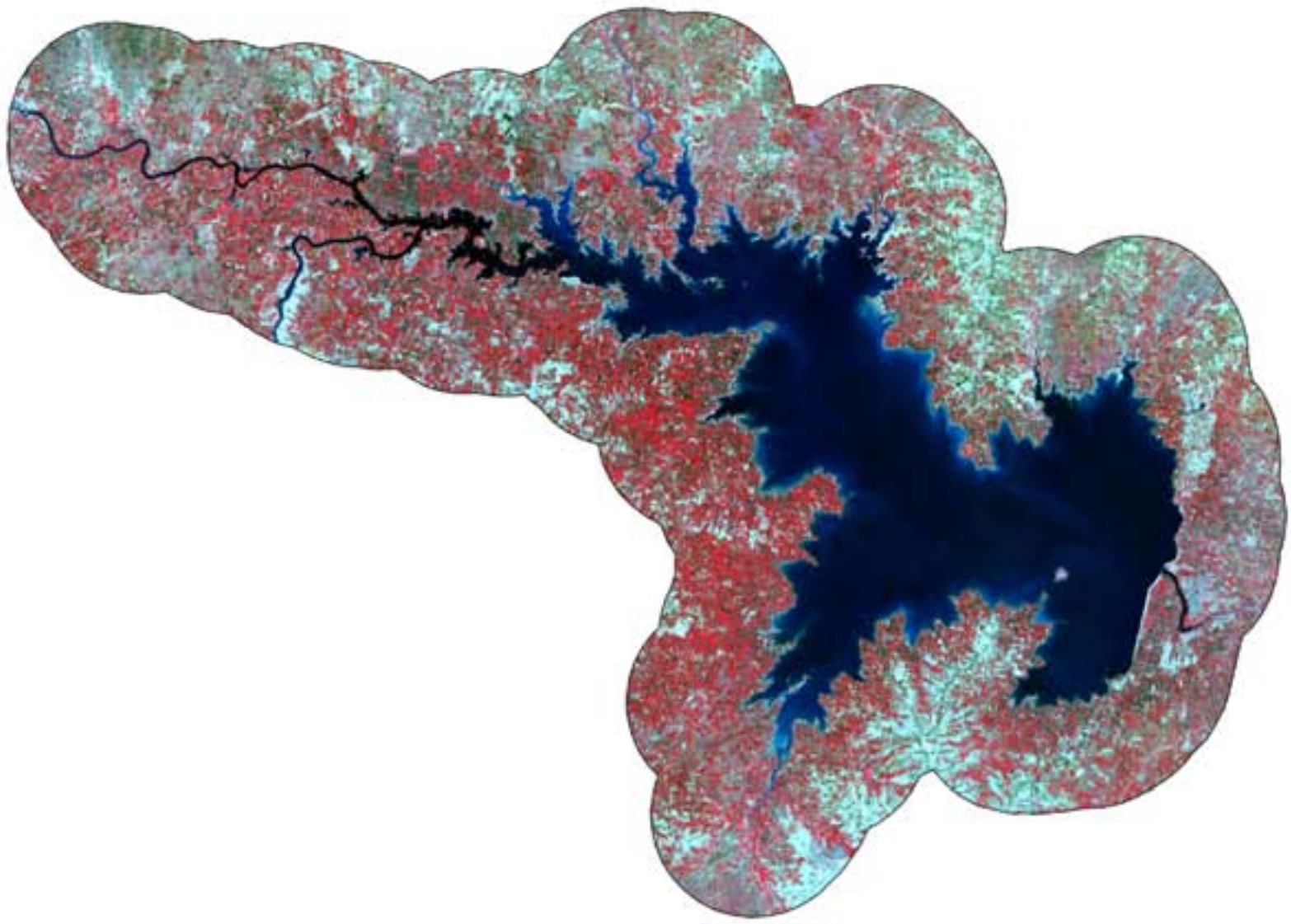
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 7: Wetland map - 5 km buffer area of Nathsagar Reservoir Notified Wetland

State : Maharashtra

Nathsagar Notified Wetland

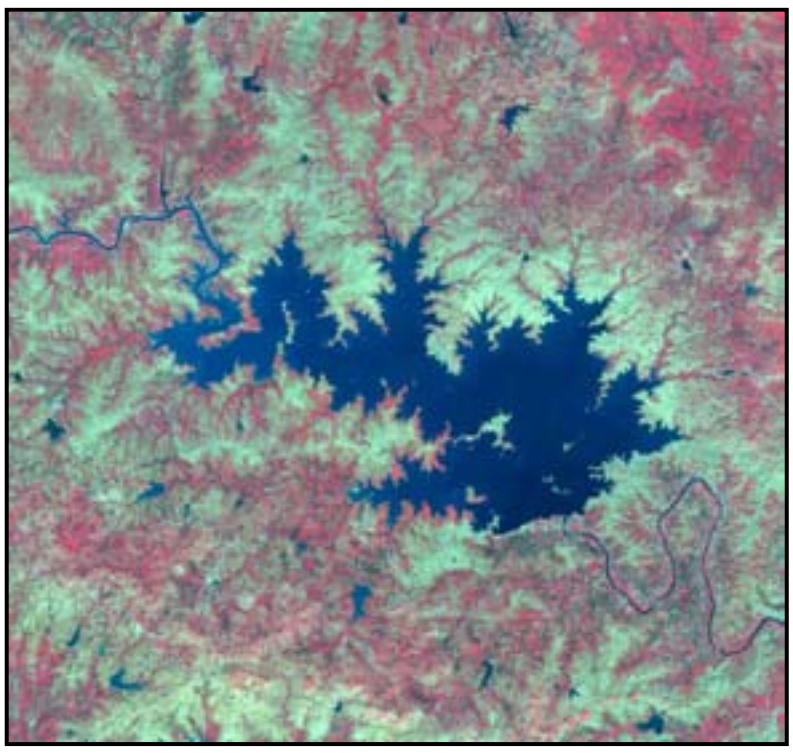


IRS-P6 LISS-III Post-monsoon data(2006-2007)

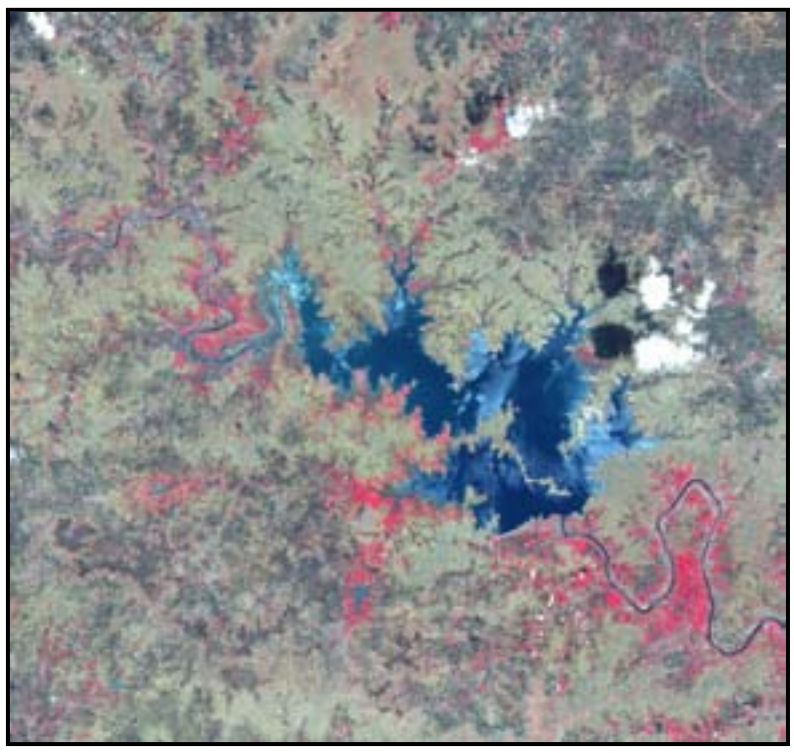
Plate 8: IRS LISS III FCC - 5 km buffer area of Nathsagar Reservoir Notified Wetland

9.3 Yeldari Reservoir

Name	Yeldari Reservoir
Location	Between 19^0 42' N and 19^0 50' N latitudes and 76^0 32' E and 76^0 46' E longitudes
Area	9972 ha
Climate	Tropical monsoon climate.
Salient features	The Yeldari reservoir, a purely hydro-electric project, was constricted in the year 1962 in the hilly area of Jintur tashsil, Parbhani district, Maharashtra. The reservoir is included in the Survey of India top sheet map no.564/10. The area around the reservoir comprises forest covered hills. The maximum level of reservoir is 462.380 m. Its importance for water supply, the reservoir supports a small fishery supplying local markets.
Turbidity	Low
Vegetation	Phytoplankton *population includes Anabaena* sp. *Navicula mutica, Arthrospira* spp. *Nitzchia* sp., *Chlorella vulgaris Nostoc* spp., *Cladophora* sp. *Oedogonium* sp, *Closterium* sp. *Oscillatoria chlorine, Cosmarium. Microsporum, Pandorina morum, Cyclotella operculata , Pediastrum duplex, Cymbella turgida Phormidium* sp, *Eudorina* sp. *Pinnularia viridis, Gomophonema gracile Spirogyra, margariata, Lygnbya majuscule Stichococcus* sp, *Melosira* sp. *Synedra ulna etc.*
Fauna	Zooplankton *population includes Brachionus calyflorus Euchianis dilate, B. diversicornis Filina longiseta, Alona rectangular Indialona ganapati, Biapertura karma Keratella tropica, Brachionus flacatus Lecane bulla, Candocypria osborni Mesocyclops, hyalinus, Ceriodaphnia cornuta M. leukarti, Cyclocypris globosa Moina micrura, Cyclops viridis Nauplius larva, Cypris* sp. *Neodiaptomus, lindbergi, Diaphanosoma excisum , hylladiaptomus, annae, D. sarsi Stenocypris* sp, *Diaptomus marshianus Trichocera porellus etc.*



Post-Monsoon 2006



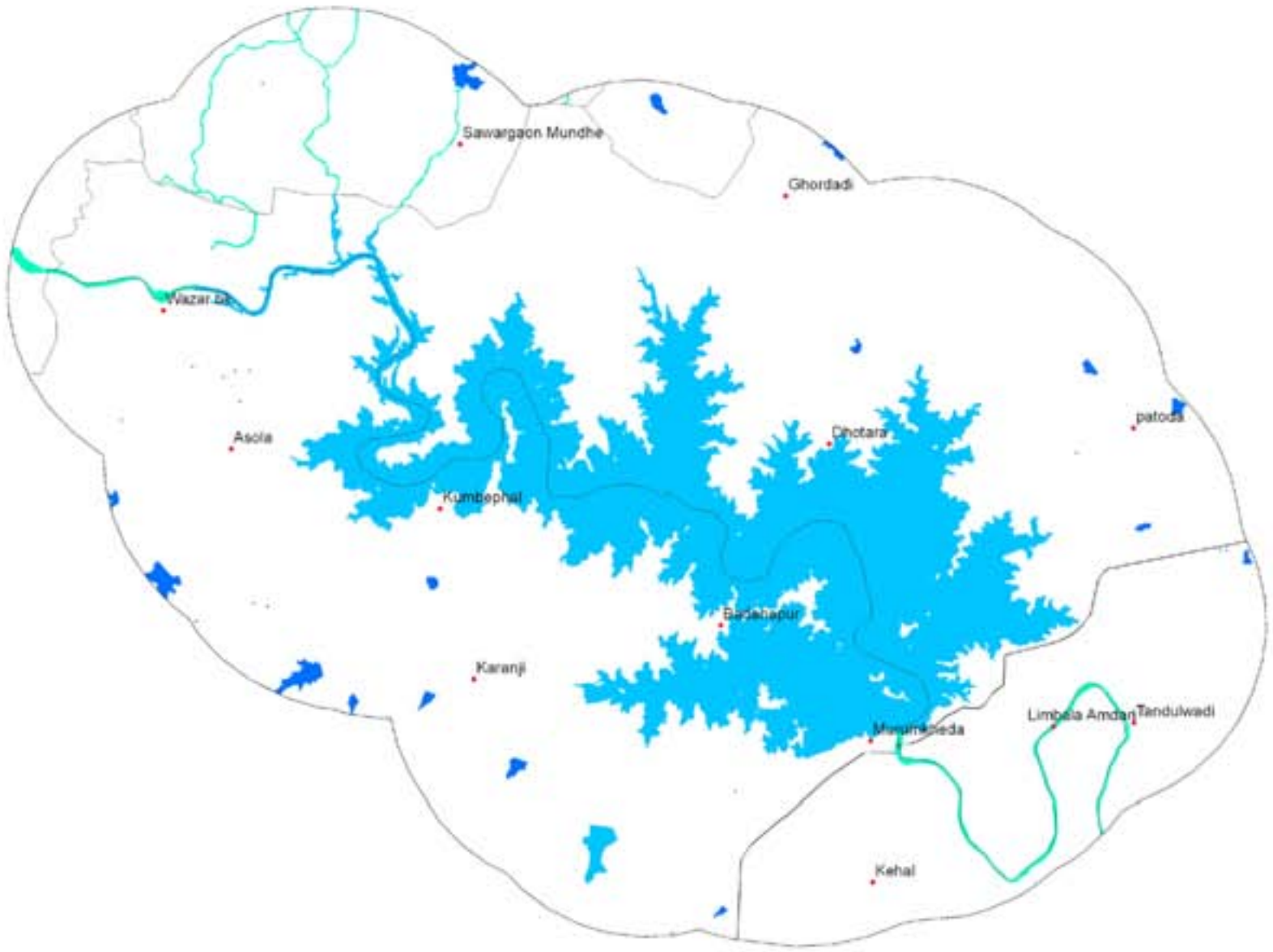
Pre-Monsoon 2007

Plate 9: Yeldari Reservoir

State : Maharashtra

WETLAND MAP

Yeldari Reservoir

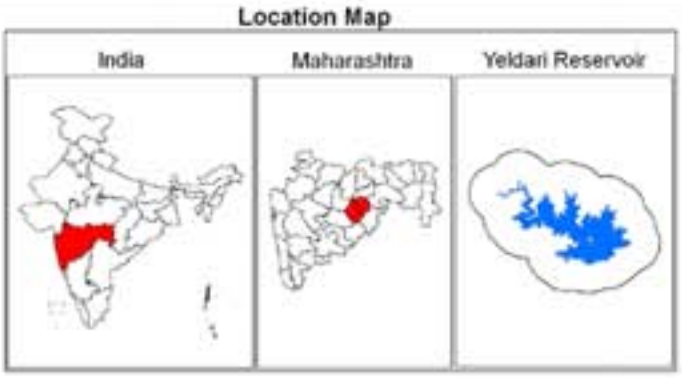


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 1.5 3 6 9 Kilometers

Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 10: Wetland map - 5 km buffer area of Yeldari Reservoir

