



# NATIONAL WETLAND ATLAS

**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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**Ministry of Environment and Forests, Government of India**

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

**Space Applications Centre (ISRO), Ahmedabad**

**March 2011**

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जयराम रमेश
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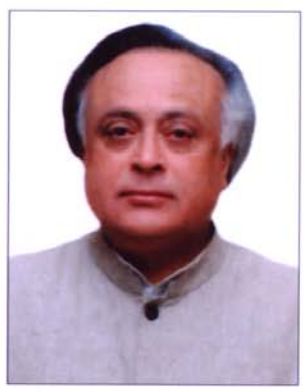

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18th May 2011

## From the Minister's Desk

I am delighted to introduce the "National Wetland Atlas", prepared by the Space Applications Centre (SAC), ISRO, Ahmedabad. This atlas provides information on wetlands in India using the latest technology in satellite imaging. Wetlands are areas of critical ecological significance that support rich biodiversity including a large variety of plant and animal species adapted to fluctuating water levels. Utility-wise, wetlands directly and indirectly support millions of people in providing services such as food, fibre and raw materials. Thus, their identification and protection becomes very important.

Recognizing the importance of wetlands, the Government of India has formulated several policies and plans for the conservation and preservation of these critical ecosystems. Since, an updated geospatial data base of these natural resources is the pre-requisite for management and conservation planning, National Wetland Inventory and Assessment (NWIA) project was formulated as a joint programme of Ministry of Environment & Forests, Government of India, and Space Applications Centre, ISRO, Ahmedabad. I am informed that the latest remote sensing images from Indian Remote Sensing satellite (IRS P6) have been used to map the wetlands.

The wetland types found in India are categorized under 19 classes. Mapping has been done at 1:50,000 scale and database organized at district, state and topographic map level. This National Atlas highlights the results in terms of statistics of various types of wetlands, extent of water, aquatic vegetation and turbidity in pre- and post-monsoon period. I am told that the total wetland area estimated is 10.002 Mha (excluding rivers). This atlas also provides database of high altitude wetlands nestled in the Himalayas at different elevation ranges. I also note that special efforts have been made to provide detailed information of important wetlands such as Ramsar sites etc.

This is the first systematic digital database of wetlands created at 1:50,000 scale following a standard classification and database design, which is essential for retrieval of accurate information of any wetland class in the country. This atlas will definitely help in monitoring the changes with high accuracy and will serve as baseline data for preservation, conservation and wise use of wetlands.

(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 P6 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 wetlands found in India have been categorized following a 19 class hierarchical system. A standard map projection and unique codification for each mapping element has been followed. The map outputs include the status of water spread, aquatic vegetation and turbidity. This National Atlas highlights results of this work in terms of statistics, maps, satellite images, field photographs etc. for the entire country 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.

Ahmedabad
May 17, 2011

(Ranganath R. Navalgund)

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We acknowledge the positive role played by 16$^{th}$ 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 role in formulation of this project.

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(Sushma Panigrahy)

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| 5 | Andhra Pradesh State Remote Sensing Applications Centre, Hyderabad |
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| 7 | Jharkhand Space Application Centre, Ranchi |
| 8 | Maharashtra Remote Sensing Application Centre, Nagpur |
| 9 | North- Eastern Space Application Centre, Shillong |
| 10 | Orissa State Remote Sensing Application Centre, Bhubaneswar |
| 11 | Assam Remote Sensing Applications Centre, Guwahati |
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## 1.0 INTRODUCTION

It is increasingly realised 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 difficulties most frequently faced for decision-making is lack of scientific data of our natural resources. Often the data are sparse or unconvincing, rarely in the form of geospatial database (map), thus open to challenges. Thus, the current thrust of every country is to have an appropriate geospatial database of natural resources that is based on unambiguous scientific methods. 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 wetlands are estimated to already have disappeared worldwide 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 techniques

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 changes over a time scale, and assist in decision-making process. The technique used in the preparation of map started with ground survey. The Survey of India (SOI) topographic maps are the earliest true maps of India showing various land use/cover classes including water resources such as lotic and lentic wetlands of the country. 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 recognized 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, we define satellite remote sensing 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 include 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 remote sensing satellites to monitor natural resource of the earth 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 - typical wetlands located in Part of Tamilnadu state. In FCC, the vegetation thus appears invariably red (due to high reflection in NIR from green leaves).

Since the early 1960s, numerous satellite 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, IRS series 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 remote sensing (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.

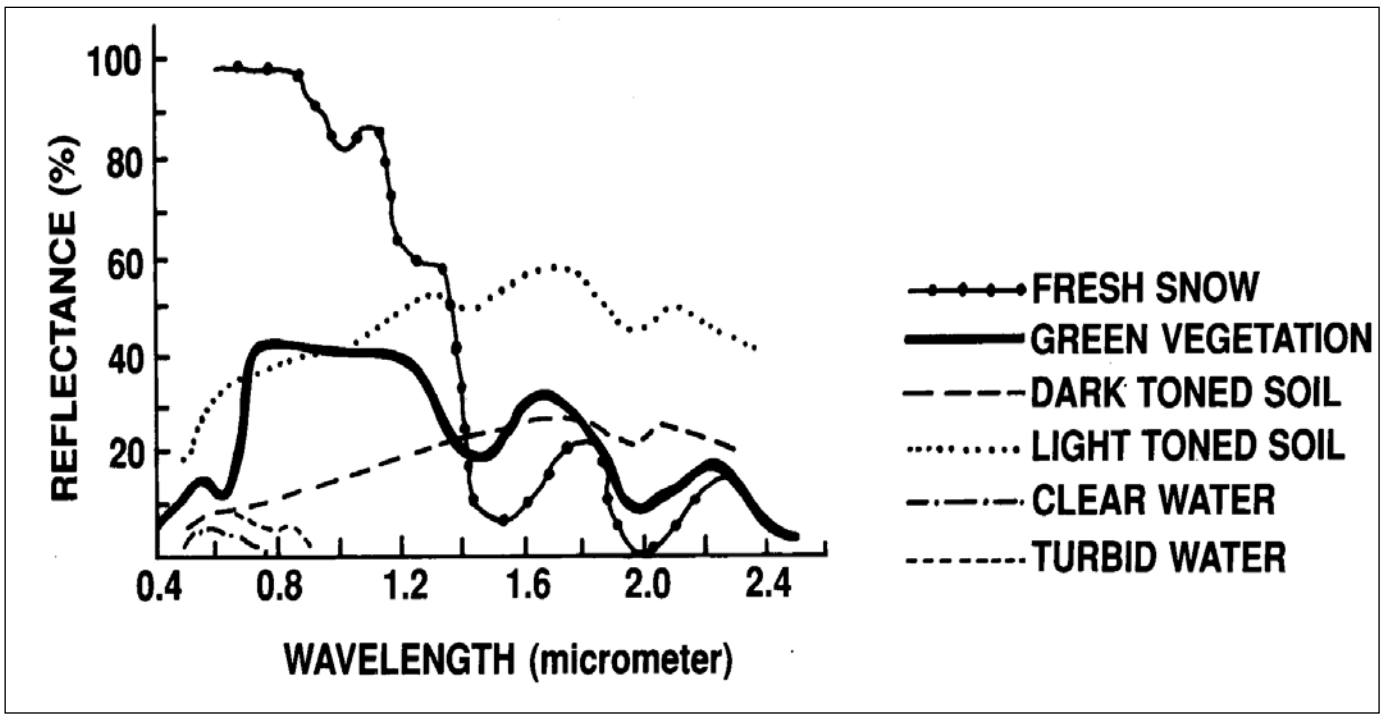



Figure 1: Spectral Signature of various targets

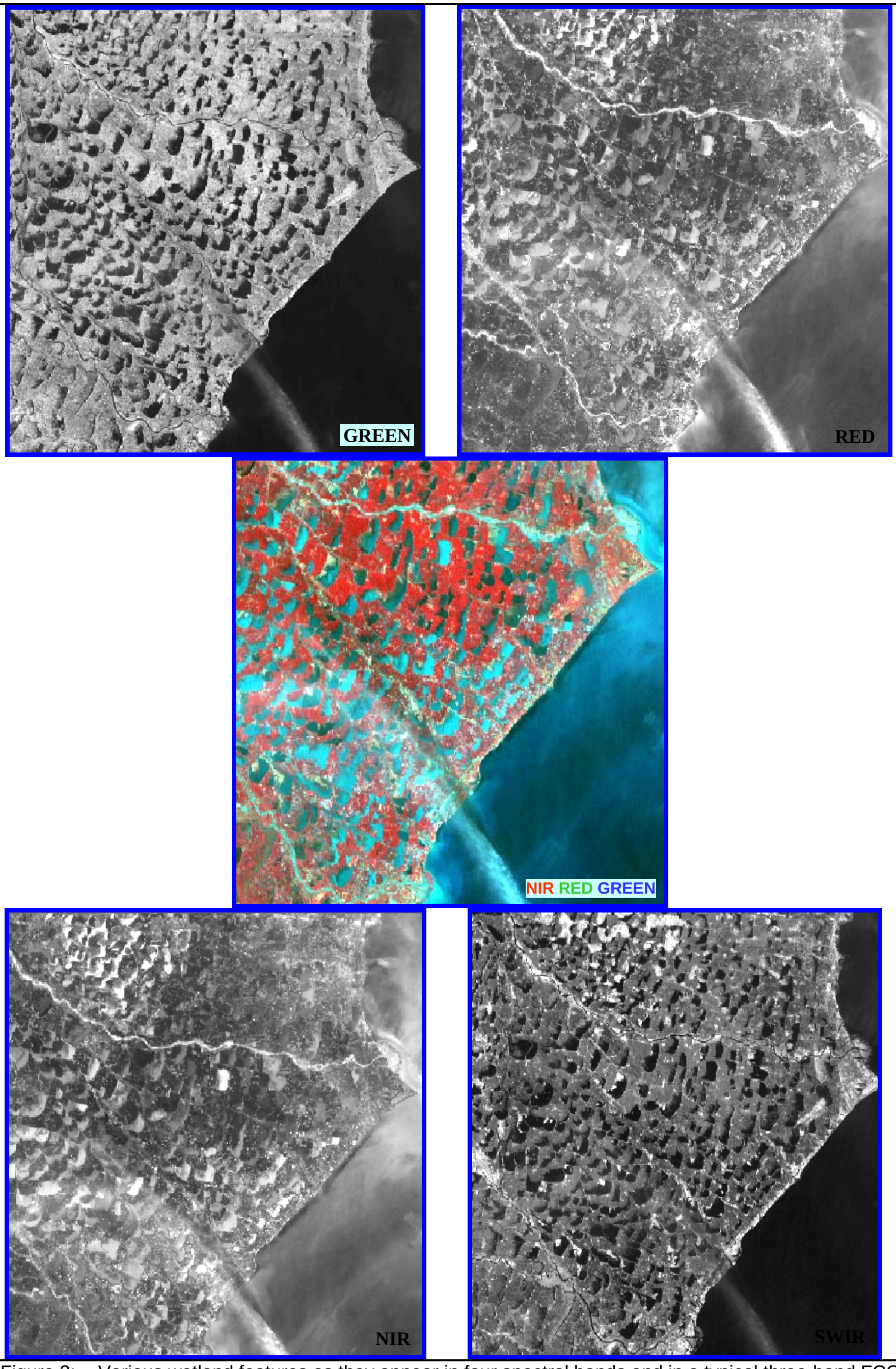



Figure 2: Various wetland features as they appear in four spectral bands and in a typical three-band FCC (part of Tamilnadu)

## 1.3 Wetland Inventory of India

India with its vast geographical extent supports a 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, peatlands, 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, peatland 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 the country was carried out by Space Applications Centre (ISRO), Ahmedabad, during1992-93 at the behest of the Ministry of Environment and Forests (MoEF), Govt. of India using remote sensing data from Indian Remote Sensing satellite (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 using remotely sensed data was finalized.

The technical / procedural 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 database and deals with the wetlands of the country.

### 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-I has two wetland classes: inland and coastal, these are further bifurcated into two categories as: natural and man-made under which 19 wetland classes are suitably placed. Two date data pertaining to pre-monsoon and post-monsoon was used to confirm the classes and also to demarcate temporal variations in its features. Wetlands put to agriculture use in any of the two seasons are not considered as a wetland class. Definition of each wetland category 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. 2007). 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 nation-wide administrative as well as natural hierarchy. 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) and surrounding hydric soils, the wetland boundary should ideally include all these. Satellite image gives a clear signature of the wetland extents from the imprint of water spread over the years.

- Water spread: Each wetland may have two water spread layers representing post-monsoon and pre-monsoon 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 level of open water: A layer pertaining to a qualitative turbidity rating is generated. Three qualitative turbidity ratings or levels (low, medium and high) were assigned to pre-monsoon and post-monsoon waters of all wetlands, which include lakes, reservoirs and other large wetlands.
- Small wetlands (smaller than minimum mappable unit) 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 | | | Lake |
| 1102 | | | Ox-Bow Lake/ Cut-Off Meander |
| 1103 | | | High altitude Wetland |
| 1104 | | | Riverine Wetland |
| 1105 | | | Waterlogged |
| 1106 | | | River/stream |
| 1200 | | Man-made | |
| 1201 | | | Reservoir/ Barrage |
| 1202 | | | Tank/Pond |
| 1203 | | | Waterlogged |
| 1204 | | | Salt pan |
| 2000 | Coastal Wetlands | | |
| 2100 | | Natural | |
| 2101 | | | Lagoon |
| 2102 | | | Creek |
| 2103 | | | Sand/Beach |
| 2104 | | | Intertidal mud flat |
| 2105 | | | Salt Marsh |
| 2106 | | | Mangrove |
| 2107 | | | Coral Reef |
| 2200 | | Man-made | |
| 2201 | | | Salt pan |
| 2202 | | | Aquaculture pond |

*: Wetland type code

## 3.0 STUDY AREA

India covers an area of 3.28 million sq kms and is the seventh largest country in the world situated between 8º 4' and 37º 6' North Latitudes and 68º 7' and 97º 25' East Longitudes. The Indian peninsula is surrounded by water in three sides - the Bay of Bengal on the east, the Arabian Sea on the west and the Indian Ocean to the south. Various landforms like the lofty mountains, the deep valleys, extensive plains and number of islands are found in India. The Himalayas separate India from China and most parts of Asia. The tallest point in India is Kanchenjunga, which stands at a height of 8,598 m above sea level.

Geographically, India can be divided into five physical units - the Great Mountains of the North, the North Indian Plain, the Peninsular Plateau, the Coastal Plains, and the Islands. Most of the north and north-eastern states come under the Himalayan Range. The rest of northern, central, and eastern India consists of the fertile Indo-Gangetic Plain. The northwestern part of the country is characterized by the Thar Desert while most of southern India falls under the Deccan Plateau. It is separated from the northern plain by the Vindhya Mountains. The Eastern and Western Ghats are coastal mountains on either side of the plateau. India is bordered by Pakistan on the north-west, Nepal, Bhutan and China on the north-east and Burma and Bangladesh on the east.

The major rivers of India include the Ganges, the Brahmaputra, the Yamuna, the Godavari, the Kaveri, the Narmada, and the Krishna.

**Physiographic Features**

There are different physiographical features, which affect the lifestyle and cultural aspect of people. These are varied in accordance to the latitudinal and longitudinal position, topography, climate, soil and vegetation. India comprises vast diversity in its topography, climate, soils and vegetation. The country presents a variety of landforms from deep valleys to lofty mountains and dry deserts to surplus water areas.

**Flora**

India has a wide variety of flora and fauna similar to its socio-cultural diversity. Forest cover of India is around 23.68% which includes alpine forest in the Himalaya, deciduous forest in the central India, Mangrove forest in the coastal regions, and thorny forest in western region mainly in Rajasthan. These areas are well supported by various species of flora and fauna and indicate the high biodiversity and also reflected in the mélange of India's climate and topography. The Flora (Vegetation or forests) provides home to many rare and unique species of flora and fauna. India is one of the countries in the world with such a rich variety of flora due to wide range of climatic conditions with about reported15,000 plant species.

India lies in tropical zone hence it is mainly covered with deciduous forests. Based on the distribution of the flora, India can be classified into;

***Himalayan Vegetation:*** The Himalayan belt is very rich in vegetation. The eastern Himalaya is covered with thick tropical forests whereas western part is covered by conifer forest. Natural vegetation varies with altitude; near the snowline evergreen forests with mainly high alpine meadows are found whereas the places with lower altitude have temperate forests in them. Northwest Himalayas grows Chir pine (*Pinus roxburghii*) except in Kashmir. Other conifers that grow in that area includes deodar, blue-pine, spruce, silver fir and junipers. Chilgoza (pine nut), oak, maple, and ash (*Fraxinus xanthoxyloides*) grow abundantly in the inner Himalayas. The Eastern Himalayan region grows trees like oak, laurels, maples, rhododendrons, alder, birch and dwarf willows. Foothills of Himalayas are covered with deciduous trees, shrubs, fern and grass. Evergreen forests grow in the Assam region dominated by bamboo forest and tall grasses. Tea plantation and rice fields are a pleasure to see as green patches in the Brahmaputra Valley of Assam.

The rain forests of the country exist on the southwestern coast, in Kerala where coconut trees leads the stretching rain forests of the country. Rain forests are also found in Andaman Islands and Arunachal Pradesh. Karnataka plateau is dominated by dense sandal, teak, and *Dalbergia sissoo*. The dry Telengana plateau in Andhra Pradesh is a home of thorny scrub and wild Indian date palm.

***The Desert Region:*** The rainfall is scanty and erratic. The trees are short and stout, underdeveloped because of the xeric conditions and leaves are mostly reduced to spines. Apart from cacti, there are reunjha (*Acacia leucophloea*), khejra (*Prosopis spicigera*), kanju (*Holoptelia integrifolia*) and Calotropis (*Calotropis gigantea*). Tropical moist deciduous forests are interspersed with tropical dry deciduous trees in this region. Trees like Sal (Shorea robusta),

Teak (Tectona grandis), Semul (Bombax ceiba), laurel, rosewood, mahua (Madhuca indica), amla (Emblica officinalis), khair (Acacia catechu), common bamboo, widely grows there.

***Indo-Gangetic Plain:*** The huge Indo-Gangetic Plain, stretches from Punjab to Assam and has a rich fertile land thus it is the most intensively farmed zone of the country and the world. Wheat is the main crop in the west, rice is widely grown in the east. Other important crops of the region are pulses, sorghum, oilseeds, and sugarcane. Mango orchards are a common sight. Other fruits of the sub-region include guavas, jackfruit, plums, lemons, oranges, and pomegranates. The soil of Terai region of Nepal is rich in silt, thus makes the plain very much suitable for farming. Primarily rice and wheat is grown on the Indo-Gangetic Plain in rotation. Other major crops are maize, sugarcane, and cotton. Numerous rivers arising from or passing through Himalayas provide sustained water supply to meet demand for irrigation.

**Fauna**

Around 400 varieties of mammals, 1250 species of birds and 10,000 types of insects and 2546 variety of fish, 197 species of amphibians and 408 reptile species are found in India.

***Mammalian faunas in India****:* Popular mammals include the Elephant, the famous Asiatic lion, the Royal Bengal Tiger, Rhinoceros, Wild Bison, deer, monkeys, wild goats, etc. Elephants are found in the sparsely populated hilly areas of Karnataka, Kerala and Orissa. A variety of deer and antelope species are also found but nowadays these are mostly confined to the protected areas. Wild buffaloes, massive Indian bison (gaur), shaggy sloth bear, striped hyena, wild pig, jackal, Indian fox, wolves and Indian wild dog (dhole) are also found in forests of India. Lions are found in the Gir forests of Gujarat, Tigers in the Sunderbans and the Brahmaputra valley. Project Tiger was launched by the government of India in 1973-74 to protect the tiger in its natural environment. The project was initially started in nine reserves covering an area of 13,017 sq. km. Wild ass is found in Great Runn of Kuchchh, Nilgiri Langur, Lion-tailed macaque, Nilgiri mongoose and Malaber civer in the southern hills and the spotted deer, leopards are found in almost all forests, Wolves throughout the country.

***Avi-fauna in India****:* India is blessed with over 1250 species and sub-species of birds. Out of total species, at least 141 species are endemic to this region. 77 families of birds are found in India. Indian forests includes various birds like large hornbills, serpent eagles and fishing owls, as well as the national bird of India, the beautiful peacock. Waterbirds, such as herons, ibises, storks, cranes, pelicans and others, are also found in India and are commonly seen in parks and sanctuaries.

Bird-life in India is rich and colourful. The birds include the beautiful Peacock to the Parrots, and thousands of migrant birds. Other common Indian birds are pheasants, geese ducks, mynahs, parakeets, pigeons, cranes, and hornbills.

***Reptiles in India:*** The reptile life includes over 450 species of reptiles and amphibians, including magnificent king cobra, Krait, python, crocodile, large freshwater tortoise and monitor lizard. There are also 10,000 insect species like praying mantis, Idiopid spider, Scorpions, locusts, bees, silkworms and the Lac insect.

***The Himalaya Foothills:*** The Himalayan foothills include three regions- bhabar, tarai and the Siwalik ranges in the South. The bhabar region is relatively drier. The tarai region is one of the richest areas for monsoon forests and fauna as the typical big mammals of Northern India, the elephant, the swamp deer, cheetal, hog deer, barking deer, wild boar, all are found in this area. Panther, wild dogs, hyena, the jackal, tiger, both the black and the sloth bears are found in this area. Amongst the rodents, porcupine is the most prominent animal of this region. The rare great India One horned rhinoceros is now found in some regions of Assam and Nepal tarai.

***The High Altitude Region of Western Himalayas (Kashmir & Western Ladakh to Kumaon):*** A belt of coniferous - pine forests separates altitudinal zone i.e. from 1500 m to 2500 m. from the alpine zone. The pine belt is a transition zone for the rich fauna of the alpine zone in the higher altitudes. When the environment in the alpine zone becomes extremely cold in winter, many species move down in this region. With the coming summer as snow melts, the alpine pastures turn green and become the grazing grounds for these animals. The rare and endangered wild ass is found in cold desert regions of Ladakh and paratactic deserts of Asia. A well known member of bovid family - the Yalk, has been domesticated for centuries by the people of Tibet and Ladakh but wild yalk can still be found. Three species of wild goats occur in the Indian Himalaya. Thar, Markhor and Ibex. Ibex spreads over mountainous regions all over Central Asia from the Himalaya to the Altai and westwards as far as Spain. Three species of wild sheep are found in Western Himalaya- Nayan, in Ladakh to Tibet. Argali sheep in the Himalaya to Siberia and Bhral or blue sheep occurs in the western himalaya extending to Sikkim and Nepal. Two kinds of antelopes, the chiru and the Tibetan gazelle are also found in the high cold plateau regions of Tibet and adjoining areas.

The musk deer found here is threatened now. Government of Uttarakhand launched a project “Musk - deer Breeding Project” to increase the number of Musk deer.

***The Eastern Himalayan Sub – Zone :*** Due to high humidity and higher altitudes than the west, snowfall is less common. The animal life is characterised by the presence of Indo-Chinese fauna. The red panda, hog badgers, ferret badgers, crestless porcupines are archetypal species of this area.Three varieties of goat occur in the eastern Himalaya.

***The Peninsular Indian Sub-Region:*** Peninsular India is characterised by the Deccan plateau extending northwards to the flood pains of the Indo-Gangetic basin and westwards to the Great Thar desert of Rajasthan. ***Peninsular India and the Drainage Basin of the Ganges:*** The deciduous forests in these regions is a home to Elephant, sambar, deer and wild boar. Seladang is found in rain forests of Malaya. Indian mouse deer is also found here. The four-horned antelope is also found here. The nilgai, the blackbuck and Chinkara are the other antelopes.

***Climate***

Climate of India cannot be categorised as one climatic zone due to its vastness and diversity of geography and whether across different parts of the country. As India lies above equator, most of Southern India falls in sub-tropical climate zone and the Peninsular India witnesses Maritime Climate due to closeness of sea on all three sides.

The climate of India is deeply influenced by the Himalayas and the Thar Desert. Himalayas in the North act as barrier to cold winds from Central Asia keeping Northern India warm and only slightly cool during winters, much warmer as compared to other countries on the same latitude. The Thar Desert plays a significant role in gathering a huge amount of rainfall for the country by absorbing the southwest monsoon winds.

***Climatic Regions of India***

Considering the vastness and variety in India’s whether and geography the country can be divided in to four climatic regions or groups which can further be divided in seven climatic types. They are 1) Tropical rainy climatic group, 2) Dry climate group, 3) Humid sub-tropical climate group and 4) Mountain climate

***Seasons of India***

India experiences a wide range of climatic conditions due to different geography and whether in different parts of the country. India is a tropical country of sub-continental size, peninsular in shape and has extensive coastline on three sides. Antarctica happens to be the next door neighbor on the south. Himalayas is making a tallest wall towards north.

This unique geographical condition gives India the peculiar weather with two monsoon seasons with hot and cold weather seasons. In all India have forests; glaciers with rivers flowing from them, also fog, snow, thunder, and hail form an integral part of India’s climate. There are four Main Seasons in India: i) winter, ii) summer, iii) monsoon and iv) post-monsoon.

**Wetlands**

The wetland ecosystems in India are spread over a wide range of varied climatic conditions, ranging from cold and humid Jammu and Kashmir to hot and humid conditions in Peninsular India with a great variety of. Under the conservation of Wetlands in India, number of wetlands have been recognised that are part of national parks and sanctuaries. Twenty-five wetlands have been declared as Ramsar Sites.

IRS LISS III satellite data has been analyzed for delineating wetlands in the country. The country has thirty five states/union territories covered in 5112 of topographical maps of Survey of India (SOI) on 1:50,000 scale that form the spatial frame work for mapping (Figure 3). The spatial framework was prepared using 15’ x 15’ grid. A detail of state information followed in the atlas is given in Annexure-II.

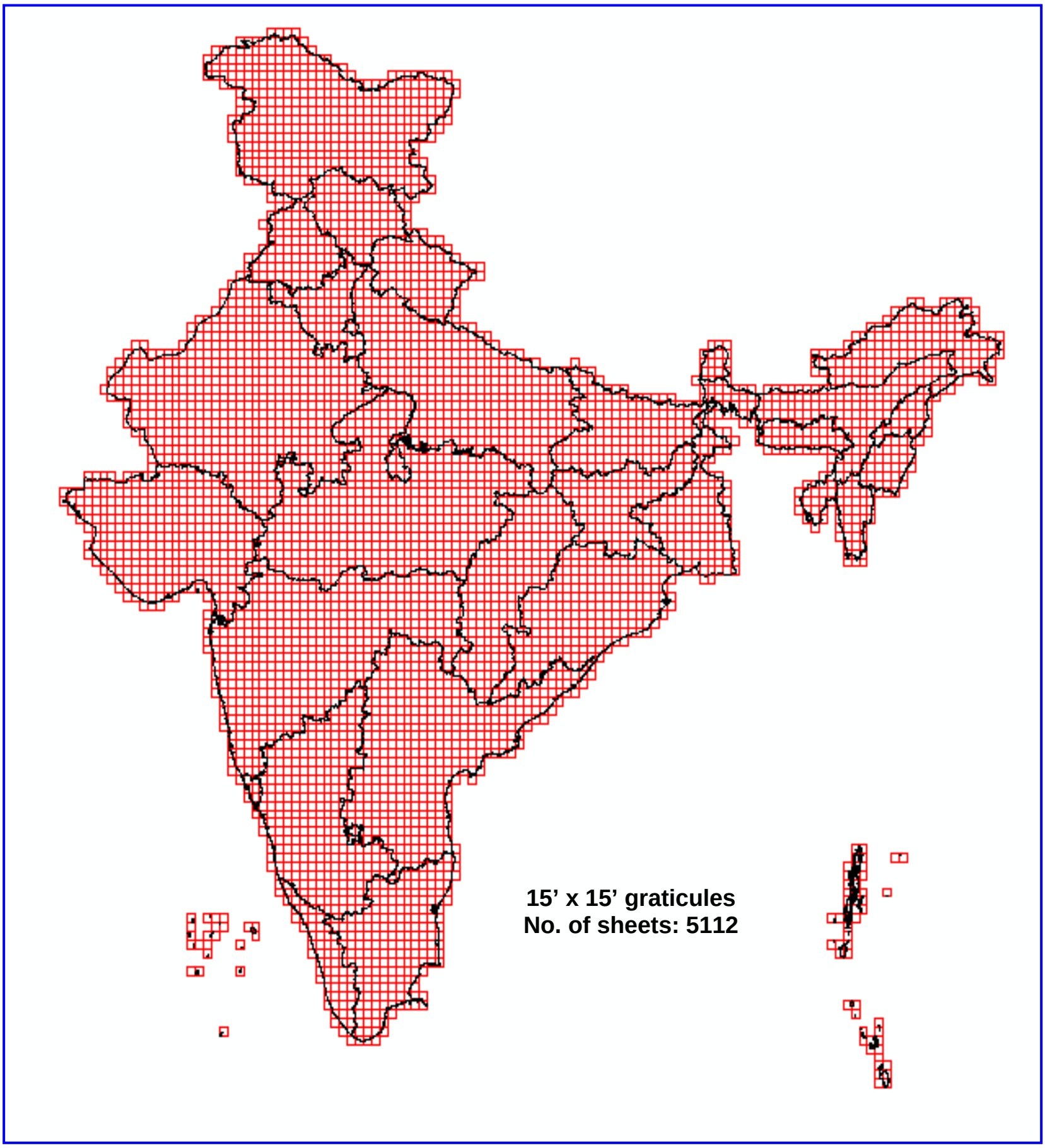



Figure 3: Spatial Framework of India

## 4.0 DATA USED

### *Remote sensing data*

IRS P6 LISS III data was used to map the wetlands. LISS III provides 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. India is covered in 365 IRS LISS III scene (Figure 4). Two-date data, one set acquired during March to June and another during November to December were used to capture the pre-monsoon and post-monsoon hydrological variability of the wetlands respectively. Figure 5 shows the overview of the part of Gujarat state as seen in the LISS III FCC of post-monsoon and pre-monsoon data respectively.

### *Ground truth data*

Remotely sensed data require certain amount of field observation called “ground truth” in order to convert it into meaningful information. Such work involves visiting a number of test sites, usually taking the satellite data. 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.

### *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.

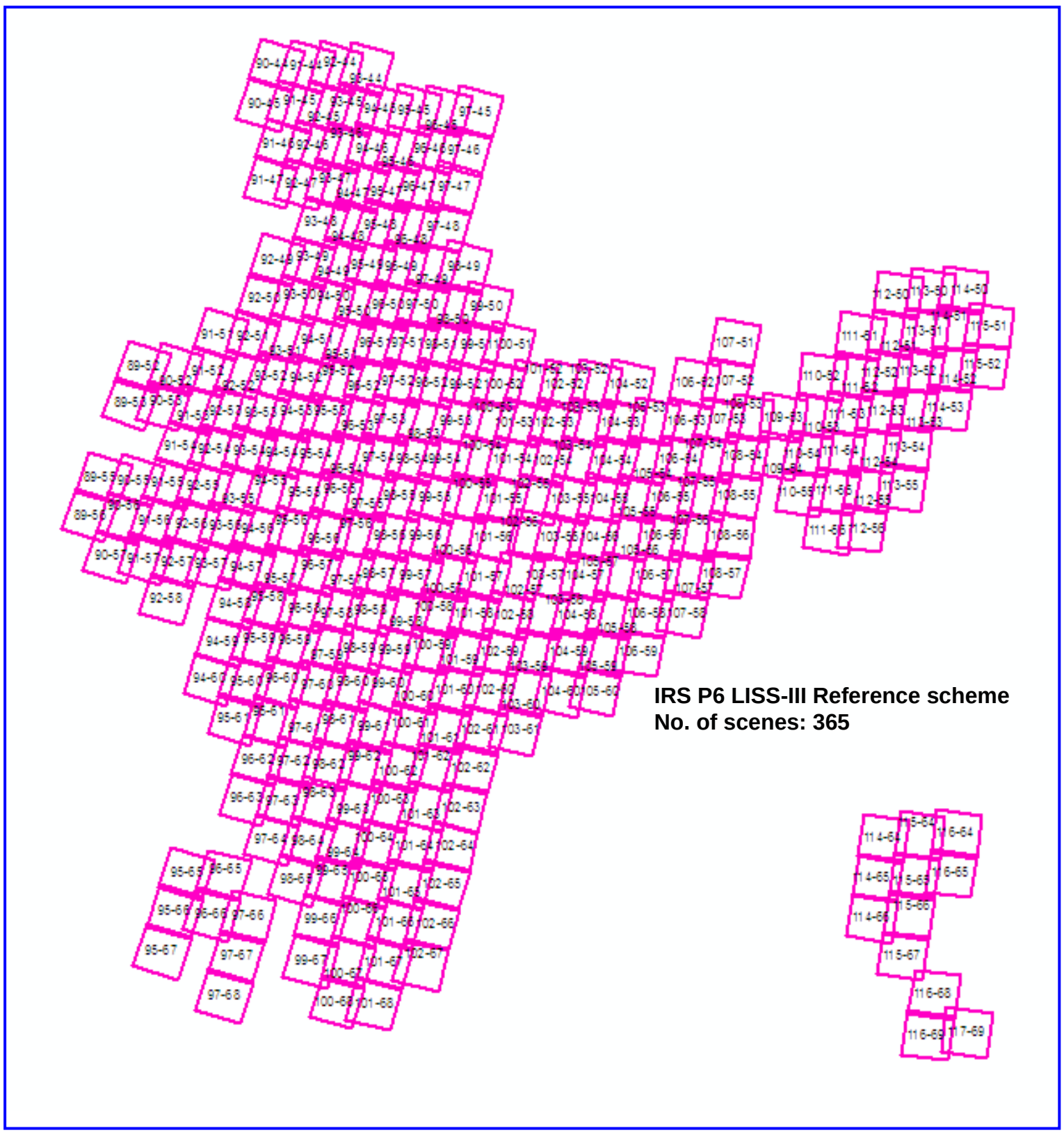



Figure 4: IRS P6 LISS-III coverage (path-row) of India

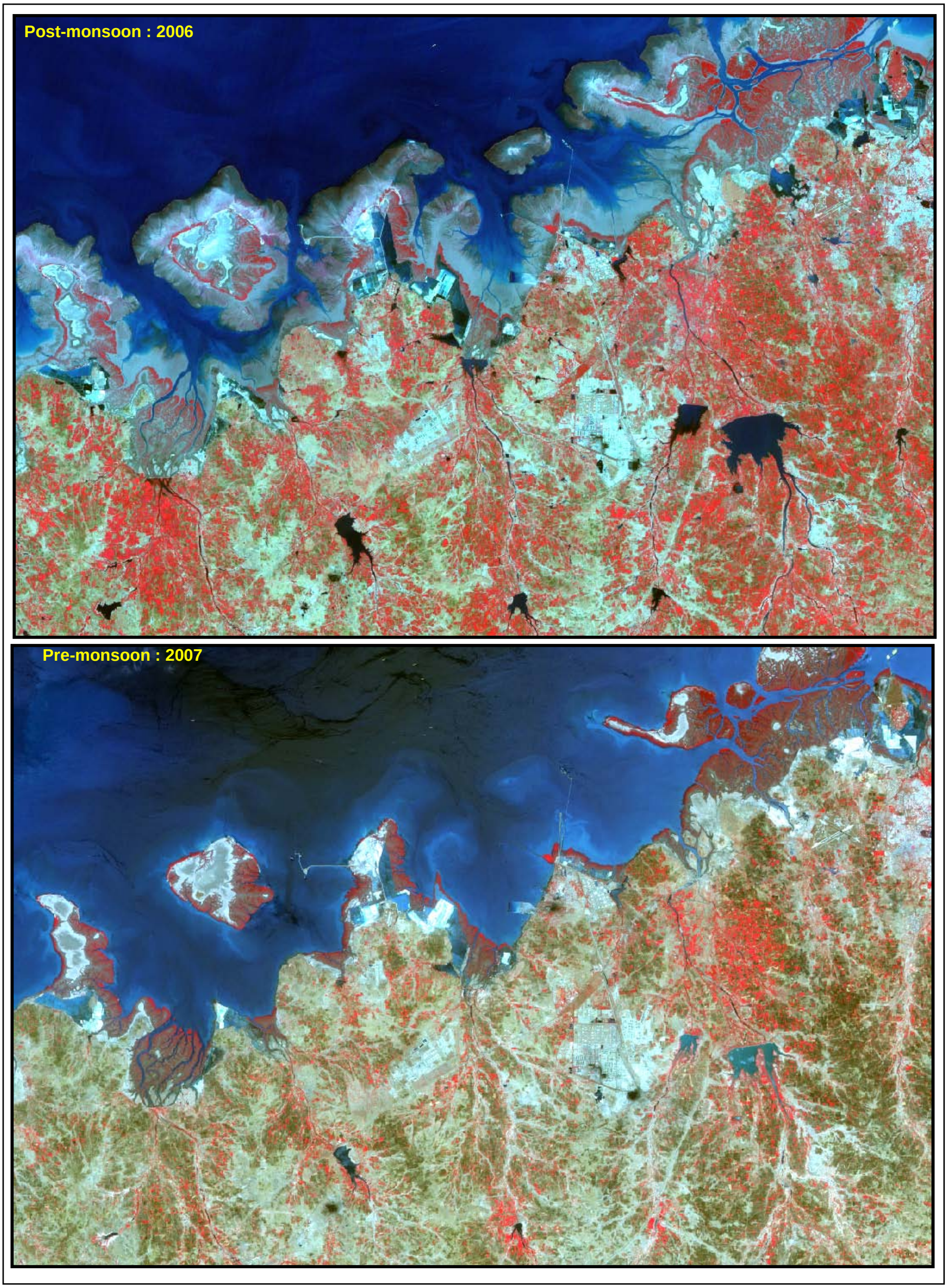



Figure 5: IRS LISS-III FCC (Post-monsoon and Pre-monsoon): Part of Gujarat state

## 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 6. 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 Design considerations and database organisation*

Any spatial information system requires systematic database design and organisation. Organisation of the database recognizes the fact that the system has to support information retrieval in terms of spatial units, which are generally at state/district level. These units are invariably the administrative units like state, district, and taluka. Seamless GIS database has been organised at different level. The wetland database and other reference layers are designed in such a way that information retrieval and query at various spatial units can be performed. In addition, wetland type/category wise information retrieval mechanism is also provided. Figure 7 shows four levels of database organization and Figure 8 shows GIS workspaces and file organisation.

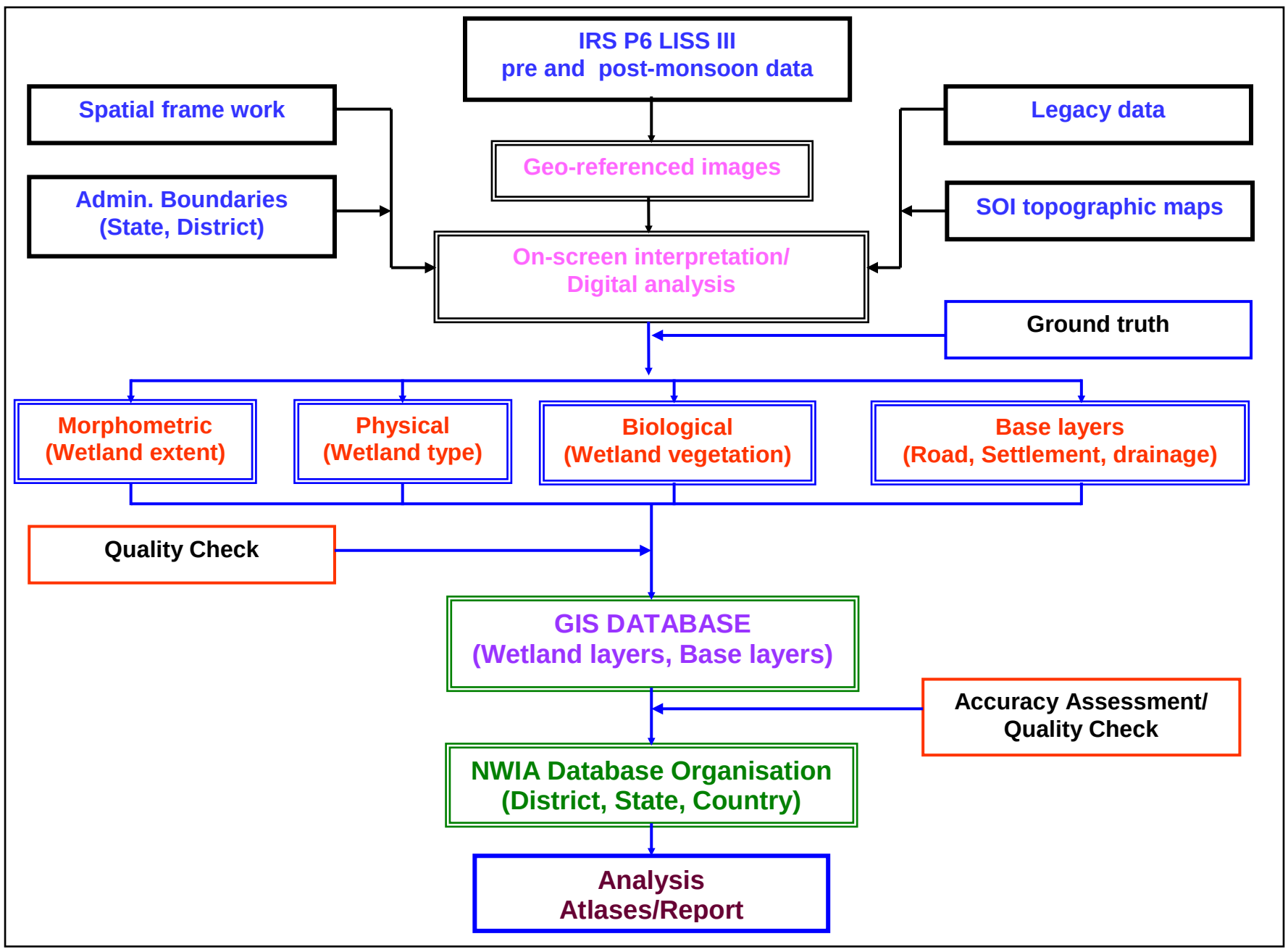



Figure 6: Flow chart of the methodology used

### *5.2 Creation of spatial framework*

This is the most important task as the state forms a part of the national frame work and is 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') grids 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 (Garg and Patel 2007). The spatial framework for India state is shown in Figure 3.

### *5.3 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 archived 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 archived image. The second date data was then registered with the first date data.

### *5.4 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 on-screen 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)

The indices were generated using standard image processing software, stacked as layers (Figure 9). Various combinations of the indices/spectral bands were used to identify the wetland features as shown in Figure 10. 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 :
  MNDWI image was used to generate qualitative turbidity level (high, moderate and low) based on signature statistics and standard deviations (Table-2). In the False Colour Composite (FCC) these generally appear in different hues from cyan (high) to blue/dark blue (low).

Table 2: Qualitative turbidity ratings

| Sr. No. | Qualitative Turbidity | Based on $\sigma$ of MNDWI | Hue on False Colour Composite |
|---|---|---|---|
| 1. | Low | > $+1\sigma$ | Dark blue/blackish |
| 2. | Moderate | > $-1\sigma$ to <= $+1\sigma$ | Medium blue |
| 3. | High/Bottom reflectance | <= $\mu - 1\sigma$ | Light blue/whitish blue |

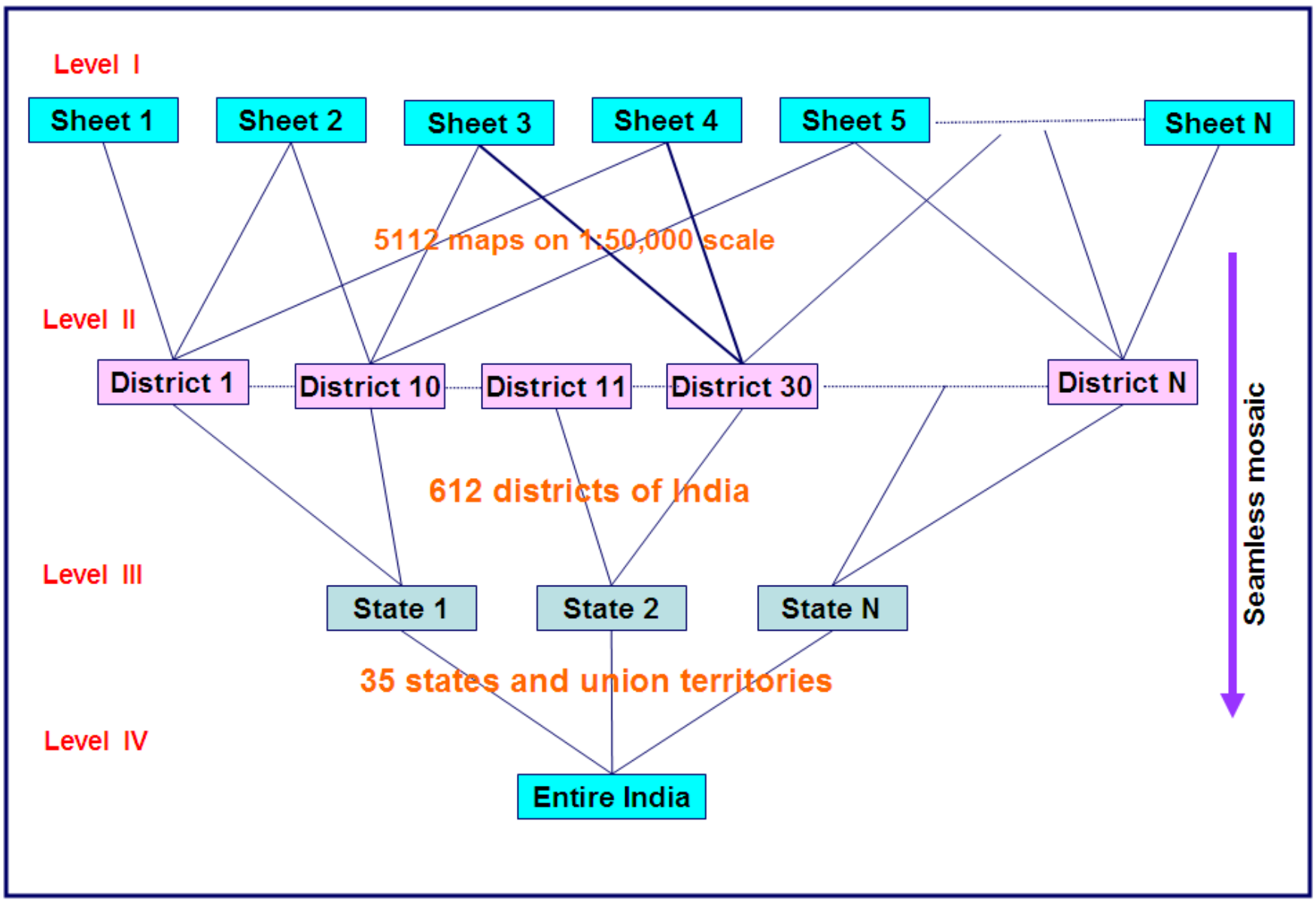



Figure 7: NWIA levels of database organisation

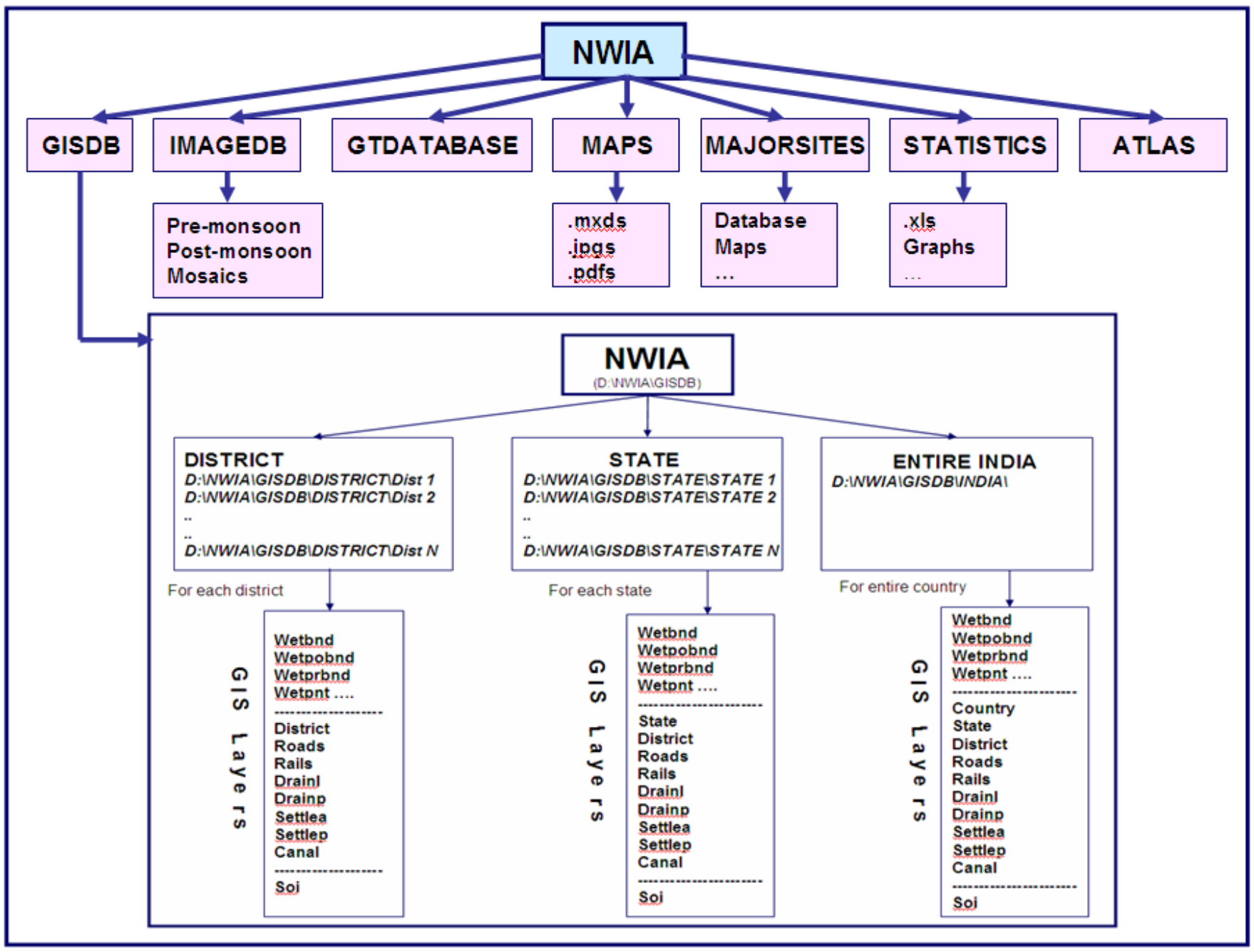



Figure 8: NWIA GIS workspaces and file organisation

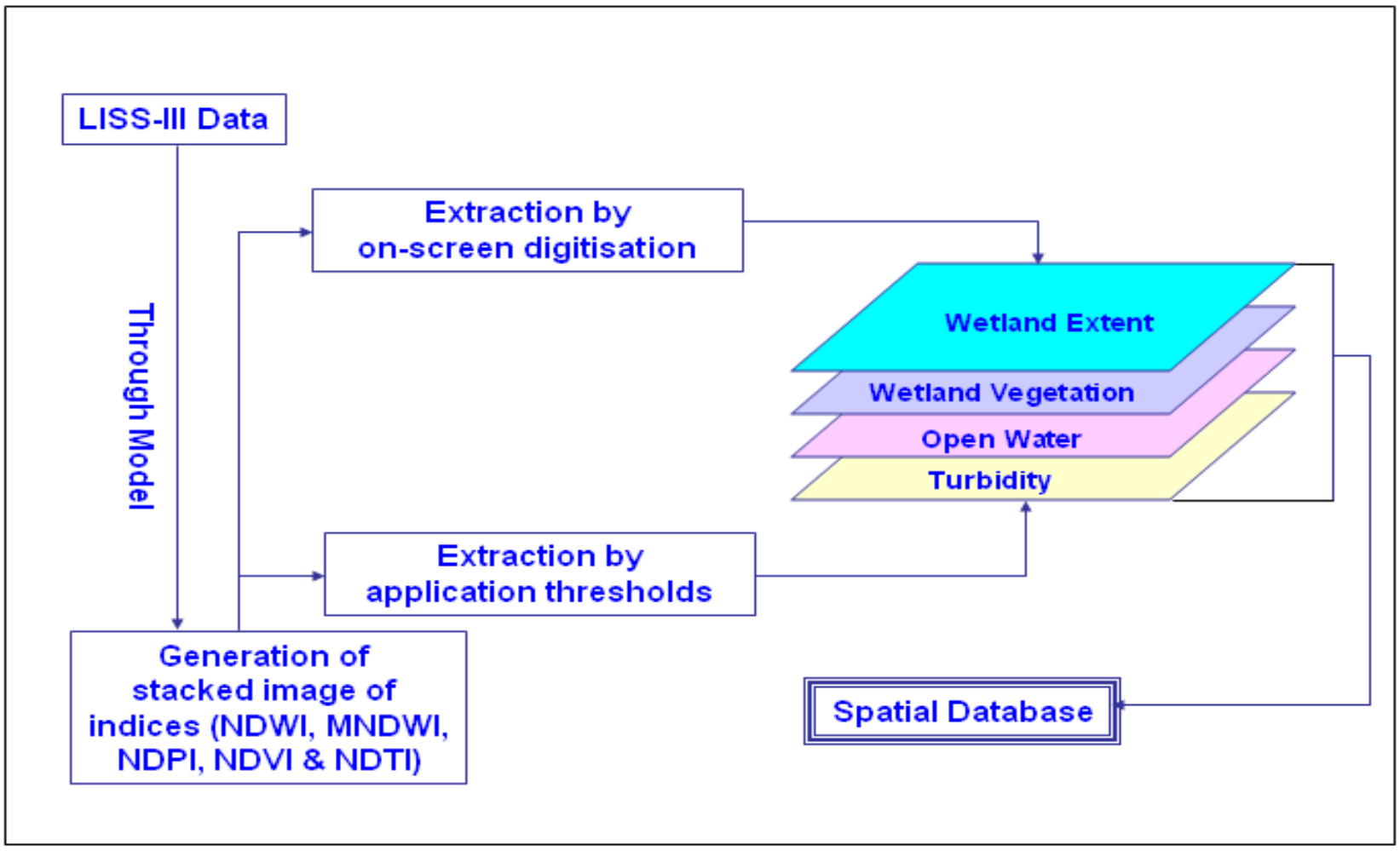



Figure 9: Steps in the extraction of wetland components

### 5.5 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 digitisation.

### 5.6 Creation of spatial layers

Spatial layers have been designed, created and organized in *ArcGIS/Arcinfo* Environment. There are eight wetland resources layers for wetland boundary, water-spread, aquatic vegetation, and turbidity representing national inventory and assessment of wetland resources of the country. In addition base layers like major rail, road network, settlements, and drainage are interpreted from the current image or taken from other project database. The administrative boundaries (district, state) are taken from the known reference data. List of data generated and naming conventions used is given in Table – 3.

### 5.7 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.

**Coding 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, which are self explanatory with short forms. This have an attribute/look-up table and a key field (link-code), which links this look-up table and the database layer.

***Attribute tables for wetland boundary layer****:* A wetland attribute table has been created for *WETBND* (Table 4)*.* Attribute table (wetcode.dat) is created for recording details of each wetland*.* Wetland boundary layer (*WETBND*) is linked to *wetcode.dat*

*wetcode.dat* describes wetland codes and its description (Table 5). Pre-monsoon water spread layer (*WETPRBND*) and post-monsoon water spread layer (*WETPOBND*) are also linked with *wetcode.dat.*

### *5.8* 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 on A3 size.

Table 3: List of data generated and naming conventions

| Sl. No. | Theme | Theme name | Key field | Source |
|---|---|---|---|---|
| 1 | Wetland boundary | WETBND | Wetcode<br>Wettcode | RS data |
| 2 | Wetland pre-monsoon water spread | WETPRBND | Wetcode<br>Wettcode | RS data |
| 3 | Wetland post-monsoon water spread | WETPOBND | Wetcode<br>Wettcode | RS data |
| 4. | Aquatic vegetation (post-monsoon) | AQVEGPOST | Wetcode | RS data |
| 5. | Aquatic vegetation (pre-monsoon) | AQVEGPRE | Wetcode | RS data |
| 6 | Turbidity (post-monsoon) | TURBIDITYPO | Wetcode | RS data |
| 7 | Turbidity (pre-monsoon) | TURBIDITYPR | Wetcode | RS data |
| 8 | Wetlands (< 2.25 ha) | WETPNT | Wetcode<br>Wettcode | RS data |
| 9 | Drainage lines | DRAINL | Attributes as per NNRMS Standards | RS Data/SOI Maps/ NRIS/NRDB wherever available on 1:50,000 scale |
| 10 | Drainage polygons | DRAINP | | |
| 11 | Road network | ROADS | | |
| 12 | Rail network | RAILS | | |
| 13 | Settlements (points/area) | SETTLEP | | |
| 14 | Settlements (area) | SETTLEA | | |
| 15 | State boundary | STATE | | |
| 16 | District boundary | DISTRICT | | |
| 17 | Canal | CANAL | | |
| 18 | Lat-Long grid | SOI | | |

Table 4: Attribute table of *WETBND*

| Sl. No | Field Name | Field Type | Key Field (Y/N) | Remarks |
|---|---|---|---|---|
| 1 | Wetcode | 16, 16, C | Y | Unique identifier for each wetland |
| 2. | Wettcode | 4, 4, I | Y | Wetland type code based on wetland classification scheme |
| 3. | Wetname | 50,50,C | N | Wetland name if any |
| 4. | Aqveg | 2,2, C | N | Status of Aquatic vegetation (Y – Present, N – Absent) |
| 5. | Turbidity | 2,2,C | N | Status of Turbidity (H – High, M – Moderate, L – Low) |

Table 5: Database structure of *Wetcode.dat*

| Field name | Field type | Key field | Remarks |
|---|---|---|---|
| Wetcode | 16,16,C | Y | 16 digit code (explained below) ** |
| State | 2,2,C | N | Coding scheme as per NNRMS/NRDB standards |
| District | 2,2,C | N | Coding scheme as per NNRMS/NRDB standards |
| Taluka/Tehsil | 2,2,C | N | Coding scheme as per NNRMS/NRDB standards |
| Toposheet | 6,6,C | N | Ex. 46E/12 = 460512, 46A/16 = 460116 |
| Wetnumber | 4,4,C | N | Unique code for each wetland in a Map sheet |

**** Coding scheme for wetcode**:

Wetcode for each wetland is **'AABBCCDDDDDDEEEE'** (16 digits).

Where AA – State code
BB – District code
CC – Taluka code
DDDDDD – Map Sheet number
EEEE – Wetland number

Details of state codes, district codes and other technical information are provided in NWIA Technical Guideline and Manual. (Garg and Patel, 2007).

## 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 locational 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.

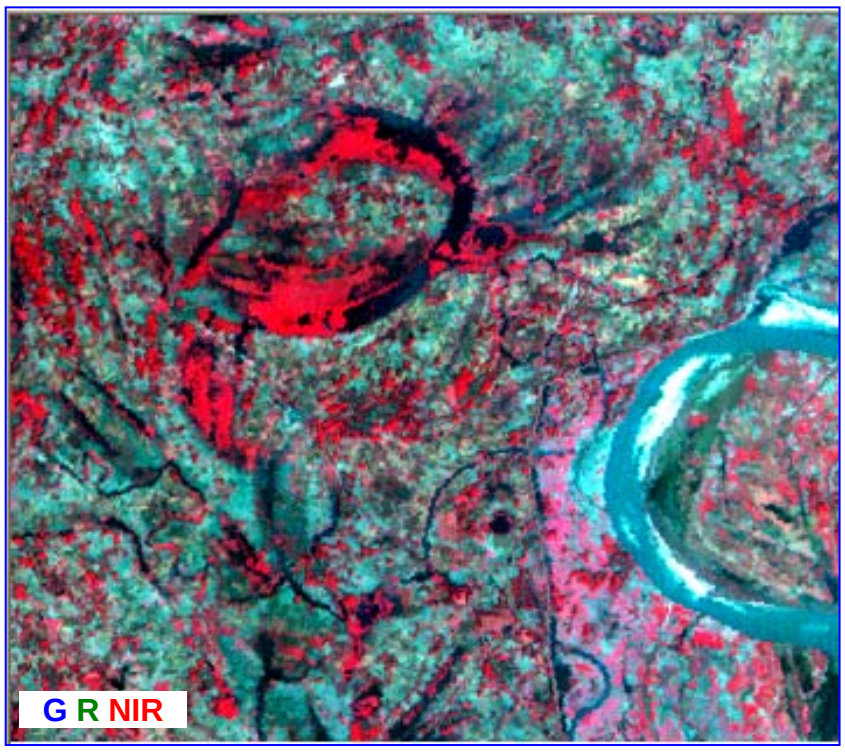
This study used well established, time-tested, fully documented data collection conventions. It employed skilled and trained personnel for image interpretation, processing and digital database creation. All interpreted imageries were reviewed by technical expert team for accuracy and code. The reviewing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

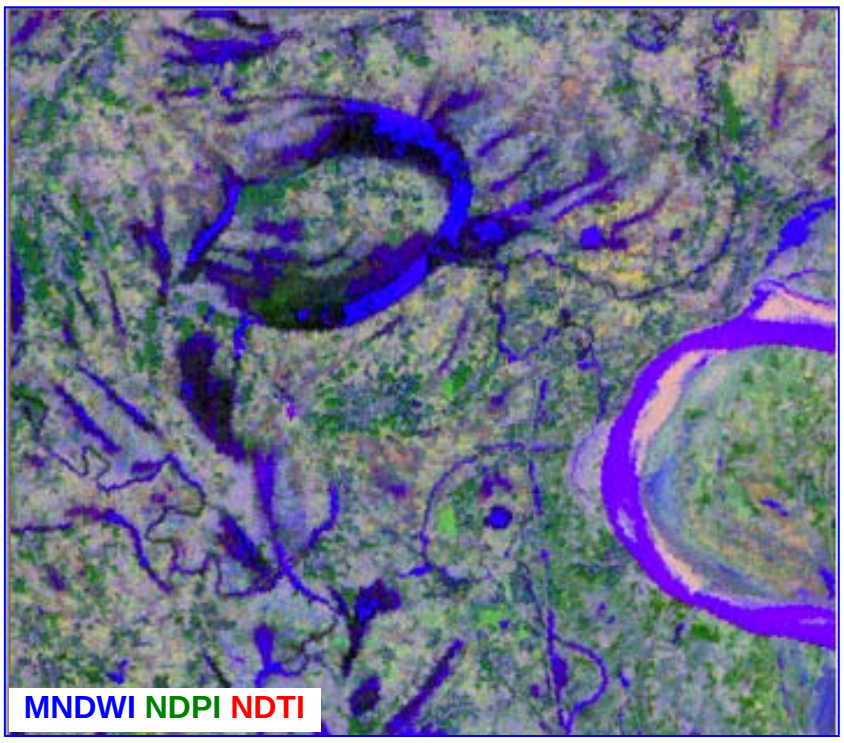
1. Image-to-Image Geo-referencing/Data generation
2. Reference layer preparation using NWIA post monsoon and pre-monsoon LISS-III data.
3. Wetland mapping using visual/digital interpretation techniques.
4. Geo-data base creation and organization
5. Output products.

### 6.1 Data verification and Quality Assurance of Output Digital Data Files

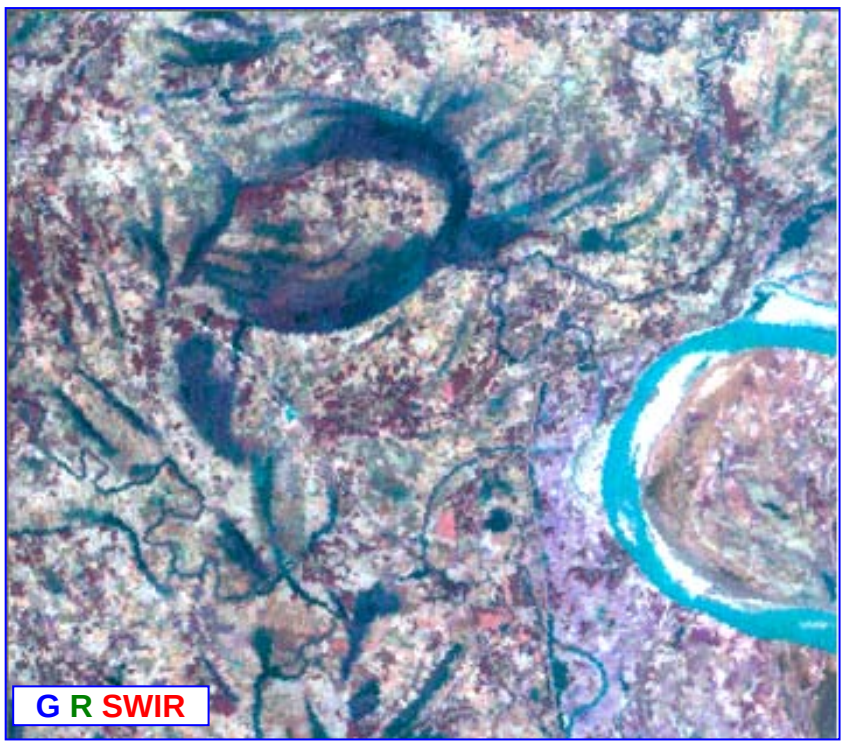
All digital data files were subjected to rigorous quality control inspections. Digital data verification included quality control checks that addressed the geospatial correctness, digital integrity and some cartographic aspects of the data. Implementation of quality checks ensured that the data conformed 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 (ArcGIS) 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.

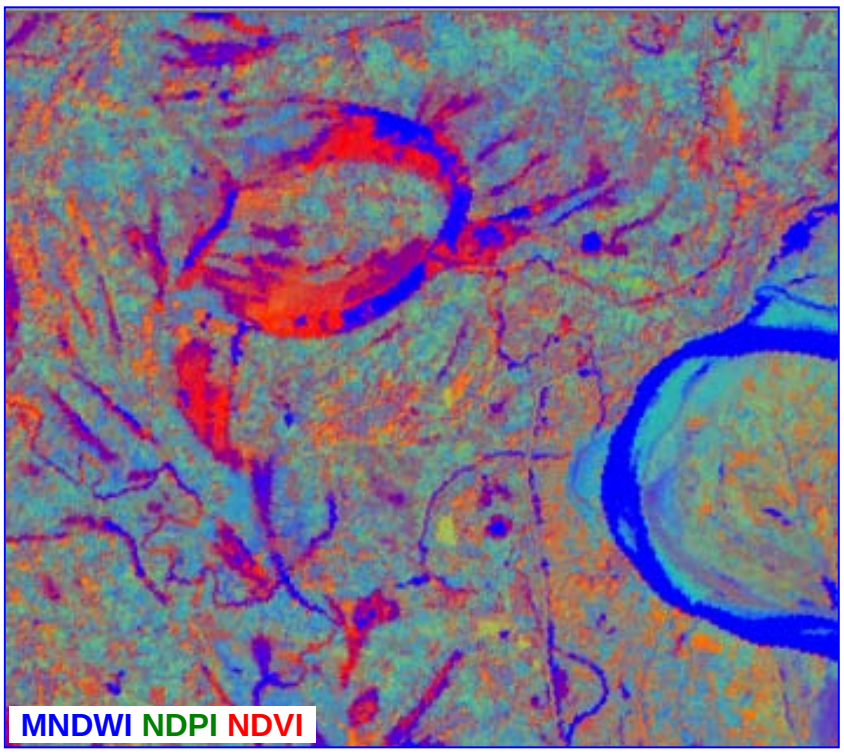
**IRS P6 LISS-III FCC**



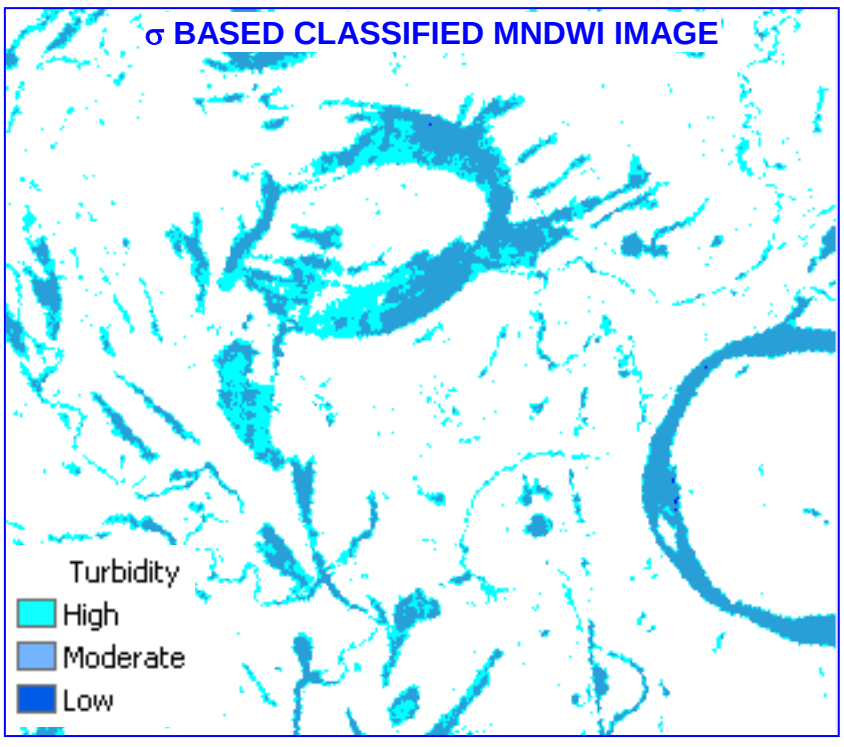




**Useful for wetland boundary extraction/delineation**




**Useful for wetland vegetation & open water features**




**Useful for qualitative turbidity delineation**

Figure 10: Various combinations of the spectral/indices bands used to identify wetland components

# MAJOR WETLAND TYPES

## 7.0 MAJOR WETLAND TYPES OF INDIA

As mentioned in Chapter 2, all the wetlands of India have been classified into 19 classes. River/stream reservoir/barrage, inter-tidal mud-flat and natural lake/pond are some of the major wetland types of India. Lagoon, mangrove, coral, riverine wetland and high altitude lake (>3000 m elevation) are some of the unique wetland types of the country.

Each wetland type also exhibit a wide diversity in terms of shape, size, water quality, aquatic vegetation etc, which are well captured on the satellite imagery. Representative of these wetland types as seen on LISS-III imagery along with actual field photographs are given in Plate-1 to 21.


Plate - 1: Inland – Natural – Lake/Pond

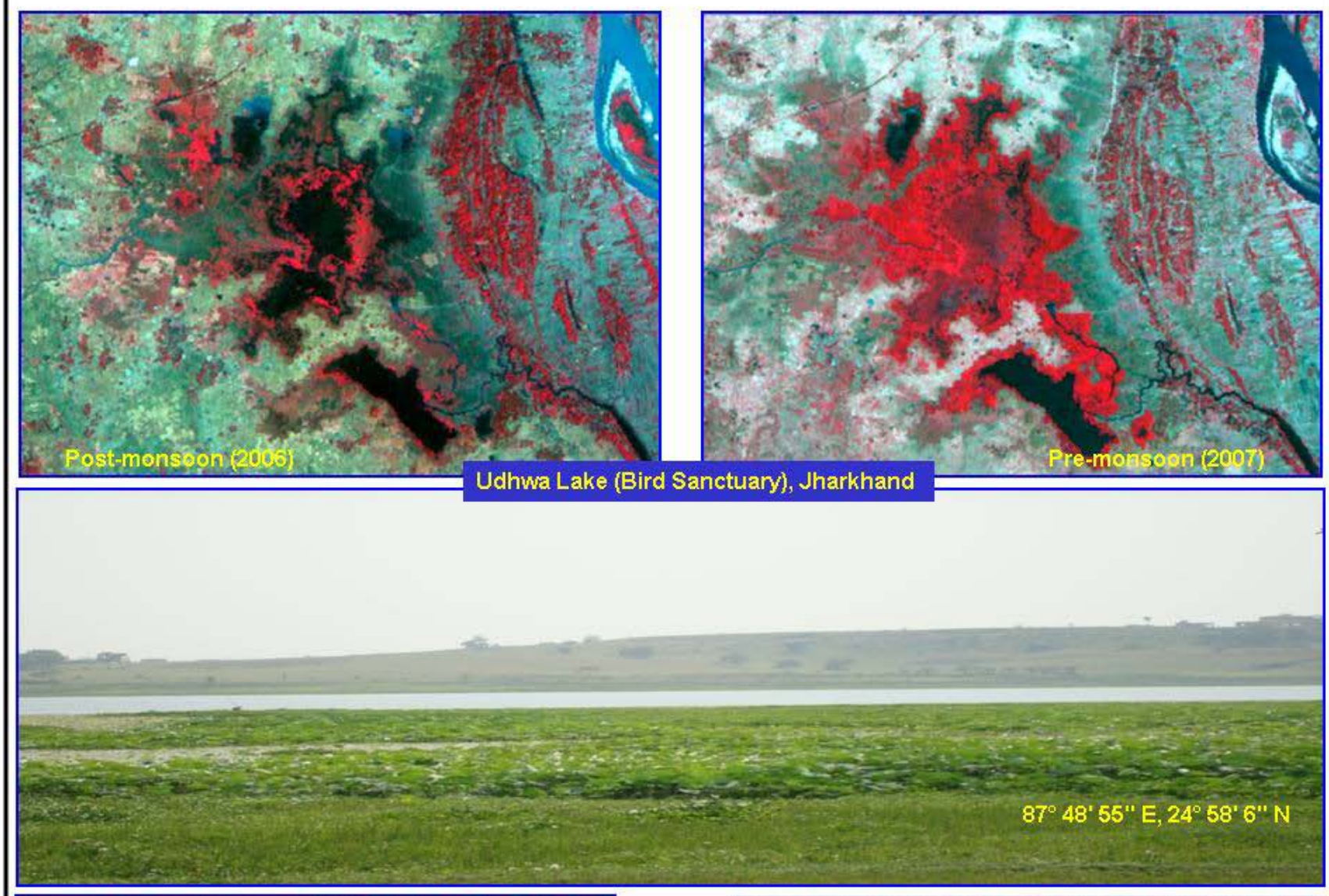



Plate - 2: Inland – Natural – Lake/Pond

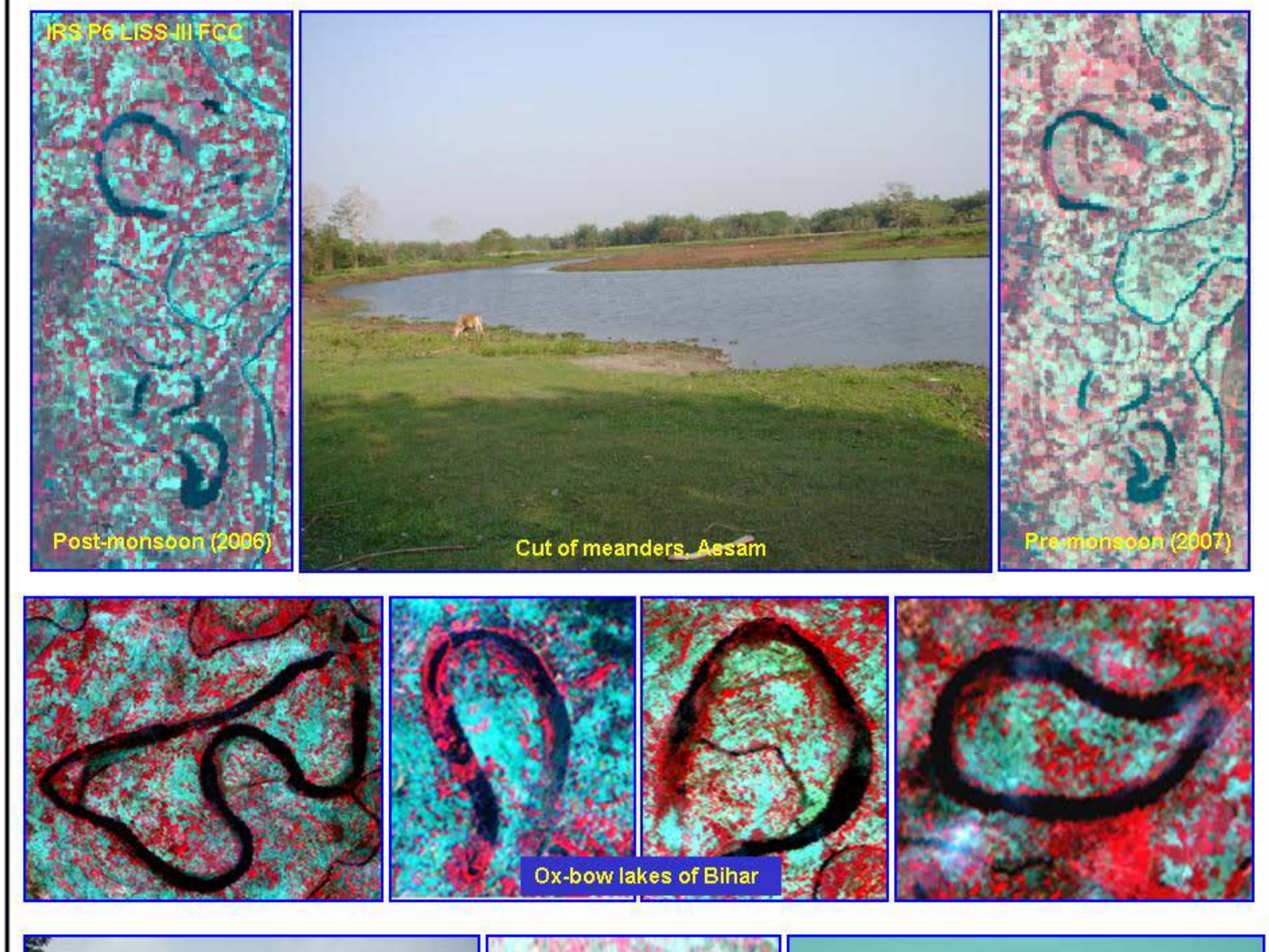
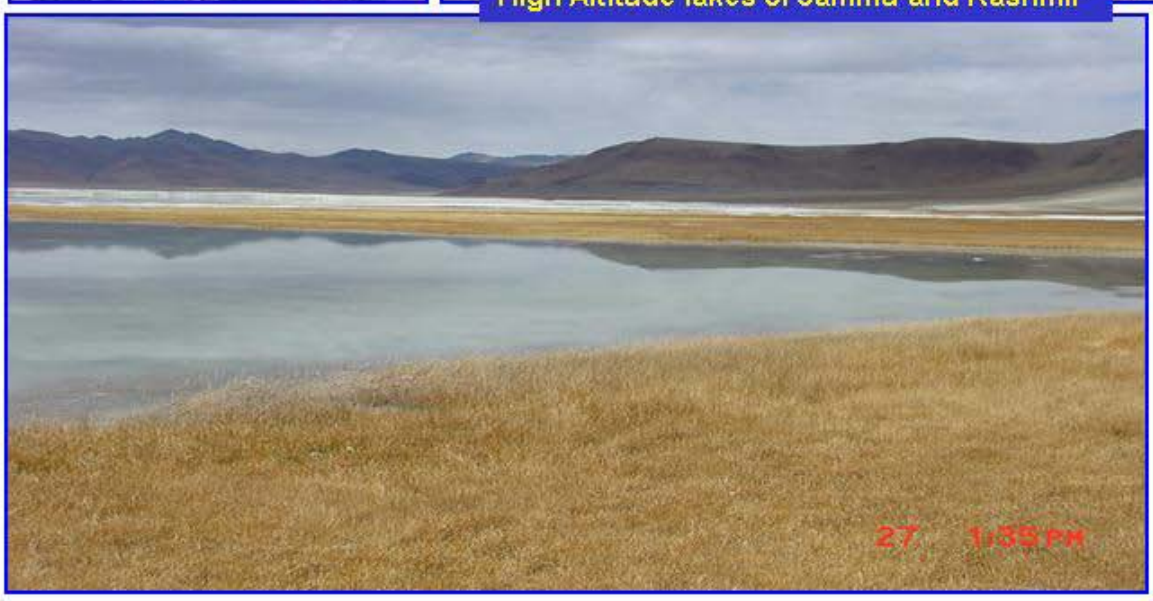
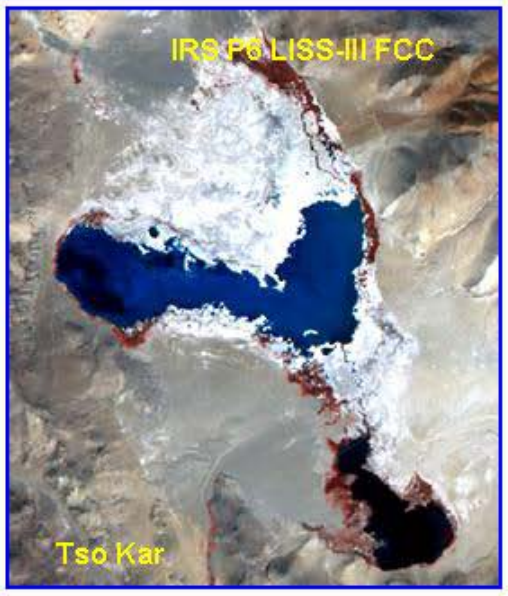



Plate - 3: Inland – Natural – Ox-bow lake/Cut off meander



High Altitude lakes of Jammu and Kashmir







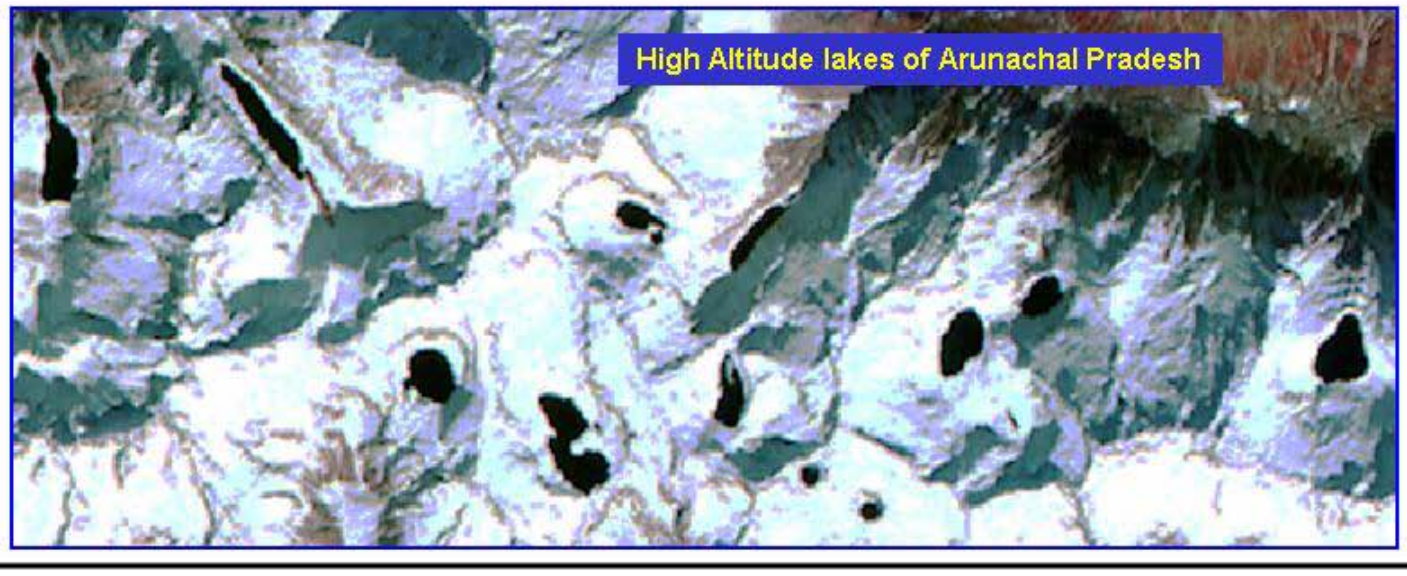



Plate - 4: Inland – Natural – High Altitude Wetland


Plate - 5: Inland – Natural – Riverine Wetland


Plate - 6: Inland – Natural – River/Stream

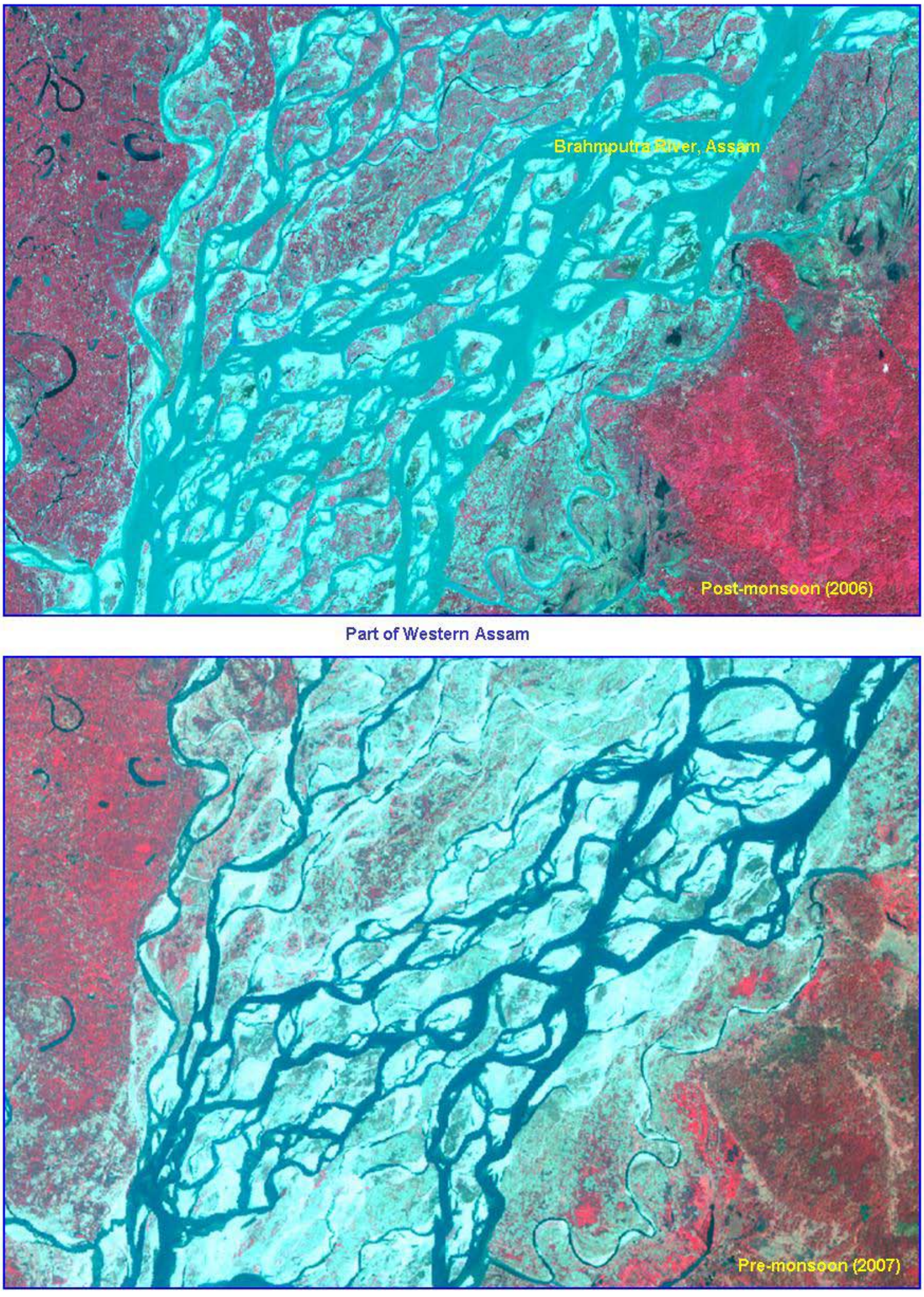



Plate - 7: Inland – Natural – River/Stream

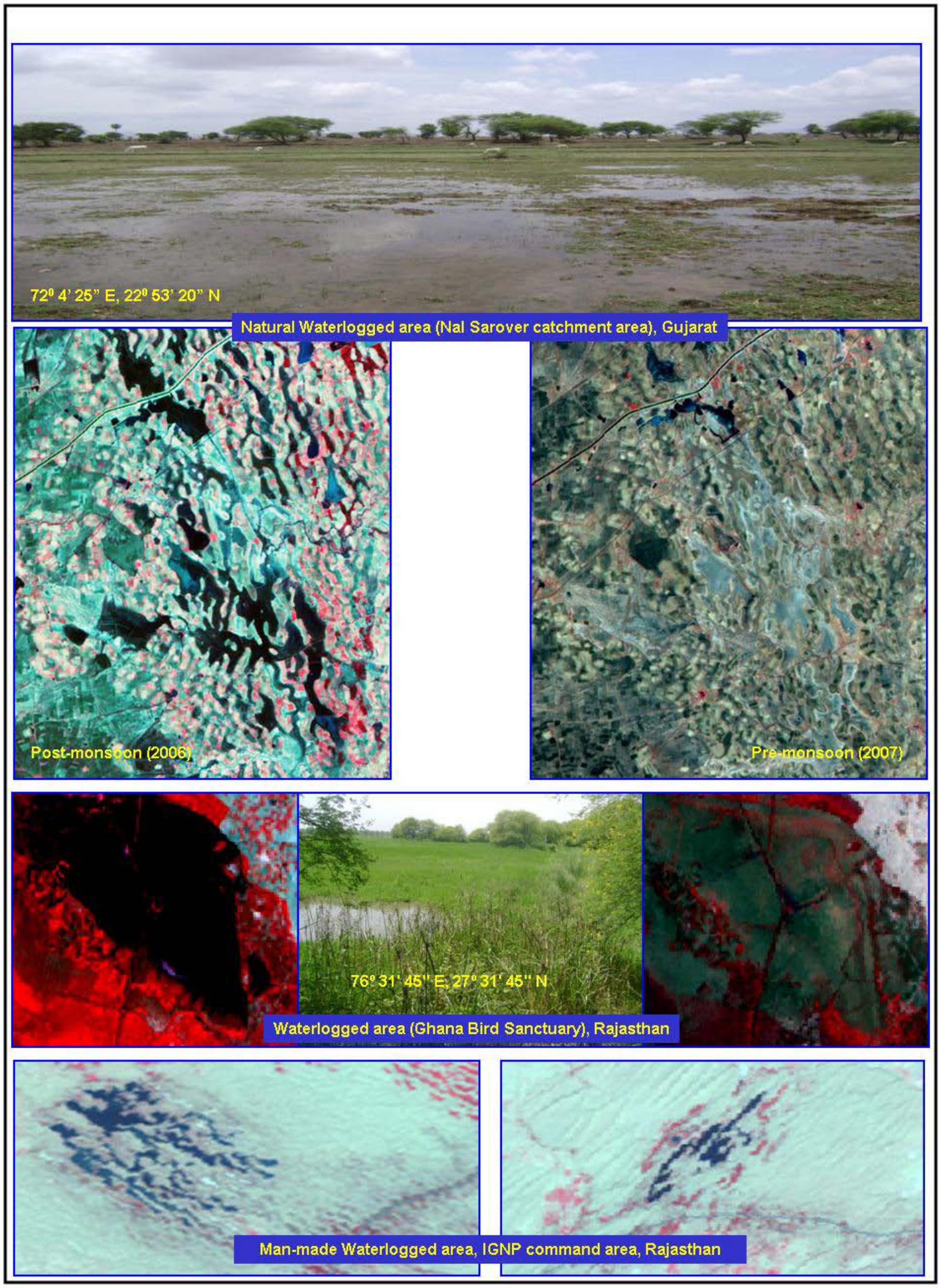



Plate - 8: Inland – Natural and Man-made – Waterlogged

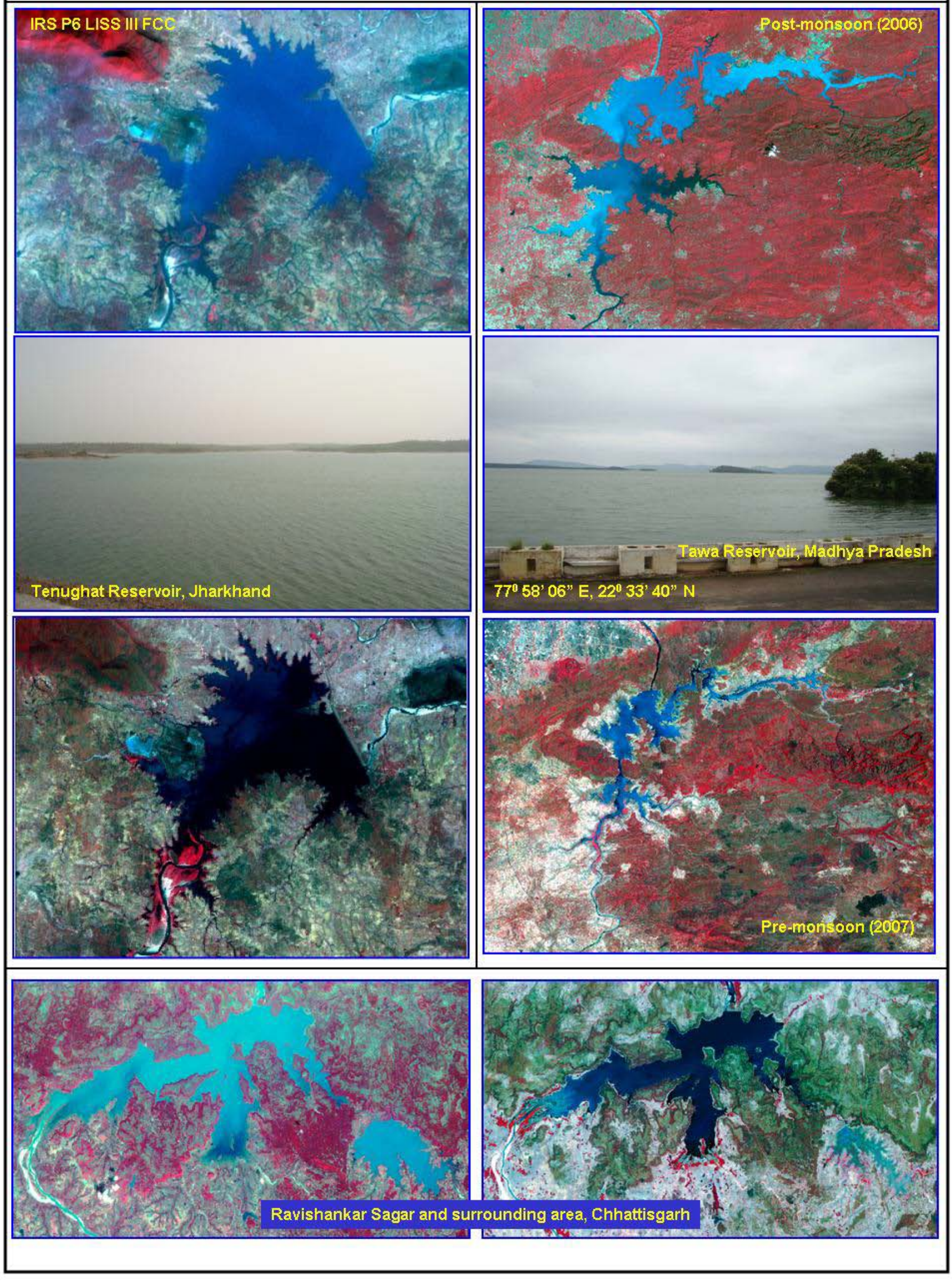



Plate - 9: Inland – Man-made – Reservoir/Barrage

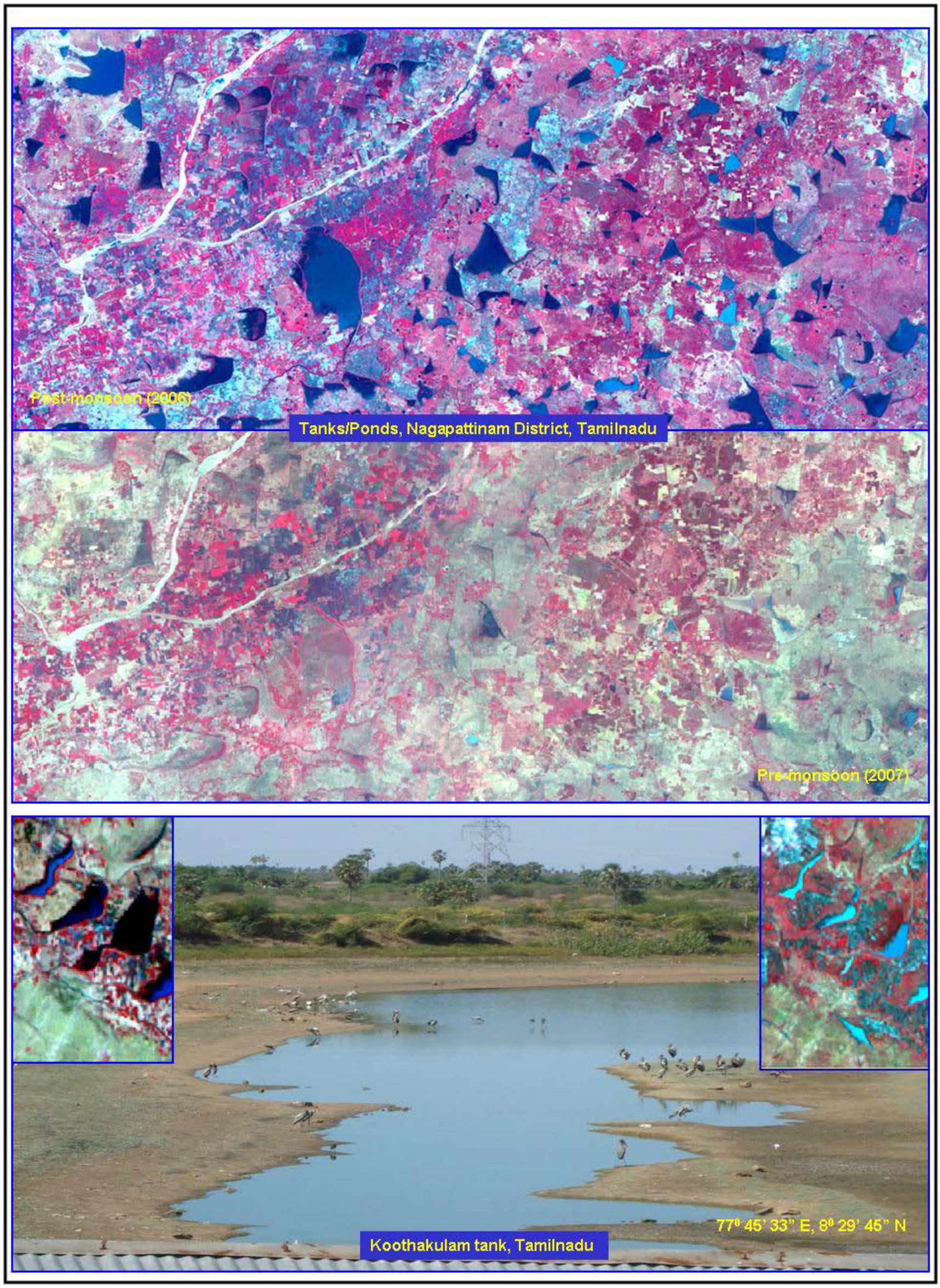



Plate - 10: Inland – Man-made – Tank/Pond

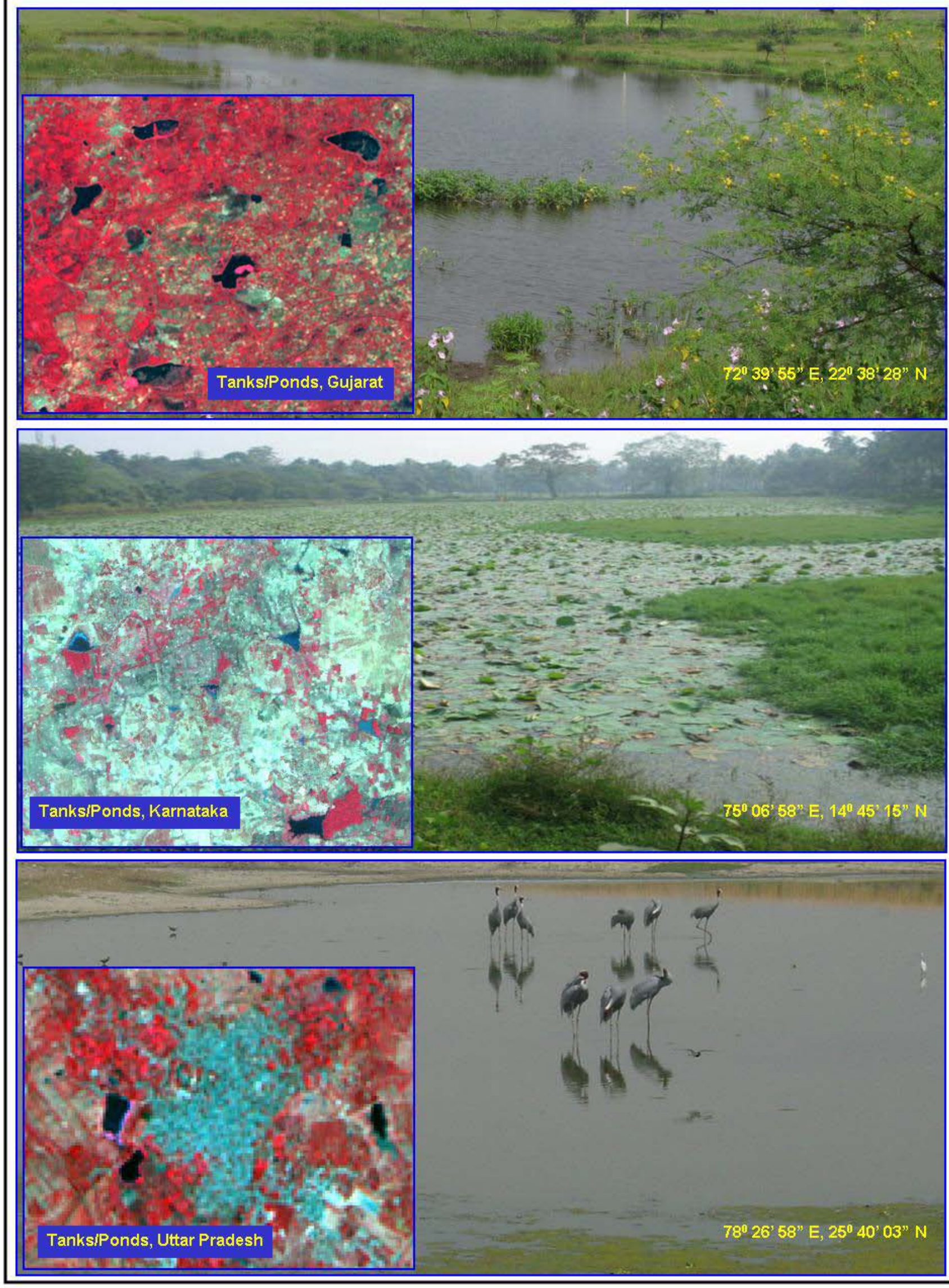



Plate - 11: Inland – Man-made – Tank/Pond

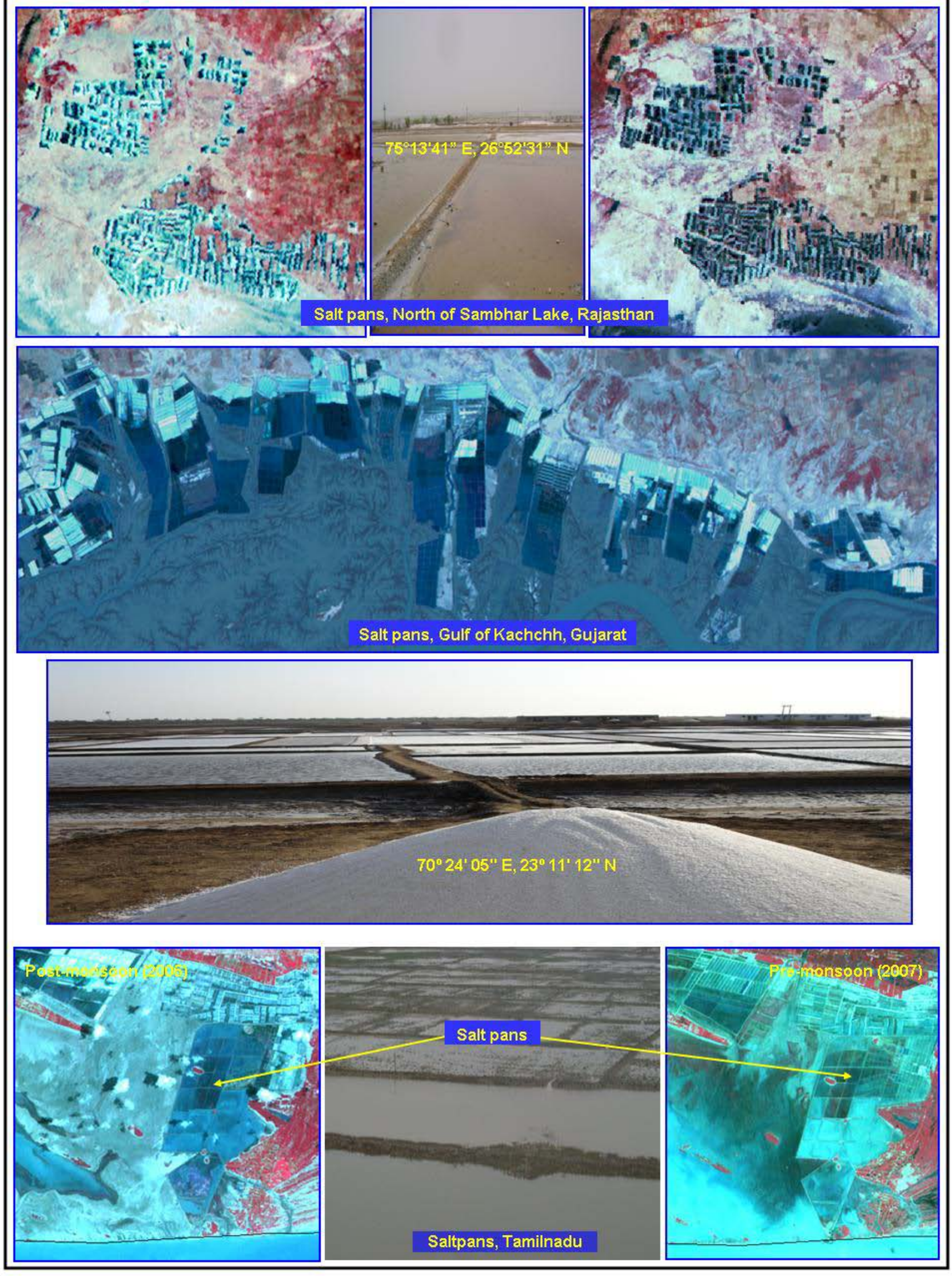



Plate - 12: Inland – Man-made – Salt pans and Coastal – Man-made – Salt pan




Lagoons, Kerala



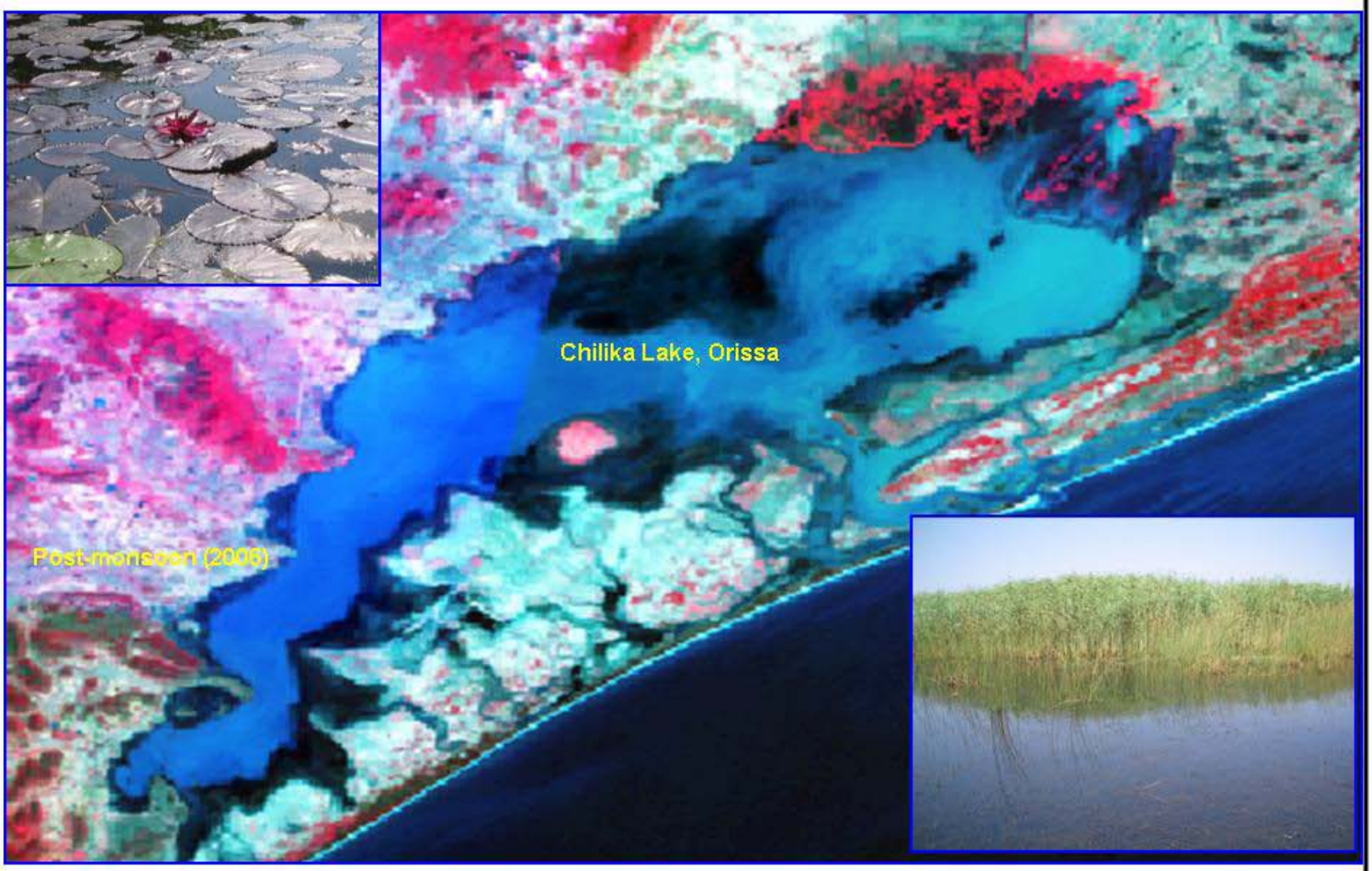
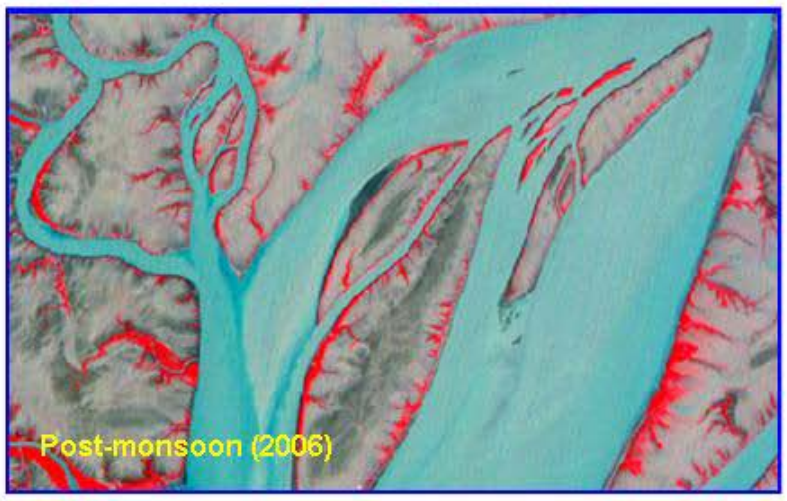