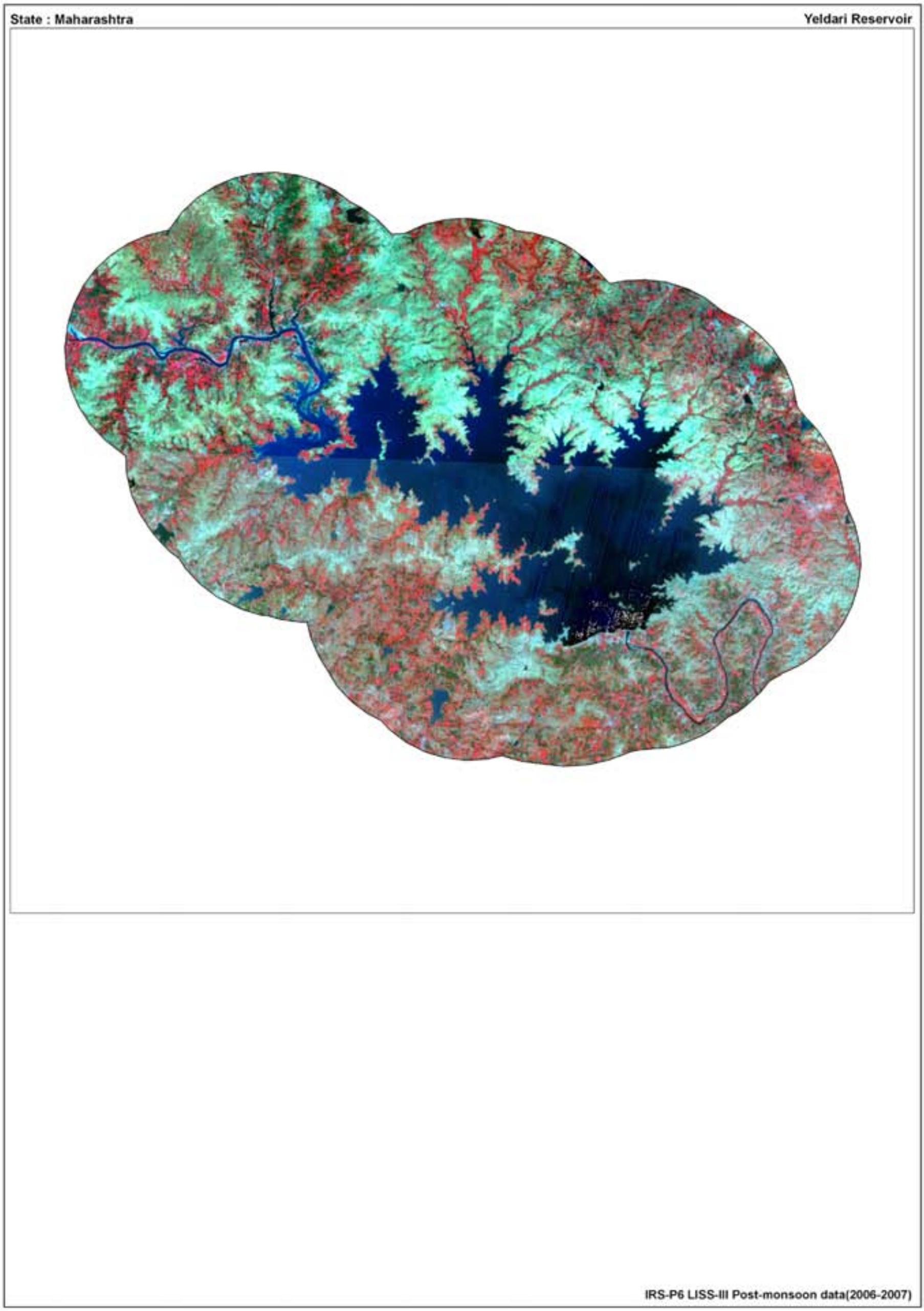


Plate 11: IRS LISS III FCC - 5 km buffer area of Gangapur Tank

9.4 Nandur Madhyameshwar Tank

Name	Nandur Madhyameshwar Tank
Location	Between 20^0 01' N and 20^0 07' N latitudes and 74^0 05' E and 74^0 07' E longitudes
Area	608 ha
Climate	Average annual rainfall : 500 mm : Semi-arid, tropical monsoon climate Temperature: 4^o to 26^o C.
Salient features	The reservoir fills with monsoon run-off during July-September and may overflow in years of heavy rainfall. Water is released from the reservoir at fixed intervals from October to April. Huge amounts of silt have been deposited over the last 80 years; consequently much of the lake is now marshland or very shallow water. There are three large islands covered with reed-beds and sedge marshes. As the dry season progresses, the Godavari river becomes the main water-course once again. An ancient temple (Madhameshwar) is situated on the banks of Godavari river below the dam. The presence of about 23 small lakes within a radius of 25 km of the reservoir adds to the overall importance of the region.
Turbidity	Moderate
Vegetation	Almeida (1983) lists 463 species of plants, including over 80 species of aquatic plants; The latter include *Azolla pinnata P. geniculatum*, *Cryptdcorine spiralis Phyla nodiflora*, *Cyperus* spp. *Polygonum glabrum* , *Echiinochloa colnum P. plebeium*, *Eichhornia crassipes Potamogeton crispus*, *Hydrilla verticillata P. pectinata.* The surrounding areas are intensively cultivated for sugarcane, wheat, jawar, and vineyards, and the landscape is almost devoid of trees
Fauna	Over 20 species of fish have been recorded in the reservoir, including *Aspidoparis morar Mastacembelus, armatus, Barilius bendelisis Mystus cavasius, Channa ranga Ompok bimaculatus.* At least 235 species of bird are known to occur, of which 85% are migratory. The reservoir is particularly important as a staging and wintering area for migratory waterfowl. Up to 15,000 waterfowl have been recorded in winter, and even more are reported to be present during the migration seasons. A waterfowl census in January 1987 recorded aIn1ost 12,000 waterfowl, including: *Anastolmus oscitans, Nycticorax , nycticorax , Anthropoides virgo, Phalacrocorax niger, Ardeola grayii* , *Platalea leucorodia, Bubulcus ibis,Plegadis falcinellus, Calidris minuta, Pseudibis papillosa, Ciconia ciconia* , Other ducks, *Limosa limosa* .

Post-Monsoon 2006

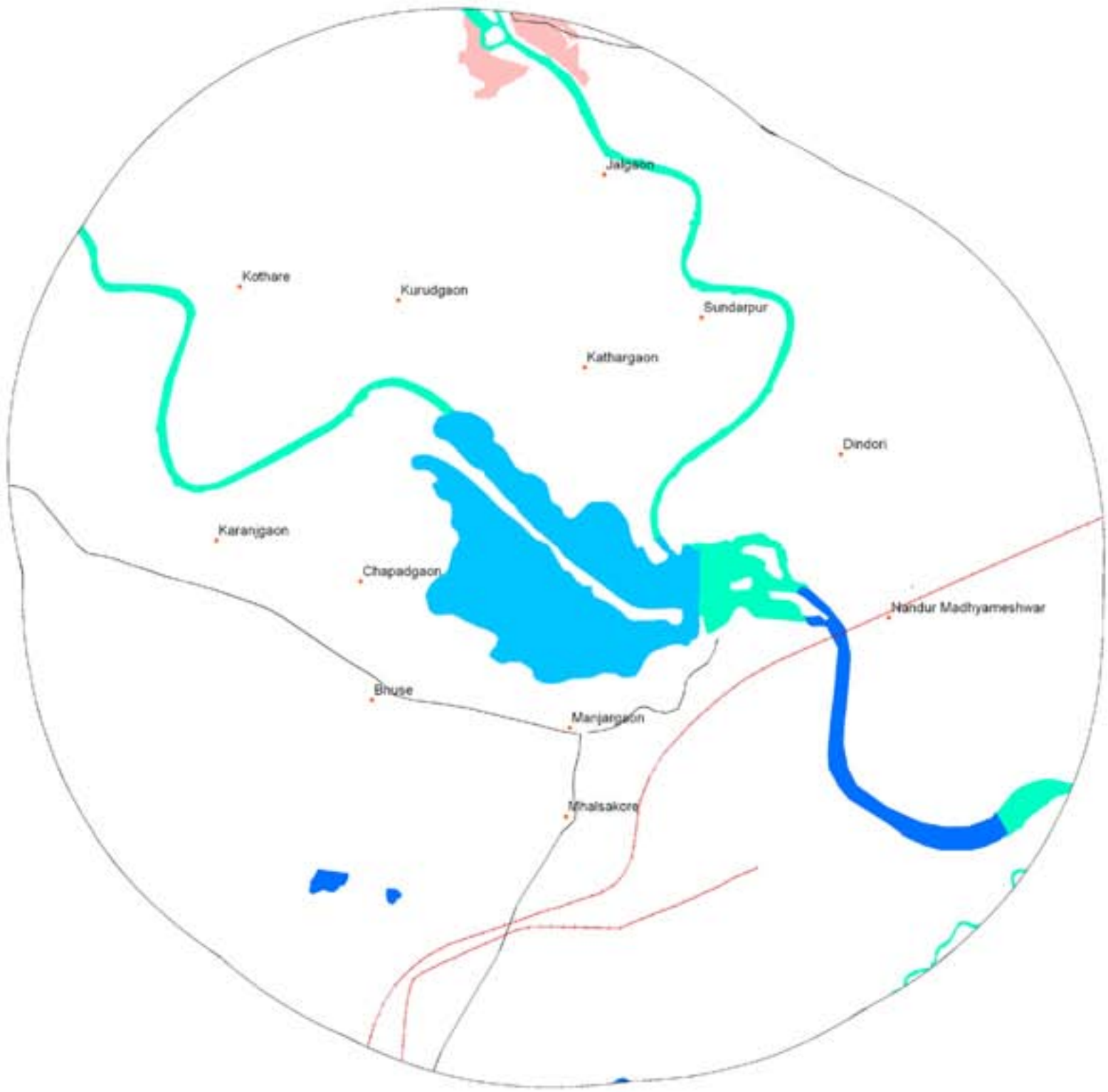
Pre-Monsoon 2007

Plate 12: Namdur Madhyameshwar Tank

State : Maharashtra

WETLAND MAP

Nandur-Madhyameshwar Tank

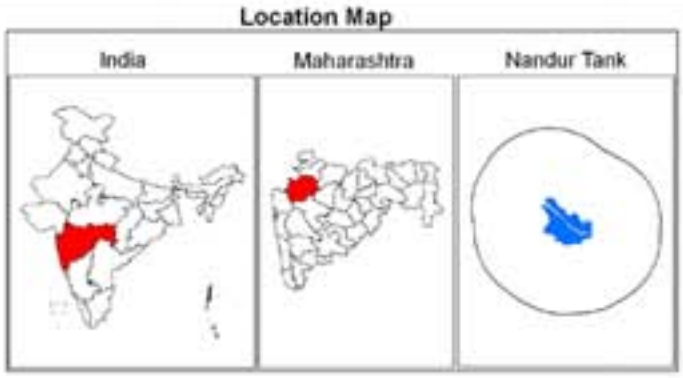


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 0.5 1 2 3 Kilometers

Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 13: Wetland map - 5 km buffer area of Namdur Madhyameshwar Tank

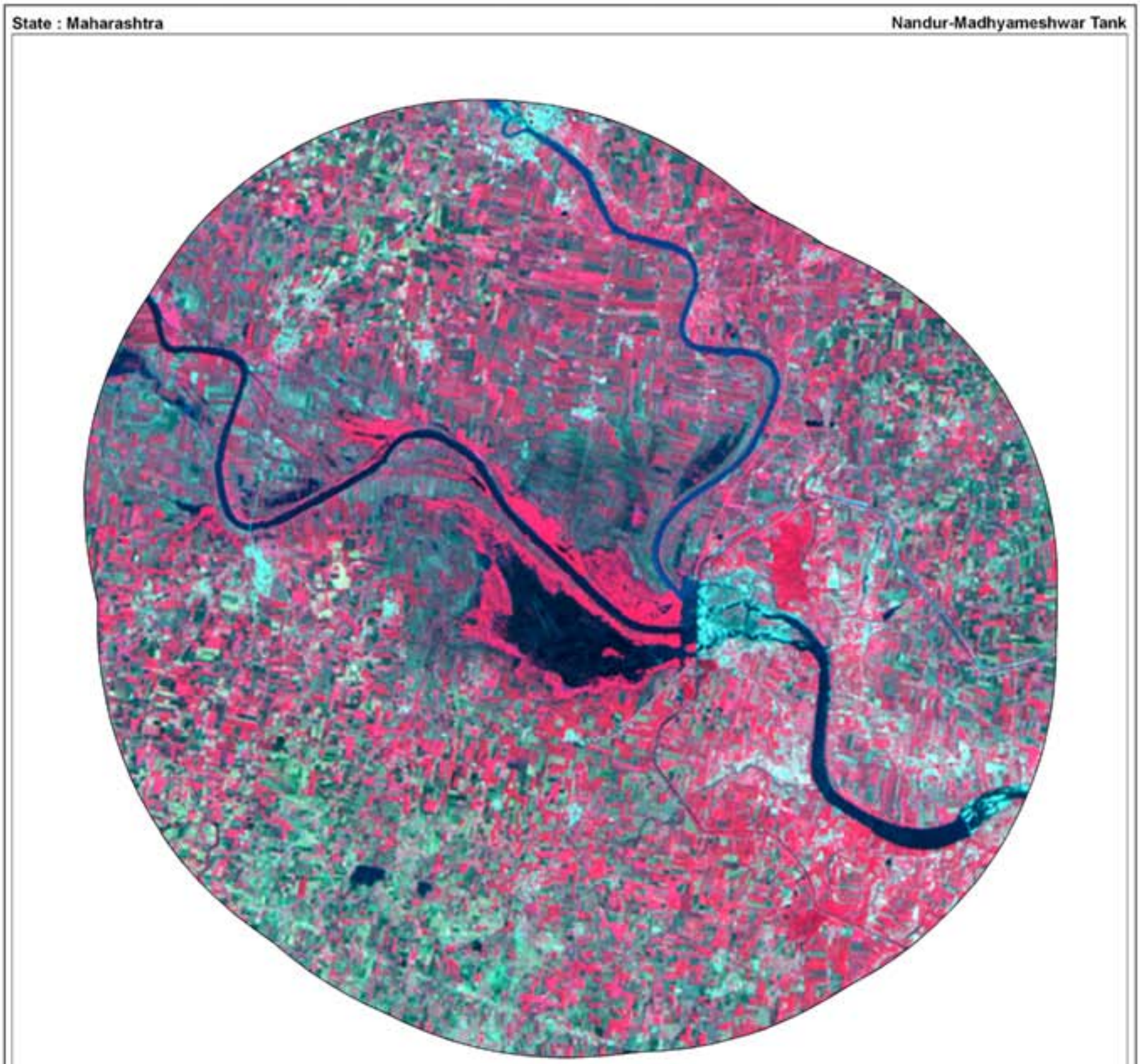
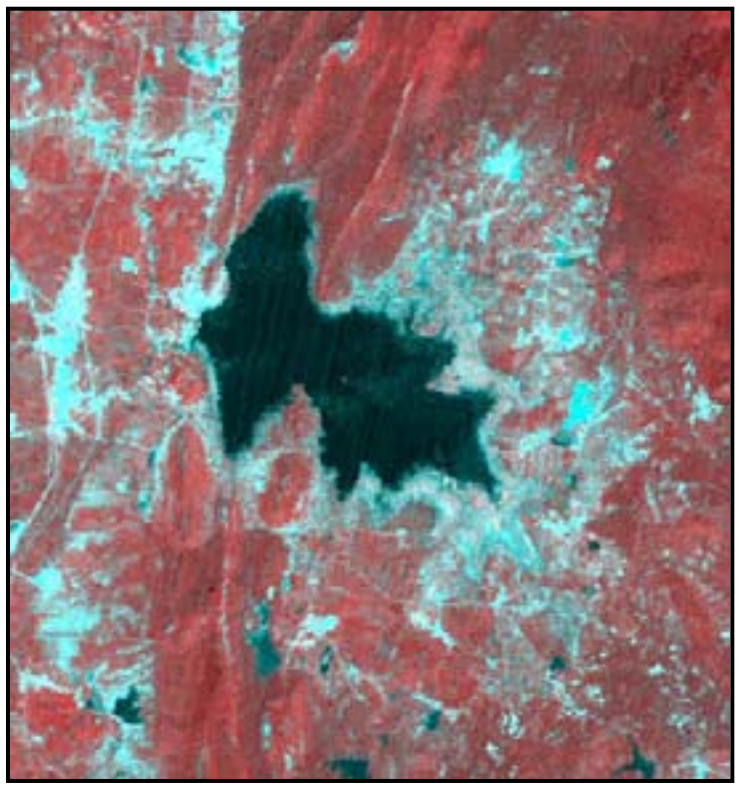


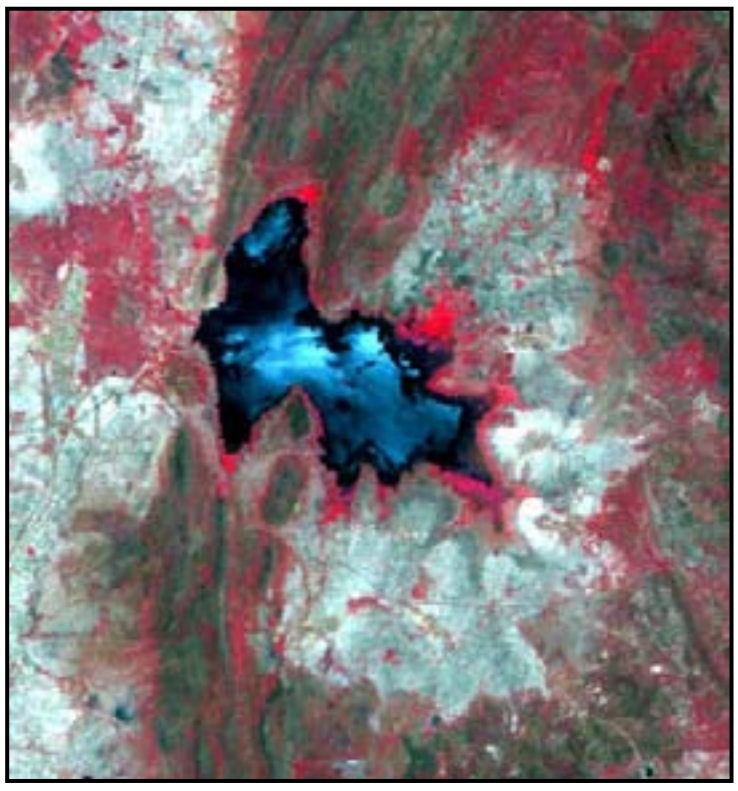
Plate 14: IRS LISS III FCC - 5 km buffer area of Namdur Madhyameshwar Tank

9.5 Navegaon Notified Wetland

Name	Navegaon Notified Wetland
Location	Between 20^0 53' N and 20^0 56' N latitudes and 80^0 06' E and 80^0 09' E longitudes
Area	1305 ha
Salient features	It is a Reservoir attracts large number of resident and migratory avifauna. Vidarbha's most popular forest resort, is the ultimate adventure spot. It is said to have been built by Kolu Patel Kohli in the beginning of the 18th century. There's picturesque lake set in the midst of hill ranges with watchtowers that enable you to view wildlife. A visit the deer park is a must, the Dr. Salim Ali Bird Sanctuary, the three beautiful gardens and the children's park.
Turbidity	Low to high
Vegetation	Eastern part of the reservoir is dominated with aquatic vegetation. The emergent vegetation and reeds attract large number of migratory birds. However, the details of species composition is scanty.
Fauna	Almost 60% of the birds species found in Maharashtra have been recorded in Nawegaon. You may see the leopard, sloth bear, gaur, sambar, chital or the langur.



Post-Monsoon 2006



Pre-Monsoon 2007

Plate 15: Navegaon Notified Wetland

State : Maharashtra

WETLAND MAP

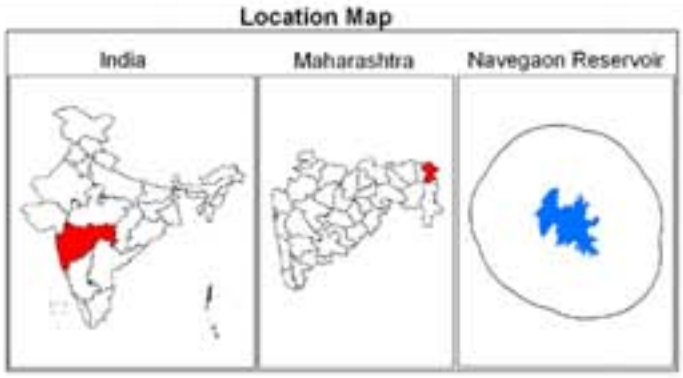
Navegaon Reservoir

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 0.5 1 2 3 Kilometers

Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

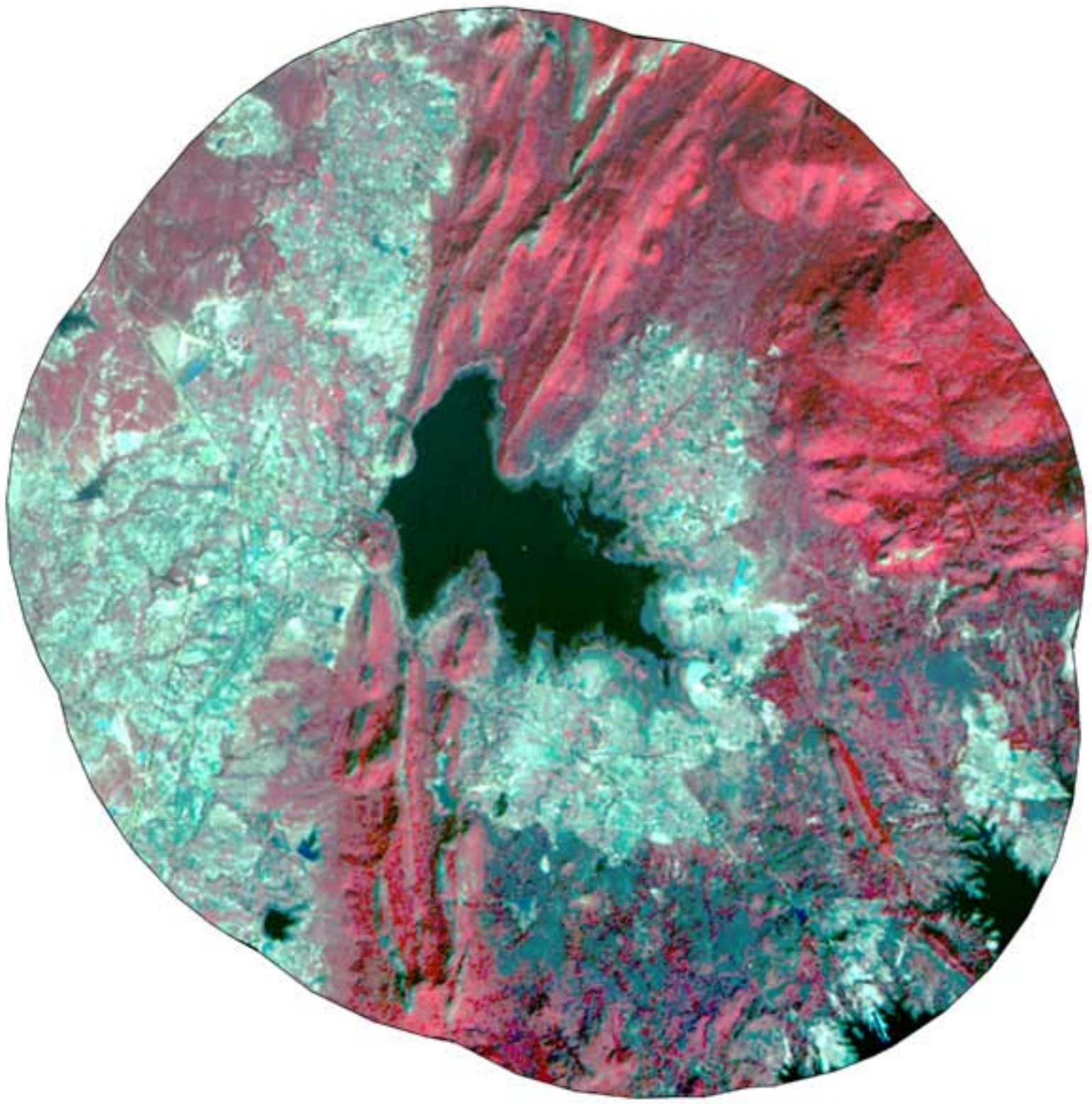
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 16: Wetland map - 5 km buffer area of Navegaon Notified Wetland

State : Maharashtra

Navegaon Reservoir

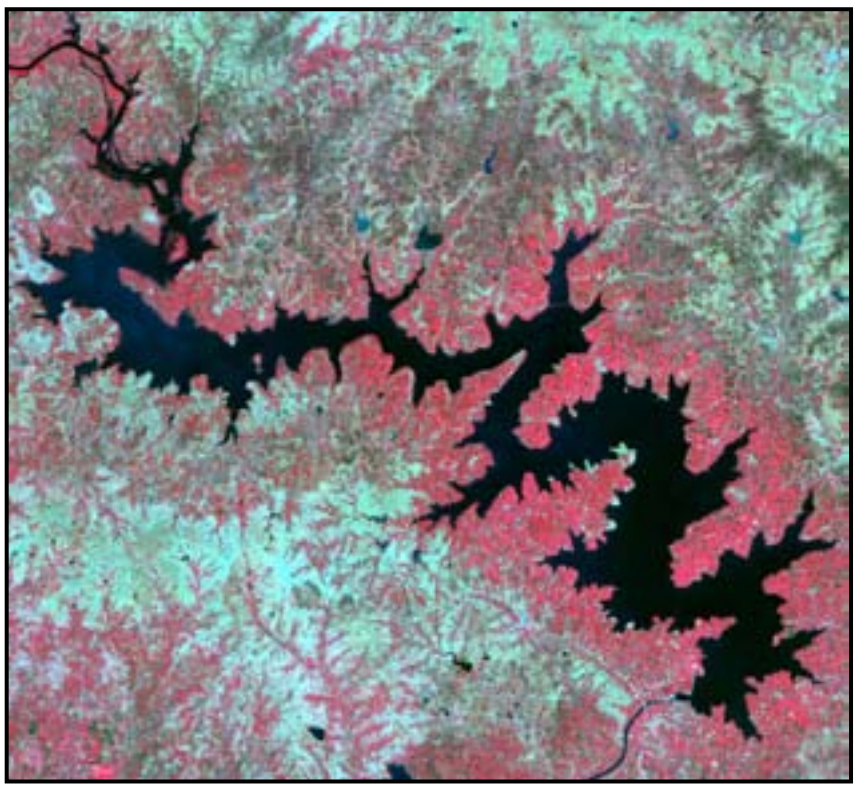


IRS P6 LISS-III Post-monsoon data (2006)

Plate 17: IRS LISS III FCC - 5 km buffer area of Navegaon Notified Wetland

9.6 Ujani Reservoir

Name	Ujani Reservoir
Location	Between 18^0 03' N and 18^0 26' N latitudes and 74^0 44' E and 75^0 12' E longitudes
Area	30179 ha
Climate	Tropical monsoon climate
Salient features	Ujjini is a large reservoir of the Maharashtra state is constructed across river Bhima in 1978. The maximum depth of the reservoir is 10.7 m. The lake supports an important fishing industry and is a valuable source of water for irrigation and domestic use.
Turbidity	Low
Vegetation	Not available
Fauna	The reservoir was stocked with fingerlings of Indian major carps at two numbers of them per hectare.