Plate - 13: Coastal – Natural – Lagoon





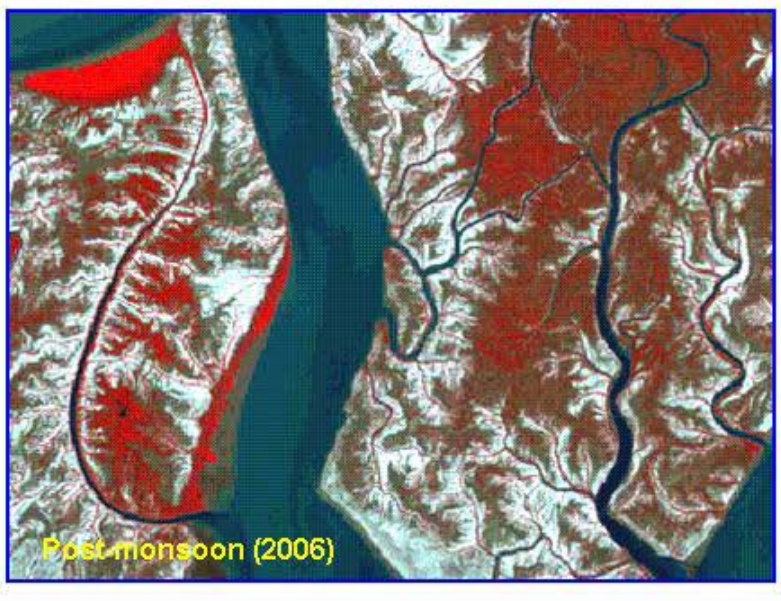





Plate - 14: Coastal – Natural – Creek


Plate - 15: Coastal – Natural – Sand/Beach

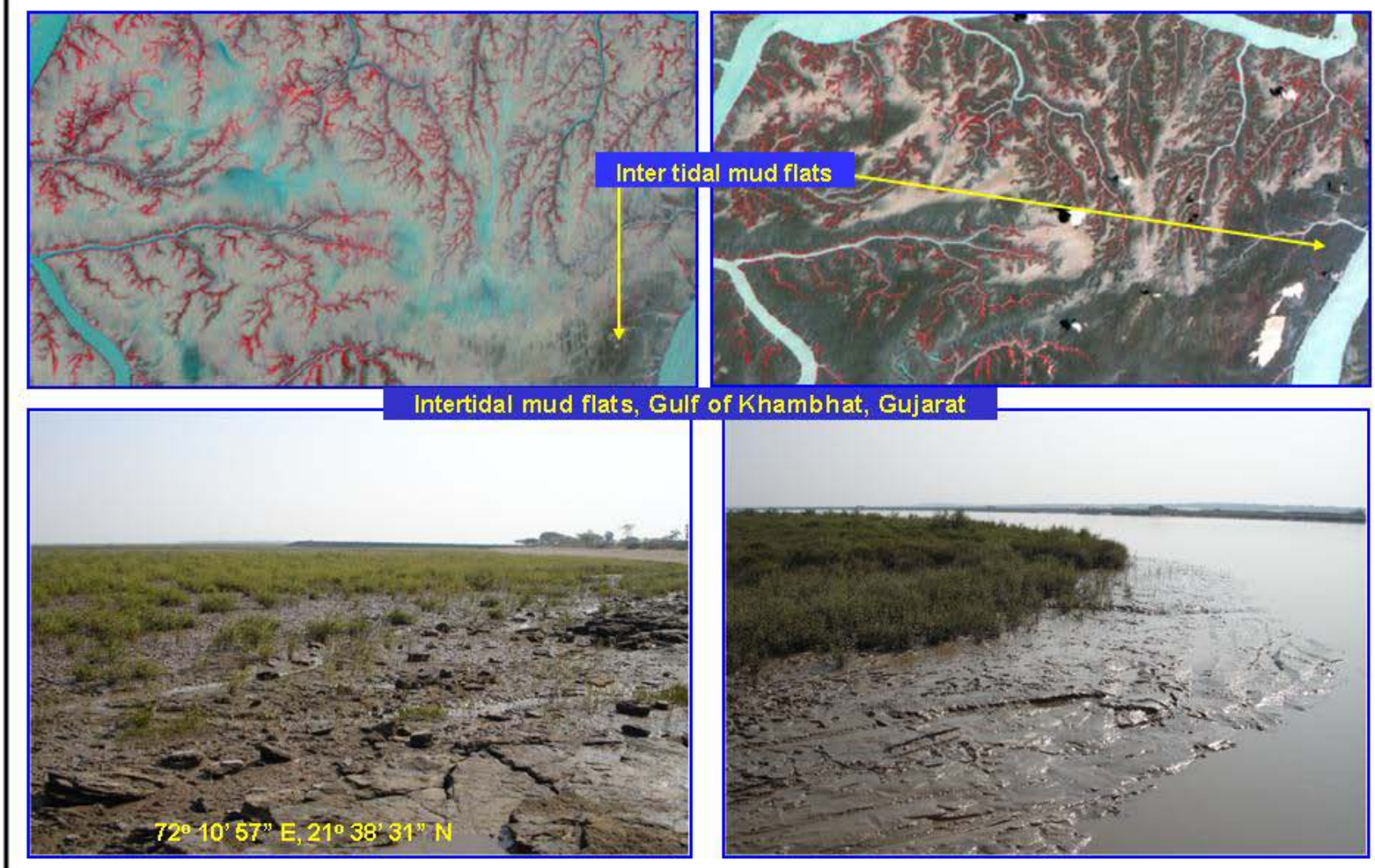
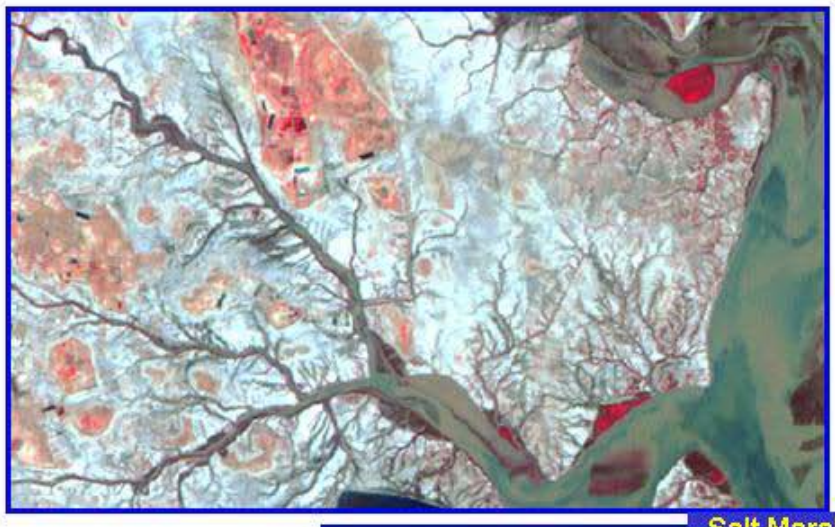
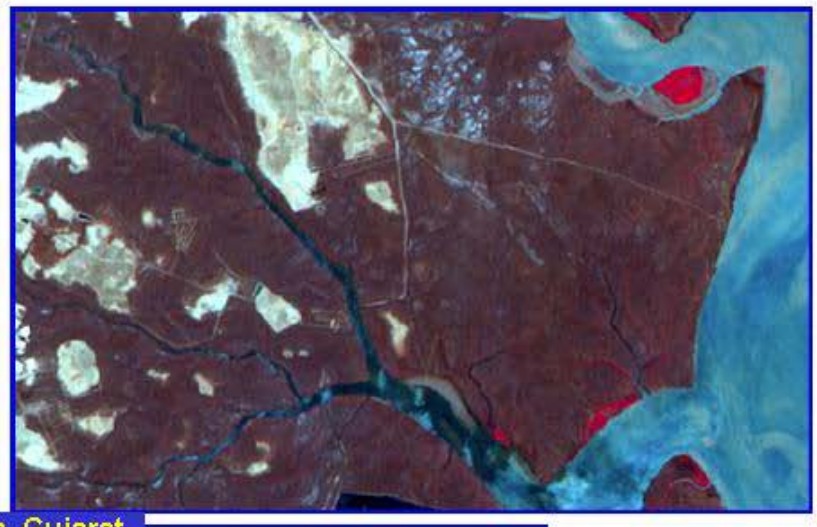



Plate - 16: Coastal – Natural – Inter-tidal mud flat





Salt Marsh, Gujarat



Plate - 17: Coastal – Natural – Salt Marsh

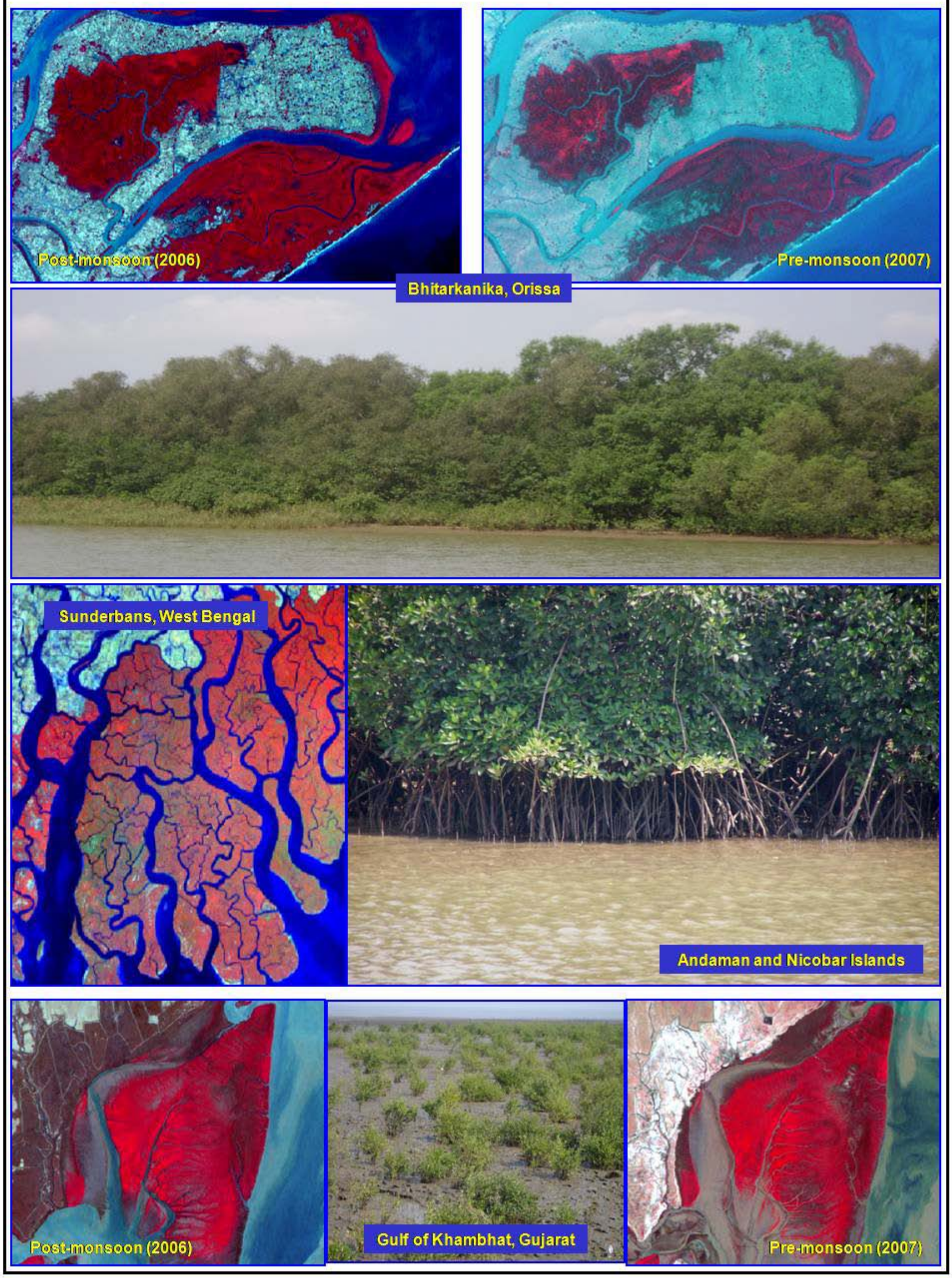
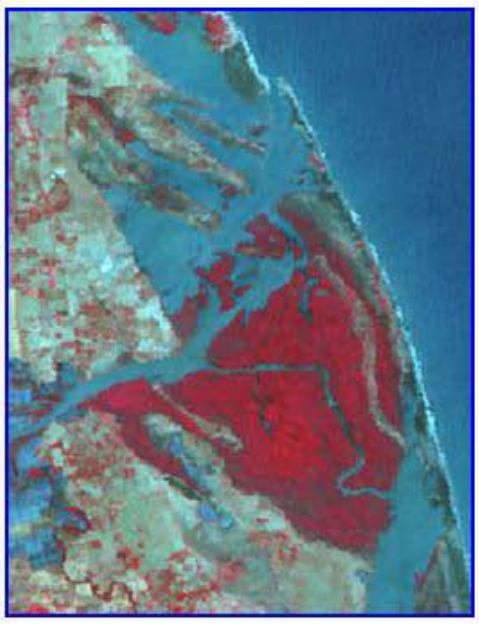
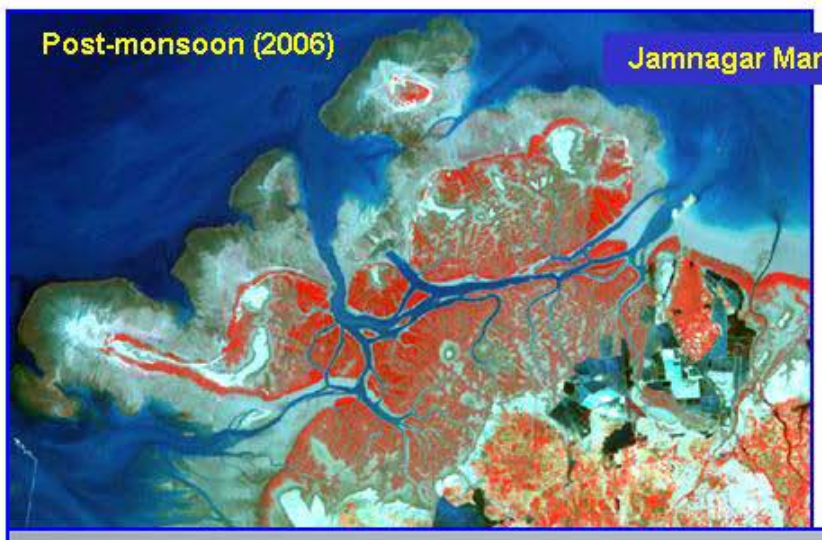



Plate - 18: Coastal – Natural – Mangrove








Jamnagar Mangroves, Gujarat

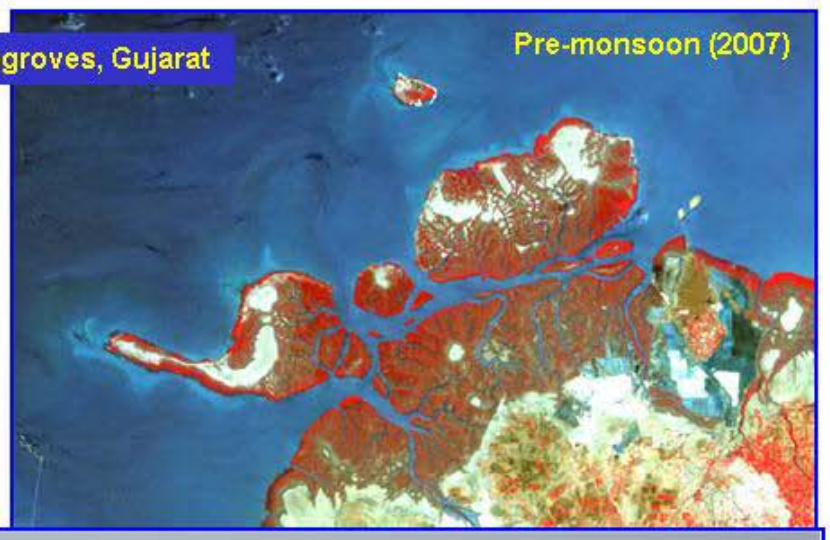




Plate - 19: Coastal – Natural – Mangrove

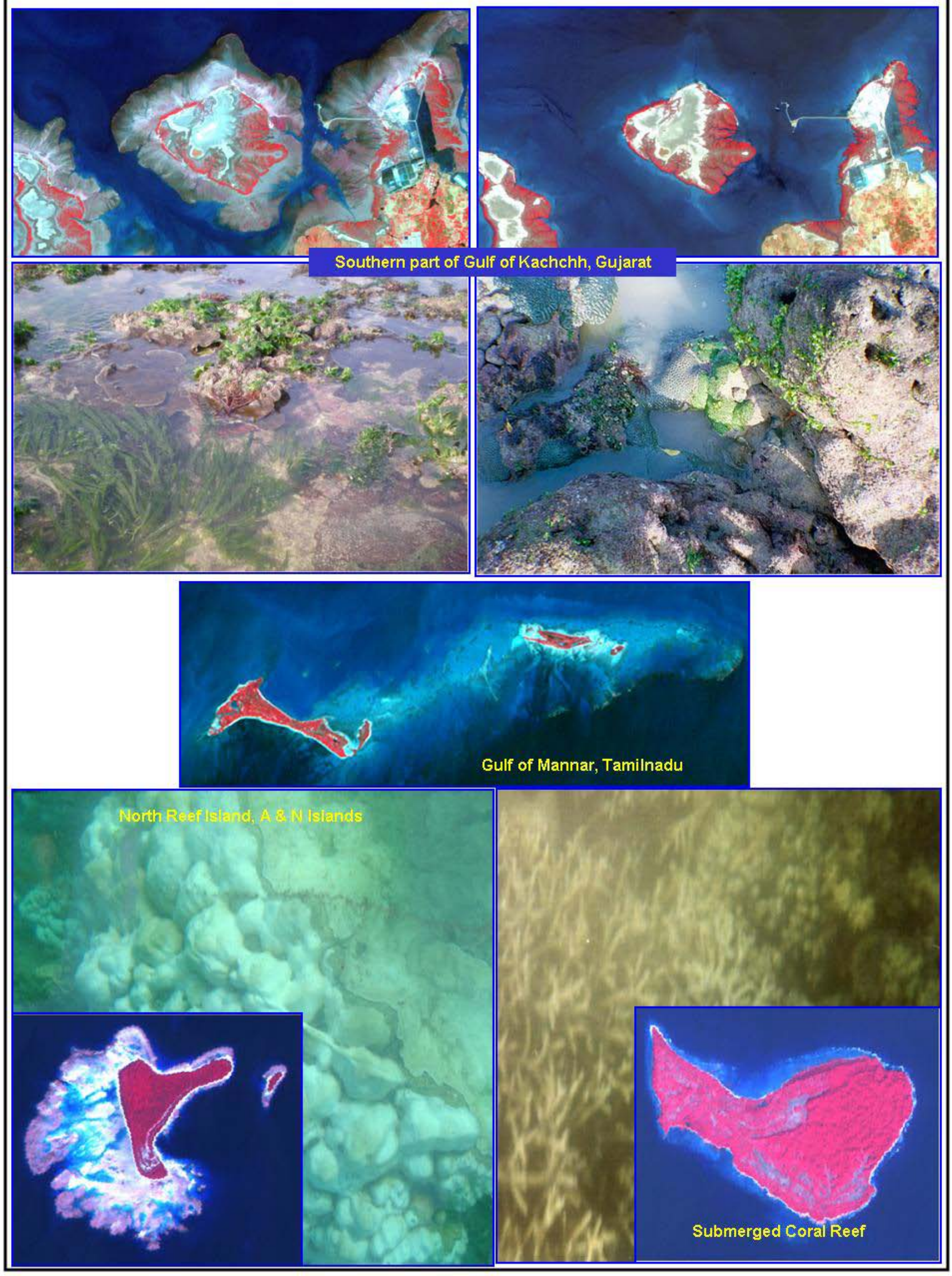
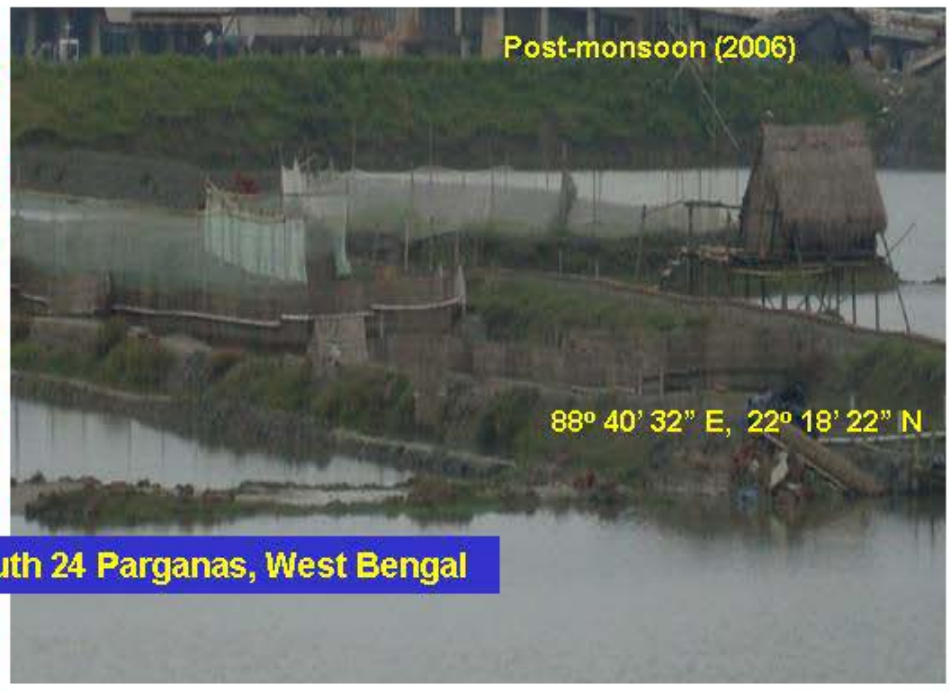
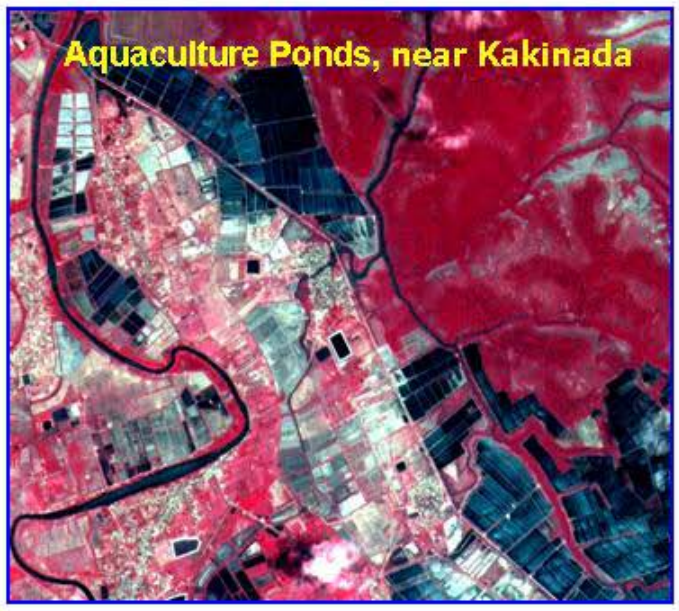



Plate - 20: Coastal – Natural – Coral Reef




Aquaculture Ponds , South 24 Parganas, West Bengal



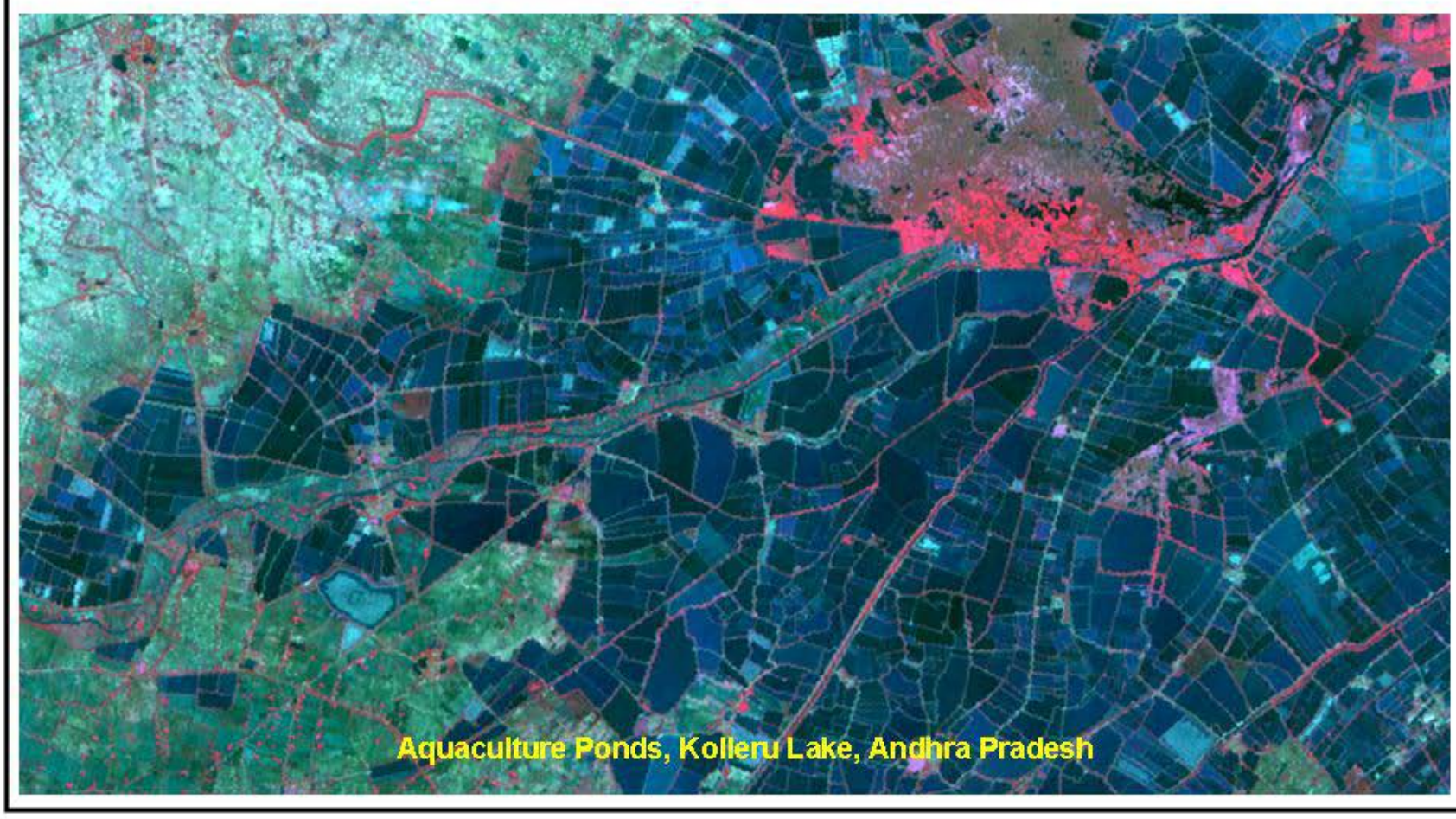




Plate - 21: Coastal – Man-made – Aquaculture pond

# MAPS AND STATISTICS

## 8.0 WETLANDS OF INDIA: MAPS AND STATISTICS

Entire country including the islands territories has been considered for inventory and assessment of wetlands. Mapping was carried out on 1:50,000 scale. Area estimates of various wetland categories for India have been carried out using GIS layers of wetland boundary, water-spread, aquatic vegetation and turbidity. Total 201503 wetlands have been mapped at 1:50,000 scale in the country. In addition, 555557 wetlands (< 2.25 ha) have also been identified. Total wetland area estimated is 15.26 Mha, which is around 4.63 per cent of the geographic area of the country.

Wetlands were categorised in to two major categories, 4 sub-categories and 19 classes. Area under inland wetlands is 10.56 Mha and area under coastal wetlands is 4.14 Mha. Category-wise distribution of wetlands in the country is shown in Table 6 and Figure 11. Analysis of wetland status in terms of open water shows that out of the total wetland area the extent of open water is 58.5 per cent in post-monsoon and 39.4 per cent in pre-monsoon. There is a significant reduction in the extent of open water (about 32.5%) from post-monsoon to pre-monsoon (8.60 Mha to 5.80 Mha). It is reflected in all the Inland wetland types.

The aquatic vegetation in India accounts for about 9 and 14 per cent of total wetland area in post-monsoon (1.32 Mha) and pre-monsoon (2.06 Mha) respectively.

Table 6: Area estimates of wetlands in India

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 | 45658 | 6623067 | 43.40 | 4100766 | 3115701 |
| 2 | 1200 | Inland Wetlands -Man-made | 142812 | 3941832 | 25.83 | 3267602 | 1654170 |
| | | Total - Inland | 188470 | 10564899 | 69.23 | 7368368 | 4769871 |
| 3 | 2100 | Coastal Wetlands - Natural | 10204 | 3703971 | 24.27 | 930663 | 750339 |
| 4 | 2200 | Coastal Wetlands - Man-made | 2829 | 436145 | 2.86 | 301767 | 281010 |
| | | Total - Coastal | 13033 | 4140116 | 27.13 | 1232430 | 1031349 |
| | | **Sub-Total** | **201503** | **14705015** | **96.36** | **8600798** | **5801220** |
| 5 | 3100 | Wetlands (<2.25 ha) | 555557 | 555557 | 3.64 | - | - |
| | | **Total** | **757060** | **15260572** | **100** | **8600798** | **5801220** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 1322837 | 2065096 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 3206003 | 1888493 |
| Moderate | 4168401 | 2967523 |
| High | 1226394 | 945204 |

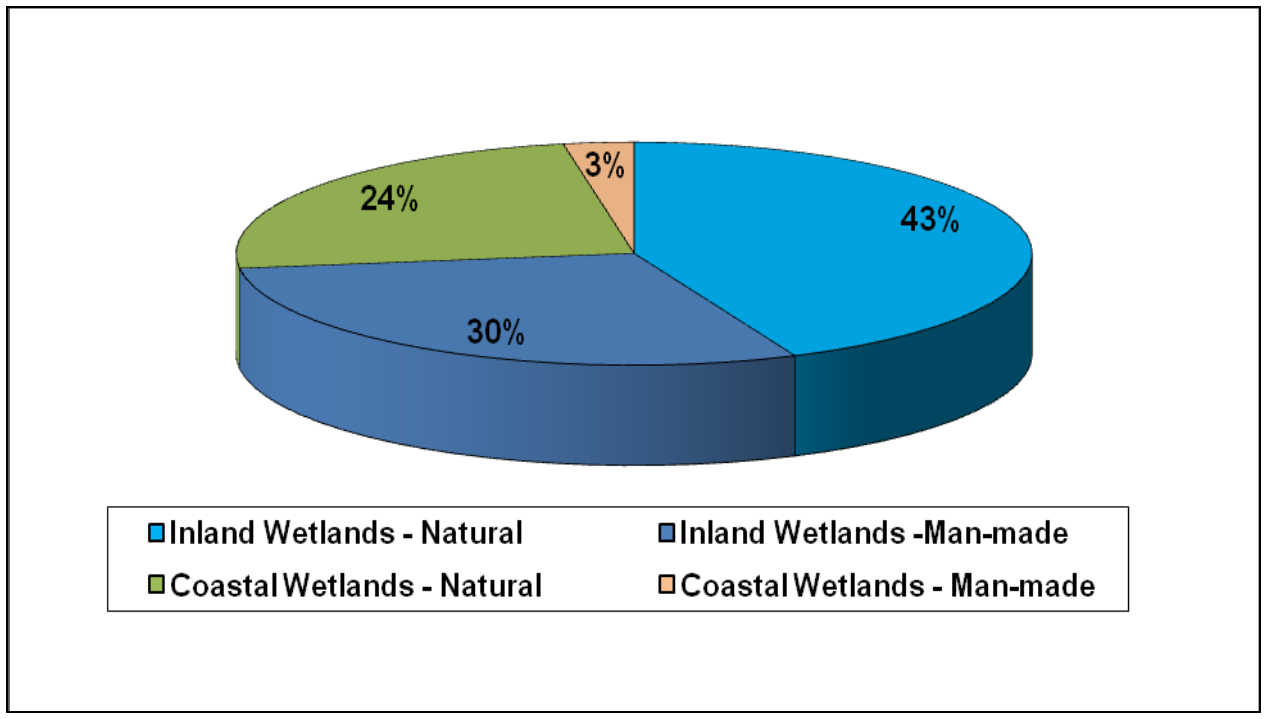



Figure 11: Type-wise (Level-II) wetland distribution in India

## Type-wise wetland distribution

The major wetland types in inland category are river/stream, reservoir/barrage, tank/pond and lake/pond. In coastal wetland category, major types are inter-tidal mudflat, mangrove, aquaculture pond and lagoon. Type-wise area estimates are shown in Table 7. Among all the wetland types river/stream occupy 5.26 Mha area (34.46 %), reservoirs occupy 2.48 Mha (16.26%), inter-tidal mud flats occupy 2.41 Mha (15.82%), tank/pond occupy 1.31 Mha area (8.6%) and lake/pond occupy 0.73 Mha area(4.78%) As far as wetland units are concerned tanks are maximum in number (122370). However, the small wetlands (< 2.25 ha) accounts for about 3.64 per cent (0.56 Mha) assuming that each is of one ha. Type-wise distribution of wetlands in India is shown in Figure 12.

Table 7: Type-wise area estimates of wetlands in India

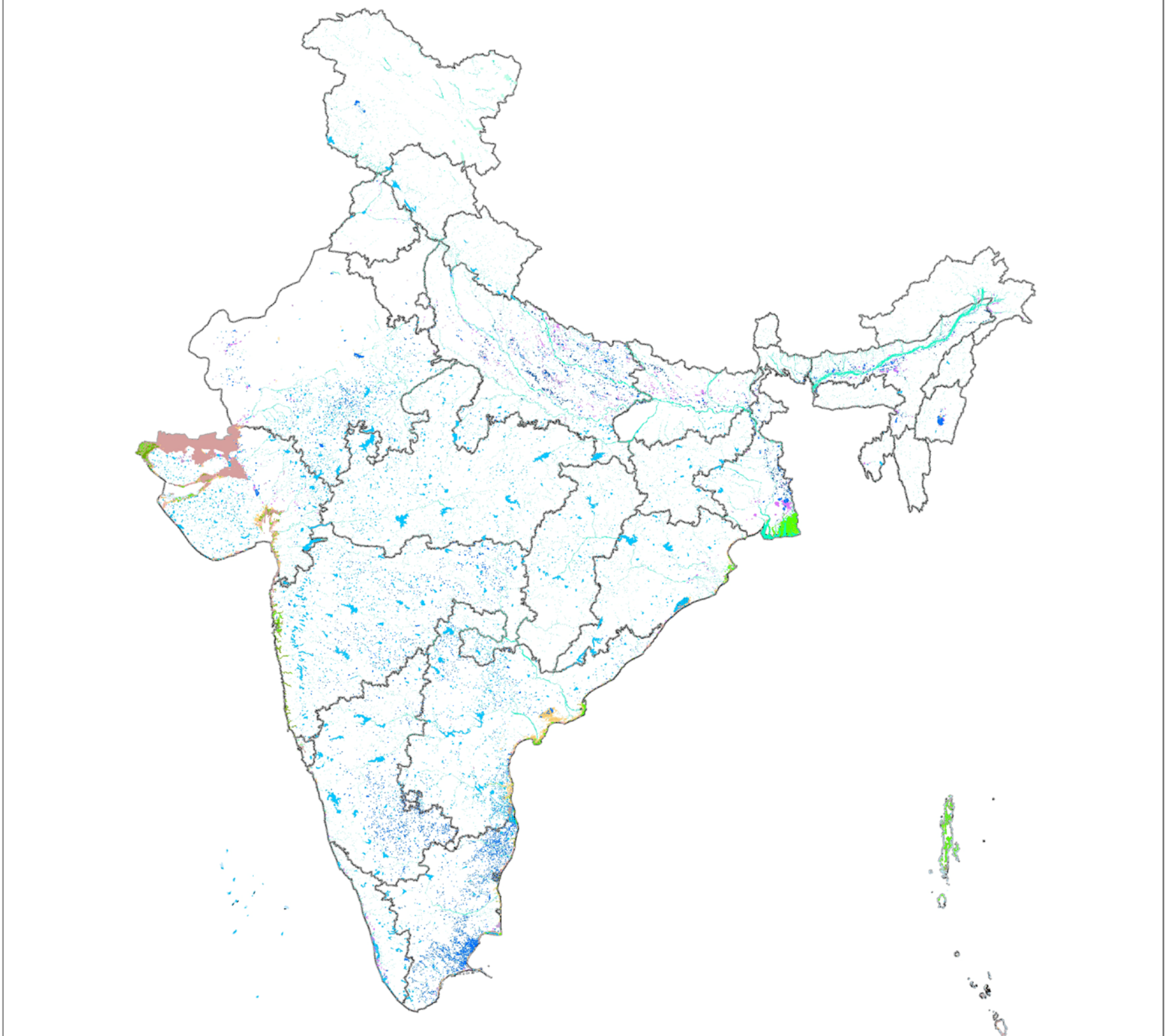
Area in ha

| 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 | Lake/Pond | 11740 | 729532 | 4.78 | 454416 | 198054 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 4673 | 104124 | 0.68 | 57576 | 37818 |
| 3 | 1103 | High altitude wetland | 2707 | 124253 | 0.81 | 116615 | 109277 |
| 4 | 1104 | Riverine wetland | 2834 | 91682 | 0.60 | 48918 | 29739 |
| 5 | 1105 | Waterlogged | 11957 | 315091 | 2.06 | 197003 | 112631 |
| 6 | 1106 | River/Stream | 11747 | 5258385 | 34.46 | 3226238 | 2628182 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 14894 | 2481987 | 16.26 | 2260574 | 1268237 |
| 8 | 1202 | Tank/Pond | 122370 | 1310443 | 8.59 | 916020 | 349512 |
| 9 | 1203 | Waterlogged | 5488 | 135704 | 0.89 | 85715 | 33822 |
| 10 | 1204 | Salt pan | 60 | 13698 | 0.09 | 5293 | 2599 |
| | | **Total - Inland** | **188470** | **10564899** | **69.23** | **7368368** | **4769871** |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 11 | 2101 | Lagoon | 178 | 246044 | 1.61 | 208915 | 191301 |
| 12 | 2102 | Creek | 586 | 206698 | 1.35 | 199743 | 189489 |
| 13 | 2103 | Sand/Beach | 1353 | 63033 | 0.41 | - | - |
| 14 | 2104 | Intertidal mud flat | 2931 | 2413642 | 15.82 | 516636 | 366953 |
| 15 | 2105 | Salt Marsh | 744 | 161144 | 1.06 | 5369 | 2596 |
| 16 | 2106 | Mangrove | 3806 | 471407 | 3.09 | - | - |
| 17 | 2107 | Coral Reef | 606 | 142003 | 0.93 | - | - |
| | **2200** | **Coastal Wetlands - Man-made** | | | | | |
| 18 | 2201 | Salt pan | 609 | 148913 | 0.98 | 105253 | 94047 |
| 19 | 2202 | Aquaculture pond | 2220 | 287232 | 1.88 | 196514 | 186963 |
| | | **Total - Coastal** | **13033** | **4140116** | **27.13** | **1232430** | **1031349** |
| | | **Sub-Total** | **201503** | **14705015** | **96.36** | **8600798** | **5801220** |
| | | Wetlands (<2.25 ha) | 555557 | 555557 | 3.64 | - | - |
| | | **Total** | **757060** | **15260572** | **100.00** | **8600798** | **5801220** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 1322837 | 2065096 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 3206003 | 1888493 |
| Moderate | 4168401 | 2967523 |
| High | 1226394 | 945204 |

# WETLANDS OF INDIA



| 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 | | | Riverine 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

N

S

0 75 150 300 450 600

Kilometers

**Data Source :**

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

**Prepared By :**

Space Applications Centre (ISRO), Ahmedabad

**Sponsored By :**

Ministry of Environment and Forests
Government of India

Plate 22 : Wetland map of India

Aquatic vegetation is observed in lakes, riverine wetlands, ox-bow lakes, tanks and reservoirs. The vegetation spread in wetlands is more during pre-monsoon (2.06 Mha) compared to post-monsoon (1.32 Mha).

The qualitative turbidity of water in wetlands is low in 37.3% areas, moderate in 48.5% and high in 14.2% area in post-monsoons season. During pre-monsoon season low turbidity was observed in 32.6% area, moderate turbidity in 51.1% and high turbidity in16.3% area.

***Water-spread in inland wetlands:***

Analysis of **lakes/ponds** status in terms of open water shows that out of the total wetland area the extent of open water is 62.3 per cent in post-monsoon and 27.1 per cent in pre-monsoon. There is a significant reduction in the extent of open water from post-monsoon to pre-monsoon (454416 ha to 198054 ha).

In **rivers/streams** water-spread analysis shows that out of the total wetland area the extent of open water is 61.3 per cent in post-monsoon and 50.0 per cent in pre-monsoon. There is a significant reduction in the extent of open water of reservoirs from post-monsoon to pre-monsoon in central and southern India.

There is a significant reduction in the extent of open water from post-monsoon to pre-monsoon (2.26 Mha to 1.27 Mha) in **reservoirs**. Analysis of wetland status in terms of open water shows that out of the total wetland area the extent of open water is 91.1 per cent in post-monsoon and 51.1 per cent in pre-monsoon.

Analysis of **tanks/ponds** status in terms of open water shows that out of the total wetland area the extent of open water is 69.9 per cent in post-monsoon and 26.7 per cent in pre-monsoon. There is a significant reduction in the extent of open water from post-monsoon to pre-monsoon (916020 ha to 349512 ha).

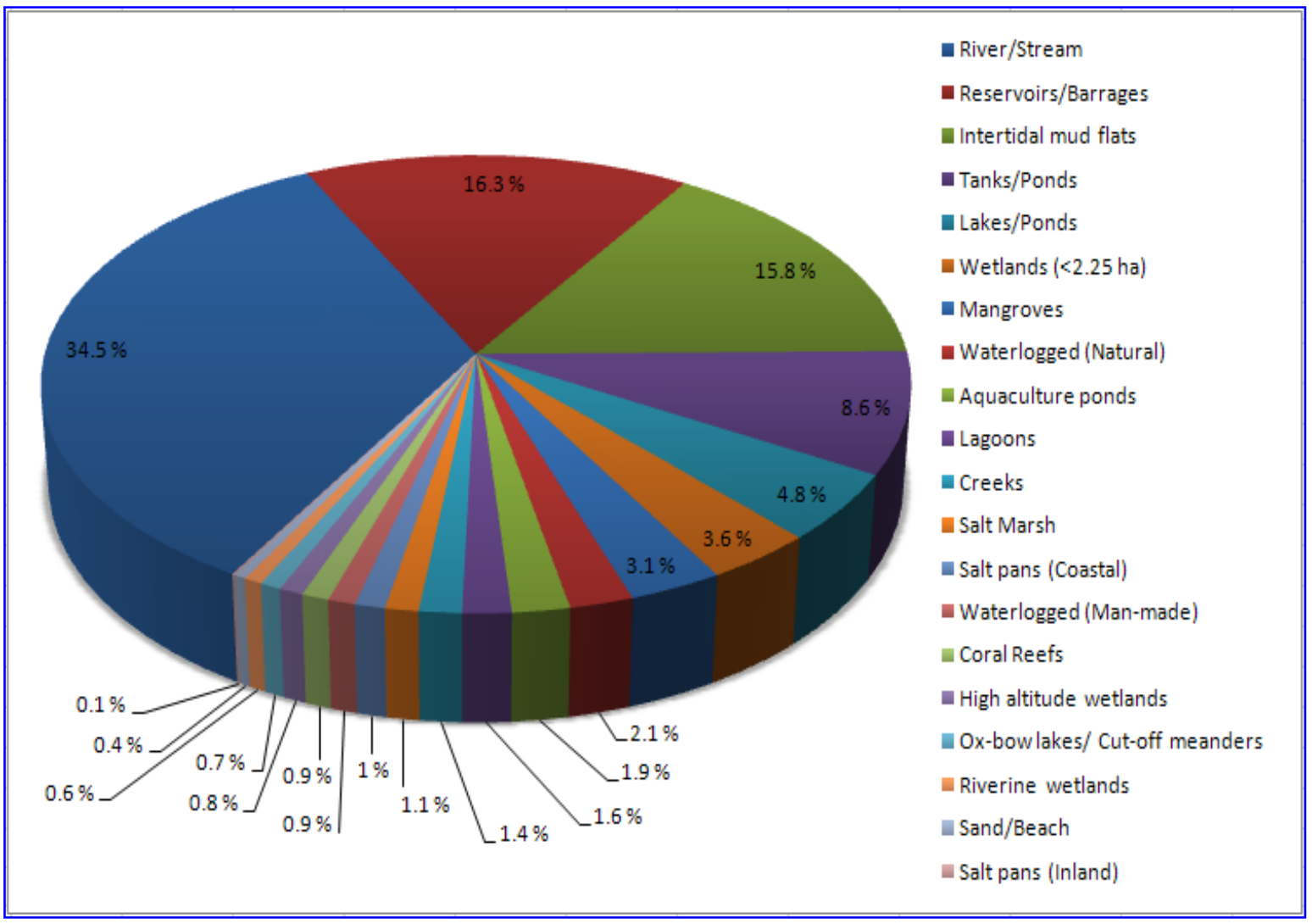



Figure 12: Type-wise (Level-III) wetland distribution in India

## 8.1 STATE-WISE WETLAND MAPS AND STATISTICS

The country has 35 States/Union Territories. State-wise distribution of wetlands showed that Lakshadweep has 96.12% of geographic area under wetlands followed by Andaman & Nicobar Islands (18.52%), Daman & Diu(18.46%) and Gujarat (17.56%), have the highest extent of wetlands. Puducherry (12.88%), West Bengal (12.48%), Assam (9.74%), Tamil Nadu (6.92%), Goa (5.76%), Andhra Pradesh (5.26%), and Uttar Pradesh (5.16%) are wetland rich states. The least extents (less than 1.5 % of the state geographic area) have been observed in Mizoram (0.66%) followed by Haryana (0.86%), Delhi (0.93%), Sikkim (1.05%), Nagaland (1.30%), and Meghalaya (1.34%). State-wise wetland distribution is given in Table 8. It has been observed that large area of wetlands is under aquatic vegetation in West Bengal, Tamil Nadu, Andhra Pradesh, Assam, and Uttar Pradesh. Graphical distribution of wetlands in term of wetland area is shown in Figure 13.

State-wise wetland distribution based on wetland type is summarized in Table 9.

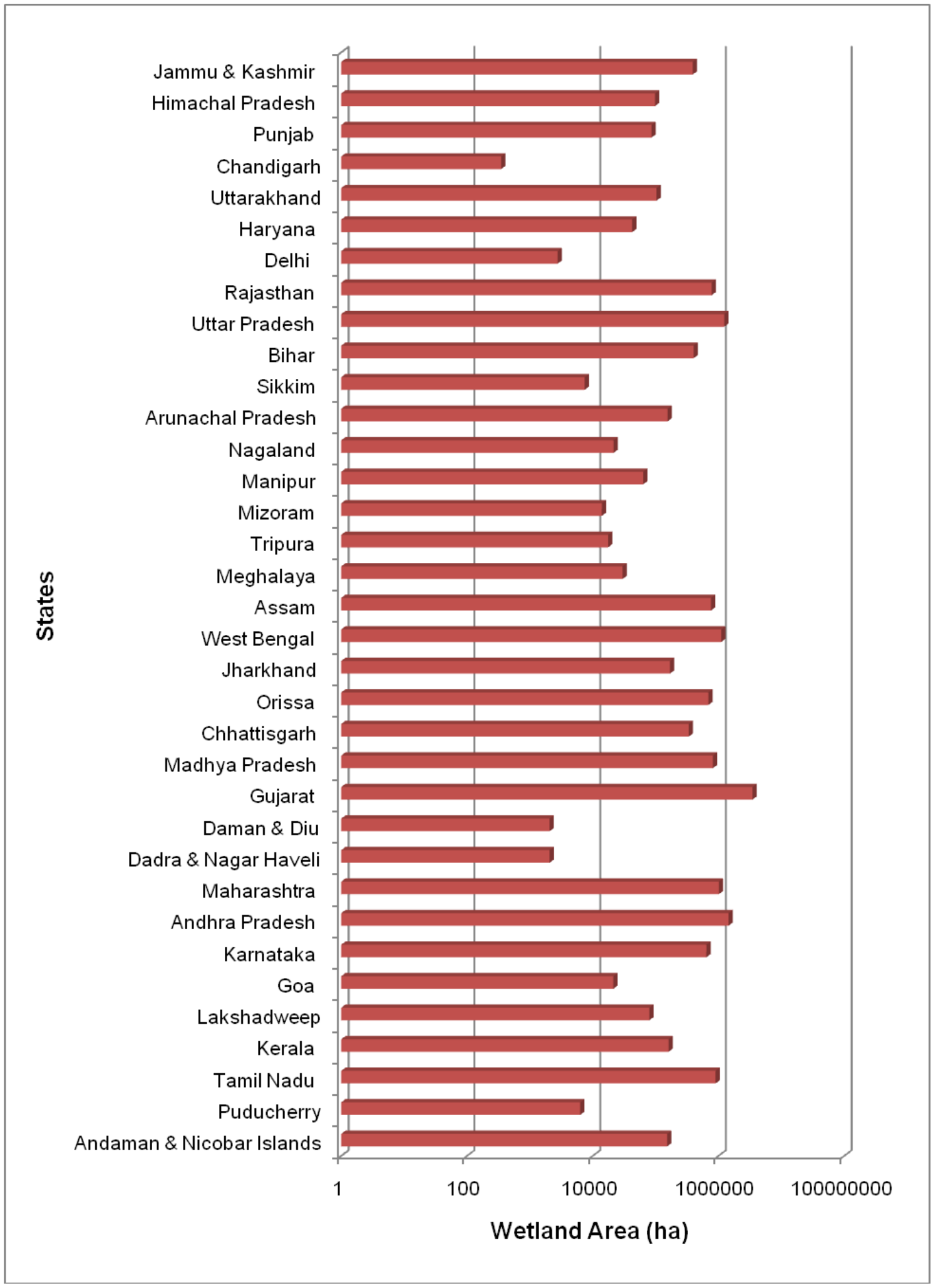



Figure 13: State-wise graphical distribution of wetlands

## Table 8: State-wise wetland distribution in India

Area in ha

| State code | State/UT | Geographic area # (sq. km) | Wetland area | % of total wetland area | % of state geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| 1 | Jammu & Kashmir | 222111 | 391501 | 2.57 | 1.76 | 301818 | 314209 | 19826 | 15434 | 300480 | 1295 | 43 | 306201 | 1644 | 6364 |
| 2 | Himachal Pradesh | 55673 | 98496 | 0.65 | 1.77 | 69107 | 49245 | - | 5294 | 46871 | 22236 | - | 33949 | 15296 | - |
| 3 | Punjab | 50362 | 86283 | 0.57 | 1.71 | 36344 | 24386 | 15920 | 17160 | 30906 | 5117 | 321 | 20504 | 3573 | 309 |
| 4 | Chandigarh * | 114 | 350 | 0.00 | 3.07 | 242 | 225 | 10 | 19 | 65 | 177 | - | 70 | 155 | - |
| 5 | Uttarakhand | 53566 | 103882 | 0.68 | 1.94 | 54221 | 46244 | 5288 | 11697 | 22893 | 31328 | - | 11235 | 35009 | - |
| 6 | Haryana | 49663 | 42478 | 0.28 | 0.86 | 14216 | 18912 | 2245 | 1497 | 6953 | 3295 | 3968 | 6423 | 9481 | 3008 |
| 7 | Delhi | 2966 | 2771 | 0.02 | 0.93 | 1282 | 1526 | 700 | 835 | 1239 | 43 | - | 1461 | 65 | - |
| 8 | Rajasthan | 342269 | 782314 | 5.13 | 2.29 | 368129 | 158696 | 4102 | 5166 | 294322 | 40945 | 32862 | 107553 | 7390 | 43753 |
| 9 | Uttar Pradesh | 240928 | 1242530 | 8.14 | 5.16 | 690216 | 494994 | 219289 | 129228 | 212518 | 415651 | 62047 | 190992 | 216623 | 87379 |
| 10 | Bihar | 91689 | 403209 | 2.64 | 4.40 | 224655 | 148382 | 25179 | 17360 | 132318 | 75292 | 17045 | 316 | 146269 | 1797 |
| 11 | Sikkim | 7096 | 7477 | 0.05 | 1.05 | 7189 | 5035 | 7 | 7 | 2380 | 4809 | - | 885 | 4150 | - |
| 12 | Arunachal Pradesh | 87658 | 155728 | 1.02 | 1.78 | 66222 | 57516 | 6002 | 5924 | 56471 | 7984 | 1767 | 45810 | 9541 | 2165 |
| 13 | Nagaland | 16521 | 21544 | 0.14 | 1.30 | 20938 | 20650 | 7 | 604 | 2243 | 8071 | 10624 | 1065 | 7926 | 11659 |
| 14 | Manipur | 22327 | 63616 | 0.42 | 2.85 | 45304 | 39391 | 16756 | 23500 | 17866 | 26911 | 527 | 17261 | 21841 | 289 |
| 15 | Mizoram | 21087 | 13988 | 0.09 | 0.66 | 13799 | 13778 | 37 | 42 | 13755 | 44 | - | 13722 | 56 | - |
| 16 | Tripura | 11040 | 17542 | 0.11 | 1.59 | 9847 | 7023 | 1779 | 5232 | 2672 | 7148 | 27 | 641 | 6329 | 53 |
| 17 | Meghalaya | 22420 | 29987 | 0.20 | 1.34 | 27912 | 27420 | 819 | 852 | 24919 | 1928 | 1065 | 24692 | 1168 | 1560 |
| 18 | Assam | 78438 | 764372 | 5.01 | 9.74 | 423068 | 390152 | 36817 | 76036 | 64137 | 358429 | 502 | 22834 | 366654 | 664 |
| 19 | West Bengal | 88805 | 1107907 | 7.26 | 12.48 | 632450 | 583620 | 228174 | 239058 | 32402 | 537144 | 62904 | 21196 | 500546 | 61878 |
| 20 | Jharkhand | 79714 | 170051 | 1.11 | 2.13 | 152879 | 103225 | 3437 | 7244 | 21014 | 88410 | 43455 | 12774 | 64127 | 26324 |
| 21 | Orissa | 153845 | 690904 | 4.53 | 4.49 | 508282 | 419310 | 62733 | 142584 | 116369 | 378117 | 13796 | 138906 | 264017 | 16387 |
| 22 | Chhattisgarh | 135194 | 337966 | 2.21 | 2.50 | 243814 | 173678 | 2123 | 19600 | 28985 | 183025 | 31804 | 79103 | 85841 | 8734 |
| 23 | Madhya Pradesh | 308414 | 818166 | 5.36 | 2.65 | 571961 | 245289 | 13379 | 62751 | 2827 | 532712 | 36422 | 713 | 213784 | 30792 |
| 24 | Gujarat | 197841 | 3474950 | 22.77 | 17.56 | 1150755 | 732481 | 152318 | 205159 | 331081 | 136136 | 683538 | 145292 | 83970 | 503219 |
| 25 | Daman & Diu * | 112 | 2068 | 0.01 | 18.46 | 570 | 262 | 54 | 58 | 265 | 299 | 6 | 137 | 118 | 7 |
| 26 | Dadra & Nagar Haveli * | 487 | 2070 | 0.01 | 4.25 | 1915 | 1131 | - | 145 | 1286 | 629 | - | 812 | 319 | - |
| 27 | Maharashtra | 307748 | 1014522 | 6.65 | 3.30 | 796834 | 370357 | 47551 | 84702 | 633128 | 139816 | 23890 | 202581 | 159856 | 7920 |
| 28 | Andhra Pradesh | 275045 | 1447133 | 9.48 | 5.26 | 887143 | 610668 | 126187 | 268267 | 295604 | 531282 | 60257 | 227855 | 350782 | 32031 |
| 29 | Karnataka | 191791 | 643576 | 4.22 | 3.36 | 427921 | 262991 | 80818 | 107259 | 65547 | 326173 | 36201 | 60149 | 178414 | 24428 |
| 30 | Goa | 3702 | 21337 | 0.14 | 5.76 | 18899 | 18899 | 1752 | 1752 | 2363 | 10280 | 6256 | 2363 | 10280 | 6256 |
| 31 | Lakshadweep * | 828 | 79586 | 0.52 | 96.12 | 23674 | 23674 | - | - | 23674 | - | - | 23674 | - | - |
| 32 | Kerala | 38863 | 160590 | 1.05 | 4.13 | 138962 | 130468 | 13364 | 8925 | 102026 | 36501 | 435 | 94722 | 35119 | 627 |
| 33 | Tamil Nadu | 130409 | 902534 | 5.91 | 6.92 | 657861 | 296268 | 167273 | 531600 | 314273 | 247677 | 95911 | 70189 | 159206 | 66873 |
| 34 | Puducherry * | 492 | 6335 | 0.04 | 12.88 | 4028 | 2535 | 622 | 1753 | 1186 | 2748 | 94 | 515 | 1968 | 52 |
| 35 | Andaman & Nicobar Islands * | 8249 | 152809 | 1.00 | 18.52 | 8341 | 8580 | 68269 | 68352 | 965 | 6749 | 627 | 1898 | 6006 | 676 |
| | **Total** | **3297467** | **15260572** | **100.00** | **4.63** | **8600798** | **5801220** | **1322837** | **2065096** | **3206003** | **4168401** | **1226394** | **1888493** | **2967523** | **945204** |

# - Data source : http://nic.in , for Jammu & Kashmir and Lakshdweep GIS area considered for analysis
* - Union Territories

# Table 9: State-wise wetland distribution (type-wise) in India

Area in ha

| State code | State | Geographic Area | Wetland Type | | | | | | | | | | | | | | | | | | Sub-total | Wetland (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1103 | 1104 | 1105 | 1106 | 1201 | 1202 | 1203 | 1204 | 2101 | 2102 | 2103 | 2104 | 2105 | 2106 | 2107 | 2201 | 2202 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | High altitude wetland | Riverine wetland | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | Salt pan | Lagoon | Creek | Sand/ Beach | Intertidal mud flat | Salt Marsh | Mangrove | Coral Reef | Salt pan | Aquaculture pond | | | |
| | | (sq. km.) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Jammu & Kashmir | 222111 | 13762 | - | 109170 | 9594 | - | 231597 | 25132 | 6 | - | - | - | - | - | - | - | - | - | - | - | 389261 | 2240 | 391501 |
| 2 | Himachal Pradesh | 55673 | 52 | - | 387 | - | 47 | 55558 | 41817 | 134 | 30 | - | - | - | - | - | - | - | - | - | - | 98025 | 471 | 98496 |
| 3 | Punjab | 50362 | 1934 | 373 | - | 306 | 2032 | 59864 | 11858 | 3526 | 1341 | - | - | - | - | - | - | - | - | - | - | 81234 | 5049 | 86283 |
| 4 | Chandigarh* | 114 | 160 | - | - | - | - | 167 | - | 14 | - | - | - | - | - | - | - | - | - | - | - | 341 | 9 | 350 |
| 5 | Uttarakhand | 53566 | 2081 | 63 | 142 | - | 9 | 80133 | 20319 | 108 | 211 | - | - | - | - | - | - | - | - | - | - | 103066 | 816 | 103882 |
| 6 | Haryana | 49663 | 801 | 24 | - | - | 1412 | 17025 | 1775 | 7573 | 3339 | - | - | - | - | - | - | - | - | - | - | 31949 | 10529 | 42478 |
| 7 | Delhi* | 2966 | 49 | - | - | - | 380 | 1074 | 479 | 260 | 228 | - | - | - | - | - | - | - | - | - | - | 2470 | 301 | 2771 |
| 8 | Rajasthan | 342269 | 38269 | - | - | - | 16856 | 312570 | 190600 | 151027 | 7636 | 12283 | - | - | - | 18950 | - | - | - | - | - | 748191 | 34123 | 782314 |
| 9 | Uttar Pradesh | 240928 | 122531 | 51371 | - | 61100 | 76263 | 607315 | 105641 | 33263 | 87694 | - | - | - | - | - | - | - | - | - | - | 1145178 | 97352 | 1242530 |
| 10 | Bihar | 91689 | 20281 | 16172 | - | 2118 | 34878 | 298408 | 8612 | 4822 | 336 | - | - | - | - | - | - | - | - | - | - | 385627 | 17582 | 403209 |
| 11 | Sikkim | 7096 | 15 | - | 3050 | - | - | 4131 | - | - | - | - | - | - | - | - | - | - | - | - | - | 7196 | 281 | 7477 |
| 12 | Arunachal Pradesh | 87658 | 18 | 520 | 11422 | - | 8146 | 134244 | 164 | 95 | - | - | - | - | - | - | - | - | - | - | - | 154609 | 1119 | 155728 |
| 13 | Nagaland | 16521 | 3 | 9 | - | - | 423 | 19254 | 1547 | 41 | - | - | - | - | - | - | - | - | - | - | - | 21277 | 267 | 21544 |
| 14 | Manipur | 22327 | 39123 | 64 | - | - | 3525 | 16677 | 856 | 187 | - | - | - | - | - | - | - | - | - | - | 2643 | 63075 | 541 | 63616 |
| 15 | Mizoram | 21087 | 185 | - | - | - | 133 | 13497 | 27 | - | - | - | - | - | - | - | - | - | - | - | - | 13842 | 146 | 13988 |
| 16 | Tripura | 11040 | 300 | 387 | - | - | 2946 | 7420 | 3320 | 186 | - | - | - | - | - | - | - | - | - | - | - | 14559 | 2983 | 17542 |
| 17 | Meghalaya | 22420 | 501 | 461 | - | 1272 | 1028 | 24841 | 1562 | 150 | 5 | - | - | - | - | - | - | - | - | - | - | 29820 | 167 | 29987 |
| 18 | Assam | 78438 | 51257 | 14173 | - | 4258 | 47141 | 637164 | 2833 | 921 | 544 | - | - | - | - | - | - | - | - | - | - | 758291 | 6081 | 764372 |
| 19 | West Bengal | 88805 | 58654 | 19550 | 82 | 8654 | 56603 | 559192 | 22672 | 20470 | 1435 | 71 | - | - | 3338 | 2726 | - | 209330 | - | 4866 | 1557 | 969200 | 138707 | 1107907 |
| 20 | Jharkhand | 79714 | 3204 | 83 | - | 1629 | 231 | 97743 | 48177 | 5688 | 61 | 8 | - | - | - | - | - | - | - | - | - | 156824 | 13227 | 170051 |
| 21 | Orissa | 153845 | 712 | 728 | - | 980 | 12925 | 223522 | 189972 | 29301 | 934 | - | 89023 | - | 6046 | 25514 | - | 23395 | - | 1726 | 19952 | 624730 | 66174 | 690904 |
| 22 | Chhattisgarh | 135194 | - | 26 | - | 174 | - | 179088 | 90389 | 40226 | 240 | - | - | - | - | - | - | - | - | - | - | 310143 | 27823 | 337966 |
| 23 | Madhya Pradesh | 308414 | 208 | 93 | - | 7 | 157 | 315526 | 392455 | 64768 | - | - | - | - | - | - | - | - | - | - | - | 773214 | 44952 | 818166 |
| 24 | Gujarat | 197841 | 23550 | 6 | - | - | 20660 | 275877 | 248979 | 73873 | 13951 | 1295 | 22289 | 149898 | 6508 | 2260365 | 144268 | 90475 | 33547 | 90878 | 8823 | 3465242 | 9708 | 3474950 |
| 25 | Daman & Diu* | 112 | - | - | - | - | - | 380 | 125 | 88 | - | - | 24 | - | 204 | 1054 | 57 | 63 | - | 63 | - | 2058 | 10 | 2068 |
| 26 | Dadra & Nagar Haveli* | 487 | - | - | - | - | - | 732 | 1286 | 13 | - | - | - | - | - | - | - | - | - | - | - | 2031 | 39 | 2070 |
| 27 | Maharashtra | 307748 | 9003 | 15 | - | 2 | 284 | 299730 | 368135 | 208669 | 310 | - | - | 41636 | 4873 | 22249 | 614 | 30238 | - | 7025 | 71 | 992854 | 21668 | 1014522 |
| 28 | Andhra Pradesh | 275045 | 21843 | - | - | - | 2714 | 385839 | 404499 | 201677 | 4178 | - | 47407 | 9594 | 15891 | 31767 | 4002 | 41486 | - | 17725 | 240474 | 1429096 | 18037 | 1447133 |
| 29 | Karnataka | 191791 | 638 | - | - | 1051 | 2045 | 179731 | 213527 | 222030 | 2403 | - | 72 | 97 | 1897 | 1663 | - | 967 | - | 812 | 2779 | 629712 | 13864 | 643576 |
| 30 | Goa | 3702 | 499 | 6 | - | - | - | 9362 | 2363 | 396 | 17 | 41 | - | - | 519 | 3286 | - | 1752 | - | 2929 | - | 21170 | 167 | 21337 |
| 31 | Lakshadweep* | 828 | - | - | - | - | - | - | - | - | - | - | 23674 | - | 733 | - | - | - | 55179 | - | - | 79586 | 0 | 79586 |
| 32 | Kerala | 38863 | 2643 | - | - | 410 | 20305 | 65162 | 26167 | 2435 | - | - | 38442 | 80 | 2354 | - | - | - | - | - | - | 157998 | 2592 | 160590 |
| 33 | Tamil Nadu | 130409 | 316091 | - | - | 127 | 3928 | 136878 | 56419 | 237613 | 10811 | - | 25057 | 3404 | 9798 | 33164 | 6108 | 7315 | 3899 | 22889 | 10739 | 884240 | 18294 | 902534 |
| 34 | Puducherry* | 492 | 1120 | - | - | - | 20 | 2113 | - | 867 | - | - | - | 212 | 809 | 505 | 66 | 285 | - | - | 194 | 6191 | 144 | 6335 |
| 35 | Andaman & Nicobar Islands* | 8249 | 45 | - | - | - | - | 6571 | 280 | 16 | - | - | 56 | 1777 | 10063 | 12399 | 6029 | 66101 | 49378 | - | - | 152715 | 94 | 152809 |
| | **Total** | **3297467** | **729532** | **104124** | **124253** | **91682** | **315091** | **5258385** | **2481987** | **1310443** | **135704** | **13698** | **246044** | **206698** | **63033** | **2413642** | **161144** | **471407** | **142003** | **148913** | **287232** | **14705015** | **555557** | **15260572** |

# Data source : http://nic.in , for Jammu & Kashmir and Lakshdweep GIS area considered for analysis

*- Union Territories

### 8.1.1 Jammu and Kashmir

A variety of wetland types were observed in the state of Jammu and Kashmir. Most of them are of glacial origin and mainly associated with riverine system. Total 1411 wetlands are mapped in the state occupying 389261 ha area. In addition, 2240 small wetlands (< 2.25 ha) have been demarcated as point features. The natural wetlands are in dominance in the state occupying around 93.0 % area. The major natural wetlands apart from river/stream are high altitude wetland. Total 1143 such wetlands are mapped having an area of 109170 ha (27.88%). There are 36 lakes/ponds (3.5%). Reservoir/Barrage is the major man-made wetland type. Total 4 of this category are mapped having 25132 ha area (6.4%). Detailed statistics is given in Table 10. Graphical distribution of wetland type is shown in Figure 14.

Area under aquatic vegetation varied from 19826 ha to 15434 ha during post and pre-monsoon season respectively. Vegetation is mainly found in lake/pond, riverine wetland. The open water area of these wetlands does not show significant seasonal variation (301818 ha during post-monsoon season and 314209 ha in pre-monsoon season). Most of the wetlands are oligotrophic in nature. Qualitative turbidity of water is in general low in both the seasons. Wetland map of the state is shown in Plate 23.

Table 10: Area estimates of wetlands in Jammu and Kashmir

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 | Lake/Pond | 36 | 13762 | 3.52 | 3371 | 6821 |
| 2 | 1103 | High altitude wetland | 1143 | 109170 | 27.88 | 105110 | 105072 |
| 3 | 1104 | Riverine wetland | 88 | 9594 | 2.45 | 153 | 1639 |
| 4 | 1106 | River/Stream | 138 | 231597 | 59.16 | 170063 | 175550 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 5 | 1201 | Reservoir/Barrage | 4 | 25132 | 6.42 | 23115 | 25121 |
| 6 | 1202 | Tank/Pond | 2 | 6 | 0.00 | 6 | 6 |
| | | **Sub-Total** | **1411** | **389261** | **99.43** | **301818** | **314209** |
| | | Wetlands (<2.25 ha) | 2240 | 2240 | 0.57 | - | - |
| | | **Total** | **3651** | **391501** | **100.00** | **301818** | **314209** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 19826 | 15434 |

| | | |
|---|---|---|
| **Area under turbidity levels** | | |
| Low | 300480 | 306201 |
| Moderate | 1295 | 1644 |
| High | 43 | 6364 |

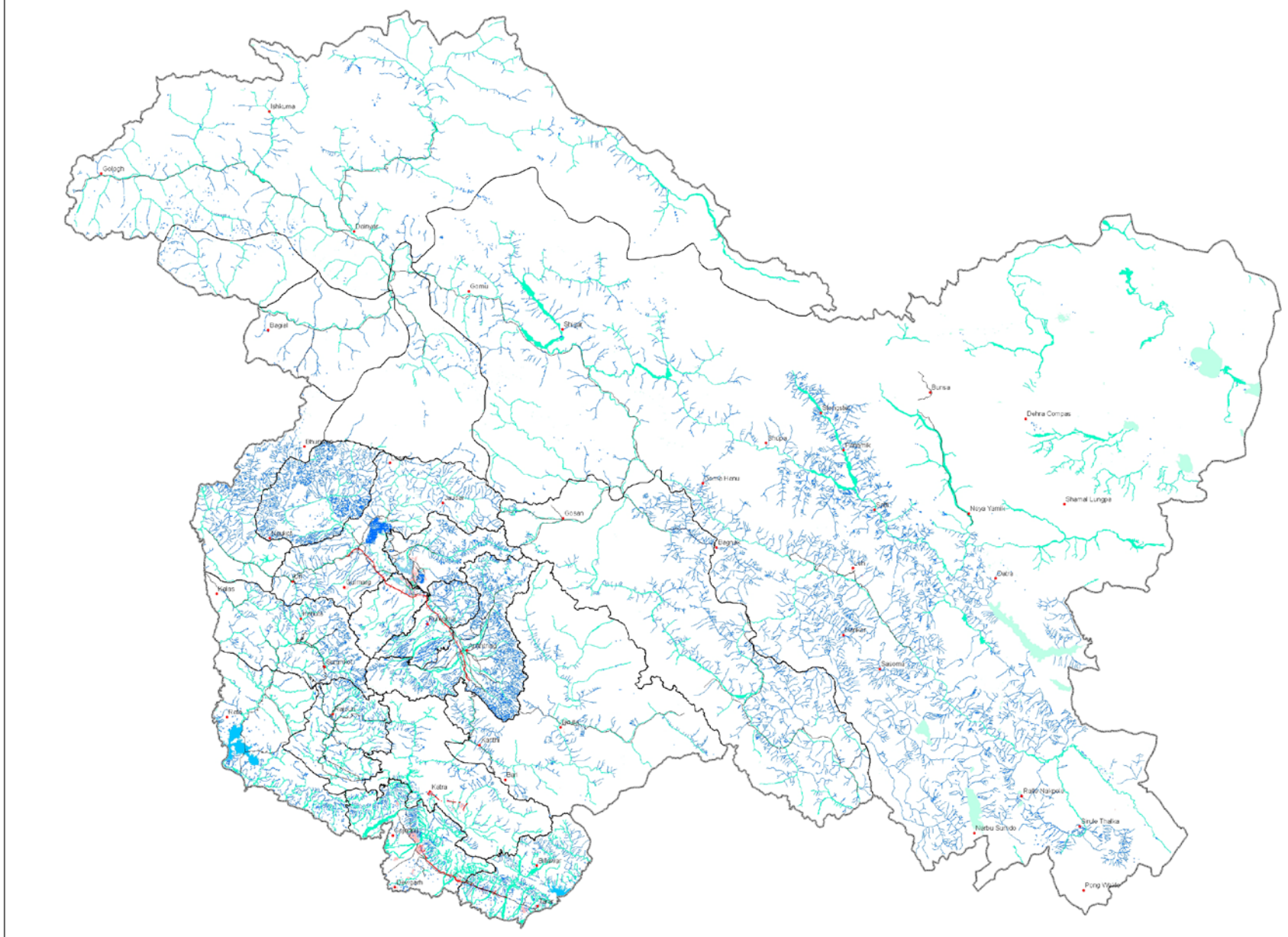
**District-wise wetland area estimates in Jammu and Kashmir**

The total numbers of districts in the state are twenty, with Leh having largest geographic area and Budgam, the lowest. Leh has the highest area under wetlands (51.9%). This is mainly due to the large number of high altitude wetlands found in the area. Konu has the lowest wetland share (0.40%). Baramula, Jammu, Katua, Gilgit, and Mirpur are the districts having more than 4.0% wetlands. Geographic area wise, Kathua has highest per centage (8.13%) and Gilghit Wazara has lowest (0.45%). District-wise wetland area estimates is given in Table 11 and Figure 15 shows district-wise wetland distribution. District-wise area of wetlands (type-wise) in Jammu and Kashmir is given in Table 12.

Leh can be called as the land of high altitude wetlands. Total 485 such wetlands are mapped with 202755 ha area (out of total 1143 in the state). In addition, 440 small (<2.25 ha) wetlands are identified and marked as points belong to high altitude type. Baramulla has highest share of lake/pond wetland type. Though only 2 lake/pond type are there, the area occupied is 11273 ha (out of total 13762). This is mainly due to the presence of Wular Lake, the largest fresh water lake. Mirpur has the largest reservoir with 19146 ha area which is used for irrigation and hydropower generation.

State : Jammu and Kashmir

## WETLAND MAP

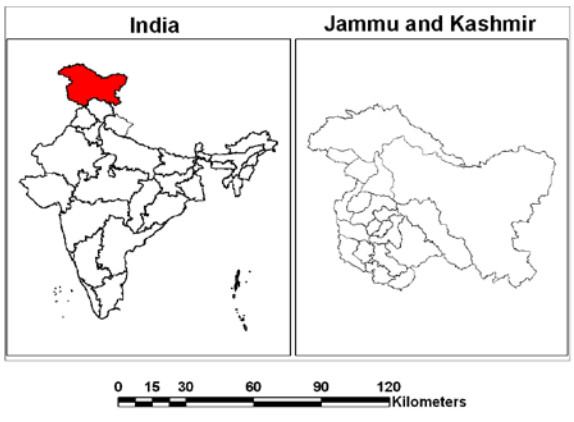



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Riverine wetland |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Settlements
- Roads
- Railway
- Drainage (line)
- 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
The University of Kashmir, Srinagar

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 23: Wetland map of Jammu and Kashmir

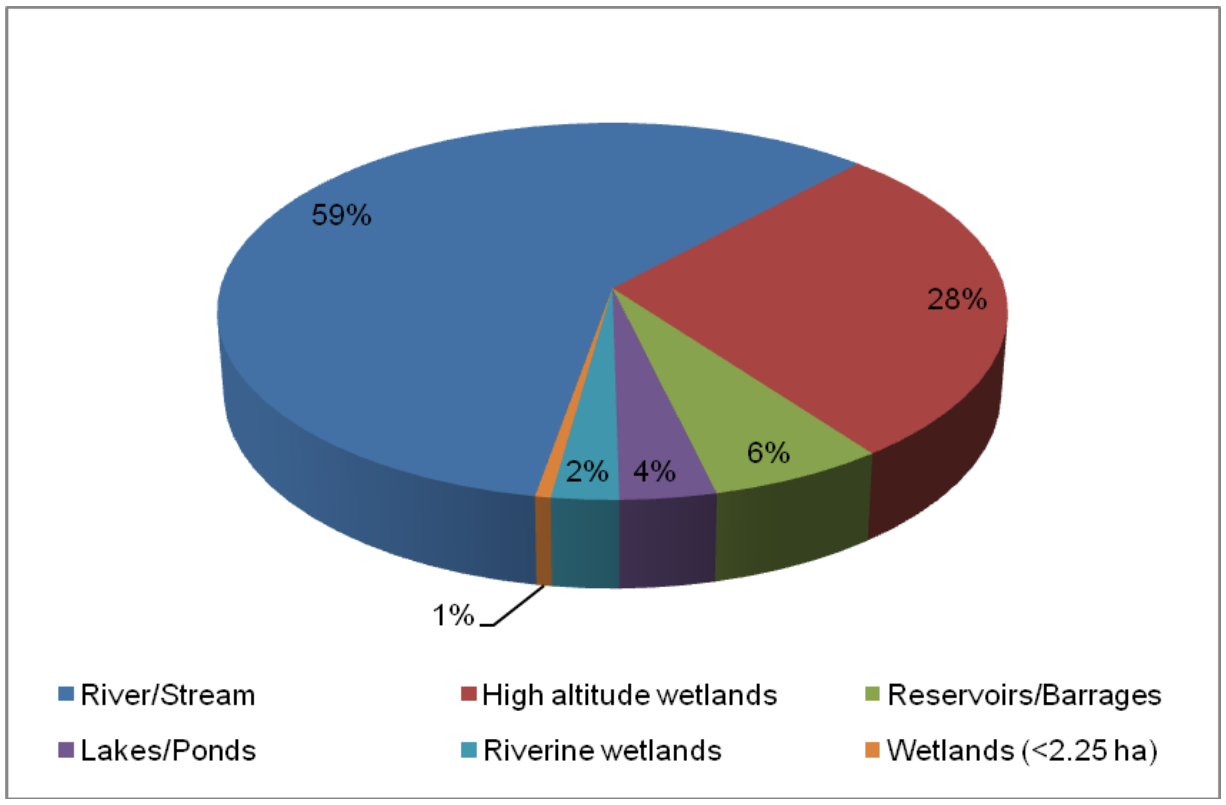



Figure 14: Type-wise wetland distribution in Jammu and Kashmir

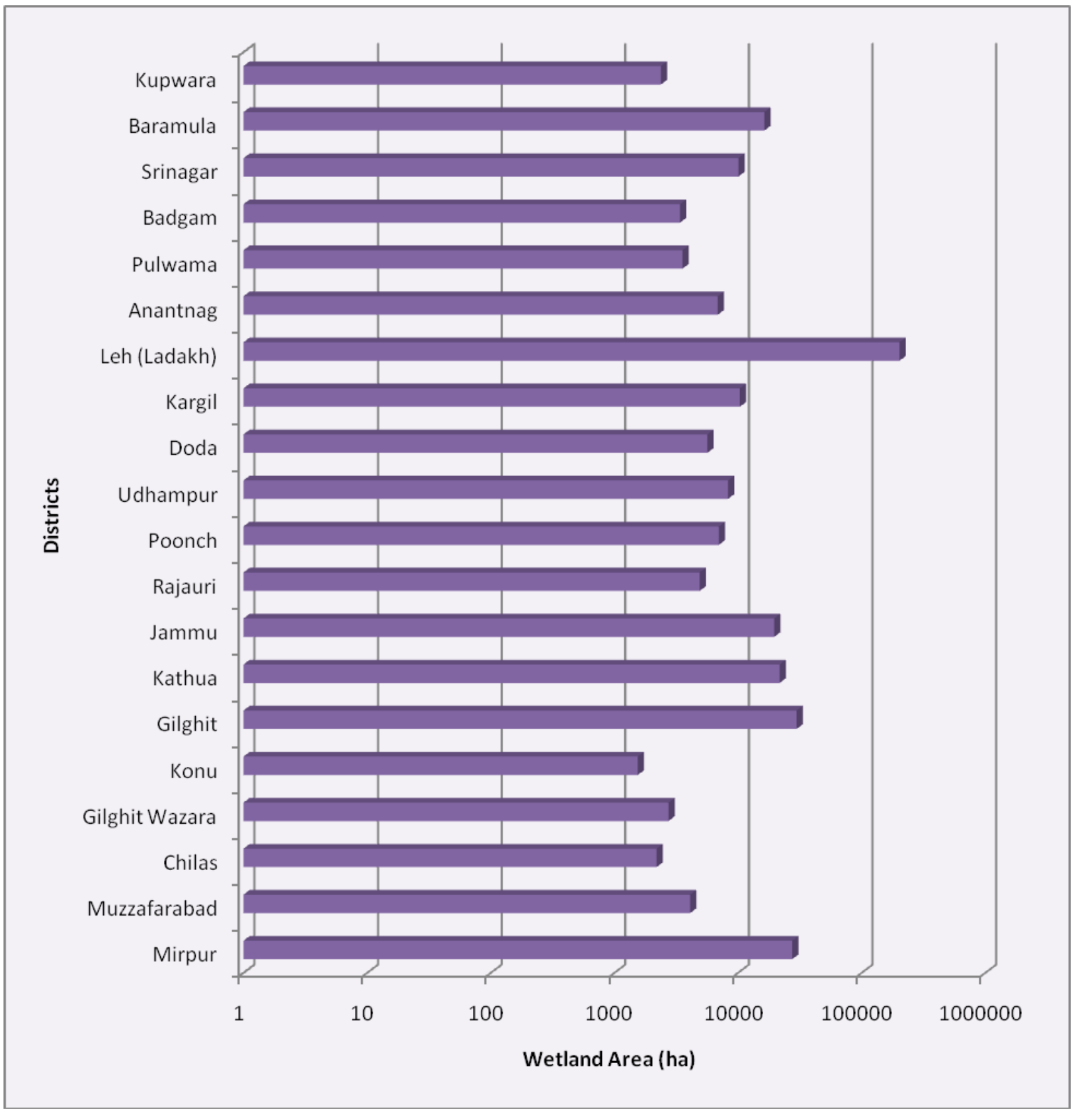



Figure 15: District-wise graphical distribution of wetlands in Jammu and Kashmir

Table 11: District-wise area of wetlands in Jammu and Kashmir

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Kupwara | 3028 | 2384 | 0.61 | 0.79 | 1760 | 2110 | 67 | 44 | 1743 | 17 | - | 2074 | 36 | - |
| 2 | Baramula | 5183 | 16360 | 4.18 | 3.16 | 5082 | 8807 | 10922 | 7532 | 5058 | 8 | 16 | 3523 | 15 | 5269 |
| 3 | Srinagar | 1865 | 10081 | 2.57 | 5.41 | 3748 | 4678 | 6254 | 4999 | 2523 | 1207 | 18 | 2283 | 1388 | 1007 |
| 4 | Badgam | 1267 | 3402 | 0.87 | 2.69 | 1420 | 1493 | 1927 | 1914 | 1400 | 20 | - | 1400 | 93 | - |
| 5 | Pulwama | 1456 | 3561 | 0.91 | 2.45 | 1745 | 1804 | 338 | 259 | 1732 | 4 | 9 | 1712 | 4 | 88 |
| 6 | Anantnag | 3986 | 6875 | 1.76 | 1.72 | 4336 | 4509 | 273 | 217 | 4297 | 39 | - | 4401 | 108 | - |
| 7 | Leh (Ladakh) | 105306 | 203195 | 51.90 | 1.93 | 186147 | 186421 | - | 424 | 186147 | - | - | 186421 | - | - |
| 8 | Kargil | 16296 | 10380 | 2.65 | 0.64 | 5719 | 7724 | - | - | 5719 | - | - | 7724 | - | - |
| 9 | Doda | 11683 | 5667 | 1.45 | 0.49 | 5265 | 5685 | - | - | 5265 | - | - | 5685 | - | - |
| 10 | Udhampur | 4580 | 8326 | 2.13 | 1.82 | 5355 | 6456 | 45 | 45 | 5355 | - | - | 6456 | - | - |
| 11 | Poonch | 3826 | 7013 | 1.79 | 1.83 | 3960 | 4655 | - | - | 6960 | - | - | 4655 | - | - |
| 12 | Rajauri | 2628 | 4910 | 1.25 | 1.87 | 4147 | 4168 | - | - | 4147 | - | - | 4168 | - | - |
| 13 | Jammu | 3017 | 19638 | 5.02 | 6.51 | 4001 | 4686 | - | - | 4001 | - | - | 4686 | - | - |
| 14 | Kathua | 2675 | 21740 | 5.55 | 8.13 | 6454 | 7498 | - | - | 6454 | - | - | 7498 | - | - |
| 15 | Gilghit | 34380 | 29844 | 7.62 | 0.87 | 28937 | 29158 | - | - | 28937 | - | - | 29158 | - | - |
| 16 | Konu | 2773 | 1547 | 0.40 | 0.56 | 1488 | 1488 | - | - | 1488 | - | - | 1488 | - | - |
| 17 | Gilghit Wazara | 6098 | 2743 | 0.70 | 0.45 | 2566 | 2566 | - | - | 2566 | - | - | 2566 | - | - |
| 18 | Chilas | 4276 | 2200 | 0.56 | 0.51 | 2186 | 2186 | - | - | 2186 | - | - | 2186 | - | - |
| 19 | Muzzafarabad | 3711 | 4106 | 1.05 | 1.11 | 3596 | 3805 | - | - | 3596 | - | - | 3805 | - | - |
| 20 | Mirpur | 4077 | 27529 | 7.03 | 6.75 | 23906 | 24312 | - | - | 23906 | - | - | 24312 | - | - |
| | **Total** | **222111** | **391501** | **100.00** | **1.76** | **301818** | **314209** | **19826** | **15434** | **303480** | **1295** | **43** | **306201** | **1644** | **6364** |

* Data Source: http://nic.in and GIS area, GIS area considered for analysis

Table 12: District-wise area of wetlands (type-wise) in Jammu and Kashmir

| District code | District | Geographic area * | Wetland Type | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1103 | 1104 | 1106 | 1201 | 1202 | | | |
| | | | Lake/ pond | High altitude wetland | Riverine wetland | River/ Stream | Reservoir/ Barrage | Tank/ Pond | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Kupwara | 3028 | 96 | - | 6 | 2212 | - | - | 2314 | 70 | 2384 |
| 2 | Baramula | 5183 | 11273 | 448 | 1478 | 3146 | - | - | 16345 | 15 | 16360 |
| 3 | Srinagar | 1865 | 2194 | 392 | 5457 | 2012 | - | 3 | 10058 | 23 | 10081 |
| 4 | Badgam | 1267 | - | 150 | 1932 | 1272 | - | - | 3354 | 48 | 3402 |
| 5 | Pulwama | 1456 | - | 4 | 347 | 2956 | - | 3 | 3310 | 251 | 3561 |
| 6 | Anantnag | 3986 | - | 1026 | 273 | 5553 | - | - | 6852 | 23 | 6875 |
| 7 | Leh (Ladakh) | 105306 | - | 102934 | - | 99821 | - | - | 202755 | 440 | 203195 |
| 8 | Kargil | 16296 | - | 219 | - | 10151 | - | - | 10370 | 10 | 10380 |
| 9 | Doda | 11683 | - | 79 | - | 5567 | - | - | 5646 | 21 | 5667 |
| 10 | Udhampur | 4580 | 58 | 13 | 45 | 7591 | 576 | - | 8283 | 43 | 8326 |
| 11 | Poonch | 3826 | - | 59 | - | 6932 | - | - | 6991 | 22 | 7013 |
| 12 | Rajauri | 2628 | - | 37 | - | 4835 | - | - | 4872 | 38 | 4910 |
| 13 | Jammu | 3017 | 31 | - | - | 19372 | - | - | 19403 | 235 | 19638 |
| 14 | Kathua | 2675 | - | - | - | 16130 | 5410 | - | 21540 | 200 | 21740 |
| 15 | Gilghit | 34380 | - | 2426 | - | 27025 | - | - | 29451 | 393 | 29844 |
| 16 | Konu | 2773 | - | 585 | - | 903 | - | - | 1488 | 59 | 1547 |
| 17 | Gilghit Wazara | 6098 | - | 450 | - | 2233 | - | - | 2683 | 60 | 2743 |
| 18 | Chilas | 4276 | - | 47 | - | 2139 | - | - | 2186 | 14 | 2200 |
| 19 | Muzzafarabad | 3711 | 101 | 301 | - | 3677 | - | - | 4079 | 27 | 4106 |
| 20 | Mirpur | 4077 | 9 | - | 56 | 8070 | 19146 | - | 27281 | 248 | 27529 |
| | **Total** | **222111** | **13762** | **109170** | **9594** | **231597** | **25132** | **6** | **389261** | **2240** | **391501** |

* Data Source: http://nic.in and GIS area, GIS area considered for analysis

### 8.1.2 Himachal Pradesh

Total 170 wetlands have been mapped at 1:50,000 scale in the state. In addition, 471 small wetlands (< 2.25 ha) have also been identified. Total wetland area estimated is 98496 ha that is around 1.77 per cent of the geographic area (Table 13). The major wetland types are river/stream (55558 ha). The major rivers are Sutlej, Ravi, Chenab, Jhelum and Bias. There are 13 reservoir/barrage with 41817 ha area. Total 42 high altitude lakes are mapped with 387 ha area. However, among the 471 small wetlands mapped as point feature, many are high altitude lakes. Chandratal is a famous high altitude lake of the state which is a popular tourist destination. The other wetlands are tank/pond, waterlogged and lake/pond. Graphical distribution of wetland type is shown in Figure 16.