Post-Monsoon 2006

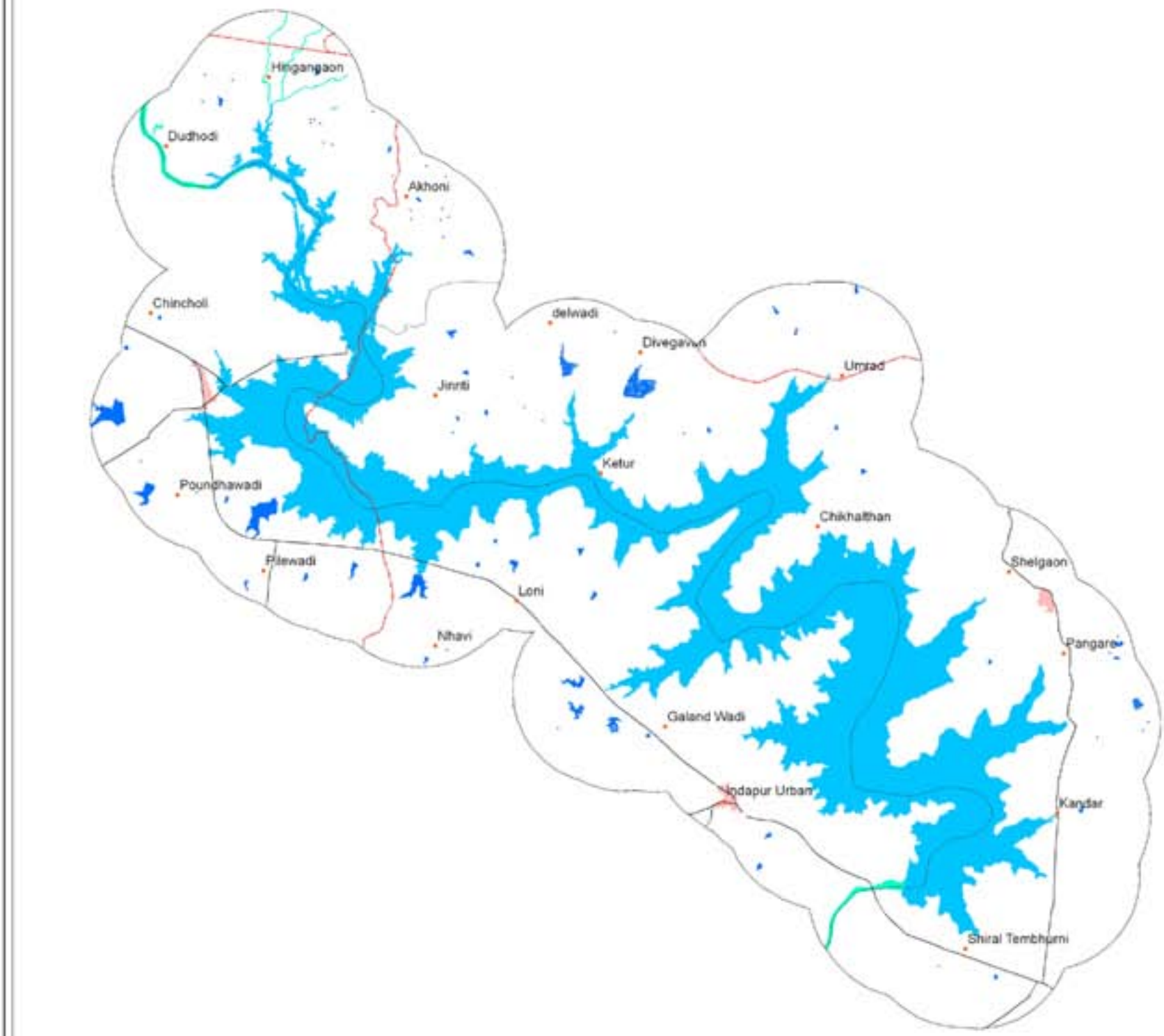
Pre-Monsoon 2007

Plate 18: Ujani Reservoir

State : Maharashtra

WETLAND MAP

Ujani Reservoir

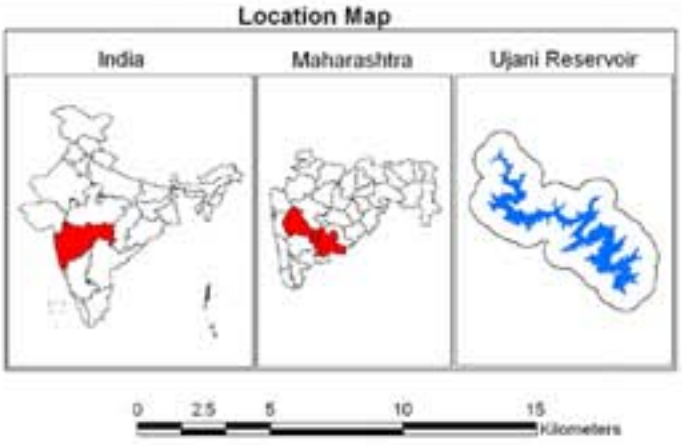


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 2.5 5 10 15 Kilometers

Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

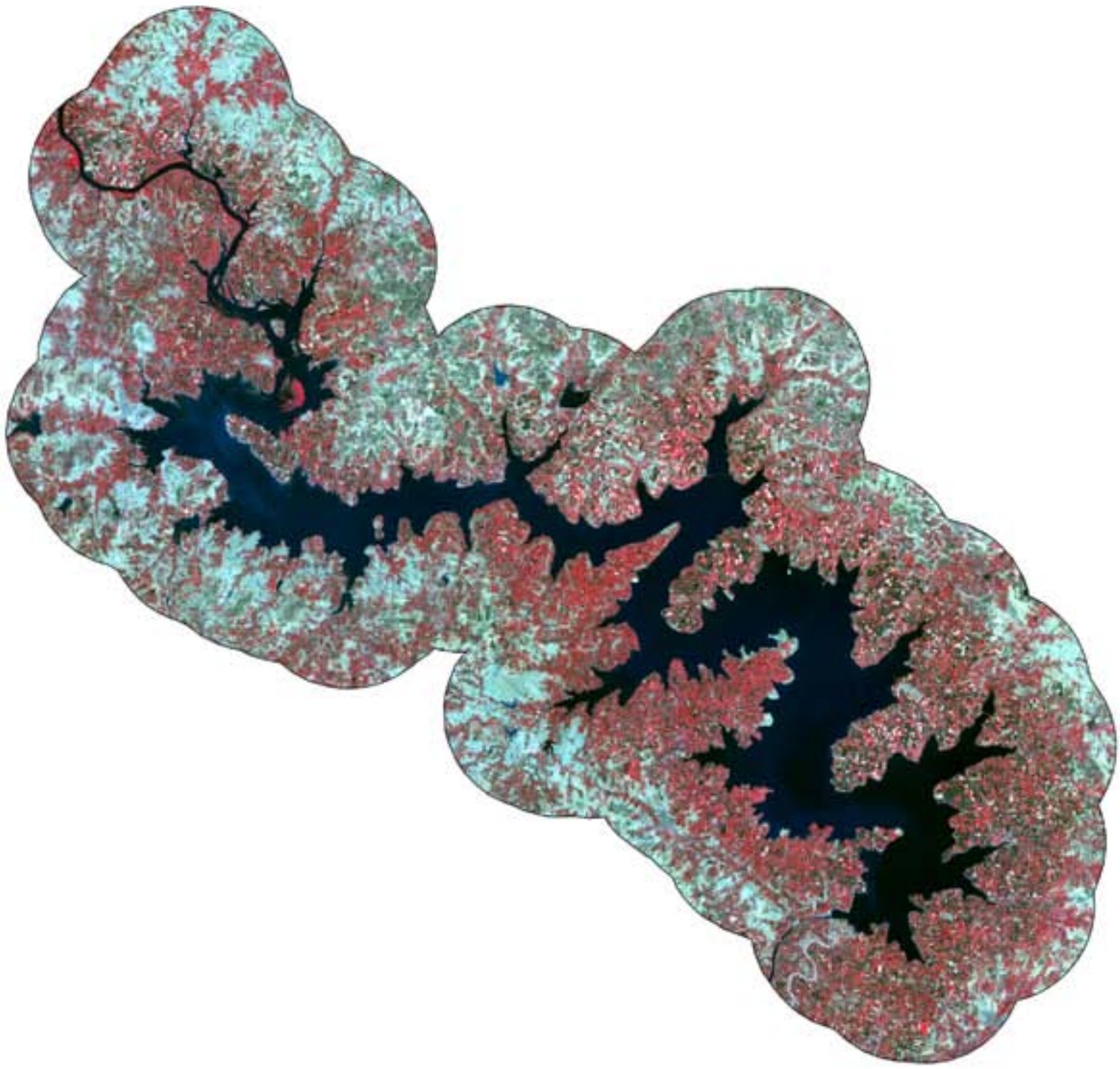
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 19: Wetland map - 5 km buffer area of Ujani Reservoir

State : Maharashtra

Ujani Reservoir



IRS-P6 LISS-III Post-monsoon data(2006-2007)

Plate 20: IRS LISS III FCC - 5 km buffer area of Ujani Reservoir

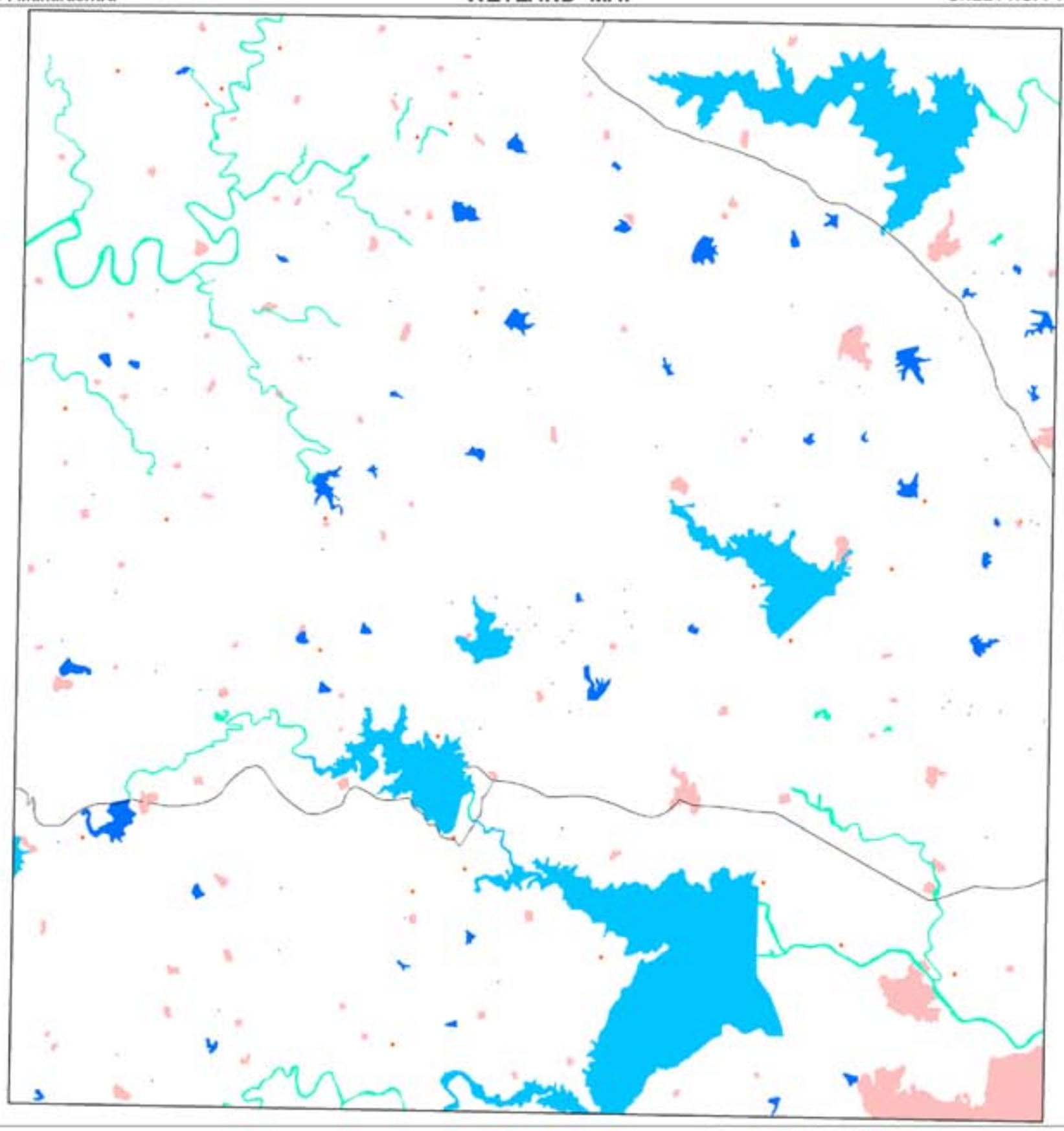
SOI MAP SHEET-WISE WETLAND MAPS

(Selected)

State : Maharashtra

WETLAND MAP

SHEET NO. : 46H/12

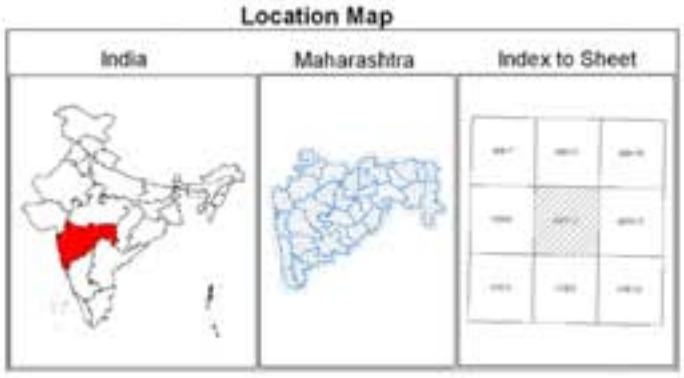


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 1 2 4 6 8 Kilometers

Data Source :

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

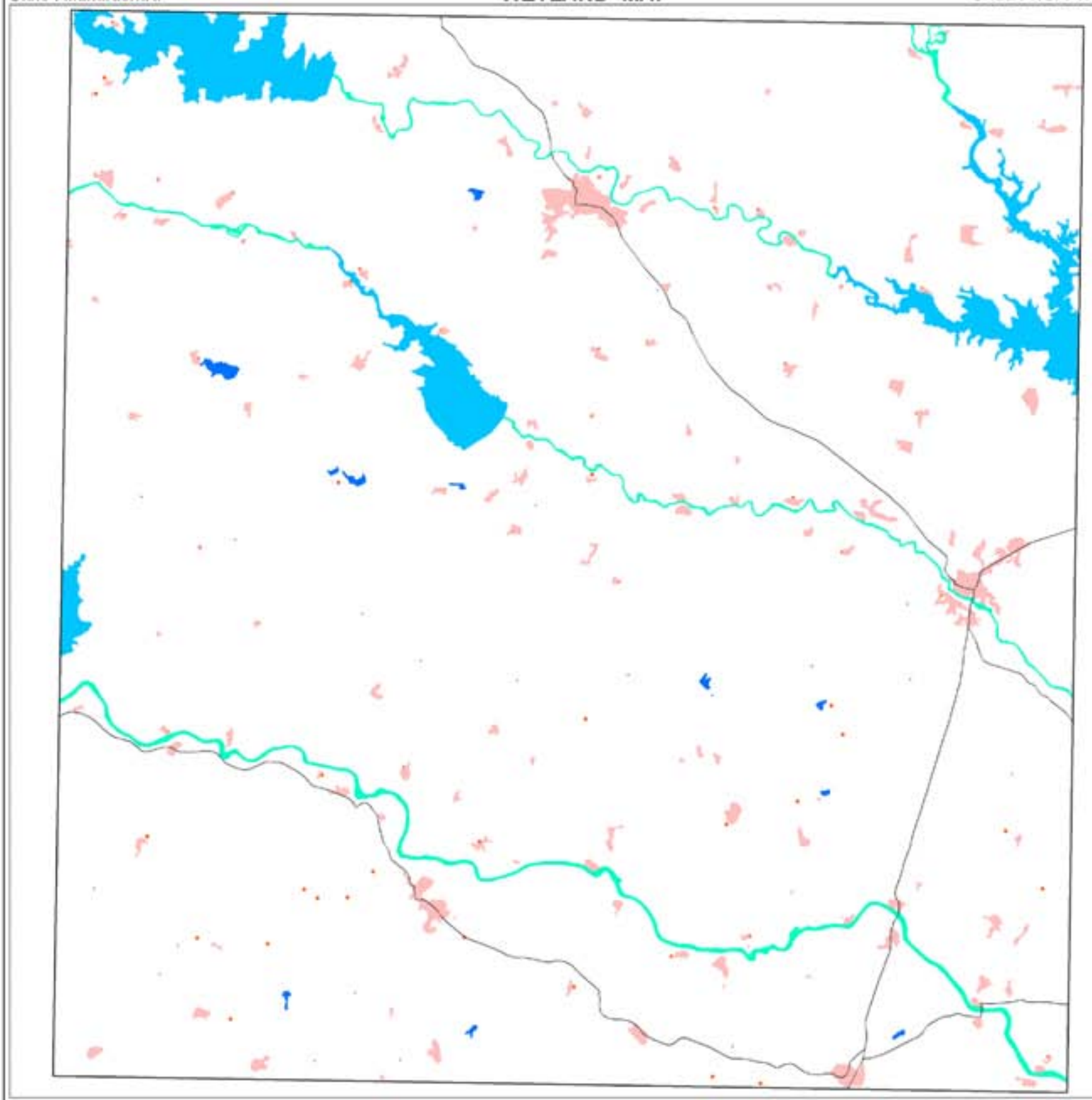
Sponsored By:

Ministry of Environment and Forests
Government of India

State : Maharashtra

WETLAND MAP

SHEET NO. : 47E/16

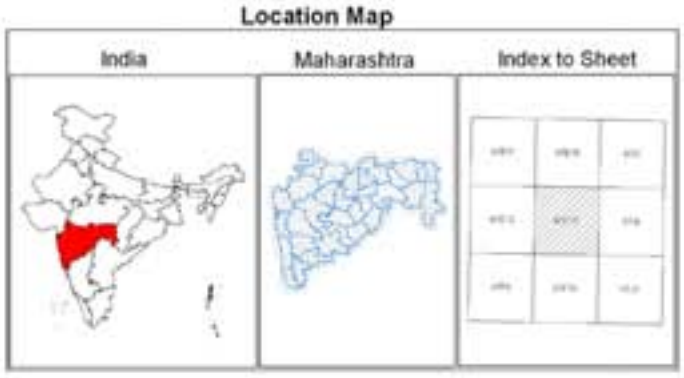


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 1 2 4 6 8 Kilometers

Data Source :

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

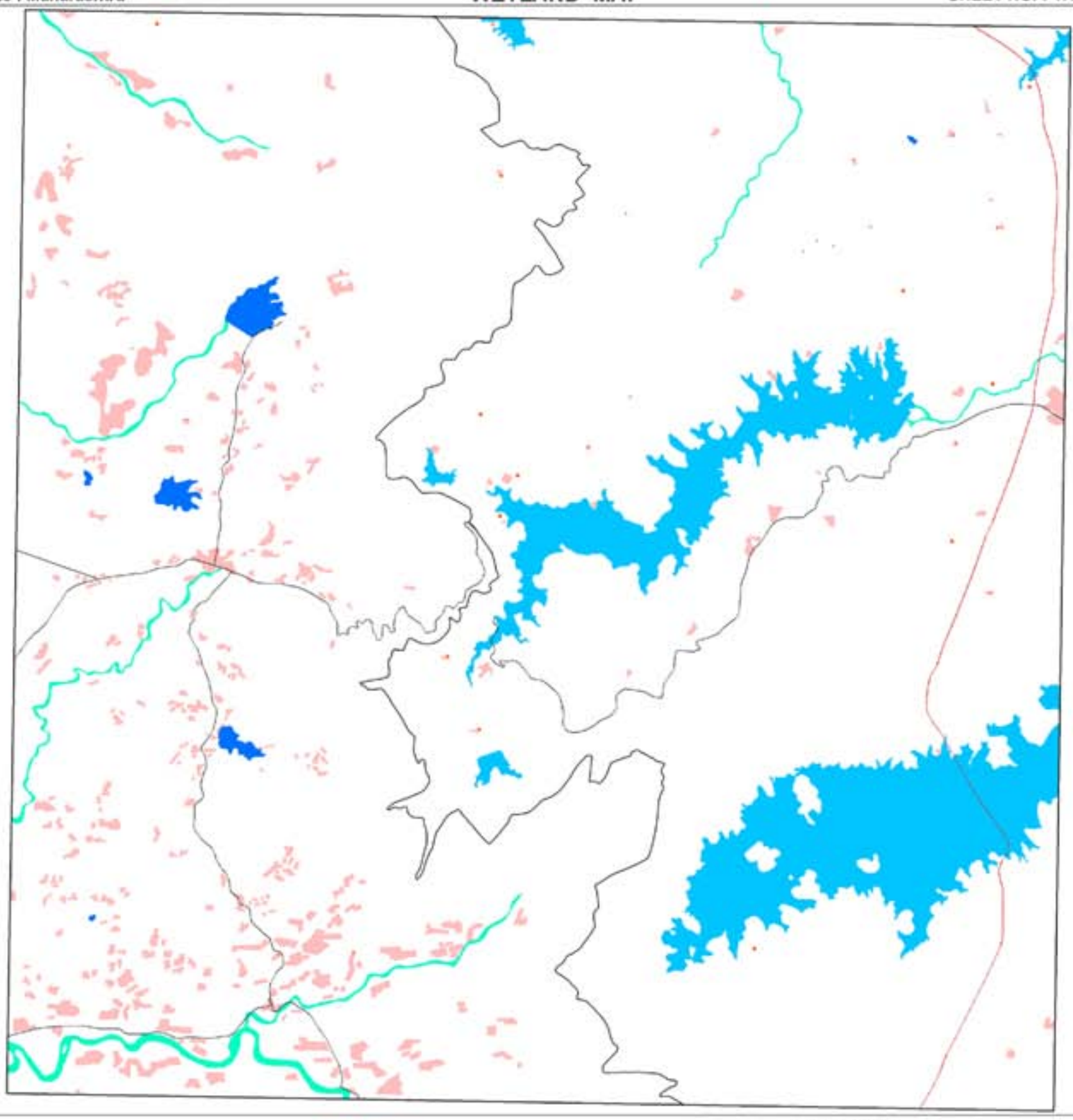
Sponsored By:

Ministry of Environment and Forests
Government of India

State : Maharashtra

WETLAND MAP

SHEET NO. : 47H/15



Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
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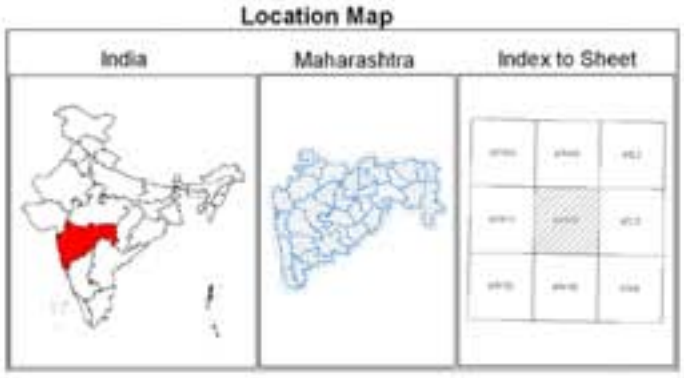
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 1 2 4 6 8 Kilometers

Data Source :

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Maharashtra Remote Sensing Applications Centre (MRSAC), Nagpur

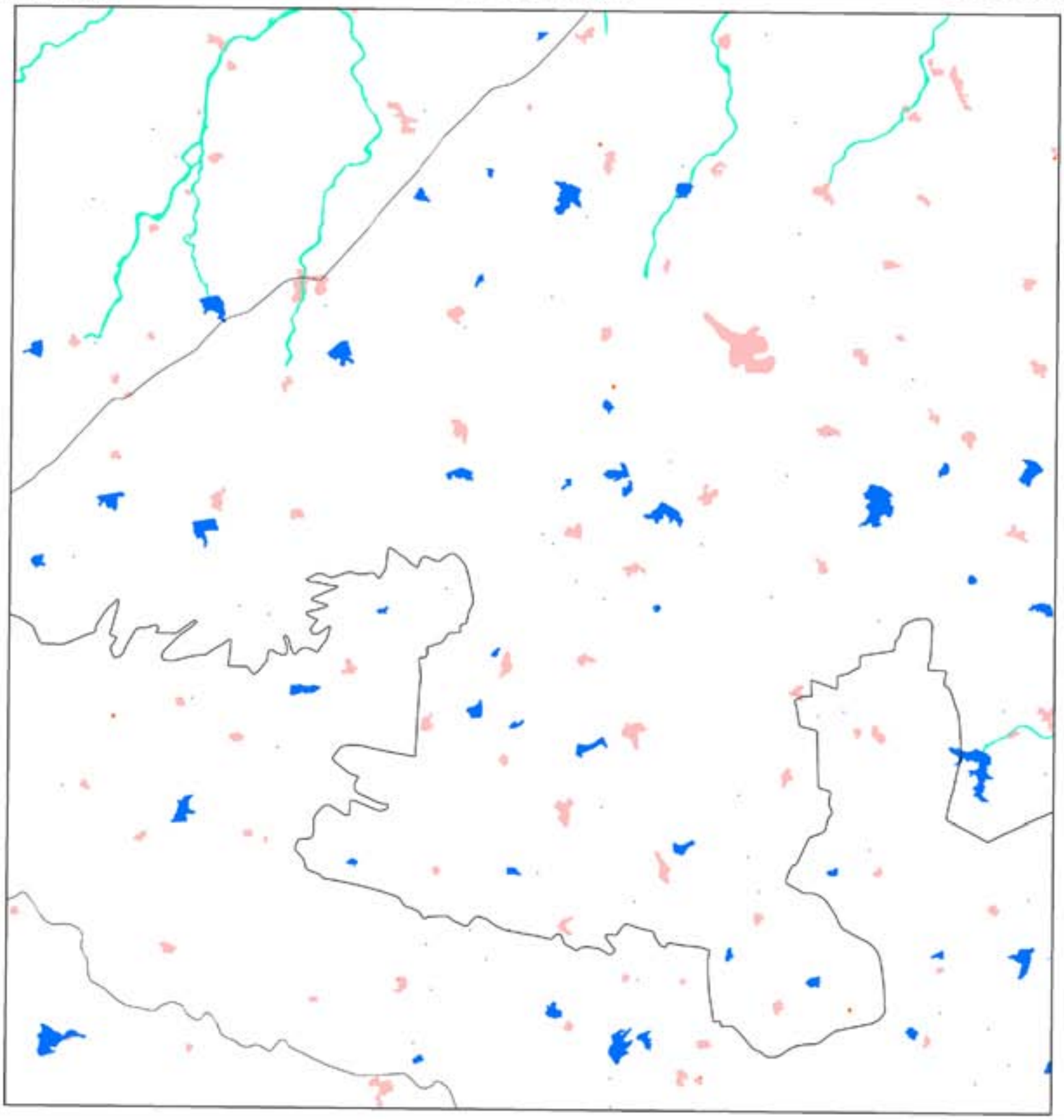
Sponsored By:

Ministry of Environment and Forests
Government of India

State : Maharashtra

WETLAND MAP

SHEET NO. : 47N/04



Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
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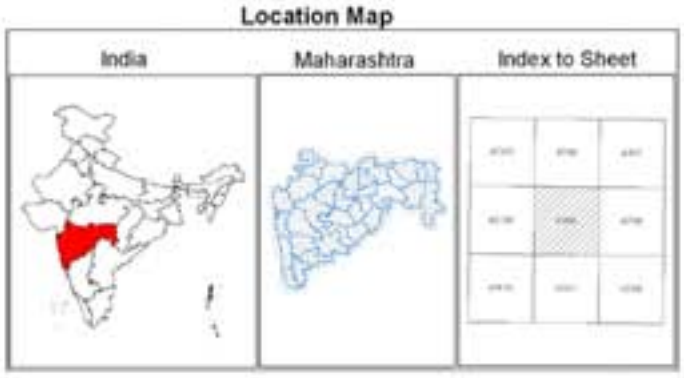
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 1 2 4 6 8 Kilometers

Data Source :

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
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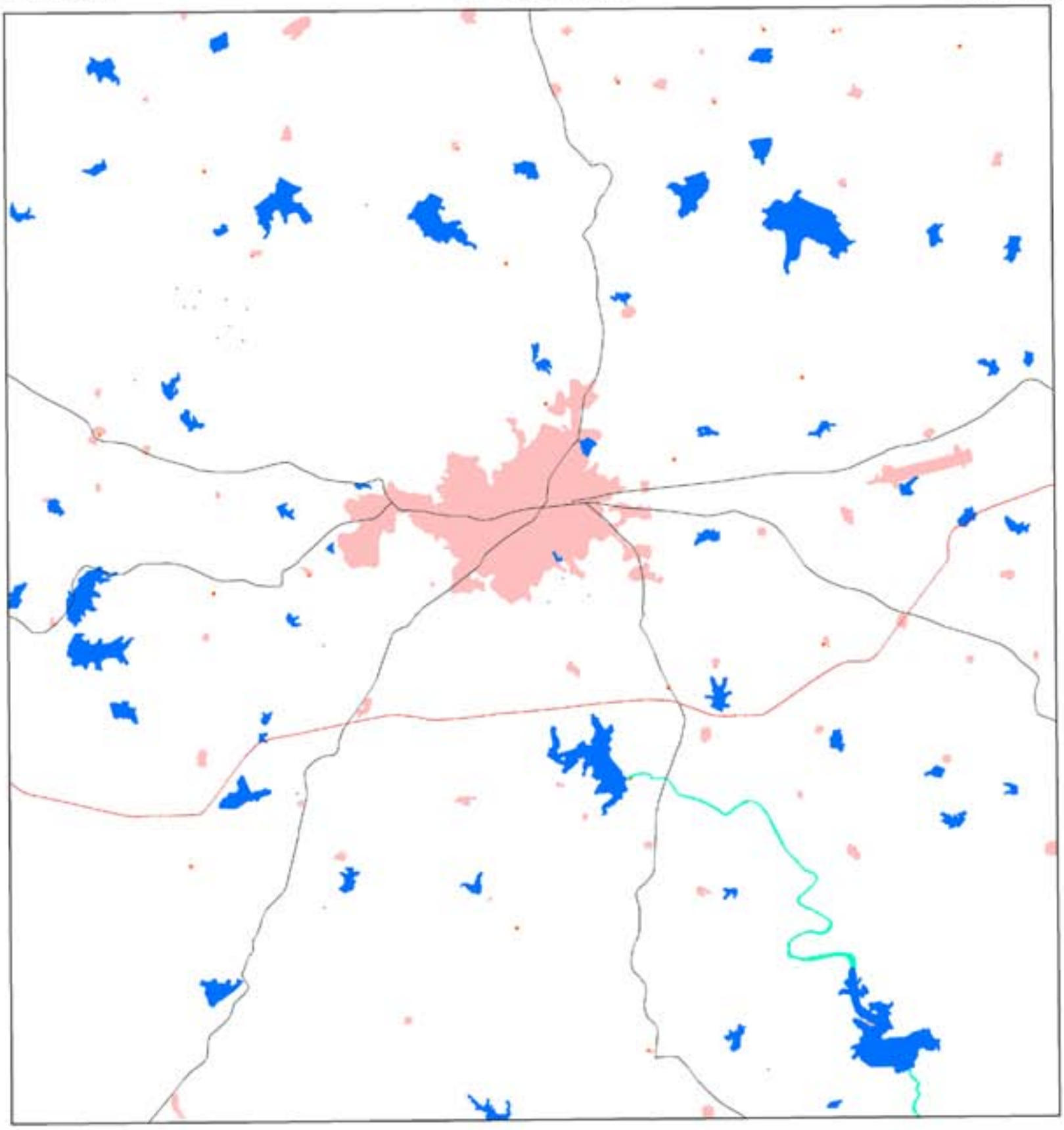
Government of India