Aquatic vegetation is observed in reservoir/barrage and tank/pond. The aquatic vegetation in wetlands was observed only during pre-monsoon (5294 ha). The open water spread area is significantly lower during pre-monsoon (49245 ha) compared to post-monsoon (69107 ha). The qualitative turbidity of water is mainly low to moderate in both the seasons. Wetland map of the state is shown in Plate 24.

Table 13: Area estimates of wetlands in Himachal Pradesh

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 | Lake/Pond | 8 | 52 | 0.05 | 49 | 26 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | - | - | - | - | - |
| 3 | 1103 | High altitude wetland | 42 | 387 | 0.39 | 285 | 128 |
| 4 | 1104 | Riverine wetland | - | - | - | - | - |
| 5 | 1105 | Waterlogged | 10 | 47 | 0.05 | 39 | 19 |
| 6 | 1106 | River/Stream | 67 | 55558 | 56.41 | 27153 | 17063 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 13 | 41817 | 42.46 | 41445 | 31966 |
| 8 | 1202 | Tank/Pond | 27 | 134 | 0.14 | 106 | 29 |
| 9 | 1203 | Waterlogged | 3 | 30 | 0.03 | 30 | 14 |
| 10 | 1204 | Salt pan | - | - | - | - | - |
| | | **Total - Inland** | **170** | **98025** | **99.52** | **69107** | **49245** |
| | | Wetlands (<2.25 ha) | 471 | 471 | 0.48 | - | - |
| | | **Total** | **641** | **98496** | **100.00** | **69107** | **49245** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | - | 5294 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 46870 | 33949 |
| Moderate | 22236 | 15296 |
| High | - | - |

### District-wise wetland area estimates in Himachal Pradesh

There are 12 districts in the state. The geographic area of the districts varies from 1118 sq.km (Hamirpur) to 13835 sq.km (Lahul and Spiti). The wetlands occupy as high as 10.63% of geographic area ( Bilaspur district), and as low as 0.46% (Shimla). In terms of total wetland area (% wetland area), Kangra is the leading district (34605 ha, 35.13%) and Hamirpur is the least (2182 ha, 2.22 %). District-wise wetland area estimates is given in Table 14 and graphical distribution of wetlands is shown in Figure 17. River/Stream and reservoir/barrage are the dominate wetland types in almost all districts. District-wise area of wetlands (type-wise) in the state is given in Table 15.

The following section gives the details of district wise wetland statistics and maps. The districts are arranged as per census serial number.

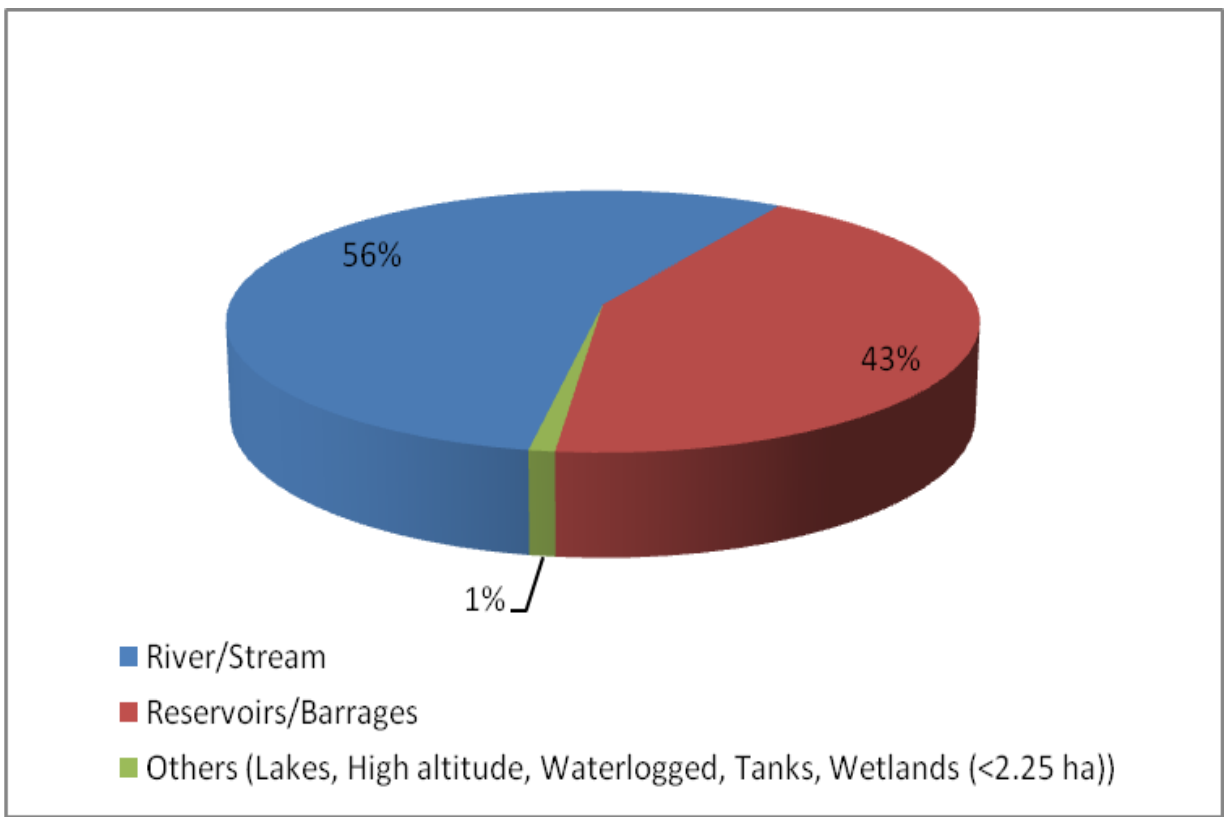



Figure 16: Type-wise wetland distribution in Himachal Pradesh

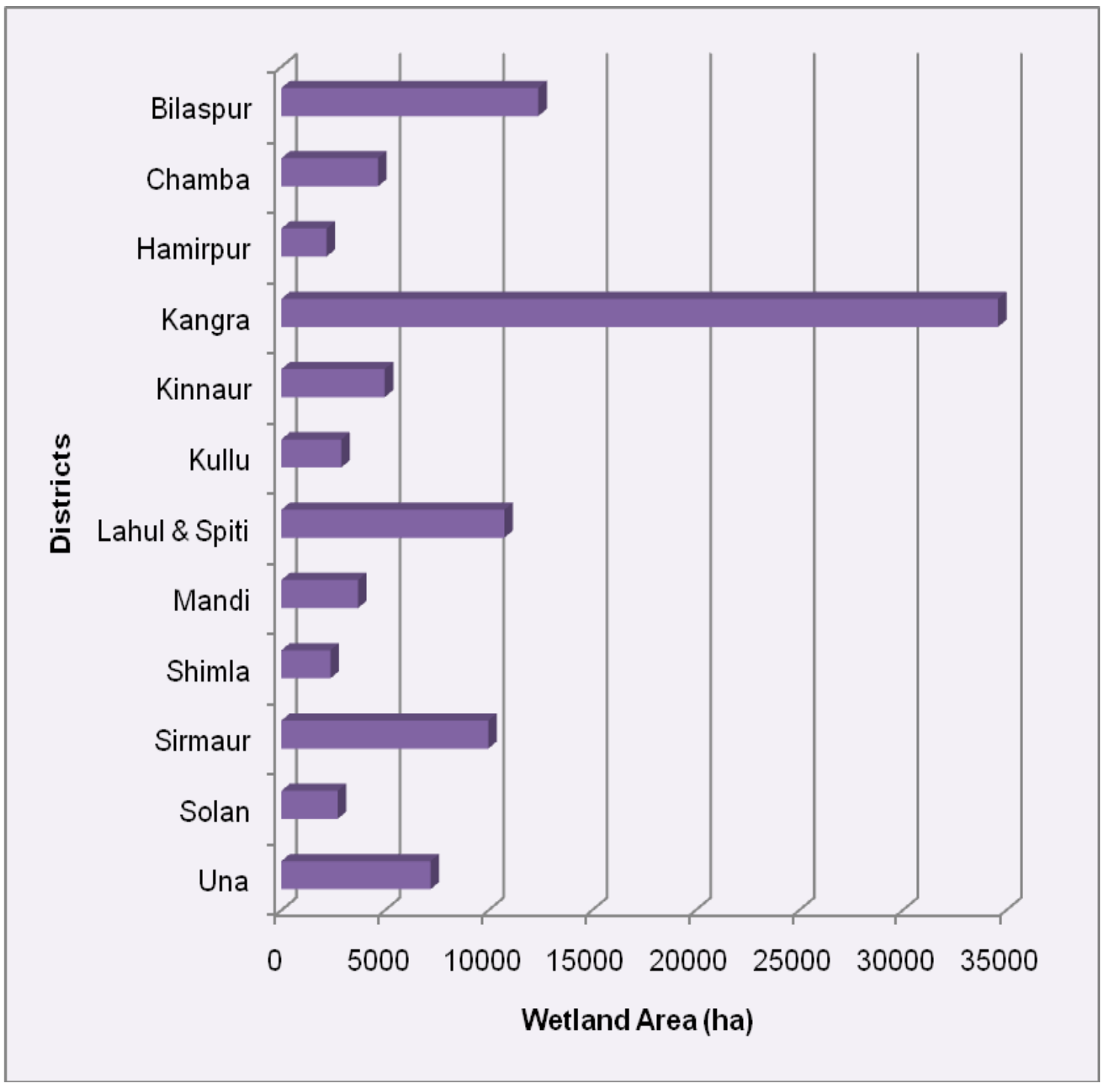



Figure 17: District-wise graphical distribution of wetlands in Himachal Pradesh

Table 14: District-wise area of wetlands in Himachal Pradesh

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Bilaspur | 1167 | 12407 | 12.60 | 10.63 | 12257 | 8527 | - | 396 | 11306 | 951 | - | 7866 | 661 | - |
| 2 | Chamba | 6528 | 4667 | 4.74 | 0.71 | 3568 | 2307 | - | 2 | 3310 | 258 | - | 1130 | 1177 | - |
| 3 | Hamirpur | 1118 | 2182 | 2.22 | 1.95 | 875 | 643 | - | - | - | 875 | - | 44 | 599 | - |
| 4 | Kangra | 5739 | 34605 | 35.13 | 6.03 | 28375 | 22265 | - | 3731 | 24648 | 3727 | - | 20342 | 1923 | - |
| 5 | Kinnaur | 6401 | 4990 | 5.07 | 0.78 | 1426 | 1312 | - | - | 40 | 1386 | - | 12 | 1300 | - |
| 6 | Kullu | 5503 | 2894 | 2.94 | 0.53 | 1907 | 2015 | - | - | 52 | 1855 | - | 2 | 2013 | - |
| 7 | Lahul & Spiti | 13835 | 10766 | 10.93 | 0.78 | 4406 | 2376 | - | - | 2315 | 2091 | - | 163 | 2213 | - |
| 8 | Mandi | 3950 | 3704 | 3.76 | 0.94 | 2300 | 2139 | - | - | 198 | 2103 | - | 254 | 1885 | - |
| 9 | Shimla | 5131 | 2368 | 2.40 | 0.46 | 1517 | 1440 | - | - | 31 | 1486 | - | 277 | 1163 | - |
| 10 | Sirmaur | 2825 | 9990 | 10.14 | 3.54 | 5795 | 1750 | - | 7 | 78 | 5716 | - | 711 | 1039 | - |
| 11 | Solan | 1936 | 2720 | 2.76 | 1.40 | 1400 | 1040 | - | - | 137 | 1264 | - | 159 | 881 | - |
| 12 | Una | 1540 | 7203 | 7.31 | 4.68 | 5281 | 3431 | - | 1158 | 4755 | 524 | - | 2989 | 442 | - |
| | **Total** | **55673** | **98496** | **100.00** | **1.77** | **69107** | **49245** | **-** | **5294** | **46870** | **22236** | **-** | **33949** | **15296** | **-** |

* - Data source : http://nic.in

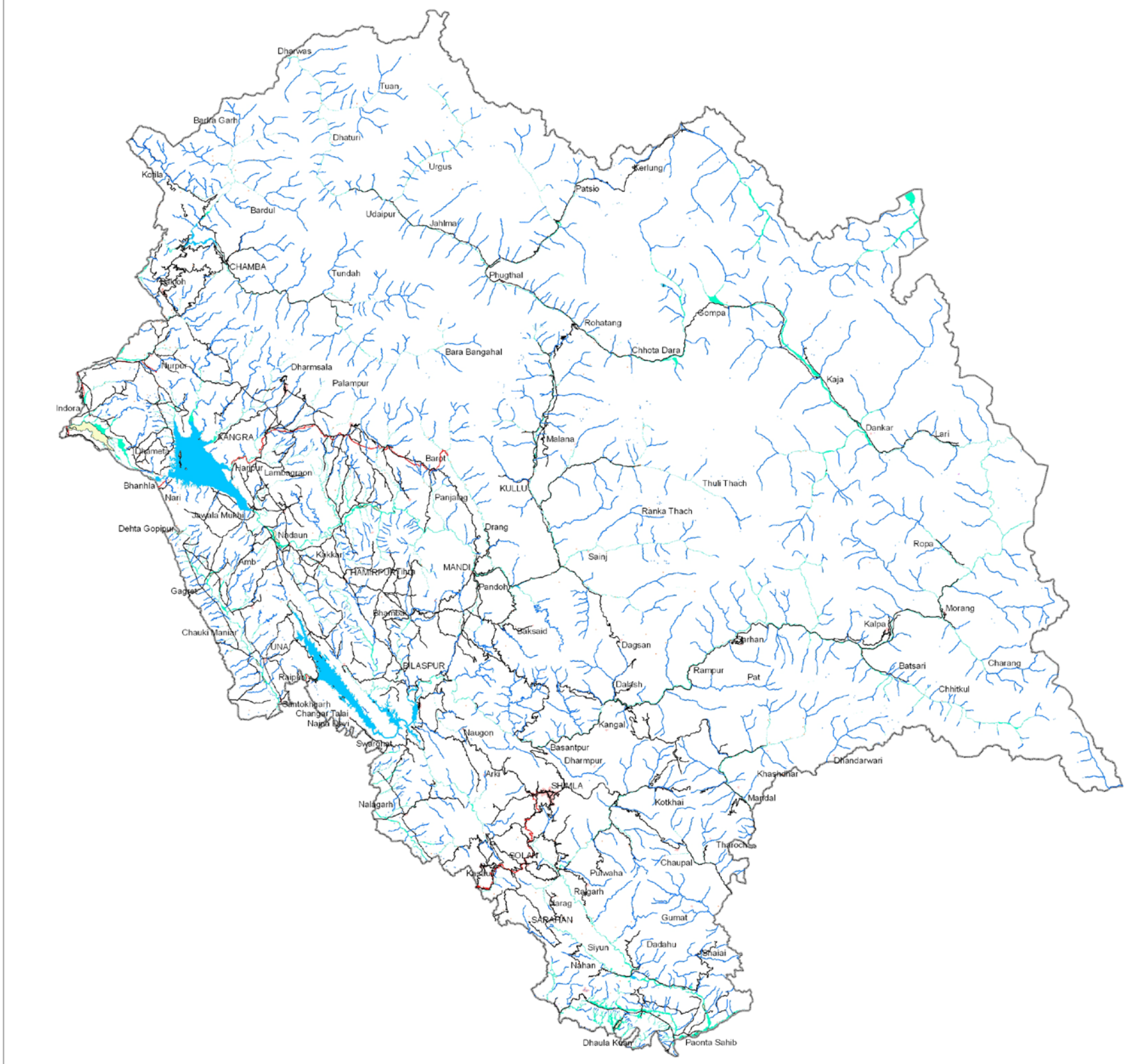
Table 15: District-wise area of wetlands (type-wise) in Himachal Pradesh

| District code | District | Geographic area * | Wetland Type | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1103 | 1105 | 1106 | 1201 | 1202 | 1203 | | | |
| | | | Lake/ pond | High altitude wetland | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Bilaspur | 1167 | - | 42 | 5 | 1227 | 11090 | - | 10 | 12374 | 33 | 12407 |
| 2 | Chamba | 6528 | 2 | 30 | - | 3631 | 991 | - | - | 4654 | 13 | 4667 |
| 3 | Hamirpur | 1118 | - | - | - | 2174 | - | - | - | 2174 | 8 | 2182 |
| 4 | Kangra | 5739 | - | - | 6 | 9908 | 24589 | 14 | 20 | 34537 | 68 | 34605 |
| 5 | Kinnaur | 6401 | - | 47 | 8 | 4859 | 5 | 28 | - | 4947 | 43 | 4990 |
| 6 | Kullu | 5503 | - | 27 | - | 2748 | - | 54 | - | 2829 | 65 | 2894 |
| 7 | Lahul & Spiti | 13835 | - | 184 | 8 | 10368 | 111 | 8 | - | 10679 | 87 | 10766 |
| 8 | Mandi | 3950 | 4 | - | 7 | 3478 | 193 | 18 | - | 3700 | 4 | 3704 |
| 9 | Shimla | 5131 | - | 57 | - | 2298 | - | - | - | 2355 | 13 | 2368 |
| 10 | Sirmaur | 2825 | 40 | - | 8 | 9723 | 189 | - | - | 9960 | 30 | 9990 |
| 11 | Solan | 1936 | 6 | - | 2 | 2641 | 7 | 3 | - | 2659 | 61 | 2720 |
| 12 | Una | 1540 | - | - | 3 | 2503 | 4642 | 9 | - | 7157 | 46 | 7203 |
| | **Total** | **55673** | **52** | **387** | **47** | **55558** | **41817** | **134** | **30** | **98025** | **471** | **98496** |

* - Data source : http://nic.in

State : Himachal Pradesh

# WETLAND MAP

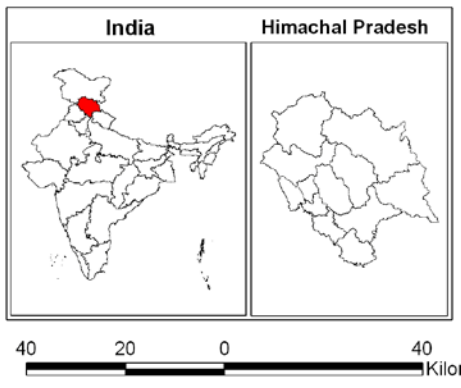



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Riverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

**Prepared by:**
Space Applications Centre (ISRO), Ahmedabad
and
HP Remote Sensing Cell
State Council for Science, Technology & Environment, Shimla

**Sponsored by:**
Ministry of Environment and Forests
Government of India

Plate 24: Wetland map of Himachal Pradesh

### 8.1.3 Punjab

Total 1381 wetlands have been mapped at 1:50,000 scale in the state. In addition, 5049 small wetlands (< 2.25 ha) have also been identified. Total wetland area estimated is 86283 ha accounting for about 1.71 per cent of the geographic area of state The river/stream is the major type, accounting for 69.38 per cent of the wetlands (59864 ha),reservoir/barrage ranked second with 13.74 % share (11858 ha area). The other wetland types observed are: tank/pond (3526 ha), waterlogged, lake/pond, ox-bow lake and riverine wetland. Details of state level wetland statistics are shown in Table 16. Graphical distribution of wetland type is shown in Figure 18.

Aquatic vegetation is observed in lake/pond, riverine wetland, tank/pond and reservoir/barrage. The vegetation spread in wetlands is more during pre-monsoon (17160 ha) compared to post-monsoon (15920 ha). The open water spread of wetlands is more during post-monsoon (36344 ha) that during pre-monsoon (24386 ha). The qualitative turbidity of water in wetlands is in general low in both the seasons. Wetland map of the state is shown in Plate 25.

Table 16: Area estimates of wetlands in Punjab

Area in ha

| Sr. No. | Wettcode | Wetland Category | Number of wetland | Total wetland area | % of wetland area | Open Water | |
|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon area | Pre-monsoon area |
| | **1100** | **Inland Wetlands – Natural** | | | | | |
| 1 | 1101 | Lake/Pond | 200 | 1934 | 2.24 | 1052 | 778 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 11 | 373 | 0.43 | 152 | 105 |
| 3 | 1103 | High altitude wetland | - | - | - | - | - |
| 4 | 1104 | Riverine wetland | 9 | 306 | 0.35 | 13 | 13 |
| 5 | 1105 | Waterlogged | 43 | 2032 | 2.36 | 151 | 35 |
| 6 | 1106 | River/Stream | 151 | 59864 | 69.38 | 25748 | 15955 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 31 | 11858 | 13.74 | 6220 | 5488 |
| 8 | 1202 | Tank/Pond | 878 | 3526 | 4.09 | 2196 | 1937 |
| 9 | 1203 | Waterlogged | 58 | 1341 | 1.55 | 812 | 75 |
| 10 | 1204 | Salt pan | - | - | - | - | - |
| | | **Sub-Total** | **1381** | **81234** | **94.15** | **36344** | **24386** |
| | | Wetlands (<2.25 ha) | 5049 | 5049 | 5.85 | - | - |
| | | **Total** | **6430** | **86283** | **100.00** | **36344** | **24386** |

| **Area under Aquatic Vegetation** | 15920 | 17160 |
|---|---|---|

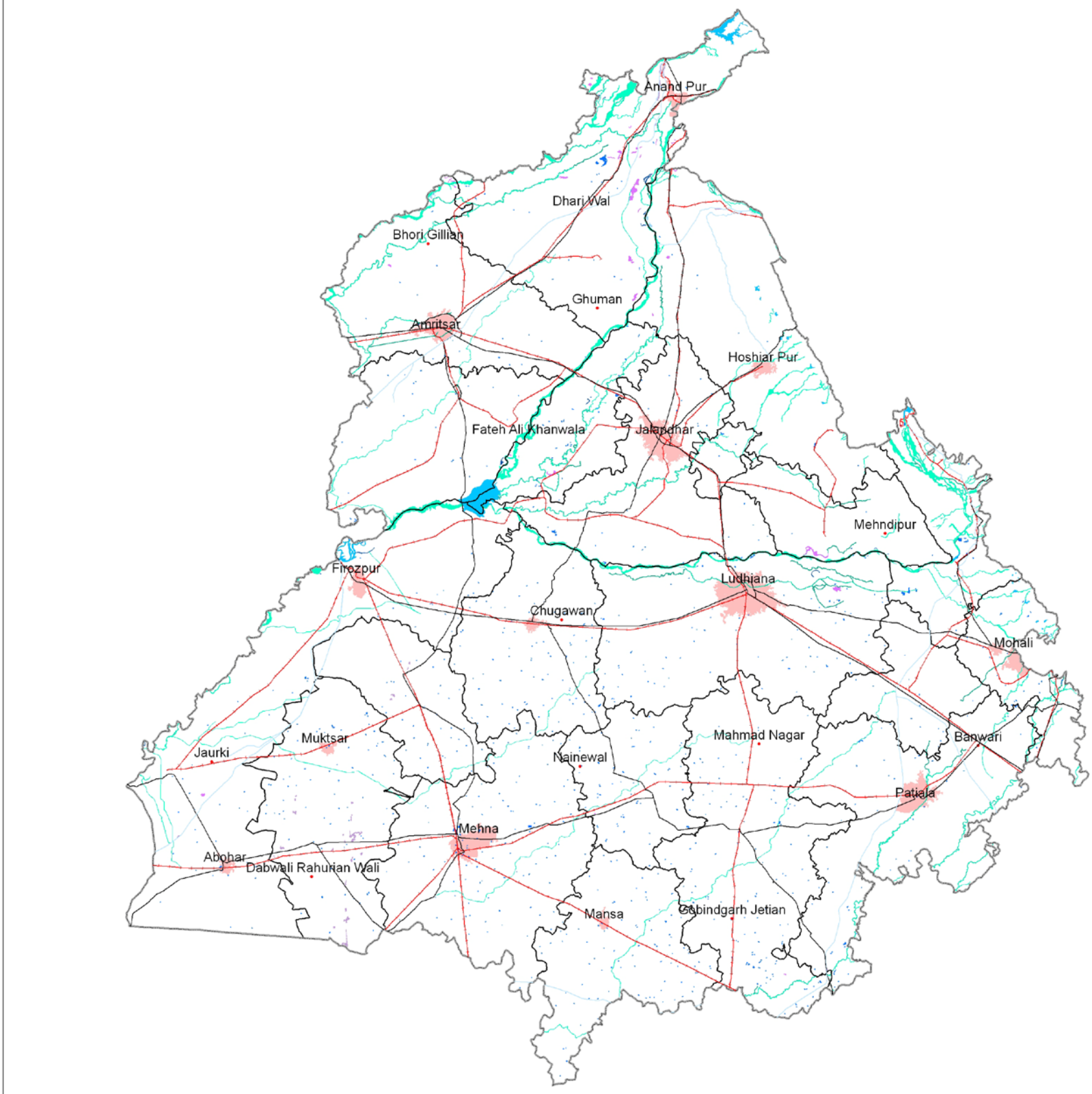
| **Area under turbidity levels** | | |
|---|---|---|
| Low | 30906 | 20504 |
| Moderate | 5117 | 3573 |
| High | 321 | 309 |

### District-wise wetland area estimates in Punjab

The state has twenty districts. The wetland area as a per cent of geographic area of the districts varied from 0.23% (Fatehgarh Sahib) to 8.75% (Rupnagar). The wetland area of the districts as a per cent of total wetland area of the state varied from 0.68% (Barnala and Faridkot) to 19.19% ( Gurdaspur). Gurdaspur, Kapurthala, Rupnagar and Firozpur are the districts each having more than 10.0% share of wetland area (Table 17, Figure 19). Gurdaspur ranks first in terms of area under river/stream (11969 ha), and lake/pond (388 ha), waterlogged-natural (1108 ha). Kapurthala leads in terms of area under reservoir/barrage (3252 ha). Tarn-Taran leads in terms of small wetland (< 2.25 ha) which are mainly Tanks; 430 such wetlands are identified. Riverine wetland are observed in Gurdaspur, Amritsar, Kapurthala, Hoshiarpur and Sas Nagar districts; Hoshiarpur having the highest area (128 ha). District-wise area of wetlands (type-wise) in the state is given in Table 18.

State : Punjab

# WETLAND MAP

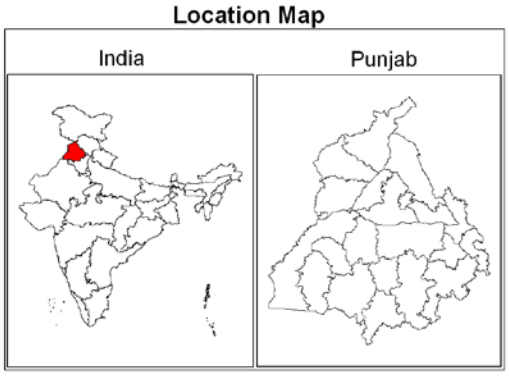



| Symbol Typecode | Level I | Level II | Level III |
|---|---|---|---|
| | Inland Wetlands | | |
| | | Natural | |
| 1101 | | | Lakes/Ponds |
| 1102 | | | Ox-bow lakes/ Cut-off meanders |
| 1103 | | | High altitude wetlands |
| 1104 | | | Reverine wetlands |
| 1105 | | | Waterlogged |
| 1106 | | | River/Stream |
| | | 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
Punjab Remote Sensing Applications Centre, Ludhiana

**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 25: Wetland map of Punjab

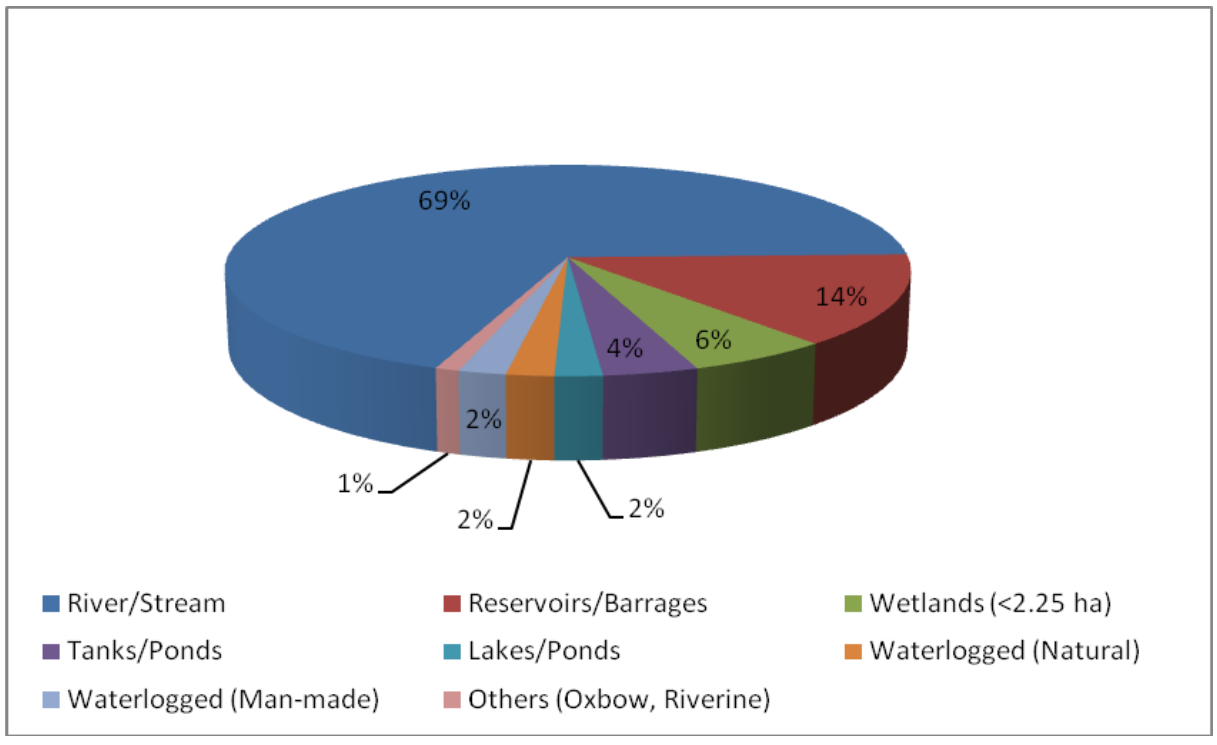



Figure 18: Type-wise wetland distribution in Punjab

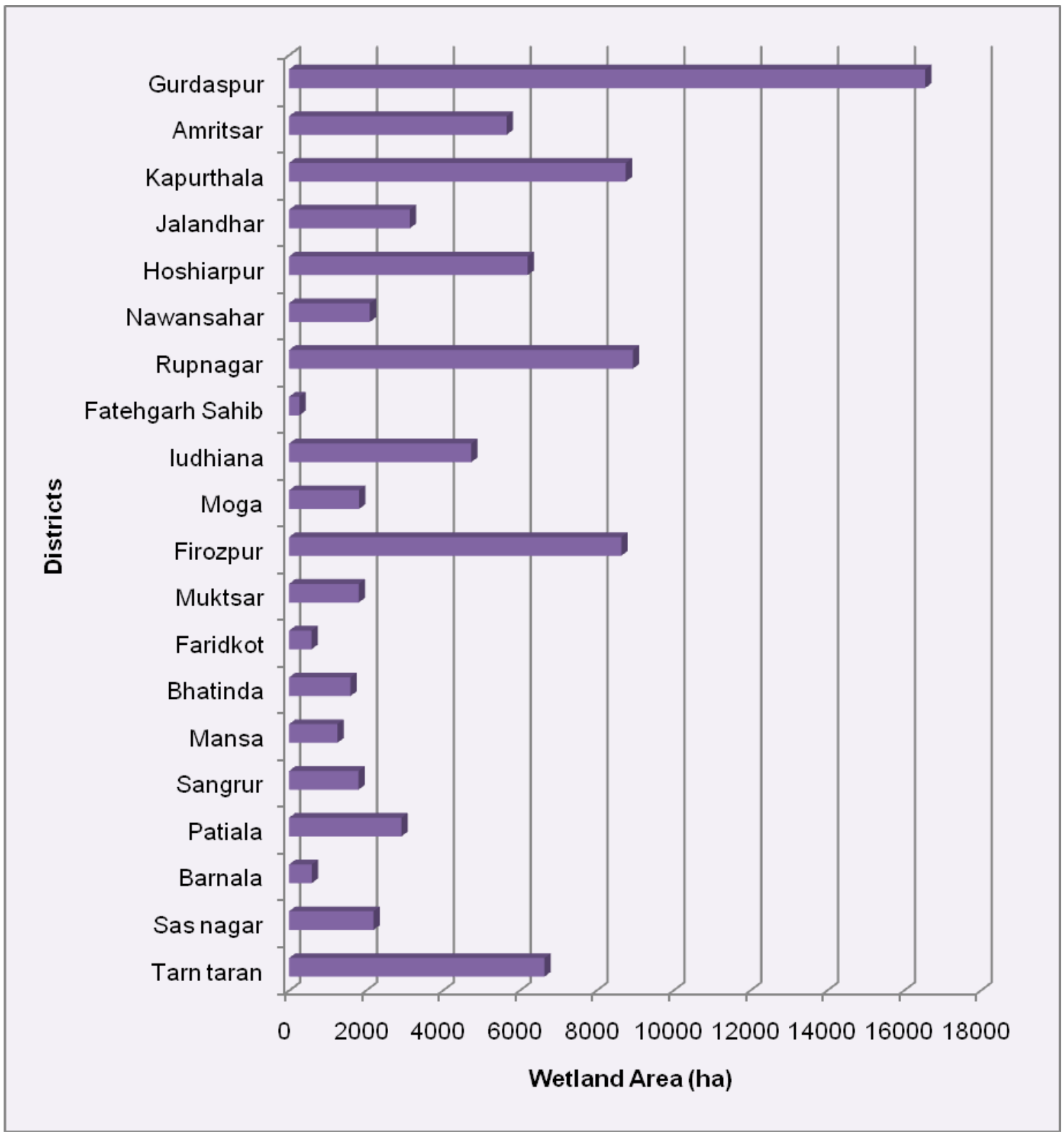



Figure 19: District-wise graphical distribution of wetlands in Punjab

Table 17: District-wise area of wetlands in Punjab

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Gurdaspur | 3570 | 16557 | 19.19 | 4.64 | 6885 | 4208 | 3289 | 4348 | 6523 | 362 | - | 3643 | 565 | - |
| 2 | Amritsar | 2656 | 5661 | 6.56 | 2.13 | 2323 | 1157 | 1851 | 1934 | 2136 | 187 | - | 886 | 271 | - |
| 3 | Kapurthala | 1646 | 8765 | 10.16 | 5.33 | 3476 | 3761 | 4004 | 3681 | 3207 | 212 | 57 | 3605 | 111 | 45 |
| 4 | Jalandhar | 2658 | 3140 | 3.64 | 1.18 | 1705 | 637 | 127 | 261 | 1566 | 139 | - | 576 | 61 | - |
| 5 | Hoshiarpur | 3310 | 6209 | 7.20 | 1.88 | 2675 | 1541 | 747 | 737 | 2484 | 191 | - | 1458 | 83 | - |
| 6 | Nawansahar | 1258 | 2103 | 2.44 | 1.67 | 793 | 412 | 351 | 367 | 779 | 14 | - | 406 | 6 | - |
| 7 | Rupnagar | 1023 | 8950 | 10.37 | 8.75 | 3633 | 2590 | 75 | 101 | 3191 | 318 | 124 | 2239 | 238 | 113 |
| 8 | Fatehgarh Sahib | 1180 | 267 | 0.31 | 0.23 | 39 | 35 | 21 | 76 | - | 39 | - | - | 35 | - |
| 9 | Ludhiana | 3744 | 4740 | 5.49 | 1.27 | 2299 | 1197 | 486 | 582 | 2022 | 277 | - | 961 | 236 | - |
| 10 | Moga | 1672 | 1823 | 2.11 | 1.09 | 804 | 343 | 149 | 196 | 584 | 220 | - | 210 | 133 | - |
| 11 | Firozpur | 5865 | 8647 | 10.02 | 1.47 | 2881 | 2037 | 1512 | 1222 | 2600 | 268 | 13 | 1755 | 260 | 22 |
| 12 | Muktsar | 2596 | 1812 | 2.10 | 0.70 | 1174 | 350 | 221 | 664 | 192 | 982 | - | 105 | 245 | - |
| 13 | Faridkot | 1472 | 585 | 0.68 | 0.40 | 53 | 65 | 152 | 48 | - | 53 | - | - | 65 | - |
| 14 | Bhatinda | 3377 | 1597 | 1.85 | 0.47 | 715 | 407 | 154 | 183 | 240 | 371 | 104 | - | 303 | 104 |
| 15 | Mansa | 2174 | 1258 | 1.46 | 0.58 | 676 | 477 | 100 | 77 | 430 | 246 | - | 259 | 218 | - |
| 16 | Sangrur | 3608 | 1810 | 2.10 | 0.50 | 934 | 604 | 169 | 195 | 537 | 374 | 23 | 287 | 292 | 25 |
| 17 | Patiala | 3627 | 2924 | 3.39 | 0.81 | 1597 | 1353 | 271 | 419 | 1283 | 314 | - | 1210 | 143 | - |
| 18 | Barnala* | 1414 | 590 | 0.68 | 0.42 | 194 | 139 | 97 | 114 | 16 | 178 | - | - | 139 | - |
| 19 | Sas nagar* | 1093 | 2198 | 2.55 | 2.01 | 938 | 580 | 61 | 80 | 675 | 263 | - | 466 | 114 | - |
| 20 | Tarn taran* | 2419 | 6647 | 7.70 | 2.75 | 2550 | 2493 | 2083 | 1875 | 2441 | 109 | - | 2438 | 55 | - |
| | **Total** | **50362** | **86283** | **100.00** | **1.71** | **36344** | **24386** | **15920** | **17160** | **30906** | **5117** | **321** | **20504** | **3573** | **309** |

* - Data source : http://nic.in , GIS area

Table 18: District-wise area of wetlands (type-wise) in Punjab

| District code | District | Geographic area * | Wetland Type | | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total wetland area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1103 | 1104 | 1105 | 1106 | 1201 | 1202 | 1203 | 1204 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | High altitude wetland | Riverine wetland | Waterlogged (Natural) | River/Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | Salt pan | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Gurdaspur | 3570 | 388 | 171 | - | 47 | 1108 | 11969 | 2333 | 81 | 322 | - | 16419 | 138 | 16557 |
| 2 | Amritsar | 2656 | 13 | - | - | 98 | 105 | 5240 | - | 63 | - | - | 5519 | 142 | 5661 |
| 3 | Kapurthala | 1646 | 89 | 22 | - | 9 | 126 | 5046 | 3252 | 143 | - | - | 8687 | 78 | 8765 |
| 4 | Jalandhar | 2658 | 139 | - | - | - | - | 2768 | - | 76 | - | - | 2983 | 157 | 3140 |
| 5 | Hoshiarpur | 3310 | 55 | - | - | 128 | 95 | 5404 | 379 | 13 | 51 | - | 6125 | 84 | 6209 |
| 6 | Nawansahar | 1258 | 12 | - | - | - | 325 | 1666 | - | 14 | - | - | 2017 | 86 | 2103 |
| 7 | Rupnagar | 1023 | 21 | - | - | - | - | 7997 | 502 | 315 | - | - | 8835 | 115 | 8950 |
| 8 | Fatehgarh Sahib | 1180 | 7 | - | - | - | - | 66 | - | 56 | - | - | 129 | 138 | 267 |
| 9 | Ludhiana | 3744 | 133 | 38 | - | - | 199 | 3587 | - | 308 | - | - | 4265 | 475 | 4740 |
| 10 | Moga | 1672 | 133 | - | - | - | - | 1177 | - | 237 | - | - | 1547 | 276 | 1823 |
| 11 | Firozpur | 5865 | 37 | 87 | - | - | 57 | 5293 | 2425 | 228 | 22 | - | 8149 | 498 | 8647 |
| 12 | Muktsar | 2596 | 125 | - | - | - | - | 244 | - | 239 | 845 | - | 1453 | 359 | 1812 |
| 13 | Faridkot | 1472 | 6 | - | - | - | - | 114 | - | 120 | 88 | - | 328 | 257 | 585 |
| 14 | Bhatinda | 3377 | 151 | - | - | - | - | 533 | - | 504 | - | - | 1188 | 409 | 1597 |
| 15 | Mansa | 2174 | 98 | - | - | - | - | 591 | - | 266 | - | - | 955 | 303 | 1258 |
| 16 | Sangrur | 3608 | 186 | - | - | - | 12 | 828 | - | 384 | 3 | - | 1413 | 397 | 1810 |
| 17 | Patiala | 3627 | 144 | - | - | - | - | 2199 | - | 150 | 10 | - | 2503 | 421 | 2924 |
| 18 | Barnala* | 1414 | 110 | - | - | - | 5 | 176 | - | 165 | - | - | 456 | 134 | 590 |
| 19 | Sas nagar* | 1093 | 64 | - | - | 24 | - | 1682 | 210 | 66 | - | - | 2046 | 152 | 2198 |
| 20 | Tarn taran* | 2419 | 23 | 55 | - | - | - | 3284 | 2757 | 98 | - | - | 6217 | 430 | 6647 |
| | **Total** | **50362** | **1934** | **373** | **-** | **306** | **2032** | **59864** | **11858** | **3526** | **1341** | **-** | **81234** | **5049** | **86283** |

* - Data source : http://nic.in , GIS area

### 8.1.4 Chandigarh

Total 20 wetlands are mapped including 9 small wetlands (< 2.25 ha) with 350 ha area**.** River/Stream contributed 47.71% to the total wetland area. The lake/pond with 160 ha (45.71% area) is the second major wetland category, followed by tank/pond with 14 ha area i.e. 4.0 %. Details of wetland statistics is given in Table 19.

Open water spread of the wetlands is higher in post-monsoon (242 ha) than during pre-monsoon (225 ha). Aquatic vegetation is slightly more during pre-monsoon (19 ha) than in post-monsoon (10 ha). The qualitative turbidity of water is moderate in both the seasons. Type-wise distribution of wetlands and wetland map of Chandigarh are shown in Figure 20 and Plate–26 respectively.

Table 19: Area estimates of wetlands in Chandigarh

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 | Lake/Pond | 1 | 160 | 45.71 | 155 | 138 |
| 2 | 1106 | River/Stream | 8 | 167 | 47.71 | 78 | 80 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 3 | 1201 | Reservoir/Barrage | - | - | - | - | - |
| 4 | 1202 | Tank/Pond | 2 | 14 | 4.00 | 9 | 7 |
| | | **Total - Inland** | **11** | **341** | **97.43** | **242** | **225** |
| | | **Sub-Total** | **11** | **341** | **97.43** | **242** | **225** |
| | | Wetlands (<2.25 ha) | 9 | 9 | 2.57 | - | - |
| | | **Total** | **20** | **350** | **100.00** | **242** | **225** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 10 | 19 |

| | | |
|---|---|---|
| **Area under turbidity levels** | | |
| Low | 65 | 70 |
| Moderate | 177 | 155 |
| High | - | - |

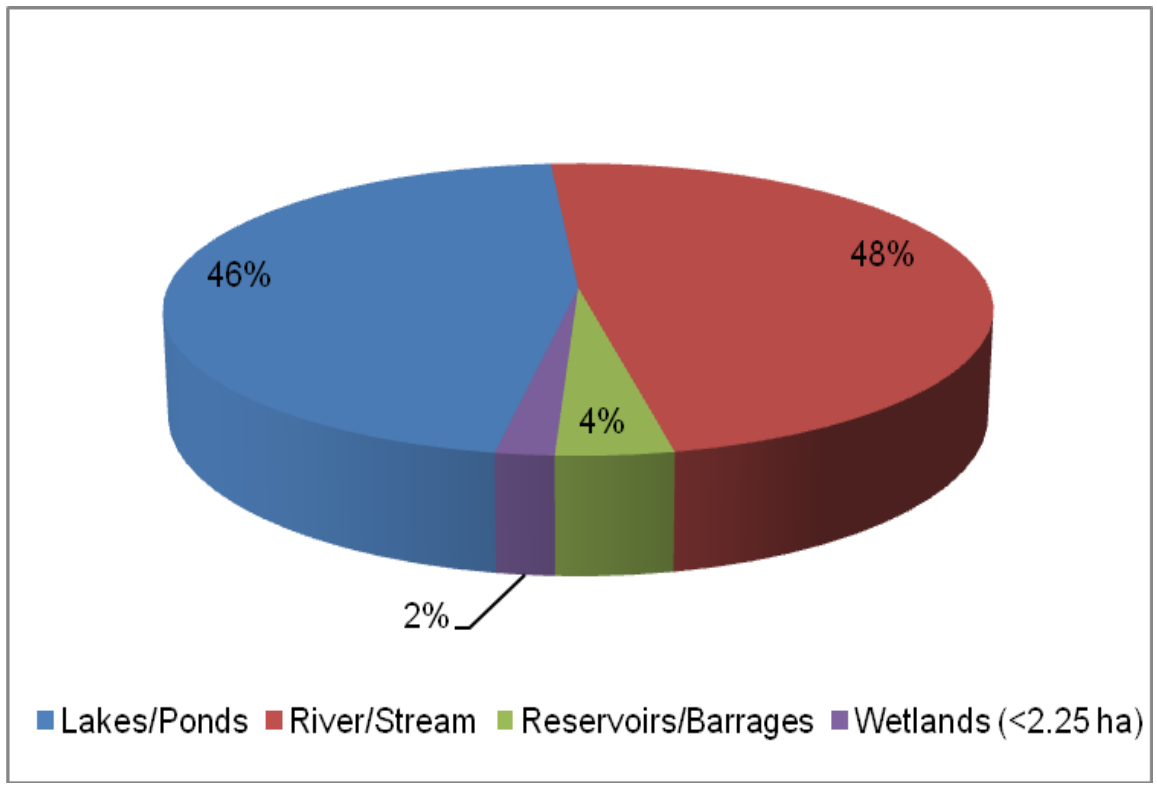
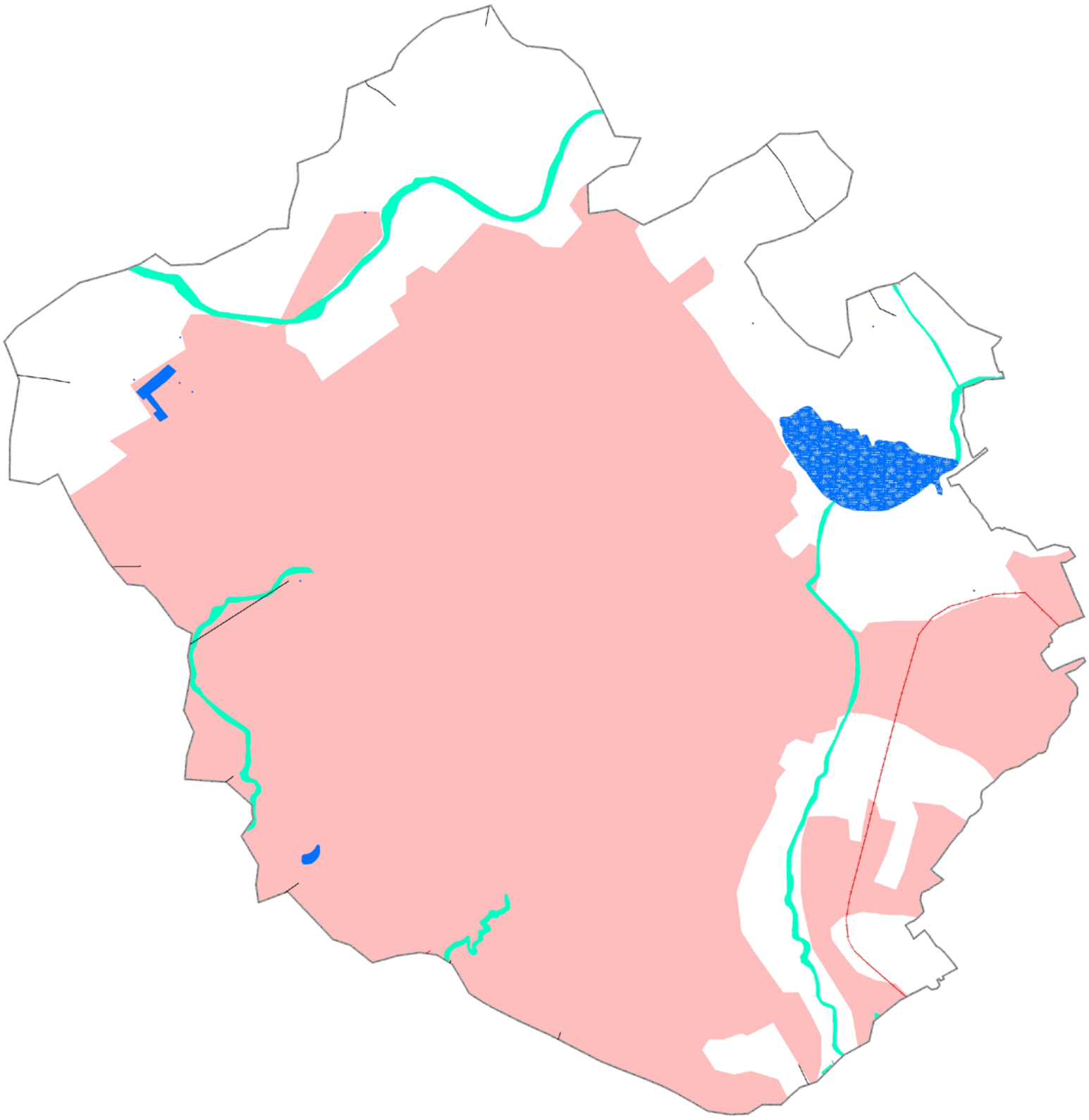



Figure 20: Type-wise wetland distribution in Chandigarh

State : Chandigarh

## WETLAND MAP

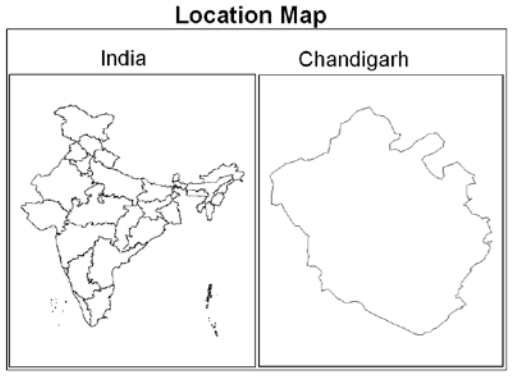


| Symbol Typecode | Level I | Level II | Level III |
|---|---|---|---|
| | Inland Wetlands | | |
| | | Natural | |
| 1101 | | | Lakes/Ponds |
| 1102 | | | Ox-bow lakes/ Cut-off meanders |
| 1103 | | | High altitude wetlands |
| 1104 | | | Reverine wetlands |
| 1105 | | | Waterlogged |
| 1106 | | | River/Stream |
| | | 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 0.5 1 2 3 4 Kilometers

**Data Source :**

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

**Prepared By :**

Space Applications Centre (ISRO), Ahmedabad
and
Punjab Remote Sensing Applications Centre, Ludhiana

**Sponsored By :**

Ministry of Environment and Forests
Government of India

Plate 26: Wetland map of Chandigarh

### 8.1.5 Uttarakhand

Total 994 wetland are mapped, including 816 small wetlands (<2.25 ha area). The total area under the wetlands is 103882 ha which is 1.92 per cent of the total geographic area of the state (Table 20). River/Stream is the most dominant one with 77.14 per cent share of wetlands (81033 ha). reservoir/barrage are the second largest wetland category. Total 10 reservoir/barrages are mapped with 20319 ha area, contributing 19.56 per cent of wetland area of the state. High altitude wetlands, mainly lakes are of specific feature of the state. Total 29 such wetlands are mapped which lie above 3000 m altitude. However, there are numerous small (<2.25 ha) high altitude wetlands in the state which are mapped as point features. The other wetland types are: lake/pond (2081 ha), tank/pond and waterlogged. Graphical distribution of wetland type is shown in Figure 21.

The open water area of these wetlands ranges from 54221 ha during post-monsoon season and 46244 ha in pre-monsoon season. Most of the wetlands are oligotrophic in nature. The turbidity of water is mainly moderate. Wetland map of the state is shown in Plate 27.

Table 20: Area estimates of wetlands in Uttarakhand

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 | Lake/Pond | 12 | 2081 | 2.00 | 1747 | 757 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 15 | 63 | 0.06 | 49 | 57 |
| 3 | 1103 | High altitude wetland | 29 | 142 | 0.14 | 142 | 115 |
| 4 | 1104 | Riverine wetland | - | - | - | - | - |
| 5 | 1105 | Waterlogged | 1 | 9 | 0.01 | 5 | 9 |
| 6 | 1106 | River/Stream | 81 | 80133 | 77.14 | 37567 | 34945 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 10 | 20319 | 19.56 | 14411 | 10213 |
| 8 | 1202 | Tank/Pond | 21 | 108 | 0.10 | 89 | 108 |
| 9 | 1203 | Waterlogged | 9 | 211 | 0.20 | 211 | 40 |
| 10 | 1204 | Salt pan | - | - | - | - | - |
| | | **Sub-Total** | **178** | **103066** | **99.21** | **54221** | **46244** |
| | | Wetlands (<2.25 ha) | 816 | 816 | 0.79 | - | - |
| | | **Total** | **994** | **103882** | **100.00** | **54221** | **46244** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 5288 | 11697 |

| | | |
|---|---|---|
| **Area under turbidity levels** | | |
| Low | 22893 | 11235 |
| Moderate | 31328 | 35009 |
| High | - | - |

### District-wise wetland area estimates in Uttarakhand

The state has 13 districts. The geographic area of districts varied from 1781 sq km (Champawat) to 7951 sq km (Uttarkashi). The wetland area in districts varied from as low as 0.42 per cent ( Chamoli) to as high as 6.9 per cent ( Udham singh nagar) of the geographic area of the district. The major wetland districts, which contributed more than 10.0 per cent of the wetland area of the state are Udhams Singh Nagar, Hardwar, Nainital and Dehradun. The districts having high altitude wetlands are Chamoli, Pithoragarh, Uttarkashi and Rudraprayag. Chamoli has the highest number of high altitude wetlands (16), followed by Pithoragarh (11). District-wise wetland area estimates are given in Table 21. Figure 22 shows district-wise graphical distribution of wetlands. District-wise area of wetlands (type-wise) in the state is given in Table 22.

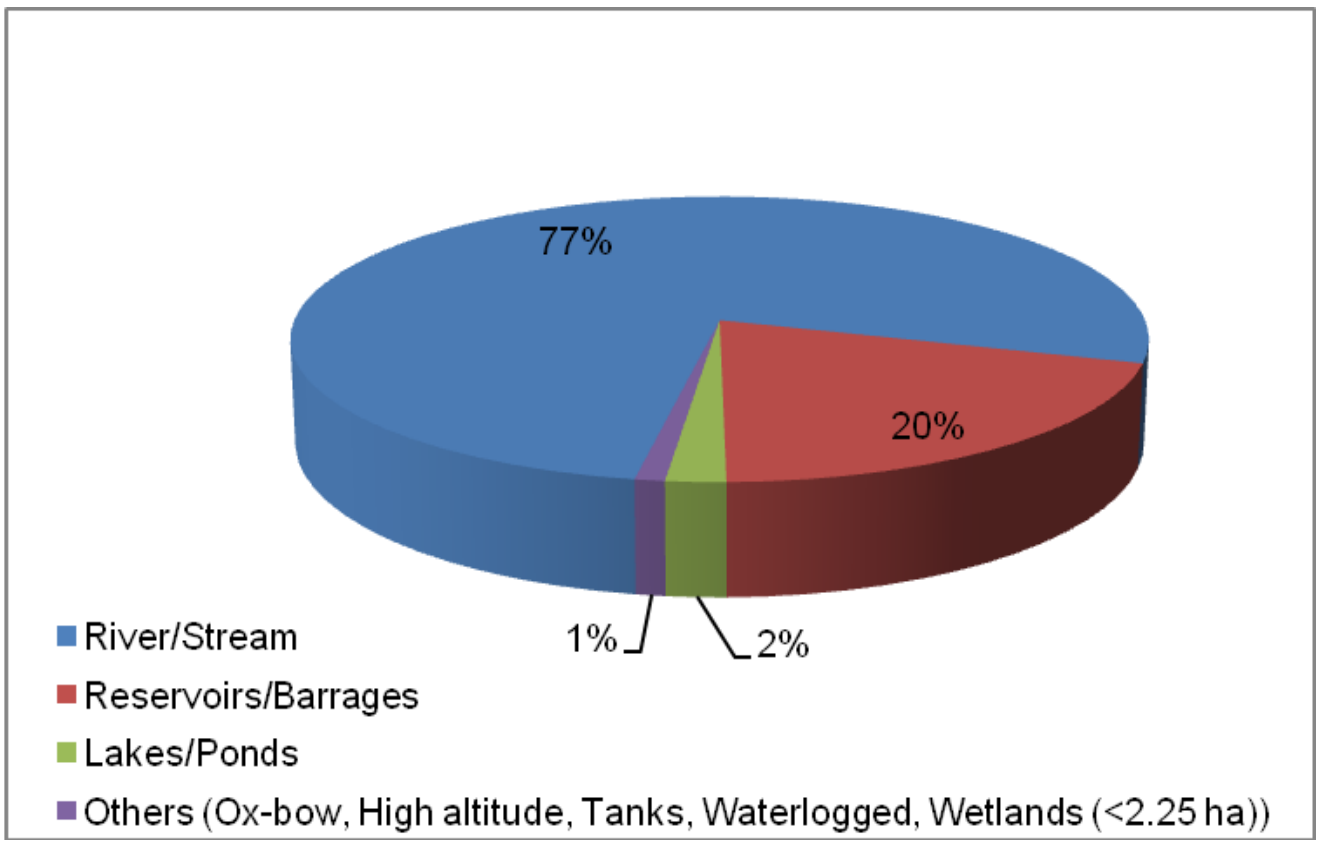



Figure 21: Type-wise wetland distribution in Uttarakhand

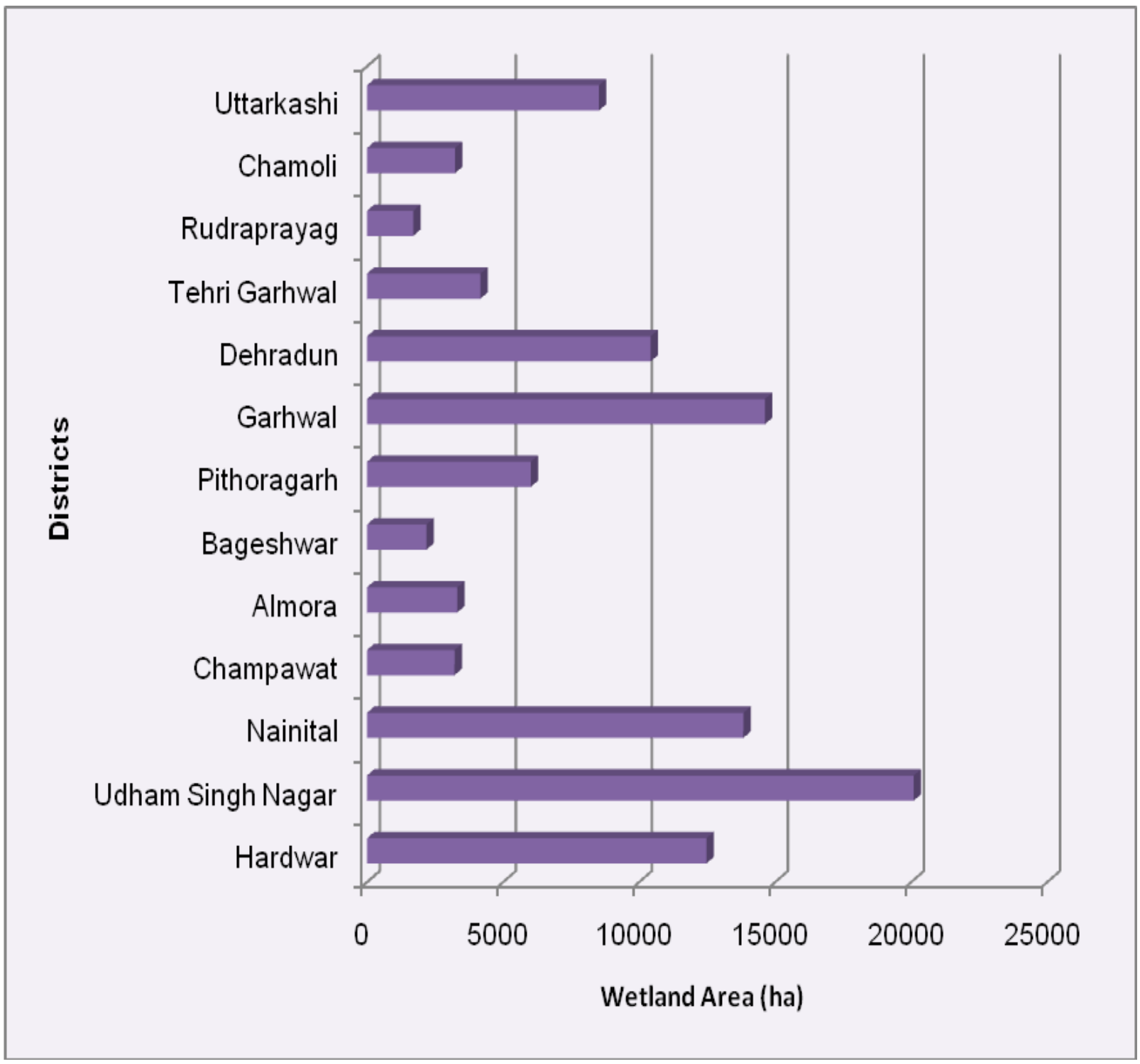



Figure 22: District-wise graphical distribution of wetlands in Uttarakhand

Table 21: District-wise area of wetlands in Uttarakhand

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Uttarkashi | 7951 | 8532 | 8.21 | 1.07 | 3982 | 8489 | - | - | 2595 | 1387 | - | 4805 | 3684 | - |
| 2 | Chamoli | 7692 | 3240 | 3.12 | 0.42 | 2964 | 3164 | - | - | 66 | 2898 | - | 40 | 3124 | - |
| 3 | Rudraprayag | 1896 | 1702 | 1.64 | 0.90 | 1092 | 1701 | - | - | 1092 | - | - | 2 | 1699 | - |
| 4 | Tehri Garhwal | 4085 | 4173 | 4.02 | 1.02 | 2558 | 3776 | - | - | 2300 | 258 | - | 1065 | 2711 | - |
| 5 | Dehradun | 3088 | 10432 | 10.04 | 3.38 | 2595 | 1668 | - | - | 2290 | 305 | - | 1244 | 424 | - |
| 6 | Garhwal | 5438 | 14631 | 14.08 | 2.69 | 10553 | 7372 | - | 3059 | 3461 | 7092 | - | 81 | 7291 | - |
| 7 | Pithoragarh | 7110 | 6023 | 5.80 | 0.85 | 5006 | 5998 | - | - | 62 | 4944 | - | 62 | 5936 | - |
| 8 | Bageshwar | 2310 | 2187 | 2.11 | 0.95 | 2060 | 2181 | - | - | 610 | 1450 | - | 691 | 1490 | - |
| 9 | Almora | 3090 | 3326 | 3.20 | 1.08 | 3098 | 2292 | - | - | 897 | 2201 | - | - | 2292 | - |
| 10 | Champawat | 1781 | 3222 | 3.10 | 1.81 | 1577 | 386 | - | - | 754 | 823 | - | 3 | 383 | - |
| 11 | Nainital | 3853 | 13835 | 13.32 | 3.59 | 4239 | 445 | 953 | 1331 | 3787 | 452 | - | 150 | 295 | - |
| 12 | Udham Singh Nagar | 2912 | 20099 | 19.35 | 6.90 | 10282 | 6279 | 4305 | 7098 | 3748 | 6534 | - | 1585 | 4694 | - |
| 13 | Hardwar | 2360 | 12480 | 12.01 | 5.29 | 4215 | 2493 | 30 | 209 | 1231 | 2984 | - | 1507 | 986 | - |
| | **Total** | **53566** | **103882** | **100.00** | **1.94** | **54221** | **46244** | **5288** | **11697** | **22893** | **31328** | **-** | **11235** | **35009** | **-** |

* - Data source : http://nic.in

Table 22: District-wise area of wetlands (type-wise) in Uttarakhand

| District code | District | Geographic area * | Wetland Type | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1103 | 1105 | 1106 | 1201 | 1202 | 1203 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | High altitude wetland | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Uttarkashi | 7951 | - | - | 12 | - | 8477 | - | - | - | 8489 | 43 | 8532 |
| 2 | Chamoli | 7692 | - | - | 66 | - | 3125 | - | - | - | 3191 | 49 | 3240 |
| 3 | Rudraprayag | 1896 | - | - | 2 | - | 1699 | - | - | - | 1701 | 1 | 1702 |
| 4 | Tehri Garhwal | 4085 | - | - | - | - | 2909 | 1247 | - | - | 4156 | 17 | 4173 |
| 5 | Dehradun | 3088 | - | - | - | - | 10206 | 104 | 18 | - | 10328 | 104 | 10432 |
| 6 | Garhwal | 5438 | - | - | - | - | 7523 | 7093 | - | - | 14616 | 15 | 14631 |
| 7 | Pithoragarh | 7110 | - | - | 62 | - | 5936 | - | - | - | 5998 | 25 | 6023 |
| 8 | Bageshwar | 2310 | - | - | - | - | 2181 | - | - | - | 2181 | 6 | 2187 |
| 9 | Almora | 3090 | - | - | - | - | 3321 | - | - | - | 3321 | 5 | 3326 |
| 10 | Champawat | 1781 | 3 | - | - | - | 3200 | - | - | - | 3203 | 19 | 3222 |
| 11 | Nainital | 3853 | 155 | - | - | - | 12281 | 1382 | - | - | 13818 | 17 | 13835 |
| 12 | Udham Singh Nagar | 2912 | 1923 | 45 | - | 9 | 7416 | 10493 | - | 40 | 19926 | 173 | 20099 |
| 13 | Hardwar | 2360 | - | 18 | - | - | 11859 | - | 90 | 171 | 12138 | 342 | 12480 |
| | **Total** | **53566** | **2081** | **63** | **142** | **9** | **80133** | **20319** | **108** | **211** | **103066** | **816** | **103882** |

* - Data source : http://nic.in

State : Uttarakhand

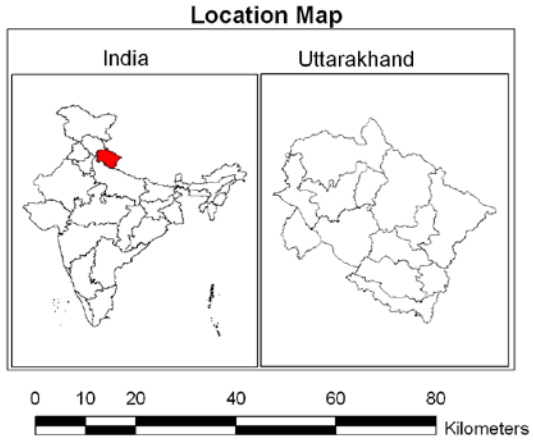
# WETLAND MAP


| 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**




**Data Source :**

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

**Prepared By :**

Space Applications Centre (ISRO), Ahmedabad
and
Uttarakhand Space Applications Centre, Dehradun

**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 27: Wetland map of Uttarakhand

### 8.1.6 Haryana

Total 1441 wetlands have been mapped at 1:50,000 scale in the state. In addition, 10529 wetlands (smaller than 2.25 ha) have also been identified. Total wetland area estimated is 42478 ha that is around 0.86 per cent of the geographic area (Table 23). The major wetland types are river/stream accounting for 40.08 per cent of the wetlands (17025 ha), tank/pond (7573 ha), waterlogged (3339 ha) and reservoir/barrage (1775 ha). Graphical distribution of wetland type is shown in Figure 23.

Analysis of wetland status in terms of open water and aquatic vegetation showed that around 14216 ha and 2245 ha respectively. Lotic wetlands include rivers and major streams and contribute an area of 17025 ha. Open water in post-monsoon season is very less (3121 ha). It clearly indicates that these rivers are mainly seasonal and receives scanty rainfall. Perennial rivers are few and river flow is restricted to narrow streams of the river. Presence of aquatic vegetation is more during post-monsoon season and it is mainly due to dispersion of floating vegetation by wind and water current. Aquatic vegetation occupies an area of 2245 and 1497 during post-monsoon and pre-monsoon respectively. High turbidity (3968 ha) is observed during post-monsoon season. Lakes and ponds showed low turbidity in general where as tank/pond located around thermal plants and industrial area showed high turbidity. Inland wetlands mainly lakes and ponds shown drastic decrease in terms of area in pre-monsoon season (20 ha) and it is due to high temperature during this season. Wetland map of the state is shown in Plate 28.

Table 23: Area estimates of wetlands in Haryana

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 | Lake/Pond | 5 | 801 | 1.89 | 284 | 20 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 3 | 24 | 0.06 | 17 | 17 |
| 3 | 1103 | High altitude wetland | - | - | - | - | - |
| 4 | 1104 | Riverine wetland | - | - | - | - | - |
| 5 | 1105 | Waterlogged | 76 | 1412 | 3.32 | 1123 | 819 |
| 6 | 1106 | River/Stream | 20 | 17025 | 40.08 | 3121 | 9362 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 4 | 1775 | 4.18 | 59 | 175 |
| 8 | 1202 | Tank/Pond | 1097 | 7573 | 17.83 | 6782 | 6344 |
| 9 | 1203 | Waterlogged | 236 | 3339 | 7.86 | 2830 | 2175 |
| 10 | 1204 | Salt pan | - | - | - | - | - |
| | | **Sub-Total** | **1441** | **31949** | **75.21** | **14216** | **18912** |
| | | Wetlands (<2.25 ha) | 10529 | 10529 | 24.79 | - | - |
| | | **Total** | **11970** | **42478** | **100.00** | **14216** | **18912** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 2245 | 1497 |

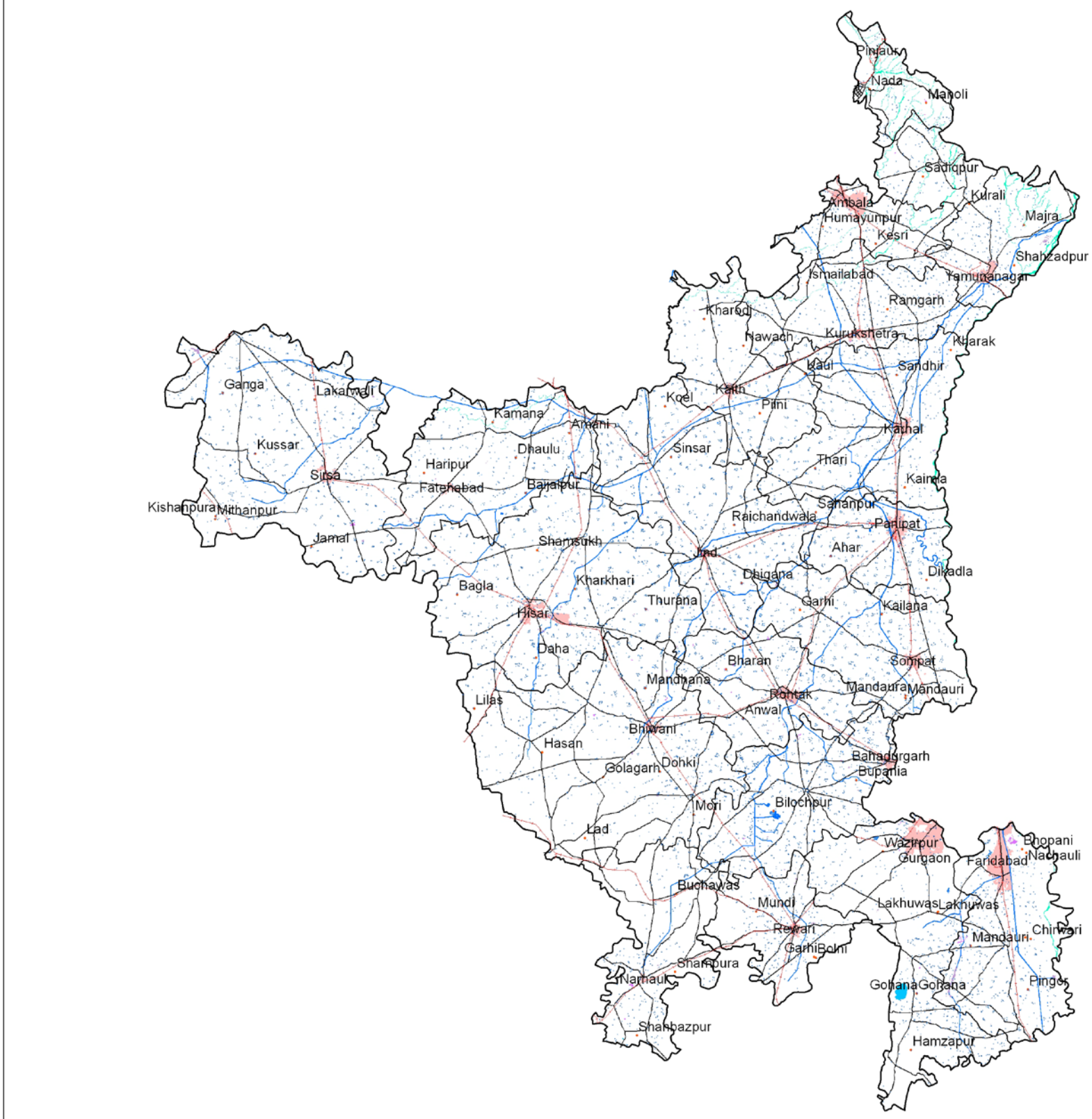
| **Area under turbidity levels** | | |
|---|---|---|
| Low | 6953 | 6423 |
| Moderate | 3295 | 9481 |
| High | 3968 | 3008 |

### District-wise wetland area estimates in Haryana

The state has nineteen districts. District-wise distribution of wetlands showed that three districts could be called as wetland rich. Panchkula has highest concentration which is around 3.53 per cent of geographic area under wetland. The other two districts are: Yamunanagar and Karnal have 2.79 and 1.64 per cent area under wetland respectively. Five districts Kaithal Fatehabad, Sirsa, and Bhiwani have least amount of wetland area.

State : Haryana

# WETLAND MAP

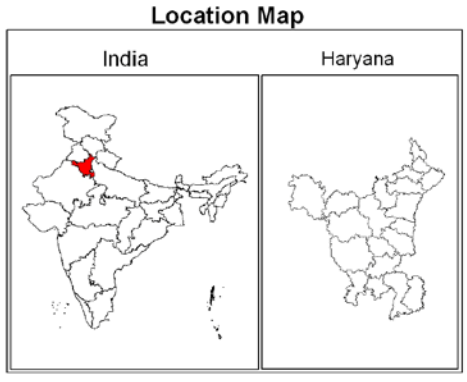



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Settlements
- Drainage (line)
- Major Roads
- Railway
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

**Location Map**




0 15 30 60 90 Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Haryana Space Applications Centre, Hisar
and
M. G. Science Institute, Ahmedabad

Sponsored By :
Ministry of Environment and Forests
Government of India

Plate 28: Wetland map of Harayana

These districts are small in terms of geographic area and highly industrialized due to proximity to national capital. District-wise wetland area estimates is given in Table 24. Figure 24 shows district-wise graphical distribution of wetlands. Mahendragadh and Rewari districts have less wetland area. District-wise area of wetlands (type-wise) in the state is given in Table 25.

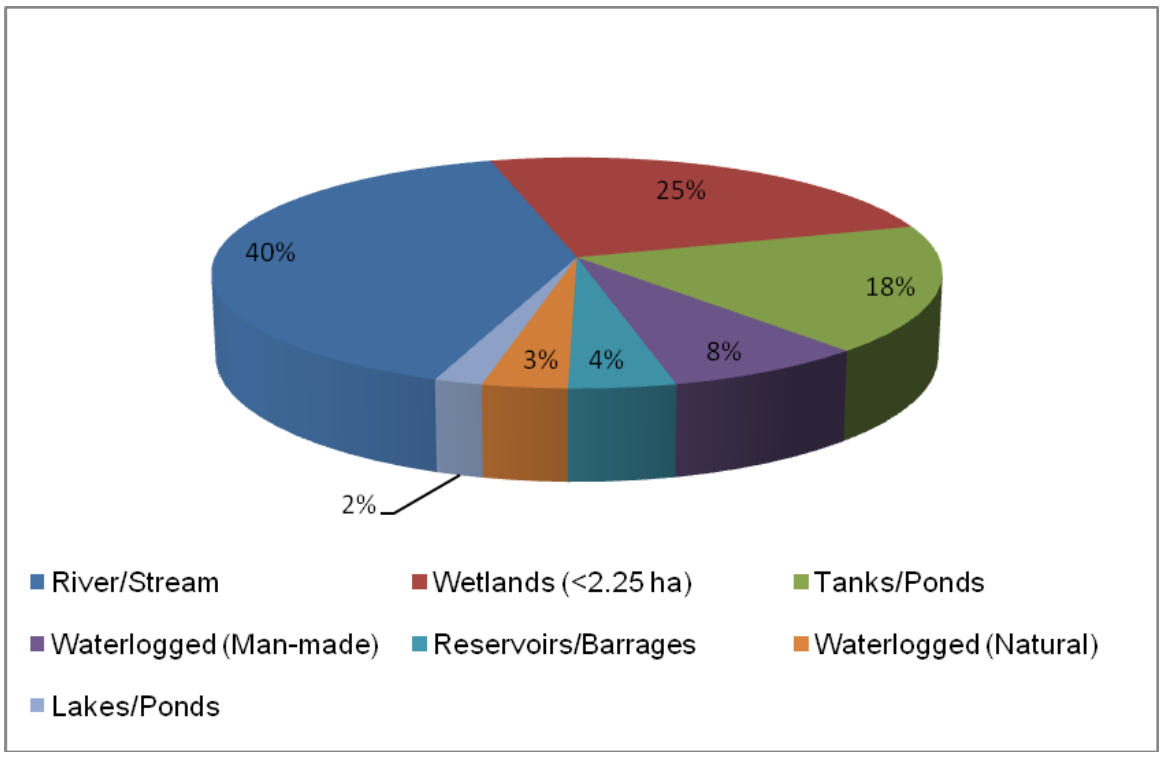



Figure 23: Type-wise wetland distribution in Haryana

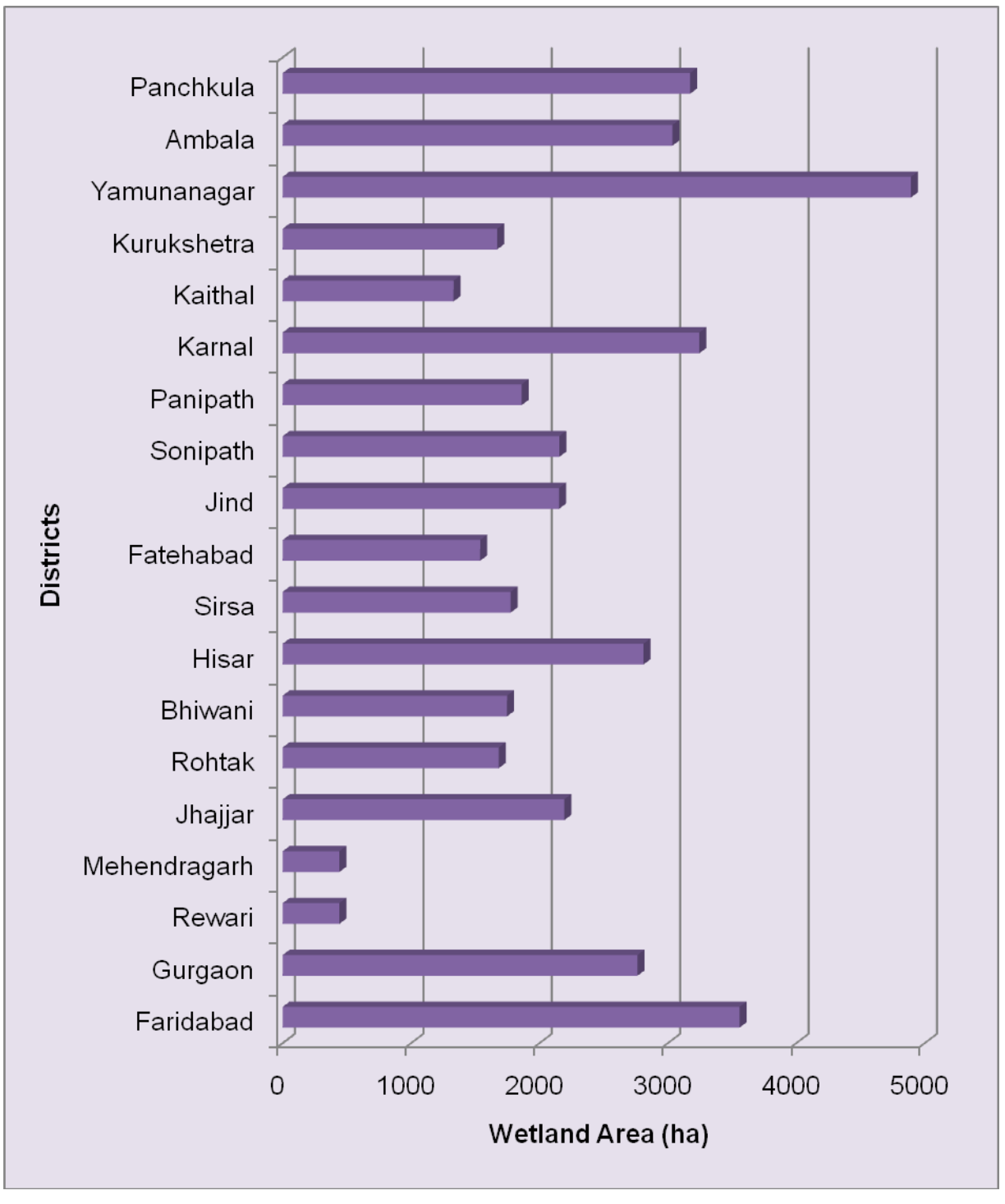



Figure 24: District-wise graphical distribution of wetlands in Haryana

Table 24: District-wise area of wetlands in Haryana

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Panchkula | 898 | 3173 | 7.47 | 3.53 | 86 | 2723 | - | - | 6 | 42 | 39 | 6 | 2681 | 36 |
| 2 | Ambala | 2385 | 3036 | 7.15 | 1.27 | 128 | 1050 | 4 | 11 | 78 | - | 49 | 78 | 935 | 36 |
| 3 | Yamunanagar | 1756 | 4893 | 11.52 | 2.79 | 689 | 2077 | 9 | 8 | 57 | 392 | 240 | 45 | 1965 | 67 |
| 4 | Kurukshetra | 1217 | 1671 | 3.93 | 1.37 | 340 | 332 | 63 | 65 | 153 | 105 | 82 | 167 | 117 | 49 |
| 5 | Kaithal | 2799 | 1332 | 3.14 | 0.48 | 413 | 807 | 173 | 97 | 387 | 7 | 19 | 459 | 328 | 20 |
| 6 | Karnal | 1967 | 3246 | 7.64 | 1.65 | 1130 | 1198 | 34 | 54 | 518 | 528 | 84 | 487 | 661 | 50 |
| 7 | Panipath | 1754 | 1862 | 4.38 | 1.06 | 646 | 1214 | 85 | 36 | 307 | 273 | 66 | 303 | 794 | 117 |
| 8 | Sonipath | 1385 | 2154 | 5.07 | 1.56 | 1076 | 946 | 6 | 11 | 497 | 380 | 199 | 441 | 342 | 163 |
| 9 | Jind | 2736 | 2153 | 5.07 | 0.79 | 1122 | 1070 | 69 | 92 | 963 | 4 | 155 | 926 | 4 | 140 |
| 10 | Fatehabad | 2760 | 1539 | 3.62 | 0.56 | 848 | 741 | 139 | 106 | 199 | 604 | 45 | 207 | 462 | 72 |
| 11 | Sirsa | 4276 | 1776 | 4.18 | 0.42 | 635 | 445 | 48 | 147 | 259 | 12 | 364 | 238 | - | 207 |
| 12 | Hisar | 6279 | 2811 | 6.62 | 0.45 | 1534 | 1402 | 129 | 106 | 1162 | - | 372 | 1135 | - | 267 |
| 13 | Bhiwani | 5099 | 1748 | 4.12 | 0.34 | 769 | 653 | 72 | 14 | 498 | - | 271 | 458 | - | 195 |
| 14 | Rohtak | 4411 | 1683 | 3.96 | 0.38 | 1251 | 974 | 13 | - | 875 | - | 376 | 696 | - | 278 |
| 15 | Jhajjar | 1834 | 2194 | 5.17 | 1.20 | 978 | 692 | 378 | 49 | 683 | - | 295 | 369 | - | 323 |
| 16 | Mehendragarh | 1683 | 442 | 1.04 | 0.26 | 153 | 24 | - | - | 16 | 13 | 124 | 3 | 2 | 19 |
| 17 | Rewari | 1559 | 442 | 1.04 | 0.28 | 126 | 24 | - | - | 20 | - | 106 | 20 | - | 4 |
| 18 | Gurgaon | 2105 | 2764 | 6.51 | 1.31 | 289 | 421 | 599 | 312 | 75 | 48 | 166 | 212 | 20 | 189 |
| 19 | Faridabad | 2760 | 3559 | 8.38 | 1.29 | 2003 | 2119 | 424 | 389 | 200 | 887 | 916 | 173 | 1170 | 776 |
| | **Total** | **49663** | **42478** | **100** | **0.86** | **14216** | **18912** | **2245** | **1497** | **6953** | **3295** | **3968** | **6423** | **9481** | **3008** |

* - Data source : http://nic.in

Table 25: District-wise area of wetlands (type-wise) in Haryana

| District code | District | Geographic area * | Wetland Type | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1105 | 1106 | 1201 | 1202 | 1203 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Panchkula | 898 | - | - | 37 | 3051 | - | 7 | - | 3095 | 78 | 3173 |
| 2 | Ambala | 2385 | - | - | 23 | 2583 | - | 85 | 27 | 2718 | 318 | 3036 |
| 3 | Yamunanagar | 1756 | - | - | - | 4335 | 37 | 34 | 240 | 4646 | 247 | 4893 |
| 4 | Kurukshetra | 1217 | - | - | 46 | 904 | - | 181 | 67 | 1198 | 473 | 1671 |
| 5 | Kaithal | 2799 | - | - | 4 | 373 | - | 556 | 26 | 959 | 373 | 1332 |
| 6 | Karnal | 1967 | - | - | 27 | 2048 | - | 555 | 61 | 2691 | 555 | 3246 |
| 7 | Panipath | 1754 | - | - | 33 | 987 | - | 325 | 111 | 1456 | 406 | 1862 |
| 8 | Sonipath | 1385 | - | 6 | 29 | 733 | - | 549 | 185 | 1502 | 652 | 2154 |
| 9 | Jind | 2736 | - | - | 61 | - | - | 1033 | 106 | 1200 | 953 | 2153 |
| 10 | Fatehabad | 2760 | - | - | 29 | 602 | - | 332 | 105 | 1068 | 471 | 1539 |
| 11 | Sirsa | 4276 | - | - | 98 | - | 12 | 305 | 319 | 734 | 1042 | 1776 |
| 12 | Hisar | 6279 | - | - | 18 | - | - | 1308 | 375 | 1701 | 1110 | 2811 |
| 13 | Bhiwani | 5099 | - | - | 94 | - | - | 562 | 210 | 866 | 882 | 1748 |
| 14 | Rohtak | 4411 | - | - | 150 | - | - | 888 | 232 | 1270 | 413 | 1683 |
| 15 | Jhajjar | 1834 | 563 | - | 76 | - | - | 499 | 227 | 1365 | 829 | 2194 |
| 16 | Mehendragarh | 1683 | - | - | 97 | - | 13 | 17 | 26 | 153 | 289 | 442 |
| 17 | Rewari | 1559 | - | - | - | - | - | 20 | 106 | 126 | 316 | 442 |
| 18 | Gurgaon | 2105 | 158 | - | 79 | - | 1712 | 63 | 156 | 2168 | 596 | 2764 |
| 19 | Faridabad | 2760 | 81 | 17 | 511 | 1409 | - | 254 | 761 | 3033 | 526 | 3559 |
| | **Total** | **49663** | **802** | **23** | **1412** | **17025** | **1774** | **7573** | **3340** | **31949** | **10529** | **42478** |

* - Data source : http://nic.in

### 8.1.7 Delhi

Total 98 wetlands have been mapped at 1:50,000 scale in the state. In addition, 301 wetlands (smaller than 2.25 ha) have also been identified. Total wetland area estimated is 2771 ha that is around 0.93 per cent of the geographic area (Table 26). The major wetland types are river/stream (1074 ha), reservoir/barrage (479 ha) and waterlogged (natural) accounting for 13.71 per cent of the wetlands (380 ha). Graphical distribution of wetland type is shown in Figure 25. Wetland map of the state is shown in Plate 29.

Analysis of wetland status in terms of open water and aquatic vegetation showed that around 46 and 55 per cent of wetland area is under open water category during post-monsoon and pre-monsoon respectively. Aquatic vegetation (floating/emergent) occupies around 30 and 35 per cent of wetland area during post-monsoon and pre-monsoon respectively. Aquatic vegetation comprised of various types hydrophytes which include mainly grasses in the periphery of the banks and on exposed sand beds. Water hyacinth is a dominant floating hygrophyte in open water. It is observed that *Ipomoea aquatica* showed luxuriant growth in waters which are mainly influenced by sewage. Aquatic vegetation (floating/emergent) accounted for more than 60 per cent area in particular to Okhla barrage and dispersion of floating vegetation is more during post-monsoon season.

Most of the wetlands showed low turbidity and the area was 1239 ha in post-monsoon season and 1461 ha in pre-monsoon season.

Table 26: Area estimates of wetlands in the Delhi

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 | Lake/Pond | 2 | 49 | 1.77 | 42 | 28 |
| 2 | 1105 | Waterlogged | 15 | 380 | 13.71 | 80 | 135 |
| 3 | 1106 | River/Stream | 2 | 1074 | 38.76 | 756 | 849 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 4 | 1201 | Reservoir/Barrage | 1 | 479 | 17.29 | 173 | 234 |
| 5 | 1202 | Tank/Pond | 66 | 260 | 9.38 | 180 | 182 |
| 6 | 1203 | Waterlogged | 12 | 228 | 8.23 | 51 | 98 |
| | | **Sub-Total** | **98** | **2470** | **89.14** | **1282** | **1526** |
| | | Wetlands (<2.25 ha) | 301 | 301 | 10.86 | - | - |
| | | **Total** | **399** | **2771** | **100.00** | **1282** | **1526** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 700 | 835 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 1239 | 1461 |
| Moderate | 43 | 65 |
| High | - | - |

### District-wise wetland area estimates in Delhi

Delhi is divided into nine districts. They are North, Central, East, West, South, New Delhi, North-East, North-West, and South-East. Each district is headed by a Deputy Commissioner. All Deputy Commissioners report to the Divisional Magistrate. Every district has three sub-divisions headed by a sub-divisional magistrate.

District-wise distribution of wetlands showed that total wetland per cent area (0.93) is much less compare to country average. South district has 2.89 per cent of geographic area under wetland. The other three districts are: North West, North and East with around 1.70, 7.28 and 6.68 per cent area under wetland respectively.

New Delhi and South West districts have the lowest area under wetland. Wetland category of reservoir/barrage was observed only in South and East districts, mainly due to the presence of the Okhla barrage. District-wise wetland area estimates is given in Table 27. Figure 26 shows district-wise graphical distribution of wetlands. District-wise area of wetlands (type-wise) in the state is given in Table 28.

South West and North West district have 111 and 108 small wetlands (<2.25 ha) respectively, While other districts have less wetlands.

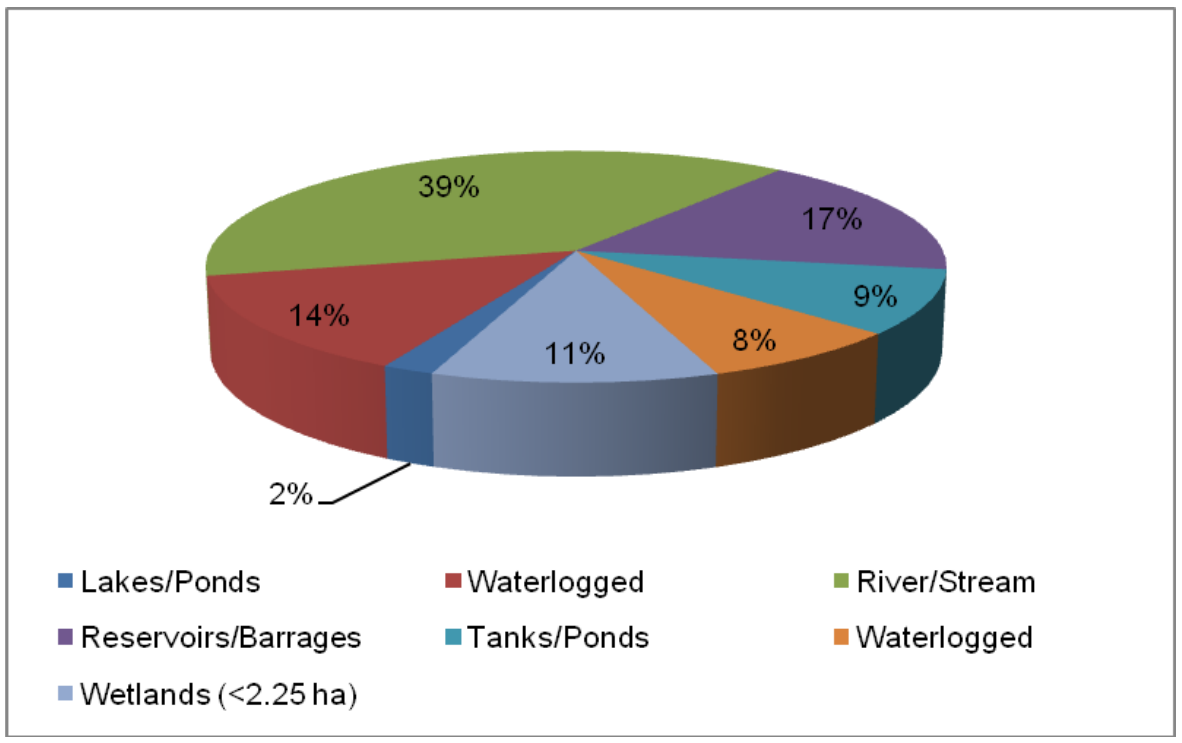



Figure 25: Type-wise wetland distribution in Delhi

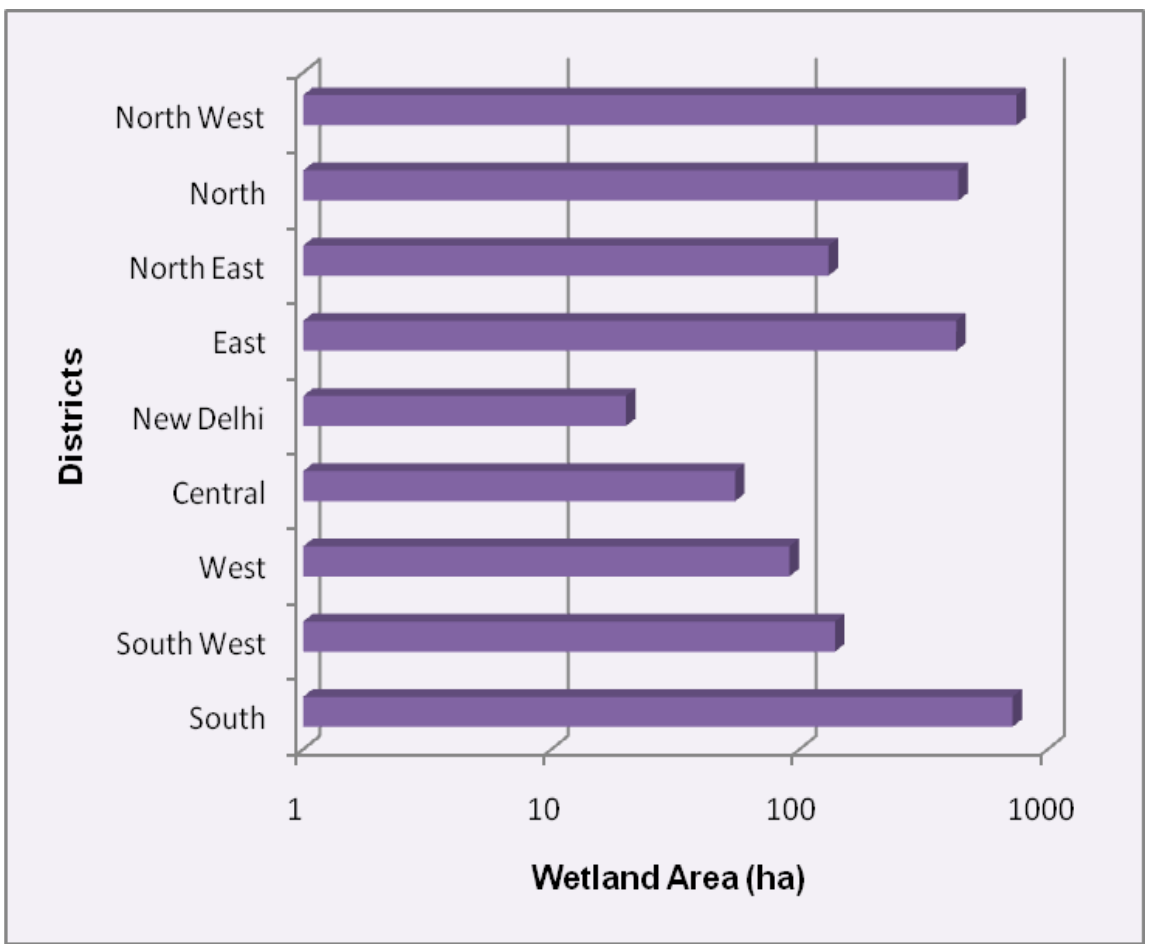



Figure 26: District-wise graphical distribution of wetlands in Delhi

Table 27: District-wise area of wetlands in Delhi

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | North West | 440 | 748 | 26.99 | 1.70 | 232 | 291 | 273 | 258 | 227 | 5 | - | 283 | 8 | - |
| 2 | North | 60 | 437 | 15.77 | 7.28 | 324 | 338 | 21 | 82 | 319 | 5 | - | 331 | 7 | - |
| 3 | North East | 60 | 131 | 4.73 | 2.18 | 86 | 107 | - | 7 | 86 | - | - | 107 | - | - |
| 4 | East | 64 | 428 | 15.45 | 6.69 | 207 | 233 | 170 | 186 | 206 | 1 | - | 233 | - | - |
| 5 | New Delhi | 1483 | 20 | 0.72 | 0.01 | 17 | 17 | - | - | 17 | - | - | 17 | - | - |
| 6 | Central | 60 | 55 | 1.98 | 0.92 | 47 | 48 | 3 | 2 | 36 | 11 | - | 33 | 15 | - |
| 7 | West | 129 | 91 | 3.28 | 0.71 | 38 | 43 | 20 | 15 | 18 | 20 | - | 10 | 33 | - |
| 8 | South West | 420 | 139 | 5.02 | 0.33 | 26 | 23 | 3 | 5 | 25 | 1 | - | 21 | 2 | - |
| 9 | South | 250 | 722 | 26.06 | 2.89 | 305 | 426 | 210 | 280 | 305 | - | - | 426 | - | - |
| | **Total** | **2966** | **2771** | **100.00** | **0.93** | **1282** | **1526** | **700** | **835** | **1239** | **43** | **-** | **1461** | **65** | **-** |

* - Data source : http://nic.in

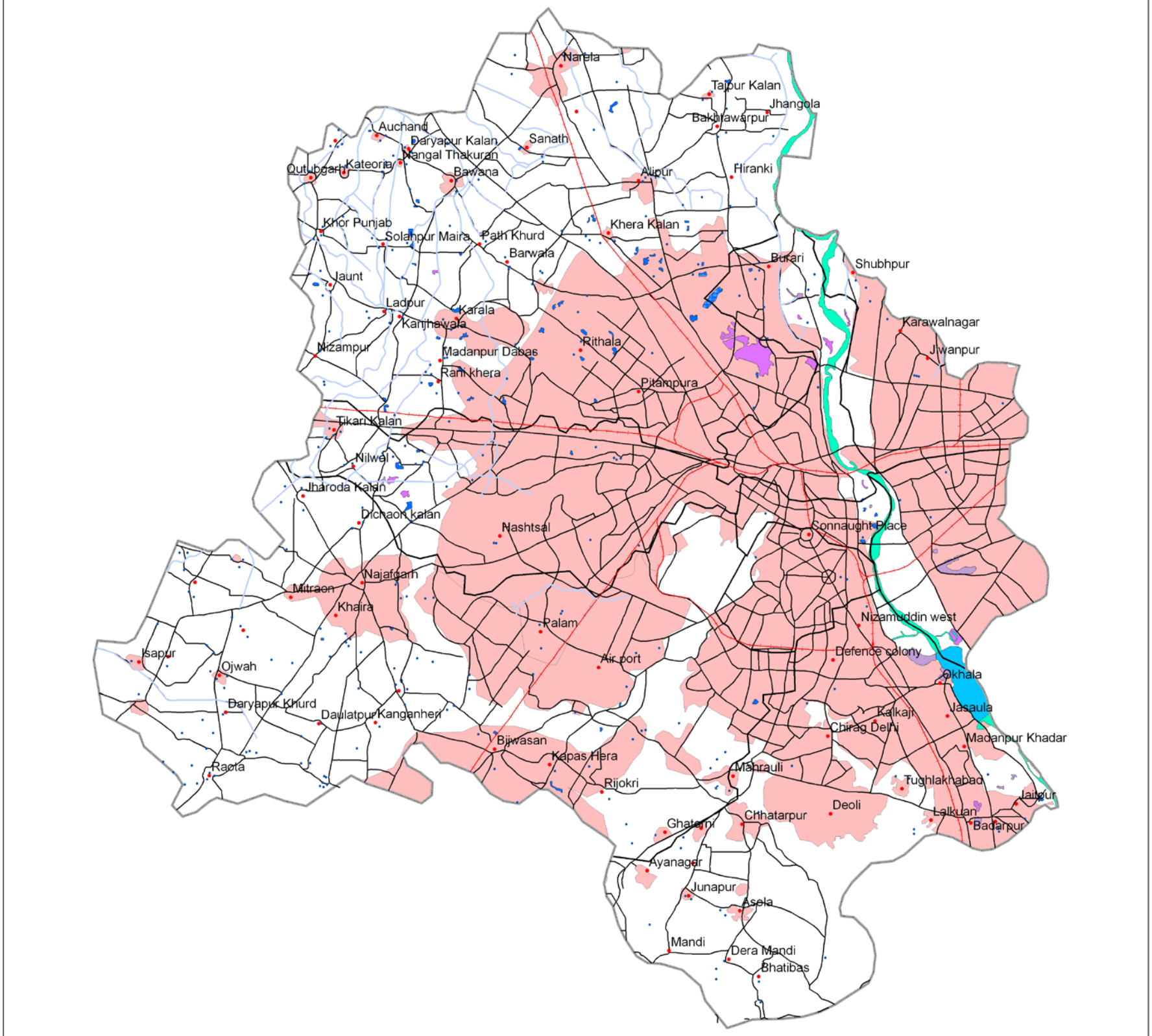
Table 28: District-wise area of wetlands (type-wise) in Delhi

| District code | District | Geographic area * | Wetland Type | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1105 | 1106 | 1201 | 1202 | 1203 | | | |
| | | | Lake/ pond | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | North West | 440 | 21 | 285 | 152 | - | 179 | 3 | 640 | 108 | 748 |
| 2 | North | 60 | 28 | 34 | 349 | - | 4 | 12 | 427 | 10 | 437 |
| 3 | North East | 60 | - | - | 123 | - | - | - | 123 | 8 | 131 |
| 4 | East | 64 | - | 26 | 231 | 87 | - | 84 | 428 | - | 428 |
| 5 | New Delhi | 1483 | - | - | 17 | - | - | - | 17 | 3 | 20 |
| 6 | Central | 60 | - | - | 33 | - | 15 | 2 | 50 | 5 | 55 |
| 7 | West | 129 | - | 23 | - | - | 30 | 8 | 61 | 30 | 91 |
| 8 | South West | 420 | - | - | - | - | 28 | - | 28 | 111 | 139 |
| 9 | South | 250 | - | 11 | 169 | 392 | 4 | 120 | 696 | 26 | 722 |
| | **Total** | **2966** | **49** | **379** | **1074** | **479** | **260** | **229** | **2470** | **301** | **2771** |

* - Data source : http://nic.in

State : Delhi

# WETLAND MAP

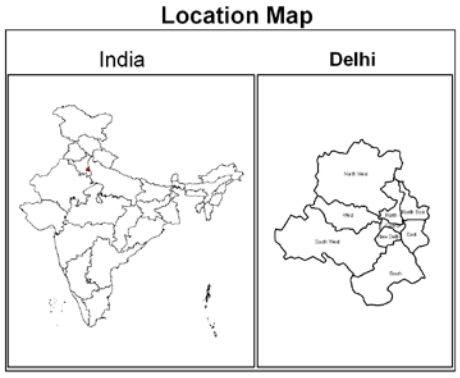



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- State Boundary
- Towns/Settlements

**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
Haryana Space Applications Centre, Hisar

**Sponsored By:**
Ministry of Environment and Forests
Government of India

Plate 29 : Wetland map of Delhi

### 8.1.8 Rajasthan

Total 12625 wetlands have been mapped at 1:50,000 scale in the state. In addition, 34123 small wetlands (< 2.25 ha) have also been identified. Total wetland area estimated is 782314 ha that is around 2.29 per cent of the geographic area (Table 29). River/Stream contributed 39.95% to the total wetland area. The reservoir/barrage with 190600 ha (24.36% area) is the second major wetland category. Area under tank/pond is 151027 ha (19.31%). Graphical distribution of wetland type is shown in Figure 27.

Open water spread is more during in post-monsoon (368129 ha) than during pre-monsoon (158696 ha). Aquatic vegetation is slightly more during pre-monsoon (5166 ha) than in post-monsoon (4102 ha). The qualitative turbidity of water is low in both the seasons. Wetland map of the state is shown in Plate 30.

Table 29: Area estimates of wetlands in Rajasthan

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 | Lake/Pond | 65 | 38269 | 4.89 | 28122 | 21711 |
| 2 | 1105 | Waterlogged | 61 | 16856 | 2.15 | 12933 | 5091 |
| 3 | 1106 | River/Stream | 648 | 312570 | 39.95 | 52080 | 28021 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 4 | 1201 | Reservoir/Barrage | 979 | 190600 | 24.36 | 165938 | 71546 |
| 5 | 1202 | Tank/Pond | 10731 | 151027 | 19.31 | 100594 | 18659 |
| 6 | 1203 | Waterlogged | 101 | 7636 | 0.98 | 4423 | 1284 |
| 7 | 1204 | Salt pan | 39 | 12283 | 1.57 | 4030 | 2433 |
| | | **Total - Inland** | **12624** | **729241** | **93.22** | **368120** | **148745** |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 8 | 2104 | Intertidal mud flat | 1 | 18950 | 2.42 | 9 | 9951 |
| | | **Total - Coastal** | **1** | **18950** | **2.42** | **9** | **9951** |
| | | **Sub-Total** | **12625** | **748191** | **95.64** | **368129** | **158696** |
| | | Wetlands (<2.25 ha) | 34123 | 34123 | 4.36 | - | - |
| | | **Total** | **46748** | **782314** | **100.00** | **368129** | **158696** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 4102 | 5166 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 294322 | 107553 |
| Moderate | 40945 | 7390 |
| High | 32862 | 43753 |

**District-wise wetland area estimates in Rajasthan**

There are 32 districts in the state. The wetlands occupy as high as 6.94% of geographic area (Bhilwara), and as low as 0.08% (Churu). Reservoir/Barrage and tank/pond are the dominate wetland types in almost all districts. Jalore is the only district containing coastal wetlands, which includes mudflats. District-wise wetland area estimates is given in Table 30 and graphical distribution of wetlands is shown in Figure 28. District-wise area of wetlands (type-wise) in the state is given in Table 31.

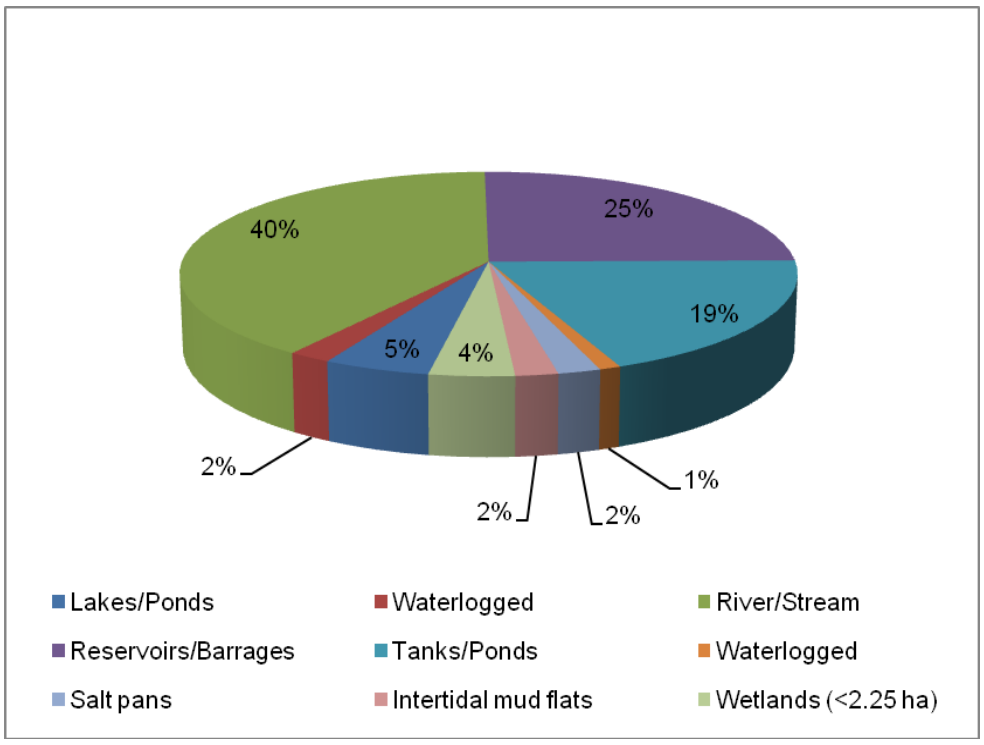



Figure 27: Type-wise wetland distribution in Rajasthan

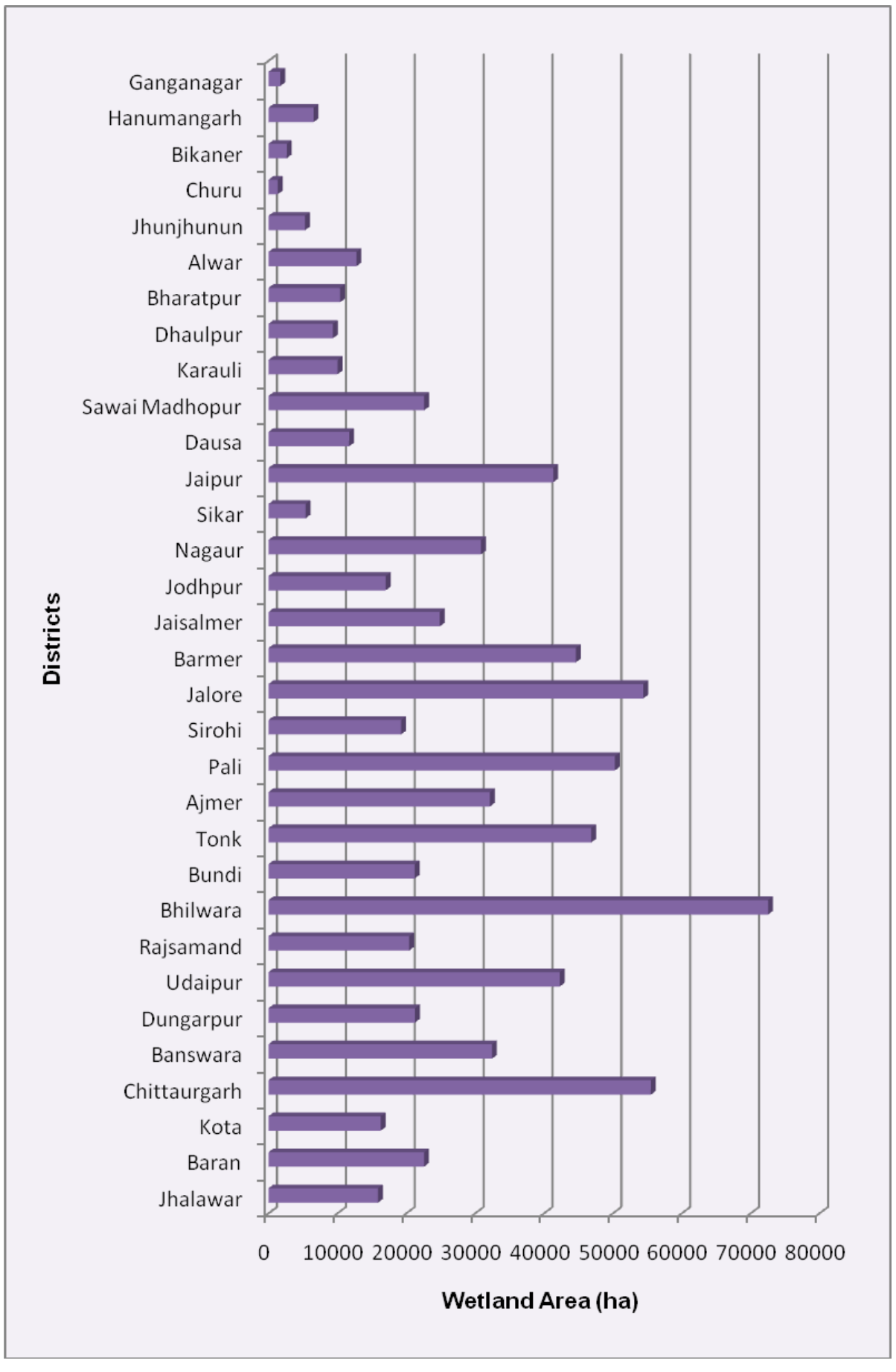



Figure 28: District-wise graphical distribution of wetlands in Rajasthan

Table 30: District-wise area of wetlands in Rajasthan

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Ganganagar | 7984 | 1708 | 0.22 | 0.21 | 175 | 158 | - | - | 100 | 30 | 45 | 158 | - | - |
| 2 | Hanumangarh | 12645 | 6549 | 0.84 | 0.52 | 513 | 2197 | - | - | 435 | - | 78 | 2171 | - | 26 |
| 3 | Bikaner | 27244 | 2666 | 0.34 | 0.10 | 778 | 255 | - | - | 759 | - | 19 | 255 | - | - |
| 4 | Churu | 16830 | 1368 | 0.17 | 0.08 | 108 | 66 | - | - | 98 | 5 | 5 | 56 | - | 10 |
| 5 | Jhunjhunun | 5928 | 5319 | 0.68 | 0.90 | 57 | 60 | - | - | 16 | - | 41 | 23 | - | 37 |
| 6 | Alwar | 8380 | 12774 | 1.63 | 1.52 | 3192 | 747 | 16 | - | 2091 | 219 | 882 | 615 | - | 132 |
| 7 | Bharatpur | 5066 | 10415 | 1.33 | 2.06 | 2959 | 619 | 2250 | 4 | 2716 | 66 | 177 | 446 | 173 | - |
| 8 | Dhaulpur | 3084 | 9370 | 1.20 | 3.04 | 4296 | 3108 | 86 | 58 | 4269 | - | 27 | 2970 | - | 138 |
| 9 | Karauli | 5530 | 10042 | 1.28 | 1.82 | 4384 | 2457 | 29 | 59 | 4339 | 15 | 30 | 2168 | 268 | 21 |
| 10 | Sawai Madhopur | 4500 | 22606 | 2.89 | 5.02 | 7121 | 3395 | 7 | 10 | 6162 | 191 | 768 | 3088 | - | 307 |
| 11 | Dausa | 3429 | 11720 | 1.50 | 3.42 | 1281 | 485 | - | 22 | 512 | 254 | 515 | 107 | 2 | 376 |
| 12 | Jaipur | 11152 | 41352 | 5.29 | 3.71 | 10854 | 8673 | 82 | 13 | 2506 | 4864 | 3484 | 772 | 120 | 7781 |
| 13 | Sikar | 7732 | 5388 | 0.69 | 0.70 | 1192 | 473 | - | 28 | 337 | - | 855 | 154 | - | 319 |
| 14 | Nagaur | 17718 | 30876 | 3.95 | 1.74 | 12971 | 10080 | - | - | 894 | 4275 | 7802 | 203 | 91 | 9786 |
| 15 | Jodhpur | 22850 | 17032 | 2.18 | 0.75 | 1381 | 254 | - | - | 1107 | - | 274 | 254 | - | - |
| 16 | Jaisalmer | 38401 | 24876 | 3.18 | 0.65 | 16988 | 5526 | - | - | 14655 | 1711 | 622 | 5526 | - | - |
| 17 | Barmer | 28387 | 44638 | 5.71 | 1.57 | 13769 | 5925 | - | 150 | 13575 | - | 194 | 1979 | 36 | 3910 |
| 18 | Jalore | 10640 | 54440 | 6.96 | 5.12 | 9024 | 8992 | 43 | 42 | 7263 | 121 | 1640 | 634 | 140 | 8218 |
| 19 | Sirohi | 5136 | 19259 | 2.46 | 3.75 | 6147 | 739 | - | 348 | 5535 | 272 | 340 | 234 | 505 | - |
| 20 | Pali | 12387 | 50304 | 6.43 | 4.06 | 16823 | 2173 | 141 | 463 | 10867 | 2907 | 3049 | 1883 | 84 | 206 |
| 21 | Ajmer | 8481 | 32167 | 4.11 | 3.79 | 14663 | 2928 | 153 | 98 | 12562 | 1010 | 1091 | 1360 | 32 | 1536 |
| 22 | Tonk | 7194 | 46875 | 5.99 | 6.52 | 26016 | 15337 | 6 | - | 23594 | 576 | 1846 | 12882 | 370 | 2085 |
| 23 | Bundi | 5550 | 21238 | 2.71 | 3.83 | 12701 | 4104 | 108 | 36 | 9583 | 1013 | 2105 | 3498 | 127 | 479 |
| 24 | Bhilwara | 10455 | 72563 | 9.27 | 6.94 | 46994 | 4377 | 37 | 1125 | 35667 | 8888 | 2439 | 4130 | 148 | 99 |
| 25 | Rajsamand | 3853 | 20435 | 2.61 | 5.30 | 11445 | 2355 | 19 | 146 | 10504 | 690 | 251 | 1062 | 736 | 557 |
| 26 | Udaipur | 13430 | 42292 | 5.41 | 3.15 | 26524 | 13066 | 75 | 190 | 25514 | 869 | 141 | 11848 | 754 | 464 |
| 27 | Dungarpur | 3770 | 21278 | 2.72 | 5.64 | 15625 | 8537 | 120 | 367 | 15153 | 452 | 20 | 8526 | - | 11 |
| 28 | Banswara | 5037 | 32468 | 4.15 | 6.45 | 24334 | 11620 | 137 | 624 | 19572 | 4676 | 86 | 5768 | 167 | 5685 |
| 29 | Chittaurgarh | 10856 | 55537 | 7.10 | 5.12 | 45192 | 27867 | 126 | 1128 | 41020 | 3340 | 821 | 26410 | 114 | 1343 |
| 30 | Kota | 5446 | 16316 | 2.09 | 3.00 | 10055 | 5709 | 140 | 177 | 7634 | 1735 | 686 | 5408 | 219 | 82 |
| 31 | Baran | 6955 | 22602 | 2.89 | 3.25 | 10553 | 3114 | 365 | 8 | 7479 | 937 | 2148 | 2281 | 741 | 92 |
| 32 | Jhalawar | 6219 | 15911 | 2.03 | 2.56 | 10014 | 3300 | 162 | 70 | 7804 | 1829 | 381 | 684 | 2563 | 53 |
| | **Total** | **342269** | **782384** | **100.00** | **2.29** | **368129** | **158696** | **4102** | **5166** | **294322** | **40945** | **32862** | **107553** | **7390** | **43753** |

* Data Source: http://nic.in

Table 31: District-wise area of wetlands (type-wise) in Rajasthan

| District code | District | Geographic area * | Wetland Type | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1105 | 1106 | 1201 | 1202 | 1203 | 1204 | 2104 | | | |
| | | | Lake/ pond | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | Salt pan | Intertidal mud flat | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Ganganagar | 7984 | - | - | - | - | 360 | - | - | - | 360 | 1346 | 1706 |
| 2 | Hanumangarh | 12645 | - | - | 3966 | - | 1397 | - | - | - | 5363 | 1186 | 6549 |
| 3 | Bikaner | 27244 | - | - | - | 190 | 750 | 543 | 5 | - | 1488 | 1178 | 2666 |
| 4 | Churu | 16830 | - | - | 23 | 154 | 117 | - | 683 | - | 977 | 391 | 1368 |
| 5 | Jhunjhunun | 5928 | - | - | 4929 | - | 80 | - | - | - | 5009 | 310 | 5319 |
| 6 | Alwar | 8380 | 798 | - | 7066 | 949 | 2891 | - | - | - | 11704 | 1070 | 12774 |
| 7 | Bharatpur | 5066 | - | - | 3067 | 1217 | 1568 | 3042 | - | - | 8894 | 1521 | 10415 |
| 8 | Dhaulpur | 3084 | - | - | 6786 | 1551 | 691 | - | - | - | 9028 | 342 | 9370 |
| 9 | Karauli | 5530 | 99 | - | 6270 | 1231 | 1679 | - | - | - | 9279 | 763 | 10042 |
| 10 | Sawai Madhopur | 4500 | 22 | - | 15981 | 3957 | 1860 | - | - | - | 21820 | 786 | 22606 |
| 11 | Dausa | 3429 | - | - | 8685 | 1299 | 1513 | - | - | - | 11497 | 223 | 11720 |
| 12 | Jaipur | 11152 | 8350 | - | 23598 | 2926 | 3774 | - | 1650 | - | 40298 | 1054 | 41352 |
| 13 | Sikar | 7732 | - | - | 3359 | 1264 | 369 | - | 26 | - | 5018 | 370 | 5388 |
| 14 | Nagaur | 17718 | 16024 | - | 7016 | 1352 | 1450 | - | 3030 | - | 28872 | 2004 | 30876 |
| 15 | Jodhpur | 22850 | 81 | - | 8284 | 725 | 1798 | - | 4471 | - | 15359 | 1673 | 17032 |
| 16 | Jaisalmer | 38401 | 81 | 7826 | 2367 | 97 | 8976 | 3394 | - | - | 22741 | 2135 | 24876 |
| 17 | Barmer | 28387 | 155 | 4283 | 19700 | 187 | 11189 | 657 | 1589 | 5294 | 43054 | 1584 | 44638 |
| 18 | Jalore | 10640 | - | 4741 | 27601 | 3813 | 2864 | - | 357 | 13656 | 53032 | 1408 | 54440 |
| 19 | Sirohi | 5136 | 132 | - | 10887 | 4565 | 2960 | - | - | - | 18544 | 715 | 19259 |
| 20 | Pali | 12387 | 323 | 6 | 27216 | 13178 | 8144 | - | - | - | 48867 | 1437 | 50304 |
| 21 | Ajmer | 8481 | 1464 | - | 6928 | 6599 | 14682 | - | 472 | - | 30145 | 2022 | 32167 |
| 22 | Tonk | 7194 | 39 | - | 12126 | 22692 | 10169 | - | - | - | 45026 | 1849 | 46875 |
| 23 | Bundi | 5550 | - | - | 10205 | 6905 | 3529 | - | - | - | 20639 | 599 | 21238 |
| 24 | Bhilwara | 10455 | 1293 | - | 18004 | 19020 | 31970 | - | - | - | 70287 | 2213 | 72500 |
| 25 | Rajsamand | 3853 | 1367 | - | 6805 | 6518 | 5008 | - | - | - | 19698 | 732 | 20430 |
| 26 | Udaipur | 13430 | 6908 | - | 14373 | 13944 | 6295 | - | - | - | 41520 | 772 | 42292 |
| 27 | Dungarpur | 3770 | 363 | - | 4865 | 10829 | 4403 | - | - | - | 20460 | 818 | 21278 |
| 28 | Banswara | 5037 | - | - | 9956 | 18858 | 3211 | - | - | - | 32025 | 443 | 32468 |
| 29 | Chittaurgarh | 10856 | 226 | - | 9360 | 35786 | 9145 | - | - | - | 54517 | 1020 | 55537 |
| 30 | Kota | 5446 | 447 | - | 10780 | 1238 | 3171 | - | - | - | 15636 | 680 | 16316 |
| 31 | Baran | 6955 | 51 | - | 14570 | 4479 | 2635 | - | - | - | 21735 | 867 | 22602 |
| 32 | Jhalawar | 6219 | 46 | - | 7797 | 5077 | 2379 | - | - | - | 15299 | 612 | 15911 |
| | **Total** | **92691** | **38269** | **16856** | **312570** | **190600** | **151027** | **7636** | **12283** | **18950** | **748191** | **34123** | **782314** |

* Data Source: http://nic.in

State : Rajasthan

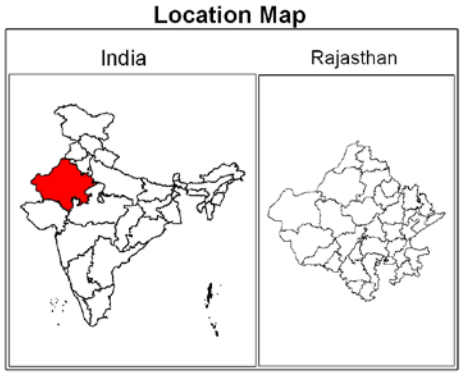
# WETLAND MAP


| 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 (<2.25ha)
- Drainage (line)
- Major Roads
- Railway
- Settlements
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

**Location Map**




60 30 0 60 120 Kilometers

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

**Prepared By :**
Space Applications Centre (ISRO), Ahmedabad
and
State Remote Sensing Application Centre, Jodhpur

**Sponsored By:**
Ministry of Environment and Forests
Government of India

Plate 30: Wetland map of Rajasthan

### 8.1.9 Uttar Pradesh

Total 23890 wetlands have been mapped at 1:50,000 scale in the state. In addition, 97352 smaller wetlands (smaller than 2.25 ha) are also identified. Total wetland area estimated is 1242530 ha; this is around 5.16 per cent of the geographic area (Table 32). Graphical distribution of wetland type is shown in Figure 29.

The natural wetlands dominated the area with around 74 per cent share. The major natural wetland types observed in the state are: river/stream, lake/pond, ox-bow lake, riverine wetland and waterlogged areas. The rivers and streams which are perennial, contribute around 49 per cent of wetland area of the state. Reservoir/Barrage and waterlogged areas dominated the man-made wetlands.

Aquatic vegetation is more during post-monsoon season with 219289 ha during post-monsoon and 129228 ha during pre-monsoon season. The open water area of the wetlands decreased by around 28.0 per cent in pre-monsoon compared to post-monsoon season. This is mainly due to change in water spread observed in two major types: river/stream (6.0%) and reservoir/barrage (37.0%). The turbidity of open water is in general moderate and low in both the seasons. Wetland map of the state is shown in Plate 31.

Table 32: Area estimates of wetlands in Uttar Pradesh

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 | Lake/Pond | 3684 | 122531 | 9.86 | 42276 | 32030 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 1672 | 51371 | 4.13 | 22104 | 14422 |
| 3 | 1103 | High altitude wetland | - | - | - | - | - |
| 4 | 1104 | Riverine wetland | 1638 | 61100 | 4.92 | 34229 | 16968 |
| 5 | 1105 | Waterlogged | 3951 | 76263 | 6.14 | 41211 | 21227 |
| 6 | 1106 | River/Stream | 1278 | 607315 | 48.88 | 376712 | 315457 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 1608 | 105641 | 8.50 | 100309 | 62883 |
| 8 | 1202 | Tank/Pond | 5441 | 33263 | 2.68 | 19483 | 11410 |
| 9 | 1203 | Waterlogged | 4618 | 87694 | 7.06 | 53892 | 20597 |
| 10 | 1204 | Salt pan | - | - | - | - | - |
| | | **Sub-Total** | **23890** | **1145178** | **92.17** | **690216** | **494994** |
| | | Wetlands (<2.25 ha) | 97352 | 97352 | 7.83 | - | - |
| | | **Total** | **121242** | **1242530** | **100.00** | **690216** | **494994** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 219289 | 129228 |

| | | |
|---|---|---|
| **Area under turbidity levels** | | |
| Low | 212518 | 190992 |
| Moderate | 415651 | 216623 |
| High | 62047 | 87379 |

**District-wise wetland area estimates in Uttar Pradesh**

The state has seventy-one districts. The geographic area of districts varied from 1015 to 7680 sq.km. District-wise distribution of wetlands showed that there are many districts having wetland area more than 5 per cent of their geographic area. Wetland area varied from 11.7 per cent (Bahraich district) to as low as 1.22 per cent (Hathras district) of geographic area. In terms of wetland area, Sonbhadra district has highest share (5.08 per cent) of total wetland area of the state. This is mainly due to a number of reservoirs present in this district. There are 699 reservoir/barrage in this district, including Rihand, constructed over Rihand river, that account for 66 per cent of total wetland area of the district. The other major contribution is from river/stream, Son river being the main one. Thus, this is mainly a wetland district belonging to man-made category.

Baghpat and Hathras districts have the least share of wetlands. The districts with very high concentration of small wetlands (< 2.25 ha) are Siddharthnagar, Azamgarh and Jaunpur with 3657, 3406 and 3301 numbers respectively, while Baghpat district has the lowest with 365 such wetlands.

District-wise wetland area estimates are given in Table 33 and Figure 30. District-wise area of wetlands (type-wise) in the state is given in Table 34.

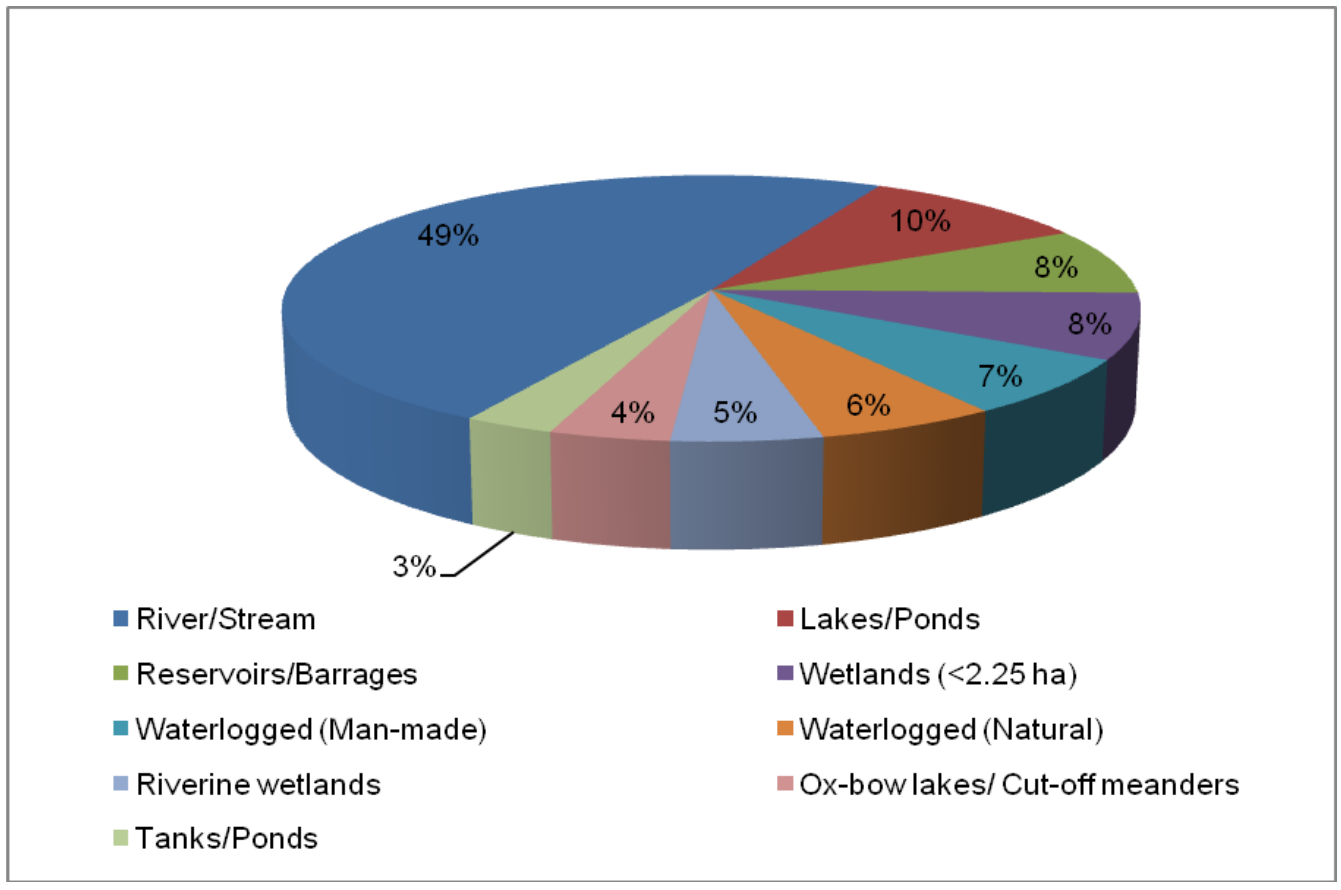



Figure 29: Type-wise wetland distribution in Uttar Pradesh

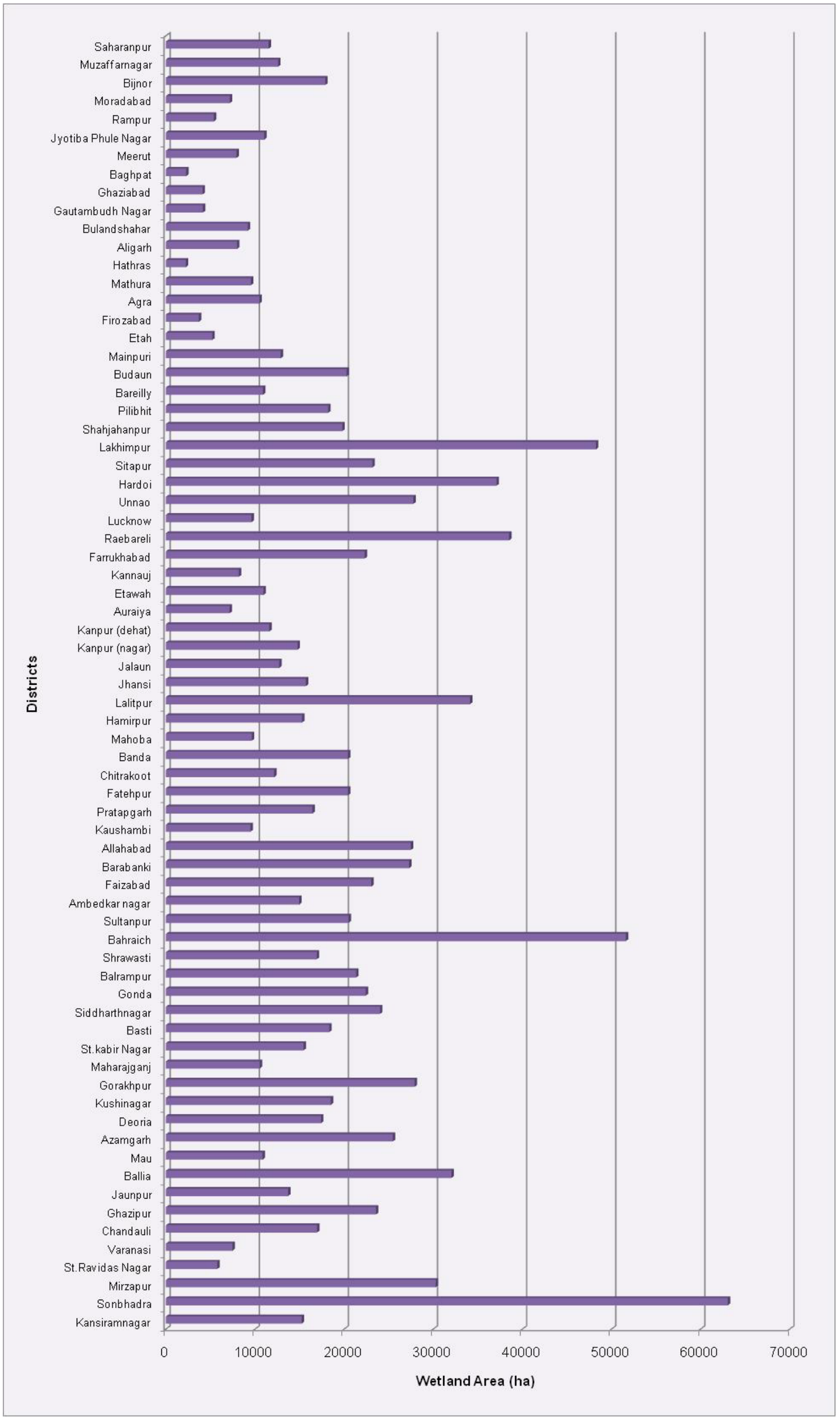



Figure 30: District-wise graphical distribution of wetlands in Uttar Pradesh

Table 33: District-wise area of wetlands in Uttar Pradesh

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Saharanpur | 3689 | 11537 | 0.93 | 3.13 | 4644 | 4287 | 71 | 59 | 791 | 3792 | 61 | 56 | 4104 | 127 |
| 2 | Muzaffarnagar | 4008 | 12589 | 1.01 | 3.14 | 7343 | 4155 | 2893 | 4754 | 1190 | 5882 | 271 | 576 | 2959 | 620 |
| 3 | Bijnor | 4561 | 17879 | 1.44 | 3.92 | 10883 | 8698 | 1476 | 1306 | 2016 | 7551 | 1316 | 1664 | 4298 | 2736 |
| 4 | Moradabad | 3718 | 7174 | 0.58 | 1.93 | 3815 | 2767 | 386 | 68 | 477 | 3250 | 88 | 585 | 1210 | 972 |
| 5 | Rampur | 2367 | 5376 | 0.43 | 2.27 | 3470 | 2640 | 150 | 74 | 263 | 3202 | 5 | 139 | 2002 | 499 |
| 6 | Jyotiba Phule Nagar | 2249 | 11026 | 0.89 | 4.90 | 4875 | 4437 | 339 | 227 | 697 | 4091 | 87 | 769 | 3647 | 20 |
| 7 | Meerut | 2590 | 7922 | 0.64 | 3.06 | 5079 | 2829 | 826 | 1951 | 2478 | 2597 | 4 | 665 | 2150 | 14 |
| 8 | Baghpat | 1321 | 2277 | 0.18 | 1.72 | 1305 | 1362 | 19 | 11 | 892 | 413 | - | 234 | 1128 | - |
| 9 | Ghaziabad | 2590 | 4116 | 0.33 | 1.59 | 2567 | 1911 | 375 | 101 | 772 | 1653 | 142 | 222 | 1675 | 13 |
| 10 | Gautambudh Nagar | 1442 | 4153 | 0.33 | 2.88 | 2567 | 1464 | 720 | 295 | 1480 | 1079 | 8 | 132 | 1002 | 330 |
| 11 | Bulandshahar | 2910 | 9193 | 0.74 | 3.16 | 5142 | 3498 | 829 | 290 | 1224 | 3833 | 85 | 438 | 2893 | 167 |
| 12 | Aligarh | 3650 | 7984 | 0.64 | 2.19 | 4977 | 2465 | 953 | 963 | 1360 | 3602 | 15 | 697 | 1245 | 523 |
| 13 | Hathras | 1840 | 2236 | 0.18 | 1.22 | 828 | 357 | 765 | 683 | 108 | 710 | 10 | 15 | 323 | 19 |
| 14 | Mathura | 3340 | 9536 | 0.77 | 2.86 | 5888 | 4438 | 467 | 199 | 820 | 4949 | 119 | 196 | 1056 | 3186 |
| 15 | Agra | 4027 | 10502 | 0.85 | 2.61 | 6420 | 6746 | 532 | 481 | 218 | 5703 | 499 | 197 | 3035 | 3514 |
| 16 | Firozabad | 2361 | 3695 | 0.30 | 1.57 | 1657 | 1499 | 215 | 78 | 85 | 1570 | 2 | 2 | 46 | 1451 |
| 17 | Etah | 2486 | 5204 | 0.42 | 2.09 | 2526 | 1284 | 1859 | 891 | 200 | 2150 | 176 | 76 | 1051 | 157 |
| 18 | Mainpuri | 2760 | 12887 | 1.04 | 4.67 | 6781 | 3192 | 5491 | 1431 | 2769 | 4002 | 10 | 1181 | 1870 | 141 |
| 19 | Budaun | 5168 | 20288 | 1.63 | 3.93 | 10267 | 6150 | 2448 | 1985 | 911 | 8779 | 577 | 505 | 4747 | 898 |
| 20 | Bareilly | 4120 | 10896 | 0.88 | 2.64 | 7381 | 4640 | 1101 | 545 | 620 | 6532 | 229 | 427 | 3204 | 1009 |
| 21 | Pilibhit | 3499 | 18216 | 1.47 | 5.21 | 12041 | 11046 | 1418 | 686 | 3919 | 8122 | - | 8121 | 2925 | - |
| 22 | Shahjahanpur | 4575 | 19803 | 1.59 | 4.33 | 11718 | 6292 | 4239 | 1948 | 1543 | 10175 | - | 1263 | 4122 | 907 |
| 23 | Lakhimpur | 7680 | 48267 | 3.88 | 6.28 | 26859 | 25958 | 3101 | 2982 | 9404 | 17455 | - | 21618 | 4331 | 9 |
| 24 | Sitapur | 5743 | 23174 | 1.87 | 4.04 | 13475 | 11018 | 4716 | 2429 | 9253 | 4222 | - | 9838 | 1180 | - |
| 25 | Hardoi | 5986 | 37108 | 2.99 | 6.20 | 15995 | 9868 | 12426 | 6480 | 3067 | 12875 | 53 | 3071 | 5935 | 862 |
| 26 | Unnao | 4558 | 27759 | 2.23 | 6.09 | 11945 | 8898 | 7367 | 3187 | 3772 | 7482 | 691 | 2625 | 5850 | 423 |
| 27 | Lucknow | 2528 | 9607 | 0.77 | 3.80 | 5090 | 3698 | 3573 | 1363 | 3565 | 1353 | 172 | 2266 | 1101 | 331 |
| 28 | Raebareli | 4609 | 38522 | 3.10 | 8.36 | 20075 | 11432 | 10249 | 4565 | 7269 | 12140 | 666 | 3711 | 7277 | 444 |
| 29 | Farrukhabad | 2181 | 22309 | 1.80 | 10.23 | 13961 | 7544 | 1759 | 516 | 2072 | 11502 | 387 | 1086 | 6193 | 265 |
| 30 | Kannauj | 2093 | 8190 | 0.66 | 3.91 | 4457 | 2421 | 2403 | 712 | 824 | 3633 | - | 202 | 2037 | 182 |
| 31 | Etawah | 2311 | 10946 | 0.88 | 4.74 | 5646 | 4811 | 1422 | 413 | 1841 | 3797 | 8 | 2435 | 717 | 1659 |
| 32 | Auraiya | 2015 | 7148 | 0.58 | 3.55 | 4059 | 3015 | 939 | 200 | 1091 | 2930 | 38 | 1681 | 55 | 1279 |
| 33 | Kanpur (dehat) | 3021 | 11603 | 0.93 | 3.84 | 5336 | 4367 | 2554 | 892 | 1460 | 3821 | 55 | 2052 | 750 | 1565 |
| 34 | Kanpur (nagar) | 3155 | 14770 | 1.19 | 4.68 | 7069 | 6061 | 1191 | 472 | 808 | 6162 | 99 | 739 | 4146 | 1176 |
| 35 | Jalaun | 4565 | 12719 | 1.02 | 2.79 | 7286 | 6375 | 203 | 94 | 3974 | 3033 | 279 | 3596 | 60 | 2719 |
| 36 | Jhansi | 5024 | 15711 | 1.26 | 3.13 | 9321 | 7295 | 2271 | 1144 | 8147 | 937 | 237 | 6190 | 953 | 152 |

Table 33: District-wise area of wetlands in Uttar Pradesh

Cont...

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 37 | Lalitpur | 5039 | 34122 | 2.75 | 6.77 | 28405 | 12657 | 1261 | 671 | 27352 | 620 | 433 | 12449 | 145 | 63 |
| 38 | Hamirpur | 4282 | 15283 | 1.23 | 3.57 | 8726 | 7158 | 533 | 259 | 6363 | 2342 | 21 | 5652 | 71 | 1435 |
| 39 | Mahoba | 2884 | 9647 | 0.78 | 3.35 | 7781 | 5681 | 862 | 785 | 7192 | 568 | 21 | 5523 | 137 | 21 |
| 40 | Banda | 4532 | 20432 | 1.64 | 4.51 | 11210 | 7209 | 1252 | 376 | 6128 | 5082 | - | 3271 | 1294 | 2644 |
| 41 | Chitrakoot | 3092 | 12153 | 0.98 | 3.93 | 8701 | 5245 | 770 | 155 | 3081 | 5296 | 324 | 1201 | 2073 | 1971 |
| 42 | Fatehpur | 4152 | 20432 | 1.64 | 4.92 | 10788 | 6690 | 2772 | 251 | 1516 | 9220 | 52 | 921 | 2741 | 3028 |
| 43 | Pratapgarh | 3717 | 16441 | 1.32 | 4.42 | 8442 | 7992 | 3038 | 778 | 2638 | 5602 | 202 | 1387 | 6303 | 302 |
| 44 | Kaushambi | 2124 | 9485 | 0.76 | 4.47 | 4233 | 3139 | 826 | 316 | 210 | 4020 | 3 | 175 | 1325 | 1639 |
| 45 | Allahabad | 5137 | 27487 | 2.21 | 5.35 | 16088 | 17748 | 3701 | 1457 | 2395 | 13596 | 97 | 1417 | 14197 | 2134 |
| 46 | Barabanki | 4402 | 27290 | 2.20 | 6.20 | 14238 | 6160 | 6364 | 2417 | 5366 | 8642 | 230 | 4768 | 1333 | 59 |
| 47 | Faizabad | 2174 | 23050 | 1.86 | 10.60 | 8711 | 7472 | 6796 | 2278 | 1034 | 6950 | 727 | 4782 | 1542 | 1148 |
| 48 | Ambedkar nagar | 2337 | 14947 | 1.20 | 6.40 | 5914 | 5559 | 4345 | 2867 | 1056 | 4851 | 7 | 4122 | 1430 | 7 |
| 49 | Sultanpur | 4436 | 20503 | 1.65 | 4.62 | 10406 | 7311 | 6916 | 2531 | 4374 | 3022 | 3010 | 3567 | 2689 | 1055 |
| 50 | Bahraich | 4420 | 51618 | 4.15 | 11.68 | 33446 | 25856 | 6041 | 3735 | 16881 | 12329 | 4236 | 20503 | 1632 | 3721 |
| 51 | Shrawasti | 2458 | 16930 | 1.36 | 6.89 | 9619 | 6793 | 4772 | 3223 | 5506 | 4045 | 68 | 3346 | 3442 | 5 |
| 52 | Balrampur | 2981 | 21348 | 1.72 | 7.16 | 12473 | 7757 | 4537 | 4576 | 4868 | 7462 | 143 | 3545 | 4094 | 118 |
| 53 | Gonda | 4003 | 22427 | 1.80 | 5.60 | 9951 | 5669 | 6778 | 5251 | 4883 | 3977 | 1091 | 3332 | 1799 | 538 |
| 54 | Siddharthnagar | 2895 | 24029 | 1.93 | 8.30 | 8902 | 8427 | 10905 | 6033 | 5092 | 3484 | 326 | 4212 | 2812 | 1403 |
| 55 | Basti | 2688 | 18335 | 1.48 | 6.82 | 6861 | 5323 | 5752 | 4620 | 2706 | 4002 | 153 | 4009 | 1087 | 227 |
| 56 | St.kabir Nagar | 1646 | 15443 | 1.24 | 9.38 | 5837 | 4383 | 6467 | 9421 | 3658 | 1767 | 412 | 2345 | 1623 | 415 |
| 57 | Maharajganj | 2952 | 10532 | 0.85 | 3.57 | 3512 | 2433 | 3294 | 2462 | 381 | 2230 | 901 | 290 | 1428 | 715 |
| 58 | Gorakhpur | 3321 | 27916 | 2.25 | 8.41 | 13321 | 7606 | 9027 | 5403 | 1038 | 11002 | 1281 | 2610 | 3801 | 1195 |
| 59 | Kushinagar | 2906 | 18506 | 1.49 | 6.37 | 8020 | 6291 | 4212 | 1831 | 1716 | 6294 | 10 | 1040 | 4738 | 513 |
| 60 | Deoria | 2538 | 17408 | 1.40 | 6.86 | 7472 | 4313 | 2385 | 1426 | 338 | 6889 | 245 | 2142 | 2061 | 110 |
| 61 | Azamgarh | 4234 | 25472 | 2.05 | 6.02 | 9654 | 6847 | 7360 | 6426 | 1221 | 8409 | 24 | 2686 | 4106 | 55 |
| 62 | Mau | 1713 | 10841 | 0.87 | 6.33 | 4439 | 2844 | 3343 | 3173 | 314 | 4119 | 6 | 715 | 1749 | 380 |
| 63 | Ballia | 3349 | 32047 | 2.58 | 9.57 | 14996 | 11648 | 7544 | 3875 | 1602 | 9129 | 4265 | 5585 | 2287 | 3776 |
| 64 | Jaunpur | 4038 | 13709 | 1.10 | 3.39 | 6384 | 5986 | 4009 | 1934 | 2121 | 4147 | 116 | 1783 | 4072 | 131 |
| 65 | Ghazipur | 3377 | 23581 | 1.90 | 6.98 | 12016 | 9307 | 5678 | 2961 | 392 | 11160 | 464 | 312 | 8279 | 716 |
| 66 | Chandauli | 2549 | 16961 | 1.37 | 6.65 | 12606 | 7658 | 1783 | 1083 | 1356 | 10764 | 486 | 567 | 7039 | 52 |
| 67 | Varanasi | 1528 | 7470 | 0.60 | 4.89 | 4323 | 3358 | 799 | 414 | 342 | 3977 | 4 | 288 | 3067 | 3 |
| 68 | St.Ravidas Nagar | 1015 | 5767 | 0.46 | 5.68 | 2914 | 2472 | 844 | 370 | 5 | 2909 | - | - | 2472 | - |
| 69 | Mirzapur | 4521 | 30291 | 2.44 | 6.70 | 22594 | 14713 | 627 | 384 | 2678 | 17937 | 1979 | 1392 | 12834 | 487 |
| 70 | Sonbhadra | 6788 | 63068 | 5.08 | 9.29 | 55984 | 42031 | 633 | 298 | 3867 | 17834 | 34283 | 1309 | 11844 | 28880 |
| 71 | Kansiramnagar | 1960 | 15237 | 1.23 | 7.77 | 8501 | 4340 | 1317 | 713 | 1468 | 6995 | 38 | 476 | 3800 | 64 |
| | **Total** | **240928** | **1242530** | **90.80** | **5.16** | **690216** | **494994** | **219289** | **129228** | **212518** | **415651** | **62047** | **190992** | **216623** | **87379** |

* Data Source: http://nic.in and GIS area

Table 34: District-wise area of wetlands (type-wise) in Uttar Pradesh

| District code | District | Geographic area * | Wetland Type | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1104 | 1105 | 1106 | 1201 | 1202 | 1203 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | Riverine wetland | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Saharanpur | 3689 | 60 | 10 | - | - | 10440 | - | 413 | 4 | 10927 | 610 | 11537 |
| 2 | Muzaffarnagar | 4008 | - | 186 | 3011 | 227 | 5013 | 2252 | 920 | 229 | 11838 | 751 | 12589 |
| 3 | Bijnor | 4561 | 118 | 243 | 962 | 383 | 12826 | 931 | 786 | 271 | 16520 | 1359 | 17879 |
| 4 | Moradabad | 3718 | 224 | 268 | 22 | 242 | 4874 | - | 276 | 185 | 6091 | 1083 | 7174 |
| 5 | Rampur | 2367 | 126 | 203 | 78 | 202 | 3899 | - | 5 | 179 | 4692 | 684 | 5376 |
| 6 | Jyotiba Phule Nagar | 2249 | 52 | 111 | 140 | 293 | 9744 | - | 132 | 129 | 10601 | 425 | 11026 |
| 7 | Meerut | 2590 | 5 | - | 2209 | 156 | 4140 | - | 649 | 61 | 7220 | 702 | 7922 |
| 8 | Baghpat | 1321 | - | 9 | - | 10 | 1663 | - | 218 | 12 | 1912 | 365 | 2277 |
| 9 | Ghaziabad | 2590 | 164 | 7 | 353 | 31 | 1771 | - | 330 | 772 | 3428 | 688 | 4116 |
| 10 | Gautambudh Nagar | 1442 | 718 | 191 | 18 | 276 | 1033 | 424 | 320 | 690 | 3670 | 483 | 4153 |
| 11 | Bulandshahr | 2910 | 674 | 49 | 11 | 102 | 5009 | - | 382 | 1999 | 8226 | 967 | 9193 |
| 12 | Aligarh | 3650 | 955 | 7 | 281 | 205 | 1895 | 4 | 467 | 2869 | 6683 | 1301 | 7984 |
| 13 | Hathras | 1840 | 826 | - | - | 26 | 248 | - | 133 | 357 | 1590 | 646 | 2236 |
| 14 | Mathura | 3340 | 817 | 24 | 168 | 181 | 4429 | - | 1098 | 1299 | 8016 | 1520 | 9536 |
| 15 | Agra | 4027 | - | 13 | - | 6 | 8337 | 787 | 123 | 26 | 9292 | 1210 | 10502 |
| 16 | Firozabad | 2361 | 33 | - | - | 5 | 1880 | - | 186 | 551 | 2655 | 1040 | 3695 |
| 17 | Etah | 2486 | 1022 | 429 | 5 | 637 | 732 | - | 252 | 1345 | 4422 | 782 | 5204 |
| 18 | Mainpuri | 2760 | 2246 | 914 | 80 | 558 | 1861 | - | 444 | 6190 | 12293 | 594 | 12887 |
| 19 | Budaun | 5168 | 897 | 969 | 4030 | 939 | 12215 | 4 | 110 | 211 | 19375 | 913 | 20288 |
| 20 | Bareilly | 4120 | 473 | 574 | 1370 | 391 | 6269 | - | 59 | 612 | 9748 | 1148 | 10896 |
| 21 | Pilibhit | 3499 | 486 | 846 | 34 | 679 | 11678 | 3337 | 19 | 536 | 17615 | 601 | 18216 |
| 22 | Shahjahanpur | 4575 | 1728 | 789 | 4597 | 2066 | 8285 | - | 55 | 1194 | 18714 | 1089 | 19803 |
| 23 | Lakhimpur | 7680 | 1122 | 1839 | 1588 | 2783 | 38119 | 212 | 74 | 857 | 46594 | 1673 | 48267 |
| 24 | Sitapur | 5743 | 1623 | 416 | 216 | 6692 | 10094 | - | 364 | 1363 | 20768 | 2406 | 23174 |
| 25 | Hardoi | 5986 | 9503 | 2665 | 2771 | 3318 | 12426 | 3 | 1600 | 1829 | 34115 | 2993 | 37108 |
| 26 | Unnao | 4558 | 3967 | 4097 | 159 | 419 | 12349 | - | 1529 | 3344 | 25864 | 1895 | 27759 |
| 27 | Lucknow | 2528 | 1948 | 1308 | 3 | 385 | 2073 | 193 | 908 | 2014 | 8832 | 775 | 9607 |
| 28 | Raebareli | 4609 | 4428 | 5457 | 577 | 414 | 11123 | 119 | 1556 | 12813 | 36487 | 2035 | 38522 |
| 29 | Farrukhabad | 2181 | 658 | 589 | 7073 | 1142 | 12078 | - | 28 | 456 | 22024 | 285 | 22309 |
| 30 | Kannauj | 2093 | 1345 | 193 | 554 | 634 | 3489 | 10 | 36 | 1561 | 7822 | 368 | 8190 |
| 31 | Etawah | 2311 | 609 | 105 | 35 | 668 | 6942 | - | 111 | 1799 | 10269 | 677 | 10946 |
| 32 | Auraiya | 2015 | 155 | - | 79 | 1203 | 2947 | - | 208 | 1050 | 5642 | 1506 | 7148 |
| 33 | Kanpur (dehat) | 3021 | 883 | 180 | 19 | 1082 | 5380 | 6 | 781 | 1420 | 9751 | 1852 | 11603 |
| 34 | Kanpur (nagar) | 3155 | 124 | 94 | 120 | 264 | 11152 | - | 853 | 974 | 13581 | 1189 | 14770 |
| 35 | Jalaun | 4565 | 39 | 208 | 59 | 490 | 10161 | - | 346 | 5 | 11308 | 1411 | 12719 |

Table 34: District-wise area of wetlands (type-wise) in Uttar Pradesh

Cont...

| District code | District | Geographic area * | Wetland Type | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1104 | 1105 | 1106 | 1201 | 1202 | 1203 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | Riverine wetland | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 36 | Jhansi | 5024 | 356 | - | 339 | 389 | 10725 | 2059 | 1397 | - | 15265 | 446 | 15711 |
| 37 | Lalitpur | 5039 | 1338 | 30 | 368 | 275 | 5225 | 23221 | 2535 | - | 32992 | 1127 | 34119 |
| 38 | Hamirpur | 4282 | 403 | 49 | 4 | 118 | 11083 | 1336 | 851 | 66 | 13910 | 1373 | 15283 |
| 39 | Mahoba | 2884 | 1222 | - | 54 | 87 | 1111 | 5257 | 1065 | 5 | 8801 | 846 | 9647 |
| 40 | Banda | 4532 | 675 | 654 | 2 | 975 | 13164 | 562 | 1375 | 439 | 17846 | 2586 | 20432 |
| 41 | Chitrakoot | 3092 | 190 | 45 | - | 271 | 6222 | 3209 | 735 | 256 | 10928 | 1225 | 12153 |
| 42 | Fatehpur | 4152 | 1125 | 192 | 266 | 106 | 12691 | - | 390 | 3679 | 18449 | 1986 | 20435 |
| 43 | Pratapgarh | 3717 | 2228 | 1624 | 6 | 554 | 6874 | - | 234 | 3071 | 14591 | 1850 | 16441 |
| 44 | Kaushambi | 2124 | 463 | 3 | 35 | 15 | 7009 | 2 | 315 | 575 | 8417 | 1068 | 9485 |
| 45 | Allahabad | 5137 | 1879 | 382 | 313 | 590 | 18143 | 1270 | 794 | 2224 | 25595 | 1892 | 27487 |
| 46 | Barabanki | 4402 | 4069 | 740 | 1282 | 2024 | 13381 | - | 1745 | 2067 | 25308 | 1982 | 27290 |
| 47 | Faizabad | 2174 | 3839 | 936 | 1256 | 849 | 13287 | - | 589 | 1053 | 21809 | 1241 | 23050 |
| 48 | Ambedkar nagar | 2337 | 1979 | 1619 | 572 | 325 | 8427 | - | 183 | 748 | 13853 | 1094 | 14947 |
| 49 | Sultanpur | 4436 | 4327 | 587 | 678 | 1844 | 3331 | - | 488 | 6266 | 17521 | 2982 | 20503 |
| 50 | Bahraich | 4420 | 715 | 1876 | 2617 | 11438 | 30965 | 1866 | 240 | 1015 | 50732 | 886 | 51618 |
| 51 | Shrawasti | 2458 | 2200 | 1088 | 709 | 3788 | 7191 | 309 | 131 | 746 | 16162 | 768 | 16930 |
| 52 | Balrampur | 2981 | 3463 | 1559 | 1206 | 1800 | 9474 | 1283 | 383 | 369 | 19537 | 1811 | 21348 |
| 53 | Gonda | 4003 | 2043 | 3122 | 3517 | 2010 | 9274 | - | 537 | 261 | 20764 | 1663 | 22427 |
| 54 | Siddharthnagar | 2895 | 6620 | 1312 | 2204 | 1697 | 6052 | - | 1800 | 687 | 20372 | 3657 | 24029 |
| 55 | Basti | 2688 | 3736 | 1233 | 1069 | 1192 | 9203 | - | 228 | 52 | 16713 | 1622 | 18335 |
| 56 | St.kabir Nagar | 1646 | 6167 | 1371 | 703 | 1347 | 4652 | - | 28 | 86 | 14354 | 1089 | 15443 |
| 57 | Maharajganj | 2952 | 3370 | 288 | 635 | 316 | 3017 | - | 3 | 258 | 7887 | 2645 | 10532 |
| 58 | Gorakhpur | 3321 | 6959 | 2773 | 2382 | 1082 | 11477 | - | 32 | 1497 | 26202 | 1714 | 27916 |
| 59 | Kushinagar | 2906 | 2051 | 442 | 1282 | 2023 | 8998 | - | 11 | 2089 | 16896 | 1610 | 18506 |
| 60 | Deoria | 2538 | 1850 | 202 | 999 | 333 | 12456 | - | - | - | 15840 | 1568 | 17408 |
| 61 | Azamgarh | 4234 | 5800 | 1750 | 797 | 1710 | 9972 | - | 31 | 2006 | 22066 | 3406 | 25472 |
| 62 | Mau | 1713 | 4767 | 296 | 201 | 659 | 3615 | - | - | 207 | 9745 | 1096 | 10841 |
| 63 | Ballia | 3349 | 4747 | 1328 | 1636 | 1194 | 21405 | - | 8 | 287 | 30605 | 1442 | 32047 |
| 64 | Jaunpur | 4038 | 2262 | 722 | 66 | 2179 | 3145 | - | 39 | 1995 | 10408 | 3301 | 13709 |
| 65 | Ghazipur | 3377 | 1597 | 1588 | 478 | 3017 | 13567 | 5 | 15 | 970 | 21237 | 2344 | 23581 |
| 66 | Chandauli | 2549 | 572 | - | 305 | 551 | 5719 | 5511 | 39 | 3394 | 16091 | 870 | 16961 |
| 67 | Varanasi | 1528 | 224 | 135 | 18 | 544 | 5323 | - | - | 145 | 6389 | 1081 | 7470 |
| 68 | St.Ravidas Nagar | 1015 | 347 | - | 10 | 589 | 3400 | - | 59 | 349 | 4754 | 1013 | 5767 |
| 69 | Mirzapur | 4521 | 31 | 234 | - | 321 | 16193 | 9960 | 515 | 1371 | 28625 | 1666 | 30291 |
| 70 | Sonbhadra | 6788 | 130 | - | 19 | 1236 | 17524 | 41509 | 571 | 162 | 61151 | 1917 | 63068 |
| 71 | Kansiramnagar | 1960 | 759 | 198 | 4450 | 1706 | 7446 | - | 126 | 93 | 14778 | 459 | 15237 |
| | **Total** | **240928** | **122531** | **51371** | **61100** | **76263** | **607315** | **105641** | **33263** | **87694** | **1145178** | **97352** | **1242530** |

* Data Source: http://nic.in and GIS area

State : Uttar Pradesh

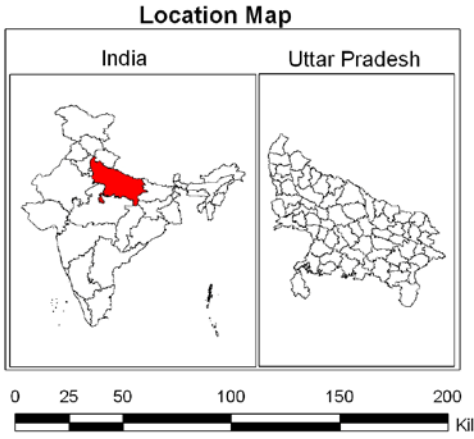
# WETLAND MAP


| 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 | | | Riverine 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**

Remote Sensing Applications Centre, Uttar Pradesh, Lucknow
and
Space Applications Centre (ISRO), Ahmedabad

**Sponsored by**

Ministry of Environment and Forests
Government of India

Plate 31 : Wetland map of Uttar Pradesh

### 8.1.10 Bihar

Total 4416 wetlands have been mapped at 1:50,000 scale in the state. In addition, 17582 wetlands (smaller than 2.25 ha) have also been identified. Total wetland area estimated is 403209 ha that is around 4.4 per cent of the geographic area. The major wetland types are river/stream accounting for about 74 per cent of the wetlands (298408 ha), natural waterlogged (34878 ha) lake/pond (20281 ha), and ox-bow lake/ cut-off meander (16172 ha). Graphical distribution of wetland type is shown in Figure 31. The inland natural dominate the wetlands in Bihar which comprise about 92 per cent of the total wetland extent while the man-made accounts for about 3.5 per cent. However, the small wetlands (< 2.25 ha) accounts for about 4.5 per cent assuming that each is of one ha. Wetland map of the state is shown in Plate 32.

Analysis of wetland status in terms of open water shows that out of the total wetland area the extent of open water is 58 per cent in post-monsoon and 38 per cent in pre-monsoon. There is a significant reduction in the extent of open water (about 34%) from post-monsoon (224655 ha) to 148382 ha in pre-monsoon. It is reflected in all the wetland types except reservoir/barrage (Table 35). Turbidity is observed to be dominantly low in turbidity in post-monsoon (132318 ha) out of 224655 ha of open water followed by moderate (75292 ha) and high turbidity (17045 ha). In case of pre-monsoon the scenario has drastically altered and the moderate turbidity (146269 ha) which accounted for about 98 per cent and dominated the open water (148382 ha). The other turbidity levels like high (1797 ha) and low (316 ha) remained insignificant together accounting for about 2 per cent of pre-monsoon open water extent.

The aquatic vegetation accounted for about 7 and 5 per cent of total wetland area in post-monsoon (25179 ha) and pre-monsoon (17360 ha) respectively.

Table 35: Area estimates of wetlands in Bihar

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 | Lake/Pond | 514 | 20281 | 5.03 | 11506 | 6345 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 989 | 16172 | 4.01 | 10130 | 5264 |
| 3 | 1103 | High altitude wetland | - | - | - | - | - |
| 4 | 1104 | Riverine wetland | 200 | 2118 | 0.53 | 1664 | 777 |
| 5 | 1105 | Waterlogged | 1300 | 34878 | 8.65 | 21185 | 9507 |
| 6 | 1106 | River/Stream | 238 | 298408 | 74.01 | 168984 | 118481 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 90 | 8612 | 2.14 | 7587 | 6005 |
| 8 | 1202 | Tank/Pond | 1067 | 4822 | 1.20 | 3363 | 1870 |
| 9 | 1203 | Waterlogged | 18 | 336 | 0.08 | 236 | 133 |
| 10 | 1204 | Salt pan | - | - | - | - | - |
| | | **Sub-Total** | **4416** | **385627** | **95.64** | **224655** | **148382** |
| | | Wetlands (<2.25 ha) | 17582 | 17582 | 4.36 | - | - |
| | | **Total** | **21998** | **403209** | **100.00** | **224655** | **148382** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 25179 | 17360 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 132318 | 316 |
| Moderate | 75292 | 146269 |
| High | 17045 | 1797 |

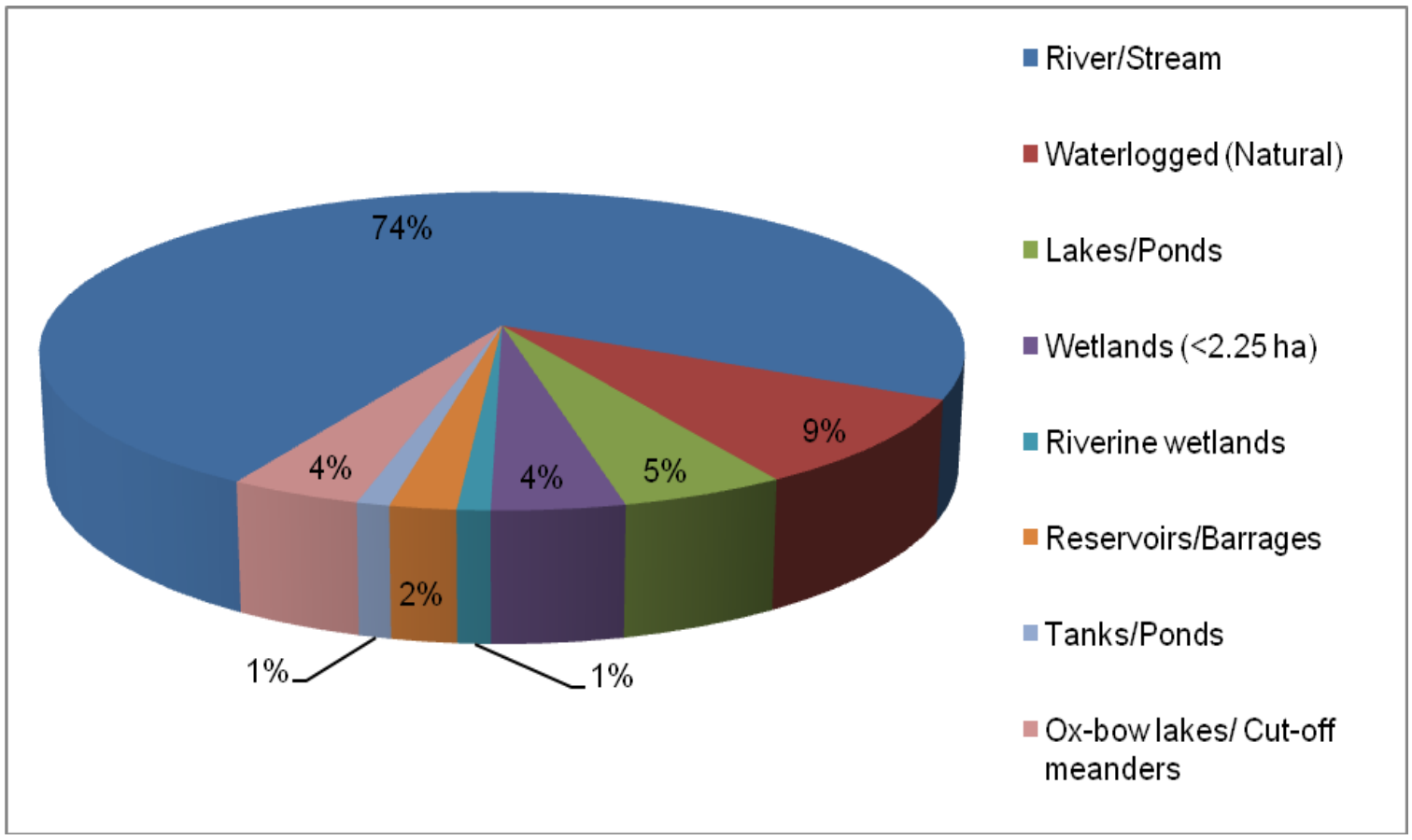



Figure 31: Type-wise wetland distribution in Bihar

**District-wise wetland area estimates in Bihar**

The state has thirty seven districts. District-wise distribution of wetlands showed that Begusarai followed by Katihar and Saharsa have the highest extent of wetlands about 10 per cent of the geographical area of the respective districts (Table 33). The least extents (less than 1 per cent) of wetlands has been shown in Kaimur (Bhabua), Sheikhpura and Sitamarhi. The mean seasonal change in the extent of open water is about 37 per cent with Gaya district ranking first in terms of highest change (84%) and Madhubani district showing the least change (5%). In Supaul district has shown a slight increase in the extent of open water from post-monsoon (9004 ha) to pre-monsoon (9021 ha) which is due to non-seasonal rainfall. Aquatic vegetation variability is very high across the districts. It ranged from a minimum of about 2.5 ha (Rohtas district) to 3767 ha (katihar district) in post-monsoon. While in pre-monsoon, wetlands in Rohtas district did not show the presence of aquatic vegetation but Vaishali registered a maximum extent (1884 ha). Kaimur district has shown aquatic vegetation of 6 ha, which remained unchanged in both the seasons. Overall, on an average each district has 681 ha in post-monsoon and 469 ha in pre-monsoon season. Analysis of data on turbidity reveals that Sheikhpura has least extent (17 ha) under low turbidity while Bhagalpur has the largest extent (12628 ha) in post-monsoon. The area statistics provided for each district has detailed information on turbidity levels. District-wise wetland area estimate is given in Table 36. Figure 32 shows graphical distribution of district-wise wetlands. District-wise area of wetlands (type-wise) in the state is given in Table 37.

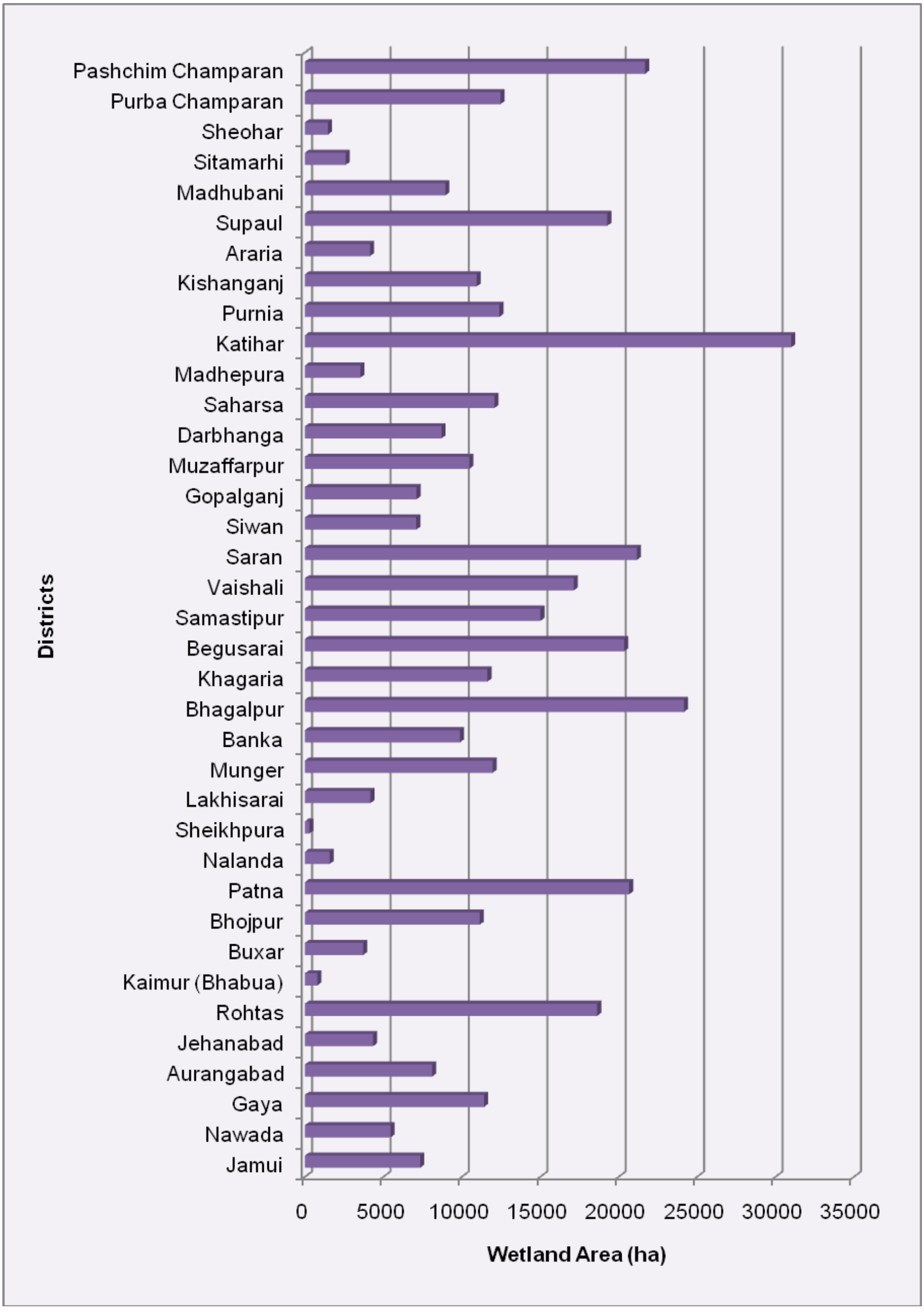



Figure 32: District-wise graphical distribution of wetlands in Bihar

Table 36: District-wise area of wetlands in Bihar

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Pashchim Champaran | 4250 | 21697 | 5.38 | 5.11 | 11924 | 10118 | 758 | 487 | 7324 | 4417 | 183 | - | 10114 | 4 |
| 2 | Purba Champaran | 4155 | 12477 | 3.09 | 3.00 | 8915 | 5119 | 1410 | 1274 | 5006 | 3744 | 165 | - | 5116 | 3 |
| 3 | Sheohar | 443 | 1476 | 0.37 | 3.33 | 845 | 782 | 19 | 27 | 586 | 259 | - | - | 782 | - |
| 4 | Sitamarhi | 2628 | 2601 | 0.65 | 0.99 | 906 | 588 | 140 | 70 | 475 | 431 | - | - | 562 | 26 |
| 5 | Madhubani | 3478 | 8958 | 2.22 | 2.58 | 2411 | 2280 | 162 | 175 | 596 | 1347 | 468 | - | 2262 | 18 |
| 6 | Supaul | 2985 | 19285 | 4.78 | 6.46 | 9004 | 9021 | 381 | 126 | 3760 | 2659 | 2585 | - | 9021 | - |
| 7 | Araria | 2797 | 4157 | 1.03 | 1.49 | 2245 | 1930 | 1013 | 659 | 236 | 1832 | 177 | - | 1930 | - |
| 8 | Kishanganj | 1939 | 10954 | 2.72 | 5.65 | 5542 | 4886 | 533 | 416 | 1399 | 3462 | 681 | - | 4886 | - |
| 9 | Purnia | 3203 | 12401 | 3.08 | 3.87 | 5279 | 3365 | 3495 | 1816 | 1623 | 3101 | 555 | - | 3365 | - |
| 10 | Katihar | 3010 | 31011 | 7.69 | 10.30 | 17135 | 14574 | 3767 | 1785 | 12538 | 3935 | 662 | - | 14574 | - |
| 11 | Madhepura | 1797 | 3539 | 0.88 | 1.97 | 1589 | 967 | 1100 | 163 | 412 | 1130 | 47 | - | 967 | - |
| 12 | Saharsa | 1196 | 12086 | 3.00 | 10.11 | 7202 | 4125 | 1752 | 738 | 2405 | 3209 | 1588 | - | 4110 | 15 |
| 13 | Darbhanga | 2502 | 8709 | 2.16 | 3.48 | 5171 | 2467 | 1366 | 1539 | 2323 | 2556 | 292 | - | 1652 | 815 |
| 14 | Muzaffarpur | 3123 | 10490 | 2.60 | 3.36 | 6984 | 4048 | 1485 | 1740 | 4424 | 2560 | - | - | 3984 | 64 |
| 15 | Gopalganj | 2003 | 7122 | 1.77 | 3.56 | 5128 | 3783 | 365 | 286 | 3293 | 1746 | 89 | - | 3783 | - |
| 16 | Siwan | 2213 | 7105 | 1.76 | 3.21 | 4295 | 2117 | 944 | 571 | 2337 | 1949 | 9 | - | 2100 | 17 |
| 17 | Saran | 2624 | 21170 | 5.25 | 8.07 | 12118 | 7950 | 1704 | 487 | 8967 | 3131 | 20 | - | 7940 | 10 |
| 18 | Vaishali | 1995 | 17148 | 4.25 | 8.60 | 11405 | 5970 | 1118 | 1884 | 7971 | 3407 | 27 | - | 5937 | 33 |
| 19 | Samastipur | 2579 | 15022 | 3.73 | 5.82 | 10867 | 7133 | 1198 | 558 | 5848 | 3074 | 1945 | - | 6893 | 240 |
| 20 | Begusarai | 1889 | 20365 | 5.05 | 10.78 | 10628 | 7703 | 924 | 958 | 6105 | 3322 | 1201 | 20 | 7504 | 179 |
| 21 | Khagaria | 1486 | 11645 | 2.89 | 7.84 | 9060 | 5807 | 486 | 374 | 5235 | 2652 | 1173 | 13 | 5794 | - |
| 22 | Bhagalpur | 2502 | 24171 | 5.99 | 9.66 | 16237 | 10273 | 349 | 152 | 12628 | 3489 | 120 | - | 10265 | 8 |
| 23 | Banka | 3020 | 9895 | 2.45 | 3.28 | 5151 | 3847 | 48 | 128 | 2708 | 1669 | 774 | - | 3825 | 22 |
| 24 | Munger | 1419 | 11979 | 2.97 | 8.44 | 7001 | 5498 | 112 | 10 | 5430 | 1054 | 517 | 187 | 5309 | 2 |
| 25 | Lakhisarai | 1229 | 4177 | 1.04 | 3.40 | 1759 | 1447 | 34 | 18 | 571 | 1073 | 115 | 96 | 1335 | 16 |
| 26 | Sheikhpura | 689 | 296 | 0.07 | 0.43 | 163 | 73 | 10 | 20 | 17 | 143 | 3 | - | 65 | 8 |
| 27 | Nalanda | 2362 | 1589 | 0.39 | 0.67 | 756 | 283 | 16 | 21 | 182 | 477 | 97 | - | 280 | 3 |
| 28 | Patna | 3130 | 20678 | 5.13 | 6.61 | 11943 | 7570 | 50 | 22 | 9246 | 2351 | 346 | - | 7551 | 19 |
| 29 | Bhojpur | 2337 | 11154 | 2.77 | 4.77 | 5700 | 2435 | 79 | 164 | 4833 | 768 | 99 | - | 2430 | 5 |
| 30 | Buxar | 1634 | 3717 | 0.92 | 2.27 | 2449 | 1408 | 270 | 223 | 1635 | 607 | 207 | - | 1401 | 7 |
| 31 | Kaimur (Bhabua) | 1840 | 796 | 0.20 | 0.43 | 296 | 174 | 6 | 6 | 103 | 182 | 11 | - | 125 | 49 |
| 32 | Rohtas | 3838 | 18641 | 4.62 | 4.86 | 9259 | 4040 | 2 | - | 7623 | 1360 | 276 | - | 4031 | 9 |
| 33 | Jehanabad | 1569 | 4345 | 1.08 | 2.77 | 1843 | 564 | 17 | 11 | 948 | 797 | 98 | - | 564 | - |
| 34 | Aurangabad | 3389 | 8116 | 2.01 | 2.39 | 3428 | 1436 | 10 | 28 | 1967 | 1252 | 209 | - | 1436 | - |
| 35 | Gaya | 4941 | 11422 | 2.83 | 2.31 | 3979 | 626 | 5 | 10 | 72 | 3025 | 882 | - | 527 | 99 |
| 36 | Nawada | 2498 | 5464 | 1.36 | 2.19 | 2445 | 1241 | 22 | 241 | 746 | 1290 | 409 | - | 1216 | 25 |
| 37 | Jamui | 2997 | 7351 | 1.82 | 2.45 | 3593 | 2734 | 29 | 173 | 746 | 1832 | 1015 | - | 2633 | 101 |
| | **Total** | **91689** | **403209** | **100.00** | **4.40** | **224655** | **148382** | **25179** | **17360** | **132318** | **75292** | **17045** | **316** | **146269** | **1797** |

* Data Source: http://nic.in

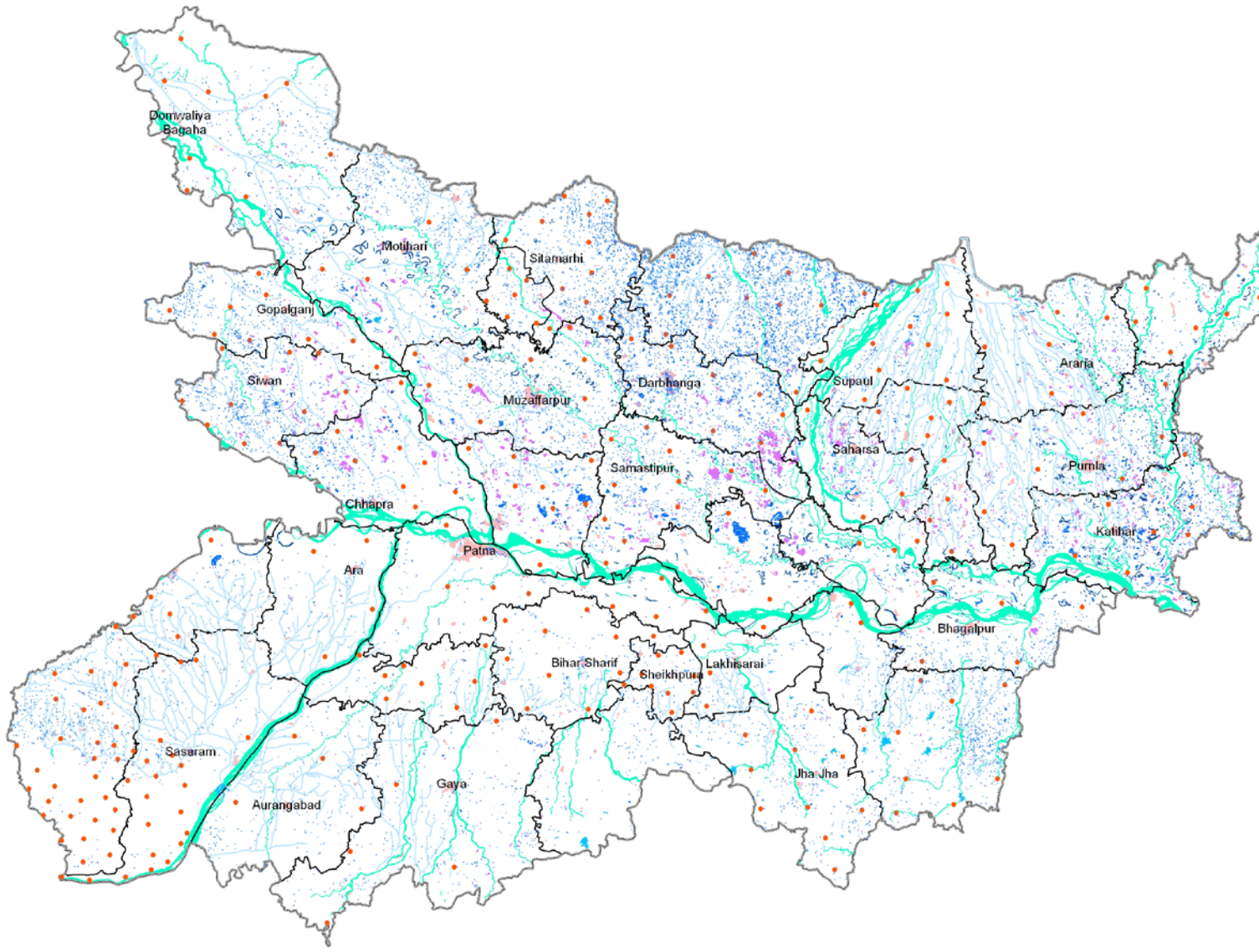
Table 37: District-wise area of wetlands (type-wise) in Bihar

| District code | District | Geographic area * | Wetland Type | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1104 | 1105 | 1106 | 1201 | 1202 | 1203 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | Riverine wetland | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Pashchim Champaran | 4250 | 580 | 938 | 25 | 338 | 19250 | - | 112 | 2 | 21245 | 452 | 21697 |
| 2 | Purba Champaran | 4155 | 862 | 2481 | 30 | 1481 | 6134 | 480 | 254 | - | 11722 | 755 | 12477 |
| 3 | Sheohar | 443 | - | 4 | - | 152 | 1175 | - | 18 | - | 1349 | 127 | 1476 |
| 4 | Sitamarhi | 2628 | 80 | 172 | 6 | 304 | 846 | - | 122 | - | 1530 | 1071 | 2601 |
| 5 | Madhubani | 3478 | 15 | 159 | - | 135 | 4645 | 6 | 407 | - | 5367 | 3591 | 8958 |
| 6 | Supaul | 2985 | 164 | 48 | 19 | 436 | 18286 | - | 12 | - | 18965 | 320 | 19285 |
| 7 | Araria | 2797 | 93 | 420 | 35 | 1044 | 2108 | - | 61 | - | 3761 | 396 | 4157 |
| 8 | Kishanganj | 1939 | 176 | 534 | 44 | 125 | 9865 | 7 | 45 | 3 | 10799 | 155 | 10954 |
| 9 | Purnia | 3203 | 831 | 1404 | 22 | 1892 | 7564 | 102 | 140 | 10 | 11965 | 436 | 12401 |
| 10 | Katihar | 3010 | 3146 | 2768 | 451 | 2377 | 21255 | - | 303 | 109 | 30409 | 602 | 31011 |
| 11 | Madhepura | 1797 | 194 | 81 | 3 | 1431 | 1562 | - | 38 | 3 | 3312 | 227 | 3539 |
| 12 | Saharsa | 1196 | 546 | 241 | 45 | 2501 | 8502 | - | 28 | - | 11863 | 223 | 12086 |
| 13 | Darbhanga | 2502 | 580 | 187 | - | 4220 | 1496 | 14 | 584 | - | 7081 | 1628 | 8709 |
| 14 | Muzaffarpur | 3123 | 858 | 1387 | 37 | 2769 | 4537 | - | 99 | - | 9687 | 803 | 10490 |
| 15 | Gopalganj | 2003 | 78 | 51 | - | 716 | 5668 | - | 15 | 12 | 6540 | 582 | 7122 |
| 16 | Siwan | 2213 | 297 | 83 | 48 | 2478 | 3303 | - | 66 | - | 6275 | 830 | 7105 |
| 17 | Saran | 2624 | 737 | 121 | 102 | 2801 | 16886 | - | 93 | - | 20740 | 430 | 21170 |
| 18 | Vaishali | 1995 | 3095 | 184 | 46 | 2926 | 10594 | - | 24 | 4 | 16873 | 275 | 17148 |
| 19 | Samastipur | 2579 | 2664 | 404 | 12 | 3953 | 7252 | - | 184 | - | 14469 | 553 | 15022 |
| 20 | Begusarai | 1889 | 3240 | 1177 | 242 | 347 | 15142 | - | 101 | - | 20249 | 116 | 20365 |
| 21 | Khagaria | 1486 | 416 | 1264 | 509 | 1217 | 8084 | - | 80 | - | 11570 | 75 | 11645 |
| 22 | Bhagalpur | 2502 | 558 | 1034 | 157 | 445 | 21446 | 5 | 99 | - | 23744 | 427 | 24171 |
| 23 | Banka | 3020 | 16 | - | 2 | 68 | 5681 | 3196 | 166 | 3 | 9132 | 763 | 9895 |
| 24 | Munger | 1419 | 22 | 3 | 194 | 4 | 11155 | 352 | 125 | - | 11855 | 124 | 11979 |
| 25 | Lakhisarai | 1229 | 8 | 21 | 32 | 42 | 3660 | 107 | 184 | - | 4054 | 123 | 4177 |
| 26 | Sheikhpura | 689 | 19 | - | - | - | 2 | - | 203 | - | 224 | 72 | 296 |
| 27 | Nalanda | 2362 | 86 | - | - | 31 | 1057 | - | 158 | 79 | 1411 | 178 | 1589 |
| 28 | Patna | 3130 | 5 | 207 | 35 | 83 | 19986 | - | 87 | 111 | 20514 | 164 | 20678 |
| 29 | Bhojpur | 2337 | 22 | 387 | 22 | 10 | 10565 | - | 44 | - | 11050 | 104 | 11154 |
| 30 | Buxar | 1634 | 705 | 396 | - | 4 | 2444 | - | 32 | - | 3581 | 136 | 3717 |
| 31 | Kaimur (Bhabua) | 1840 | 10 | 6 | - | 45 | 126 | 36 | 82 | - | 305 | 491 | 796 |
| 32 | Rohtas | 3838 | - | - | - | 16 | 17288 | 1045 | 69 | - | 18418 | 223 | 18641 |
| 33 | Jehanabad | 1569 | 15 | 4 | - | 7 | 4190 | - | 79 | - | 4295 | 50 | 4345 |
| 34 | Aurangabad | 3389 | - | 6 | - | 22 | 7436 | 358 | 86 | - | 7908 | 208 | 8116 |
| 35 | Gaya | 4941 | 58 | - | - | 225 | 10620 | - | 114 | - | 11017 | 405 | 11422 |
| 36 | Nawada | 2498 | 75 | - | - | 51 | 3914 | 1124 | 161 | - | 5325 | 139 | 5464 |
| 37 | Jamui | 2997 | 30 | - | - | 182 | 4684 | 1780 | 347 | - | 7023 | 328 | 7351 |
| | **Total** | **91689** | **20281** | **16172** | **2118** | **34878** | **298408** | **8612** | **4822** | **336** | **385627** | **17582** | **403209** |

* Data Source: http://nic.in

State : Bihar

# 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
- Canal
- Railway
- Drainage (line)
- Roads
- 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
Institute of Environmental Studies and Wetland Management (IESWM), Kolkata

**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 32 : Wetland map of Bihar

### 8.1.11 Sikkim

Total 272 wetlands have been mapped at 1:50,000 scale in the state. In addition, 281 wetlands (smaller than 2.25 ha) have also been identified. Total wetland area estimated is 7477 ha accounting for about 1.05 per cent of the geographic area of state.

The major wetland types are high altitude lake accounting for 40.79 per cent of the wetlands (3050 ha), river/stream (4131 ha), lake/pond (15 ha). Graphical distribution of wetland type is shown in Figure 33. Details of the wetland statistics of the district is given in Table 38.