State : Maharashtra

WETLAND MAP

SHEET NO. : 55L/03

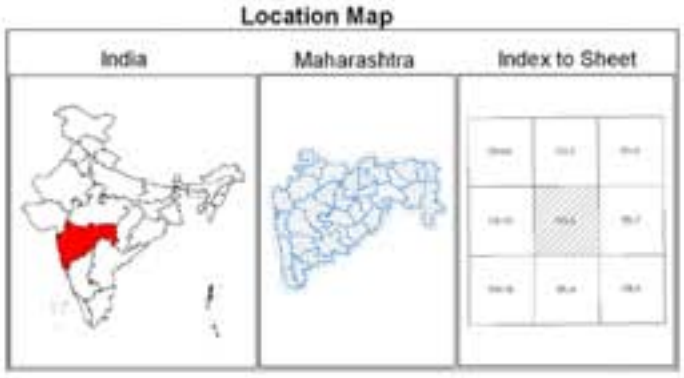


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 1 2 4 6 8 Kilometers

Data Source :

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Prepared By :

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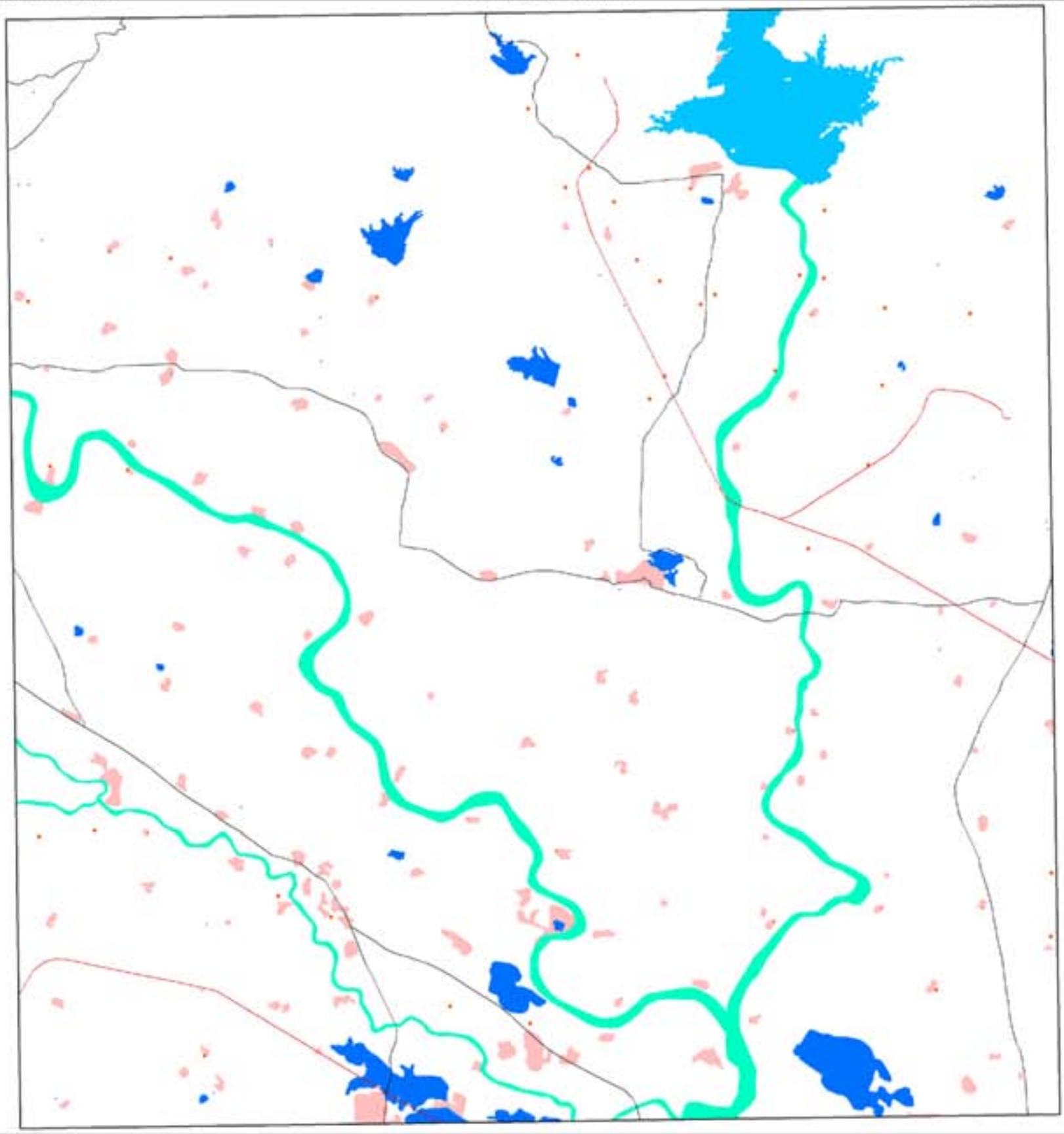
Government of India

State : Maharashtra

WETLAND MAP

SHEET NO. : 55O/03

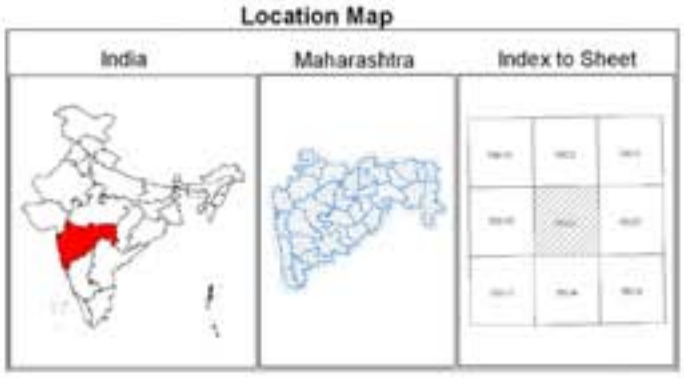


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 1 2 4 6 8 Kilometers

Data Source :

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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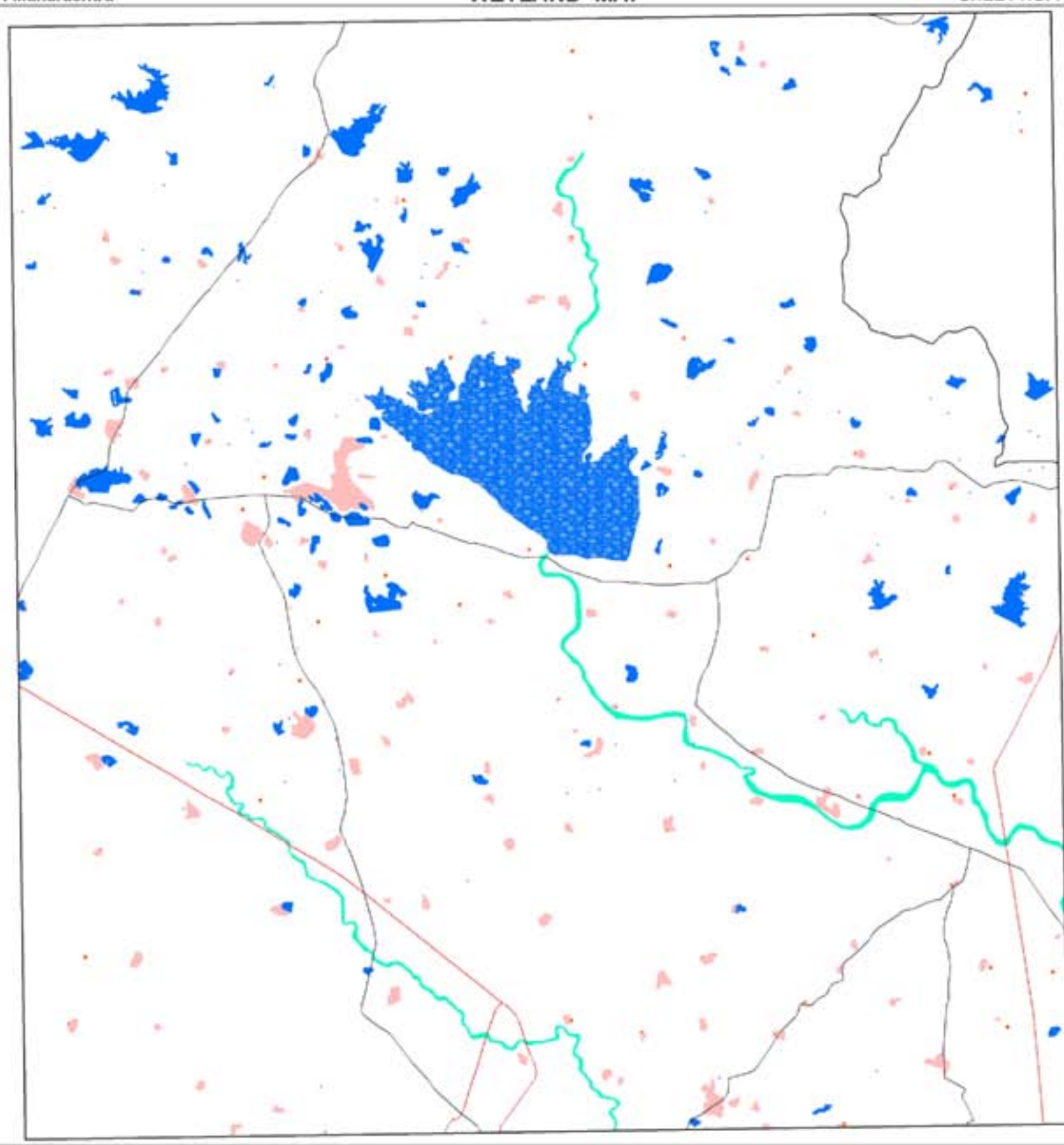
Government of India

State : Maharashtra

WETLAND MAP

SHEET NO. : 55O/07

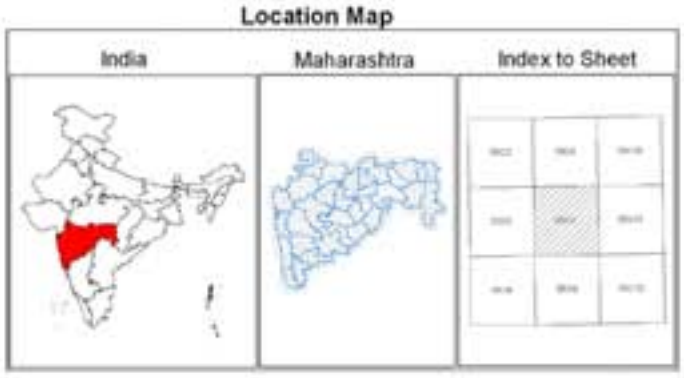


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 1 2 4 6 8 Kilometers

Data Source :

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :

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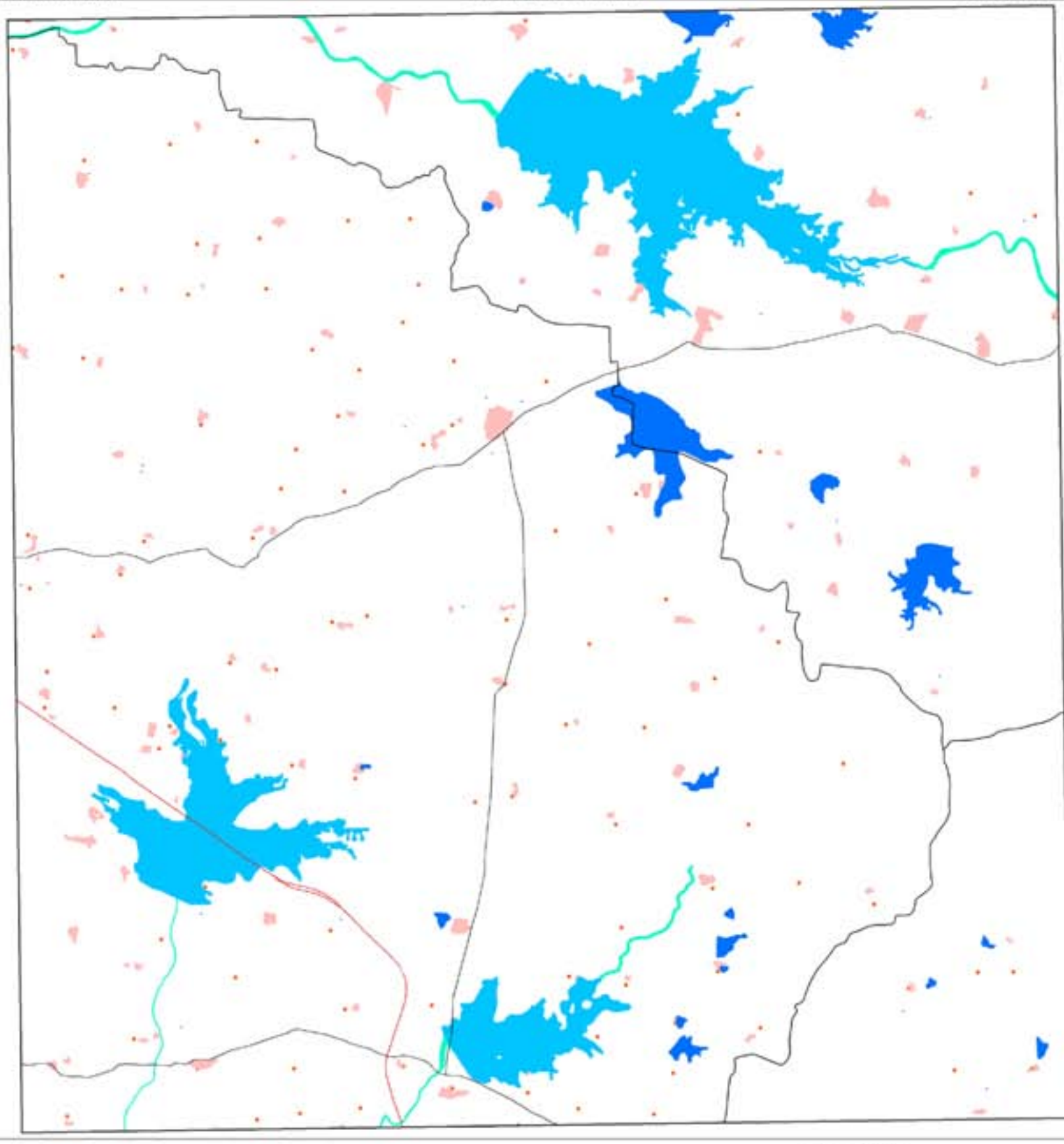
State : Maharashtra