The extent of open water in post-monsoon of the year 2006 is 7189 ha. The qualitative turbidity of water in wetland types belonging to lake/pond, high altitude lake and river/stream was in general moderate. Aquatic vegetation in the water bodies was very low. Wetland map of the state is shown in Plate 33.

Table 38: Area estimates of wetlands in Sikkim

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 | Lake/Pond | 1 | 15 | 0.20 | 8 | 8 |
| 2 | 1103 | High altitude wetland | 259 | 3050 | 40.79 | 3050 | 896 |
| 3 | 1106 | River/Stream | 12 | 4131 | 55.25 | 4131 | 4131 |
| | | **Sub-Total** | **272** | **7196** | **96.24** | **7189** | **5035** |
| | | Wetlands (<2.25 ha) | 281 | 281 | 3.76 | - | - |
| | | **Total** | **553** | **7477** | **100.00** | **7189** | **5035** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 7 | 7 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 2380 | 885 |
| Moderate | 4809 | 4150 |
| High | - | - |

-

High altitude wetlands occupy an important place in terms of their ecological character and conservation value. Analysis of these wetlands falling three altitudinal zones has been carried out with the aid of a Digital Elevation Model (SRTM-DEM). Accordingly, three altitudinal zones were identified and distribution along with extent has been estimated. There are 10 wetlands of this category with an extent of 108 ha in 3000-4000 m altitude zone. While the zone between 4000-5000 m, there are 130 wetlands with an extent of 920 ha and in the zone > 5000 m, there are 119 wetlands with an extent of 2022 ha.

**District-wise wetland area estimates in Sikkim**

The state has four districts. District-wise distribution of wetlands showed that three districts can be called as wetland rich. North has highest concentration with around 63.72 per cent of total wetland area in state and it share 1.13% of geographic area of district. This is mainly due to the location of the famous Gurudogmar lake. The other two districts are: South and East with around 0.99 and 0.95 per cent of geographic area under wetland respectively. West district has the lowest area under wetland (0.92 per cent). Wetland category of high altitude was observed only in three districts. District-wise wetland area estimates is given in Table 39. Figure 34 shows district-wise graphical distribution of wetlands. The districts with very high concentration of small wetlands (< 2.25 ha) is North with 221 followed by East and West district with 42 and 16 respectively, while South district has lowest with 2 such wetlands. District-wise area of wetlands (type-wise) in the state is given in Table 40.

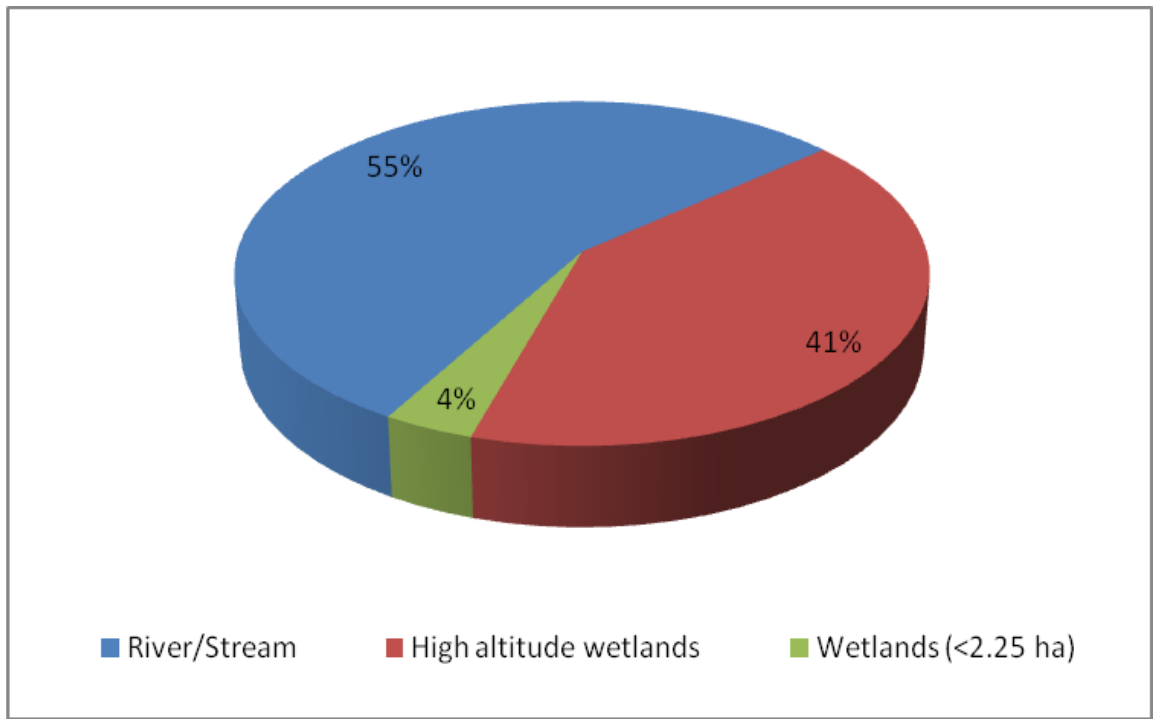



Figure 33: Type-wise wetland distribution in Sikkim

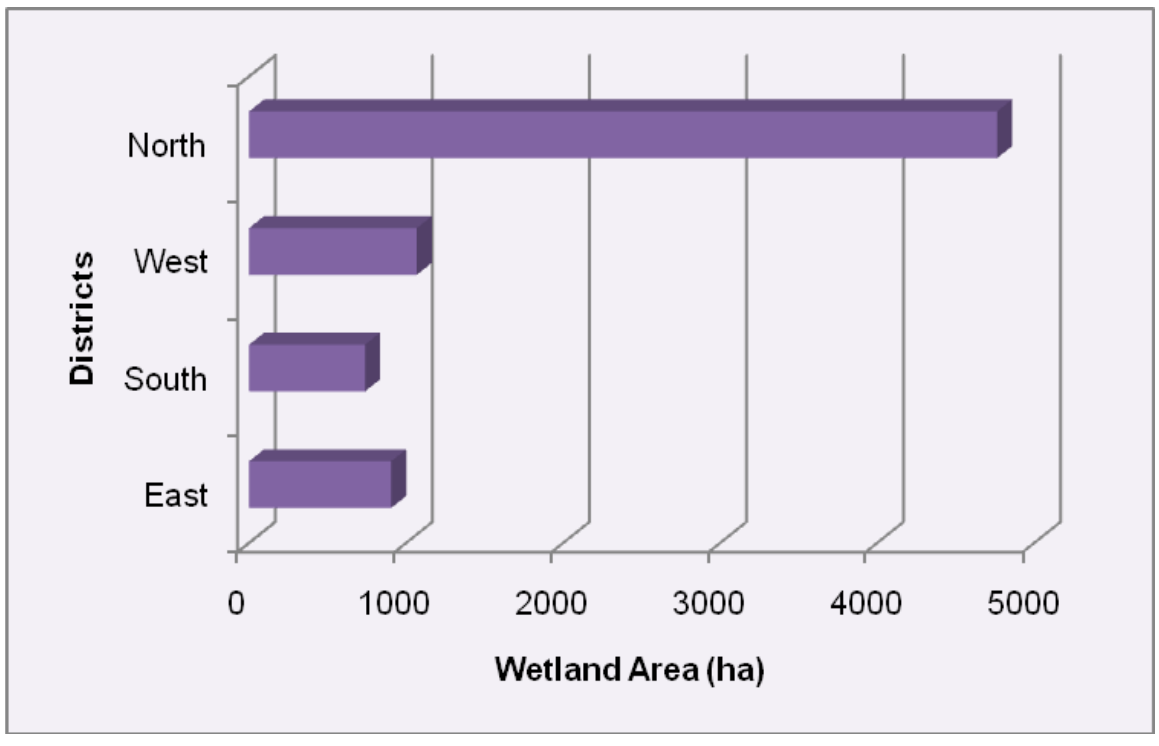



Figure 34: District-wise graphical distribution of wetlands in Sikkim

Table 39: District-wise area of wetlands in Sikkim

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | North | 4226 | 4764 | 63.72 | 1.13 | 4543 | 2585 | - | - | 2171 | 2372 | - | 598 | 1987 | - |
| 2 | West | 1166 | 1069 | 14.30 | 0.92 | 1046 | 963 | 7 | 7 | 158 | 888 | - | 235 | 728 | - |
| 3 | South | 750 | 739 | 9.88 | 0.99 | 737 | 737 | - | - | - | 737 | - | - | 737 | - |
| 4 | East | 954 | 905 | 12.10 | 0.95 | 863 | 750 | - | - | 51 | 812 | - | 52 | 698 | - |
| | **Total** | **7096** | **7477** | **100.00** | **1.05** | **7189** | **5035** | **7** | **7** | **2380** | **4809** | **-** | **885** | **4150** | **-** |

* Data Source: http://nic.in

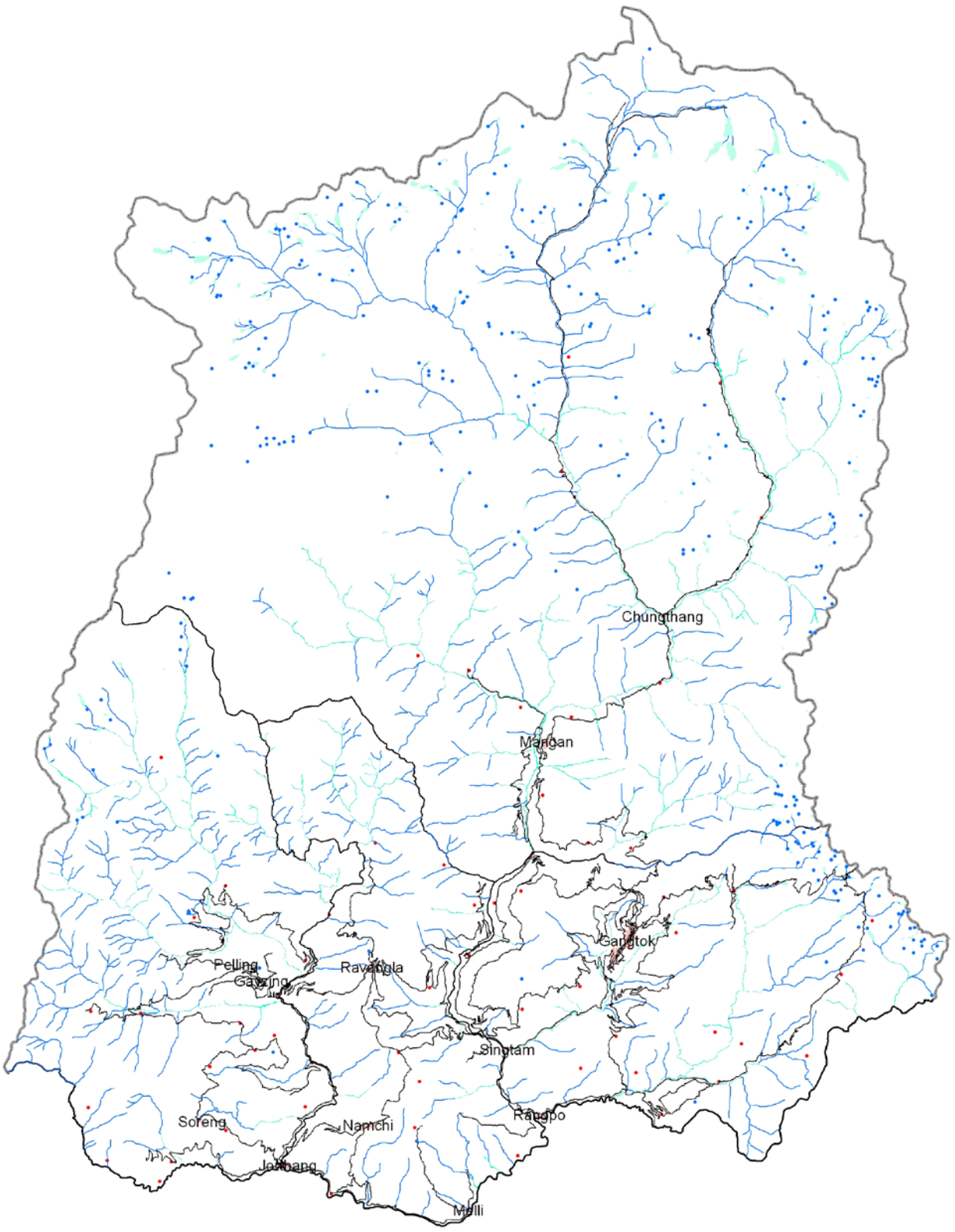
Table 40: District-wise area of wetlands (type-wise) in Sikkim

| District code | District | Geographic area * | Wetland Type | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1103 | 1106 | | | |
| | | | Lake/ pond | High altitude wetland | River/ Stream | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | North | 4226 | - | 2674 | 1869 | 4543 | 221 | 4764 |
| 2 | West | 1166 | 15 | 178 | 860 | 1053 | 16 | 1069 |
| 3 | South | 750 | - | - | 737 | 737 | 2 | 739 |
| 4 | East | 954 | - | 198 | 665 | 863 | 42 | 905 |
| | **Total** | **7096** | **15** | **3050** | **4131** | **7196** | **281** | **7477** |

* Data Source: http://nic.in

State : Sikkim

# 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 (<2.25ha)
- Settlements
- Drainage (line)
- Major Roads
- Railway
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

**Location Map**


0 5 10 20 Kilometers

**Data Source:**
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Seasons: 2005)

**Prepared By:**
Space Applications Centre (ISRO), Ahmedabad
and
Sikkim State Council of Science and Technology, DST

**Sponsored By:**
Ministry of Environment and Forests
Government of India

Plate 33 : Wetland map of Sikkim

### 8.1.12 Arunachal Pradesh

Total 1534 wetlands have been mapped at 1:50,000 scale in the state. In addition, 1119 wetlands (smaller than 2.25 ha) have also been identified. Total wetland area estimated is 155728 ha that is around 1.78 per cent of the geographic area (Table 41). The major wetland types are river/stream accounting for 86 per cent of the wetlands (134244 ha), high altitude wetland (11422 ha), and waterlogged (8146 ha). Graphical distribution of wetland type is shown in Figure 35.

The open water in wetlands is in general higher during post-monsoon, with around 43 per cent than that of pre-monsoon (37 per cent). Aquatic vegetation (floating/emergent) occupies around 3.8 and 3.3 per cent of wetland area during post-and pre-monsoon respectively. Qualitative turbidity analysis of the open water showed that low and moderate turbidity prevail (around 85 and 12 per cent respectively during post-monsoon). Wetland map of the state is shown in Plate 34.

Table 41: Area estimates of wetlands in Arunachal Pradesh

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 | Lake/Pond | 3 | 18 | 0.01 | 16 | - |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 29 | 520 | 0.33 | 180 | 39 |
| 3 | 1103 | High altitude wetland | 1231 | 11422 | 7.33 | 7946 | 2984 |
| 4 | 1105 | Waterlogged | 107 | 8146 | 5.23 | 60 | 7 |
| 5 | 1106 | River/Stream | 128 | 134244 | 86.20 | 57811 | 54354 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 6 | 1201 | Reservoir/Barrage | 4 | 164 | 0.11 | 162 | 124 |
| 7 | 1202 | Tank/Pond | 32 | 95 | 0.06 | 47 | 8 |
| | | **Sub-Total** | **1534** | **154609** | **99.28** | **66222** | **57516** |
| | | Wetlands (<2.25 ha) | 1119 | 1119 | 0.72 | - | - |
| | | **Total** | **2653** | **155728** | **100.00** | **66222** | **57516** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 6002 | 5924 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 56471 | 45810 |
| Moderate | 7984 | 9541 |
| High | 1767 | 2165 |

**District-wise wetland area estimates in Arunachal Pradesh**

The state has thirteen districts. District-wise distribution of wetlands showed that three districts can be called as wetland rich. Lohit has highest concentration with around 45719 ha area under wetland. This is mainly due to the large number of river/stream area. The other two districts are: Dibang valley and East Siang with around 37,602 ha and 25,512 ha area under wetland. Tirap district has the lowest area under wetland (around 1,262 ha). Wetland category of High altitude lake was observed in Dibang Valley (443), Lohit(204) and Tawang(204) districts. Few high altitude lakes are observed in West Kameng, East Kameng, West Siang Lower Subansiri, Upper Subansiri and Upper Siang districts also. There are no major reservoirs exists in the state. District-wise wetland area estimates is given in Table 42. Figure 36 shows district-wise graphical distribution of wetlands. District-wise area of wetlands (type-wise) in the state is given in Table 43.

The districts with very high concentration of small wetlands (< 2.25 ha) are Dibang Valley and Lohit with 266 and 240 numbers respectively, while East Kameng district has lowest with 12 such wetlands.

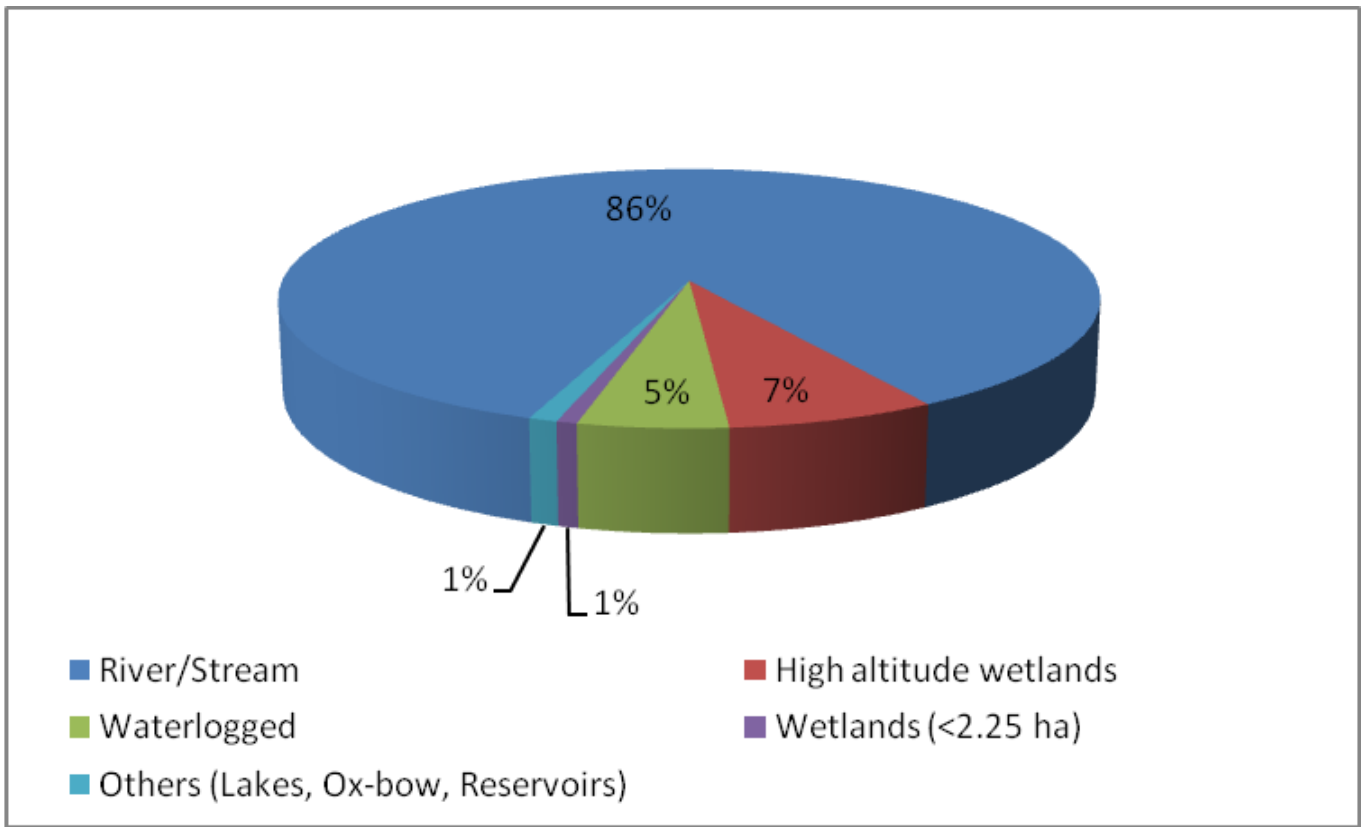



Figure 35: Type-wise wetland distribution in Arunachal Pradesh

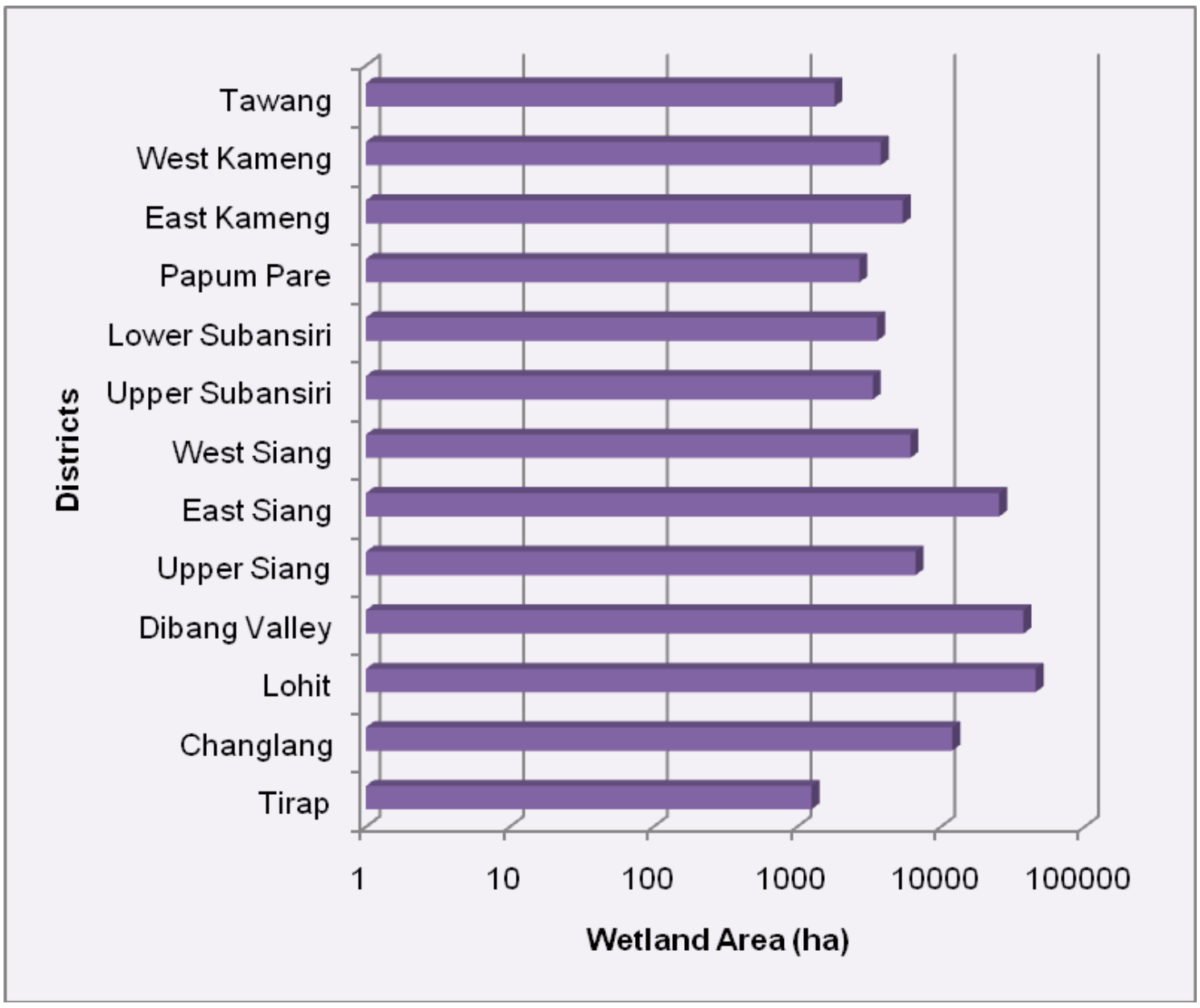



Figure 36: District-wise graphical distribution of wetlands in Arunachal Pradesh

Table 42: District-wise area of wetlands in Arunachal Pradesh

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Tawang | 2172 | 1822 | 1.17 | 0.84 | 1718 | 1661 | - | - | 1698 | 2 | 18 | 1661 | - | - |
| 2 | West Kameng | 7422 | 3825 | 2.46 | 0.52 | 2964 | 2969 | - | - | 2673 | 239 | 52 | 2969 | - | - |
| 3 | East Kameng | 4134 | 5443 | 3.50 | 1.32 | 3572 | 3524 | - | - | 2507 | 724 | 341 | 3524 | - | - |
| 4 | Papum Pare | 2875 | 2718 | 1.75 | 0.95 | 1748 | 2013 | - | - | 1390 | 202 | 156 | 1934 | 79 | - |
| 5 | Lower Subansiri | 10125 | 3607 | 2.32 | 0.36 | 3193 | 3023 | - | - | 2665 | 271 | 257 | 3023 | - | - |
| 6 | Upper Subansiri | 7032 | 3365 | 2.16 | 0.48 | 2924 | 2447 | - | - | 2800 | 109 | 15 | 2426 | 21 | - |
| 7 | West Siang | 8325 | 6147 | 3.95 | 0.74 | 4644 | 5007 | - | - | 2291 | 2089 | 264 | 3665 | 448 | 894 |
| 8 | East Siang | 4005 | 25512 | 16.38 | 6.37 | 11041 | 7848 | 554 | 244 | 10720 | 321 | - | 7152 | 321 | 375 |
| 9 | Upper Siang | 10113 | 6686 | 4.29 | 0.66 | 5314 | 3884 | - | - | 3670 | 1538 | 106 | 3260 | 620 | 4 |
| 10 | Dibang Valley | 13029 | 37605 | 24.15 | 2.89 | 12682 | 9623 | 382 | 23 | 10708 | 1927 | 47 | 1103 | 7628 | 892 |
| 11 | Lohit | 11402 | 45719 | 29.36 | 4.01 | 11676 | 10695 | 4208 | 4724 | 11496 | 180 | - | 10624 | 71 | - |
| 12 | Changlang | 4662 | 12017 | 7.72 | 2.58 | 3543 | 3642 | 851 | 928 | 2668 | 364 | 511 | 3289 | 353 | - |
| 13 | Tirap | 2362 | 1262 | 0.81 | 0.53 | 1203 | 1180 | 7 | 5 | 1185 | 18 | - | 1180 | - | - |
| | **Total** | **87658** | **155728** | **100.00** | **1.78** | **66222** | **57516** | **6002** | **5924** | **56471** | **7984** | **1767** | **45810** | **9541** | **2165** |

* Data Source: http://nic.in

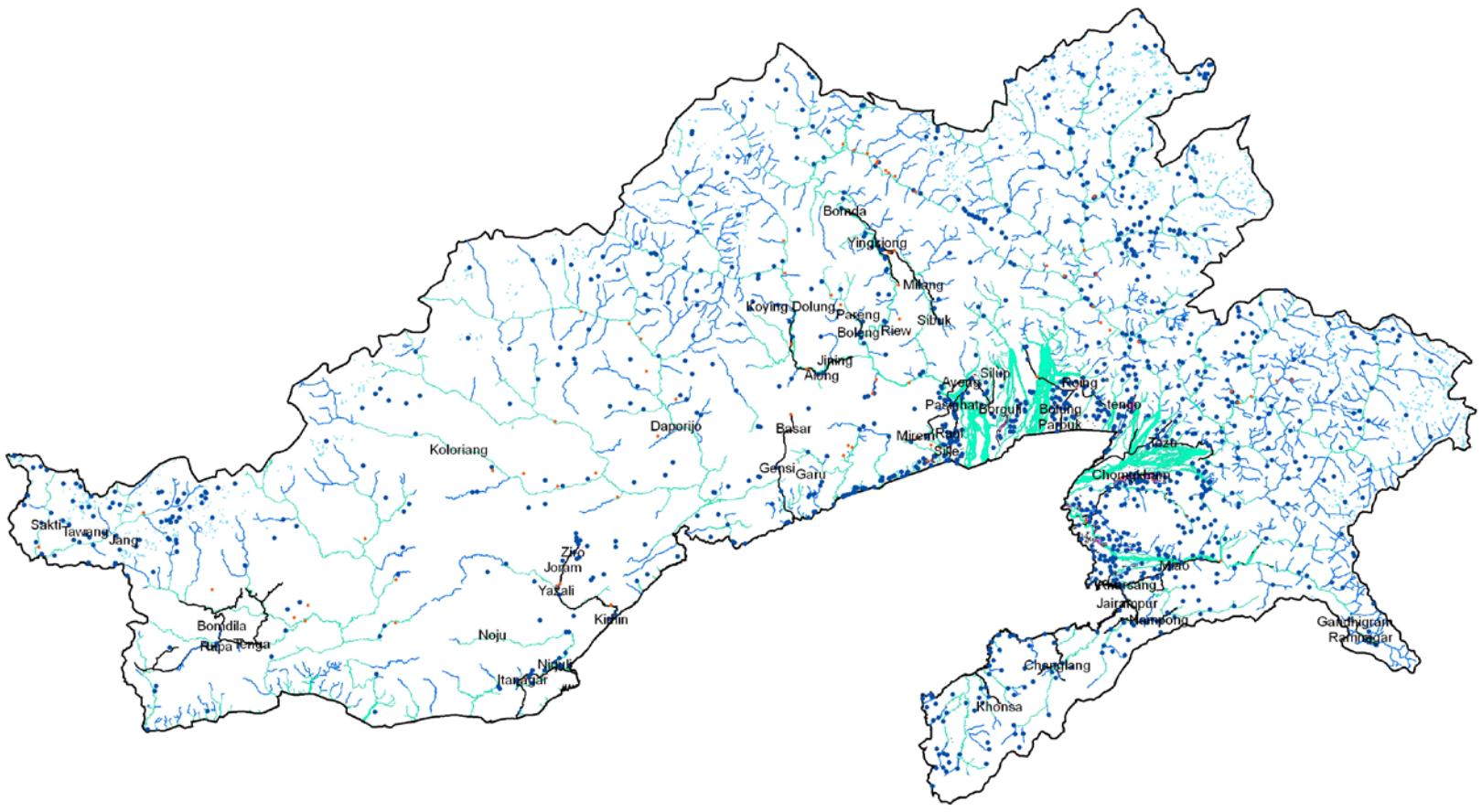
Table 43: District-wise area of wetlands (type-wise) in Arunachal Pradesh

| District code | District | Geographic area * | Wetland Type | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1103 | 1105 | 1106 | 1201 | 1202 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | High altitude wetland | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Tawang | 2172 | - | - | 1084 | - | 680 | - | - | 1764 | 58 | 1822 |
| 2 | West Kameng | 7422 | - | - | 421 | - | 3381 | - | - | 3802 | 23 | 3825 |
| 3 | East Kameng | 4134 | - | - | 215 | - | 5216 | - | - | 5431 | 12 | 5443 |
| 4 | Papum Pare | 2875 | - | - | - | - | 2681 | 9 | - | 2690 | 28 | 2718 |
| 5 | Lower Subansiri | 10125 | - | - | 241 | - | 3322 | - | - | 3563 | 44 | 3607 |
| 6 | Upper Subansiri | 7032 | 11 | - | 577 | - | 2749 | - | - | 3337 | 28 | 3365 |
| 7 | West Siang | 8325 | - | - | 368 | - | 5703 | - | 4 | 6075 | 72 | 6147 |
| 8 | East Siang | 4005 | - | 50 | - | 634 | 24648 | - | 50 | 25382 | 130 | 25512 |
| 9 | Upper Siang | 10113 | - | - | 567 | - | 6070 | - | - | 6637 | 49 | 6686 |
| 10 | Dibang Valley | 13029 | - | 7 | 5291 | 397 | 31503 | 120 | 21 | 37339 | 266 | 37605 |
| 11 | Lohit | 11402 | 7 | 290 | 2640 | 5525 | 36967 | 35 | 15 | 45479 | 240 | 45719 |
| 12 | Changlang | 4662 | - | 155 | 18 | 1583 | 10144 | - | - | 11900 | 117 | 12017 |
| 13 | Tirap | 2362 | - | 18 | - | 7 | 1180 | - | 5 | 1210 | 52 | 1262 |
| | **Total** | **87658** | **18** | **520** | **11422** | **8146** | **134244** | **164** | **95** | **154609** | **1119** | **155728** |

* Data Source: http://nic.in

State : Arunachal Pradesh

# WETLAND MAP

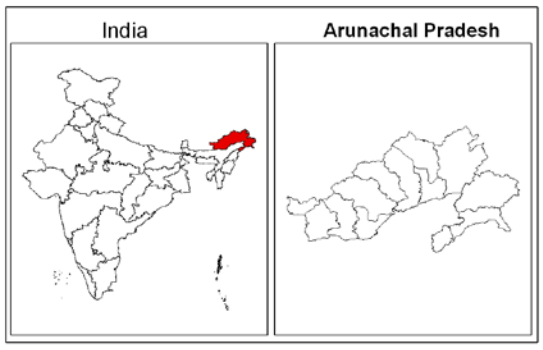



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Riverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 15 30 60 90 Kilometers

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

**Prepared By :**
Space Applications Centre (ISRO), Ahmedabad

**Sponsored By:**
Ministry of Environment and Forests
Government of India

Plate 34 : Wetland map of Arunachal Pradesh

### 8.1.13 Nagaland

The estimated wetland area of the state is 21544 ha area, that includes 267 small wetlands (< 2.25 ha). River/Stream is the single most dominant wetland type of the state with 89.37% contribution. Among, other wetland types, reservoir/barrage is the major one. Two reservoirs are mapped with 1547 ha area (7.18%). Only one natural lake/pond is mapped with 3 ha area. Area estimates of wetlands in the state is given in Table 44. Graphical distribution of wetland type is shown in Figure 37.

Aquatic vegetation in the wetlands is negligible during post-monsoon, while it occupied 604 ha area during pre-monsoon. The open water spread of river/stream is almost same in both the seasons, indicating perennial condition. The open water in reservoir/barrage is slightly less during pre-monsoon than during post-monsoon. The turbidity of water is mainly high in both the seasons. Wetland map of the state is shown in Plate 35.

Table 44: Area estimates of wetlands in Nagaland

Area in ha

| Sr. No. | Wettcode | Category | Number | Total wetland area | % of wetland area | Open Water | |
|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon area | Pre-monsoon area |
| | **1100** | **Inland Wetlands - Natural** | | | | | |
| 1 | 1101 | Lake/Pond | 1 | 3 | 0.01 | 1 | 1 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 3 | 9 | 0.04 | 9 | 3 |
| 3 | 1105 | Waterlogged | 90 | 423 | 1.96 | 351 | 283 |
| 4 | 1106 | River/Stream | 50 | 19254 | 89.37 | 19254 | 19254 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 5 | 1201 | Reservoir/Barrage | 2 | 1547 | 7.18 | 1287 | 1083 |
| 6 | 1202 | Tank/Pond | 8 | 41 | 0.19 | 36 | 26 |
| | | **Total - Inland** | **154** | **21277** | **98.76** | **20938** | **20650** |
| | | **Sub-Total** | **154** | **21277** | **98.76** | **20938** | **20650** |
| | | Wetlands (<2.25 ha) | 267 | 267 | 1.24 | - | - |
| | | **Total** | **421** | **21544** | **100.00** | **20938** | **20650** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 7 | 604 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 2243 | 1065 |
| Moderate | 8071 | 7926 |
| High | 10624 | 11659 |

**District-wise wetland area estimates in Nagaland**

The state has eleven districts. The geographic area of the districts varied from 563 sq.km. (Longleng) to 216 sq.km. (Mon). District Wokha has highest concentration of wetlands with 2946 ha area. District Kiphire has lowest concentration of wetland with 860 ha area. Dimapur district has highest concentration of small wetlands (<2.25 ha area). District-wise wetland area estimates is given in Table 45. The graphical distribution of district-wise wetland area is shown in Figure 38. District-wise area of wetlands (type-wise) in the state is given in Table 46.

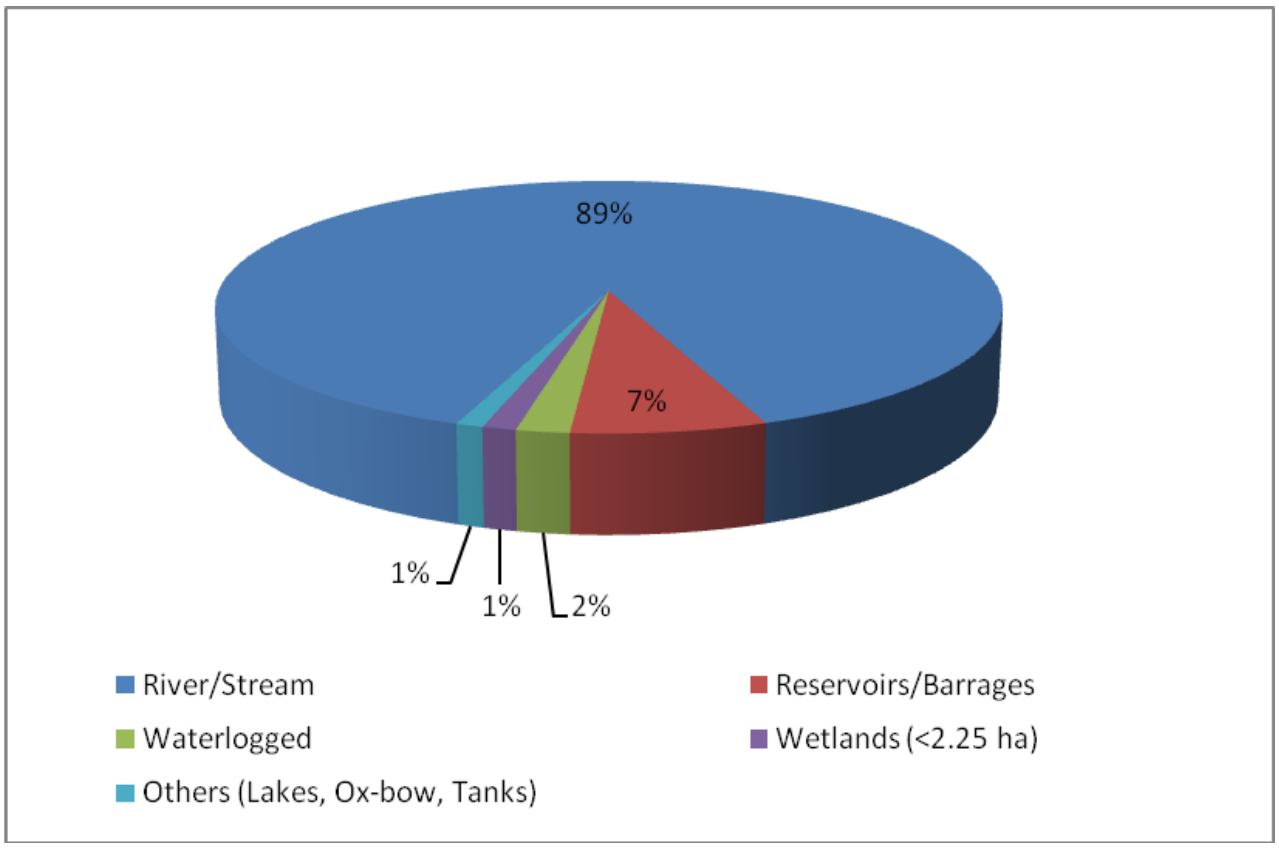



Figure 37: Type-wise wetland distribution in Nagaland

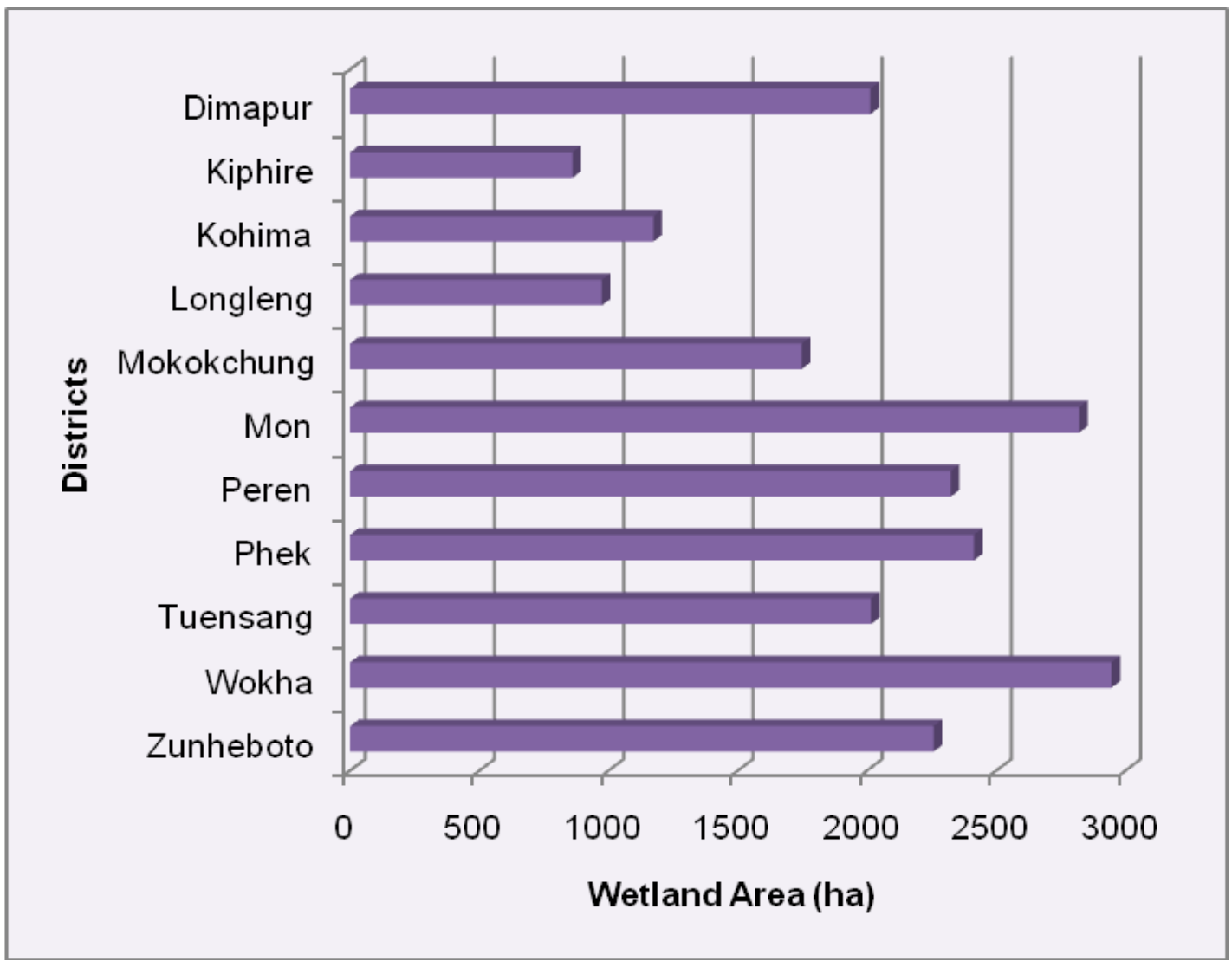



Figure 38: District-wise graphical distribution of wetlands in Nagaland

Table 45: District-wise area of wetlands in Nagaland

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Dimapur | 927 | 2013 | 9.34 | 2.17 | 1835 | 1756 | 4 | 105 | 25 | 1446 | 364 | 20 | 1403 | 333 |
| 2 | Kiphire | 1162 | 860 | 3.99 | 0.74 | 857 | 857 | - | - | - | 267 | 590 | - | 267 | 590 |
| 3 | Kohima | 1322 | 1173 | 5.44 | 0.89 | 1162 | 1162 | - | 2 | 42 | 613 | 507 | 42 | 408 | 712 |
| 4 | Longleng | 563 | 974 | 4.52 | 1.73 | 971 | 971 | - | - | - | 465 | 506 | - | 465 | 506 |
| 5 | Mokokchung | 1605 | 1747 | 8.11 | 1.09 | 1722 | 1720 | 1 | 12 | 5 | 524 | 1193 | 6 | 521 | 1193 |
| 6 | Mon | 2162 | 2820 | 13.09 | 1.30 | 2802 | 2797 | - | 5 | 2 | 288 | 2512 | - | 285 | 2512 |
| 7 | Peren | 1740 | 2324 | 10.79 | 1.34 | 2291 | 2296 | - | 1 | 1 | 1068 | 1222 | 1 | 1073 | 1222 |
| 8 | Phek | 2026 | 2414 | 11.20 | 1.19 | 2407 | 2407 | - | 3 | 4 | 1139 | 1264 | 4 | 1139 | 1264 |
| 9 | Tuensang | 2142 | 2015 | 9.35 | 0.94 | 2013 | 2013 | - | - | - | 409 | 1604 | - | 409 | 1604 |
| 10 | Wokha | 1618 | 2946 | 13.67 | 1.82 | 2636 | 2429 | 2 | 476 | 1310 | 1207 | 119 | 138 | 1311 | 980 |
| 11 | Zunheboto | 1255 | 2258 | 10.48 | 1.80 | 2242 | 2242 | - | - | 854 | 645 | 743 | 854 | 645 | 743 |
| | **Total** | **16521** | **21544** | **100.00** | **1.30** | **20938** | **20650** | **7** | **604** | **2243** | **8071** | **10624** | **1065** | **7926** | **11659** |

* Data Source: http://nic.in

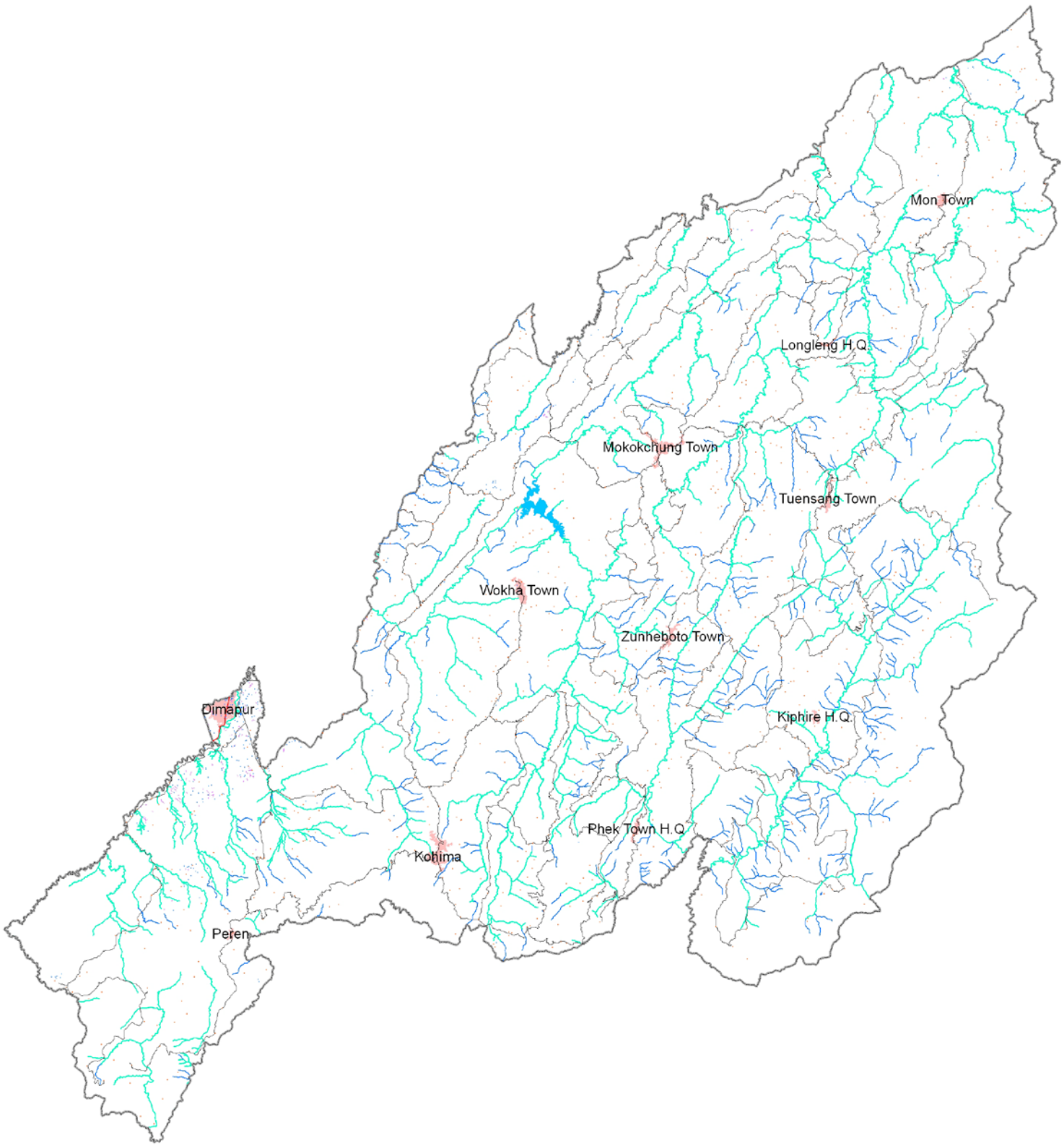
Table 46: District-wise area of wetlands (type-wise) in Nagaland

| District code | District | Geographic area * | Wetland Type | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1105 | 1106 | 1201 | 1202 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | | | |
| | | (sq. km.) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Dimapur | 927 | - | 3 | 334 | 1494 | 11 | 41 | 1883 | 130 | 2013 |
| 2 | Kiphire | 1162 | - | - | - | 857 | - | - | 857 | 3 | 860 |
| 3 | Kohima | 1322 | 3 | - | - | 1161 | - | - | 1164 | 9 | 1173 |
| 4 | Longleng | 563 | - | - | - | 971 | - | - | 971 | 3 | 974 |
| 5 | Mokokchung | 1605 | - | - | 20 | 1713 | - | - | 1733 | 14 | 1747 |
| 6 | Mon | 2162 | - | 6 | 6 | 2792 | - | - | 2804 | 16 | 2820 |
| 7 | Peren | 1740 | - | - | 16 | 2281 | - | - | 2297 | 27 | 2324 |
| 8 | Phek | 2026 | - | - | 15 | 2394 | - | - | 2409 | 5 | 2414 |
| 9 | Tuensang | 2142 | - | - | - | 2013 | - | - | 2013 | 2 | 2015 |
| 10 | Wokha | 1618 | - | - | 32 | 1336 | 1536 | - | 2904 | 42 | 2946 |
| 11 | Zunheboto | 1255 | - | - | - | 2242 | - | - | 2242 | 16 | 2258 |
| | **Total** | **3973.82** | **3** | **9** | **423** | **19254** | **1547** | **41** | **21277** | **267** | **21544** |

* Data Source: http://nic.in

State : Nagaland

# WETLAND MAP

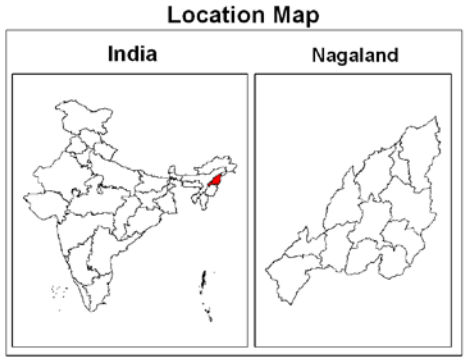



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Riverline wetlands |
| | 1105 | | | Waterlogged |
| | 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 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

**Prepared by:**
Space Application Centre (ISRO), Ahmedabad
and
Nagaland Science & Technology Council (NASTEC), Kohima

**Sponsored by:**
Ministry of Environment and Forests
Government of India

Plate 35 : Wetland map of Nagaland

### 8.1.14 Manipur

Total 167 wetlands have been mapped at 1:50,000 scale in the state. In addition, 541 wetlands (smaller than 2.25 ha) have also been identified. Total wetland area estimated is 63616 ha that is around 2.85 per cent of the geographic area (Table 47). The major wetland types are lake/pond accounting for 62 per cent of the wetlands (39123 ha), river/stream (16677 ha), waterlogged (3525 ha) and aquaculture pond (2643 ha). Graphical distribution of wetland type is shown in Figure 39.

Analysis of wetland status in terms of open water and aquatic vegetation showed that around 71 and 62 per cent of wetland area is under open water category during post-monsoon and pre-monsoon respectively. Aquatic vegetation (floating/emergent) occupies around 26 and 37 per cent of wetland area during post-monsoon and pre-monsoon respectively. Qualitative turbidity analysis of the open water showed that low and moderate turbidity prevail (around 39 and 59 per cent respectively during post-monsoon). Wetland map of the state is shown in Plate 36.

Table 47: Area estimates of wetlands in Manipur

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 | Lake/Pond | 15 | 39123 | 61.50 | 22300 | 17276 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 9 | 64 | 0.10 | 59 | 64 |
| 3 | 1105 | Waterlogged | 61 | 3525 | 5.54 | 2845 | 2191 |
| 4 | 1106 | River/Stream | 15 | 16677 | 26.22 | 16677 | 16677 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 5 | 1201 | Reservoir/Barrage | 3 | 856 | 1.35 | 856 | 657 |
| 6 | 1202 | Tank/Pond | 53 | 187 | 0.29 | 184 | 187 |
| | | **Total - Inland** | **156** | **60432** | **94.99** | **42921** | **37052** |
| | **2200** | **Coastal Wetlands - Man-made** | | | | | |
| 7 | 2202 | Aquaculture pond | 11 | 2643 | 4.15 | 2383 | 2339 |
| | | **Total - Coastal** | **11** | **2643** | **4.15** | **2383** | **2339** |
| | | **Sub-Total** | **167** | **63075** | **99.15** | **45304** | **39391** |
| | | Wetlands (<2.25 ha) | 541 | 541 | 0.85 | - | - |
| | | **Total** | **708** | **63616** | **100.00** | **45304** | **39391** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 16756 | 23500 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 17866 | 17261 |
| Moderate | 26911 | 21841 |
| High | 527 | 289 |

### District-wise wetland area estimates in Manipur

The state has nine districts. District-wise distribution of wetlands showed that three districts can be called as wetland rich. Bishnupur has highest concentration with around 30.7 per cent of geographic area under wetland. This is mainly due to the location of the famous Loktok lake. The other two districts are: Thoubal and Imphal West with around 30.3 and 2.6 per cent area under wetland. Chandel district has the lowest area under wetland (around 0.44 per cent). Wetland category of aquaculture pond was observed only in Bishnupur and Imphal West district, mainly due to the presence of the Loktak lake. Only three reservoir/barrages are observed. District-wise wetland area estimates is given in Table 48. Figure 40 shows district-wise graphical distribution of wetlands. District-wise area of wetlands (type-wise) in the state is given in Table 49.

The districts with very high concentration of small wetlands (< 2.25 ha) are Senapati and Thoubal with 120 and 91 numbers respectively, while Chandel district has lowest with 25 such wetlands.

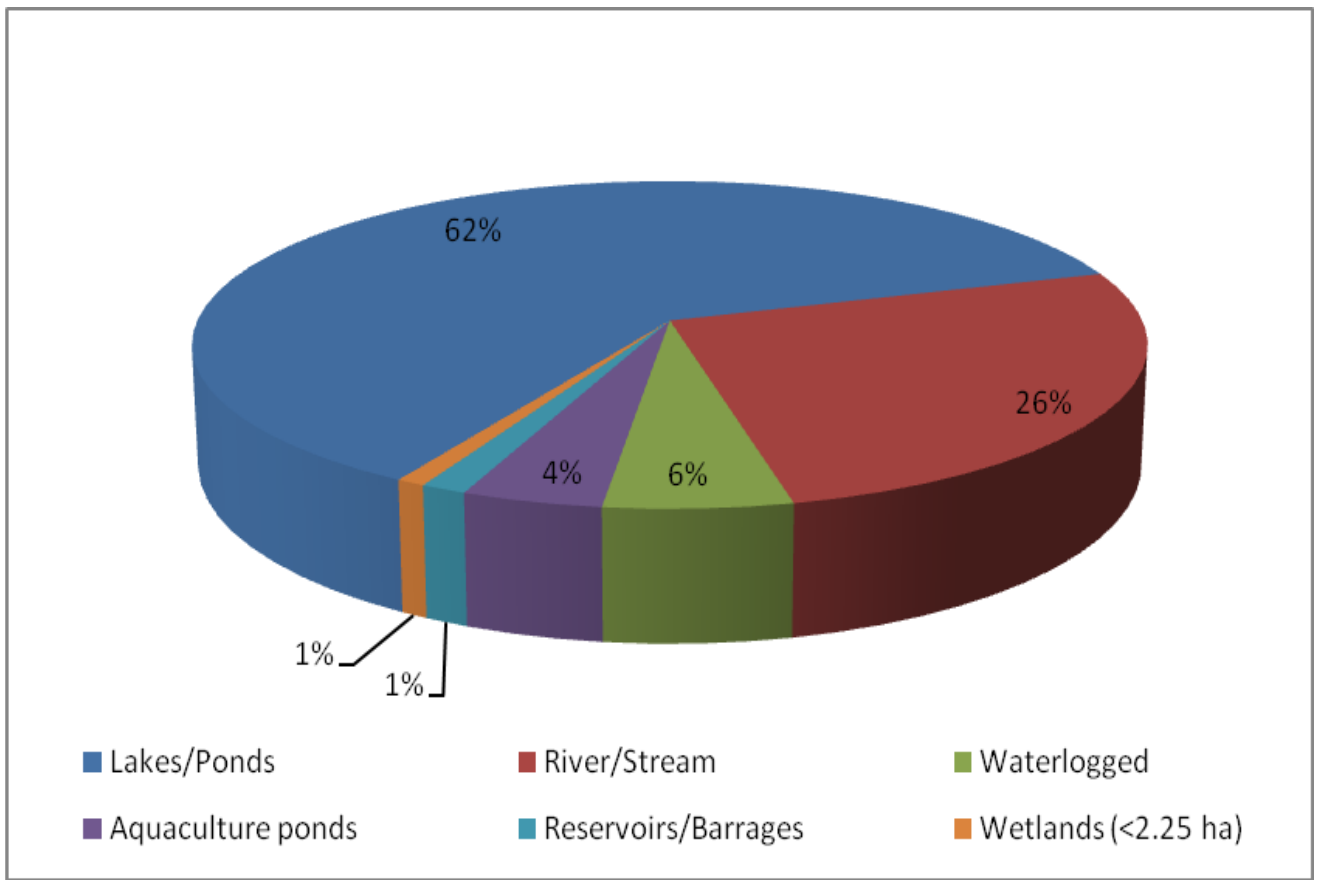



Figure 39: Type-wise wetland distribution in Manipur

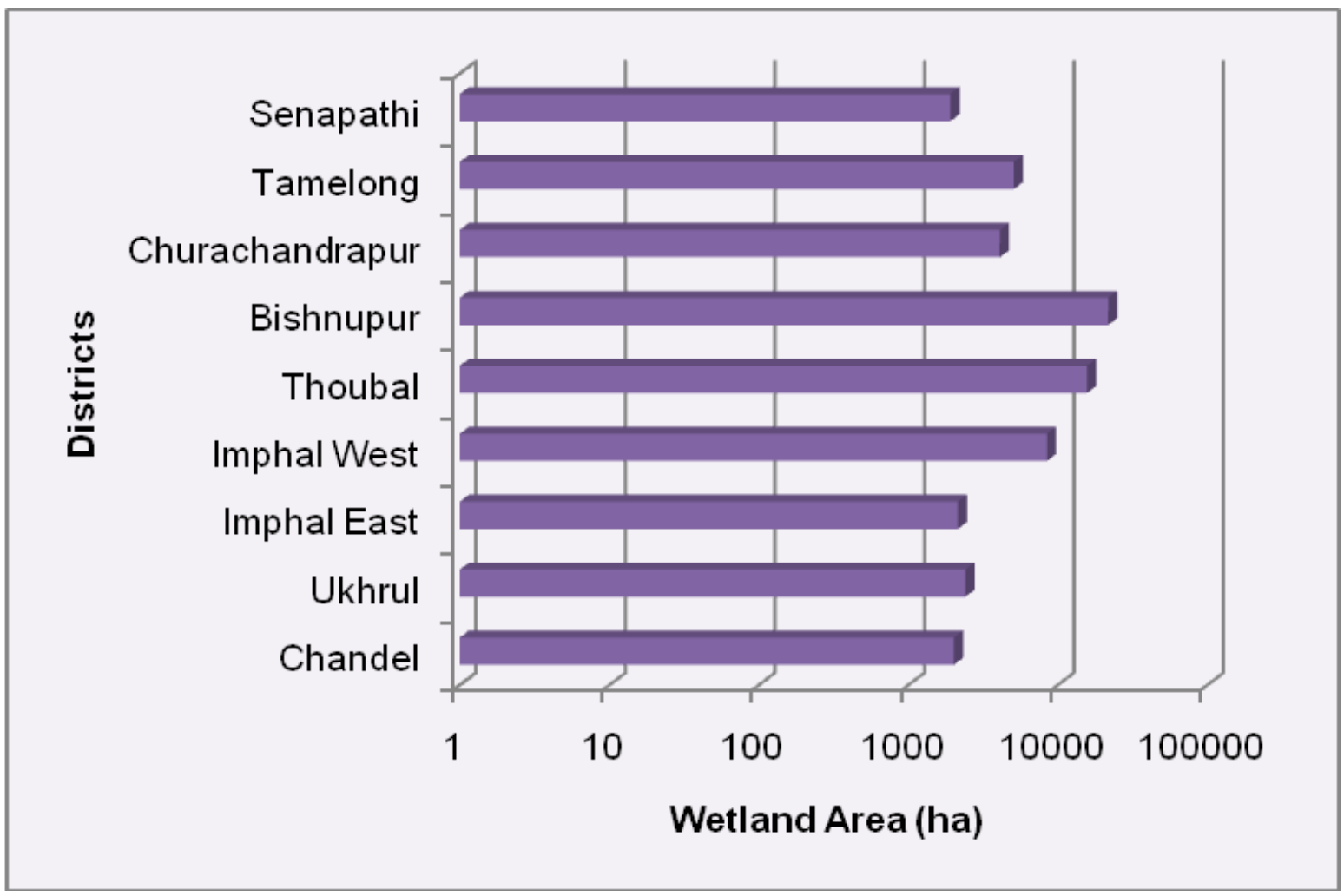



Figure 40: District-wise graphical distribution of wetlands in Manipur

Table 48: District-wise area of wetlands in Manipur

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Senapathi | 496 | 1911 | 3.00 | 3.85 | 1791 | 1784 | - | - | 1767 | 24 | - | 1760 | 24 | - |
| 2 | Tamelong | 3313 | 5086 | 7.99 | 1.54 | 5039 | 5039 | - | - | 4959 | 80 | - | 4959 | 80 | - |
| 3 | Churachandrapur | 4570 | 4102 | 6.45 | 0.90 | 4046 | 3854 | - | - | 4034 | 4 | 8 | 3842 | 4 | 8 |
| 4 | Bishnupur | 709 | 21753 | 34.19 | 30.68 | 14108 | 13872 | 7541 | 7943 | 369 | 13739 | - | 369 | 13503 | - |
| 5 | Thoubal | 519 | 15718 | 24.71 | 30.29 | 9610 | 3509 | 5907 | 12136 | 1259 | 8110 | 241 | 854 | 2655 | - |
| 6 | Imphal West | 3271 | 8470 | 13.31 | 2.59 | 4795 | 5186 | 3011 | 3231 | 418 | 4150 | 227 | 417 | 4544 | 225 |
| 7 | Imphal East | 4391 | 2149 | 3.38 | 0.49 | 1569 | 1801 | 297 | 190 | 737 | 795 | 37 | 737 | 1022 | 42 |
| 8 | Ukhrul | 514 | 2411 | 3.79 | 4.69 | 2355 | 2355 | - | - | 2348 | 7 | - | 2348 | 7 | - |
| 9 | Chandel | 4544 | 2016 | 3.17 | 0.44 | 1991 | 1991 | - | - | 1975 | 2 | 14 | 1975 | 2 | 14 |
| | **Total** | **22327** | **63616** | **100.00** | **2.85** | **45304** | **39391** | **16756** | **23500** | **17866** | **26911** | **527** | **17261** | **21841** | **289** |

* Data Source: http://nic.in

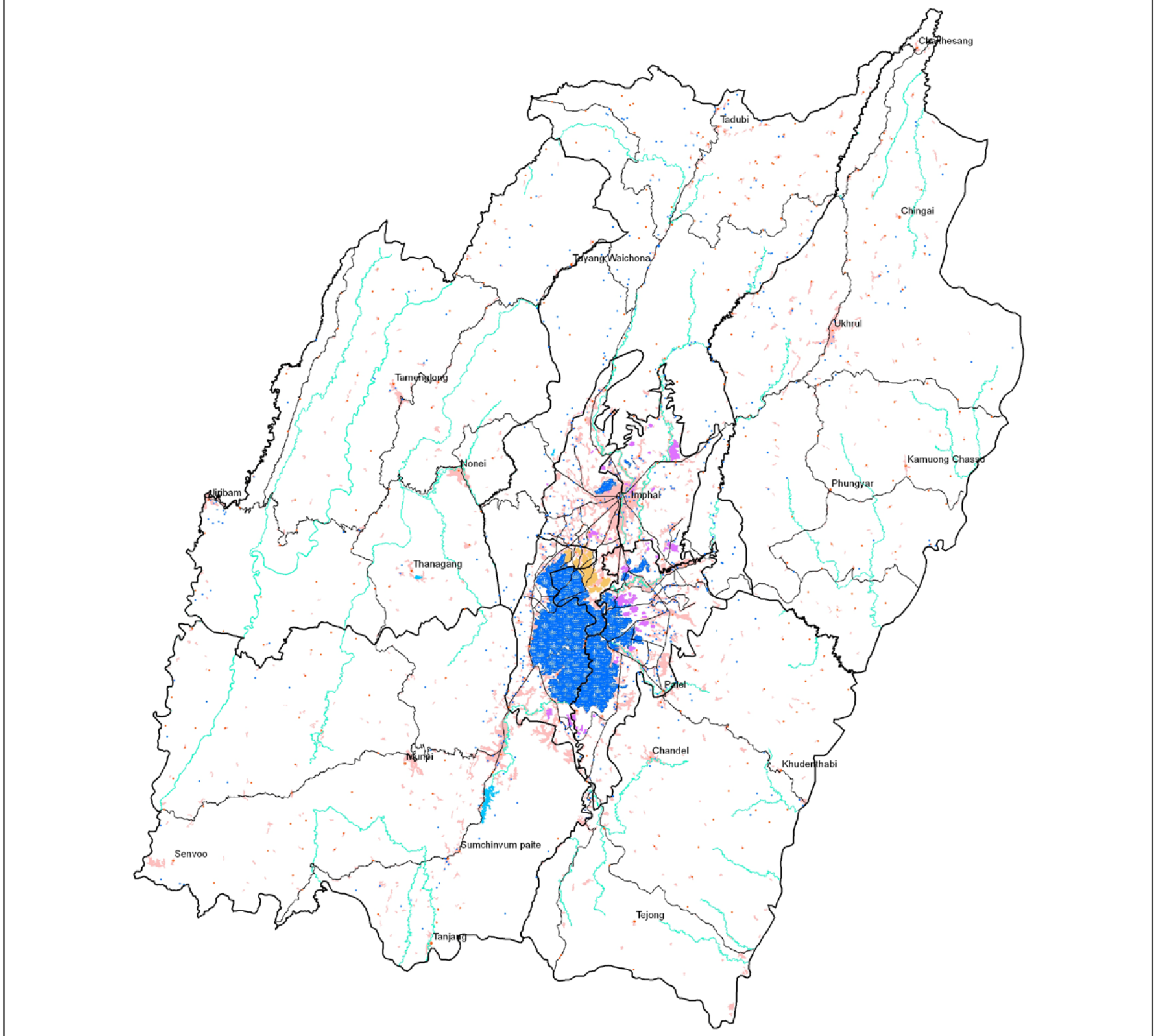
Table 49: District-wise area of wetlands (type-wise) in Manipur

| District code | District | Geographic area * | Wetland Type | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1105 | 1106 | 1201 | 1202 | 2202 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Aquaculture pond | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Senapathi | 496 | - | - | 13 | 1723 | 43 | 12 | - | 1791 | 120 | 1911 |
| 2 | Tamelong | 3313 | - | - | - | 4959 | 73 | 7 | - | 5039 | 47 | 5086 |
| 3 | Churachandrapur | 4570 | - | 8 | - | 3294 | 740 | 4 | - | 4046 | 56 | 4102 |
| 4 | Bishnupur | 709 | 19900 | - | 283 | 369 | - | 37 | 1121 | 21710 | 43 | 21753 |
| 5 | Thoubal | 519 | 12875 | - | 1829 | 854 | - | 69 | - | 15627 | 91 | 15718 |
| 6 | Imphal West | 3271 | 6242 | - | 223 | 418 | - | 13 | 1522 | 8418 | 52 | 8470 |
| 7 | Imphal East | 4391 | 106 | 42 | 1177 | 737 | - | 36 | - | 2098 | 51 | 2149 |
| 8 | Ukhrul | 514 | - | - | - | 2348 | - | 7 | - | 2355 | 56 | 2411 |
| 9 | Chandel | 4544 | - | 14 | - | 1975 | - | 2 | - | 1991 | 25 | 2016 |
| | **Total** | **9088** | **39123** | **64** | **3525** | **16677** | **856** | **187** | **2643** | **63075** | **541** | **63616** |

* Data Source: http://nic.in

State : Manipur

# WETLAND MAP

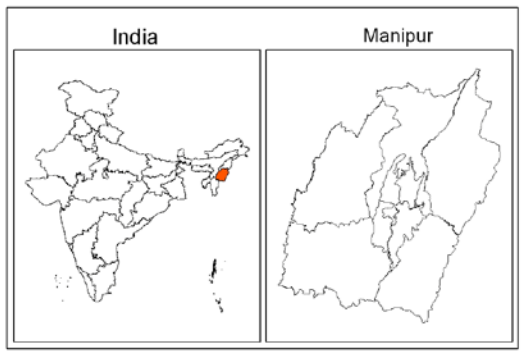



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Riverine wetlands |
| | 1105 | | | Waterlogged |
| | 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
- Canal
- Railway
- Drainage (line)
- Roads
- 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

**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 36: Wetland map of Manipur

### 8.1.15 Mizoram

In the state of Mizoram, 82 wetlands have been delineated, in addition, 146 small wetlands (<2.25 ha) have also been identified. Total wetland area estimated is 13988 ha (Table 50). Graphical distribution of wetland type is shown in Figure 41. Wetland map of the state is shown in Plate 37.

Table 50: Area estimates of wetlands in Mizoram

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 | Lake/Pond | 25 | 185 | 1.32 | 153 | 149 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | - | - | - | - | - |
| 3 | 1103 | High altitude wetland | - | - | - | - | - |
| 4 | 1104 | Riverine wetland | - | - | - | - | - |
| 5 | 1105 | Waterlogged | 15 | 133 | 0.95 | 122 | 105 |
| 6 | 1106 | River/Stream | 46 | 13497 | 96.49 | 13497 | 13497 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 2 | 27 | 0.19 | 27 | 27 |
| 8 | 1202 | Tank/Pond | - | - | - | - | - |
| 9 | 1203 | Waterlogged | - | - | - | - | - |
| 10 | 1204 | Salt pan | - | - | - | - | - |
| | | **Sub-Total** | **88** | **13842** | **98.96** | **13799** | **13778** |
| | | Wetlands (<2.25 ha) | 146 | 146 | 1.04 | - | - |
| | | **Total** | **234** | **13988** | **100.00** | **13799** | **13778** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 37 | 42 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 13755 | 13722 |
| Moderate | 44 | 56 |
| High | - | - |

**District-wise wetland area estimates in Mizoram**

The state has eight districts. Luinglei district covers the maximum wetland area (22.78%). A major portion of wetland areas are observed in Mamit, Lawngtlai, Saiha and in Aizawl. Champhai, Serchhip and Kolasib district covers small portion of wetland area. District-wise wetland area estimates is given in Table 51. The graphical distribution of district-wise wetland area is shown in Figure 42. District-wise area of wetlands (type-wise) in the state is given in Table 52.

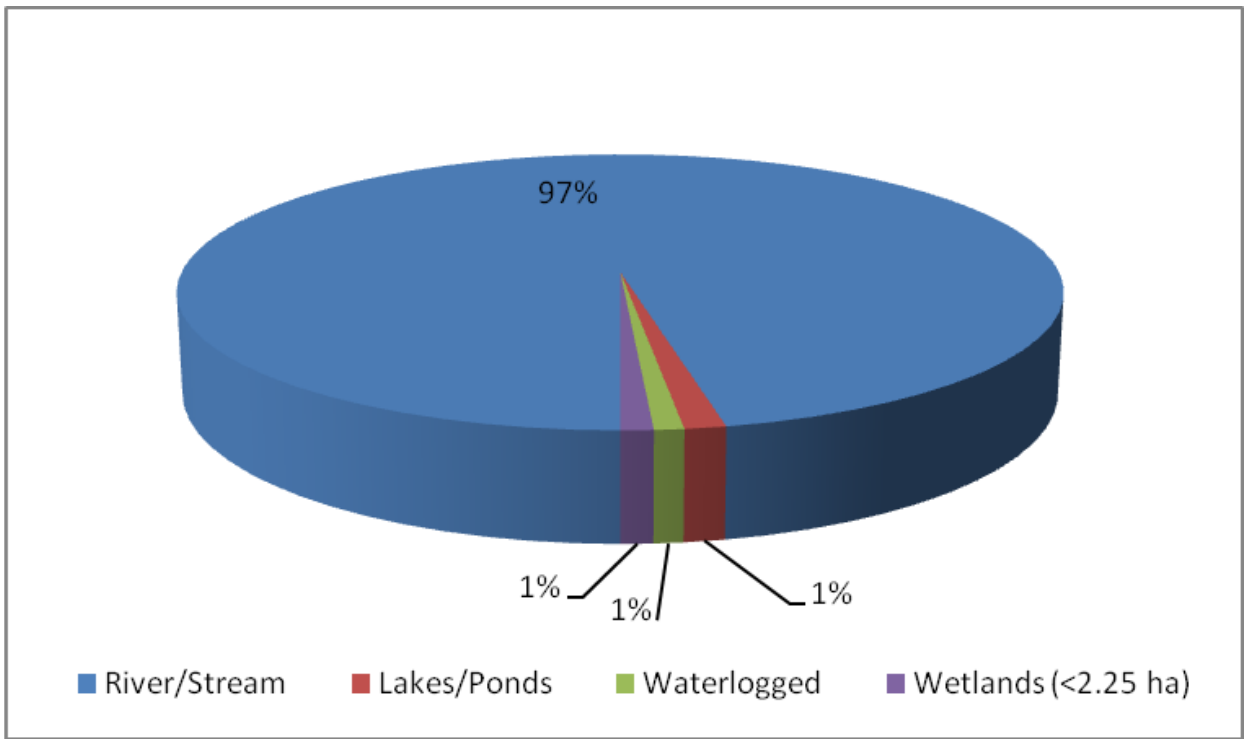



Figure 41: Type-wise wetland distribution in Mizoram

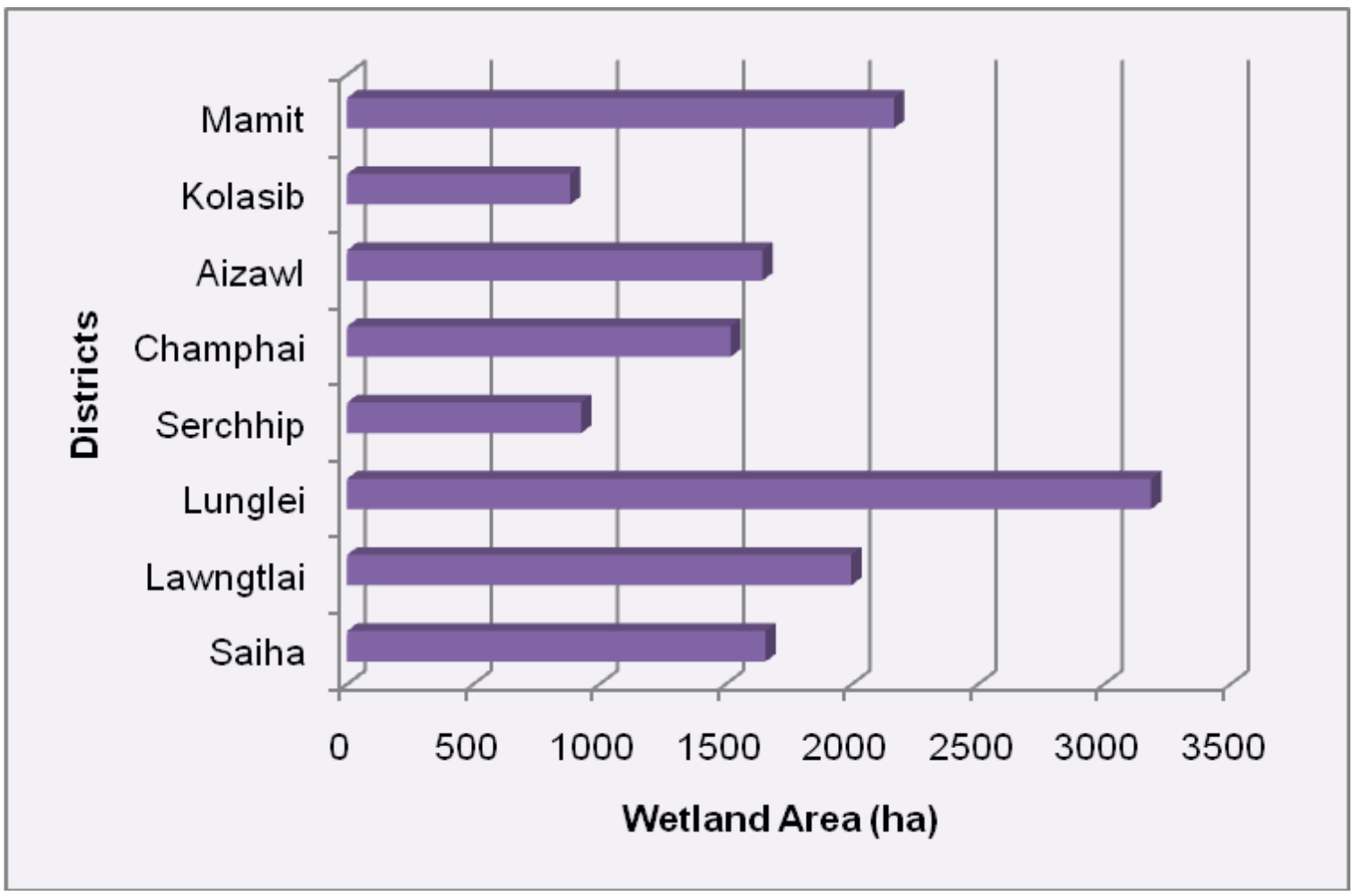



Figure 42: District-wise graphical distribution of wetlands in Mizoram

Table 51: District-wise area of wetlands in Mizoram

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Mamit | 3026 | 2167 | 15.49 | 0.72 | 2103 | 2101 | - | - | 2097 | 6 | - | 2083 | 18 | - |
| 2 | Kolasib | 1383 | 884 | 6.32 | 0.64 | 834 | 820 | - | - | 834 | - | - | 820 | - | - |
| 3 | Aizawl | 3576 | 1646 | 11.77 | 0.46 | 1639 | 1639 | - | - | 1639 | - | - | 1639 | - | - |
| 4 | Champhai | 3186 | 1520 | 10.87 | 0.48 | 1517 | 1517 | - | - | 1517 | - | - | 1517 | - | - |
| 5 | Serchhip | 1422 | 928 | 6.63 | 0.65 | 927 | 927 | - | - | 927 | - | - | 927 | - | - |
| 6 | Lunglei | 4538 | 3186 | 22.78 | 0.70 | 3158 | 3153 | 12 | 17 | 3138 | 20 | - | 3135 | 18 | - |
| 7 | Lawngtlai | 2557 | 1998 | 14.28 | 0.78 | 1989 | 1989 | - | - | 1989 | - | - | 1989 | - | - |
| 8 | Saiha | 1400 | 1659 | 11.86 | 1.19 | 1632 | 1632 | 25 | 25 | 1614 | 18 | - | 1612 | 20 | - |
| | **Total** | **21088** | **13988** | **100.00** | **0.66** | **13799** | **13778** | **37** | **42** | **13755** | **44** | **-** | **13722** | **56** | **-** |

* Data Source: http://nic.in

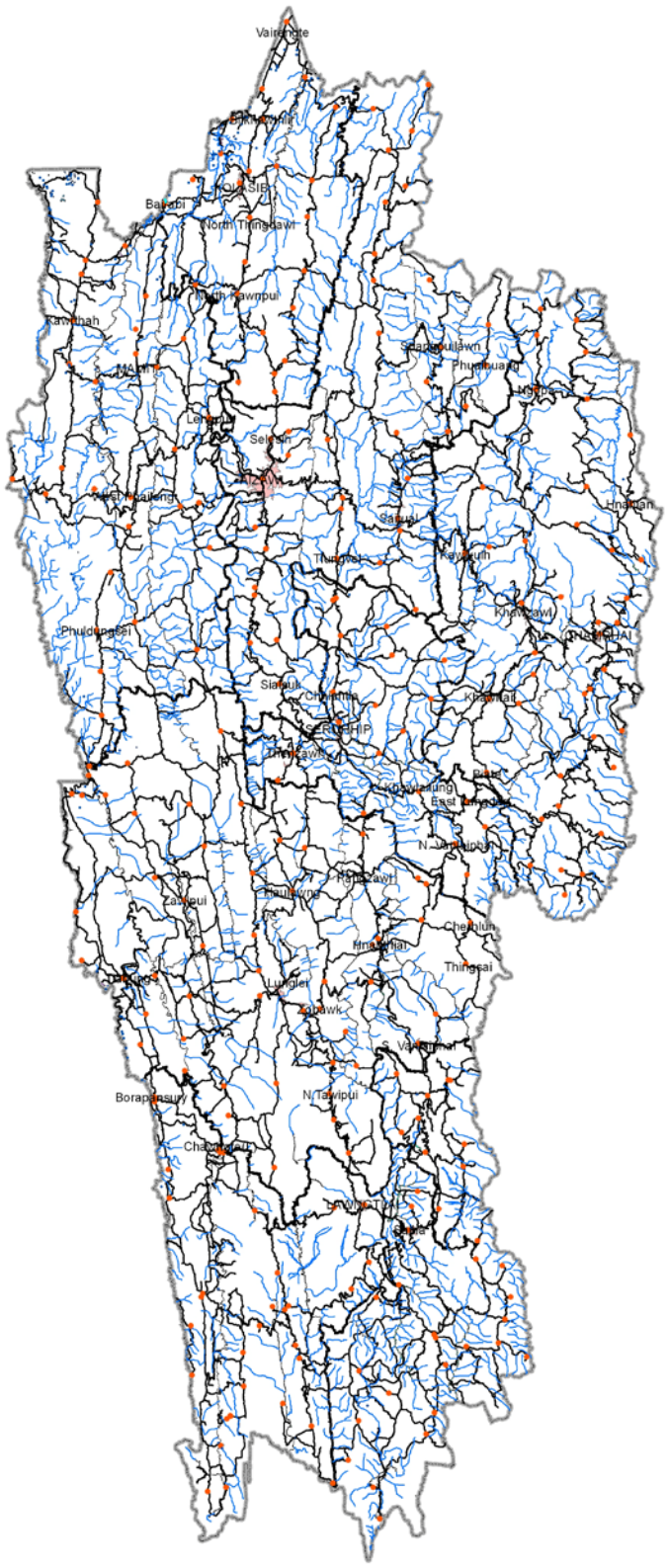
Table 52: District-wise area of wetlands (type-wise) in Mizoram

| District code | District | Geographic area * | Wetland Type | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1105 | 1106 | 1201 | | | |
| | | | Lake/ pond | Waterlogged (Natural) | River/ Stream | Reservoir Barrage | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Mamit | 3026 | 84 | 47 | 1951 | 27 | 2109 | 58 | 2167 |
| 2 | Kolasib | 1383 | 26 | 64 | 744 | - | 834 | 50 | 884 |
| 3 | Aizawl | 3576 | 10 | - | 1629 | - | 1639 | 7 | 1646 |
| 4 | Champhai | 3186 | - | - | 1517 | - | 1517 | 3 | 1520 |
| 5 | Serchhip | 1422 | - | - | 927 | - | 927 | 1 | 928 |
| 6 | Lunglei | 4538 | 22 | 22 | 3126 | - | 3170 | 16 | 3186 |
| 7 | Lawngtlai | 2557 | - | - | 1989 | - | 1989 | 9 | 1998 |
| 8 | Saiha | 1400 | 43 | - | 1614 | - | 1657 | 2 | 1659 |
| | **Total** | **11171** | **185** | **133** | **13497** | **27** | **13842** | **146** | **13988** |

* Data Source: http://nic.in

State : Mizoram

# 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)
- Railway
- Roads
- District Boundary
- State Boundary
- Towns/Settlements

**Location Map**


0 15 30 60 90 Kilometers

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

**Prepared By:**
Space Applications Centre (ISRO), Ahmedabad
and
Mizoram Remote Sensing Application Centre (MIRSAC)

**Sponsored By:**
Ministry of Environment and Forests
Government of India

Plate 37: Wetland map of Mizoram

### 8.1.16 Tripura

In the state, 432 wetlands have been mapped and 2983 small wetlands (< 2.25 ha) identified. Total wetland area estimated is 17542 ha. Inland natural wetlands dominated in the state with 63% share. The major natural wetland types are; river/stream (42.30%) and waterlogged (16.79%). There are 60 lake/pond with about 1.7% area. Under man-made wetlands, reservoir/barrage is the major wetland type with 18.93% share. Graphical distribution of wetland type is shown in Figure 43. The details of type-wise aerial extents of wetland is given in the Table 53. Wetland map of the state is shown in Plate 38.

In terms of open water area, the natural wetlands showed 6769 ha in post-monsoon and 6085 ha in pre-monsoon seasons. The reduction in open water area is mainly due to change in waterlogged. In case of man-made wetlands, the open water is 3078 ha and 938 ha respectively for post-monsoon and pre-monsoon. The reduction in open water in pre-monsoon is significant in reservoir/barrage. Lake/Pond, ox-bow lake/cut-off meander, waterlogged, river/stream, reservoir/barrage and tank/pond are the only wetland types that have vegetation. Together the all classes comprise 1779 ha in post-monsoon season while it has shown an increase to 5232 ha in pre-monsoon.

Overall six wetland types are assessed for qualitative turbidity namely; lake/pond, ox-bow lake/ cut-off meander, waterlogged, river/stream, reservoir/barrage and tank/pond. Turbidity of water in all natural wetlands is in general moderate in both the seasons. The turbidity of water in reservoir/barrage types is low to moderate in post-monsoon, while mainly moderate in pre-monsoon. Overall, the open water features of wetlands in Tripura are dominantly moderate in turbidity in both the seasons followed by low and high turbidity. Moderate turbidity constituted largest area in post-monsoon (7148 ha) out of 9847 ha of open water i.e. about 73 per cent. While in pre-monsoon it dominated the open water with 6329 ha out of 7023 ha of open water, which turns out to be about 90 per cent. Low turbidity accounted for about 27% in post-monsoon and 9% in pre-monsoon while the area under high turbidity was insignificant (about 1%) in both the seasons.

Table 53: Area estimates of wetlands in Tripura

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 | Lake/Pond | 60 | 300 | 1.71 | 180 | 153 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 78 | 387 | 2.21 | 229 | 170 |
| 3 | 1105 | Waterlogged | 244 | 2946 | 16.79 | 1872 | 647 |
| 4 | 1106 | River/Stream | 17 | 7420 | 42.30 | 4488 | 5115 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 5 | 1201 | Reservoir/Barrage | 12 | 3320 | 18.93 | 2936 | 796 |
| 6 | 1202 | Tank/Pond | 21 | 186 | 1.06 | 142 | 142 |
| | | **Sub-Total** | **432** | **14559** | **83.00** | **9847** | **7023** |
| | | Wetlands (<2.25 ha) | 2983 | 2983 | 17.00 | - | - |
| | | **Total** | **3415** | **17542** | **100.00** | **9847** | **7023** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 1779 | 5232 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 2672 | 641 |
| Moderate | 7148 | 6329 |
| High | 27 | 53 |

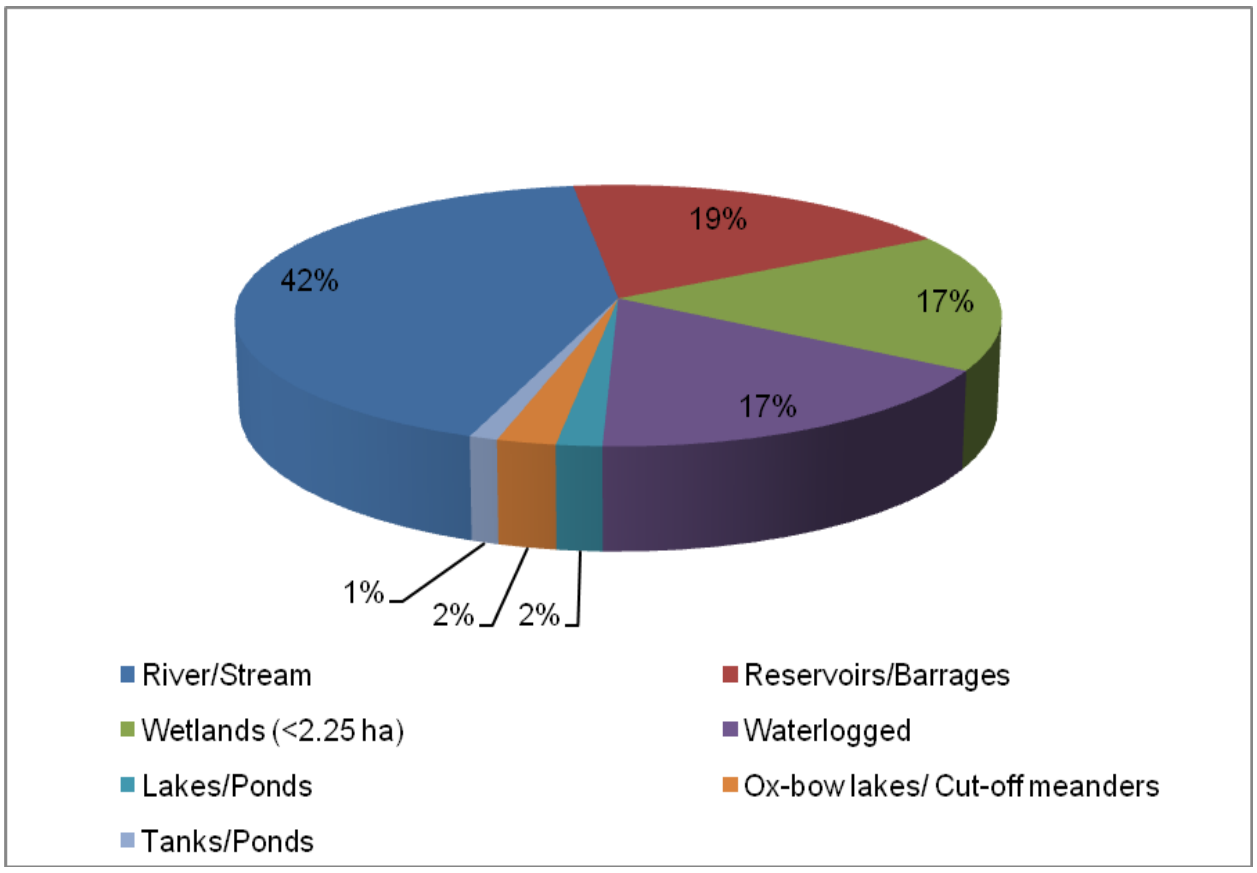



Figure 43: Type-wise wetland distribution in Tripura

## DISTRICT-WISE WETLAND MAPS AND STATISTICS

The state of Tripura has four districts, namely; West Tripura, South Tripura, Dhalai and North Tripura. The geographical extents of these districts ranging from 2152 $km^2$ (South Tripura) to 3544 $km^2$ (West Tripura). The wetlands are more or less equally distributed among the districts (Figure 44) except in North Tripura where they constitute 3404 ha (Table 54). In terms of per cent geographical area of district, the variation is about 1 ranging from a minimum of 1.21 in North Tripura to 2.13 in South Tripura (Table 54). District-wise area of wetlands (type-wise) in the state is given in Table 55.

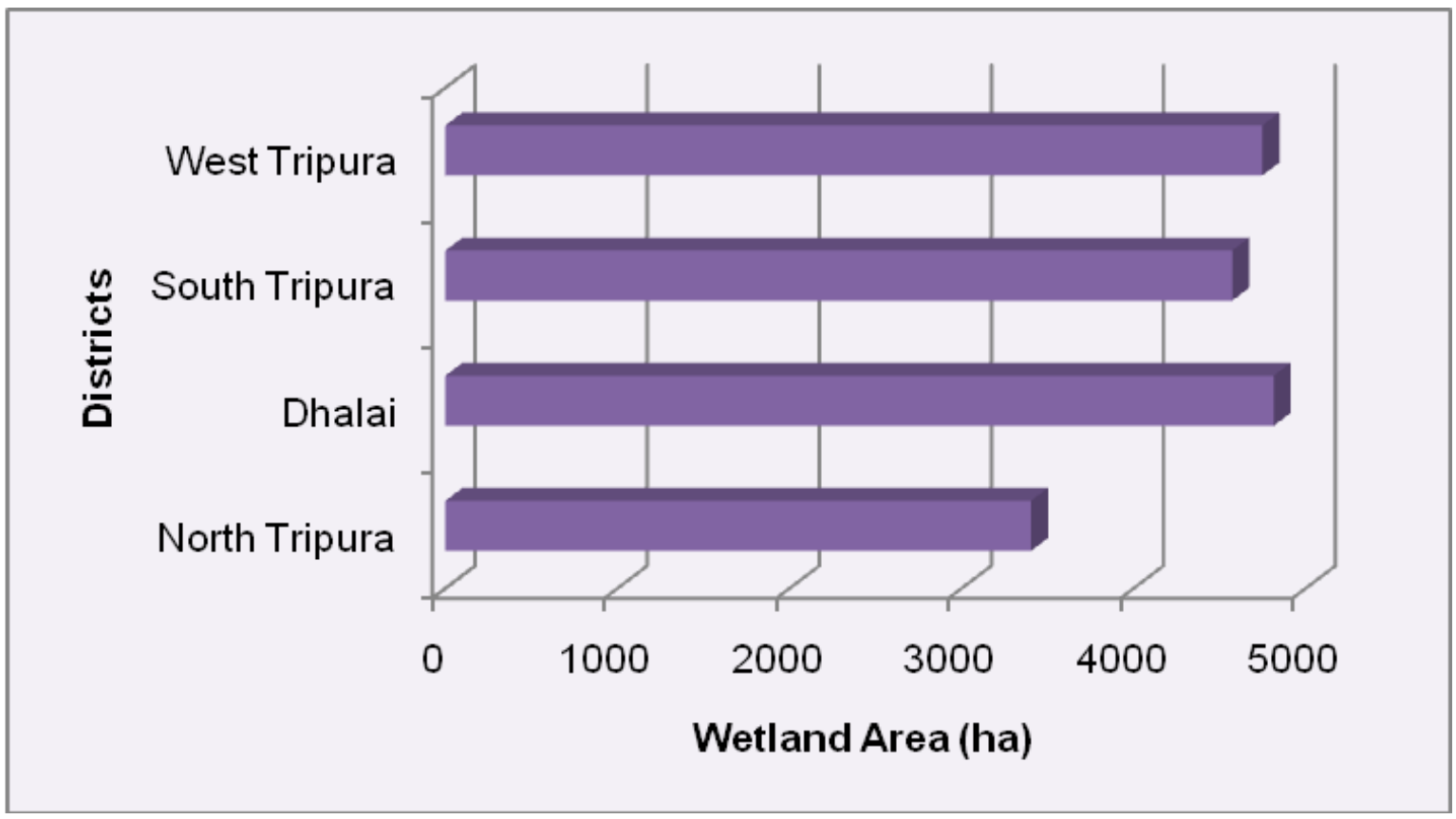



Figure 44: District-wise graphical distribution of wetlands Tripura

Table 54: District-wise area of wetlands in Tripura

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | West Tripura | 3544 | 4749 | 27.07 | 1.34 | 2430 | 1876 | 637 | 1435 | 528 | 1891 | 11 | 199 | 1625 | 52 |
| 2 | South Tripura | 2152 | 4574 | 26.07 | 2.13 | 2474 | 1799 | 526 | 1412 | 633 | 1830 | 11 | 210 | 1589 | - |
| 3 | Dhalai | 2523 | 4815 | 27.45 | 1.91 | 3361 | 1864 | 344 | 1983 | 1309 | 2047 | 5 | 166 | 1697 | 1 |
| 4 | North Tripura | 2821 | 3404 | 19.40 | 1.21 | 1582 | 1484 | 272 | 402 | 202 | 1380 | - | 66 | 1418 | - |
| | **Total** | **11040** | **17542** | **100.00** | **1.59** | **9847** | **7023** | **1779** | **5232** | **2672** | **7148** | **27** | **641** | **6329** | **53** |

* Data Source: http://nic.in

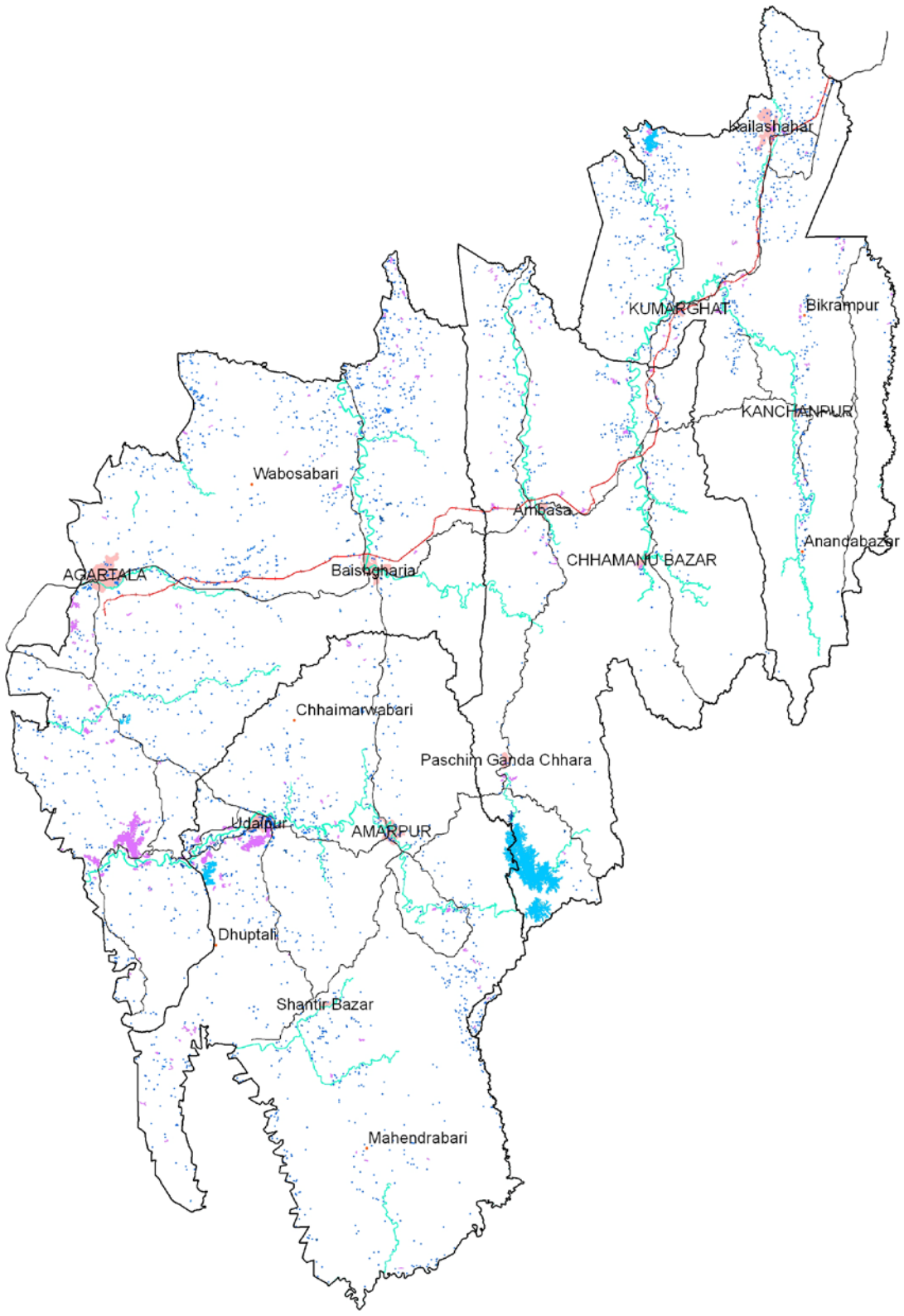
Table 55: District-wise area of wetlands (type-wise) in Tripura

| District code | District | Geographic area * | Wetland Type | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1105 | 1106 | 1201 | 1202 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | West Tripura | 3544 | 225 | 88 | 1527 | 1764 | 57 | 13 | 3674 | 1075 | 4749 |
| 2 | South Tripura | 2152 | 41 | 134 | 873 | 1909 | 625 | 168 | 3750 | 824 | 4574 |
| 3 | Dhalai | 2523 | 9 | 54 | 264 | 1751 | 2383 | 5 | 4466 | 349 | 4815 |
| 4 | North Tripura | 2821 | 25 | 111 | 282 | 1996 | 255 | - | 2669 | 735 | 3404 |
| | **Total** | **11040** | **300** | **387** | **2946** | **7420** | **3320** | **186** | **14559** | **2983** | **17542** |

* Data Source: http://nic.in

State : Tripura

# WETLAND MAP

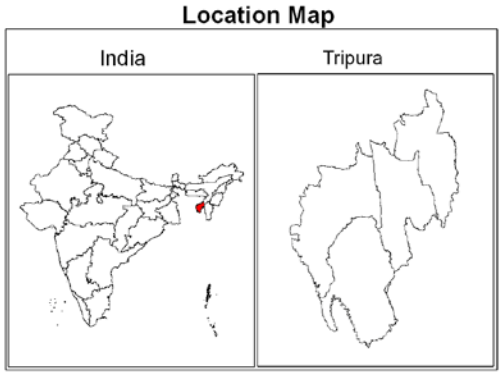



| Symbol Typecode | Level I | Level II | Level III |
|---|---|---|---|
| | Inland Wetlands | | |
| | | Natural | |
| 1101 | | | Lakes/Ponds |
| 1102 | | | Ox-bow lakes/ Cut-off meanders |
| 1103 | | | High altitude wetlands |
| 1104 | | | Reverine wetlands |
| 1105 | | | Waterlogged |
| 1106 | | | River/Stream |
| | | 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 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

**Sponsored By :**
Ministry of Environment and Forests
Government of India

Plate 38 : Wetland map of Tripura

### 8.1.17 Meghalaya

In the state of Meghalaya, 259 wetlands have been delineated. Total wetland area estimated is 29987 ha. (Table 56). Small wetlands, which are less than minimum mapable units (MMU), are 167 in the district. The major wetland types are river/stream (24841 ha) and reservoir/barrage (1562 ha). Graphical distribution of wetland type is shown in Figure 45. Wetland map of the state is shown in Plate 39.

Table 56: Area estimates of wetlands in Meghalaya

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 | Lake/Pond | 15 | 501 | 1.67 | 337 | 175 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 1 | 461 | 1.54 | 316 | 107 |
| 3 | 1104 | Riverine wetland | 4 | 1272 | 4.24 | 836 | 1271 |
| 4 | 1105 | Waterlogged | 77 | 1028 | 3.43 | 678 | 280 |
| 5 | 1106 | River/Stream | 124 | 24841 | 82.84 | 24112 | 24051 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 6 | 1201 | Reservoir/Barrage | 8 | 1562 | 5.21 | 1520 | 1415 |
| 7 | 1202 | Tank/Pond | 29 | 150 | 0.50 | 113 | 121 |
| 8 | 1203 | Waterlogged | 1 | 5 | 0.02 | - | - |
| | | **Sub-Total** | **259** | **29820** | **99.44** | **27912** | **27420** |
| | | Wetlands (<2.25 ha) | 167 | 167 | 0.56 | - | - |
| | | **Total** | **426** | **29987** | **100.00** | **27912** | **27420** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 819 | 852 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 24919 | 24692 |
| Moderate | 1928 | 1168 |
| High | 1065 | 1560 |

**District-wise wetland area estimates in Meghalaya**

The state of Meghalaya has 7 districts, The geographical extents of these districts ranging from 1871 $km^2$ (South Garo Hills) to 5225 $km^2$ (West Khasi Hills). District-wise wetland area estimates is given in Table 57. Graphical distribution of wetland area is shown in Figure 46. District-wise area of wetlands (type-wise) in the state is given in Table 58.

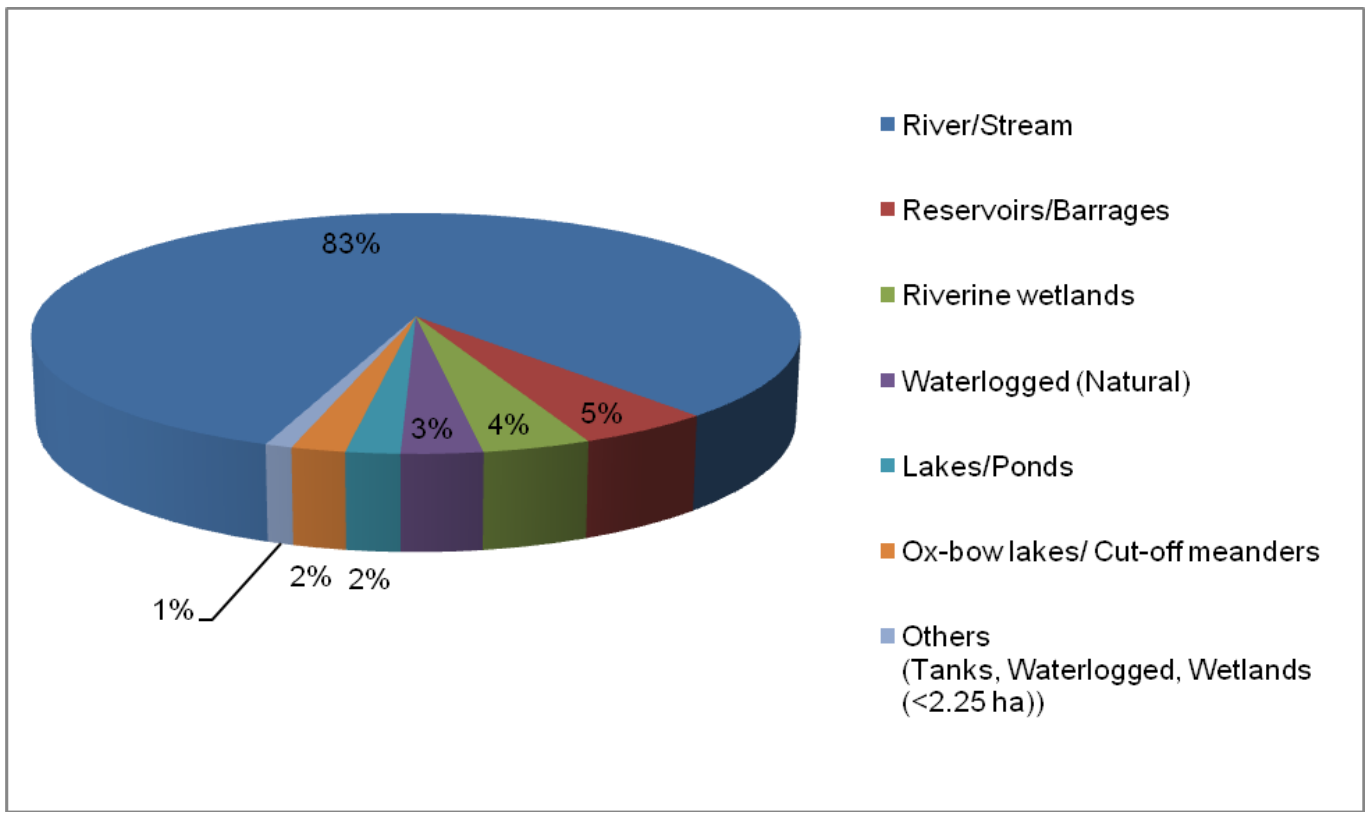



Figure 45: Type-wise wetland distribution in Meghalaya

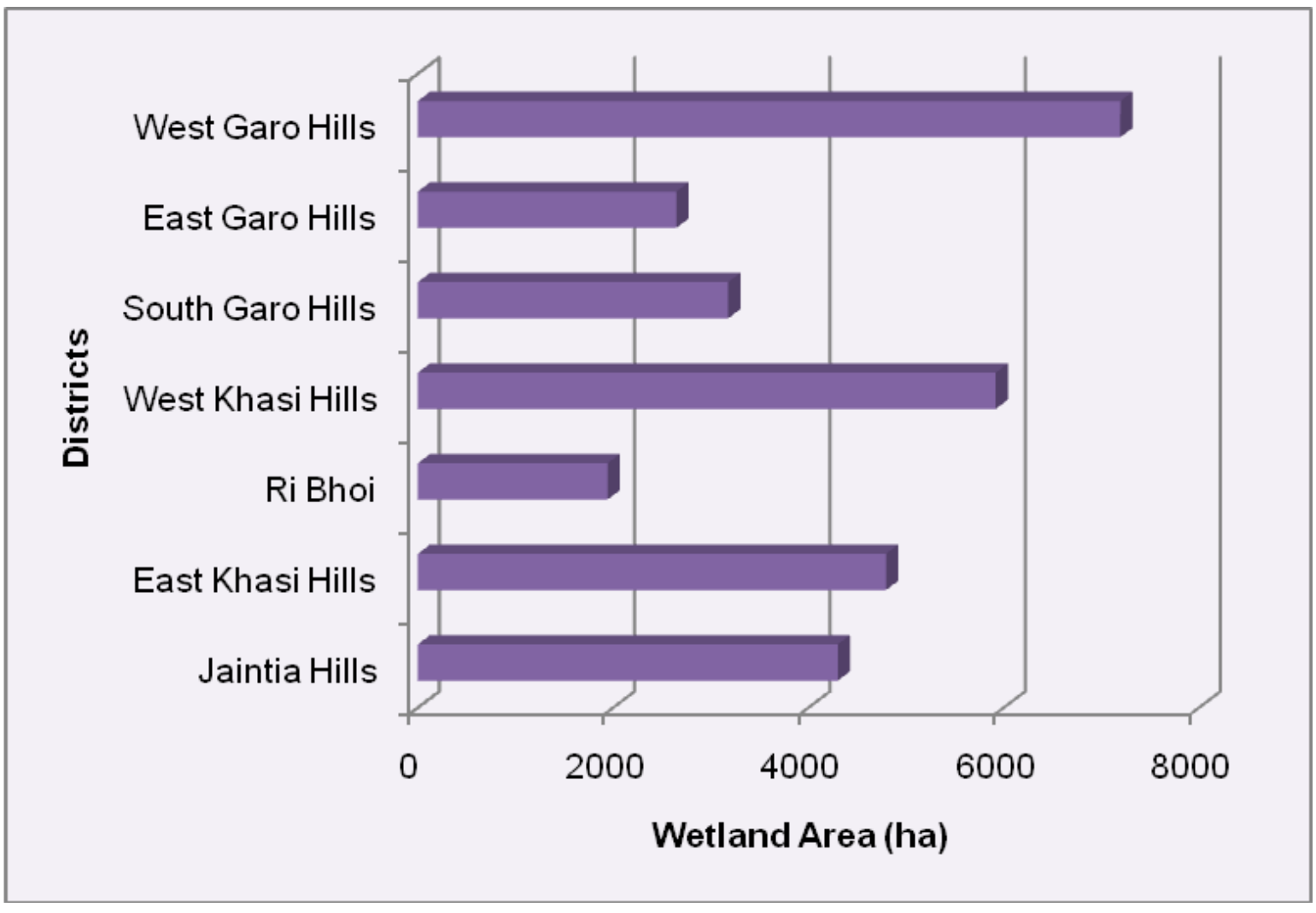



Figure 46: District-wise graphical distribution of wetlands in Meghalaya

Table 57: District-wise area of wetlands in Meghalaya

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | West Garo Hills | 3439 | 7196 | 24.00 | 2.09 | 6496 | 5672 | 630 | 778 | 5664 | 716 | 114 | 5297 | 302 | 70 |
| 2 | East Garo Hills | 2869 | 2649 | 8.83 | 0.92 | 2607 | 2607 | 28 | 10 | 2564 | 45 | - | 2565 | 41 | 2 |
| 3 | South Garo Hills | 1871 | 3179 | 10.60 | 1.70 | 3168 | 3168 | - | - | 3169 | - | - | 3169 | - | - |
| 4 | West Khasi Hills | 5225 | 5920 | 19.74 | 1.13 | 5529 | 5731 | 60 | 4 | 5074 | 29 | 423 | 5078 | 25 | 628 |
| 5 | Ri Bhoi | 2370 | 1945 | 6.49 | 0.82 | 1971 | 1948 | 8 | 30 | 1401 | 512 | 58 | 1437 | 347 | 164 |
| 6 | East Khasi Hills | 2852 | 4796 | 15.99 | 1.68 | 4685 | 4898 | 93 | 30 | 3862 | 392 | 432 | 3962 | 241 | 696 |
| 7 | Jaintia Hills | 3793 | 4302 | 14.35 | 1.13 | 3456 | 3396 | - | - | 3185 | 234 | 38 | 3184 | 212 | - |
| | **Total** | **22420** | **29987** | **100** | **1.34** | **27912** | **27420** | **819** | **852** | **24919** | **1928** | **1065** | **24692** | **1168** | **1560** |

* Data Source: http://nic.in

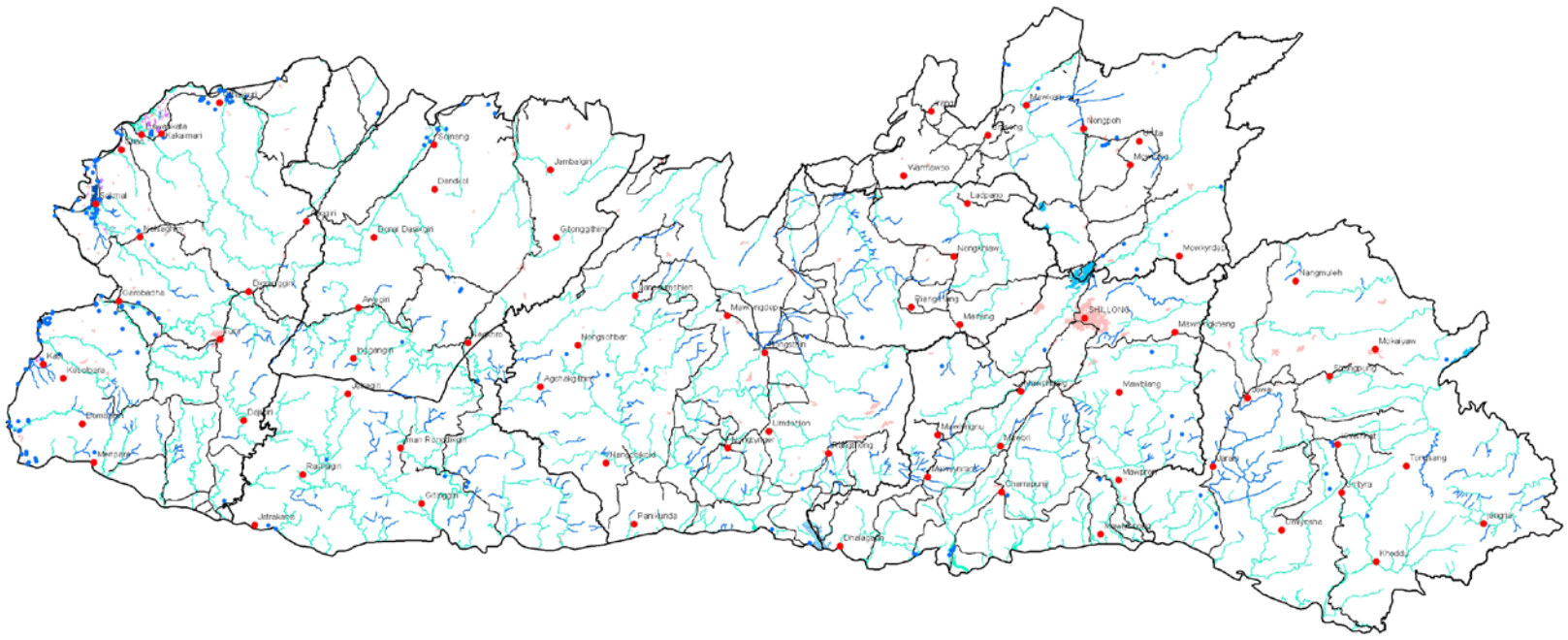
Table 58: District-wise area of wetlands (type-wise) in Meghalaya

| District code | District | Geographic area * | Wetland Type | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1104 | 1105 | 1106 | 1201 | 1202 | 1203 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | Riverine wetland | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | West Garo Hills | 3439 | 501 | 461 | - | 1010 | 5083 | - | 37 | 5 | 7097 | 99 | 7196 |
| 2 | East Garo Hills | 2869 | - | - | - | 18 | 2563 | - | 54 | - | 2635 | 14 | 2649 |
| 3 | South Garo Hills | 1871 | - | - | - | - | 3172 | - | - | - | 3172 | 7 | 3179 |
| 4 | West Khasi Hills | 5225 | - | - | 679 | - | 5192 | 39 | - | - | 5910 | 10 | 5920 |
| 5 | Ri Bhoi | 2370 | - | - | - | - | 1156 | 754 | 22 | - | 1932 | 13 | 1945 |
| 6 | East Khasi Hills | 2852 | - | - | 593 | - | 3656 | 509 | 25 | - | 4783 | 13 | 4796 |
| 7 | Jaintia Hills | 3793 | - | - | - | - | 4019 | 260 | 12 | - | 4291 | 11 | 4302 |
| | **Total** | **13403.85** | **501** | **461** | **1272** | **1028** | **24841** | **1562** | **150** | **5** | **29820** | **167** | **29987** |

* Data Source: http://nic.in

State : Meghalaya

## WETLAND MAP

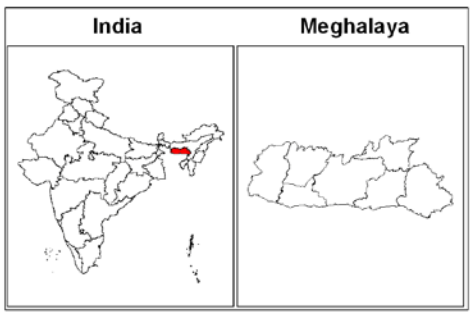



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Riverine wetland |
| | 1105 | | | Waterlogged |
| | 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




20 10 0 20 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
North Eastern Space Applications Centre (NESAC)
Dept. of Space, Umiam, Meghalaya

**Sponsored By:**
Ministry of Environment and Forests
Government of India

Plate 39 : Wetland map of Meghalaya

### 8.1.18 Assam

Total 5097 wetlands have been mapped at 1:50,000 scale in the state. In addition, 6081small wetlands (< 2.25 ha) have been identified. Total wetland area estimated is 764372 ha that is around 9.74 per cent of the geographic area (Table 59). Natural wetlands dominate the state. The major wetland types are river/stream accounting for 84 per cent of the wetlands (637164 ha), lake/pond (51257 ha), waterlogged (47141 ha) and ox-bow lake (14173 ha). There are two reservoir/barrages mapped having total 2833 ha area, which are the major man-made wetland type. Graphical distribution of wetland type is shown in Figure 47. Wetland map of the state is shown in Plate 40.

Aquatic vegetation is observed in lake/pond, waterlogged, riverine wetland type. The area under aquatic vegetation is more during pre-monsoon (76036 ha) than that of post-monsoon (36817 ha). The open water spread in river/stream showed very little seasonal fluctuations. However, the open water spread in case of lake/pond, waterlogged is significantly lower during pre-monsoon compared to post-monsoon.

Table 59: Area estimates of wetlands in Assam

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 | Lake/Pond | 1175 | 51257 | 6.71 | 34408 | 14526 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 873 | 14173 | 1.85 | 7721 | 5848 |
| 3 | 1103 | High altitude wetland | - | - | - | - | - |
| 4 | 1104 | Riverine wetland | 139 | 4258 | 0.56 | 1669 | 942 |
| 5 | 1105 | Waterlogged | 2461 | 47141 | 6.17 | 33660 | 12630 |
| 6 | 1106 | River/Stream | 213 | 637164 | 83.63 | 342197 | 353756 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 2 | 2833 | 0.37 | 2185 | 1346 |
| 8 | 1202 | Tank/Pond | 180 | 921 | 0.12 | 892 | 801 |
| 9 | 1203 | Waterlogged | 54 | 544 | 0.07 | 336 | 303 |
| | | **Sub-Total** | **5097** | **758291** | **99.20** | **423068** | **390152** |
| | | Wetlands (<2.25 ha) | 6081 | 6081 | 0.80 | - | - |
| | | **Total** | **11178** | **764372** | **100.00** | **423068** | **390152** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 36817 | 76036 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 64137 | 22834 |
| Moderate | 358429 | 366654 |
| High | 502 | 664 |

### District-wise wetland area estimates in Assam

There are 23 districts. The geographic area of the districts varies from 1317 sq.km (Hailakandi) to 10434 sq.km (Karbi Anglong). The wetlands occupy as high as 21.43% of geographic area ( Dibrugarh district), and as low as 1.35% (North Cachar Hills). In terms of total wetland area (% wetland area), Sonitpur is the leading district (83427 ha, 10.9%) and Hailakandi is the least (2600 ha, 0.34%).

River/Stream is the dominate wetland type in almost all districts, except few districts like Karimganj , Naogaon etc. Lake/Pond locally known as beels are the major wetlands in many districts. Naogaon district has very high area under waterlogged.

District-wise wetland area estimates is given in Table 60. Figure 48 shows district-wise graphical distribution of wetlands. District-wise area of wetlands (type-wise) in the state is given in Table 61.

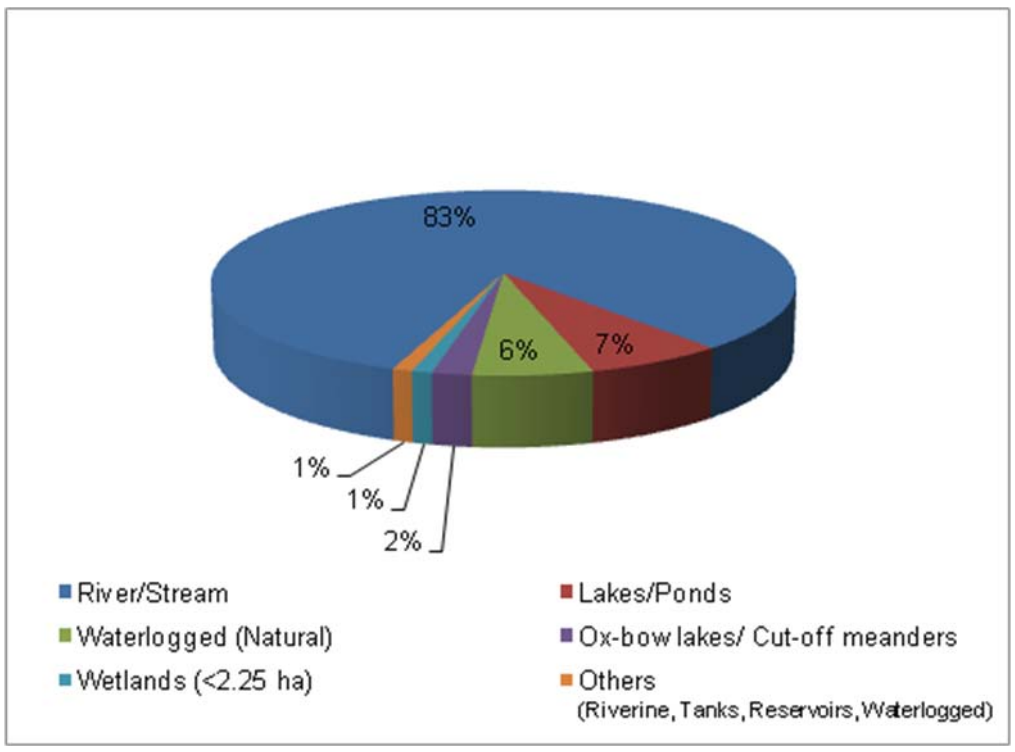



Figure 47: Type-wise wetland distribution in Assam

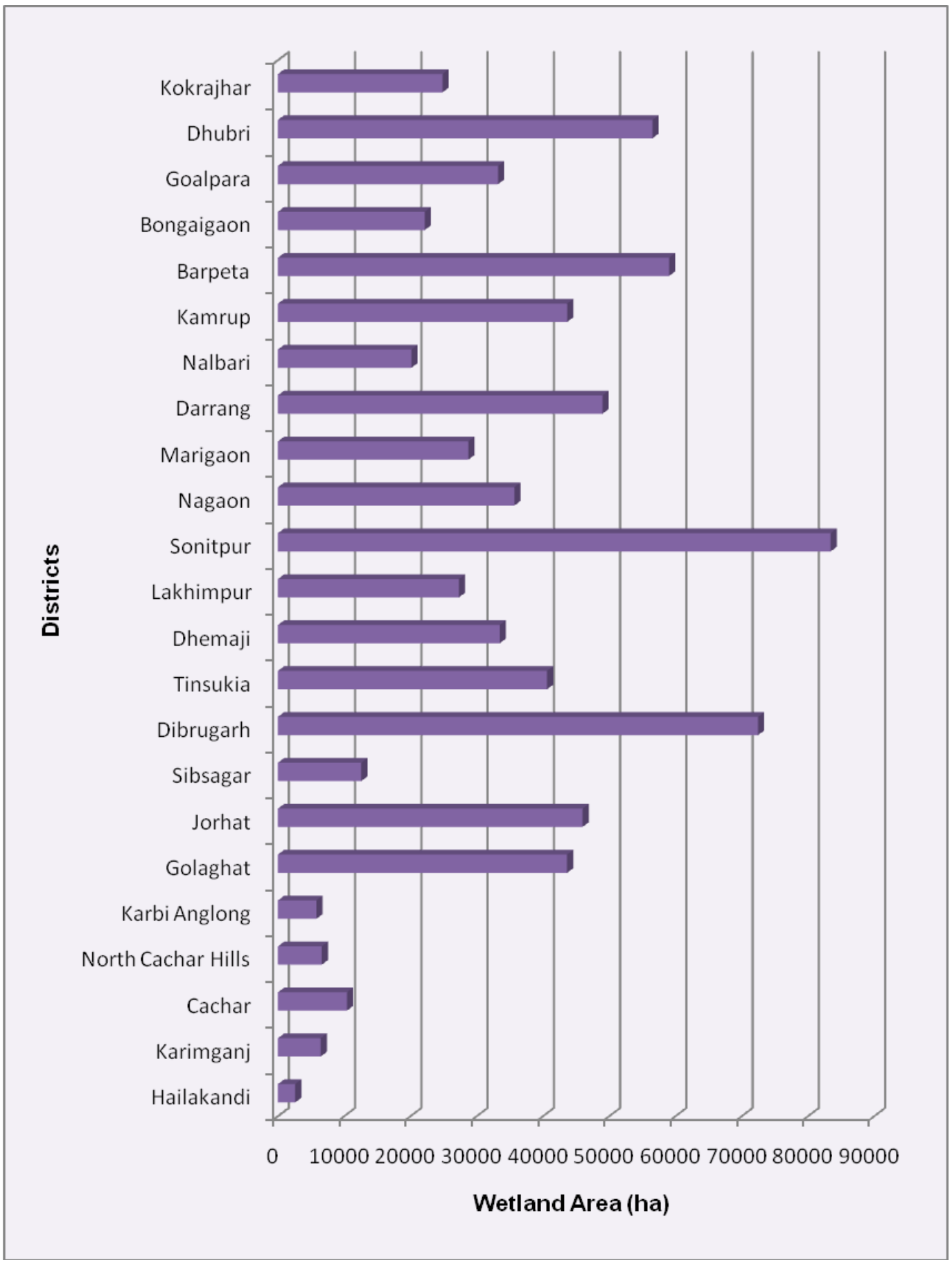



Figure 48: District-wise graphical distribution of wetlands

Table 60: District-wise area of wetlands in Assam

| District code | District | Geographic Area * | Wetland Area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km.) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Kokrajhar | 3129 | 24833 | 3.25 | 7.94 | 23266 | 22659 | - | - | 250 | 23016 | - | 161 | 22489 | 9 |
| 2 | Dhubri | 2838 | 56538 | 7.40 | 19.92 | 41072 | 37695 | - | 10 | 4259 | 36813 | - | 1758 | 35937 | - |
| 3 | Goalpara | 1824 | 33221 | 4.35 | 18.21 | 20348 | 20065 | 1901 | 2670 | 1959 | 18389 | - | 1887 | 18178 | - |
| 4 | Bongaigaon | 2510 | 22149 | 2.90 | 8.82 | 14933 | 14221 | 1571 | 2353 | 1567 | 13366 | - | 1583 | 12638 | - |
| 5 | Barpeta | 3245 | 59038 | 7.72 | 18.19 | 31162 | 29407 | 1187 | 2967 | 2468 | 28694 | - | 511 | 28896 | - |
| 6 | Kamrup | 4345 | 43655 | 5.71 | 10.05 | 25106 | 18443 | 2992 | 9833 | 10188 | 14918 | - | 3148 | 15246 | 49 |
| 7 | Nalbari | 2257 | 20140 | 2.63 | 8.92 | 12049 | 10700 | 460 | 1811 | 1725 | 10324 | - | 163 | 10537 | - |
| 8 | Darrang | 3481 | 48983 | 6.41 | 14.07 | 27631 | 26184 | 917 | 2288 | 1844 | 25787 | - | 308 | 25876 | - |
| 9 | Marigaon | 1704 | 28737 | 3.76 | 16.86 | 17302 | 9875 | 2328 | 10118 | 9064 | 8238 | - | 1781 | 8094 | - |
| 10 | Nagaon | 3831 | 35695 | 4.67 | 9.32 | 28826 | 13580 | 5271 | 18235 | 15427 | 13399 | - | 2498 | 11082 | - |
| 11 | Sonitpur | 5324 | 83427 | 10.91 | 15.67 | 33705 | 30189 | 2203 | 2489 | 634 | 32956 | 115 | 499 | 29615 | 75 |
| 12 | Lakhimpur | 2277 | 27307 | 3.57 | 11.99 | 13739 | 13664 | 971 | 836 | 152 | 13495 | 92 | 240 | 13320 | 104 |
| 13 | Dhemaji | 3237 | 33468 | 4.38 | 10.34 | 12195 | 13118 | 2812 | 2724 | 581 | 11602 | 12 | 759 | 12347 | 12 |
| 14 | Tinsukia | 3790 | 40626 | 5.31 | 10.72 | 17712 | 22854 | 3570 | 2974 | 23 | 17661 | 28 | 25 | 22722 | 107 |
| 15 | Dibrugarh | 3381 | 72461 | 9.48 | 21.43 | 28240 | 36733 | 1769 | 1899 | 187 | 27938 | 115 | 124 | 36508 | 101 |
| 16 | Sibsagar | 2668 | 12582 | 1.65 | 4.72 | 7101 | 6773 | 2403 | 2458 | 117 | 6894 | 90 | 114 | 6591 | 68 |
| 17 | Jorhat | 2851 | 45979 | 6.02 | 16.13 | 18094 | 17287 | 3357 | 2586 | 603 | 17444 | 47 | 834 | 16317 | 136 |
| 18 | Golaghat | 3502 | 43635 | 5.71 | 12.46 | 21726 | 24363 | 1437 | 2304 | 2235 | 19491 | - | 1259 | 23104 | - |
| 19 | Karbi Anglong | 10434 | 5810 | 0.76 | 0.56 | 4802 | 4648 | 306 | 536 | 198 | 4604 | - | 121 | 4527 | - |
| 20 | North Cachar Hills | 4888 | 6619 | 0.87 | 1.35 | 6004 | 4385 | 634 | 1487 | 2190 | 3811 | 3 | 1350 | 3032 | 3 |
| 21 | Cachar | 3786 | 10419 | 1.36 | 2.75 | 10023 | 8286 | 137 | 1872 | 3654 | 6369 | - | 2023 | 6263 | - |
| 22 | Karimganj | 1809 | 6450 | 0.84 | 3.57 | 5548 | 2857 | 527 | 3206 | 4031 | 1517 | - | 1321 | 1536 | - |
| 23 | Hailakandi | 1327 | 2600 | 0.34 | 1.96 | 2484 | 2166 | 64 | 380 | 781 | 1703 | - | 367 | 1799 | - |
| | **Total** | **78438** | **764372** | **100.00** | **9.74** | **423068** | **390152** | **36817** | **76036** | **64137** | **358429** | **502** | **22834** | **366654** | **664** |

* Data Source: http://nic.in

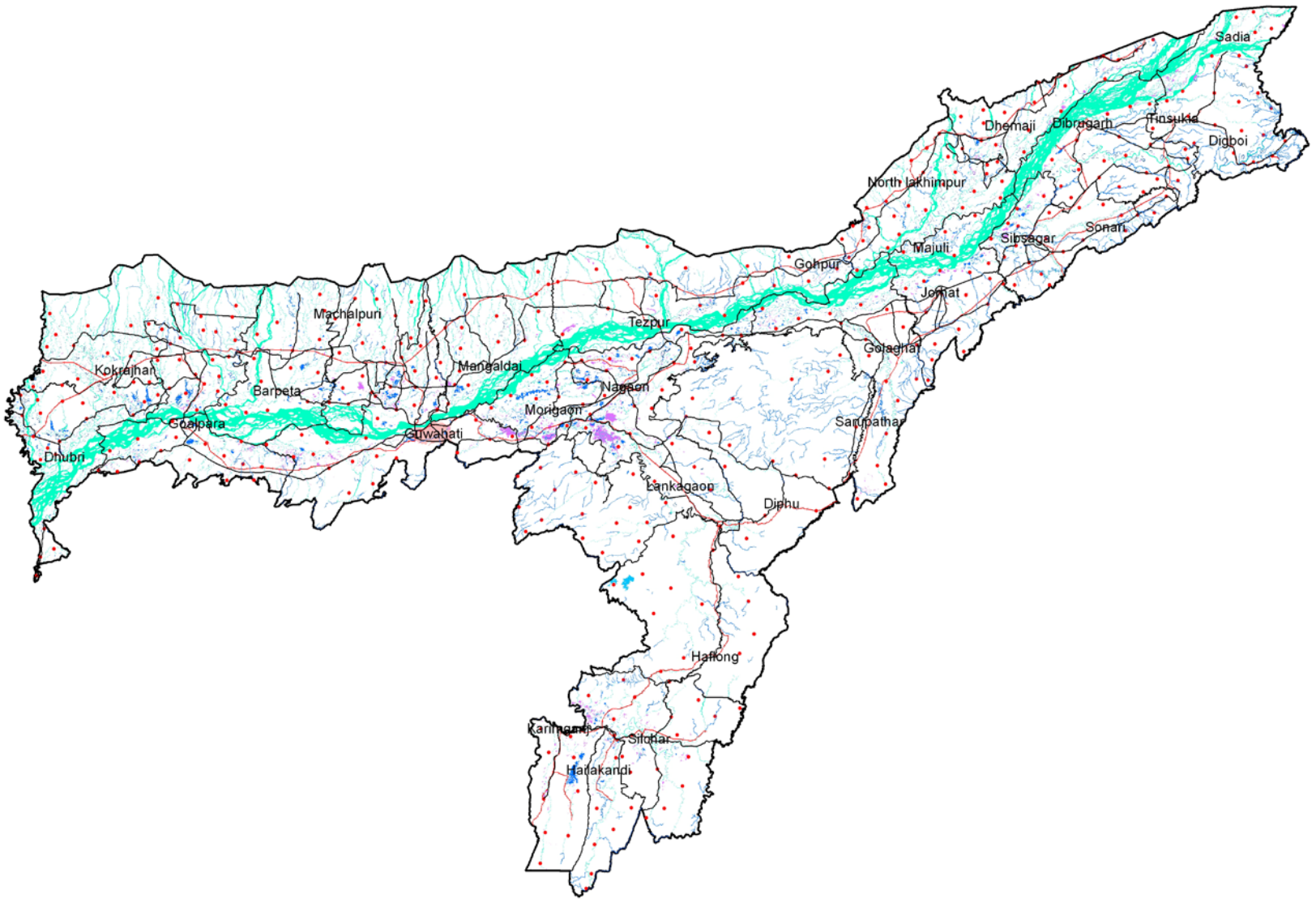
Table 61: District-wise area of wetlands (type-wise) in Assam

| District code | District | Geographic Area * | Wetland Type | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1104 | 1105 | 1106 | 1201 | 1202 | 1203 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | Riverine wetland | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | | | |
| | | (sq. km.) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Kokrajhar | 3129 | 457 | 1160 | 32 | 318 | 22681 | - | 33 | - | 24681 | 152 | 24833 |
| 2 | Dhubri | 2838 | 5967 | 1597 | - | 1102 | 47793 | - | 5 | - | 56464 | 74 | 56538 |
| 3 | Goalpara | 1824 | 2339 | 195 | - | 2374 | 28162 | - | - | - | 33070 | 151 | 33221 |
| 4 | Bongaigaon | 2510 | 2519 | 519 | 8 | 1036 | 17996 | - | - | - | 22078 | 71 | 22149 |
| 5 | Barpeta | 3245 | 2644 | 235 | - | 927 | 55037 | - | - | - | 58843 | 195 | 59038 |
| 6 | Kamrup | 4345 | 6220 | 271 | 310 | 6769 | 29813 | - | 44 | - | 43427 | 228 | 43655 |
| 7 | Nalbari | 2257 | 529 | 104 | 160 | 1393 | 17707 | - | 8 | - | 19901 | 239 | 20140 |
| 8 | Darrang | 3481 | 1282 | 404 | 8 | 955 | 45772 | - | 112 | - | 48533 | 450 | 48983 |
| 9 | Marigaon | 1704 | 6121 | 613 | 357 | 4907 | 16567 | - | 14 | - | 28579 | 158 | 28737 |
| 10 | Nagaon | 3831 | 8670 | 1198 | 490 | 12682 | 12308 | - | 114 | - | 35462 | 233 | 35695 |
| 11 | Sonitpur | 5324 | 740 | 864 | - | 1764 | 78852 | - | 85 | 142 | 82447 | 980 | 83427 |
| 12 | Lakhimpur | 2277 | 652 | 1038 | 134 | 524 | 24397 | - | 41 | 63 | 26849 | 458 | 27307 |
| 13 | Dhemaji | 3237 | 776 | 592 | 932 | 1365 | 29293 | - | 23 | 173 | 33154 | 314 | 33468 |
| 14 | Tinsukia | 3790 | 147 | 1399 | 1151 | 1685 | 35672 | - | 63 | 31 | 40148 | 478 | 40626 |
| 15 | Dibrugarh | 3381 | 590 | 1295 | 146 | 656 | 69149 | - | 45 | 45 | 71926 | 535 | 72461 |
| 16 | Sibsagar | 2668 | 1042 | 529 | 113 | 1330 | 8698 | - | 310 | 30 | 12052 | 530 | 12582 |
| 17 | Jorhat | 2851 | 2322 | 698 | 417 | 1124 | 40977 | - | 18 | 60 | 45616 | 363 | 45979 |
| 18 | Golaghat | 3502 | 2253 | 1099 | - | 1522 | 38593 | - | 3 | - | 43470 | 165 | 43635 |
| 19 | Karbi Anglong | 10434 | 317 | 332 | - | 123 | 4946 | - | 3 | - | 5721 | 89 | 5810 |
| 20 | North Cachar Hills | 4888 | 7 | - | - | - | 3735 | 2833 | - | - | 6575 | 44 | 6619 |
| 21 | Cachar | 3786 | 1495 | 31 | - | 3090 | 5757 | - | - | - | 10373 | 46 | 10419 |
| 22 | Karimganj | 1809 | 3593 | - | - | 1223 | 1536 | - | - | - | 6352 | 98 | 6450 |
| 23 | Hailakandi | 1327 | 575 | - | - | 272 | 1723 | - | - | - | 2570 | 30 | 2600 |
| | **Total** | **78438** | **51257** | **14173** | **4258** | **47141** | **637164** | **2833** | **921** | **544** | **758291** | **6081** | **764372** |

* Data Source: http://nic.in

State : Assam

# WETLAND MAP

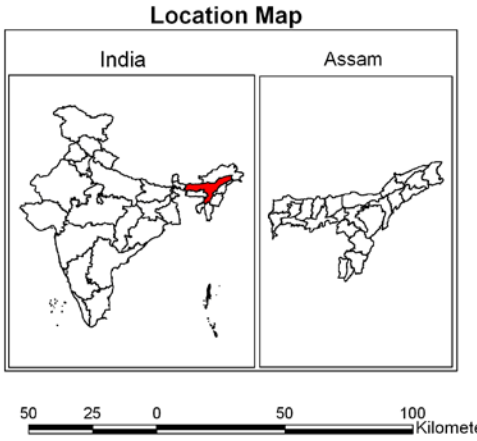



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Drainage (line)
- Major Roads
- Railway
- Settlements
- 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
Assam Remote Sensing Applications Centre, Guwahati

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Ministry of Environment and Forests
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Plate 40 : Wetland map of Assam

### 8.1.19 West Bengal

The total area under wetlands in the state of West Bengal is 1107907 ha of area accounting for about 12.5 % of geographical area of the state. Total Number of wetlands mapped in the state is 147826 including 138707 wetlands smaller than 2.25 ha. The total number of inland wetlands are found to be 8670, under natural (3675) and man-made (4995). The total number of coastal wetlands is 449 comprising of 421 natural and 28 man-made. The total area of inland and coastal wetlands are 747383 ha and 221817 ha respectively. The major wetland types are river/stream (559192 ha) followed by mangrove (209330 ha), lake/pond (58654 ha), waterlogged (56603 ha) and reservoir/barrage (22672 ha). In addition, 138707 smaller wetlands (< 2.25 ha) were also identified. An area estimate of wetlands in West Bengal is given in Table 62.

The open water in wetlands show decrease in water spread during pre-monsoon (583620 ha) compared to post-monsoon (632450 ha). Qualitative turbidity ratings assigned to open water features of wetlands, showed that wetlands belonging to “water logged class” and lake/pond in general have high turbidity with 59.0 and 54.0 per cent of the respective classes being under high turbidity during post-monsoon. The aquatic vegetation in wetlands also increase significantly during pre-monsoon (239058 ha) compared to post-monsoon (228174 ha). Graphical distribution of wetland types in West Bengal is shown in Figure 49. Wetland map of the state is shown in Plate 41.

Table 62: Area estimates of wetlands in West Bengal

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 | Lake/Pond | 1327 | 58654 | 5.29 | 45374 | 35609 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 867 | 19550 | 1.76 | 15869 | 11063 |
| 3 | 1103 | High altitude wetland | 3 | 82 | 0.01 | 82 | 82 |
| 4 | 1104 | Riverine wetland | 490 | 8654 | 0.78 | 7656 | 6026 |
| 5 | 1105 | Waterlogged | 780 | 56603 | 5.11 | 47615 | 41337 |
| 6 | 1106 | River/Stream | 208 | 559192 | 50.47 | 468488 | 453748 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 340 | 22672 | 2.05 | 20728 | 12744 |
| 8 | 1202 | Tank/Pond | 4581 | 20470 | 1.85 | 18923 | 15708 |
| 9 | 1203 | Waterlogged | 71 | 1435 | 0.13 | 1354 | 1076 |
| 10 | 1204 | Salt pan | 3 | 71 | 0.01 | 71 | 71 |
| | | **Total - Inland** | **8670** | **747383** | **67.46** | **626160** | **577464** |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 11 | 2103 | Sand/Beach | 51 | 3338 | 0.30 | - | - |
| 12 | 2104 | Intertidal mud flat | 17 | 2726 | 0.25 | - | - |
| 13 | 2106 | Mangrove | 353 | 209330 | 18.89 | - | - |
| 14 | 2107 | Coral Reef | - | - | - | - | - |
| | **2200** | **Coastal Wetlands - Man-made** | | | | | |
| 15 | 2201 | Salt pan | 14 | 4866 | 0.44 | 4865 | 4865 |
| 16 | 2202 | Aquaculture pond | 14 | 1557 | 0.14 | 1425 | 1291 |
| | | **Total - Coastal** | **449** | **221817** | **20.02** | **6290** | **6156** |
| | | **Sub-Total** | **9119** | **969200** | **87.48** | **632450** | **583620** |
| | | Wetlands (<2.25 ha) | 138707 | 138707 | 12.52 | - | - |
| | | **Total** | **147826** | **1107907** | **100.00** | **632450** | **583620** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 228174 | 239058 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 32402 | 21196 |
| Moderate | 537144 | 500546 |
| High | 62904 | 61878 |

**District-wise wetland area estimates in West Bengal**

The state has nineteen districts as administrative units (census 2001). It is observed that extent of wetlands accounts for 12.48 % with variation from a minimum of 2.1 to 58.4 %. When realized in terms of average extent it remained quite high (61764 ha) for the state of West Bengal ranging from a minimum of 724 ha to 477151 ha. In terms of wetland area Kolkata district accounts least (724 ha) compared to South twenty-four parganas (477151 ha). However, in terms of per cent Darjeeling district is least accounting for 2.1 compared to South twenty four parganas (58.5). The presence of Sunderbans is attributed as the reason for very high per cent of wetland area in this district. North twenty four parganas stands next in terms of both extent as well as per cent of wetland area (150206 ha and 36.7 % respectively). The seasonal variation in open water extent inferred by using two season data, showed that minimum open water extent was observed in Kolkata district i.e. 697 ha in post-monsoon while South twenty four parganas registered largest area under open water in post-monsoon (306931 ha). The details are given below in the Table 63 and graphically depicted in Figure 50. District-wise area of wetlands (type-wise) in the state is given in Table 64.

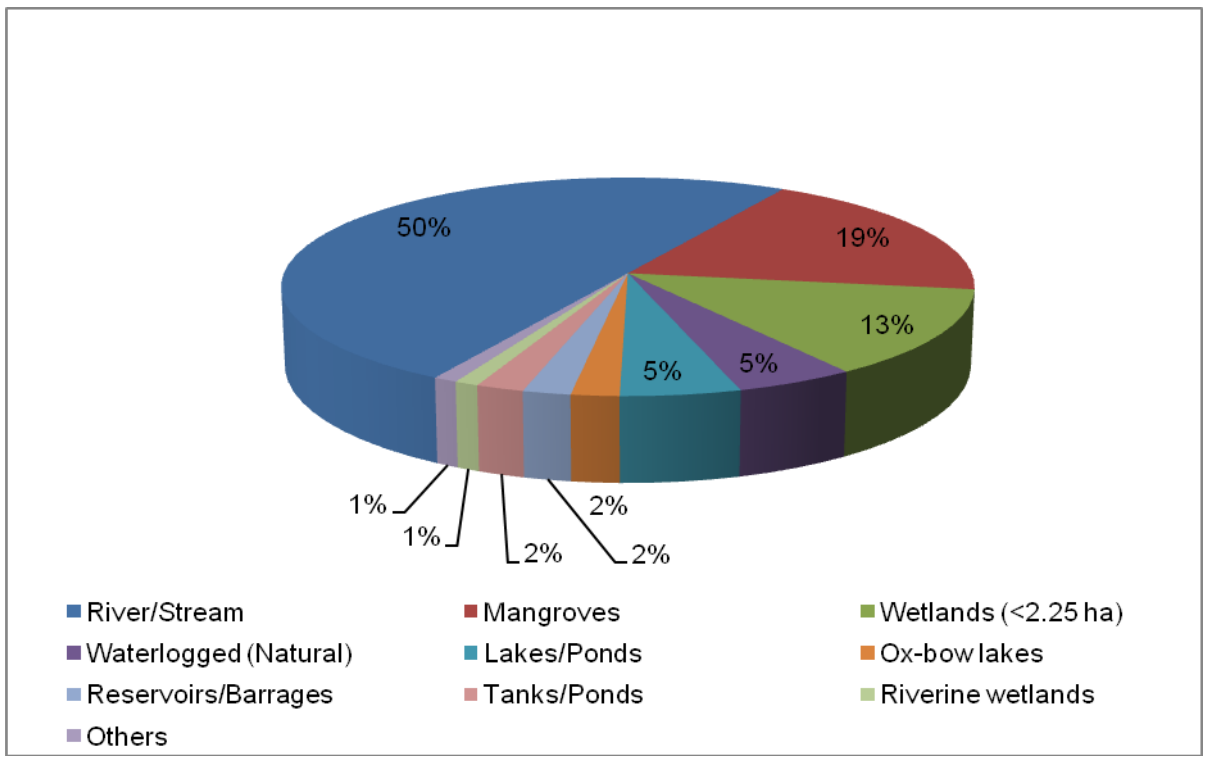



Figure 49: Type-wise wetland distribution in West Bengal

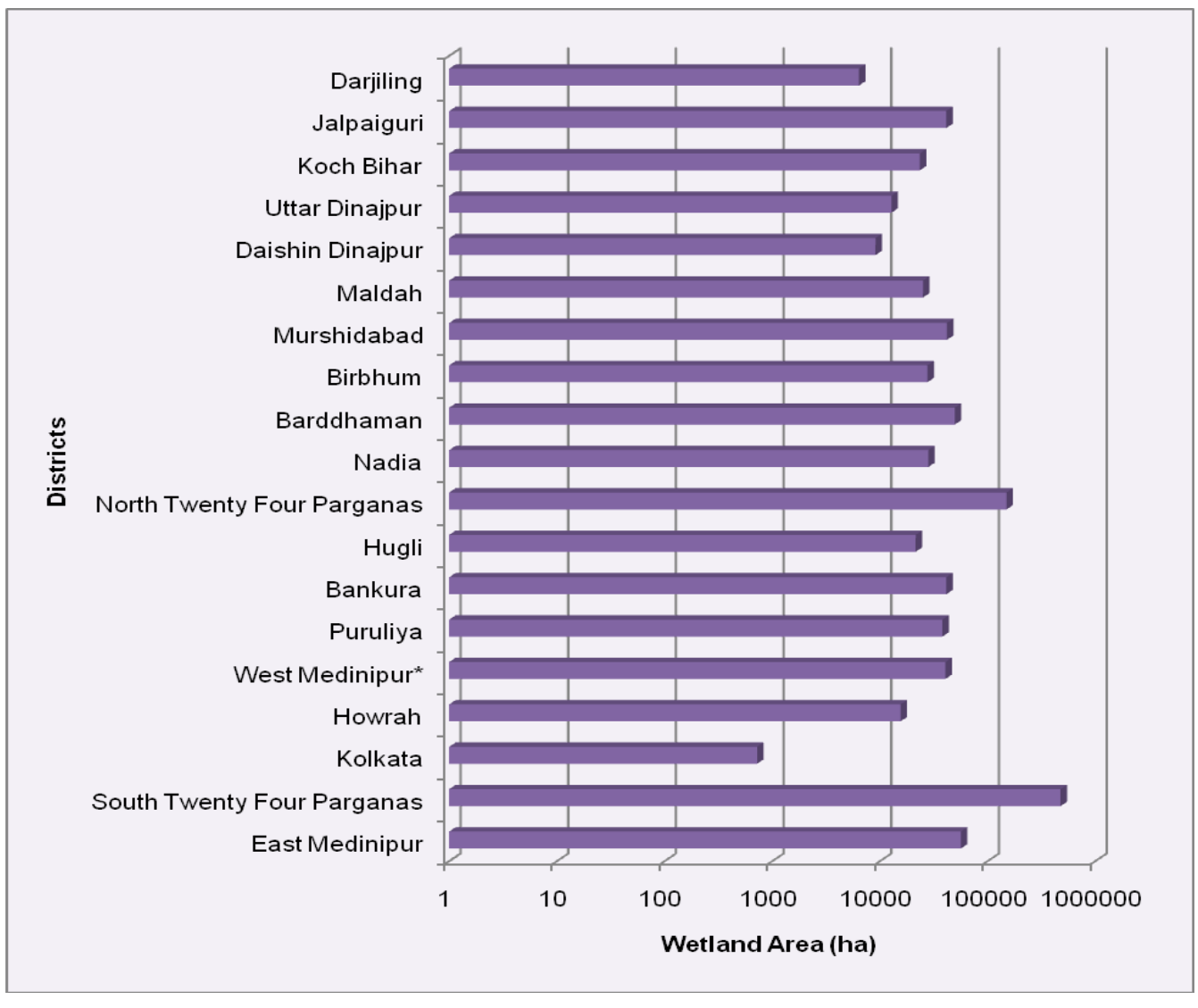



Figure 50: District-wise graphical distribution of wetlands West Bengal

Table 63: District-wise area of wetlands in West Bengal

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Darjiling | 3075 | 6395 | 0.58 | 2.08 | 2804 | 2440 | 4 | 7 | 134 | 2666 | 4 | 134 | 2303 | 3 |
| 2 | Jalpaiguri | 6227 | 41520 | 3.75 | 6.67 | 9664 | 9543 | 164 | 279 | 101 | 9443 | 120 | 63 | 9363 | 117 |
| 3 | Koch Bihar | 3387 | 23534 | 2.12 | 6.95 | 10093 | 8607 | 1866 | 3127 | 425 | 9625 | 43 | 212 | 8356 | 39 |
| 4 | Uttar Dinajpur | 3180 | 12806 | 1.16 | 4.03 | 6558 | 5498 | 2209 | 2447 | 76 | 6273 | 209 | 48 | 5148 | 302 |
| 5 | Daishin Dinajpur | 2183 | 9109 | 0.82 | 4.17 | 2258 | 1147 | 9 | 59 | 229 | 1919 | 110 | 180 | 889 | 78 |
| 6 | Maldah | 3733 | 25162 | 2.27 | 6.74 | 19384 | 15295 | 927 | 3097 | 72 | 16550 | 2762 | 47 | 14082 | 1166 |
| 7 | Murshidabad | 5324 | 41980 | 3.79 | 7.89 | 27924 | 20327 | 1138 | 1736 | 3285 | 23157 | 1482 | 2329 | 16714 | 1284 |
| 8 | Birbhum | 4545 | 27660 | 2.50 | 6.09 | 8618 | 7692 | 202 | 358 | 612 | 7152 | 854 | 626 | 6153 | 913 |
| 9 | Barddhaman | 7024 | 49542 | 4.47 | 7.05 | 15826 | 13951 | 622 | 589 | 2063 | 13201 | 562 | 1669 | 11852 | 430 |
| 10 | Nadia | 3927 | 28189 | 2.54 | 7.18 | 20628 | 12179 | 3233 | 3985 | 2308 | 15764 | 2556 | 1357 | 9423 | 1399 |
| 11 | North Twenty Four Parganas | 4094 | 150206 | 13.56 | 36.69 | 86339 | 82739 | 57346 | 58486 | 450 | 50537 | 35352 | 397 | 45143 | 37199 |
| 12 | Hugli | 3149 | 21514 | 1.94 | 6.83 | 6886 | 5840 | 191 | 214 | 96 | 6138 | 652 | 16 | 5434 | 390 |
| 13 | Bankura | 6882 | 41476 | 3.74 | 6.03 | 16763 | 12105 | 564 | 929 | 6062 | 9357 | 1344 | 3056 | 7815 | 1234 |
| 14 | Puruliya | 6259 | 38122 | 3.44 | 6.09 | 19633 | 13958 | 1157 | 2477 | 11278 | 8078 | 277 | 6347 | 7402 | 209 |
| 15 | West Medinipur* | 14081 | 40626 | 3.67 | 2.89 | 13300 | 10217 | 395 | 2116 | 614 | 9884 | 2802 | 92 | 7989 | 2136 |
| 16 | Howrah | 3467 | 15589 | 1.41 | 4.50 | 11999 | 11294 | 1076 | 1890 | 11 | 10286 | 1702 | 5 | 10289 | 1000 |
| 17 | Kolkata | 104 | 724 | 0.07 | 6.96 | 697 | 694 | - | - | - | 487 | 210 | - | 483 | 211 |
| 18 | South Twenty Four Parganas | 8164 | 477151 | 43.07 | 58.45 | 306931 | 305432 | 156102 | 156161 | 3577 | 296450 | 6904 | 3615 | 295757 | 6060 |
| 19 | East Medinipur | * | 56602 | 5.11 | | 46145 | 44662 | 969 | 1101 | 1009 | 40177 | 4959 | 1003 | 35951 | 7708 |
| | **Total** | **88805** | **1107907** | **100.00** | **12.48** | **632450** | **583620** | **228174** | **239058** | **32402** | **537144** | **62904** | **21196** | **500546** | **61878** |

* Data Source: http://nic.in

Table 64: District-wise area of wetlands (type-wise) in West Bengal

| District code | District | Geographic area * | Wetland Type | | | | | | | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1103 | 1104 | 1105 | 1106 | 1201 | 1202 | 1203 | 1204 | 2103 | 2104 | 2106 | 2201 | 2202 | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Darjiling | 3075 | 52 | 15 | 82 | 7 | - | 6080 | - | 14 | - | - | - | - | - | - | - | 6250 | 145 | 6395 |
| 2 | Jalpaiguri | 6227 | 254 | 346 | - | 124 | - | 40240 | - | 105 | - | - | - | - | - | - | - | 41069 | 451 | 41520 |
| 3 | Koch Bihar | 3387 | 2814 | 1867 | - | 132 | - | 18478 | - | 18 | - | - | - | - | - | - | - | 23309 | 225 | 23534 |
| 4 | Uttar Dinajpur | 3180 | 2797 | 149 | - | 602 | 833 | 3808 | - | 636 | - | - | - | - | - | - | - | 8825 | 3981 | 12806 |
| 5 | Daishin Dinajpur | 2183 | 30 | 10 | - | 57 | 188 | 1966 | - | 431 | - | - | - | - | - | - | - | 2682 | 6427 | 9109 |
| 6 | Maldah | 3733 | 4608 | 582 | - | 1527 | 382 | 12906 | - | 558 | 162 | - | - | - | - | - | - | 20725 | 4437 | 25162 |
| 7 | Murshidabad | 5324 | 6692 | 1822 | - | 625 | 512 | 24963 | - | 518 | 395 | - | - | - | - | - | - | 35527 | 6453 | 41980 |
| 8 | Birbhum | 4545 | 220 | 77 | - | 36 | 884 | 10499 | 899 | 1102 | - | - | - | - | - | - | - | 13717 | 13943 | 27660 |
| 9 | Barddhaman | 7024 | 1405 | 944 | - | 445 | 303 | 19983 | 1392 | 2974 | 178 | - | - | - | - | - | - | 27624 | 21918 | 49542 |
| 10 | Nadia | 3927 | 6282 | 7411 | - | 879 | 1582 | 7254 | - | 927 | 91 | - | - | - | - | - | - | 24426 | 3763 | 28189 |
| 11 | North Twenty Four Parganas | 4094 | 22912 | 4445 | - | 461 | 24702 | 38647 | - | 1980 | 283 | 43 | - | - | 52759 | - | 340 | 146572 | 3634 | 150206 |
| 12 | Hugli | 3149 | 414 | 176 | - | 31 | 936 | 5646 | - | 1060 | 55 | - | - | - | - | - | 88 | 8406 | 13108 | 21514 |
| 13 | Bankura | 6882 | 888 | 92 | - | 75 | 377 | 14427 | 7853 | 3022 | 106 | - | - | - | - | - | - | 26840 | 14636 | 41476 |
| 14 | Puruliya | 6259 | 462 | - | - | 5 | 651 | 4509 | 11741 | 3912 | 104 | - | - | - | - | - | - | 21384 | 16738 | 38122 |
| 15 | West Medinipur* | 14081 | 789 | 307 | - | 58 | 2813 | 17696 | 737 | 1350 | - | - | - | - | - | - | 16 | 23766 | 16860 | 40626 |
| 16 | Howrah | 3467 | 2209 | 228 | - | 315 | 666 | 9193 | 47 | 662 | 20 | - | - | - | - | - | - | 13340 | 2249 | 15589 |
| 17 | Kolkata | 104 | 96 | 37 | - | - | - | 476 | - | 88 | - | - | - | - | - | - | - | 697 | 27 | 724 |
| 18 | South Twenty Four Parganas | 8164 | 5730 | 970 | - | 3105 | 18300 | 285918 | - | 603 | 9 | 28 | 1627 | 2367 | 155669 | - | 525 | 474851 | 2300 | 477151 |
| 19 | East Medinipur | * | - | 72 | - | 170 | 3474 | 36503 | 3 | 510 | 32 | - | 1711 | 359 | 902 | 4866 | 588 | 49190 | 7412 | 56602 |
| | **Total** | **88805** | **58654** | **19550** | **82** | **8654** | **56603** | **559192** | **22672** | **20470** | **1435** | **71** | **3338** | **2726** | **209330** | **4866** | **1557** | **969200** | **138707** | **1107907** |

* Data Source: http://nic.in

1101 Lake/Pond
1102 Ox-bow lake/ Cut-off meander
1103 High altitude wetland
1104 Riverine wetland
1105 Waterlogged (Natural)
1106 River/Stream

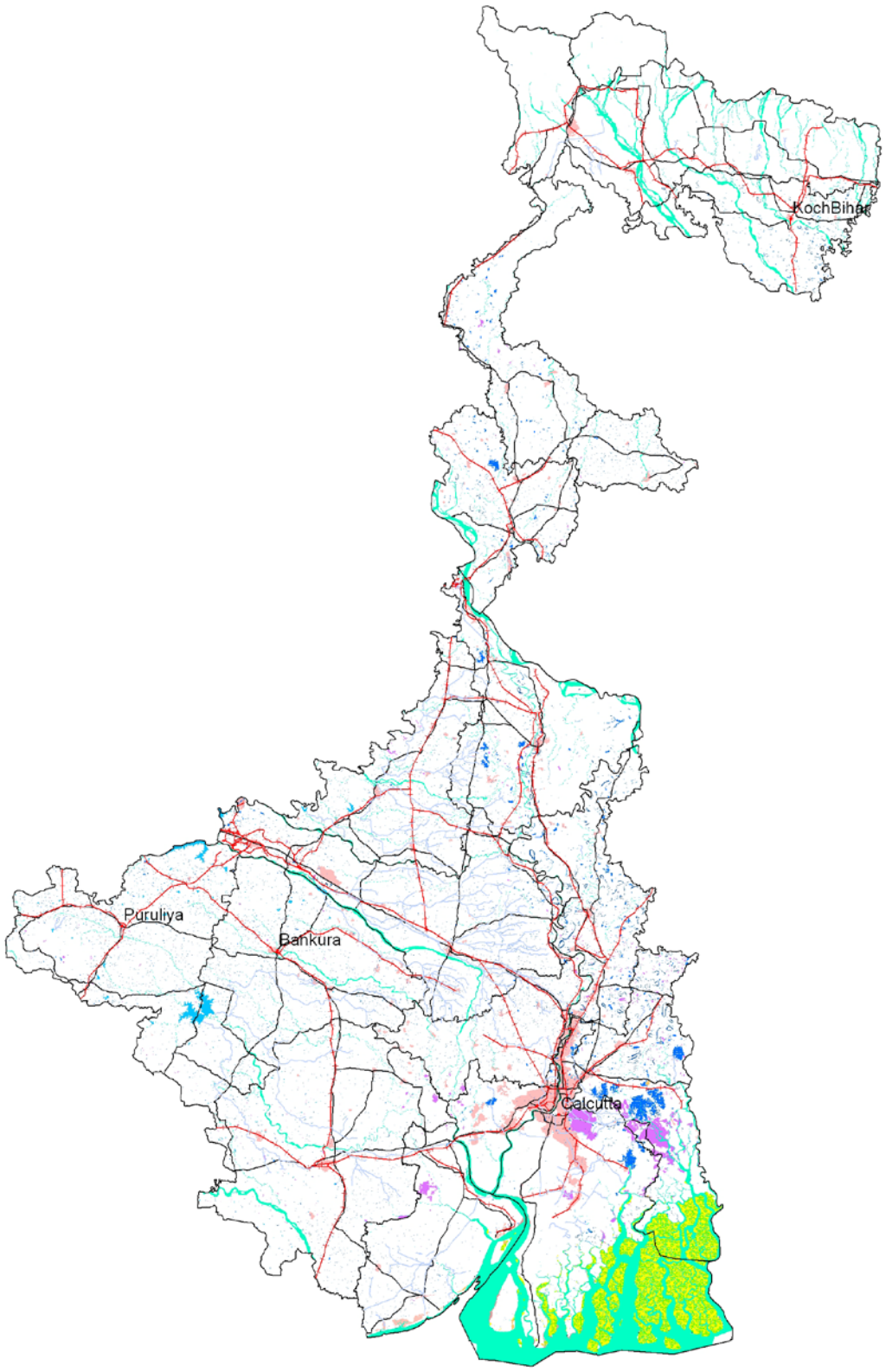
1201 Reservoir/Barrage
1202 Tank/Pond
1203 Waterlogged (Man-made)
1204 Salt pan (Inland)

2101 Lagoon
2102 Creek
2103 Sand/Beach
2104 Intertidal mud flat
2105 Salt Marsh (Coastal)
2106 Mangrove
2107 Coral Reef

2201 Salt pan
2202 Aquaculture pond

State : West Bengal

# 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**

- settlepmap
- Wetlands (<2.25 ha)
- Canal
- Railway
- Roads
- District Boundary
- State Boundary
- Towns/Settlements

**Location Map**


0 25 50 100 150 Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Institute of Environmental Studies and Wetland Management, Kolkata

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 41 : Wetland map of West Bengal

### 8.1.20 Jharkhand

In the state of Jharkhand 2463 wetlands have been delineated, in addition to 13227 small wetlands (< 2.25 ha). Total wetland area estimated is 170051 ha (Table 65), which accounts for about 2.1 % of geographical area of Jharkhand. The major wetland types are river/stream (97743 ha), reservoir/barrage (48177 ha), tank/pond (5688 ha), lake/pond (3204 ha), riverine wetland (1629 ha), waterlogged-natural (231 ha), ox-bow lake (83 ha), waterlogged-man-made (61 ha) and aquaculture pond (8 ha)**.** Graphical distribution of wetland types in Jharkhand is shown in Figure 51.

The open water spread in the wetlands in pre-monsoon is significantly low (103225 ha ) compared to post-monsoon (152879 ha). The turbidity of water in wetlands is in general moderate. Area under aquatic vegetation in pre-monsoon season is 7244 ha which is more than double that of post-monsoon season indicating submergence or reduction in growth of aquatic vegetation during post-monsoon season. Wetland map of the state is shown in Plate 42.

Table 65: Area estimates of wetlands in Jharkhand

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 | Lake/Pond | 16 | 3204 | 1.88 | 1343 | 385 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 18 | 83 | 0.05 | 71 | 70 |
| 3 | 1103 | High altitude wetland | - | - | - | - | - |
| 4 | 1104 | Riverine wetland | 42 | 1629 | 0.96 | 781 | 552 |
| 5 | 1105 | Waterlogged | 58 | 231 | 0.14 | 231 | 16 |
| 6 | 1106 | River/Stream | 344 | 97743 | 57.48 | 97743 | 63442 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 1062 | 48177 | 28.33 | 47386 | 34476 |
| 8 | 1202 | Tank/Pond | 910 | 5688 | 3.34 | 5266 | 4241 |
| 9 | 1203 | Waterlogged | 11 | 61 | 0.04 | 50 | 35 |
| 10 | 1204 | Salt pan | 2 | 8 | 0.00 | 8 | 8 |
| | | **Sub-Total** | **2463** | **156824** | **92.22** | **152879** | **103225** |
| | | Wetlands (<2.25 ha) | 13227 | 13227 | 7.78 | - | - |
| | | **Total** | **15690** | **170051** | **100.00** | **152879** | **103225** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 3437 | 7244 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 21014 | 12774 |
| Moderate | 88410 | 64127 |
| High | 43455 | 26324 |

**District-wise wetland area estimates in Jharkhand**

The state has 18 districts. Pashchimi Singhbhum district ranks first in terms of area (18939 ha) followed by Sahibganj (16118 ha) and others. In terms of per cent area under wetlands of total wetland extent, Pashchimi Singhbhum also ranks first (11%). Interestingly, 50% of the wetland area is concentrated in five districts i.e. Ranchi (9%), Dumka (9%), Palamu (10%), Sahibganj (9%) and Pashchimi Singhbhum (11%) and rest of the wetlands are distributed in the remaining 13 districts. In terms of per cent area of wetlands of the geographical area of the districts, the wetlands account for about 2%. Jharkhand state has shown a significant reduction in the extent of open water from post-monsoon (152872 ha) to pre-monsoon (102584 ha), which amounts to approximately 35%. Minimum seasonal variation (11%) in open water extent is observed in Sahibganj district while maximum in Lohardaga (69%). On an average the state has shown a decrease of 35% of open water extent. District-wise wetland area estimates is given in Table 66 as well as graphically represented in Figure 52. District-wise area of wetlands (type-wise) in the state is given in Table 67.

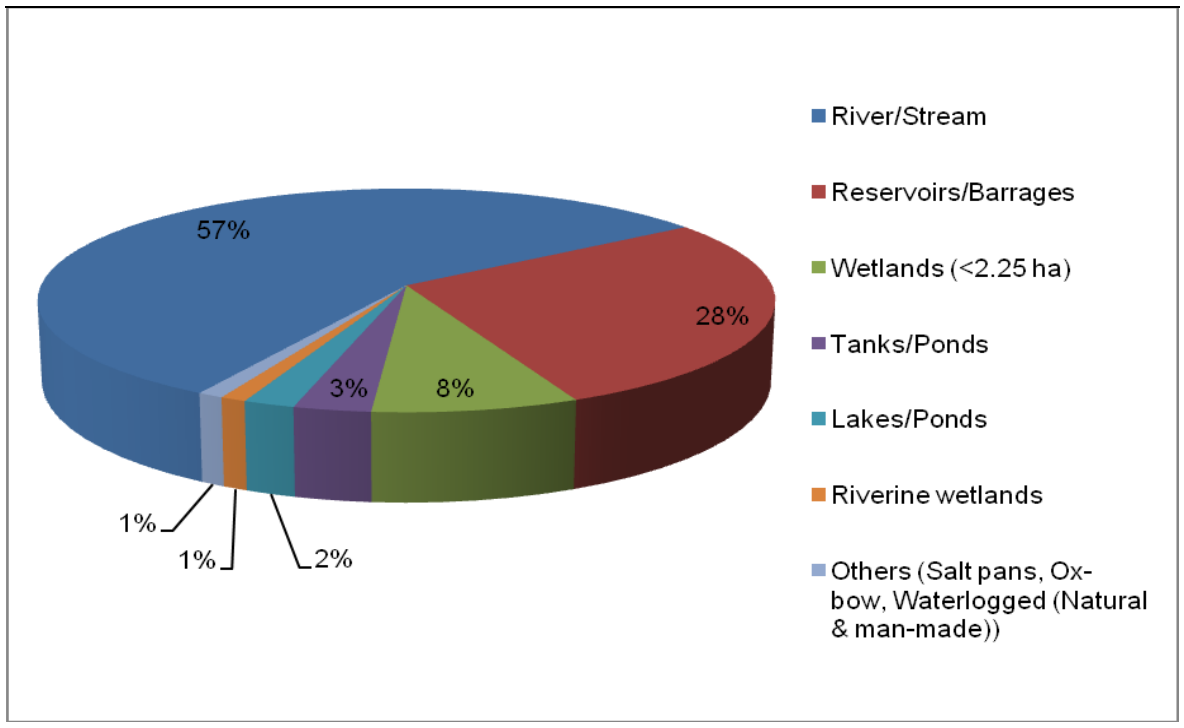



Figure 51: Type-wise wetland distribution in Jharkhand

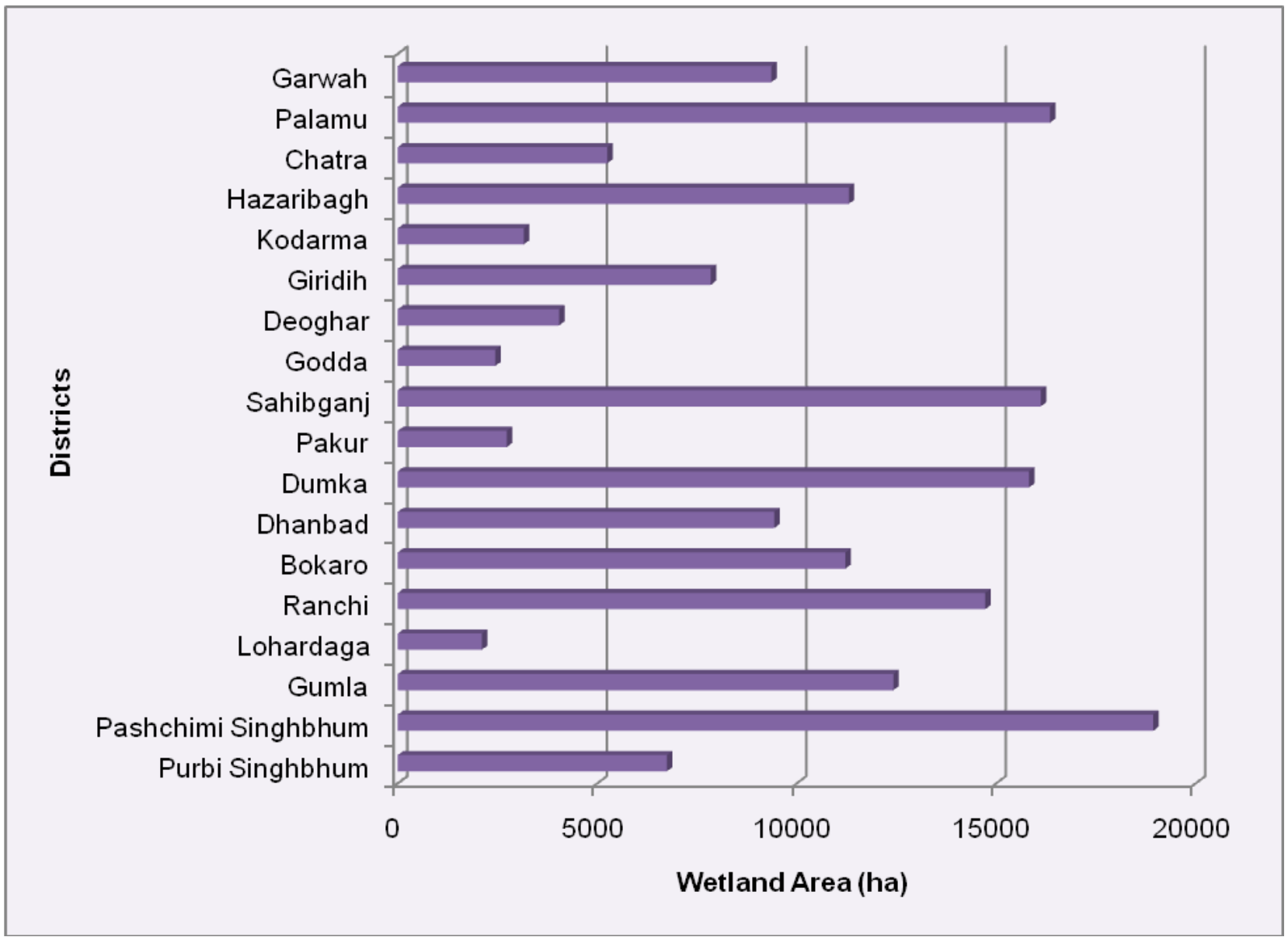



Figure 52: District-wise graphical distribution of wetlands Jharkhand

Table 66: District-wise area of wetlands in Jharkhand

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Garwah | 4044 | 9362 | 5.51 | 2.32 | 9052 | 5073 | 23 | 99 | 495 | 4050 | 4507 | 157 | 4099 | 817 |
| 2 | Palamu | 8705 | 16348 | 9.61 | 1.88 | 14948 | 7781 | 45 | 76 | 381 | 8016 | 6551 | 268 | 5556 | 1957 |
| 3 | Chatra | 3706 | 5253 | 3.09 | 1.42 | 4751 | 2117 | 46 | 54 | 142 | 3001 | 1608 | - | 1366 | 751 |
| 4 | Hazaribagh | 6147 | 11307 | 6.65 | 1.84 | 10635 | 5896 | 76 | 68 | 4171 | 4241 | 2223 | 466 | 4287 | 1143 |
| 5 | Kodarma | 1312 | 3160 | 1.86 | 2.41 | 2971 | 1382 | - | 19 | 759 | 1576 | 636 | - | 1382 | - |
| 6 | Giridih | 4975 | 7845 | 4.61 | 1.58 | 7021 | 3839 | 55 | 75 | - | 5071 | 1950 | - | 3186 | 653 |
| 7 | Deoghar | 2479 | 4046 | 2.38 | 1.63 | 3661 | 3008 | 26 | 29 | - | 647 | 3014 | - | 275 | 2733 |
| 8 | Godda | 2110 | 2445 | 1.44 | 1.16 | 2028 | 1475 | - | 119 | 233 | 1018 | 777 | 158 | 469 | 848 |
| 9 | Sahibganj | 1599 | 16118 | 9.48 | 10.08 | 12979 | 11504 | 2193 | 3392 | 67 | 12457 | 455 | 5 | 11235 | 264 |
| 10 | Pakur | 1806 | 2734 | 1.61 | 1.51 | 2047 | 1463 | 20 | 281 | 79 | 1520 | 448 | - | 799 | 664 |
| 11 | Dumka | 6212 | 15824 | 9.31 | 2.55 | 14939 | 11659 | 16 | 16 | 3688 | 8456 | 2795 | 6822 | 1372 | 3465 |
| 12 | Dhanbad | 2052 | 9438 | 5.55 | 4.60 | 8296 | 6108 | 149 | 1051 | 6097 | 1892 | 307 | 1902 | 4062 | 144 |
| 13 | Bokaro | 2861 | 11222 | 6.60 | 3.92 | 9800 | 8621 | 606 | 637 | 3258 | 5162 | 1380 | 2028 | 5974 | 619 |
| 14 | Ranchi | 7698 | 14728 | 8.66 | 1.91 | 13709 | 10165 | 94 | 276 | 244 | 8033 | 5432 | 136 | 5752 | 4277 |
| 15 | Lohardaga | 1491 | 2110 | 1.24 | 1.42 | 1809 | 568 | 6 | 12 | 241 | 1062 | 506 | 54 | 124 | 390 |
| 16 | Gumla | 9077 | 12423 | 7.31 | 1.37 | 11729 | 6147 | 14 | 14 | 262 | 4227 | 7240 | 155 | 1619 | 4373 |
| 17 | Pashchimi Singhbhum | 9907 | 18939 | 11.14 | 1.91 | 16732 | 12354 | 38 | 856 | 897 | 12766 | 3069 | 623 | 8505 | 3226 |
| 18 | Purbi Singhbhum | 3533 | 6749 | 3.97 | 1.91 | 5772 | 4065 | 30 | 170 | - | 5215 | 557 | - | 4065 | - |
| | **Total** | **79714** | **170051** | **100.00** | **2.13** | **152879** | **103225** | **3437** | **7244** | **21014** | **88410** | **43455** | **12774** | **64127** | **26324** |

* Data Source: http://nic.in

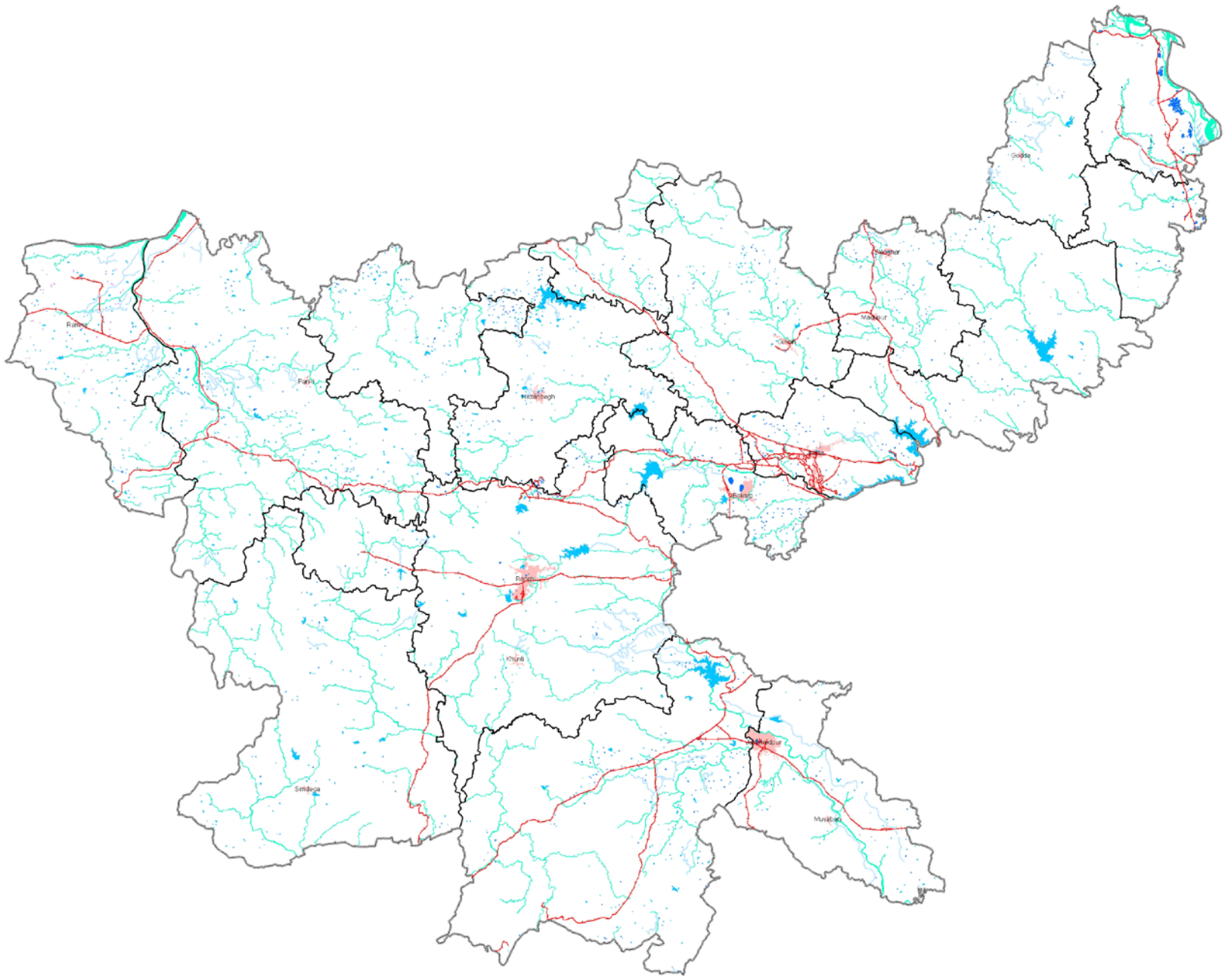
Table 67: District-wise area of wetlands (type-wise) in Jharkhand

| District code | District | Geographic area * | Wetland Type | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1104 | 1105 | 1106 | 1201 | 1202 | 1203 | 1204 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | Riverine wetland | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | Salt pan | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Garhwa | 4044 | - | - | - | 183 | 7378 | 1416 | 80 | 18 | - | 9075 | 287 | 9362 |
| 2 | Palamu | 8705 | - | - | 4 | 18 | 12655 | 2095 | 209 | 8 | - | 14989 | 1359 | 16348 |
| 3 | Chatra | 3706 | - | - | - | 20 | 3535 | 854 | 376 | 4 | - | 4789 | 464 | 5253 |
| 4 | Hazaribagh | 6147 | - | - | 3 | 4 | 3780 | 6571 | 360 | - | - | 10718 | 589 | 11307 |
| 5 | Kodarma | 1312 | - | - | - | - | 1995 | 902 | 69 | 5 | - | 2971 | 189 | 3160 |
| 6 | Giridih | 4975 | - | - | 21 | - | 6217 | 657 | 186 | - | - | 7081 | 764 | 7845 |
| 7 | Deoghar | 2479 | - | - | - | - | 3166 | 293 | 228 | - | - | 3687 | 359 | 4046 |
| 8 | Godda | 2110 | - | - | - | - | 1436 | 455 | 139 | - | - | 2030 | 415 | 2445 |
| 9 | Sahibganj | 1599 | 2861 | 73 | 1204 | - | 11378 | 16 | 104 | - | - | 15636 | 482 | 16118 |
| 10 | Pakur | 1806 | 322 | 10 | - | - | 1466 | 73 | 181 | 15 | - | 2067 | 667 | 2734 |
| 11 | Dumka | 6212 | - | - | 263 | - | 5487 | 9000 | 217 | - | - | 14967 | 857 | 15824 |
| 12 | Dhanbad | 2052 | - | - | 25 | - | 2111 | 5787 | 523 | - | - | 8446 | 992 | 9438 |
| 13 | Bokaro | 2861 | - | - | 51 | - | 3899 | 5121 | 1313 | - | - | 10384 | 838 | 11222 |
| 14 | Ranchi | 7698 | 21 | - | 58 | - | 8261 | 4945 | 519 | 3 | 8 | 13815 | 913 | 14728 |
| 15 | Lohardaga | 1491 | - | - | - | - | 1393 | 390 | 33 | - | - | 1816 | 294 | 2110 |
| 16 | Gumla | 9077 | - | - | - | 6 | 9769 | 1822 | 147 | - | - | 11744 | 679 | 12423 |
| 17 | Pashchimi Singhbhum | 9907 | - | - | - | - | 9140 | 6914 | 746 | 8 | - | 16808 | 2131 | 18939 |
| 18 | Purbi Singhbhum | 3533 | - | - | - | - | 4677 | 866 | 258 | - | - | 5801 | 948 | 6749 |
| | **Total** | **79714** | **3204** | **83** | **1629** | **231** | **97743** | **48177** | **5688** | **61** | **8** | **156824** | **13227** | **170051** |

* Data Source: http://nic.in

State : Jharkhand

# WETLAND MAP

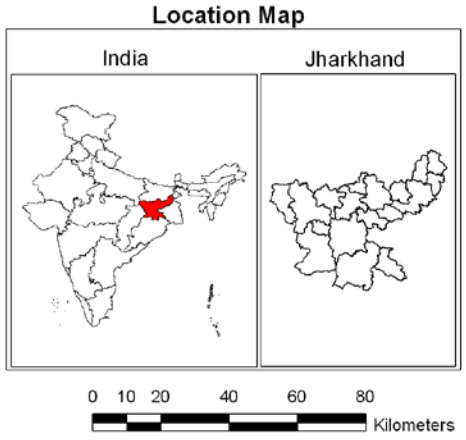



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | |
| | 1105 | | | Waterlogged |
| | 1106 | | | River/Stream |
| | | | Man-made | Riverine wetlands |
| | 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

Jharkhand Space Applications Centre, Ranchi

**Sponsored By :**

Ministry of Environment and Forests
Government of India

Plate 42 : Wetland map of Jharkhand

### 8.1.21 Orissa

In the state of Orissa 12266 wetlands have been delineated. In addition, 66174 small wetlands (< 2.25 ha) have also been discerned. Total wetland area is estimated to be 690904 ha. (Table 68). Inland wetlands dominated the extent of wetlands constituting about 66 per cent. Further, inland natural and man-made wetlands shared approximately similar extents with about 34 and 32 per cent of area under wetlands. Out of 24 per cent of coastal wetlands, the natural accounted for about 20 per cent and the rest 3 per cent is shared by man-made wetlands.

The major wetland types are river/stream (223522 ha) comprising about 32 per cent of extent wetlands followed by reservoir/barrage (189972 ha), tank/pond (29301 ha), lagoon (89023 ha), intertidal mudflat (25514 ha) and mangrove (23395 ha). There are large number of small wetlands (<2.25 ha) contributing about 9.6 per cent of the wetlands in Orissa. Wetland map of the state is shown in Plate 43.

The open water spread is 508282 ha in post-monsoon constituting about 81 per cent of the wetland area. It has reduced to 419310 ha in pre-monsoon, which turns out to be about 14 per cent. The reduction in open water spread is visibly observed in case of reservoir/barrage, which was 180240 ha in post-monsoon has got reduced to 109975 ha in pre-monsoon season. The aquatic vegetation was observed to constituting about 10 per cent of wetland area in post-monsoon (62733 ha) has shown a significant increase during pre-monsoon (142584 ha) that turns out to be about 23 per cent. Open water exhibited dominantly moderate turbidity in both seasons followed by low and high turbidity levels. Graphical distribution of wetland type is shown in Figure 53.

Table 68: Type wise area estimates of wetlands in Orissa

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 | Lake/Pond | 4 | 712 | 0.10 | 344 | 225 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 79 | 728 | 0.11 | 539 | 558 |
| 3 | 1103 | High altitude wetland | - | - | - | - | - |
| 4 | 1104 | Riverine wetland | 133 | 980 | 0.14 | 739 | 705 |
| 5 | 1105 | Waterlogged | 1158 | 12925 | 1.87 | 4487 | 4325 |
| 6 | 1106 | River/Stream | 1737 | 223522 | 32.35 | 222592 | 212960 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 1379 | 189972 | 27.50 | 180240 | 109975 |
| 8 | 1202 | Tank/Pond | 6441 | 29301 | 4.24 | 16293 | 15829 |
| 9 | 1203 | Waterlogged | 51 | 934 | 0.14 | 672 | 672 |
| 10 | 1204 | Salt pan | - | - | - | - | - |
| | | **Total - Inland** | **10982** | **459074** | **66.45** | **425906** | **345249** |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 11 | 2101 | Lagoon | 7 | 89023 | 12.89 | 60699 | 52384 |
| 12 | 2102 | Creek | - | - | - | - | - |
| 13 | 2103 | Sand/Beach | 72 | 6046 | 0.88 | - | - |
| 14 | 2104 | Intertidal mud flat | 318 | 25514 | 3.69 | - | - |
| 15 | 2105 | Salt Marsh | - | - | - | - | - |
| 16 | 2106 | Mangrove | 163 | 23395 | 3.39 | - | - |
| 17 | 2107 | Coral Reef | - | - | - | - | - |
| | **2200** | **Coastal Wetlands - Man-made** | | | | | |
| 18 | 2201 | Salt pan | 2 | 1726 | 0.25 | 1726 | 1726 |
| 19 | 2202 | Aquaculture pond | 722 | 19952 | 2.89 | 19951 | 19951 |
| | | **Total - Coastal** | **1284** | **165656** | **23.98** | **82376** | **74061** |
| | | **Sub-Total** | **12266** | **624730** | **90.42** | **508282** | **419310** |
| | | Wetlands (<2.25 ha) | 66174 | 66174 | 9.58 | - | - |
| | | **Total** | **78440** | **690904** | **100.00** | **508282** | **419310** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 62733 | 142584 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 116369 | 138906 |
| Moderate | 378117 | 264017 |
| High | 13796 | 16387 |

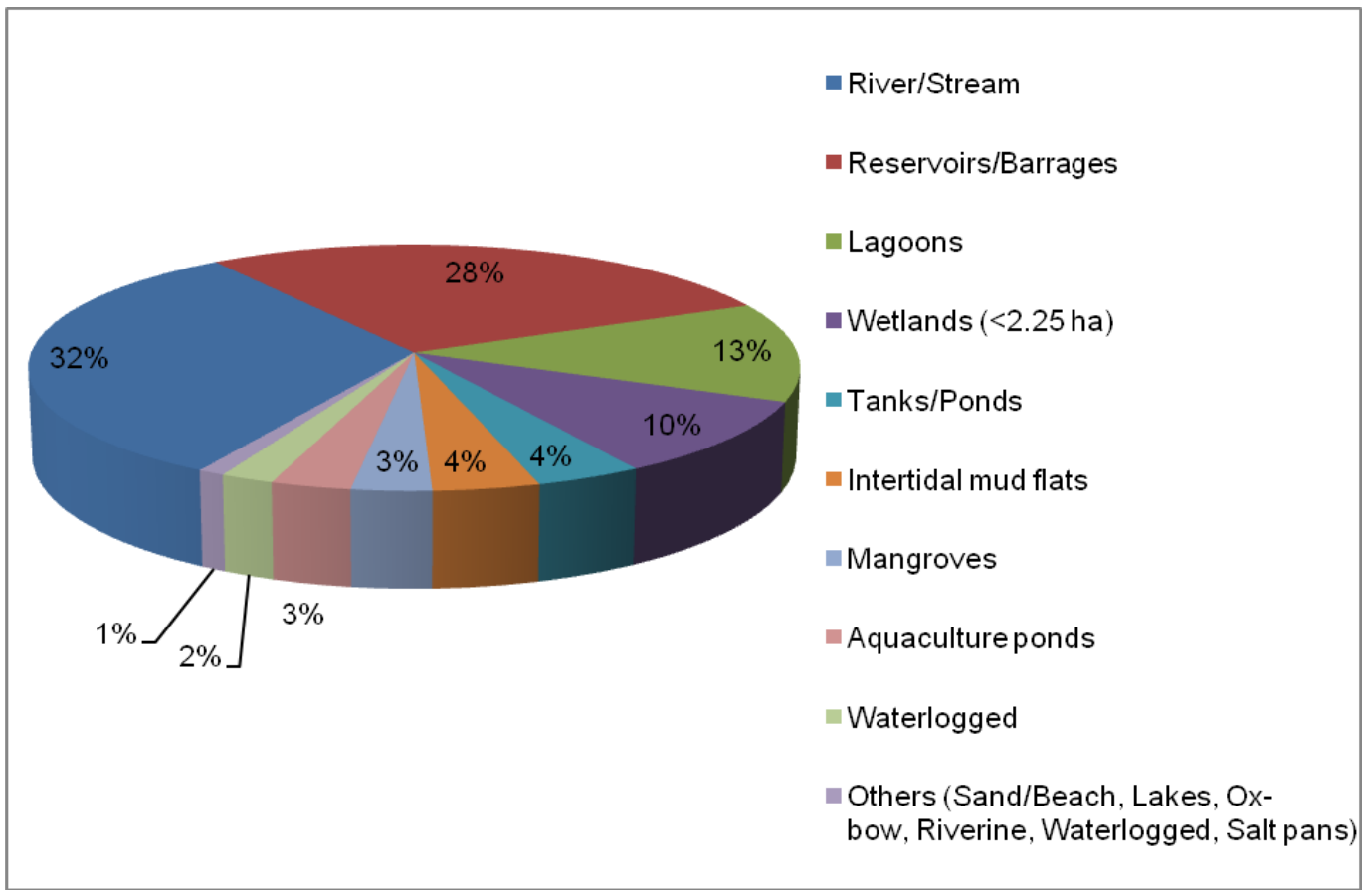



Figure 53: Type-wise wetland distribution in Orissa

**District-wise wetland area estimates in Orissa**

The state has thirty districts. Overall, the wetlands account for about 4.5 per cent of geographical area of the state. Perusal of Table 66 reveals that Puri district ranked first in terms of extent of total wetlands and open water comprising 14.2 per cent of total area under wetlands in the state. This district comprises 98096 ha of area under wetlands with open water spread of 65593 ha in post-monsoon and 59427 ha in pre-monsoon showing a reduction of about 9 per cent in open water spread.

On the other hand Gajapati district has shown least area comprising 3569 ha of wetlands with 2642 ha in post-monsoon and 1398 ha in pre-monsoon, which turns out to be about 47 per cent in terms of seasonal reduction in the extent of open water. Detailed account of wetland distribution along with their assessment in terms of their seasonal open water spread, aquatic vegetation and turbidity status is described in the subsequent account. District-wise wetland area estimates is given in Table 69 as well as graphically represented in Figure 54. District-wise area of wetlands (type-wise) in the state is given in Table 70.