WETLAND MAP

SHEET NO. : 55P/02

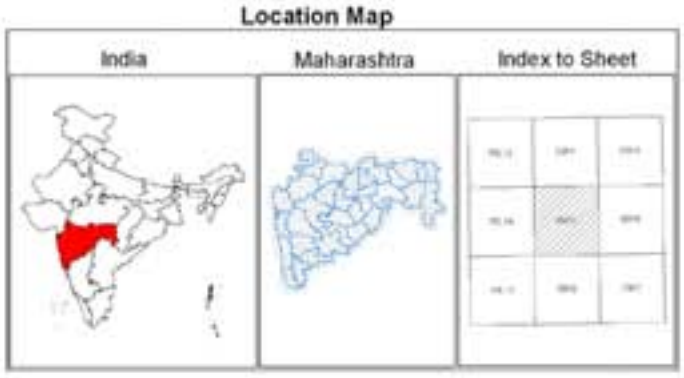


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 1 2 4 6 8 Kilometers

Data Source :

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :

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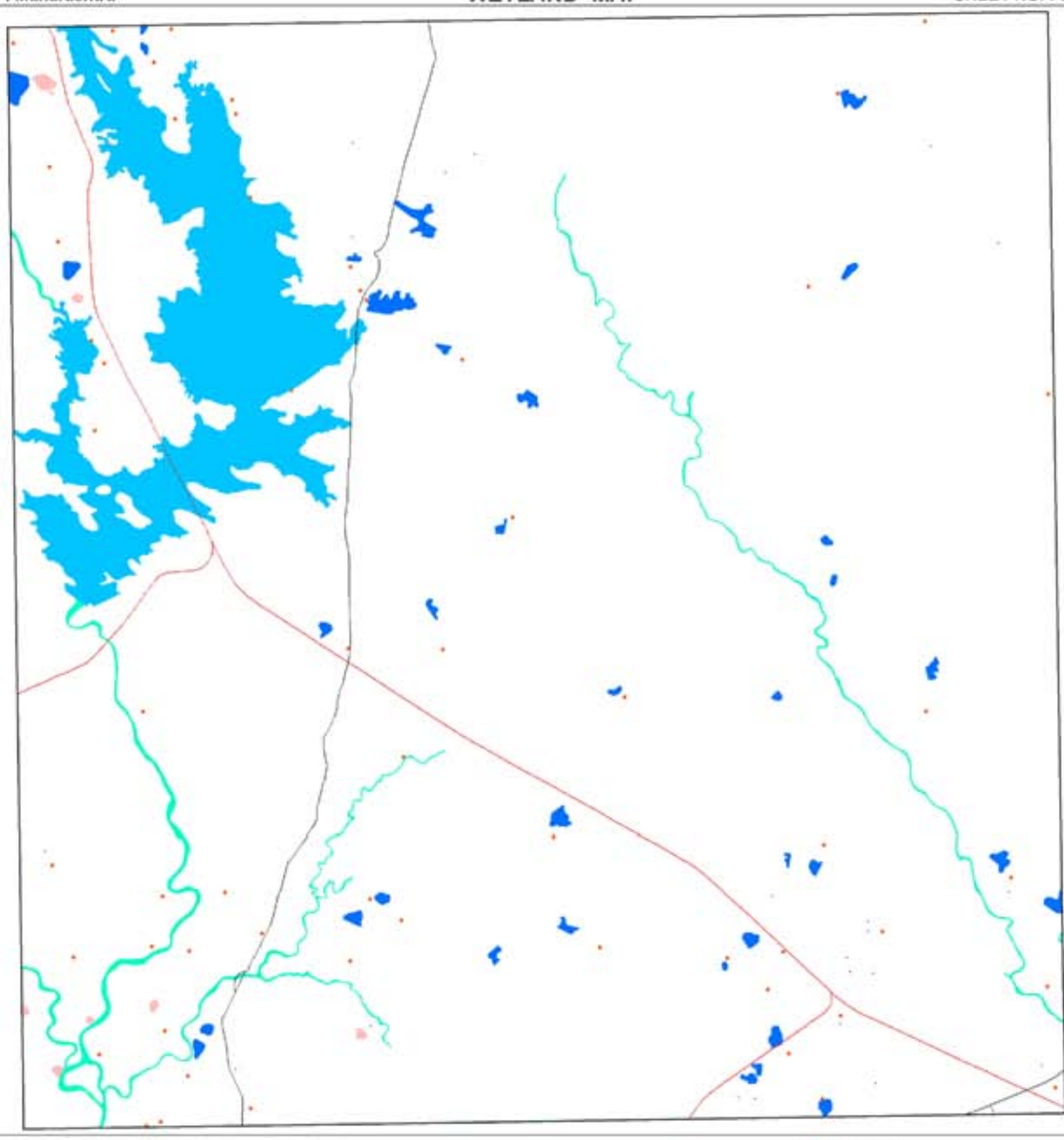
State : Maharashtra

WETLAND MAP

SHEET NO. : 55P/08



Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
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	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
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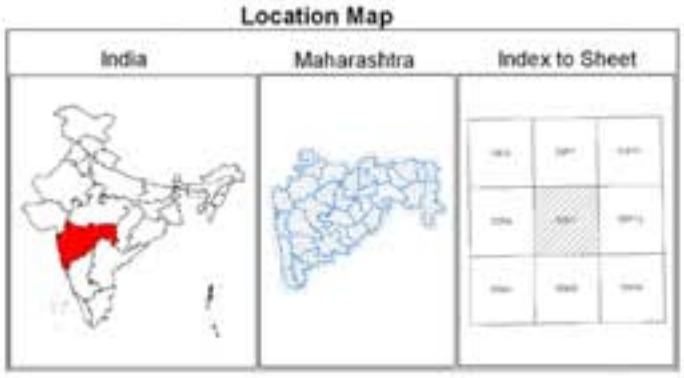
- District Boundary
- State Boundary
- International Boundary

Location Map



0 1 2 4 6 8 Kilometers

Data Source :

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :

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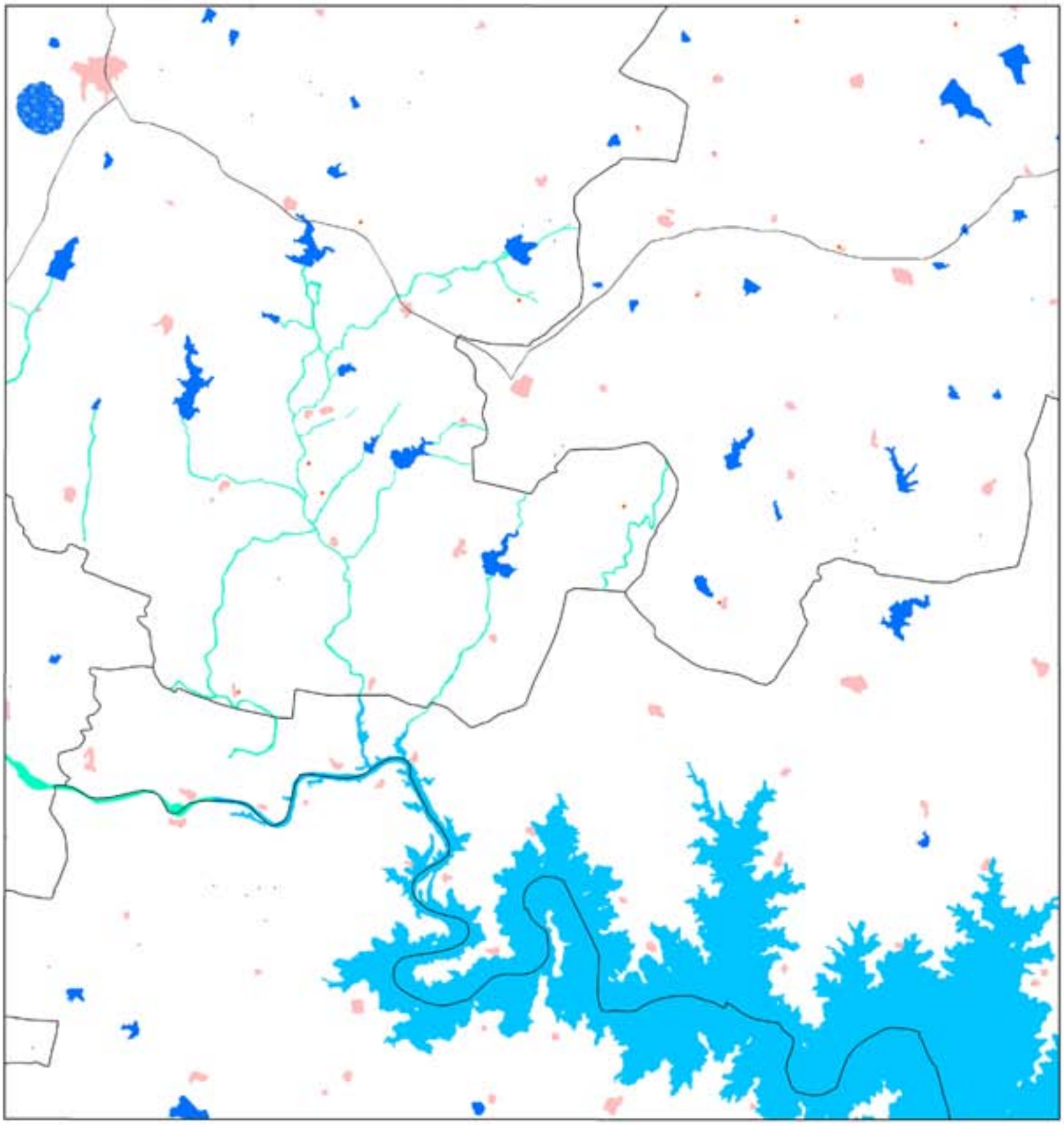
Government of India

State : Maharashtra

WETLAND MAP

SHEET NO. : 56A/09



Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
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	2106			Mangroves
	2107			Coral reefs
			Man-made	
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	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
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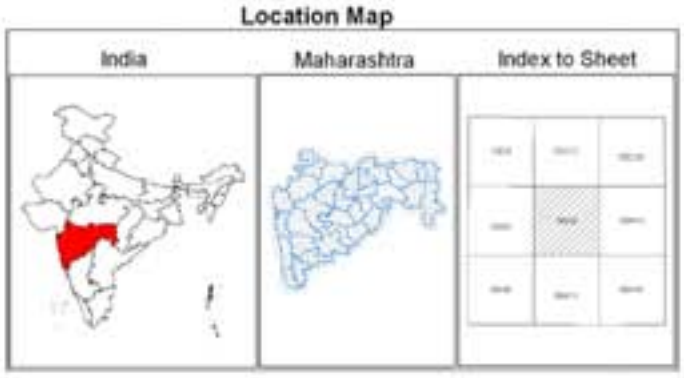
Location Map



0 1 2 4 6 8 Kilometers

Data Source :

IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :

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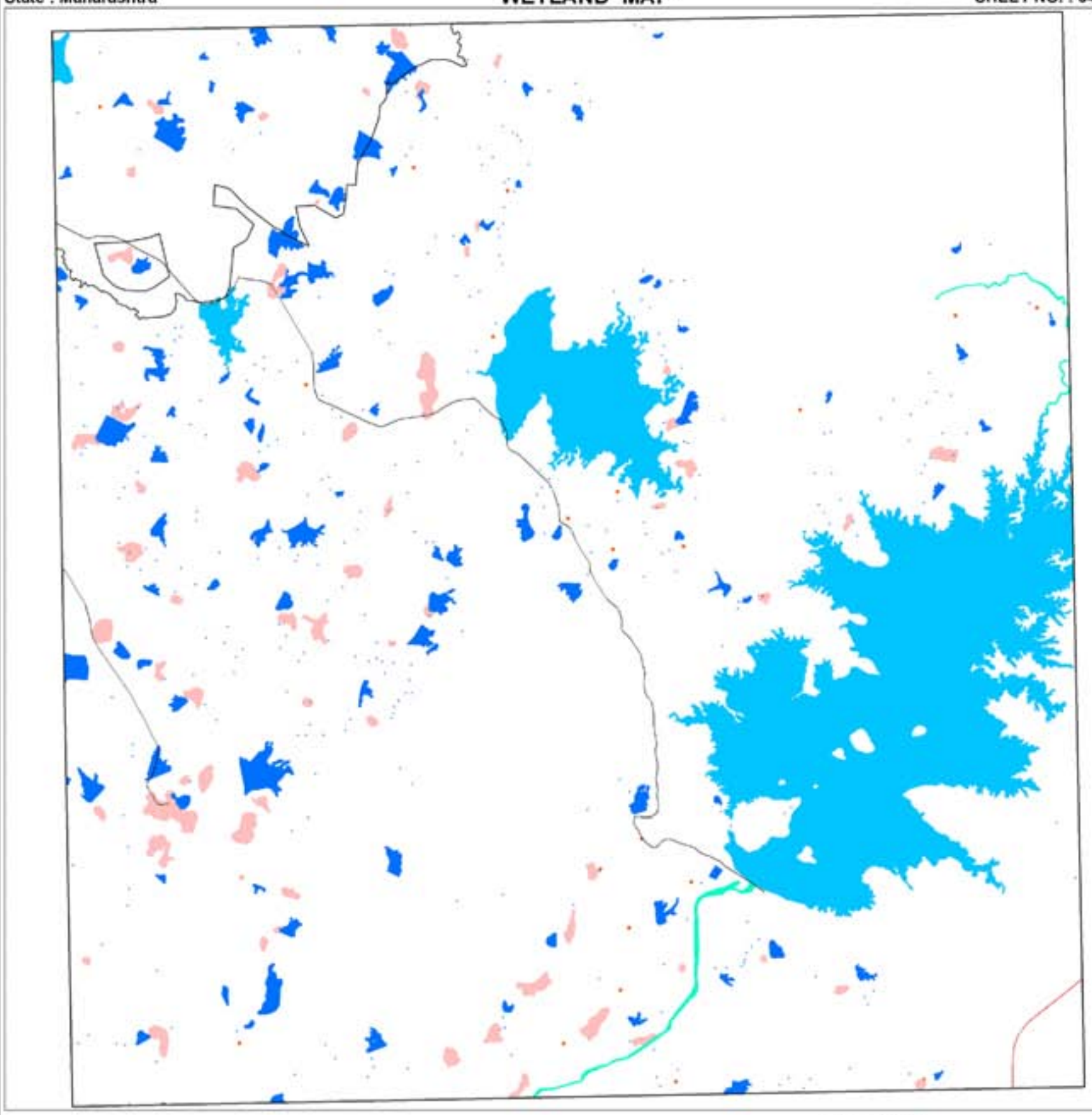
Government of India