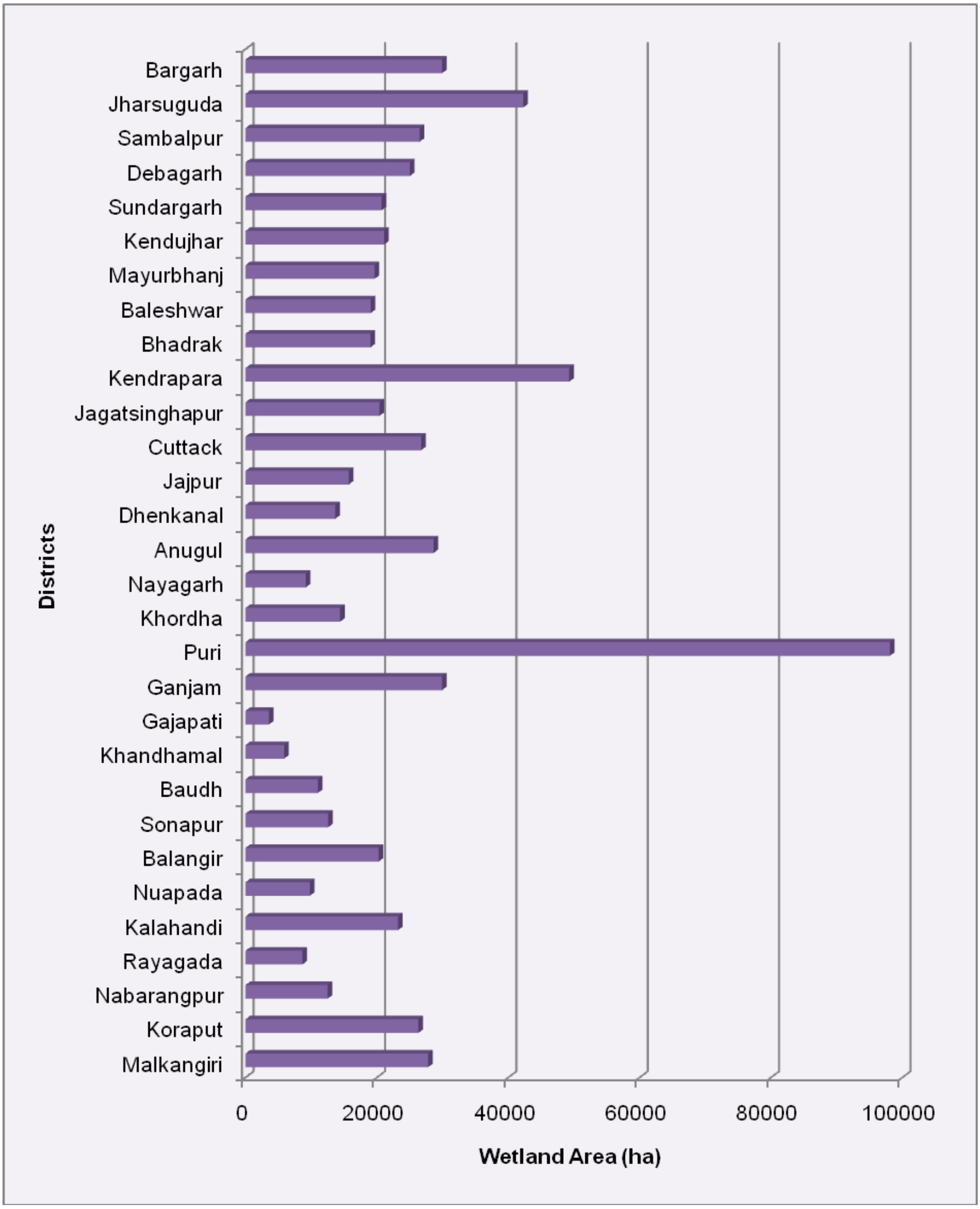



Figure 54: District-wise graphical distribution of wetlands in Orissa

Table 69: District-wise area of wetlands in Orissa

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Bargarh | 5832 | 29925 | 4.33 | 5.13 | 23672 | 17412 | 2777 | 8879 | 167 | 21641 | 1864 | 2057 | 10532 | 4823 |
| 2 | Jharsuguda | 2202 | 42297 | 6.12 | 19.21 | 39393 | 18376 | 2050 | 22729 | 13 | 38636 | 744 | 1851 | 15398 | 1127 |
| 3 | Sambalpur | 6702 | 26511 | 3.84 | 3.96 | 23786 | 17261 | 954 | 6842 | - | 21912 | 1874 | 983 | 13676 | 2602 |
| 4 | Debagarh | 2781 | 25025 | 3.62 | 9.00 | 23900 | 15343 | 289 | 8250 | 3612 | 19449 | 839 | 8784 | 6355 | 204 |
| 5 | Sundargarh | 9942 | 20725 | 3.00 | 2.08 | 17336 | 14989 | 1005 | 2495 | 5574 | 11268 | 494 | 3475 | 9754 | 1760 |
| 6 | Kendujhar | 8336 | 21089 | 3.05 | 2.53 | 16143 | 12451 | 421 | 3143 | 3516 | 11899 | 728 | 2428 | 10023 | - |
| 7 | Mayurbhanj | 10418 | 19650 | 2.84 | 1.89 | 12876 | 11100 | 603 | 2323 | 3273 | 9603 | - | 2383 | 8717 | - |
| 8 | Baleshwar | 3706 | 19061 | 2.76 | 5.14 | 10387 | 10104 | 113 | 141 | 82 | 10305 | - | 2194 | 7910 | - |
| 9 | Bhadrak | 2788 | 19017 | 2.75 | 6.82 | 9886 | 9713 | 239 | 239 | - | 9859 | 27 | 1589 | 8124 | - |
| 10 | Kendrapara | 2546 | 49284 | 7.13 | 19.36 | 21516 | 21413 | 791 | 791 | 5988 | 15506 | 22 | 6257 | 15156 | - |
| 11 | Jagatsinghapur | 1759 | 20386 | 2.95 | 11.59 | 14760 | 14428 | 801 | 801 | 2129 | 12624 | 7 | 3948 | 10480 | - |
| 12 | Cuttack | 3915 | 26738 | 3.87 | 6.83 | 21996 | 19598 | 3258 | 3641 | 680 | 21306 | 10 | 10870 | 8728 | - |
| 13 | Jajpur | 2885 | 15714 | 2.27 | 5.45 | 10759 | 10132 | 2607 | 2900 | 3830 | 6754 | 175 | 254 | 9878 | - |
| 14 | Dhenkanal | 4597 | 13663 | 1.98 | 2.97 | 9736 | 8472 | 853 | 1870 | 5206 | 3038 | 1492 | 496 | 7976 | - |
| 15 | Anugul | 6347 | 28616 | 4.14 | 4.51 | 25507 | 20112 | 720 | 5645 | 7108 | 15664 | 2735 | 8052 | 11753 | 307 |
| 16 | Nayagarh | 3954 | 9185 | 1.33 | 2.32 | 6631 | 6194 | 636 | 893 | 1265 | 5366 | - | 2730 | 3464 | - |
| 17 | Khordha | 2888 | 14407 | 2.09 | 4.99 | 6030 | 5144 | 6586 | 7290 | 2145 | 3885 | - | 3140 | 2004 | - |
| 18 | Puri | 3055 | 98096 | 14.20 | 32.11 | 65593 | 59427 | 21573 | 28255 | 41778 | 23815 | - | 46869 | 12558 | - |
| 19 | Ganjam | 8033 | 29920 | 4.33 | 3.72 | 18883 | 16099 | 4894 | 7167 | 8485 | 10398 | - | 6737 | 9362 | - |
| 20 | Gajapati | 3056 | 3569 | 0.52 | 1.17 | 2642 | 1398 | 536 | 1768 | 724 | 1918 | - | 26 | 1372 | - |
| 21 | Khandhamal | 6004 | 5865 | 0.85 | 0.98 | 5052 | 4802 | 87 | 337 | 390 | 4662 | - | 186 | 4616 | - |
| 22 | Baudh | 4289 | 11011 | 1.59 | 2.57 | 9203 | 8950 | 842 | 981 | 2348 | 6855 | - | 3949 | 4949 | 52 |
| 23 | Sonapur | 2284 | 12576 | 1.82 | 5.51 | 10899 | 10333 | 611 | 969 | 1272 | 9534 | 93 | 2773 | 6062 | 1498 |
| 24 | Balangir | 6552 | 20277 | 2.93 | 3.09 | 13407 | 12503 | 3020 | 3944 | 2717 | 10695 | - | 1126 | 10883 | 494 |
| 25 | Nuapada | 3408 | 9792 | 1.42 | 2.87 | 6842 | 4961 | 1227 | 3070 | 2295 | 4547 | - | 609 | 4332 | 20 |
| 26 | Kalahandi | 8197 | 23227 | 3.36 | 2.83 | 17408 | 16015 | 2779 | 3943 | 5047 | 12136 | 225 | 5091 | 10894 | 30 |
| 27 | Rayagada | 7585 | 8672 | 1.26 | 1.14 | 7048 | 6517 | 354 | 574 | 366 | 6682 | - | 142 | 6282 | 93 |
| 28 | Nabarangpur | 5135 | 12503 | 1.81 | 2.43 | 8588 | 7921 | 570 | 984 | 1789 | 5758 | 1041 | 2479 | 3734 | 1708 |
| 29 | Koraput | 8534 | 26307 | 3.81 | 3.08 | 24124 | 19007 | 597 | 5715 | 4574 | 19005 | 545 | 3963 | 14256 | 788 |
| 30 | Malkangiri | 6115 | 27796 | 4.02 | 4.55 | 24275 | 19130 | 940 | 6005 | - | 23396 | 879 | 3461 | 14789 | 880 |
| | **Total** | **153845** | **690904** | **100.00** | **4.49** | **508282** | **419310** | **62733** | **142584** | **116369** | **378117** | **13796** | **138906** | **264017** | **16387** |

* Data Source: http://nic.in

Table 70: District-wise area of wetlands (type-wise) in Orissa

| District code | District | Geographic area * | Wetland Type | | | | | | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1104 | 1105 | 1106 | 1201 | 1202 | 1203 | 2101 | 2103 | 2104 | 2106 | 2201 | 2202 | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Bargarh | 5832 | - | - | 35 | 419 | 5953 | 17238 | 2694 | 68 | - | - | - | - | - | - | 26407 | 3518 | 29925 |
| 2 | Jharsuguda | 2202 | - | - | 3 | 176 | 2407 | 37620 | 1123 | 4 | - | - | - | - | - | - | 41333 | 964 | 42297 |
| 3 | Sambalpur | 6702 | - | - | - | 156 | 8066 | 14566 | 1384 | 550 | - | - | - | - | - | - | 24722 | 1789 | 26511 |
| 4 | Debagarh | 2781 | - | - | - | 20 | 2681 | 21264 | 182 | 9 | - | - | - | - | - | - | 24156 | 869 | 25025 |
| 5 | Sundargarh | 9942 | - | - | 15 | 138 | 11165 | 5854 | 1114 | - | - | - | - | - | - | - | 18286 | 2439 | 20725 |
| 6 | Kendujhar | 8336 | - | - | 70 | 244 | 10200 | 5649 | 536 | - | - | - | - | - | - | - | 16699 | 4390 | 21089 |
| 7 | Mayurbhanj | 10418 | - | 55 | 10 | 169 | 7812 | 4811 | 593 | 4 | - | - | - | - | - | - | 13454 | 6196 | 19650 |
| 8 | Baleshwar | 3706 | - | 110 | 147 | 134 | 6375 | 124 | 148 | 31 | - | 943 | 4126 | 389 | - | 3396 | 15923 | 3138 | 19061 |
| 9 | Bhadrak | 2788 | - | 30 | 22 | 278 | 4989 | - | 51 | 72 | - | 114 | 3879 | 2945 | - | 4599 | 16979 | 2038 | 19017 |
| 10 | Kendrapara | 2546 | - | 47 | 6 | 589 | 17934 | - | 198 | - | - | 1562 | 5249 | 19277 | - | 3348 | 48210 | 1074 | 49284 |
| 11 | Jagatsinghapur | 1759 | - | 83 | 37 | 638 | 12153 | - | 427 | - | - | 971 | 2348 | 784 | - | 2250 | 19691 | 695 | 20386 |
| 12 | Cuttack | 3915 | 411 | 91 | 35 | 2958 | 20557 | 377 | 820 | - | - | - | - | - | - | - | 25249 | 1489 | 26738 |
| 13 | Jajpur | 2885 | - | 66 | - | 2412 | 9720 | 354 | 896 | 97 | - | - | - | - | - | - | 13545 | 2169 | 15714 |
| 14 | Dhenkanal | 4597 | - | 10 | 26 | 81 | 7756 | 1736 | 978 | - | - | - | - | - | - | - | 10587 | 3076 | 13663 |
| 15 | Anugul | 6347 | - | - | 76 | 191 | 10170 | 13864 | 1875 | - | - | - | - | - | - | - | 26176 | 2440 | 28616 |
| 16 | Nayagarh | 3954 | - | - | - | 115 | 5301 | 1241 | 582 | 27 | - | - | - | - | - | - | 7266 | 1919 | 9185 |
| 17 | Khordha | 2888 | - | 2 | 4 | 115 | 1929 | 839 | 422 | - | 9266 | - | - | - | - | 35 | 12612 | 1795 | 14407 |
| 18 | Puri | 3055 | - | 69 | 36 | 659 | 6637 | - | 259 | - | 72759 | 1649 | 8565 | - | - | 5974 | 96607 | 1489 | 98096 |
| 19 | Ganjam | 8033 | 301 | - | 12 | 1051 | 6131 | 4689 | 2397 | 23 | 6998 | 807 | 1347 | - | 1726 | 350 | 25832 | 4088 | 29920 |
| 20 | Gajapati | 3056 | - | - | - | 144 | 1275 | 1558 | 194 | - | - | - | - | - | - | - | 3171 | 398 | 3569 |
| 21 | Khandhamal | 6004 | - | - | - | - | 4455 | 620 | 61 | 3 | - | - | - | - | - | - | 5139 | 726 | 5865 |
| 22 | Baudh | 4289 | - | - | 11 | 354 | 8458 | 657 | 569 | 4 | - | - | - | - | - | - | 10053 | 958 | 11011 |
| 23 | Sonapur | 2284 | - | - | 15 | 206 | 8881 | 1248 | 1152 | 3 | - | - | - | - | - | - | 11505 | 1071 | 12576 |
| 24 | Balangir | 6552 | - | 31 | 192 | 580 | 9040 | 2483 | 4196 | 7 | - | - | - | - | - | - | 16529 | 3748 | 20277 |
| 25 | Nuapada | 3408 | - | 19 | - | 129 | 3431 | 3026 | 1534 | - | - | - | - | - | - | - | 8139 | 1653 | 9792 |
| 26 | Kalahandi | 8197 | - | 12 | 158 | 396 | 8810 | 7746 | 2826 | - | - | - | - | - | - | - | 19948 | 3279 | 23227 |
| 27 | Rayagada | 7585 | - | - | 10 | 147 | 6082 | 1028 | 134 | 3 | - | - | - | - | - | - | 7404 | 1268 | 8672 |
| 28 | Nabarangpur | 5135 | - | 20 | 8 | 119 | 4496 | 3858 | 632 | 11 | - | - | - | - | - | - | 9144 | 3359 | 12503 |
| 29 | Koraput | 8534 | - | 83 | 39 | 181 | 4908 | 18833 | 841 | 18 | - | - | - | - | - | - | 24903 | 1404 | 26307 |
| 30 | Malkangiri | 6115 | - | - | 13 | 126 | 5750 | 18689 | 483 | - | - | - | - | - | - | - | 25061 | 2735 | 27796 |
| | **Total** | **153845** | **712** | **728** | **980** | **12925** | **223522** | **189972** | **29301** | **934** | **89023** | **6046** | **25514** | **23395** | **1726** | **19952** | **624730** | **66174** | **690904** |

* Data Source: http://nic.in

1101 Lake/Pond
1102 Ox-bow lake/ Cut-off meander
1103 High altitude wetland
1104 Riverine wetland
1105 Waterlogged (Natural)
1106 River/Stream

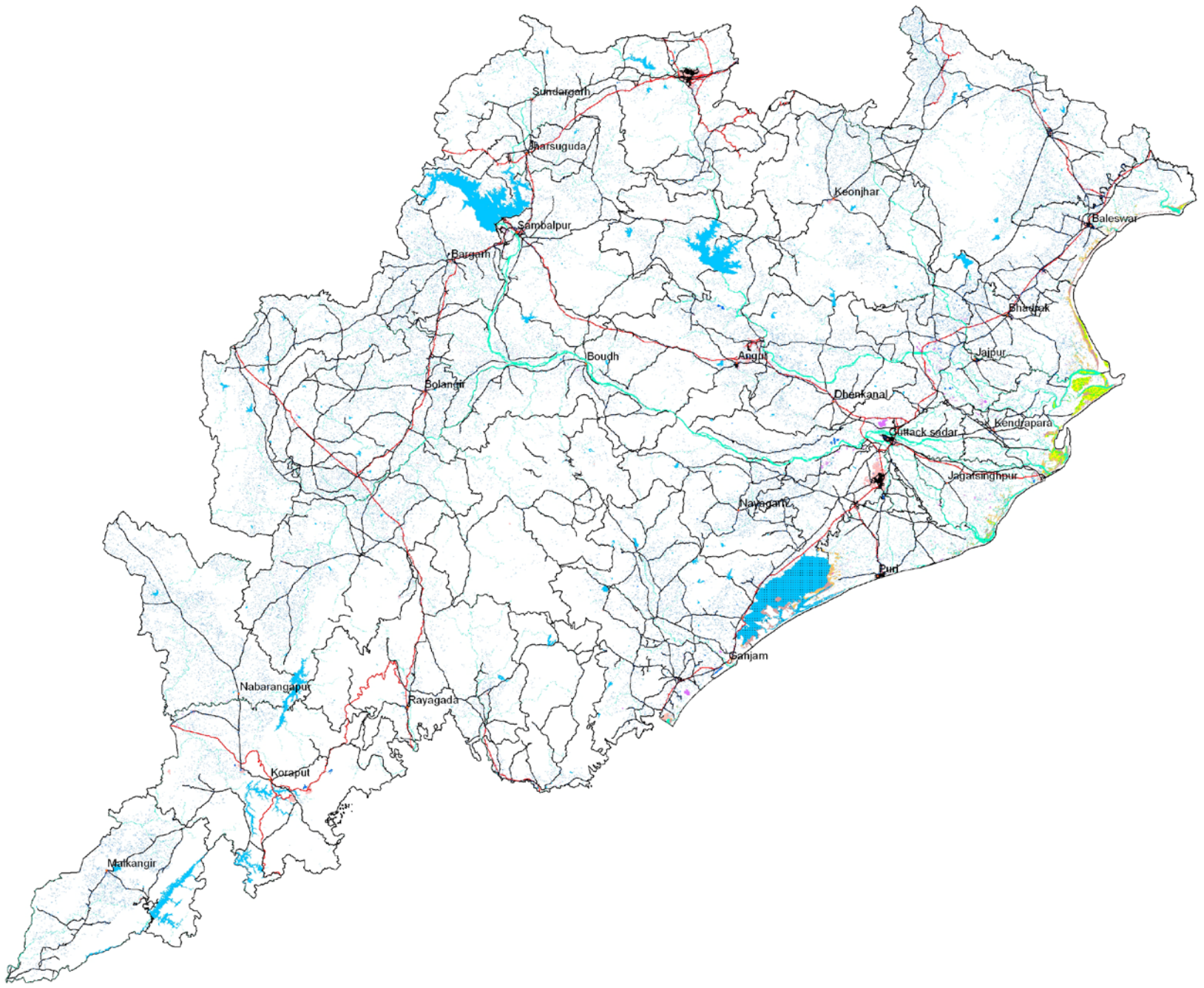
1201 Reservoir/Barrage
1202 Tank/Pond
1203 Waterlogged (Man-made)
1204 Salt pan (Inland)

2101 Lagoon
2102 Creek
2103 Sand/Beach
2104 Intertidal mud flat
2105 Salt Marsh (Coastal)
2106 Mangrove
2107 Coral Reef

2201 Salt pan
2202 Aquaculture pond

State : Orissa

# WETLAND MAP

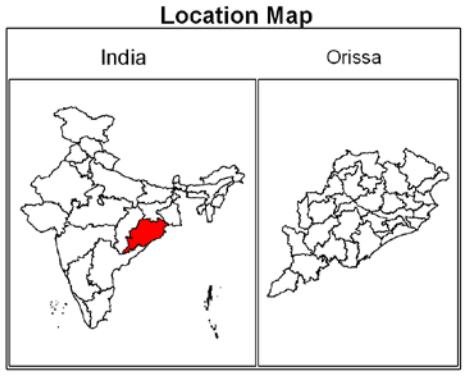



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Riverine wetlands |
| | 1105 | | | Waterlogged |
| | 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
- Canal
- Railway
- Drainage (line)
- Roads
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

**Location Map**




0 25 50 100 Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Orissa Space Applications Centre, Bhubaneswar

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 43 : Wetland map of Orissa

### 8.1.22 Chhattisgarh

Total 7711 wetlands have been mapped at 1:50,000 scale in the state. In addition, 27823 wetlands (< 2.25 ha) have also been identified and delineated. Total wetland area estimated is 337966 ha that is around 2.5 per cent of the geographic area (Table 71). The major wetland types are river/stream accounting for about 53 per cent of the wetlands (179088 ha), reservoir/barrage (90389 ha), and tank/pond (40226 ha). Graphical distribution of wetland type is shown in Figure 55. The small wetlands (< 2.25 ha) accounts for about 8.2 per cent assuming that each is of one ha. Wetland map of the state is shown in Plate 43.

The extent of open water is 243814 ha in post-monsoon and 173678 ha in pre-monsoon. Turbidity is observed to be dominantly moderate in post-monsoon and low to moderate during pre-monsoon. The aquatic vegetation in wetlands is significantly higher during pre-monsoon (5.8 per cent) than that of post-monsoon (0.6 per cent).

Table 71: Area estimates of wetlands in Chhattisgarh

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 | Lake/Pond | - | - | - | - | - |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 6 | 26 | 0.01 | 26 | 13 |
| 3 | 1103 | High altitude wetland | - | - | - | - | - |
| 4 | 1104 | Riverine wetland | 8 | 174 | 0.05 | 83 | 76 |
| 5 | 1105 | Waterlogged | - | - | - | - | - |
| 6 | 1106 | River/Stream | 156 | 179088 | 52.99 | 124712 | 93095 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 604 | 90389 | 26.74 | 85148 | 54012 |
| 8 | 1202 | Tank/Pond | 6906 | 40226 | 11.90 | 33671 | 26366 |
| 9 | 1203 | Waterlogged | 31 | 240 | 0.07 | 174 | 116 |
| 10 | 1204 | Salt pan | - | - | - | - | - |
| | | **Sub-Total** | **7711** | **310143** | **91.77** | **243814** | **173678** |
| | | Wetlands (<2.25 ha) | 27823 | 27823 | 8.23 | - | - |
| | | **Total** | **35534** | **337966** | **100.00** | **243814** | **173678** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 2123 | 19600 |

| | | |
|---|---|---|
| **Area under turbidity levels** | | |
| Low | 28985 | 79103 |
| Moderate | 183025 | 85841 |
| High | 31804 | 8734 |

**District-wise wetland area estimates in Chhattisgarh**

The state has sixteen districts. District-wise distribution of wetlands showed that Janjgir-Champa has the highest share of wetlands (6.78%) followed by Dhamtari (6.65%), Durg (3.55%), Raipur(3.53%) and Mahasamund (3.52) in terms of per cent district geographic area (Table 72). The district having very less share are Bastar (0.98%), Jashpur (1.3%) and Dantewada(1.45%). Figure 56 shows graphical distribution of district-wise wetlands. District-wise area of wetlands (type-wise) in the state is given in Table 73.

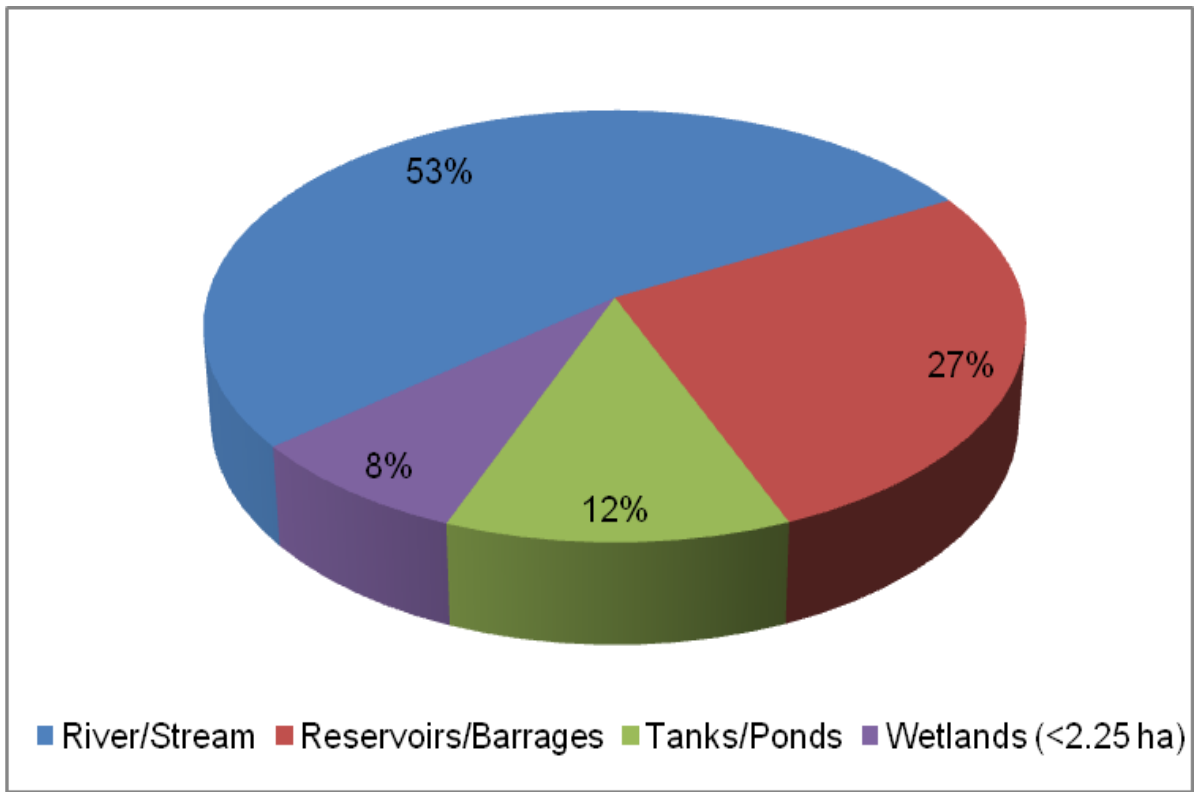



Figure 55: Type-wise wetland distribution in Chhattisgarh

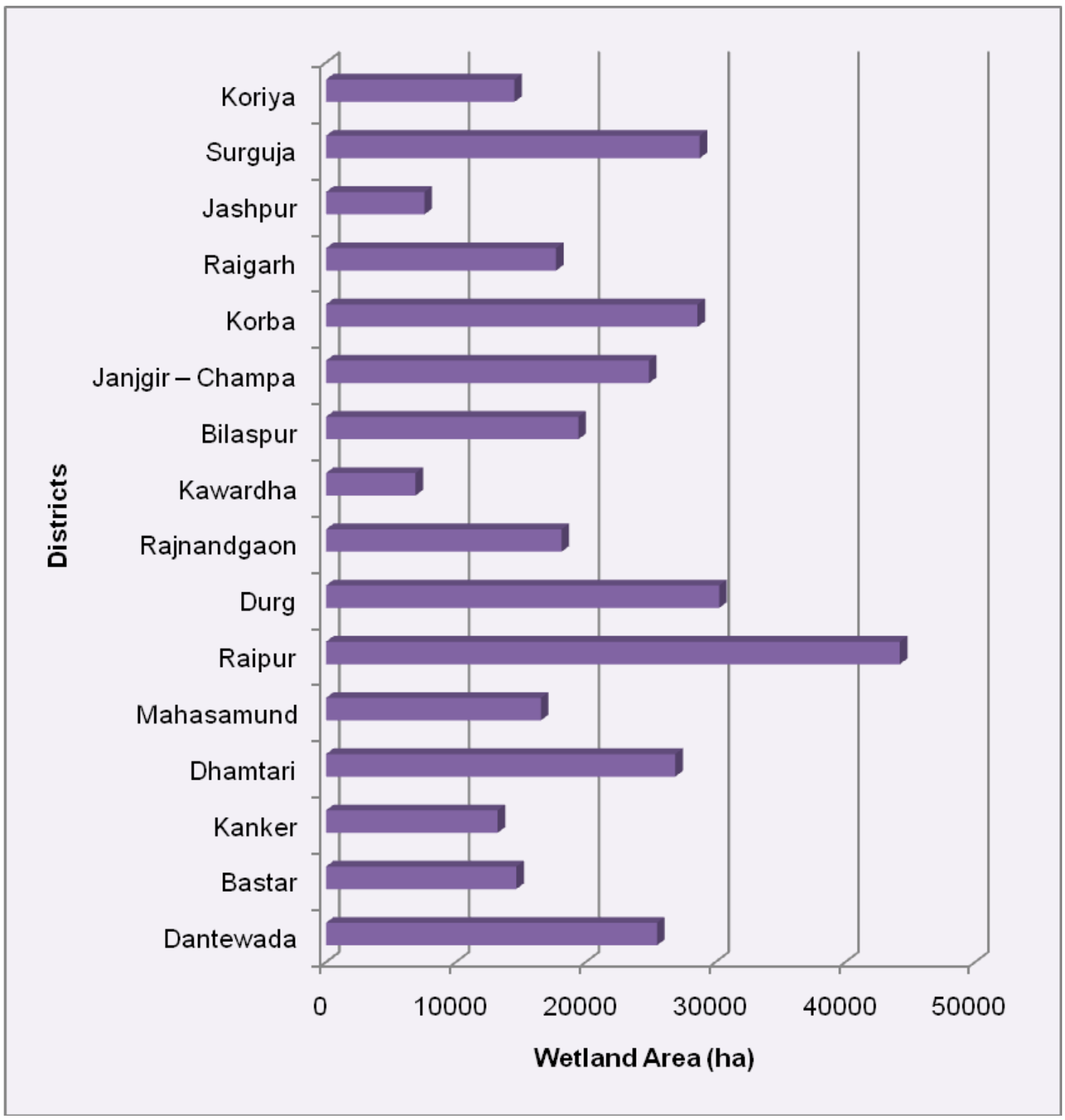



Figure 56: District-wise graphical distribution of wetlands in Chhattisgarh

Table 72: District-wise area of wetlands in Chhattisgarh

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Koriya | 6604 | 14515 | 4.29 | 2.20 | 9666 | 7486 | 60 | 155 | 736 | 8064 | 866 | 1053 | 6284 | 149 |
| 2 | Surguja | 15733 | 28794 | 8.52 | 1.83 | 20650 | 16658 | 119 | 519 | 298 | 17953 | 2399 | 2418 | 12514 | 1726 |
| 3 | Jashpur | 5838 | 7585 | 2.24 | 1.30 | 6314 | 4007 | 36 | 87 | - | 6264 | 50 | 188 | 3753 | 66 |
| 4 | Raigarh | 7086 | 17719 | 5.24 | 2.50 | 12951 | 8236 | 113 | 457 | 860 | 11422 | 669 | 5258 | 2414 | 564 |
| 5 | Korba | 9010 | 28624 | 8.47 | 3.18 | 25026 | 17708 | 70 | 705 | 420 | 9781 | 14825 | 7743 | 9615 | 350 |
| 6 | Janjgir – Champa | 3672 | 24886 | 7.36 | 6.78 | 13452 | 11035 | 218 | 1206 | 855 | 10718 | 1879 | 5399 | 5004 | 632 |
| 7 | Bilaspur | 7215 | 19443 | 5.75 | 2.69 | 15069 | 8838 | 50 | 730 | 1441 | 13551 | 77 | 4051 | 4321 | 466 |
| 8 | Kawardha | 4223 | 6899 | 2.04 | 1.63 | 4623 | 2959 | 111 | 321 | 696 | 3635 | 292 | 995 | 1736 | 228 |
| 9 | Rajnandgaon | 6904 | 18149 | 5.37 | 2.63 | 13272 | 10054 | 116 | 2195 | 330 | 11222 | 1720 | 4122 | 4706 | 1226 |
| 10 | Durg | 8537 | 30291 | 8.96 | 3.55 | 25958 | 18187 | 358 | 3772 | 9553 | 15753 | 652 | 11475 | 6193 | 519 |
| 11 | Raipur | 12507 | 44211 | 13.08 | 3.53 | 26783 | 18739 | 181 | 2130 | 3649 | 20524 | 2610 | 10899 | 6743 | 1097 |
| 12 | Mahasamund | 4702 | 16557 | 4.90 | 3.52 | 11468 | 6857 | 508 | 2312 | 3096 | 7216 | 1156 | 4161 | 1801 | 895 |
| 13 | Dhamtari | 4049 | 26909 | 7.96 | 6.65 | 19676 | 11891 | 52 | 2981 | 4778 | 14210 | 688 | 9174 | 2670 | 47 |
| 14 | Kanker | 6506 | 13219 | 3.91 | 2.03 | 9854 | 6833 | 15 | 1061 | 1751 | 6505 | 1598 | 1380 | 5200 | 253 |
| 15 | Bastar | 14974 | 14662 | 4.34 | 0.98 | 10732 | 9976 | 4 | 460 | 315 | 9216 | 1201 | 1533 | 8111 | 332 |
| 16 | Dantewada | 17634 | 25503 | 7.55 | 1.45 | 18320 | 14214 | 112 | 509 | 207 | 16991 | 1122 | 9254 | 4776 | 184 |
| | **Total** | **135194** | **337966** | **100.00** | **2.50** | **243814** | **173678** | **2123** | **19600** | **28985** | **183025** | **31804** | **79103** | **85841** | **8734** |

* Data Source: http://nic.in

Table 73: District-wise area of wetlands (type-wise) in Chhattisgarh

| District code | District | Geographic area * | Wetland Type | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1102 | 1104 | 1106 | 1201 | 1202 | 1203 | | | |
| | | | Ox-bow lake/ Cut-off meander | Riverine wetland | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Koriya | 6604 | - | - | 11594 | 1821 | 410 | - | 13825 | 690 | 14515 |
| 2 | Surguja | 15733 | - | 35 | 20689 | 4704 | 1843 | - | 27271 | 1523 | 28794 |
| 3 | Jashpur | 5838 | - | - | 7030 | 74 | 337 | - | 7441 | 144 | 7585 |
| 4 | Raigarh | 7086 | - | - | 12413 | 1866 | 1839 | - | 16118 | 1601 | 17719 |
| 5 | Korba | 9010 | - | - | 7645 | 18293 | 1311 | - | 27249 | 1375 | 28624 |
| 6 | Janjgir – Champa | 3672 | - | - | 14869 | 1605 | 4980 | 106 | 21560 | 3326 | 24886 |
| 7 | Bilaspur | 7215 | - | 64 | 6036 | 7685 | 3127 | 34 | 16946 | 2497 | 19443 |
| 8 | Kawardha | 4223 | - | - | 3372 | 1871 | 1151 | - | 6394 | 505 | 6899 |
| 9 | Rajnandgaon | 6904 | - | - | 7345 | 5364 | 3505 | 34 | 16248 | 1901 | 18149 |
| 10 | Durg | 8537 | - | - | 6295 | 14175 | 6820 | - | 27290 | 3001 | 30291 |
| 11 | Raipur | 12507 | - | 61 | 25231 | 7527 | 6768 | 57 | 39644 | 4567 | 44211 |
| 12 | Mahasamund | 4702 | - | 14 | 6136 | 4829 | 3835 | - | 14814 | 1743 | 16557 |
| 13 | Dhamtari | 4049 | - | - | 9429 | 15506 | 840 | - | 25775 | 1134 | 26909 |
| 14 | Kanker | 6506 | - | - | 7535 | 3192 | 980 | 9 | 11716 | 1503 | 13219 |
| 15 | Bastar | 14974 | 26 | - | 11025 | 1207 | 885 | - | 13143 | 1519 | 14662 |
| 16 | Dantewada | 17634 | - | - | 22444 | 670 | 1595 | - | 24709 | 794 | 25503 |
| | **Total** | **135194** | **26** | **174** | **179088** | **90389** | **40226** | **240** | **310143** | **27823** | **337966** |

* Data Source: http://nic.in

State : Chhatisgarh

# 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 (<2.25ha)
- Drainage (line)
- Major Roads
- Railway
- Settlements
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

**Location Map**


40 20 0 40 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
National Remote Sensing Centre, Hyderabad

**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 44 : Wetland map of Chhattisgarh

### 8.1.23 Madhya Pradesh

Total 17666 wetlands have been mapped at 1:50,000 scale in the state. In addition, 44952 small wetlands (< 2.25 ha) have also been identified. Total wetland area estimated is 818166 ha. The reservoir/barrage is the major type, accounting for 47.97 per cent of the wetlands (392455 ha), river/stream ranked second with 38.57 % share (315526 ha area). The other wetland types observed are: tank/pond (64768 ha), waterlogged, lake/pond, ox-bow lake and riverine wetland. Details of state level wetland statistics is shown in Table 74. Graphical distribution of wetland type is shown in Figure 57.

Aquatic vegetation is observed in lake/pond, riverine wetland, tank/pond and reservoir/barrage. The vegetation spread in wetlands is more during pre-monsoon (62751 ha) compared to post-monsoon (13379 ha). The open water spread of wetlands is more during post-monsoon (571961 ha) compared to pre-monsoon (245289 ha). The qualitative turbidity of water in wetlands is in general moderate in both the seasons. Wetland map of the state is shown in Plate 45.

Table 74: Area estimates of wetlands in Madhya Pradesh

Area in ha

| Sr. No. | Wettcode | Wetland Category | Number | Total wetland area | % of wetland area | Open Water | |
|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon area | Pre-monsoon area |
| | **1100** | **Inland Wetlands - Natural** | | | | | |
| 1 | 1101 | Lake/Pond | 40 | 208 | 0.03 | 201 | 43 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 12 | 93 | 0.01 | 78 | - |
| 3 | 1103 | High altitude wetland | - | - | - | - | - |
| 4 | 1104 | Riverine wetland | 1 | 7 | - | 4 | - |
| 5 | 1105 | Waterlogged | 20 | 157 | 0.02 | 131 | 11 |
| 6 | 1106 | River/Stream | 389 | 315526 | 38.57 | 136337 | 59256 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 2005 | 392455 | 47.97 | 379592 | 176276 |
| 8 | 1202 | Tank/Pond | 15199 | 64768 | 7.92 | 55618 | 9703 |
| 9 | 1203 | Waterlogged | - | - | - | - | - |
| 10 | 1204 | Salt pan | - | - | - | - | - |
| | | **Sub-Total** | **17666** | **773214** | **94.51** | **571961** | **245289** |
| | | Wetlands (<2.25 ha) | 44952 | 44952 | 5.49 | - | - |
| | | **Total** | **62618** | **818166** | **100.00** | **571961** | **245289** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 13379 | 62751 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 2827 | 713 |
| Moderate | 532712 | 213784 |
| High | 36422 | 30792 |

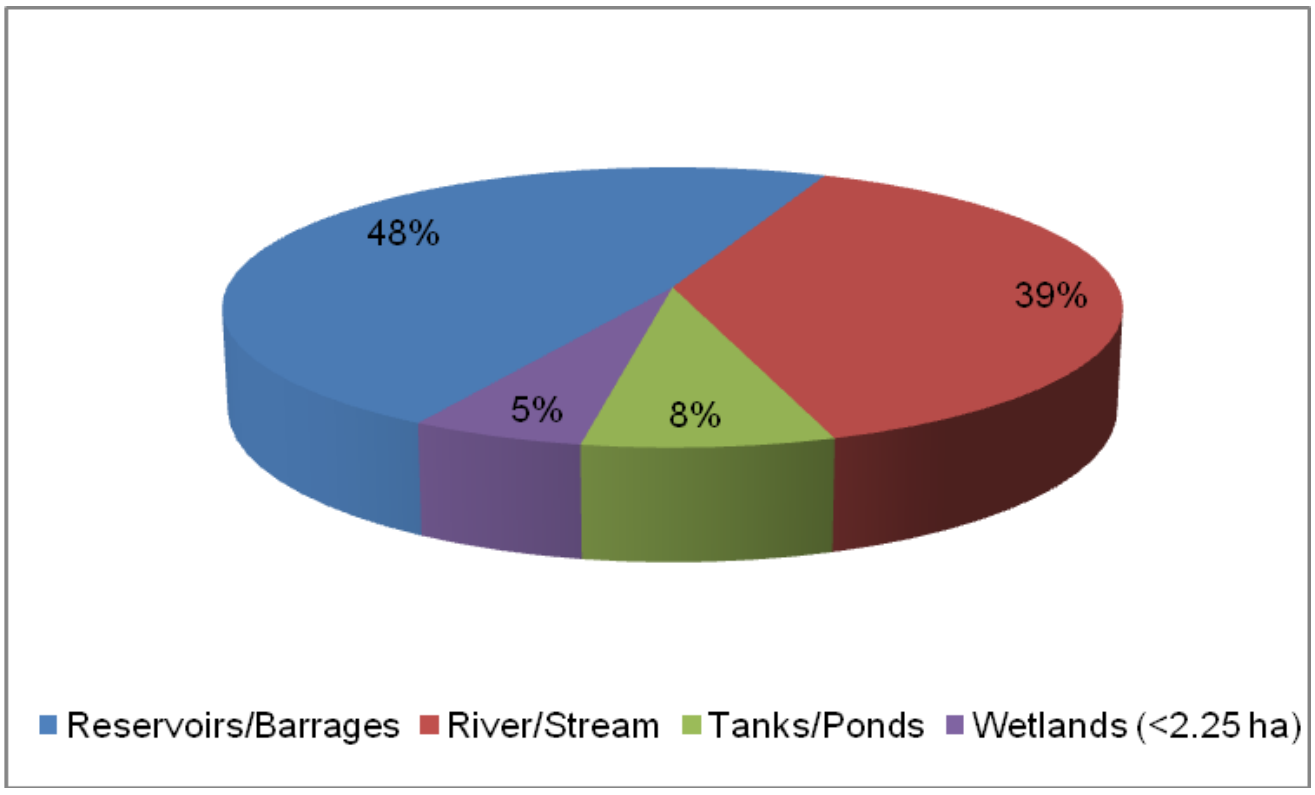



Figure 57: Type-wise wetland distribution in Madhya Pradesh

**District-wise wetland area estimates in Madhya Pradesh**

The state has 50 districts. The geographic area of districts varied from 11815 sq km (Chhindwara) to 2694 sq km (Datia). The wetland area in each district as per cent of total state wetland area ranged from 0.41% (Datia) to 7.40 % (East Nimar). The wetland area in the districts as per cent of geographic area varied from 1.23% (Rewa) to 9.43 % (Mandasaur). East Nimar, Mandasaur, Hoshangabad, Neemuch, Satna, Seoni, Mandla and Balaghat are wetland rich districts in the state. District-wise wetland area estimates is given in Table 75 and graphical distribution of wetlands is shown in Figure 58. District-wise area of wetlands (type-wise) in the state is given in Table 76.

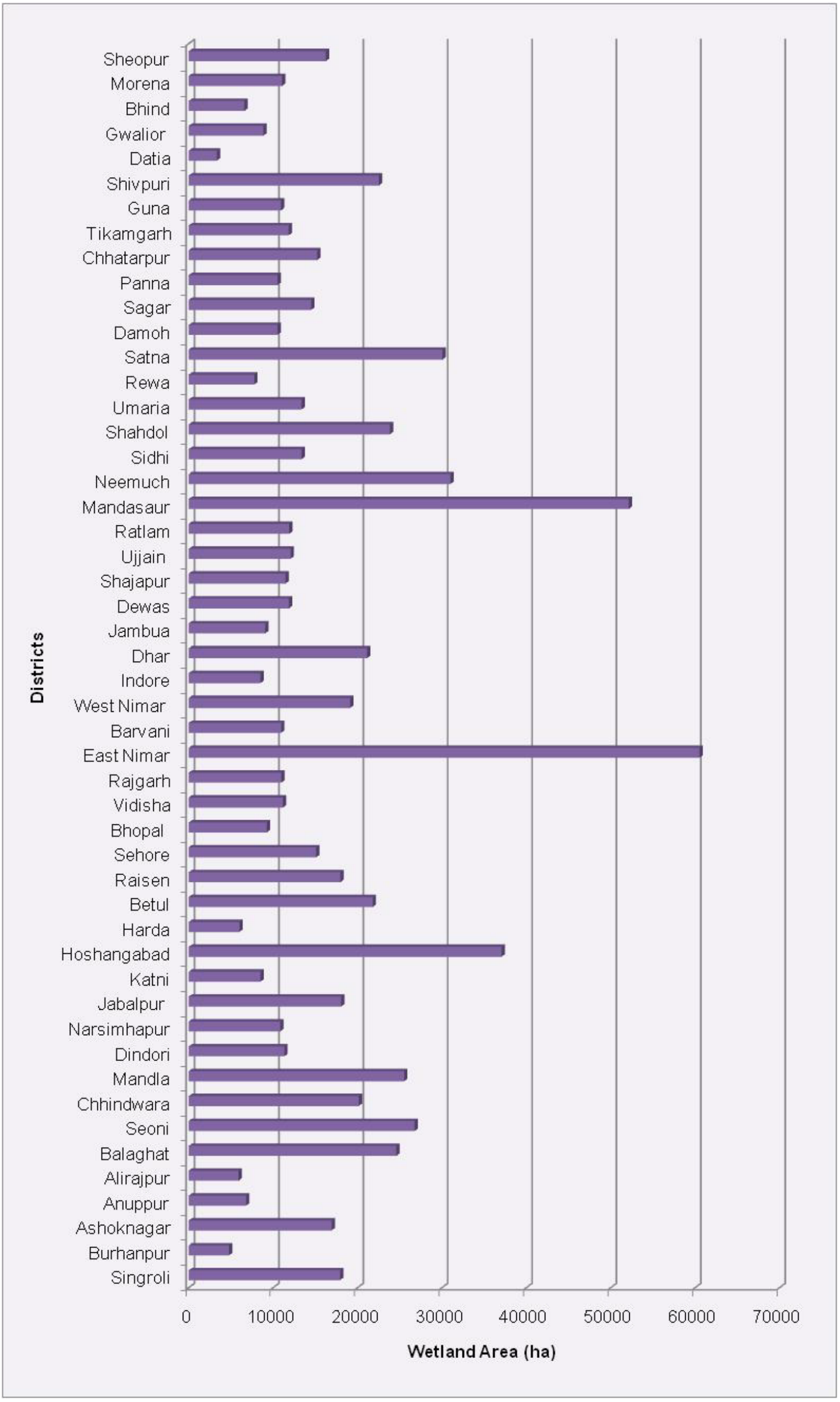



Figure 58: District-wise graphical distribution of wetlands in Madhya Pradesh

Table 75: District-wise area of wetlands in Madhya Pradesh

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Sheopur | 6585 | 16266 | 1.99 | 2.47 | 4894 | 1714 | 27 | 364 | - | 4593 | 301 | - | 1482 | 232 |
| 2 | Morena | 4991 | 11074 | 1.35 | 2.22 | 5890 | 4289 | 1110 | 866 | - | 5787 | 103 | - | 4147 | 142 |
| 3 | Bhind | 4459 | 6602 | 0.81 | 1.48 | 5378 | 2110 | 128 | 90 | - | 5369 | 9 | - | 2103 | 7 |
| 4 | Gwalior | 5465 | 8843 | 1.08 | 1.62 | 5629 | 2140 | 275 | 1346 | - | 4882 | 747 | - | 2011 | 129 |
| 5 | Datia | 2694 | 3337 | 0.41 | 1.24 | 2158 | 273 | 64 | 54 | - | 2150 | 8 | - | 258 | 15 |
| 6 | Shivpuri | 10290 | 22539 | 2.75 | 2.19 | 16065 | 6047 | 323 | 4142 | - | 15920 | 145 | - | 5486 | 561 |
| 7 | Guna | 6485 | 10939 | 1.34 | 1.69 | 6421 | 2227 | 73 | 1458 | - | 6053 | 368 | - | 2037 | 190 |
| 8 | Tikamgarh | 5055 | 11849 | 1.45 | 2.34 | 7171 | 2845 | 537 | 1308 | - | 7082 | 89 | - | 2502 | 343 |
| 9 | Chhatarpur | 8687 | 15221 | 1.86 | 1.75 | 8214 | 3475 | 1086 | 2710 | - | 8149 | 65 | - | 3191 | 284 |
| 10 | Panna | 7135 | 10529 | 1.29 | 1.48 | 4947 | 2084 | 269 | 290 | 507 | 4277 | 163 | 225 | 1806 | 53 |
| 11 | Sagar | 10252 | 14506 | 1.77 | 1.41 | 9038 | 1939 | 332 | 747 | - | 8865 | 173 | - | 882 | 1057 |
| 12 | Damoh | 7306 | 10532 | 1.29 | 1.44 | 6910 | 3706 | 301 | 1182 | - | 6831 | 79 | - | 3677 | 29 |
| 13 | Satna | 7502 | 30078 | 3.68 | 4.01 | 25503 | 9190 | 1313 | 355 | 1863 | 23565 | 75 | - | 9105 | 85 |
| 14 | Rewa | 6314 | 7774 | 0.95 | 1.23 | 5494 | 3629 | 167 | 417 | - | 4750 | 744 | - | 3591 | 38 |
| 15 | Umaria | 4062 | 13382 | 1.64 | 3.29 | 10149 | 3790 | 98 | 272 | - | 9824 | 325 | 2 | 3719 | 69 |
| 16 | Shahdol | 5672 | 23847 | 2.91 | 4.20 | 16615 | 8757 | 187 | 189 | 25 | 15794 | 796 | - | 8516 | 241 |
| 17 | Sidhi | 4766 | 13383 | 1.64 | 2.81 | 5637 | 4873 | 130 | 298 | - | 5478 | 159 | - | 4840 | 33 |
| 18 | Neemuch | 4267 | 31019 | 3.79 | 7.27 | 29045 | 17031 | 187 | 3492 | - | 29026 | 19 | 179 | 16678 | 174 |
| 19 | Mandasaur | 5530 | 52150 | 6.37 | 9.43 | 49978 | 26036 | 349 | 6815 | - | 49886 | 92 | - | 25255 | 781 |
| 20 | Ratlam | 4861 | 11903 | 1.45 | 2.45 | 9062 | 1720 | 53 | 711 | - | 8409 | 653 | - | 1056 | 664 |
| 21 | Ujjain | 6091 | 12088 | 1.48 | 1.98 | 9002 | 1462 | 423 | 2425 | - | 8811 | 191 | - | 852 | 610 |
| 22 | Shajapur | 6196 | 11476 | 1.40 | 1.85 | 8381 | 1654 | 95 | 2138 | - | 8372 | 9 | - | 766 | 888 |
| 23 | Dewas | 7020 | 11874 | 1.45 | 1.69 | 7110 | 3029 | 210 | 1397 | - | 7010 | 100 | - | 2769 | 260 |
| 24 | Jambua | 3441 | 9082 | 1.11 | 2.64 | 7348 | 1020 | 14 | 688 | - | 7348 | - | - | 482 | 538 |
| 25 | Dhar | 8153 | 21145 | 2.58 | 2.59 | 13941 | 5562 | 229 | 1854 | - | 13919 | 22 | - | 3255 | 2307 |
| 26 | Indore | 3898 | 8503 | 1.04 | 2.18 | 5466 | 995 | 800 | 2290 | - | 5231 | 235 | - | 769 | 226 |
| 27 | West Nimar | 8010 | 19133 | 2.34 | 2.39 | 11599 | 5230 | 59 | 1593 | - | 11592 | 7 | - | 4592 | 638 |
| 28 | Barvani | 5432 | 10960 | 1.34 | 2.02 | 4703 | 2404 | 6 | 375 | - | 4701 | 2 | - | 2289 | 115 |
| 29 | East Nimar | 7590 | 60520 | 7.40 | 7.97 | 53994 | 37010 | 81 | 1434 | - | 53980 | 14 | - | 36952 | 58 |
| 30 | Rajgarh | 6143 | 10980 | 1.34 | 1.79 | 6595 | 1435 | 28 | 1260 | - | 6589 | 6 | - | 965 | 470 |
| 31 | Vidisha | 7362 | 11159 | 1.36 | 1.52 | 8127 | 1894 | 590 | 630 | 424 | 7270 | 433 | 22 | 1726 | 146 |
| 32 | Bhopal | 2772 | 9250 | 1.13 | 3.34 | 8216 | 3345 | 56 | 3031 | - | 7992 | 224 | - | 3235 | 110 |
| 33 | Sehore | 6578 | 15114 | 1.85 | 2.30 | 10031 | 4963 | 58 | 2099 | - | 9983 | 48 | - | 4699 | 264 |
| 34 | Raisen | 8466 | 17979 | 2.20 | 2.12 | 14611 | 5811 | 415 | 1493 | - | 14353 | 258 | - | 2379 | 3432 |
| 35 | Betul | 10043 | 21809 | 2.67 | 2.17 | 6684 | 2947 | - | 1789 | - | 4978 | 1706 | - | 2625 | 322 |
| 36 | Harda | 3339 | 6020 | 0.74 | 1.80 | 2832 | 1501 | 26 | 138 | - | 2826 | 6 | - | 1495 | 6 |

Table 75: District-wise area of wetlands in Madhya Pradesh

Cont...

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 37 | Hoshangabad | 6698 | 37081 | 4.53 | 5.54 | 26281 | 9130 | 87 | 824 | - | 19773 | 6508 | - | 2626 | 6504 |
| 38 | Katni | 4947 | 8511 | 1.04 | 1.72 | 6269 | 1437 | 331 | 438 | - | 5853 | 416 | - | 1434 | 3 |
| 39 | Jabalpur | 5210 | 18073 | 2.21 | 3.47 | 13129 | 7797 | 1576 | 710 | - | 7434 | 5695 | - | 5520 | 2277 |
| 40 | Narsimhapur | 5133 | 10856 | 1.33 | 2.11 | 4050 | 2245 | 46 | 208 | - | 3938 | 112 | 3 | 2215 | 27 |
| 41 | Dindori | 7427 | 11335 | 1.39 | 1.53 | 6281 | 1571 | 89 | 88 | - | 6273 | 8 | - | 1559 | 12 |
| 42 | Mandla | 5805 | 25530 | 3.12 | 4.40 | 22171 | 6573 | 212 | 1058 | 6 | 19425 | 2740 | 175 | 5213 | 1185 |
| 43 | Chhindwara | 11815 | 20157 | 2.46 | 1.71 | 8954 | 3291 | 48 | 1236 | - | 8737 | 217 | 84 | 2985 | 222 |
| 44 | Seoni | 8758 | 26774 | 3.27 | 3.06 | 22232 | 8374 | 173 | 1009 | 2 | 18330 | 3900 | 23 | 7914 | 437 |
| 45 | Balaghat | 9229 | 24610 | 3.01 | 2.67 | 14793 | 1837 | 526 | 1614 | - | 13148 | 1645 | - | 1458 | 379 |
| 46 | Alirajpur | 3326 | 5919 | 0.72 | 1.78 | 3835 | 2611 | 4 | 659 | - | 3835 | - | - | 2473 | 138 |
| 47 | Anuppur | 3701 | 6802 | 0.83 | 1.84 | 2919 | 1288 | 23 | 318 | - | 2621 | 298 | - | 1255 | 33 |
| 48 | Ashoknagar | 4674 | 16942 | 2.07 | 3.62 | 14528 | 6365 | 131 | 1880 | - | 14515 | 13 | - | 2661 | 3704 |
| 49 | Burhanpur | 3107 | 4775 | 0.58 | 1.54 | 1400 | 812 | 23 | 34 | - | 1342 | 58 | - | 799 | 13 |
| 50 | Singroli | 5672 | 17936 | 2.19 | 3.16 | 12281 | 3821 | 11 | 935 | - | 5843 | 6438 | - | 3480 | 341 |
| | **Total** | **308414** | **818166** | **100.00** | **2.65** | **571961** | **245289** | **13379** | **62751** | **2827** | **532712** | **36422** | **713** | **213784** | **30792** |

* Data Source: http://nic.in

Table 76: District-wise area of wetlands (type-wise) in Madhya Pradesh

| District code | District | Geographic area * | Wetland Type | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1104 | 1105 | 1106 | 1201 | 1202 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | Riverine wetland | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Sheopur | 6585 | - | - | - | - | 13573 | 1883 | 307 | 15763 | 503 | 16266 |
| 2 | Morena | 4991 | - | - | - | - | 8021 | 2475 | 190 | 10686 | 388 | 11074 |
| 3 | Bhind | 4459 | - | - | - | - | 5118 | 560 | 255 | 5933 | 669 | 6602 |
| 4 | Gwalior | 5465 | - | - | - | - | 2449 | 4276 | 541 | 7266 | 1577 | 8843 |
| 5 | Datia | 2694 | - | - | 7 | - | 2646 | 248 | 87 | 2988 | 349 | 3337 |
| 6 | Shivpuri | 10290 | - | 13 | - | - | 7369 | 12816 | 1096 | 21294 | 1245 | 22539 |
| 7 | Guna | 6485 | - | - | - | - | 4737 | 4743 | 826 | 10306 | 633 | 10939 |
| 8 | Tikamgarh | 5055 | - | - | - | - | 7405 | 2419 | 1361 | 11185 | 664 | 11849 |
| 9 | Chhatarpur | 8687 | - | - | - | - | 8304 | 3910 | 1569 | 13783 | 1438 | 15221 |
| 10 | Panna | 7135 | 16 | - | - | - | 6759 | 1209 | 1483 | 9467 | 1062 | 10529 |
| 11 | Sagar | 10252 | - | 41 | - | - | 6649 | 3261 | 2966 | 12917 | 1589 | 14506 |
| 12 | Damoh | 7306 | - | - | - | 18 | 6096 | 2559 | 800 | 9473 | 1059 | 10532 |
| 13 | Satna | 7502 | - | - | - | - | 2695 | 20689 | 5478 | 28862 | 1216 | 30078 |
| 14 | Rewa | 6314 | - | - | - | - | 3845 | 1540 | 1897 | 7282 | 492 | 7774 |
| 15 | Umaria | 4062 | - | - | - | - | 3366 | 8177 | 1034 | 12577 | 805 | 13382 |
| 16 | Shahdol | 5672 | - | - | - | - | 6866 | 13447 | 2250 | 22563 | 1284 | 23847 |
| 17 | Sidhi | 4766 | 58 | - | - | - | 10678 | 1166 | 961 | 12863 | 520 | 13383 |
| 18 | Neemuch | 4267 | 48 | 4 | - | 28 | 1686 | 27355 | 1144 | 30265 | 754 | 31019 |
| 19 | Mandasaur | 5530 | 20 | - | - | 17 | 2854 | 46183 | 2105 | 51179 | 971 | 52150 |
| 20 | Ratlam | 4861 | 7 | - | - | 39 | 5051 | 3211 | 2173 | 10481 | 1422 | 11903 |
| 21 | Ujjain | 6091 | - | 5 | - | - | 4407 | 5211 | 1160 | 10783 | 1305 | 12088 |
| 22 | Shajapur | 6196 | 2 | - | - | - | 4959 | 4968 | 863 | 10792 | 684 | 11476 |
| 23 | Dewas | 7020 | - | - | - | - | 6045 | 4333 | 905 | 11283 | 591 | 11874 |
| 24 | Jambua | 3441 | - | - | - | - | 4645 | 2619 | 1359 | 8623 | 459 | 9082 |
| 25 | Dhar | 8153 | - | - | - | 17 | 10380 | 7216 | 2854 | 20467 | 678 | 21145 |
| 26 | Indore | 3898 | - | - | - | - | 2066 | 4060 | 1712 | 7838 | 665 | 8503 |
| 27 | West Nimar | 8010 | - | - | - | - | 10959 | 6314 | 1187 | 18460 | 673 | 19133 |
| 28 | Barvani | 5432 | - | - | - | 11 | 8718 | 1361 | 718 | 10808 | 152 | 10960 |
| 29 | East Nimar | 7590 | - | - | - | - | 6412 | 53105 | 398 | 59915 | 605 | 60520 |
| 30 | Rajgarh | 6143 | - | - | - | - | 6109 | 3438 | 820 | 10367 | 613 | 10980 |
| 31 | Vidisha | 7362 | - | - | - | - | 3667 | 3343 | 2428 | 9438 | 1721 | 11159 |
| 32 | Bhopal | 2772 | - | - | - | - | 977 | 7609 | 423 | 9009 | 241 | 9250 |
| 33 | Sehore | 6578 | - | - | - | - | 7694 | 6173 | 773 | 14640 | 474 | 15114 |
| 34 | Raisen | 8466 | - | - | - | - | 4763 | 10584 | 1540 | 16887 | 1092 | 17979 |
| 35 | Betul | 10043 | - | - | - | - | 14340 | 5480 | 545 | 20365 | 1444 | 21809 |

Table 76: District-wise area of wetlands (type-wise) in Madhya Pradesh

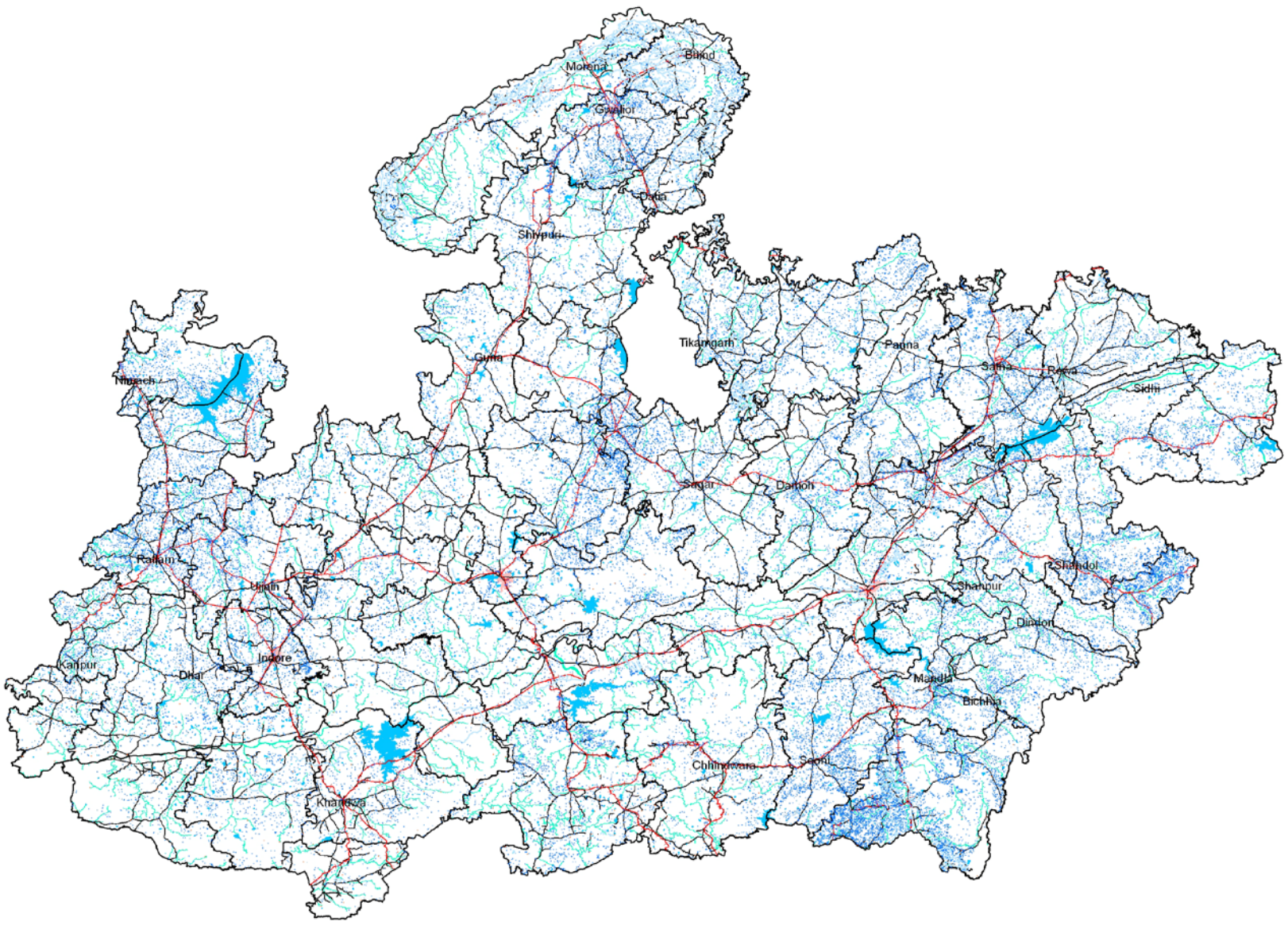
Cont...

| District code | District | Geographic area * | Wetland Type | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1104 | 1105 | 1106 | 1201 | 1202 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | Riverine wetland | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 36 | Harda | 3339 | - | - | - | - | 4859 | 963 | 101 | 5923 | 97 | 6020 |
| 37 | Hoshangabad | 6698 | - | - | - | - | 15828 | 20211 | 510 | 36549 | 532 | 37081 |
| 38 | Katni | 4947 | - | - | - | - | 2018 | 3809 | 2040 | 7867 | 644 | 8511 |
| 39 | Jabalpur | 5210 | - | - | - | - | 5955 | 8838 | 2849 | 17642 | 431 | 18073 |
| 40 | Narsimhapur | 5133 | - | - | - | - | 9813 | 350 | 340 | 10503 | 353 | 10856 |
| 41 | Dindori | 7427 | 57 | - | - | - | 8412 | 571 | 563 | 9603 | 1732 | 11335 |
| 42 | Mandla | 5805 | - | - | - | - | 5682 | 17983 | 691 | 24356 | 1174 | 25530 |
| 43 | Chhindwara | 11815 | - | 4 | - | - | 12053 | 6353 | 859 | 19269 | 888 | 20157 |
| 44 | Seoni | 8758 | - | - | - | - | 3834 | 18447 | 2154 | 24435 | 2339 | 26774 |
| 45 | Balaghat | 9229 | - | 19 | - | 27 | 12274 | 3729 | 5065 | 21114 | 3496 | 24610 |
| 46 | Alirajpur | 3326 | - | - | - | - | 3744 | 1312 | 712 | 5768 | 151 | 5919 |
| 47 | Anuppur | 3701 | - | - | - | - | 3481 | 929 | 810 | 5220 | 1582 | 6802 |
| 48 | Ashoknagar | 4674 | - | 7 | - | - | 2381 | 12977 | 1061 | 16426 | 516 | 16942 |
| 49 | Burhanpur | 3107 | - | - | - | - | 4309 | 226 | 130 | 4665 | 110 | 4775 |
| 50 | Singroli | 5672 | - | - | - | - | 8575 | 7816 | 675 | 17066 | 870 | 17936 |
| | **Total** | **308414** | **208** | **93** | **7** | **157** | **315526** | **392455** | **64768** | **773214** | **44952** | **818166** |

* Data Source: http://nic.in

State : Madhya Pradesh

# WETLAND MAP

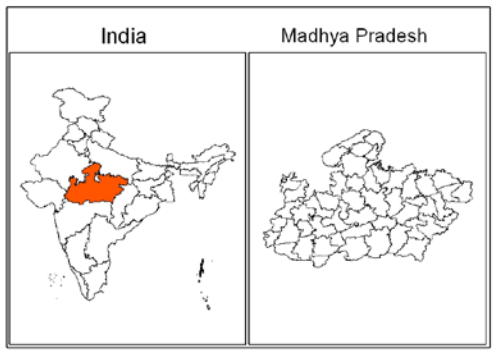



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Riverine wetlands |
| | 1105 | | | Waterlogged |
| | 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
- Canal
- Railway
- Drainage (line)
- Roads
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

**Location Map**




0 50 100 200 Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Remote Sensing Applications Centre, (MPCST), Bhopal, M.P.

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 45 : Wetland map of Madhya Pradesh

### 8.1.24 Gujarat

Total 14183 wetlands have been mapped at 1:50,000 scale in the state. In addition, 9708 small wetlands (< 2.25 ha) have also been identified. Total wetland area estimated is 3474950 ha (Table 77), which accounts for about 17.56% of geographical area of the state. The major wetland types include intertidal mud flat (2260365 ha), river/stream (275877 ha), reservoir/barrage (248979 ha), creek (149898 ha) and salt marsh (144268 ha). The coastal wetlands dominate in the state. Some of the unique wetlands like corals and mangrove are found in Gujarat state. Graphical distribution of wetland type is shown in Figure 59. Wetland map of the state is shown in Plate 46.

The water spread of wetlands is low during pre-monsoon, particularly; it is significant in case of Inland wetlands indicating rain fed nature of the wetlands. Area under aquatic vegetation is slightly more in pre-monsoon season (205159 ha) than in post-monsoon (152318 ha). Turbidity of water is in general high in both the seasons.

Table 77: Area estimates of wetlands in Gujarat

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 | Lake/Pond | 40 | 23550 | 0.68 | 8507 | 1873 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 1 | 6 | 0.00 | 6 | 0 |
| 3 | 1105 | Waterlogged | 278 | 20660 | 0.59 | 11081 | 2406 |
| 4 | 1106 | River/Stream | 1039 | 275877 | 7.94 | 86467 | 47983 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 5 | 1201 | Reservoir/Barrage | 1214 | 248979 | 7.16 | 233209 | 98187 |
| 6 | 1202 | Tank/Pond | 8818 | 73873 | 2.13 | 59621 | 14387 |
| 7 | 1203 | Waterlogged | 34 | 13951 | 0.40 | 9382 | 167 |
| 8 | 1204 | Salt pan | 9 | 1295 | 0.04 | 1143 | 46 |
| | | **Total - Inland** | **11433** | **658191** | **18.94** | **409416** | **165049** |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 9 | 2101 | Lagoon | 32 | 22289 | 0.64 | 15228 | 9882 |
| 10 | 2102 | Creek | 170 | 149898 | 4.31 | 149252 | 149660 |
| 11 | 2103 | Sand/Beach | 66 | 6508 | 0.19 | - | - |
| 12 | 2104 | Intertidal mud flat | 1066 | 2260365 | 65.05 | 513166 | 352494 |
| 13 | 2105 | Salt Marsh | 318 | 144268 | 4.15 | - | - |
| 14 | 2106 | Mangrove | 746 | 90475 | 2.60 | - | - |
| 15 | 2107 | Coral Reef | 50 | 33547 | 0.97 | - | - |
| | **2200** | **Coastal Wetlands - Man-made** | | | | | |
| 16 | 2201 | Salt pan | 209 | 90878 | 2.62 | 57809 | 49914 |
| 17 | 2202 | Aquaculture pond | 93 | 8823 | 0.25 | 5884 | 5482 |
| | | **Total - Coastal** | **2750** | **2807051** | **80.78** | **741339** | **567432** |
| | | **Sub-Total** | **14183** | **3465242** | **99.72** | **1150755** | **732481** |
| | | Wetlands (<2.25 ha) | 9708 | 9708 | 0.28 | - | - |
| | | **Total** | **23891** | **3474950** | **100.00** | **1150755** | **732481** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 152318 | 205159 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 331081 | 145292 |
| Moderate | 136136 | 83970 |
| High | 683538 | 503219 |

**District-wise wetland area estimates in Gujarat**

The state has 25 districts. The geographic area varied from 45652 sq. km (Kachchh) to 649 sq. km (Gandhinagar). The wetland area in each district as per cent of total state wetland area ranged from 0.13% (The Dangs) to 67.94 % (Kachchh). The wetland area in the districts as per cent of geographic area varied from 1.93% (Mehsana) to 51.72 % (Kachchh). Kachchh, Jamnagar, Bharuch, Bhavnagar and Surat are wetland rich districts mainly due to coastal wetlands. Coral is one of the special wetland types found only in the district of Jamnagar lying in the Gulf of Kachchh. The area occupied by coral is around 33,547 ha, scattered over 50 sites. Mangrove is another special wetland type found in 13 districts, covering an area of 90475 ha. However, maximum mangrove area is observed in Kachchh district having 50197 ha, followed by Jamnagar district with 18537 ha. Salt marsh is observed in 15 districts. Maximum area under this is observed in Bhavnagar district (25374 ha), followed by Ahmedabad district (22858 ha). There are 8818 tank/pond (man-made) distributed throughout the state covering an area of 73,873 ha. Maximum number are observed in the Kachchh district (1438 with 14449 ha area), followed by Surendranagar district (719 with 7941 ha area). Least number of tank/pond is observed in the district of Dangs (only 3). Patan, Surendranagar and Ahmedabad districts are rich in natural lake/pond with 9, 8 and 7 numbers each out of the total 40 mapped in the state.

District-wise wetland area estimates is given in Table 78 and graphical distribution of wetlands is shown in Figure 60. District-wise area of wetlands (type-wise) in the state is given in Table 79.

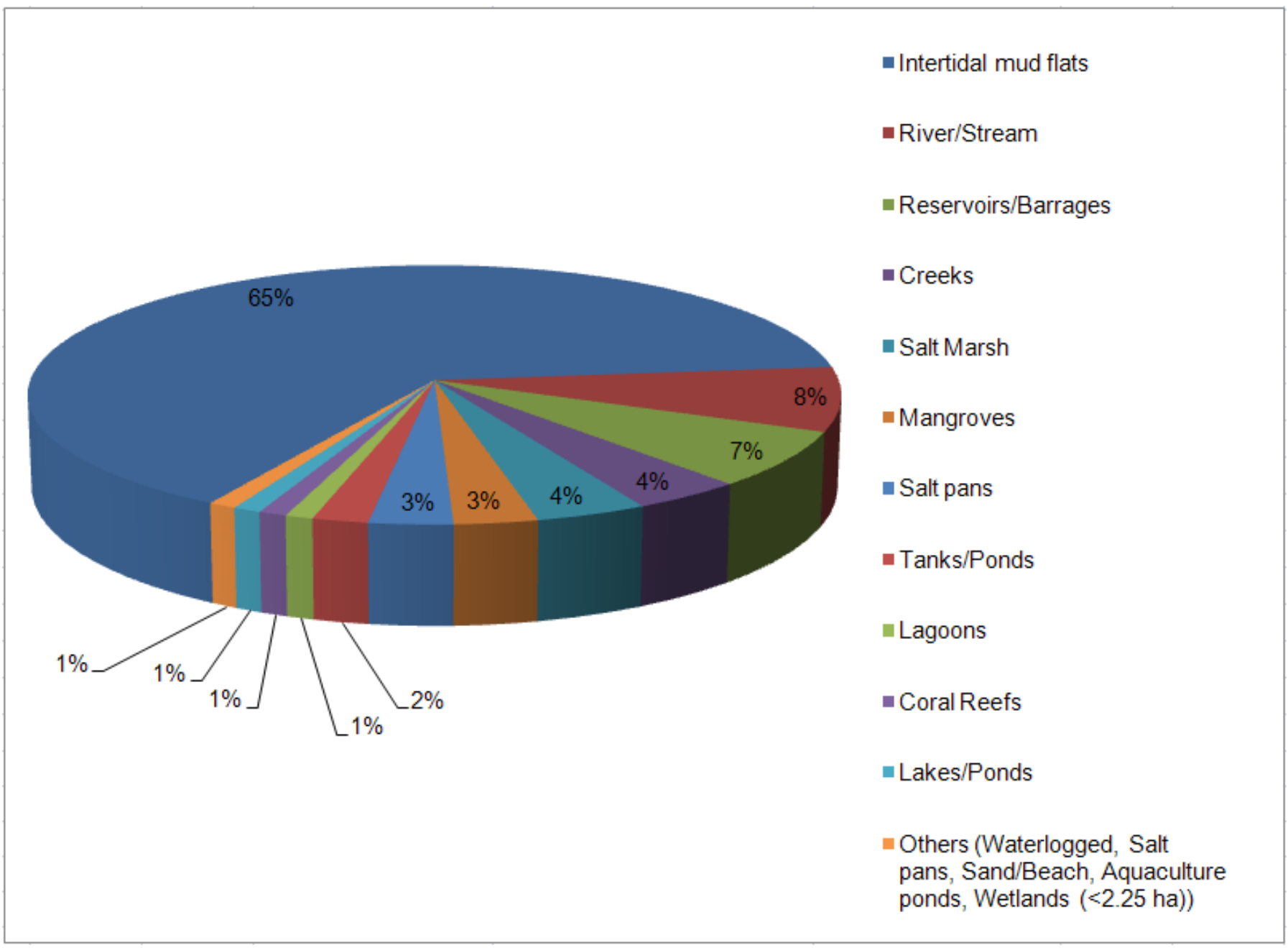



Figure 59: Type-wise wetland distribution in Gujarat

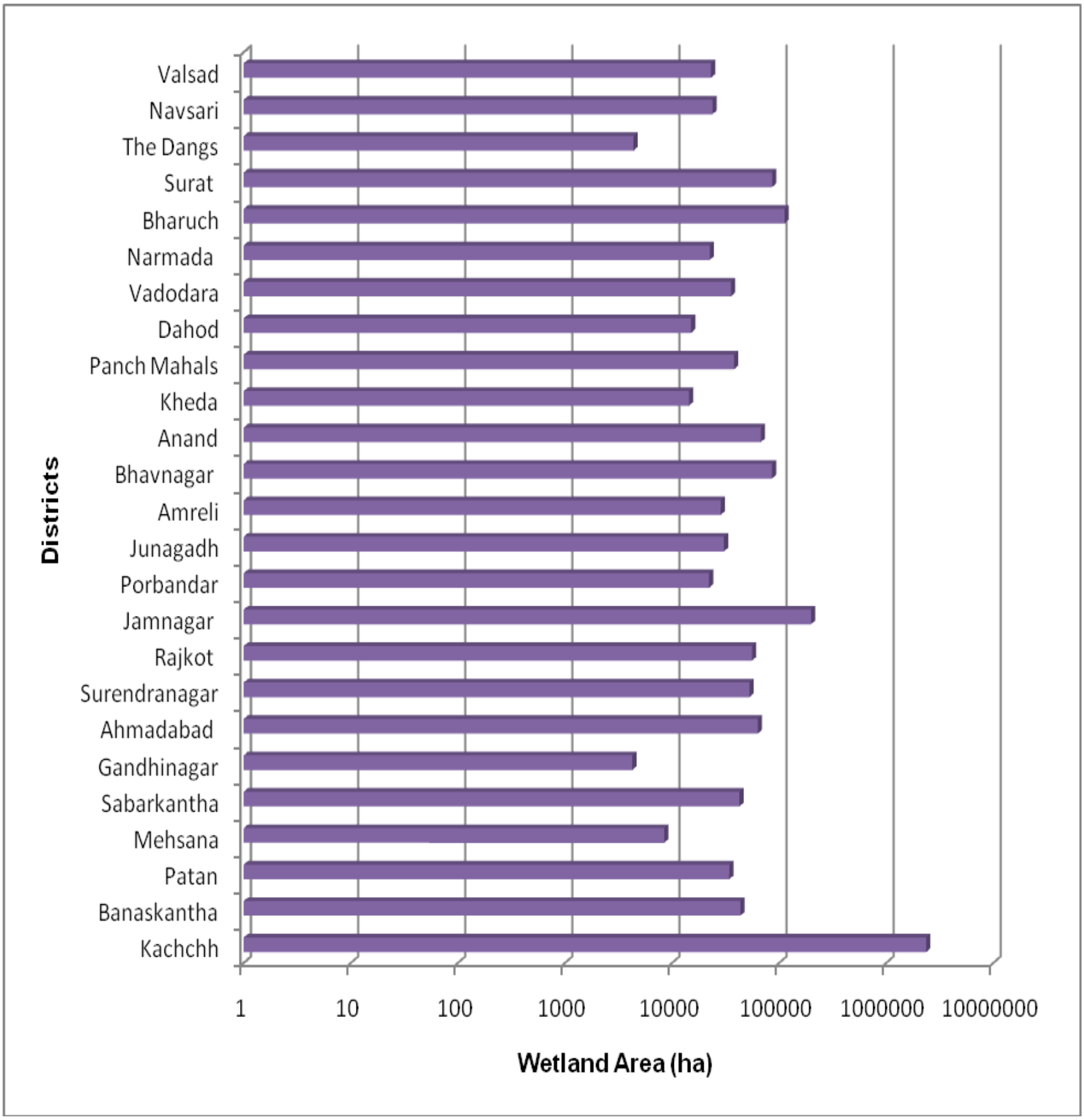



Figure 60: District-wise graphical distribution of wetlands in Gujarat

Table 78: District-wise area of wetlands in Gujarat

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Kachchh | 45652 | 2360909 | 67.94 | 51.72 | 709817 | 499905 | 59132 | 60381 | 31796 | 31856 | 646165 | 8507 | 17902 | 473496 |
| 2 | Banaskantha | 12703 | 43491 | 1.25 | 3.42 | 17718 | 4684 | 1255 | 5040 | 13883 | 3315 | 520 | 4314 | 308 | 62 |
| 3 | Patan | 5738 | 34268 | 0.99 | 5.97 | 11595 | 2593 | 2973 | 1280 | 5644 | 5245 | 706 | 1603 | 856 | 134 |
| 4 | Mehsana | 4386 | 8462 | 0.24 | 1.93 | 4395 | 1702 | 677 | 1867 | 2289 | 1395 | 711 | 918 | 653 | 131 |
| 5 | Sabarkantha | 7390 | 42653 | 1.23 | 5.77 | 29976 | 12632 | 1759 | 10775 | 25277 | 3703 | 996 | 10928 | 1592 | 112 |
| 6 | Gandhinagar | 649 | 4263 | 0.12 | 6.57 | 1973 | 360 | 118 | 140 | 1503 | 225 | 245 | 99 | 204 | 57 |
| 7 | Ahmadabad | 8707 | 63303 | 1.82 | 7.27 | 11363 | 5836 | 11204 | 7200 | 5597 | 3715 | 2051 | 2673 | 1497 | 1666 |
| 8 | Surendranagar | 10489 | 52896 | 1.52 | 5.04 | 18406 | 3273 | 14377 | 4424 | 11826 | 4878 | 1702 | 1988 | 1067 | 218 |
| 9 | Rajkot | 11203 | 55819 | 1.61 | 4.98 | 31722 | 11087 | 2708 | 10485 | 23796 | 7029 | 897 | 7644 | 3040 | 403 |
| 10 | Jamnagar | 14125 | 198656 | 5.72 | 14.06 | 47008 | 27837 | 21003 | 23887 | 21164 | 22169 | 3675 | 7627 | 17010 | 3200 |
| 11 | Porbandar | 2294 | 22199 | 0.64 | 9.68 | 13390 | 7376 | 5451 | 1880 | 11769 | 1510 | 111 | 6709 | 651 | 16 |
| 12 | Junagadh | 8839 | 30563 | 0.88 | 3.46 | 13622 | 6119 | 3121 | 4687 | 9572 | 3748 | 302 | 3795 | 2205 | 119 |
| 13 | Amreli | 6760 | 28505 | 0.82 | 4.22 | 11349 | 4649 | 761 | 2105 | 5480 | 5544 | 325 | 883 | 3618 | 148 |
| 14 | Bhavnagar | 11155 | 85895 | 2.47 | 7.70 | 34588 | 17515 | 2919 | 13009 | 17959 | 15545 | 1084 | 3001 | 13624 | 890 |
| 15 | Anand | 2942 | 67570 | 1.94 | 22.97 | 13765 | 13657 | 2149 | 2092 | 2959 | 1268 | 9538 | 2773 | 1437 | 9447 |
| 16 | Kheda | 4215 | 14415 | 0.41 | 3.42 | 8076 | 3252 | 2447 | 3387 | 5368 | 2332 | 376 | 1728 | 1435 | 89 |
| 17 | Panch Mahals | 5219 | 38049 | 1.09 | 7.29 | 27663 | 17834 | 2583 | 8066 | 23612 | 3499 | 552 | 16050 | 1682 | 102 |
| 18 | Dahod | 3642 | 15092 | 0.43 | 4.14 | 9770 | 4153 | 222 | 3833 | 6041 | 3414 | 315 | 2389 | 1645 | 119 |
| 19 | Vadodara | 7794 | 35553 | 1.02 | 4.56 | 18528 | 9592 | 2172 | 4968 | 15861 | 1879 | 788 | 8107 | 1291 | 194 |
| 20 | Narmada | 2749 | 22501 | 0.65 | 8.19 | 18012 | 11633 | 5 | 4636 | 17607 | 378 | 27 | 11352 | 275 | 6 |
| 21 | Bharuch | 6524 | 112453 | 3.24 | 17.24 | 23102 | 20805 | 9237 | 9854 | 8015 | 6272 | 8815 | 6379 | 5753 | 8673 |
| 22 | Surat | 7657 | 86063 | 2.48 | 11.24 | 58091 | 37398 | 3727 | 15886 | 52069 | 3650 | 2372 | 31228 | 3316 | 2854 |
| 23 | The Dangs | 1764 | 4368 | 0.13 | 2.48 | 717 | 1005 | - | - | 30 | 681 | 6 | 875 | 124 | 6 |
| 24 | Navsari | 2211 | 23888 | 0.69 | 10.80 | 6439 | 4848 | 1753 | 1725 | 3868 | 1390 | 1181 | 2527 | 1262 | 1059 |
| 25 | Valsad | 3034 | 23116 | 0.67 | 7.62 | 9670 | 2736 | 565 | 3552 | 8096 | 1496 | 78 | 1195 | 1523 | 18 |
| | **Total** | **197841** | **3474950** | **100.00** | **17.56** | **1150755** | **732481** | **152318** | **205159** | **331081** | **136136** | **683538** | **145292** | **83970** | **503219** |

* Data Source: http://nic.in

Table 79: District-wise area of wetlands (type-wise) in Gujarat

| District code | District | Geographic area * | Wetland Type | | | | | | | | | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1105 | 1106 | 1201 | 1202 | 1203 | 1204 | 2101 | 2102 | 2103 | 2104 | 2105 | 2106 | 2107 | 2201 | 2202 | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Kachchh | 45652 | 203 | - | 4188 | 20322 | 29995 | 14449 | 12281 | - | 3838 | 120751 | 1927 | 2044824 | 16895 | 50197 | - | 34819 | 4916 | 2359605 | 1304 | 2360909 |
| 2 | Banaskantha | 12703 | 330 | - | 840 | 14806 | 10784 | 3876 | - | 826 | - | - | - | 7023 | 3703 | - | - | 280 | - | 42468 | 1023 | 43491 |
| 3 | Patan | 5738 | 1725 | - | 1947 | 9430 | 3922 | 5035 | - | 294 | - | - | - | 11004 | 392 | - | - | 103 | - | 33852 | 416 | 34268 |
| 4 | Mehsana | 4386 | 513 | - | 126 | 3799 | 895 | 2412 | 196 | - | - | - | - | - | - | - | - | - | - | 7941 | 521 | 8462 |
| 5 | Sabarkantha | 7390 | 229 | - | 230 | 16057 | 20002 | 5035 | 552 | - | - | - | - | - | - | - | - | - | - | 42105 | 548 | 42653 |
| 6 | Gandhinagar | 649 | 13 | - | 94 | 3431 | - | 540 | - | - | - | - | - | - | - | - | - | - | - | 4078 | 185 | 4263 |
| 7 | Ahmadabad | 8707 | 7551 | - | 1045 | 11310 | 966 | 3589 | 323 | - | - | 1785 | - | 9368 | 22858 | 3940 | - | - | - | 62735 | 568 | 63303 |
| 8 | Surendranagar | 10489 | 8815 | - | 4264 | 12462 | 10047 | 7941 | 251 | - | - | - | - | 8666 | - | - | - | - | - | 52446 | 450 | 52896 |
| 9 | Rajkot | 11203 | 143 | - | 634 | 19441 | 22837 | 3190 | - | - | - | 308 | - | 2117 | 2475 | 733 | - | 3466 | - | 55344 | 475 | 55819 |
| 10 | Jamnagar | 14125 | 595 | - | 1329 | 15625 | 18516 | 2536 | - | - | 2979 | 3141 | 1079 | 63829 | 18316 | 18537 | 33547 | 17494 | 397 | 197920 | 736 | 198656 |
| 11 | Porbandar | 2294 | - | - | 472 | 2700 | 4556 | 468 | - | - | 11780 | - | 1524 | - | 76 | - | - | 528 | - | 22104 | 95 | 22199 |
| 12 | Junagadh | 8839 | - | - | - | 9996 | 9729 | 1272 | 184 | - | 2061 | 46 | 1242 | 2062 | 1608 | 251 | - | 1833 | - | 30284 | 279 | 30563 |
| 13 | Amreli | 6760 | 266 | - | 204 | 11226 | 5169 | 1362 | - | - | - | 139 | 118 | 1807 | 3331 | 55 | - | 4354 | 325 | 28356 | 149 | 28505 |
| 14 | Bhavnagar | 11155 | - | - | 234 | 14238 | 16664 | 1818 | - | - | 989 | 1708 | 352 | 9704 | 25374 | 1058 | - | 13554 | - | 85693 | 202 | 85895 |
| 15 | Anand | 2942 | 23 | - | 634 | 6081 | 52 | 1730 | 35 | - | 294 | 9395 | - | 36340 | 11210 | 1047 | - | 423 | - | 67264 | 306 | 67570 |
| 16 | Kheda | 4215 | 260 | - | 1843 | 7855 | 988 | 3084 | - | - | - | - | - | - | - | - | - | - | - | 14030 | 385 | 14415 |
| 17 | Panch Mahals | 5219 | 123 | - | 719 | 12437 | 19561 | 4779 | 98 | - | - | - | - | - | - | - | - | - | - | 37717 | 332 | 38049 |
| 18 | Dohad | 3642 | - | - | 173 | 6136 | 4787 | 3789 | - | - | - | - | - | - | - | - | - | - | - | 14885 | 207 | 15092 |
| 19 | Vadodara | 7794 | 2270 | - | 1320 | 22332 | 5257 | 3129 | 31 | - | - | - | - | 668 | - | 9 | - | - | - | 35016 | 537 | 35553 |
| 20 | Narmada | 2749 | - | - | - | 7259 | 15022 | 188 | - | - | - | - | - | - | - | - | - | - | - | 22469 | 32 | 22501 |
| 21 | Bharuch | 6524 | 254 | - | - | 16246 | 729 | 1908 | - | 152 | - | 8604 | - | 40690 | 21982 | 9073 | - | 12017 | 391 | 112046 | 407 | 112453 |
| 22 | Surat | 7657 | 237 | - | - | 16210 | 42096 | 1142 | - | - | - | 2866 | 102 | 11769 | 4923 | 3655 | - | 1617 | 1179 | 85796 | 267 | 86063 |
| 23 | The Dangs | 1764 | - | - | - | 4305 | 28 | 13 | - | - | - | - | - | - | - | - | - | - | - | 4346 | 22 | 4368 |
| 24 | Navsari | 2211 | - | - | 155 | 4854 | 623 | 306 | - | 16 | 348 | 1151 | 49 | 5732 | 7562 | 1574 | - | 6 | 1370 | 23746 | 142 | 23888 |
| 25 | Valsad | 3034 | - | 6 | 209 | 7319 | 5754 | 282 | - | 7 | - | 4 | 115 | 4762 | 3563 | 346 | - | 384 | 245 | 22996 | 120 | 23116 |
| | **Total** | **197841** | **23550** | **6** | **20660** | **275877** | **248979** | **73873** | **13951** | **1295** | **22289** | **149898** | **6508** | **2260365** | **144268** | **90475** | **33547** | **90878** | **8823** | **3465242** | **9708** | **3474950** |

* Data Source: http://nic.in

1101 Lake/Pond
1102 Ox-bow lake/ Cut-off meander
1103 High altitude wetland
1104 Riverine wetland
1105 Waterlogged (Natural)
1106 River/Stream

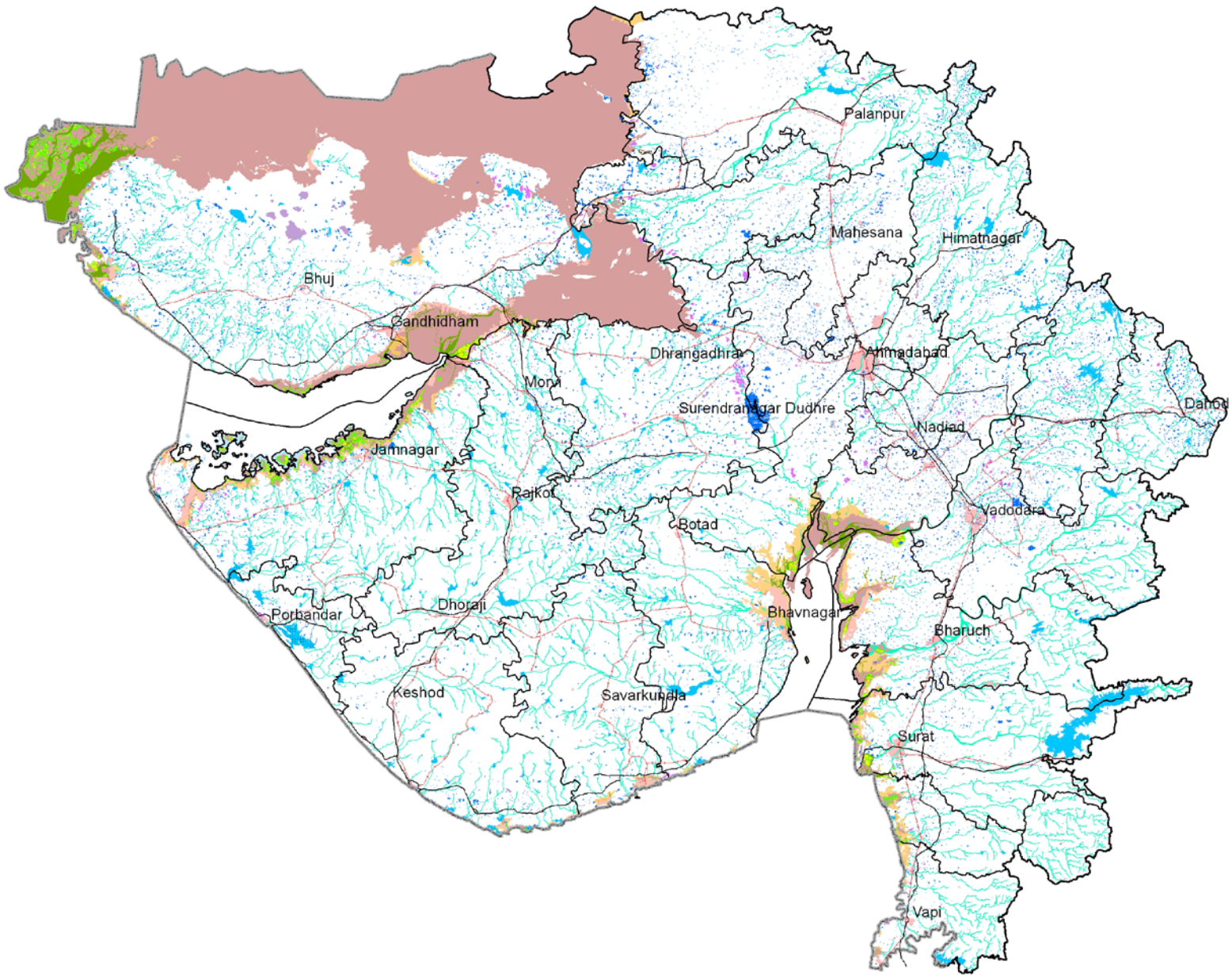
1201 Reservoir/Barrage
1202 Tank/Pond
1203 Waterlogged (Man-made)
1204 Salt pan (Inland)

2101 Lagoon
2102 Creek
2103 Sand/Beach
2104 Intertidal mud flat
2105 Salt Marsh (Coastal)
2106 Mangrove
2107 Coral Reef

2201 Salt pan
2202 Aquaculture pond

State : Gujarat

# WETLAND MAP

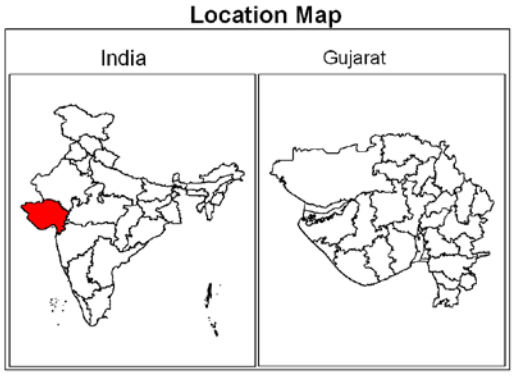



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Drainage (line)
- Major Roads
- Railway
- Settlements
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

**Location Map**




50 25 0 50 100 Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Bhaskaracharya Institute for Space Applications and Geo-informatics, Gandhinagar

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 46 : Wetland map of Gujarat

### 8.1.25 Daman & Diu

Total 62 wetlands are mapped including 10 small wetlands (< 2.25 ha) with 2068 ha area**.** Inter-tidal mud flat contributed 50.97% to the total wetland area. The river/stream with 380 ha (18.38% area) is the second major wetland category, followed by sand/beach with 2047 ha area i.e. 9.86 %. Details of wetland statistics is given in Table 80. Type-wise wetland distribution in Daman & Diu is shown in Figure 61. Wetland maps of the Diu and Daman are shown in Plates – 47 and 48 respectively.

Open water spread of the wetlands is significantly higher in post-monsoon (570 ha) than during pre-monsoon (262 ha), indicating the rainfall dependence of the wetlands in the area. Aquatic vegetation is slightly more during pre-monsoon (59 ha) than in post-monsoon (54 ha).

There are two districts in Union territory of Daman and Diu. District-wise wetland summary is given in Table 81. District-wise graphical distribution of wetlands is shown in Figure 62. District-wise area of wetlands (type-wise) in the state is given in Table 82.