State : Maharashtra

WETLAND MAP

SHEET NO. : 64D/01



Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
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	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
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	2101			Lagoons
	2102			Creeks
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	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
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	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
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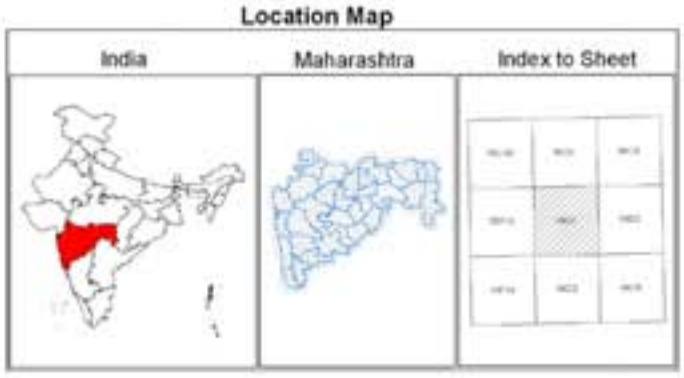
Location Map



0 1 2 4 6 8 Kilometers

Data Source :

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Annexure I
Definitions of wetland categories used in the project

For ease of understanding, definitions of wetland categories and their typical appearance on satellite imagery is given below:

Wetland type code	Definition and description
1000	**Inland Wetlands**
1100	**Natural**
1101	**Lakes**: Larger bodies of standing water occupying distinct basins (Reid *et al*, 1976). These wetlands occur in natural depressions and normally fed by streams/rivers. On satellite images lakes appear in different hues of blue interspersed with pink (aquatic vegetation), islands (white if unvegetated, red in case of terrestrial vegetation). Vegetation if scattered make texture rough.
1102	**Ox-bow lakes/ Cut off meanders**: A meandering stream may erode the outside shores of its broad bends, and in time the loops may become cut-off, leaving basins. The resulting shallow crescent-shaped lakes are called oxbow lakes (Reid *et al*, 1976). On the satellite image Ox-bow lakes occur near the rivers in plain areas. Some part of the lake normally has aquatic vegetation (red/pink in colour) during pre-monsoon season.
1103	**High Altitude lakes:** These lakes occur in the Himalayan region. Landscapes around high lakes are characterized by hilly topography. Otherwise they resemble lakes in the plain areas. For keeping uniformity in the delineation of these lakes contour line of 3000 m above msl will be taken as reference and all lakes above this contour line will be classified as high altitude lakes.
1104	**Riverine Wetlands**: Along the major rivers, especially in plains water accumulates leading to formation of marshes and swamp. **Swamps** are 'Wetland dominated by trees or shrubs' (U.S. Definition). In Europe, a forested fen (a peat accumulating wetland that has no significant inflows or outflows and supports acidophilic mosses, particularly *Sphagnum*) could be called a swamp. In some areas reed grass - dominated wetlands are also called swamps). (Mitsch and Gosselink, 1986). **Marsh**: A frequently or continually inundated wetland characterised by emergent herbaceous vegetation adapted to saturated soil conditions. In European terminology a marsh has a mineral soil substrate and does not accumulate peat (Mitsch and Gosselink, 1986). Tone is grey blue and texture is smooth. **Comment**: Using satellite data it is difficult to differentiate between swamp and marsh. Hence, both have been clubbed together.
1105	**Waterlogged:** Said of an area in which water stands near, at, or above the land surface, so that the roots of all plants except hydrophytes are drowned and the plants die (Margarate *et al*, 1974). Floods or unlined canal seepage and other irrigation network may cause waterlogging. Spectrally, during the period when surface water exists, waterlogged areas appear more or less similar to lakes/ponds. However, during dry season large or all parts of such areas dry up and give the appearance of mud/salt flats (grey bluish).
1106	**River/stream:** Rivers are linear water features of the landscape. Rivers that are wider than the mapping unit will be mapped as polygons. Its importance arises from the fact that many stretches of the rivers in Indo-Gangetic Plains and peninsular India are declared important national and international wetlands (Ex. The river Ganga between Brajghat and Garh Mukteshwar, is a Ramsar site, Ranganthattu on the Cavery river is a bird sanctuary etc.). Wherever, rivers are wide and features like sand bars etc. are visible, they will be mapped.
1200	**Man-made**
1201	**Reservoir**: A pond or lake built for the storage of water, usually by the construction of a dam across a river (Margarate et al, 1974). On RS images, reservoirs have irregular boundary behind a prominent dyke. Wetland boundary in case of reservoir incorporates water, aquatic vegetation and footprint of water as well. In the accompanying images aquatic vegetation in the reservoir is seen in bright pink tone. Tone is dark blue in deep reservoirs while it is ink blue in case of shallow reservoirs or reservoirs with high silt load. These will be annotated as Reservoirs/Dam. **Barrage:** Dykes are constructed in the plain areas over rivers for creating Irrigation/water facilities. Such water storage areas develop into wetlands (Harike Barrage on Satluj – a Ramsar site, Okhla barrage on the Yamuna etc. – a bird sanctuary). Water appears in dark blue tone with a smooth texture. Aquatic vegetation appears in pink colour, which is scattered, or contiguous depending on the density. Reservoirs formed by barrages will be annotated as reservoir/barrage.

1202	**Tanks/Ponds:** A term used in Ceylon and the drier parts of Peninsular India for an artificial pond, pool or lake formed by building a mud wall across the valley of a small stream to retain the monsoon (Margarate *et al*, 1974). **Ponds** Generally, suggest a small, quiet body of standing water, usually shallow enough to permit the growth of rooted plants from one shore to another (Reid *et al*, 1976). Tanks appear in light blue colour showing bottom reflectance. In this category **Industrial ponds/mining pools mainly comprising Abandoned Quarries are also included (**Quarry is defined as "An open or surface working or excavation for the extraction of stone, ore, coal, gravel or minerals." In such pits water accumulate (McGraw Hill Encyclopaedia of Environmental Sciences, 1974), **Ash pond/Cooling pond** (The water body created for discharging effluents in industry, especially in thermal power plants (Encyclopaedic Directory of Environment, 1988) and **Cooling pond**: An artificial lake used for the natural cooling of condenser-cooling water serving a conventional power station (Encyclopaedic Directory of Environment, 1988). These ponds can be of any shape and size. Texture is rough and tonal appearance light (quarry) to blue shade (cooling pond).
1203	**Waterlogged :** Man-made activities like canals cause waterlogging in adjacent areas due to seepage especially when canals are unlined. Such areas can be identified on the images along canal network. Tonal appearance is in various hues of blue. Sometimes, such waterlogged areas dry up and leave white scars on the land. Texture is smooth.
1204	**Salt pans:** Inland salt pans in India occur in Rajasthan (Sambhar lake). These are shallow rectangular man-made depressions in which saline water is accumulated for drying in the sun for making salt.
2000	**Coastal Wetlands**
2100	**Natural**
2101	**Lagoons/Backwaters:** Such coastal bodies of water, partly separated from the sea by barrier beaches or bass of marine origin, are more properly termed lagoons. As a rule, lagoons are elongate and lie parallel to the shoreline. They are usually characteristic of, but not restricted to, shores of emergence. Lagoons are generally shallower and more saline than typical estuaries (Reid *et al*, 1976). **Backwater**: A creek, arm of the sea or series of connected lagoons, usually parallel to the coast, separated from the sea by a narrow strip of land but communicating with it through barred outlets (Margarate *et al*, 1974).
2102	**Creek:** A notable physiographic feature of salt marshes, especially low marshes. These creeks develop as do rivers "with minor irregularities sooner or later causing the water to be deflected into definite channels" (Mitsch and Gosselink, 1986). Creeks will be delineated; however, their area will not be estimated.
2103	**Sand/Beach:** Beach is an unvegetated part of the shoreline formed of loose material, usually sand that extends from the upper berm (a ridge or ridges on the backshore of the beach, formed by the deposit of material by wave action, that marks the upper limit of ordinary high tides and wave wash to low water mark (Clark,1977).Beach comprising rocky material is called rocky beach.
2104	**Intertidal mudflats**: Most unvegetated areas that are alternately exposed and inundated by the falling and rising of the tide. They may be mudflats or sand flats depending on the coarseness of the material of which they are made (Clark, 1977).
2105	**Salt Marsh**: Natural or semi-natural halophytic grassland and dwarf brushwood on the alluvial sediments bordering saline water bodies whose water level fluctuates either tidally or non- tidally (Mitsch and Gosselink, 1986). Salt marshes look in grey blue shade when wet.
2106	**Mangroves**: The mangrove swamp is an association of halophytic trees, shrubs, and other plants growing in brackish to saline tidal waters of tropical and sub-tropical coastlines (Mitsch and Gosselink, 1986). On the satellite images mangroves occur in red colour if in contiguous patch. When mangrove associations are scattered or are degraded then instead of red colour, brick red colour may be seen.
2107	**Coral reefs:** Consolidated living colonies of microscopic organisms found in warm tropical waters. The term coral reef or organic reef is applied to the rock- like reefs built-up of living things, principally corals. They consist of accumulations of calcareous deposits of corals and corraline algae with the intervening space connected with sand, which consists largely of shells of foraminefera. Present reefs are living associations growing on this accumulation of past (Clark, 1977). Reefs appear in light blue shade.
2200	**Man-made**
2201	**Salt pans**: An undrained usually small and shallow rectangular, man-made depression or hollow in which saline water accumulates and evaporates leaving a salt deposit (Margarate *et al*, 1974). Salt pans are square or rectangular in shape. When water is there appearance is blue while salt is formed tone is white.
2202	**Aquaculture ponds**: Aquaculture is defined as "The breeding and rearing of fresh-water or marine fish in captivity. Fish farming or ranching". The water bodies used for the above are called aquaculture ponds (Encyclopedic Directory of Environment, 1988). Aquaculture ponds are geometrical in shape usually square or rectangular. Tone is blue.

Annexure II
Details of District information followed in the atlas

State : Maharashtra

District Boundary Map

List of Districts

District code	District name
01	Nandurbar
02	Dhule
03	Jalgaon
04	Buldhana
05	Akola
06	Washim
07	Amravati
08	Wardha
09	Nagpur
10	Bhandara
11	Gondia
12	Gadchiroli

District code	District name
13	Chandrapur
14	Yavatmal
15	Nanded
16	Hingoli
17	Parbhani
18	Jalna
19	Aurangabad
20	Nasik
21	Thane
22	Mumbai suburban
23	Mumba urban
24	Raigad

District code	District name
25	Pune
26	Ahmadnagar
27	Beed
28	Latur
29	Osmanabad
30	Solapur
31	Satara
32	Ratnagiri
33	Sindhudurg
34	Kolhapur
35	Sangli

Legend

State Boundary

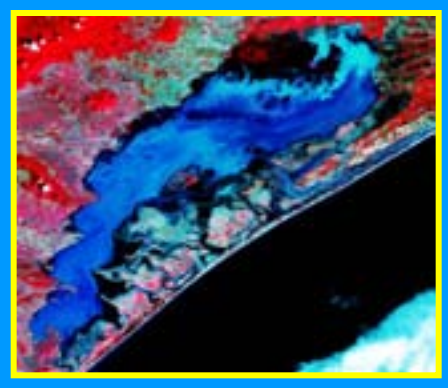
District Boundary

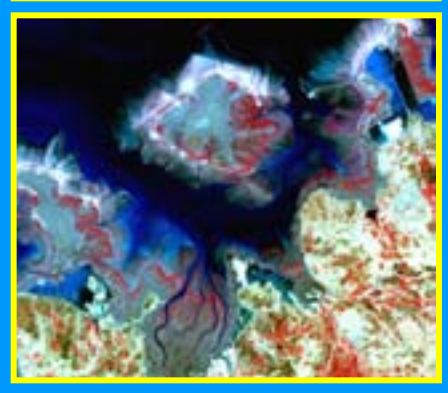
Source : Survey of India (Surveyed in 2004 and published in 2005)

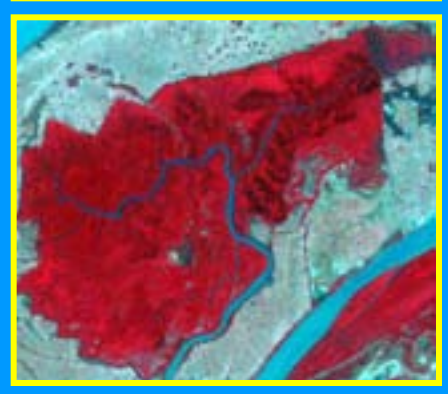
Space Applications Centre (SAC) is one of the major centres of the Indian Space Research Organisation (ISRO). It is a unique centre dealing with a wide variety of disciplines comprising design and development of payloads, societal applications, capacity building and space sciences, thereby creating a synergy of technology, science and applications. The Centre is responsible for the development, realisation and qualification of communication, navigation, earth & planetary observation, meteorological payloads and related data processing and ground systems. Several national level application programmes in the area of natural resources, weather and environmental studies, disaster monitoring/mitigation, etc are also carried out. It is playing an important role in harnessing space technology for a wide variety of applications for societal benefits.

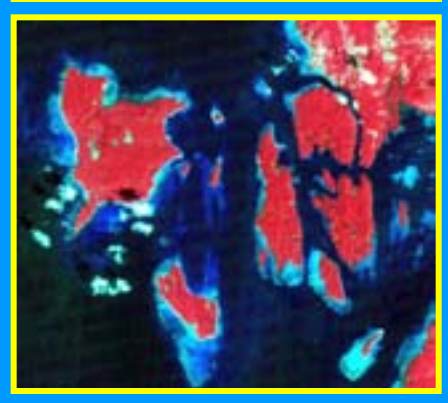
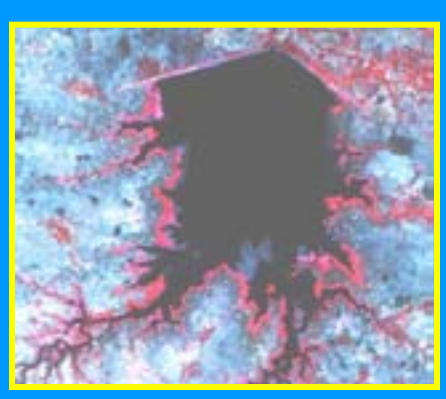
SAC is a host institution for the training programmes related to Satellite Communication, Satellite Meteorology and global change under the Centre for Space Science & Technology Education in Asia and the Pacific (CSSTEAP) affiliated to the United Nations (UN).

http://www.isro.org





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