Table 80: Area estimates of wetlands in Daman & Diu

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 | Lake/Pond | - | - | - | - | - |
| 2 | 1106 | River/Stream | 4 | 380 | 18.38 | 341 | 223 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 3 | 1201 | Reservoir/Barrage | 5 | 125 | 6.04 | 92 | - |
| 4 | 1202 | Tank/Pond | 15 | 88 | 4.26 | 60 | 28 |
| | | **Total - Inland** | **24** | **593** | **28.68** | **493** | **251** |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 5 | 2101 | Lagoon | 3 | 24 | 1.16 | 24 | 7 |
| 6 | 2103 | Sand/Beach | 7 | 204 | 9.86 | - | - |
| 7 | 2104 | Intertidal mud flat | 9 | 1054 | 50.97 | - | - |
| 8 | 2105 | Salt Marsh | 1 | 57 | 2.76 | - | - |
| 9 | 2106 | Mangrove | 7 | 63 | 3.05 | - | - |
| | **2200** | **Coastal Wetlands - Man-made** | | | | | |
| 10 | 2201 | Salt pan | 1 | 63 | 3.05 | 53 | 4 |
| 11 | 2202 | Aquaculture pond | - | - | - | - | - |
| | | **Total - Coastal** | **28** | **1465** | **70.84** | **77** | **11** |
| | | **Sub-Total** | **52** | **2058** | **99.52** | **570** | **262** |
| | | Wetlands (<2.25 ha) | 10 | 10 | 0.48 | - | - |
| | | **Total** | **62** | **2068** | **100.00** | **570** | **262** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 54 | 59 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 265 | 137 |
| Moderate | 299 | 118 |
| High | 6 | 7 |

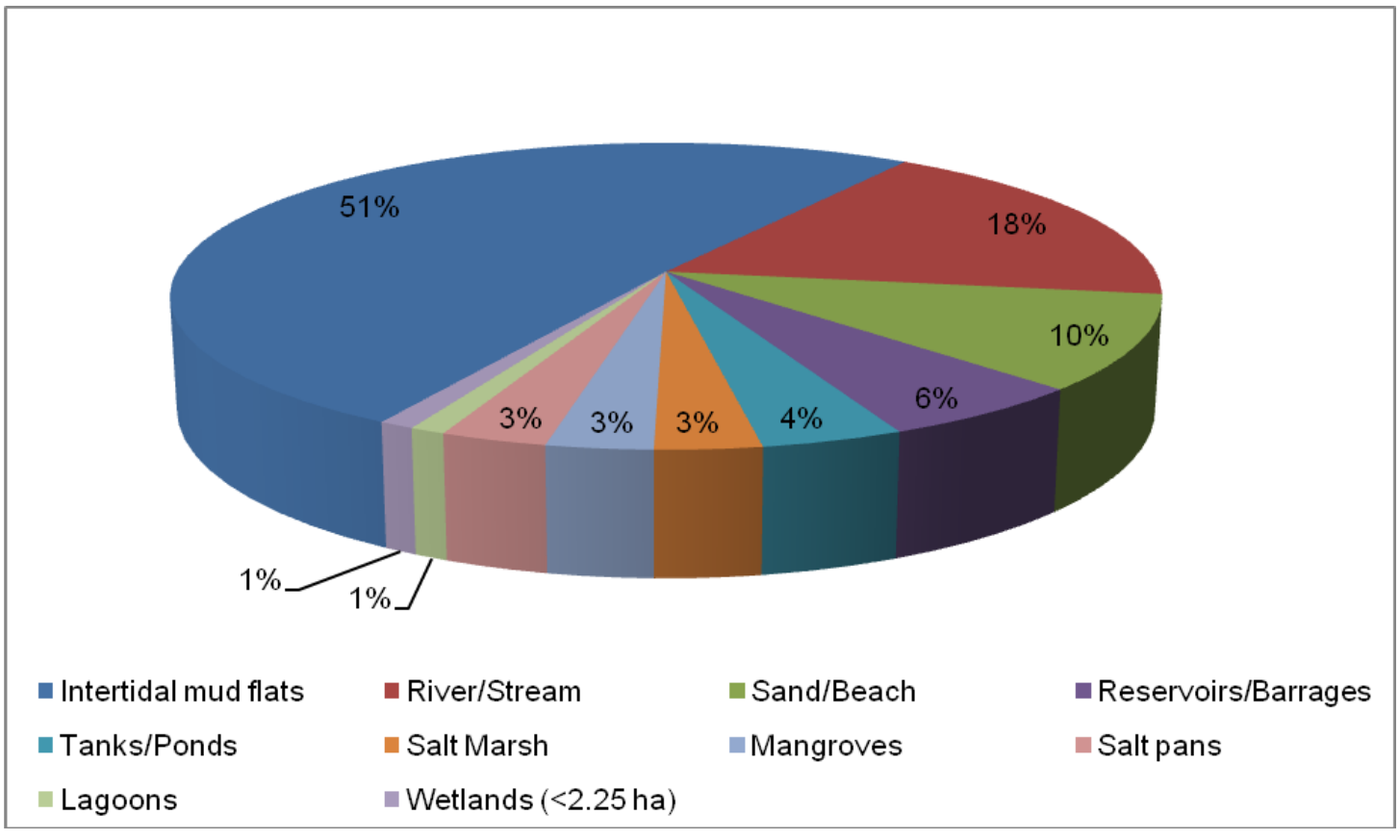



Figure 61: Type-wise wetland distribution in Daman & Diu

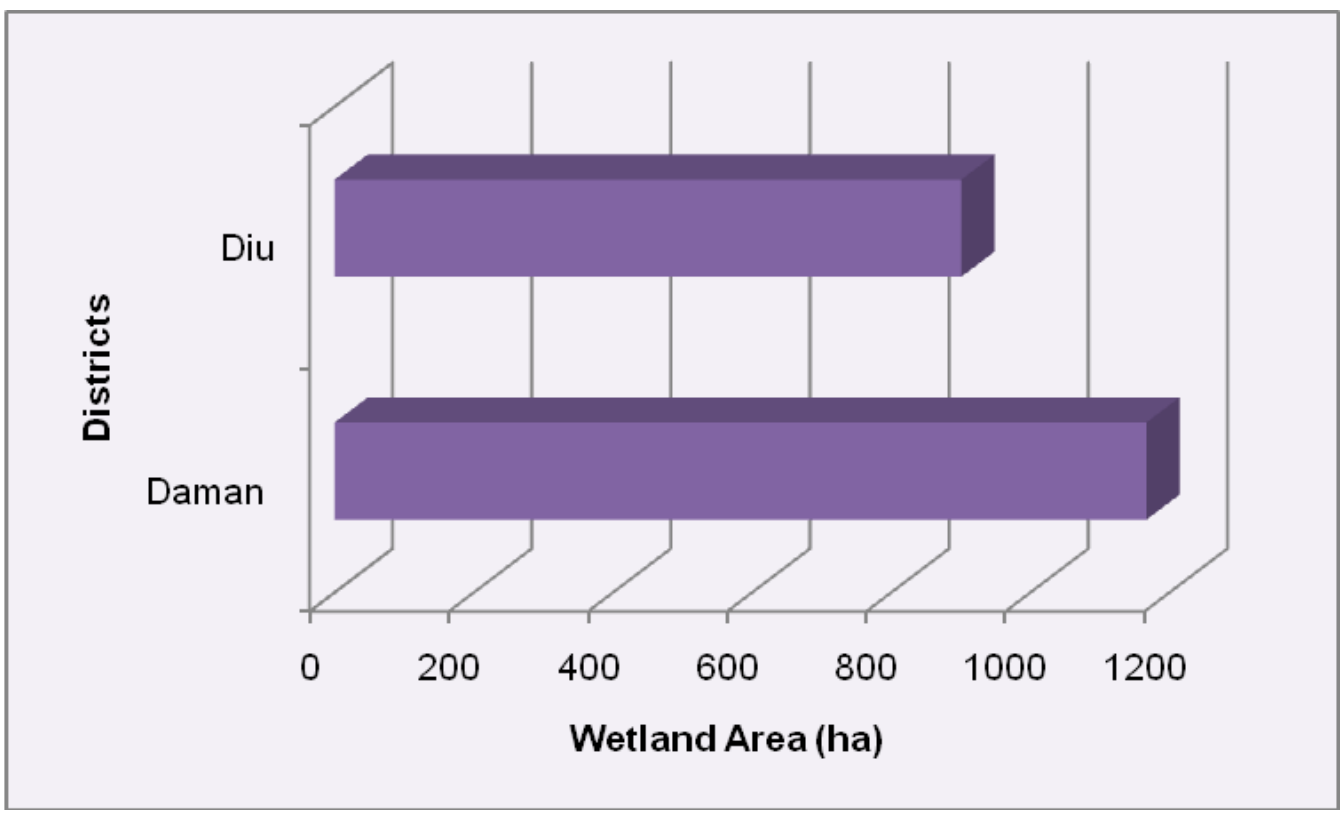



Figure 62: District-wise graphical distribution of wetlands

Table 81: District-wise area of wetlands in Daman & Diu

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Diu | 40 | 901 | 43.57 | 22.53 | 339 | 62 | 35 | 32 | 116 | 223 | - | 7 | 55 | - |
| 2 | Daman | 72 | 1167 | 56.43 | 16.21 | 231 | 200 | 19 | 26 | 149 | 76 | 6 | 130 | 63 | 7 |
| | **Total** | **112** | **2068** | **100** | **18.46** | **570** | **262** | **54** | **58** | **265** | **299** | **6** | **137** | **118** | **7** |

* Data Source: http://nic.in

Table 82: District-wise area of wetlands (type-wise) in Daman & Diu

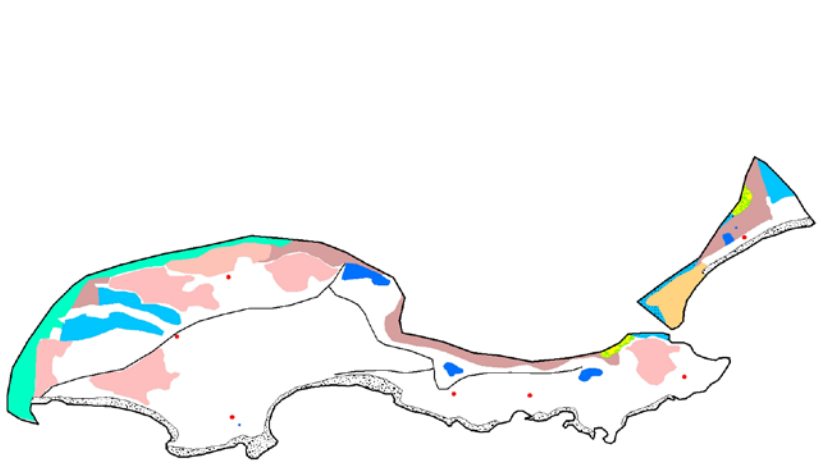
| District code | District | Geographic area * | Wetland Type | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1106 | 1201 | 1202 | 2101 | 2103 | 2104 | 2105 | 2106 | 2201 | | | |
| | | | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Lagoon | Sand/ Beach | Intertidal mud flat | Salt Marsh | Mangrove | Salt pan | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Diu | 40 | 145 | 125 | 34 | 24 | 186 | 247 | 57 | 18 | 63 | 899 | 2 | 901 |
| 2 | Daman | 72 | 235 | - | 54 | - | 18 | 807 | - | 45 | - | 1159 | 8 | 1167 |
| | **Total** | **112** | **380** | **125** | **88** | **24** | **204** | **1054** | **57** | **63** | **63** | **2058** | **10** | **2068** |

* Data Source: http://nic.in

State : Daman & diu

# WETLAND MAP

District : Diu

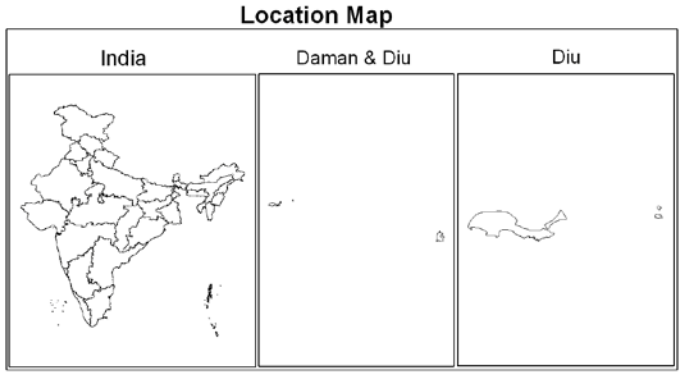


| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Riverine wetlands |
| | 1105 | | | Waterlogged |
| | 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

**Sponsored By**

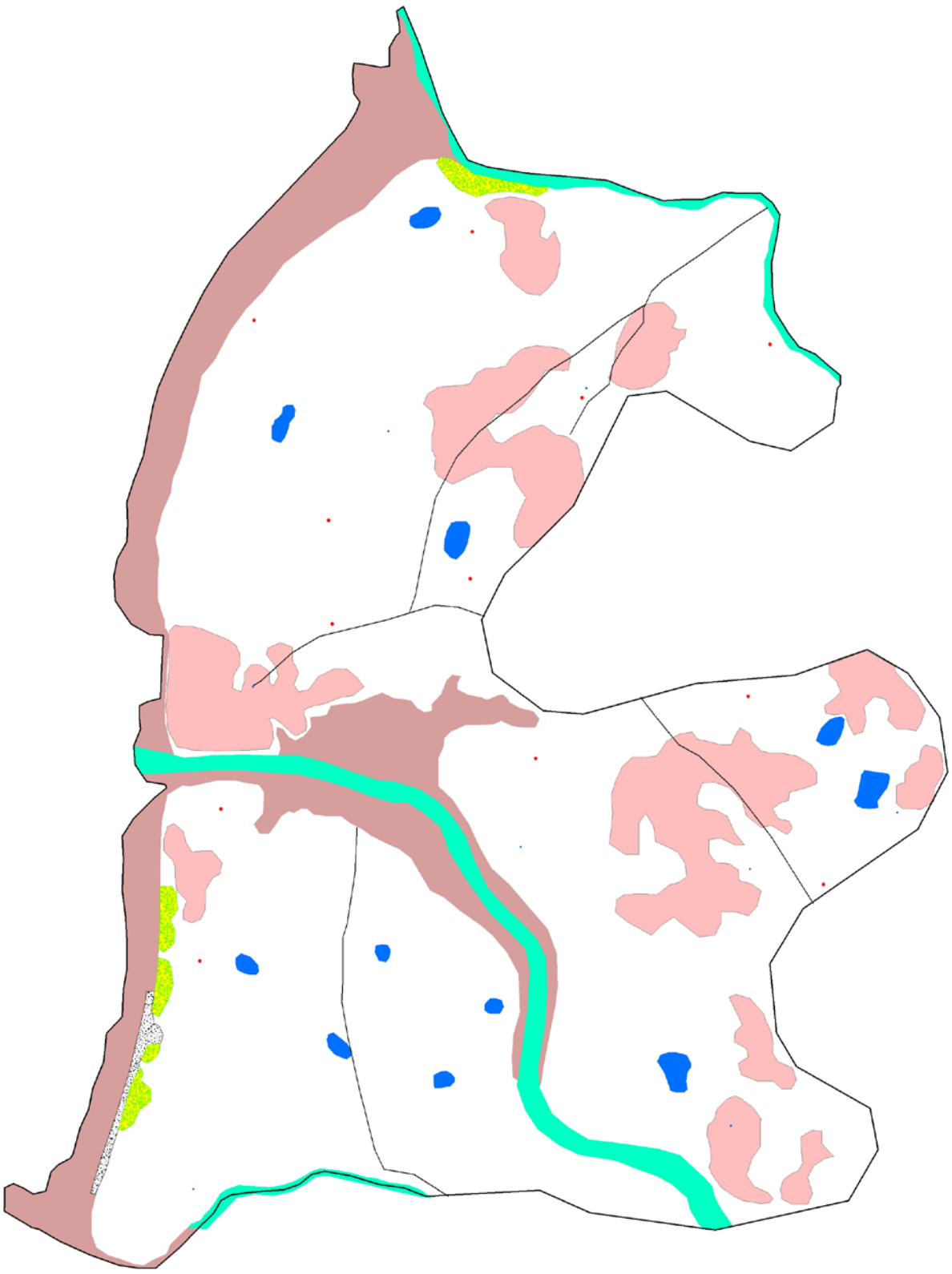
Ministry of Environment and Forests
Government of India

Plate 47: Wetland map of Diu

State : Daman & diu

# WETLAND MAP

District : Daman

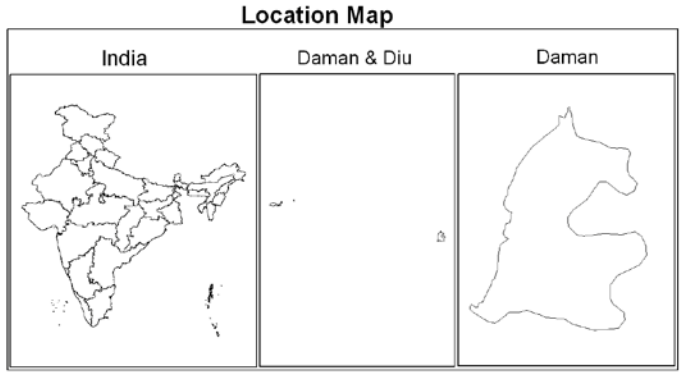


| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 0.250.5 1 1.5 2 Kilometers

**Data Source**

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

**Prepared By**

Space Applications Centre (ISRO), Ahmedabad

**Sponsored By**

Ministry of Environment and Forests
Government of India

Plate 48: Wetland map of Daman

### 8.1.26 Dadra & Nagar Haveli

Total 52 wetlands are mapped including 39 small wetlands (<2.25 ha) with 2070 ha area**.** Reservoir/Barrage contributed 62.13% to the total wetland area. The river/steam with 732 ha (35.36% area) is the second major wetland category, followed by tank/pond with 13 ha area i.e. 0.63 %. Thus, the Dadra and Nagar Haveli is dominated by man-made wetlands. Details of wetland statistics is given in Table 83. Type-wise wetland distribution in Dadra & Nagar Haveli is shown in Figure 63. Wetland map of Dadra and Nagar Haveli is shown in Plate 49. Open water spread of the wetlands is significantly higher in post-monsoon (1915 ha) than during pre-monsoon (1131 ha), indicating the rainfall dependence of the wetlands in the state. Aquatic vegetation is 145 ha in pre-monsoon. The qualitative turbidity of water is low in both the seasons.

Table 83: Area estimates of wetlands in Dadra & Nagar Haveli

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 | Lake/Pond | - | - | - | - | - |
| 2 | 1106 | River/Stream | 6 | 732 | 35.36 | 623 | 314 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 3 | 1201 | Reservoir/Barrage | 1 | 1286 | 62.13 | 1286 | 812 |
| 4 | 1202 | Tank/Pond | 6 | 13 | 0.63 | 6 | 5 |
| 5 | 1203 | Waterlogged | - | - | - | - | - |
| | | **Total - Inland** | **13** | **2031** | **98.12** | **1915** | **1131** |
| | | **Sub-Total** | **13** | **2031** | **98.12** | **1915** | **1131** |
| | | Wetlands (<2.25 ha) | 39 | 39 | 1.88 | - | - |
| | | **Total** | **52** | **2070** | **100.00** | **1915** | **1131** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | - | 145 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 1286 | 812 |
| Moderate | 629 | 319 |
| High | - | - |

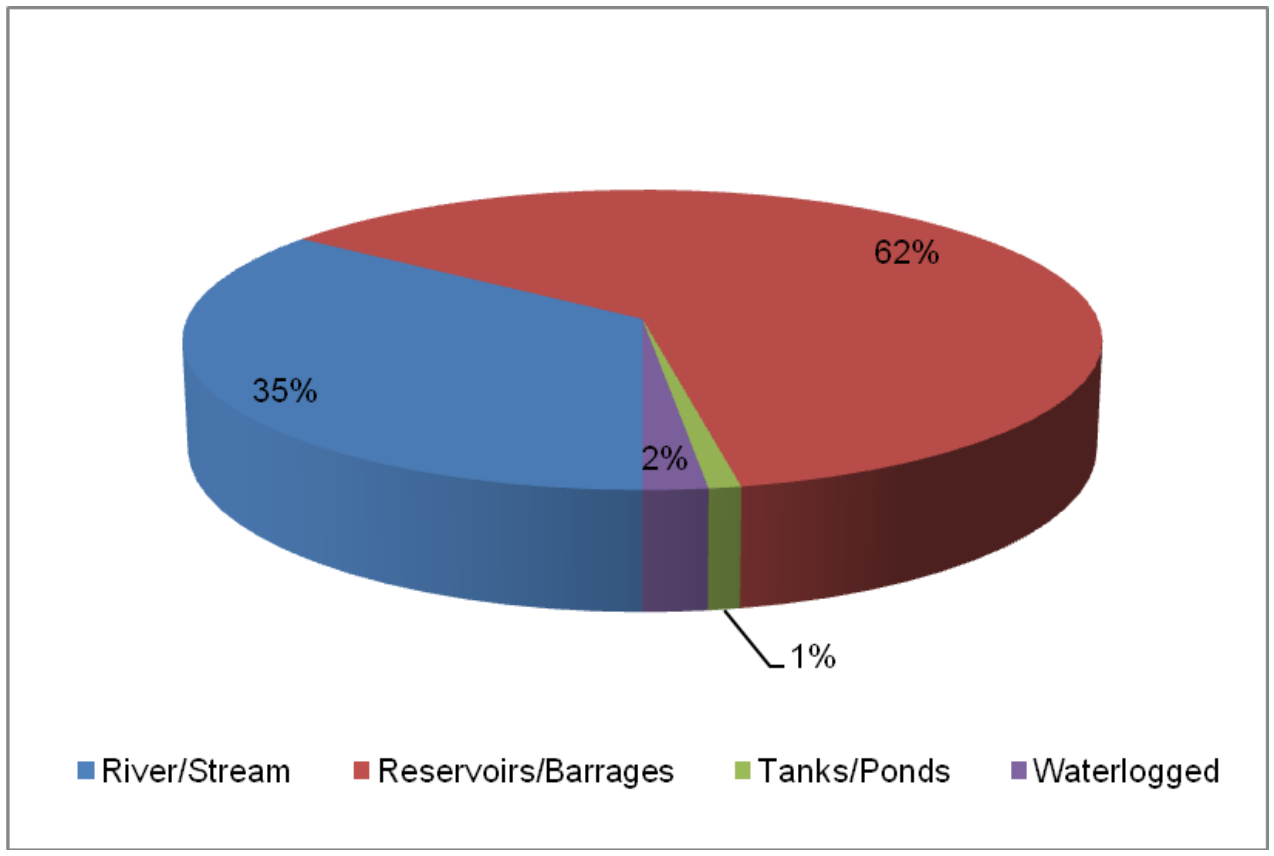
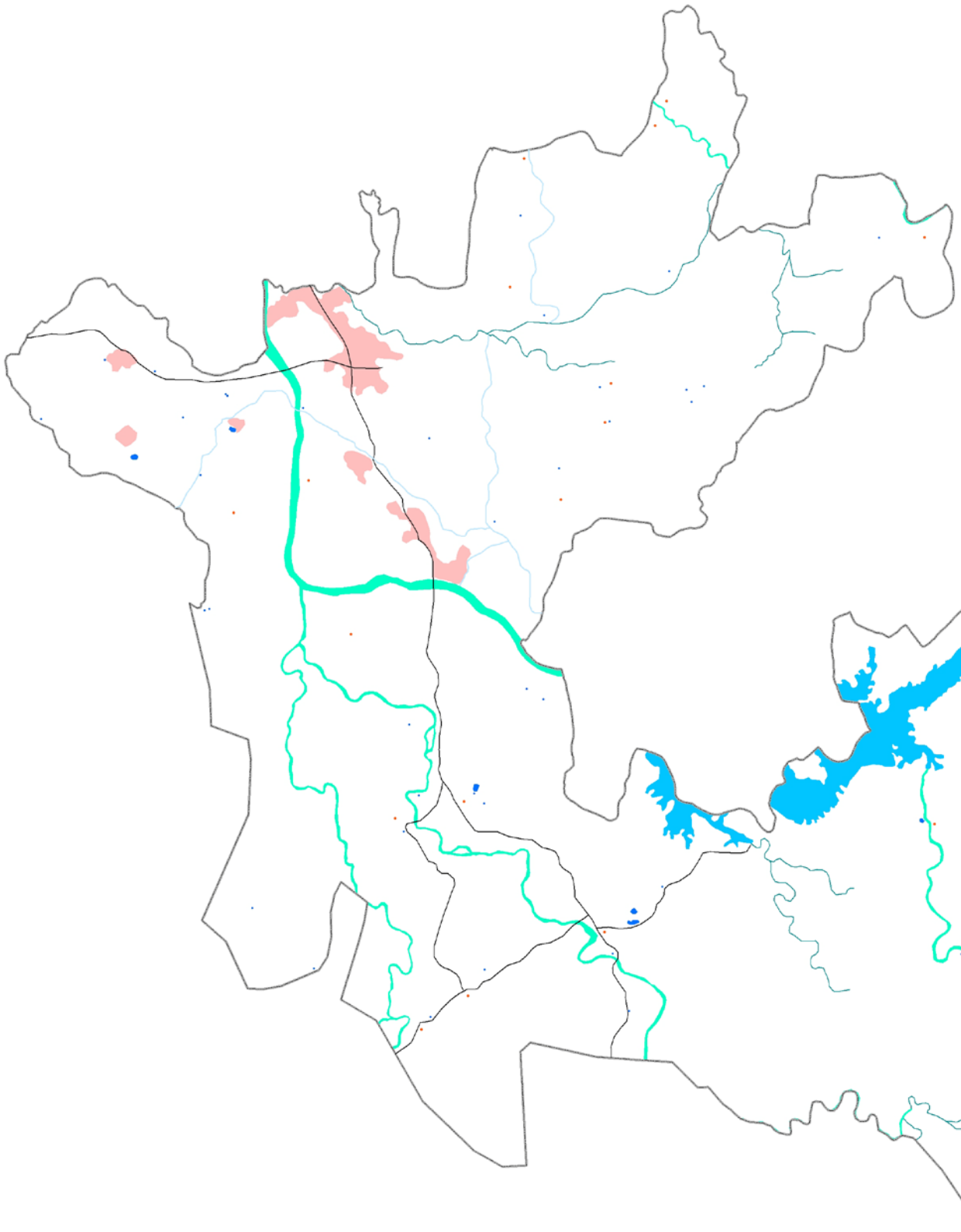



Figure 63: Type-wise wetland distribution in Dadra & Nagar Haveli

State : Dadra & Nagar Haveli

# WETLAND MAP

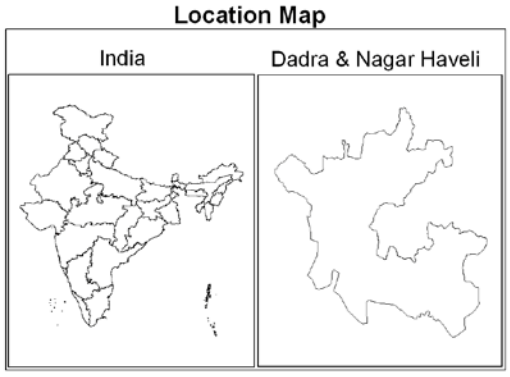


| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 1.25 2.5 5 7.5 10 Kilometers

**Data Source**

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

**Prepared By**

Space Applications Centre (ISRO), Ahmedabad

**Sponsored By**

Ministry of Environment and Forests
Government of India

Plate 49 : Wetland map of Dadra and Nagar Haveli

### 8.1.27 Maharashtra

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/barrage accounting for 36.29 per cent of the wetlands (368135 ha), tank/pond accounting for 20.57 per cent of wetland area (208669 ha), river/stream accounting for 29.54 per cent of wetland area (299730 ha), creek with 4.10 per cent and mangrove with 2.98 per cent of wetland area (41636 ha and 30238 ha respectively). Details of wetland statistics is given in Table 84. Graphical distribution of wetland type is shown in Figure 64. Wetland map of the state is shown in Plate 50.

Analysis of wetland status in terms of opens water showed that water spread is significantly more during post-monsoon (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 84: 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 | Lake/Pond | 39 | 9003 | 0.89 | 8760 | 5961 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 2 | 15 | 0.00 | 15 | 12 |
| 3 | 1104 | Riverine wetland | 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 | Reservoir/Barrage | 759 | 368135 | 36.29 | 343894 | 212394 |
| 7 | 1202 | Tank/Pond | 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 | Creek | 162 | 41636 | 4.10 | 35914 | 25376 |
| 10 | 2103 | Sand/Beach | 400 | 4873 | 0.48 | - | - |
| 11 | 2104 | Intertidal mud flat | 752 | 22249 | 2.19 | - | - |
| 12 | 2105 | Salt Marsh | 32 | 614 | 0.06 | - | - |
| 13 | 2106 | Mangrove | 1270 | 30238 | 2.98 | - | - |
| | **2200** | **Coastal Wetlands - Man-made** | | | | | |
| 14 | 2201 | Salt pan | 205 | 7025 | 0.69 | 7003 | 7000 |
| 15 | 2202 | Aquaculture pond | 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) | 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 |

**District-wise wetland area estimates in Maharashtra**

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 85 and graphical distribution of wetland area is shown in Figure 65. District-wise area of wetlands (type-wise) in the state is given in Table 86.

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 reservoir/barrage and tank/pond. Gondiya district has highest concentration of small wetlands (<2.25 ha).

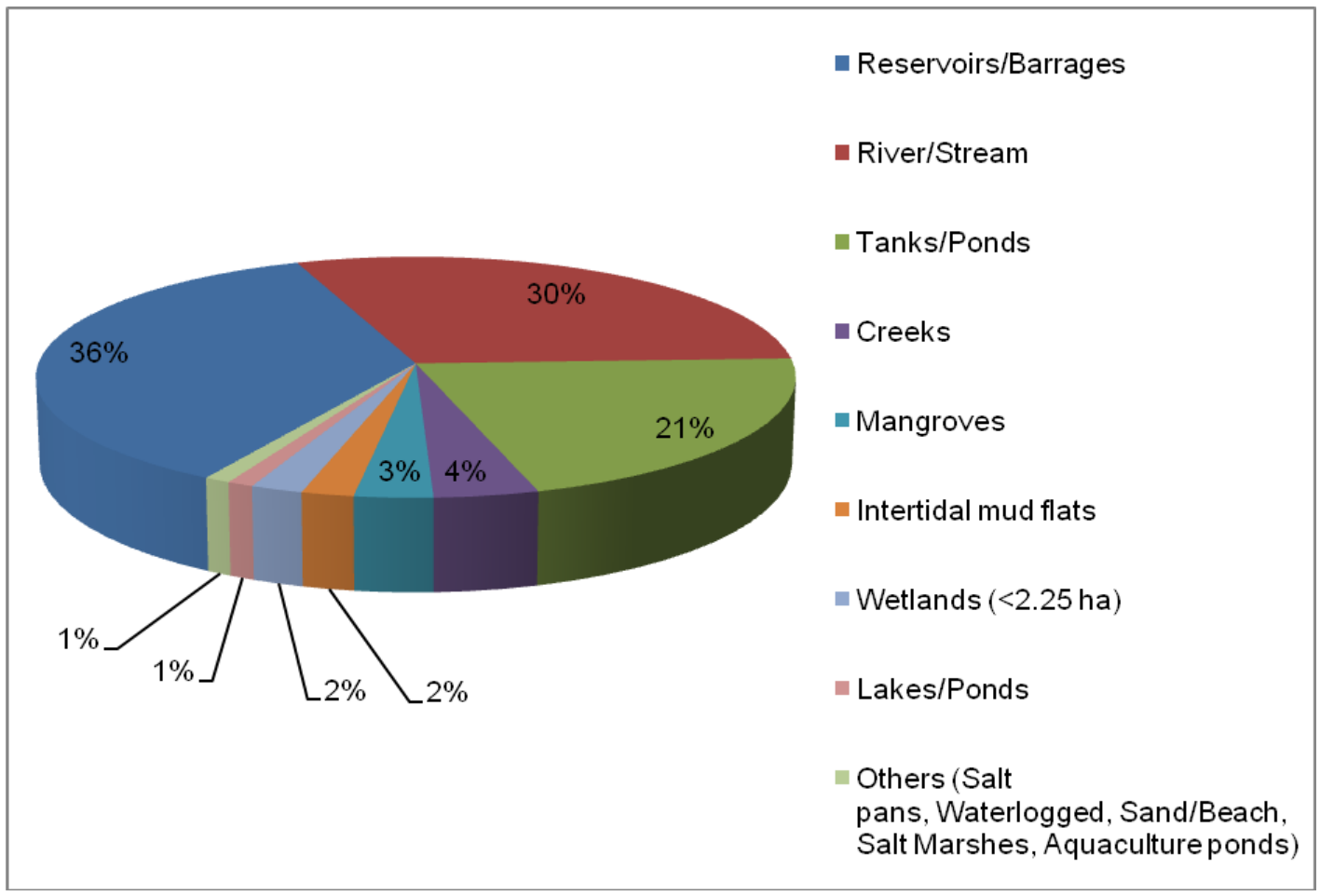



Figure 64: Type-wise wetland distribution in Maharashtra

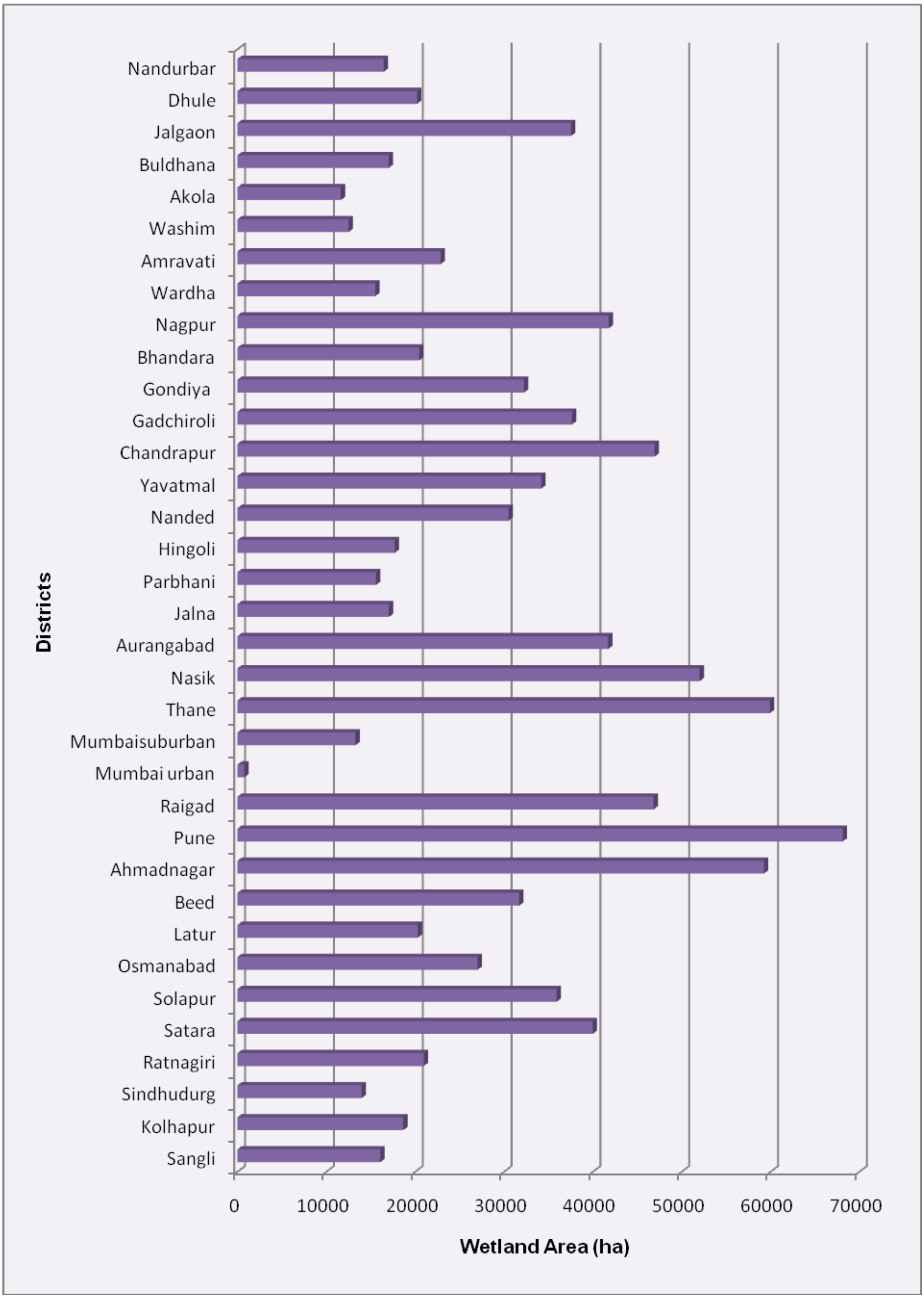



Figure 65: District-wise graphical distribution of wetlands in Maharashtra

Table 85: District-wise area of wetlands in Maharashtra

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Nandurbar | 5055 | 16457 | 1.62 | 3.26 | 13382 | 5401 | 310 | 454 | 7696 | 5249 | 437 | 1092 | 4274 | 35 |
| 2 | Dhule | 8095 | 20211 | 1.99 | 2.50 | 13120 | 3570 | 350 | 704 | 10415 | 2367 | 338 | 1566 | 1886 | 118 |
| 3 | Jalgaon | 11765 | 37558 | 3.70 | 3.19 | 21778 | 9682 | 2146 | 1978 | 16334 | 4180 | 1264 | 3136 | 5207 | 1339 |
| 4 | Buldhana | 9661 | 17015 | 1.68 | 1.76 | 15714 | 6506 | 123 | 1105 | 15536 | 178 | - | 6234 | 272 | - |
| 5 | Akola | 5429 | 11633 | 1.15 | 2.14 | 11118 | 2662 | 75 | 955 | 10897 | 205 | 16 | 2463 | 195 | 4 |
| 6 | Washim | 5155 | 12506 | 1.23 | 2.43 | 11844 | 4061 | 254 | 255 | 11335 | 488 | 21 | 3901 | 156 | 4 |
| 7 | Amravati | 12235 | 22857 | 2.25 | 1.87 | 22651 | 6739 | 180 | 1115 | 21429 | 1204 | 18 | 6129 | 608 | 2 |
| 8 | Wardha | 6309 | 15505 | 1.53 | 2.46 | 14831 | 5097 | 85 | 1398 | 12230 | 2529 | 72 | 3746 | 1290 | 61 |
| 9 | Nagpur | 9892 | 41797 | 4.12 | 4.23 | 34361 | 14984 | 854 | 5727 | 20420 | 12121 | 1820 | 10828 | 3202 | 954 |
| 10 | Bhandara | 3890 | 20469 | 2.02 | 5.26 | 13223 | 2899 | 84 | 831 | 8921 | 3533 | 769 | 705 | 1965 | 229 |
| 11 | Gondiya | 5431 | 32257 | 3.18 | 5.94 | 18540 | 7811 | 224 | 520 | 14050 | 3020 | 1470 | 1464 | 5977 | 370 |
| 12 | Gadchiroli | 14412 | 37645 | 3.71 | 2.61 | 24244 | 5301 | 572 | 931 | 22311 | 1169 | 764 | 1888 | 2760 | 653 |
| 13 | Chandrapur | 11443 | 46948 | 4.63 | 4.10 | 42145 | 15950 | 804 | 4130 | 35453 | 5377 | 1315 | 5530 | 9453 | 967 |
| 14 | Yavatmal | 13582 | 34192 | 3.37 | 2.52 | 32303 | 13786 | 812 | 2936 | 31286 | 970 | 47 | 9607 | 4141 | 38 |
| 15 | Nanded | 10528 | 30508 | 3.01 | 2.90 | 26935 | 8311 | 1559 | 2673 | 24859 | 1815 | 261 | 3224 | 4833 | 254 |
| 16 | Hingoli | 4526 | 17701 | 1.74 | 3.91 | 17002 | 8076 | 111 | 1401 | 16650 | 320 | 32 | 5473 | 2563 | 40 |
| 17 | Parbhani | 6511 | 15601 | 1.54 | 2.40 | 9195 | 6471 | 103 | 1421 | 8682 | 425 | 88 | 4021 | 2162 | 288 |
| 18 | Jalna | 7718 | 17041 | 1.68 | 2.21 | 12178 | 4400 | 59 | 1489 | 8005 | 3925 | 248 | 2416 | 1942 | 42 |
| 19 | Aurangabad | 10107 | 41724 | 4.11 | 4.13 | 37913 | 20030 | 252 | 3401 | 27039 | 7860 | 3014 | 16680 | 3350 | - |
| 20 | Nasik | 15539 | 52027 | 5.13 | 3.35 | 44151 | 18096 | 834 | 564 | 23925 | 11745 | 8481 | 1005 | 16760 | 331 |
| 21 | Thane | 9558 | 59936 | 5.91 | 6.27 | 34579 | 21743 | 7408 | 8446 | 22661 | 11913 | 5 | 5157 | 15160 | 1426 |
| 22 | Mumbaisuburban | 534 | 13282 | 1.31 | 24.87 | 5780 | 5703 | 6221 | 5534 | 777 | 5003 | - | 691 | 5012 | - |
| 23 | Mumbai urban | 69 | 763 | 0.08 | 11.06 | 378 | 378 | 285 | 285 | 28 | 350 | - | 28 | 350 | - |
| 24 | Raigad | 7152 | 46844 | 4.62 | 6.55 | 24034 | 17881 | 13124 | 13124 | 8010 | 16024 | - | 351 | 17530 | - |
| 25 | Pune | 15643 | 68137 | 6.72 | 4.36 | 64507 | 39982 | 1898 | 1840 | 61047 | 3392 | 68 | 33127 | 6853 | 2 |
| 26 | Ahmadnagar | 17048 | 59269 | 5.84 | 3.48 | 46476 | 23225 | 444 | 5148 | 39834 | 6328 | 314 | 18623 | 4602 | - |
| 27 | Beed | 10693 | 31718 | 3.13 | 2.97 | 26915 | 11740 | 327 | 4106 | 23509 | 2566 | 840 | 3236 | 8475 | 29 |
| 28 | Latur | 7157 | 20296 | 2.00 | 2.84 | 17917 | 8300 | 1486 | 851 | 13763 | 3818 | 336 | 6244 | 1809 | 247 |
| 29 | Osmanabad | 7569 | 27027 | 2.66 | 3.57 | 23318 | 9449 | 715 | 3292 | 16433 | 5829 | 1056 | 4888 | 4493 | 68 |
| 30 | Solapur | 14895 | 35918 | 3.54 | 2.41 | 32705 | 21070 | 593 | 1999 | 31019 | 1107 | 579 | 16006 | 4947 | 117 |
| 31 | Satara | 10475 | 39984 | 3.94 | 3.82 | 35625 | 15539 | 874 | 1587 | 35350 | 139 | 136 | 13936 | 1597 | 6 |
| 32 | Ratnagiri | 8208 | 20979 | 2.07 | 2.56 | 10739 | 7997 | 3381 | 3381 | 2100 | 8635 | 4 | 16 | 7981 | - |
| 33 | Sindhudurg | 5207 | 13979 | 1.38 | 2.68 | 8865 | 3340 | 955 | 955 | 4182 | 4637 | 46 | 870 | 2455 | 15 |
| 34 | Kolhapur | 7685 | 18663 | 1.84 | 2.43 | 17503 | 8613 | 27 | 73 | 16286 | 1211 | 6 | 6768 | 1790 | 55 |
| 35 | Sangli | 8572 | 16075 | 1.58 | 1.88 | 10865 | 5564 | 22 | 93 | 10656 | 184 | 25 | 1532 | 3806 | 226 |
| | **Total** | **307748** | **1014522** | **100.00** | **3.30** | **796834** | **370357** | **47551** | **84702** | **633128** | **139816** | **23890** | **202581** | **159856** | **7920** |

* Data Source: http://nic.in

Table 86: District-wise area of wetlands (type-wise) in Maharashtra

| District code | District | Geographic area * | Wetland Type | | | | | | | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1104 | 1105 | 1106 | 1201 | 1202 | 1203 | 2102 | 2103 | 2104 | 2105 | 2106 | 2201 | 2202 | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Nandurbar | 5055 | - | - | - | 29 | 7428 | 6543 | 2136 | 11 | - | - | - | - | - | - | - | 16147 | 310 | 16457 |
| 2 | Dhule | 8095 | - | - | - | 6 | 10865 | 5001 | 3928 | - | - | - | - | - | - | - | - | 19800 | 411 | 20211 |
| 3 | Jalgaon | 11765 | - | - | - | 114 | 19517 | 8961 | 8682 | 25 | - | - | - | - | - | - | - | 37299 | 259 | 37558 |
| 4 | Buldhana | 9661 | 116 | - | - | - | 4004 | 6047 | 6661 | - | - | - | - | - | - | - | - | 16828 | 187 | 17015 |
| 5 | Akola | 5429 | - | - | - | - | 6251 | 3036 | 2174 | - | - | - | - | - | - | - | - | 11461 | 172 | 11633 |
| 6 | Washim | 5155 | - | - | - | - | 3723 | 2428 | 6140 | - | - | - | - | - | - | - | - | 12291 | 215 | 12506 |
| 7 | Amravati | 12235 | - | - | - | - | 10975 | 7272 | 4450 | - | - | - | - | - | - | - | - | 22697 | 160 | 22857 |
| 8 | Wardha | 6309 | - | - | - | - | 4931 | 6953 | 3460 | - | - | - | - | - | - | - | - | 15344 | 161 | 15505 |
| 9 | Nagpur | 9892 | 1805 | - | - | - | 10317 | 11420 | 17920 | - | - | - | - | - | - | - | - | 41462 | 335 | 41797 |
| 10 | Bhandara | 3890 | - | - | - | - | 9580 | 1523 | 8889 | - | - | - | - | - | - | - | - | 19992 | 477 | 20469 |
| 11 | Gondiya | 5431 | - | - | - | - | 3766 | 13526 | 10365 | - | - | - | - | - | - | - | - | 27657 | 4600 | 32257 |
| 12 | Gadchiroli | 14412 | - | - | - | - | 27914 | 1351 | 6967 | - | - | - | - | - | - | - | - | 36232 | 1413 | 37645 |
| 13 | Chandrapur | 11443 | - | - | - | - | 19472 | 9683 | 17297 | - | - | - | - | - | - | - | - | 46452 | 496 | 46948 |
| 14 | Yavatmal | 13582 | - | - | - | - | 9413 | 13250 | 11317 | - | - | - | - | - | - | - | - | 33980 | 212 | 34192 |
| 15 | Nanded | 10528 | - | - | - | - | 17455 | 4913 | 7693 | 7 | - | - | - | - | - | - | - | 30068 | 440 | 30508 |
| 16 | Hingoli | 4526 | - | - | - | 5 | 2197 | 14339 | 1026 | - | - | - | - | - | - | - | - | 17567 | 134 | 17701 |
| 17 | Parbhani | 6511 | - | - | - | 4 | 6619 | 7289 | 1541 | 6 | - | - | - | - | - | - | - | 15459 | 142 | 15601 |
| 18 | Jalna | 7718 | - | - | - | - | 6845 | 6355 | 3336 | - | - | - | - | - | - | - | - | 16536 | 505 | 17041 |
| 19 | Aurangabad | 10107 | - | - | - | 106 | 5203 | 31015 | 4814 | - | - | - | - | - | - | - | - | 41138 | 586 | 41724 |
| 20 | Nasik | 15539 | - | - | - | - | 13081 | 27675 | 8653 | - | - | - | - | - | - | - | 25 | 49434 | 2593 | 52027 |
| 21 | Thane | 9558 | 1980 | - | - | - | 10684 | 7928 | 2427 | - | 11992 | 541 | 11884 | 70 | 7062 | 4277 | - | 58845 | 1091 | 59936 |
| 22 | Mumbai suburban | 534 | 719 | - | - | - | 18 | - | 53 | - | 4177 | 240 | 1260 | 514 | 5459 | 842 | - | 13282 | - | 13282 |
| 23 | Mumbai urban | 69 | - | - | - | - | - | - | 28 | - | 280 | 79 | 8 | 30 | 257 | 81 | - | 763 | - | 763 |
| 24 | Raigad | 7152 | - | - | - | - | 7110 | 1897 | 1713 | - | 13482 | 977 | 6415 | - | 13124 | 1806 | - | 46524 | 320 | 46844 |
| 25 | Pune | 15643 | - | - | - | - | 13136 | 48339 | 6314 | - | - | - | - | - | - | - | - | 67789 | 348 | 68137 |
| 26 | Ahmadnagar | 17048 | - | - | - | - | 15333 | 32540 | 10118 | 20 | - | - | - | - | - | - | - | 58011 | 1258 | 59269 |
| 27 | Beed | 10693 | 12 | 3 | - | - | 7547 | 12630 | 10728 | 18 | - | - | - | - | - | - | - | 30938 | 780 | 31718 |
| 28 | Latur | 7157 | - | - | - | - | 4757 | 5810 | 9440 | - | - | - | - | - | - | - | - | 20007 | 289 | 20296 |
| 29 | Osmanabad | 7569 | - | - | - | - | 2519 | 12617 | 11092 | 146 | - | - | - | - | - | - | - | 26374 | 653 | 27027 |
| 30 | Solapur | 14895 | 4325 | - | - | - | 7732 | 17868 | 5137 | - | - | - | - | - | - | - | - | 35062 | 856 | 35918 |
| 31 | Satara | 10475 | 12 | - | 2 | - | 10471 | 23503 | 5213 | 34 | - | - | - | - | - | - | - | 39235 | 749 | 39984 |
| 32 | Ratnagiri | 8208 | - | - | - | 3 | 4769 | 755 | 1136 | - | 7151 | 1955 | 1767 | - | 3381 | - | 46 | 20963 | 16 | 20979 |
| 33 | Sindhudurg | 5207 | - | - | - | 14 | 4385 | 618 | 1428 | - | 4554 | 1081 | 915 | - | 955 | 19 | - | 13969 | 10 | 13979 |
| 34 | Kolhapur | 7685 | - | 12 | - | 3 | 5257 | 13060 | 147 | - | - | - | - | - | - | - | - | 18479 | 184 | 18663 |
| 35 | Sangli | 8572 | 34 | - | - | - | 6456 | 1990 | 6246 | 43 | - | - | - | - | - | - | - | 14769 | 1306 | 16075 |
| | **Total** | **267601** | **9003** | **15** | **2** | **284** | **299730** | **368135** | **208669** | **310** | **41636** | **4873** | **22249** | **614** | **30238** | **7025** | **71** | **992854** | **21668** | **1014522** |

* Data Source: http://nic.in

1101 Lake/Pond
1102 Ox-bow lake/ Cut-off meander
1103 High altitude wetland
1104 Riverine wetland
1105 Waterlogged (Natural)
1106 River/Stream

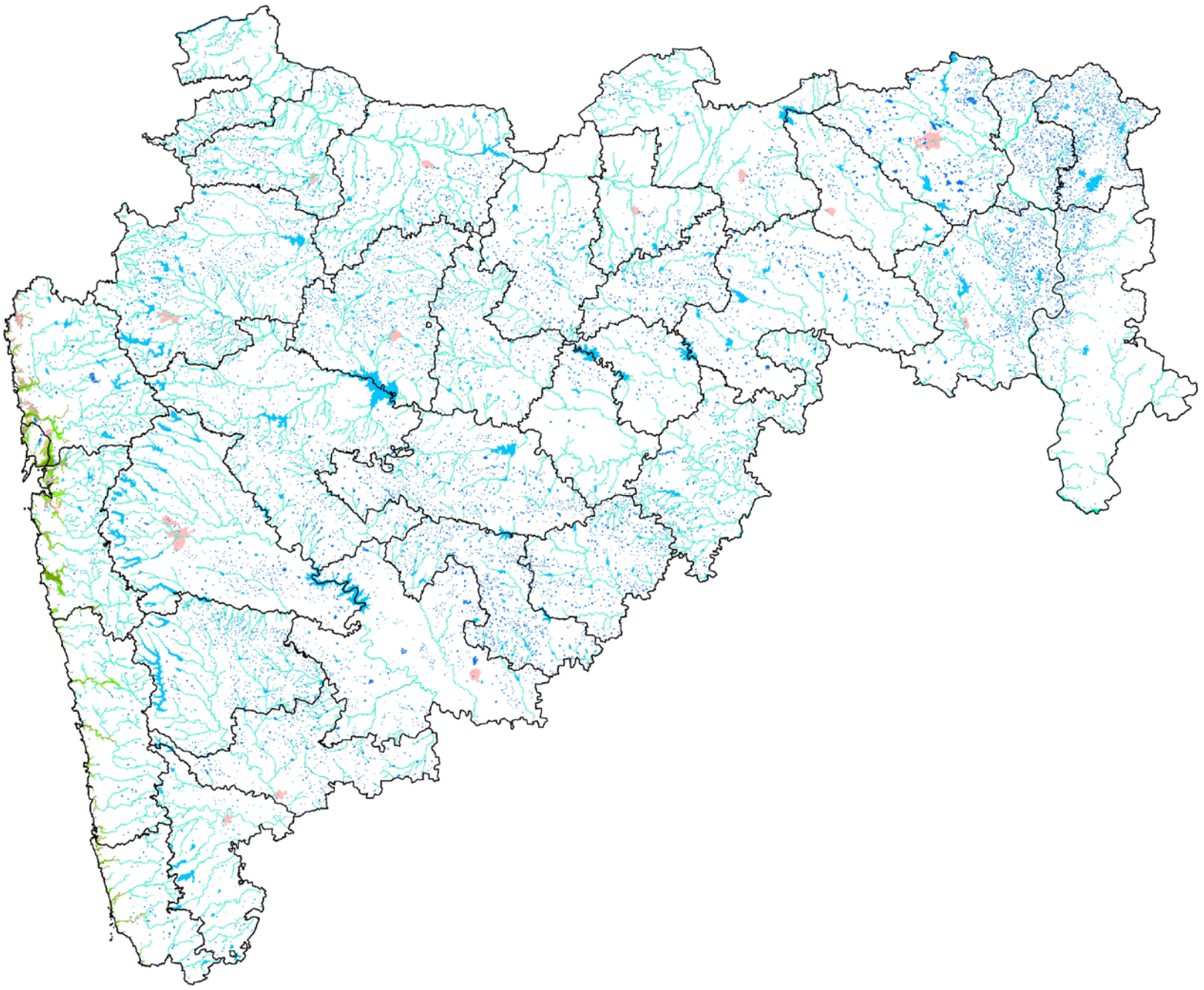
1201 Reservoir/Barrage
1202 Tank/Pond
1203 Waterlogged (Man-made)
1204 Salt pan (Inland)

2101 Lagoon
2102 Creek
2103 Sand/Beach
2104 Intertidal mud flat
2105 Salt Marsh (Coastal)
2106 Mangrove
2107 Coral Reef

2201 Salt pan
2202 Aquaculture pond

State : Maharashtra

# WETLAND MAP

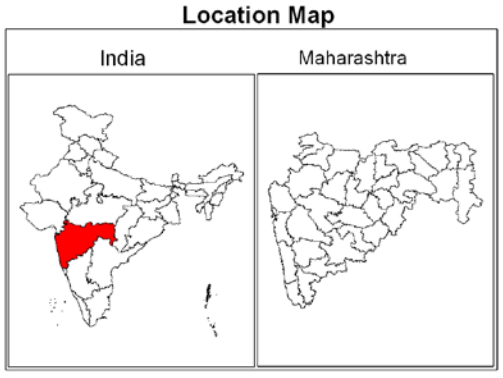


| Symbol Typecode | Level I | Level II | Level III |
|---|---|---|---|
| | Inland Wetlands | | |
| | | Natural | |
| 1101 | | | Lakes/Ponds |
| 1102 | | | Ox-bow lakes/ Cut-off meanders |
| 1103 | | | High altitude wetlands |
| 1104 | | | Riverine wetlands |
| 1105 | | | Waterlogged |
| 1106 | | | River/Stream |
| | | 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 20 40 80 120 160 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 50 : Wetland map of Maharashtra

### 8.1.28 Andhra Pradesh

Total 20477 wetlands are mapped in the state, in addition to 18037 small wetlands (<2.25 ha). The total area under wetlands in the state is 1447133 ha. The major wetland type is reservoir/barrage, accounting 27.95 per cent of total wetland area. Total 4527 number of this type has been mapped with 404499 ha area. Besides the river/stream type, the other major wetland types are the aquaculture pond (16.62%), tank/pond (13.94%), lagoon (3.28%) and mangrove (2.87%). The open water spread in wetlands is slightly more during post-monsoon (887143 ha) than during pre-monsoon (610668 ha). On the other hand, area under aquatic vegetation in wetlands is more than twice during pre-monsoon (268267 ha) compared to that of post-monsoon (126187 ha). Table 87 shows details of wetland statistics in the state. The graphical distribution is shown in Figure 66. Wetland map of the state is shown in Plate 51.

Table 87: Area estimates of wetlands in Andhra Pradesh

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 | Lake/Pond | 8 | 21843 | 1.51 | 3368 | 4334 |
| 2 | 1105 | Waterlogged | 54 | 2714 | 0.19 | 902 | 609 |
| 3 | 1106 | River/Stream | 353 | 385839 | 26.66 | 168137 | 123927 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 4 | 1201 | Reservoir/Barrage | 4527 | 404499 | 27.95 | 340275 | 200496 |
| 5 | 1202 | Tank/Pond | 13708 | 201677 | 13.94 | 155503 | 71456 |
| 6 | 1203 | Waterlogged | 51 | 4178 | 0.29 | 914 | 558 |
| | | **Total - Inland** | **18701** | **1020750** | **70.54** | **669099** | **401380** |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 7 | 2101 | Lagoon | 2 | 47407 | 3.28 | 47306 | 47407 |
| 8 | 2102 | Creek | 80 | 9594 | 0.66 | 9103 | 8946 |
| 9 | 2103 | Sand/Beach | 70 | 15891 | 1.10 | - | - |
| 10 | 2104 | Intertidal mud flat | 131 | 31767 | 2.20 | - | - |
| 11 | 2105 | Salt Marsh | 28 | 4002 | 0.28 | - | - |
| 12 | 2106 | Mangrove | 254 | 41486 | 2.87 | - | - |
| | **2200** | **Coastal Wetlands - Man-made** | | | | | |
| 13 | 2201 | Salt pan | 57 | 17725 | 1.22 | 7551 | 7064 |
| 14 | 2202 | Aquaculture pond | 1154 | 240474 | 16.62 | 154084 | 145871 |
| | | **Total - Coastal** | **1776** | **408346** | **28.22** | **218044** | **209288** |
| | | **Sub-Total** | **20477** | **1429096** | **98.75** | **887143** | **610668** |
| | | Wetlands (<2.25 ha) | 18037 | 18037 | 1.25 | - | - |
| | | **Total** | **38514** | **1447133** | **100.00** | **887143** | **610668** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 126187 | 268267 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 295604 | 227855 |
| Moderate | 531282 | 350782 |
| High | 60257 | 32031 |

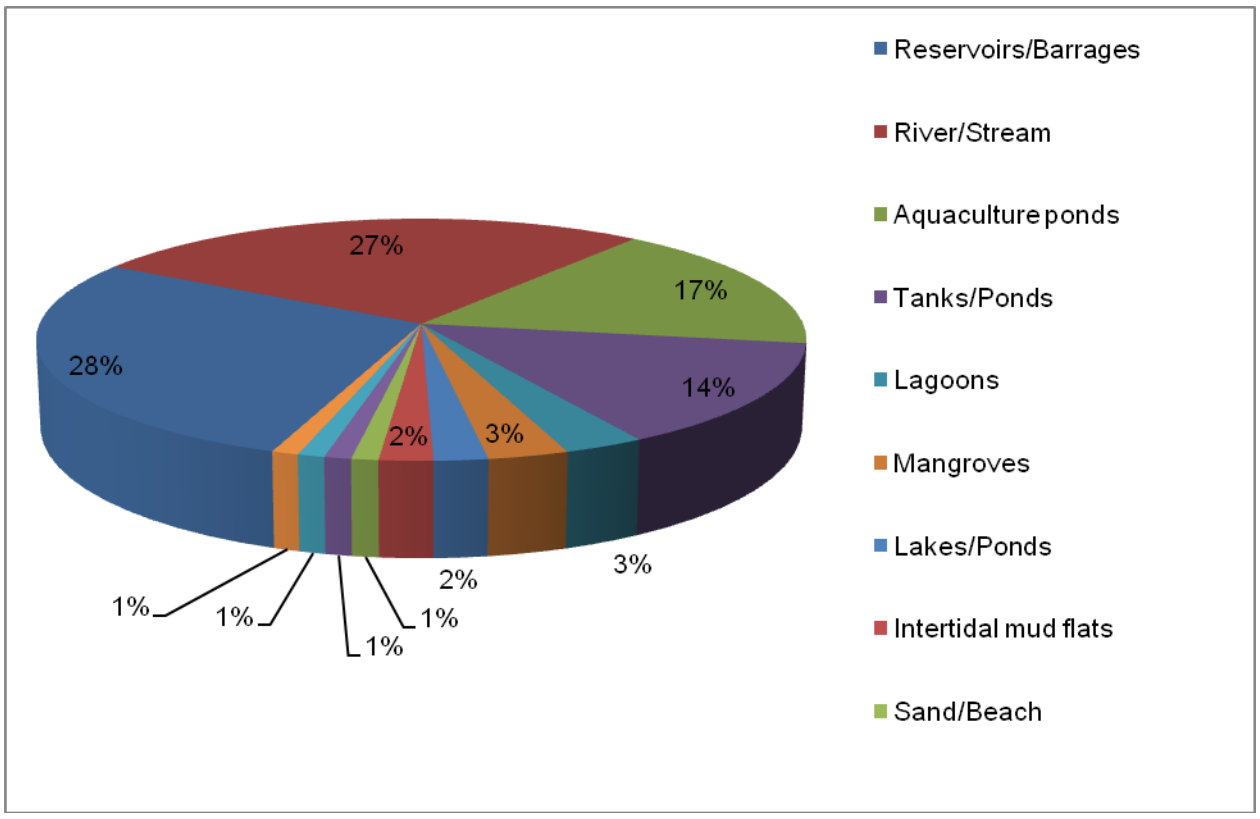



Figure 66: Type-wise wetland distribution in Andhra Pradesh

**District-wise wetland distribution in Andhra Pradesh**

The State has twenty three districts. The geographic area of districts vary from 217 sq. km (Hyderabad) to 19130 sq. km (Anantpur). Nellor district has the highest area under wetland (215404 ha), followed by Krishna district (165818 ha). However, as a per cent of geographic area , Krishna district has highest (19.00%), followed by Nellore district (16.47%), while Rangareddi district has the least (1.37%).

District-wise distribution of wetland types show that, river/stream, reservoir/barrage and tank/pond are found in all the districts. Khammam district has highest area under river/stream (41381 ha), followed by East Godavari district (36135 ha). Nellore has highest area under reservoir/barrage (45715 ha), followed by Nalgonda district (39289 ha) and Nizamabad district (36349 ha). Natural lake/pond are found only in four districts viz. West Godavari, Krishna Warangal and Khammam. Aquaculture ponds are found in nine districts; with highest area observed in Krishna district (88939 ha), followed by West Godavari (58845 ha) and Nellore district (43195 ha). Vizianagaram district has highest number of small wetlands (<2.25 ha) mainly ponds.

Mangrove, one of the unique wetland types is found in six districts, viz., East Godavari district has highest area under mangrove (18638 ha), followed by Krishna district (14794 ha) and Guntur district (6332 ha). Nellore district has the distinction of having wetland type -lagoon (47407 ha). Salt Marsh are found only in Nellore and Prakasham district. Details of wetland statistics in terms of area, open water, aquatic vegetation found in each district is shown in Table 88, while Table 89 shows type wise distribution of wetlands in each district. Figure 67 shows graphical distribution of district-wise wetland area.

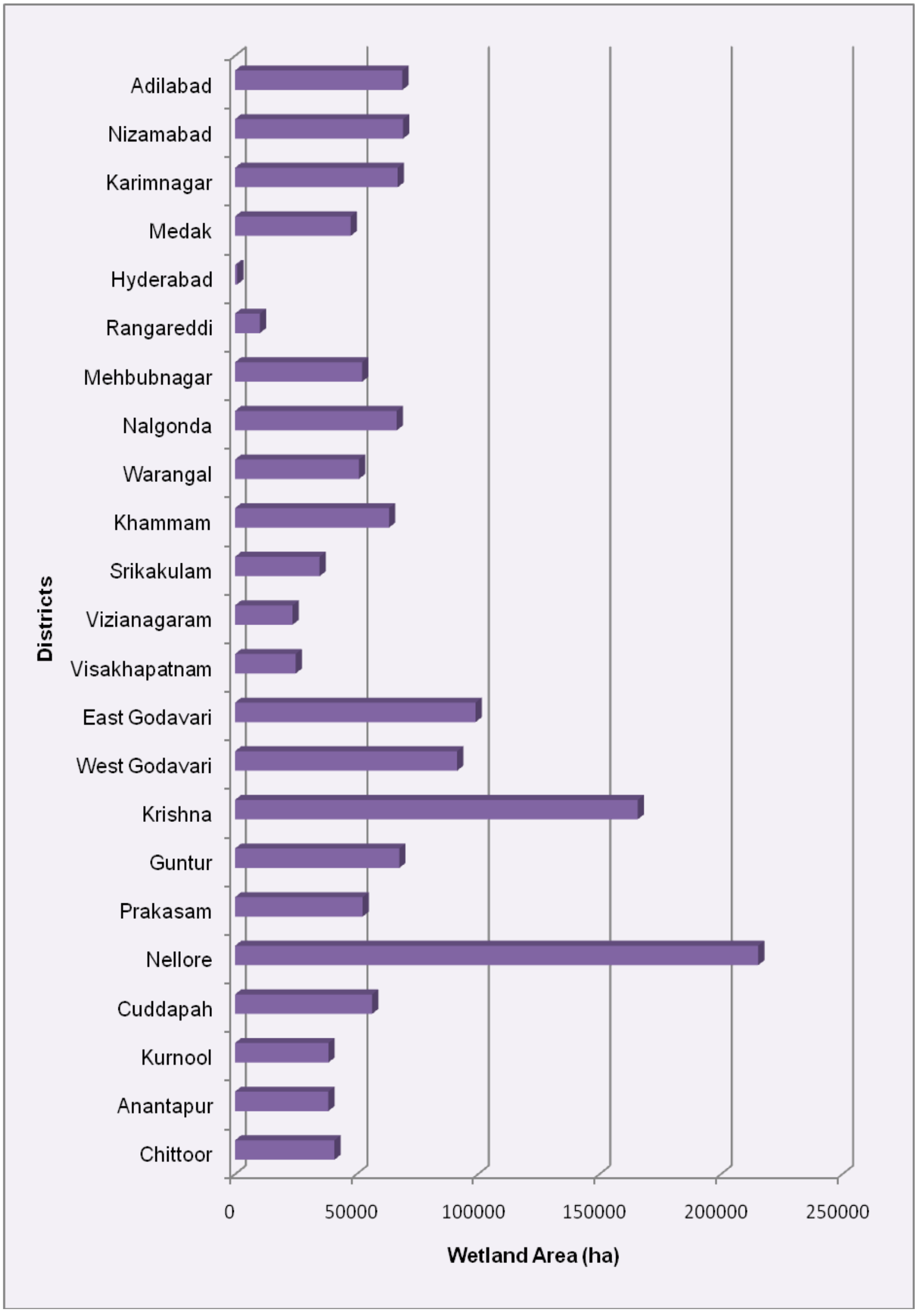



Figure 67: District-wise graphical distribution of wetlands

Table 88: District-wise area of wetlands in Andhra Pradesh

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Adilabad | 16105 | 68907 | 4.76 | 4.28 | 44355 | 21557 | 4785 | 13041 | 17976 | 22756 | 3623 | 4159 | 16303 | 1095 |
| 2 | Nizamabad | 7956 | 69213 | 4.78 | 8.70 | 55961 | 27030 | 8432 | 14894 | 26810 | 26880 | 2271 | 9923 | 17024 | 83 |
| 3 | Karimnagar | 11823 | 67017 | 4.63 | 5.67 | 37710 | 21283 | 4607 | 11471 | 796 | 33778 | 3136 | 174 | 19655 | 1454 |
| 4 | Medak | 9699 | 47639 | 3.29 | 4.91 | 39574 | 21476 | 3483 | 13563 | 3009 | 22257 | 14313 | 6366 | 14896 | 214 |
| 5 | Hyderabad | 217 | 935 | 0.06 | 4.31 | 685 | 626 | 68 | 49 | - | 623 | 62 | 495 | 131 | - |
| 6 | Rangareddi | 7493 | 10257 | 0.71 | 1.37 | 6914 | 4417 | 964 | 2264 | 274 | 5967 | 673 | 225 | 3936 | 256 |
| 7 | Mehbubnagar | 18432 | 52327 | 3.62 | 2.84 | 32655 | 20367 | 2623 | 12516 | 9147 | 21722 | 1786 | 3449 | 15278 | 1640 |
| 8 | Nalgonda | 14240 | 66606 | 4.60 | 4.68 | 44338 | 32498 | 6892 | 14128 | 4132 | 38480 | 1726 | 221 | 30954 | 1323 |
| 9 | Warangal | 12846 | 51046 | 3.53 | 3.97 | 35760 | 13092 | 2373 | 15585 | 1421 | 32083 | 2256 | 133 | 11165 | 1794 |
| 10 | Khammam | 16029 | 63422 | 4.38 | 3.96 | 33552 | 21795 | 3159 | 7026 | 6432 | 23884 | 3236 | 2045 | 18280 | 1470 |
| 11 | Srikakulam | 5837 | 34849 | 2.41 | 5.97 | 14645 | 11079 | 3049 | 5367 | 3213 | 10892 | 540 | 1475 | 8915 | 689 |
| 12 | Vizianagaram | 6539 | 23674 | 1.64 | 3.62 | 14741 | 6461 | 961 | 5222 | 3351 | 11162 | 228 | 3218 | 2873 | 370 |
| 13 | Visakhapatnam | 11161 | 24988 | 1.73 | 2.24 | 16984 | 11185 | 1410 | 3504 | 8220 | 7774 | 990 | 4477 | 4451 | 2257 |
| 14 | East Godavari | 10807 | 99057 | 6.85 | 9.17 | 54716 | 52154 | 20245 | 20742 | 32503 | 19637 | 2576 | 28491 | 21220 | 2443 |
| 15 | West Godavari | 7742 | 91447 | 6.32 | 11.81 | 67601 | 51421 | 12458 | 23906 | 35717 | 31773 | 111 | 44905 | 6426 | 91 |
| 16 | Krishna | 8727 | 165818 | 11.46 | 19.00 | 87097 | 74772 | 20371 | 28352 | 50574 | 35297 | 1226 | 39680 | 34789 | 303 |
| 17 | Guntur | 11391 | 67652 | 4.67 | 5.94 | 31185 | 29031 | 7726 | 8902 | 2476 | 27578 | 1131 | 3136 | 25600 | 295 |
| 18 | Prakasam | 17626 | 52565 | 3.63 | 2.98 | 25489 | 18743 | 2338 | 9023 | 3469 | 18580 | 3440 | 3197 | 13985 | 1559 |
| 19 | Nellore | 13076 | 215404 | 14.88 | 16.47 | 141494 | 114398 | 8145 | 25839 | 68956 | 67693 | 4840 | 57821 | 51748 | 4830 |
| 20 | Cuddapah | 15359 | 56470 | 3.90 | 3.68 | 34973 | 27073 | 2772 | 5402 | 8109 | 23599 | 3265 | 12546 | 13122 | 1405 |
| 21 | Kurnool | 17658 | 38479 | 2.66 | 2.18 | 26782 | 13972 | 2029 | 11842 | 7476 | 17750 | 1556 | 1247 | 11469 | 1256 |
| 22 | Anantapur | 19130 | 38400 | 2.65 | 2.01 | 10481 | 9334 | 6075 | 8490 | 173 | 8216 | 2092 | 325 | 4717 | 4292 |
| 23 | Chittoor | 15152 | 40961 | 2.83 | 2.70 | 29451 | 6904 | 1222 | 7139 | 1370 | 22901 | 5180 | 147 | 3845 | 2912 |
| | **Total** | **275045** | **1447133** | **100.00** | **5.26** | **887143** | **610668** | **126187** | **268267** | **295604** | **531282** | **60257** | **227855** | **350782** | **32031** |

* Data Source: http://nic.in

Table 89: District-wise area of wetlands (type-wise) in Andhra Pradesh

| District code | District | Geographic area * | Wetland Type | | | | | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1105 | 1106 | 1201 | 1202 | 1203 | 2101 | 2102 | 2103 | 2104 | 2105 | 2106 | 2201 | 2202 | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Adilabad | 16105 | - | 15 | 34133 | 27008 | 7383 | 7 | - | - | - | - | - | - | - | - | 68546 | 361 | 68907 |
| 2 | Nizamabad | 7956 | - | 31 | 13151 | 36349 | 19152 | - | - | - | - | - | - | - | - | - | 68683 | 530 | 69213 |
| 3 | Karimnagar | 11823 | - | - | 30743 | 25141 | 10535 | - | - | - | - | - | - | - | - | - | 66419 | 598 | 67017 |
| 4 | Medak | 9699 | - | - | 4787 | 22072 | 20116 | - | - | - | - | - | - | - | - | - | 46975 | 664 | 47639 |
| 5 | Hyderabad | 217 | - | - | 231 | 584 | 107 | - | - | - | - | - | - | - | - | - | 922 | 13 | 935 |
| 6 | Rangareddi | 7493 | - | 62 | 2182 | 4325 | 3287 | - | - | - | - | - | - | - | - | - | 9856 | 401 | 10257 |
| 7 | Mehbubnagar | 18432 | - | 356 | 14136 | 31256 | 5424 | 549 | - | - | - | - | - | - | - | - | 51721 | 606 | 52327 |
| 8 | Nalgonda | 14240 | - | - | 15039 | 39289 | 11702 | 40 | - | - | - | - | - | - | - | - | 66070 | 536 | 66606 |
| 9 | Warangal | 12846 | 1836 | 17 | 14147 | 24875 | 9462 | - | - | - | - | - | - | - | - | - | 50337 | 709 | 51046 |
| 10 | Khammam | 16029 | 1654 | 18 | 41381 | 11371 | 8044 | 62 | - | - | - | - | - | - | - | - | 62530 | 892 | 63422 |
| 11 | Srikakulam | 5837 | - | 1293 | 10959 | 4938 | 4678 | 168 | - | 1033 | 3733 | 2591 | - | 72 | 3934 | 41 | 33440 | 1409 | 34849 |
| 12 | Vizianagaram | 6539 | - | - | 5623 | 4778 | 10567 | - | - | 21 | 363 | - | - | - | 12 | 47 | 21411 | 2263 | 23674 |
| 13 | Visakhapatnam | 11161 | - | - | 7424 | 6666 | 4793 | - | - | 677 | 2103 | - | - | - | 2261 | 407 | 24331 | 657 | 24988 |
| 14 | East Godavari | 10807 | - | - | 36135 | 10042 | 4244 | 102 | - | 2376 | 2622 | 4513 | - | 18638 | 773 | 18440 | 97885 | 1172 | 99057 |
| 15 | West Godavari | 7742 | 12208 | - | 9329 | 3420 | 3191 | 104 | - | 50 | 329 | 475 | - | - | 2494 | 58845 | 90445 | 1002 | 91447 |
| 16 | Krishna | 8727 | 6145 | - | 27379 | 3881 | 6312 | - | - | 2817 | 2129 | 8315 | - | 14794 | 4174 | 88939 | 164885 | 933 | 165818 |
| 17 | Guntur | 11391 | - | 3 | 22725 | 9799 | 3512 | 6 | - | 561 | 847 | 2256 | - | 6332 | - | 20842 | 66883 | 769 | 67652 |
| 18 | Prakasam | 17626 | - | 272 | 13873 | 12265 | 7490 | - | - | 471 | 1221 | 1335 | 527 | 82 | 4077 | 9718 | 51331 | 1234 | 52565 |
| 19 | Nellore | 13076 | - | 369 | 26826 | 45715 | 27673 | 2082 | 47407 | 1588 | 2544 | 12282 | 3475 | 1568 | - | 43195 | 214724 | 680 | 215404 |
| 20 | Cuddapah | 15359 | - | - | 22126 | 29738 | 3584 | 662 | - | - | - | - | - | - | - | - | 56110 | 360 | 56470 |
| 21 | Kurnool | 17658 | - | - | 11012 | 24956 | 1887 | 335 | - | - | - | - | - | - | - | - | 38190 | 289 | 38479 |
| 22 | Anantapur | 19130 | - | 278 | 13718 | 13947 | 9896 | 61 | - | - | - | - | - | - | - | - | 37900 | 500 | 38400 |
| 23 | Chittoor | 15152 | - | - | 8780 | 12084 | 18638 | - | - | - | - | - | - | - | - | - | 39502 | 1459 | 40961 |
| | **Total** | **275045** | **21843** | **2714** | **385839** | **404499** | **201677** | **4178** | **47407** | **9594** | **15891** | **31767** | **4002** | **41486** | **17725** | **240474** | **1429096** | **18037** | **1447133** |

* Data Source: http://nic.in

1101 Lake/Pond
1102 Ox-bow lake/ Cut-off meander
1103 High altitude wetland
1104 Riverine wetland
1105 Waterlogged (Natural)
1106 River/Stream

1201 Reservoir/Barrage
1202 Tank/Pond
1203 Waterlogged (Man-made)
1204 Salt pan (Inland)

2101 Lagoon
2102 Creek
2103 Sand/Beach
2104 Intertidal mud flat
2105 Salt Marsh (Coastal)
2106 Mangrove
2107 Coral Reef

2201 Salt pan
2202 Aquaculture pond

State : Andhra Pradesh

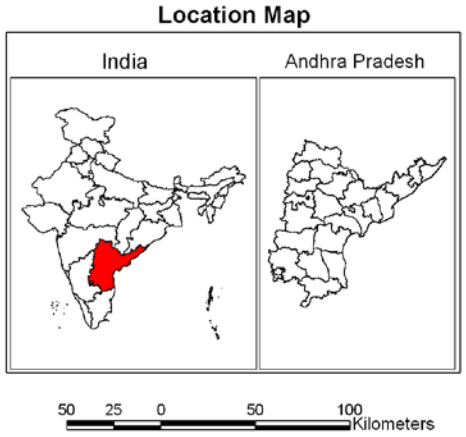
## WETLAND MAP

| 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 | | | Riverine 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 (<2.25ha)
- Drainage (line)
- Major Roads
- Railway
- Settlements
- 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
A.P. State Remote Sensing Applications Centre, Hyderabad

**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 51 : Wetland map of Andhra Pradesh

### 8.1.29 Karnataka

In the state of Karnataka 11412 wetlands have been delineated, in addition to 13864 small wetlands (< 2.25 ha), which have been shown as point features. Total wetland area estimated is 643576 ha (Table 90). Inland wetlands dominated in terms of aerial extent (621425 ha) comprising about 97 per cent of wetland area in the state. Of this, man-made wetlands accounted for about 68 per cent. Coastal wetlands were estimated to be about one per cent, while the small wetlands (<2.25 ha) constitute about 2 per cent of the wetland area. Wetland map of the state is shown in Plate 52. Graphical distribution of wetland type is shown in Figure 68.

Table 90: Area estimates of wetlands in Karnataka

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 | Lake/Pond | 27 | 638 | 0.10 | 314 | 272 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | - | - | - | - | - |
| 3 | 1103 | High altitude wetland | - | - | - | - | - |
| 4 | 1104 | Riverine wetland | 61 | 1051 | 0.16 | 558 | 319 |
| 5 | 1105 | Waterlogged | 93 | 2045 | 0.32 | 1132 | 925 |
| 6 | 1106 | River/Stream | 334 | 179731 | 27.93 | 148113 | 109240 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 7 | 1201 | Reservoir/Barrage | 70 | 213527 | 33.18 | 187002 | 92834 |
| 8 | 1202 | Tank/Pond | 10386 | 222030 | 34.50 | 86679 | 54147 |
| 9 | 1203 | Waterlogged | 53 | 2403 | 0.37 | 844 | 563 |
| 10 | 1204 | Salt pan | - | - | - | - | - |
| | | **Total - Inland** | **11024** | **621425** | **96.56** | **424642** | **258300** |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 11 | 2101 | Lagoon | 2 | 72 | 0.01 | 68 | 61 |
| 12 | 2102 | Creek | 13 | 97 | 0.02 | 80 | 45 |
| 13 | 2103 | Sand/Beach | 61 | 1897 | 0.29 | - | - |
| 14 | 2104 | Intertidal mud flat | 97 | 1663 | 0.26 | 175 | 1222 |
| 15 | 2105 | Salt Marsh | - | - | - | - | - |
| 16 | 2106 | Mangrove | 140 | 967 | 0.15 | - | - |
| 17 | 2107 | Coral Reef | - | - | - | - | - |
| | **2200** | **Coastal Wetlands - Man-made** | | | | | |
| 18 | 2201 | Salt pan | 4 | 812 | 0.13 | 812 | 812 |
| 19 | 2202 | Aquaculture pond | 71 | 2779 | 0.43 | 2144 | 2551 |
| | | **Total - Coastal** | **388** | **8287** | **1.29** | **3279** | **4691** |
| | | **Sub-Total** | **11412** | **629712** | **97.85** | **427921** | **262991** |
| | | Wetlands (<2.25 ha) | 13864 | 13864 | 2.15 | - | - |
| | | **Total** | **25276** | **643576** | **100.00** | **427921** | **262991** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 80818 | 107259 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 65547 | 60149 |
| Moderate | 326173 | 178414 |
| High | 36201 | 24428 |

The major wetland types are tank/pond (222030 ha) followed by reservoir/barrage (213527 ha) and river/stream (179731 ha). Tank/Pond were dominant in terms of number (10386) as well as extent and accounted for about 35 per cent of total wetland area in the state. Reservoir/Barrage category though less in number (70) compared to tank/pond but ranked next comprising about 33 per cent of wetland extent. The open water extent in wetlands is about 66 per cent of wetland extent (427921 ha) in post-monsoon, and decreased significantly during pre-monsoon (262991 ha), which is nearly 41.0%. This reduction is pronouncedly observed in case of reservoir/barrage (88 % to 43 %) followed by river/stream (81 % to 61 %) and tank/pond (39 % to 24 %).

In terms of aquatic vegetation in wetlands, it is more during pre-monsoon (107259 ha) than that of post monsoon period (80818 ha). This accounts for about 13 and 17 % of the total wetland area in post- and pre-monsoon seasons respectively. Qualitative turbidity of open water in wetlands is moderate in both the seasons. Out of 427921 ha of open water in post-monsoon, about 76 per cent is moderately turbid followed by low (16 %) and high (8%). During pre-monsoon, out of 262991 ha of open water, about 68 per cent is under moderate turbidity followed by low (23 %) and high (9 %).

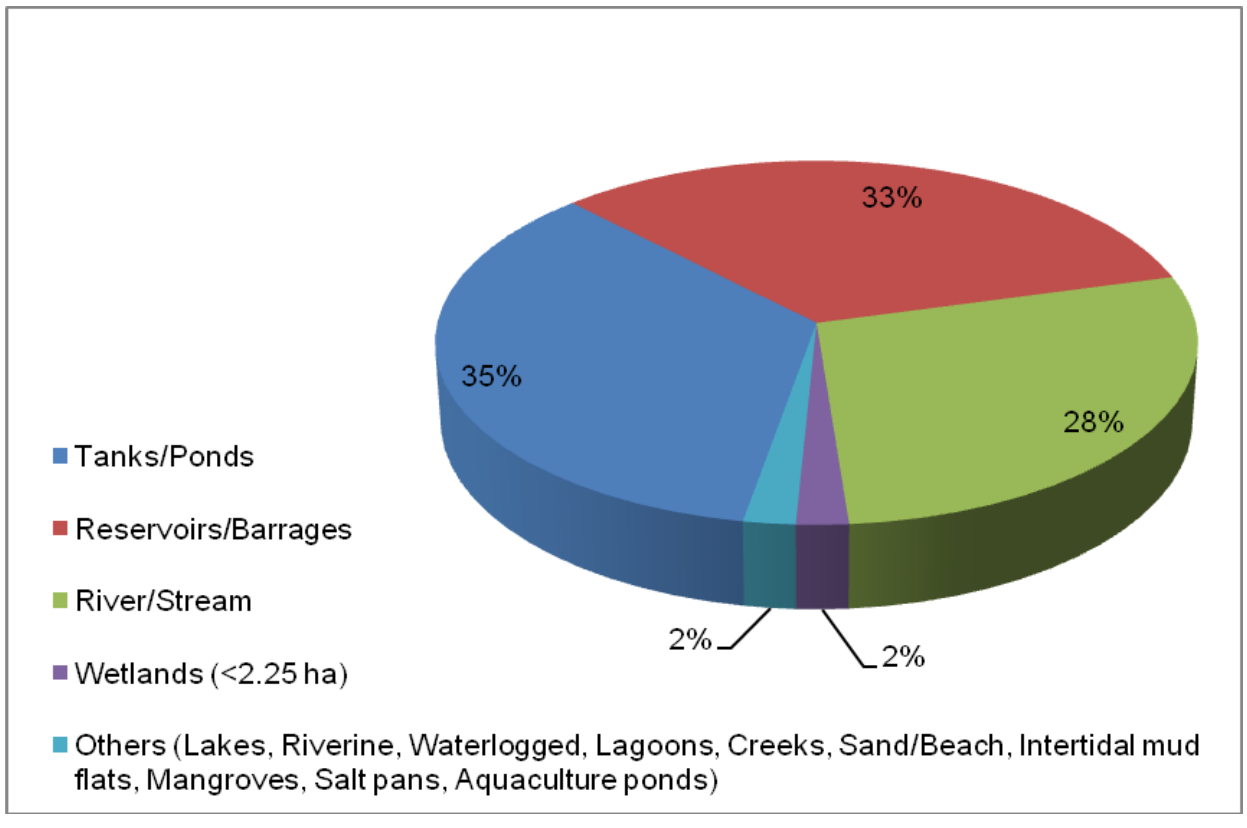



Figure 68: Type-wise wetland distribution in Karnataka

**District-wise wetland area estimates in Karnataka**

There are 27 districts in the state. District-wise distribution of wetlands shows that Dharwad, Kodagu and Gadag contribute less than one per cent to the total area under wetlands. On the other hand Uttara Kannada, Shimoga and Tumkur comprise 6 to 8 per cent of total area under wetlands (Table 93). Rest of them range in between 1 to 6 per cent. In terms of extent, Dharwad has least extent of wetlands (3965 ha) while Tumkur has highest area (50608 ha).

The seasonal change in wetland extent is least in Udupi (2 %) and highest in Koppal (80 %). Shiomga district ranked first in terms of open water spread (41254 ha) in post-monsoon while Uttar Kannada district registered highest (32070 ha) in pre-monsoon season. Wetland type river/stream and tank/pond are found in all districts. Tumkur has highest share of area under tank/pond (45130 ha). Daksina Kannada has least area under tank/pond type (50 ha). Reservoir/Barrage is found in all districts except Haveri, Udipi and Kolar districts. Shimoga has the largest extent of area under reservoir/barrage type (33840 ha), followed by Bagalkote (28223 ha).

Details of wetland statistics in terms of area, open water, aquatic vegetation found in each district is shown in Table 91, while Table 92 shows type wise distribution of wetlands in each district. District-wise distribution of wetlands is depicted graphically in Figure 69.

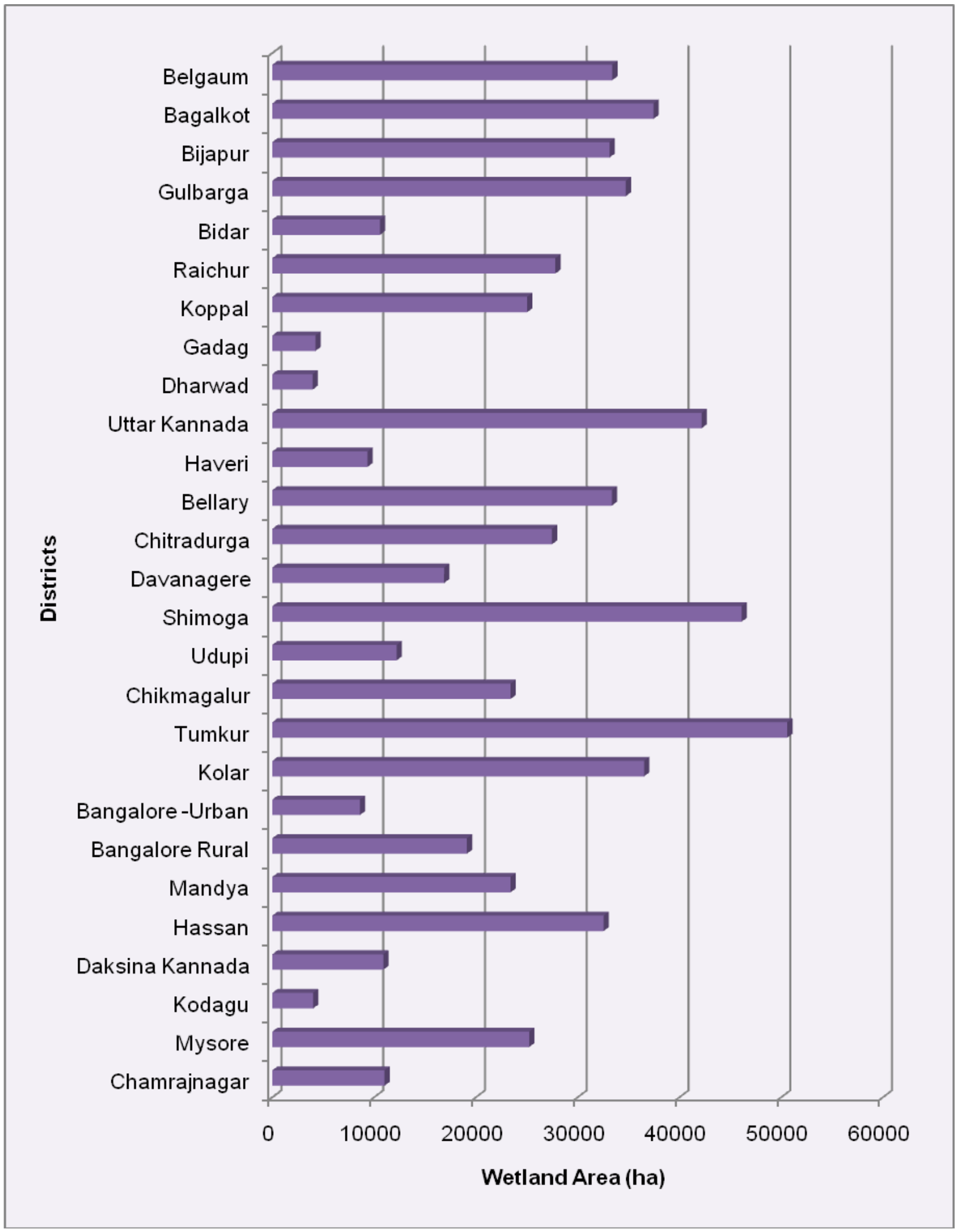



Figure 69: District-wise graphical distribution of wetlands in Karnataka

Table 91: District-wise area of wetlands in Karnataka

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Belgaum | 13415 | 33412 | 5.19 | 2.49 | 22090 | 13639 | 4190 | 5402 | - | 20625 | 1465 | 4282 | 8488 | 866 |
| 2 | Bagalkot | 6594 | 37470 | 5.82 | 5.68 | 34770 | 14577 | 879 | 1946 | 11950 | 22590 | 230 | 2133 | 12339 | 105 |
| 3 | Bijapur | 10475 | 33143 | 5.15 | 3.16 | 25935 | 12204 | 470 | 2962 | 2064 | 23196 | 675 | 4819 | 7379 | 6 |
| 4 | Gulbarga | 16224 | 34741 | 5.40 | 2.14 | 24484 | 20125 | 2791 | 1890 | 43 | 23473 | 968 | 4359 | 15766 | 3 |
| 5 | Bidar | 5448 | 10586 | 1.64 | 1.94 | 7697 | 5326 | 832 | 1115 | 377 | 7314 | 6 | 2404 | 2922 | - |
| 6 | Raichur | 5559 | 27820 | 4.32 | 5.00 | 22041 | 13270 | 1102 | 2810 | 467 | 21063 | 511 | 109 | 11909 | 1252 |
| 7 | Koppal | 8458 | 25046 | 3.89 | 2.96 | 20453 | 4011 | 1744 | 6386 | 3809 | 16434 | 210 | 1256 | 2694 | 61 |
| 8 | Gadag | 4657 | 4248 | 0.66 | 0.91 | 3579 | 2358 | 182 | 251 | 353 | 2288 | 938 | 118 | 1726 | 514 |
| 9 | Dharwad | 4230 | 3965 | 0.62 | 0.94 | 2603 | 2075 | 352 | 802 | - | 1723 | 880 | - | 1398 | 677 |
| 10 | Uttar Kannada | 10291 | 42190 | 6.56 | 4.10 | 35487 | 32070 | 3739 | 2885 | 1433 | 27446 | 6608 | 11827 | 18114 | 2129 |
| 11 | Haveri | 4851 | 9353 | 1.45 | 1.93 | 5704 | 3728 | 426 | 452 | 80 | 5112 | 512 | 9 | 3624 | 95 |
| 12 | Bellary | 8419 | 33372 | 5.19 | 3.96 | 28241 | 7640 | 1032 | 7402 | 4469 | 23176 | 596 | 517 | 6195 | 928 |
| 13 | Chitradurga | 8388 | 27486 | 4.27 | 3.28 | 14836 | 9137 | 8132 | 6588 | 1884 | 7112 | 5840 | 786 | 3168 | 5183 |
| 14 | Davanagere | 6018 | 16886 | 2.62 | 2.81 | 9171 | 6152 | 3262 | 2189 | 5255 | 3855 | 61 | 5 | 5907 | 240 |
| 15 | Shimoga | 8465 | 46131 | 7.17 | 5.45 | 41254 | 26184 | 1950 | 2915 | 3017 | 37625 | 612 | 5523 | 19446 | 1215 |
| 16 | Udupi | 3598 | 12226 | 1.90 | 3.40 | 9899 | 9739 | 1426 | 1264 | 897 | 8444 | 558 | 2605 | 4285 | 2849 |
| 17 | Chikmagalur | 7201 | 23420 | 3.64 | 3.25 | 18795 | 12188 | 3120 | 6560 | 12581 | 5384 | 830 | 6973 | 3643 | 1572 |
| 18 | Tumkur | 10598 | 50608 | 7.86 | 4.78 | 16873 | 12024 | 13787 | 11267 | 80 | 12475 | 4318 | 1102 | 8838 | 2084 |
| 19 | Kolar | 8223 | 36538 | 5.68 | 4.44 | 5823 | 3320 | 6498 | 8032 | 200 | 4611 | 1012 | 274 | 2394 | 652 |
| 20 | Bangalore -Urban | 2190 | 8620 | 1.34 | 3.94 | 2518 | 2254 | 2510 | 1674 | - | 2048 | 470 | 101 | 1749 | 404 |
| 21 | Bangalore Rural | 5815 | 19132 | 2.97 | 3.29 | 4205 | 3867 | 2603 | 3919 | 57 | 2679 | 1469 | 124 | 3080 | 663 |
| 22 | Mandya | 4961 | 23418 | 3.64 | 4.72 | 14009 | 9561 | 6075 | 8390 | 2073 | 9446 | 2490 | 1347 | 7937 | 277 |
| 23 | Hassan | 6814 | 32564 | 5.06 | 4.78 | 18590 | 11143 | 7253 | 11661 | 5265 | 10686 | 2639 | 556 | 9739 | 848 |
| 24 | Daksina Kannada | 4843 | 10911 | 1.70 | 2.25 | 9558 | 8344 | 803 | 431 | 10 | 9548 | - | 1766 | 5721 | 857 |
| 25 | Kodagu | 4102 | 4018 | 0.62 | 0.98 | 3024 | 2029 | 322 | 684 | 884 | 1846 | 294 | 224 | 1406 | 399 |
| 26 | Mysore | 6269 | 25243 | 3.92 | 4.03 | 21864 | 12410 | 576 | 6204 | 8284 | 11986 | 1594 | 6739 | 5442 | 229 |
| 27 | Chamrajnagar | 5685 | 11029 | 1.71 | 1.94 | 4418 | 3616 | 4762 | 1178 | 15 | 3988 | 415 | 191 | 3105 | 320 |
| | **Total** | **191791** | **643576** | **100.00** | **3.36** | **427921** | **262991** | **80818** | **107259** | **65547** | **326173** | **36201** | **60149** | **178414** | **24428** |

* Data Source: http://nic.in

Table 92: District-wise area of wetlands (type-wise) in Karnataka

| District code | District | Geographic area * | Wetland Type | | | | | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1104 | 1105 | 1106 | 1201 | 1202 | 1203 | 2101 | 2102 | 2103 | 2104 | 2106 | 2201 | 2202 | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Belgaum | 13415 | - | - | - | 9936 | 19213 | 3832 | - | - | - | - | - | - | - | - | 32981 | 431 | 33412 |
| 2 | Bagalkot | 6594 | - | - | - | 6817 | 28223 | 1719 | 583 | - | - | - | - | - | - | - | 37342 | 128 | 37470 |
| 3 | Bijapur | 10475 | - | - | - | 11626 | 17796 | 3619 | - | - | - | - | - | - | - | - | 33041 | 102 | 33143 |
| 4 | Gulbarga | 16224 | - | - | - | 22653 | 3385 | 8471 | - | - | - | - | - | - | - | - | 34509 | 232 | 34741 |
| 5 | Bidar | 5448 | - | 19 | - | 5259 | 2780 | 2441 | - | - | - | - | - | - | - | - | 10499 | 87 | 10586 |
| 6 | Raichur | 5559 | - | - | - | 19919 | 3335 | 3706 | 534 | - | - | - | - | - | - | - | 27494 | 326 | 27820 |
| 7 | Koppal | 8458 | - | - | - | 8376 | 15276 | 1233 | - | - | - | - | - | - | - | - | 24885 | 161 | 25046 |
| 8 | Gadag | 4657 | - | - | - | 2810 | 318 | 903 | - | - | - | - | - | - | - | - | 4031 | 217 | 4248 |
| 9 | Dharwad | 4230 | - | - | - | 660 | 568 | 2250 | 71 | - | - | - | - | - | - | - | 3549 | 416 | 3965 |
| 10 | Uttar Kannada | 10291 | 270 | 122 | 581 | 14458 | 18911 | 1294 | 19 | 22 | 60 | 989 | 1471 | 384 | 812 | 2227 | 41620 | 570 | 42190 |
| 11 | Haveri | 4851 | 138 | - | - | 4960 | - | 3660 | - | - | - | - | - | - | - | - | 8758 | 595 | 9353 |
| 12 | Bellary | 8419 | - | - | - | 10439 | 16801 | 5735 | - | - | - | - | - | - | - | - | 32975 | 397 | 33372 |
| 13 | Chitradurga | 8388 | 140 | - | - | 4360 | 7539 | 15070 | - | - | - | - | - | - | - | - | 27109 | 377 | 27486 |
| 14 | Davanagere | 6018 | - | - | - | 3851 | 748 | 12009 | - | - | - | - | - | - | - | - | 16608 | 278 | 16886 |
| 15 | Shimoga | 8465 | - | - | - | 5578 | 33840 | 5509 | - | - | - | - | - | - | - | - | 44927 | 1204 | 46131 |
| 16 | Udupi | 3598 | 50 | 605 | 702 | 8727 | - | 121 | 86 | 50 | 37 | 543 | 130 | 501 | - | 517 | 12069 | 157 | 12226 |
| 17 | Chikmagalur | 7201 | 20 | - | 10 | 3146 | 12389 | 6881 | 11 | - | - | - | - | - | - | - | 22457 | 963 | 23420 |
| 18 | Tumkur | 10598 | - | - | - | 2629 | 1700 | 45130 | - | - | - | - | - | - | - | - | 49459 | 1149 | 50608 |
| 19 | Kolar | 8223 | - | - | - | 1567 | - | 34221 | 153 | - | - | - | - | - | - | - | 35941 | 597 | 36538 |
| 20 | Bangalore -Urban | 2190 | - | - | - | 367 | 337 | 6825 | 766 | - | - | - | - | - | - | - | 8295 | 325 | 8620 |
| 21 | Bangalore Rural | 5815 | - | - | - | 2116 | 884 | 15757 | - | - | - | - | - | - | - | - | 18757 | 375 | 19132 |
| 22 | Mandya | 4961 | - | - | - | 5262 | 4797 | 12518 | 159 | - | - | - | - | - | - | - | 22736 | 682 | 23418 |
| 23 | Hassan | 6814 | - | - | - | 4197 | 7945 | 18071 | - | - | - | - | - | - | - | - | 30213 | 2351 | 32564 |
| 24 | Daksina Kannada | 4843 | 20 | 305 | 611 | 9073 | 159 | 50 | - | - | - | 365 | 62 | 82 | - | 35 | 10762 | 149 | 10911 |
| 25 | Kodagu | 4102 | - | - | - | 1667 | 1972 | 197 | - | - | - | - | - | - | - | - | 3836 | 182 | 4018 |
| 26 | Mysore | 6269 | - | - | - | 5237 | 13699 | 5239 | - | - | - | - | - | - | - | - | 24175 | 1068 | 25243 |
| 27 | Chamrajnagar | 5685 | - | - | 141 | 4041 | 912 | 5569 | 21 | - | - | - | - | - | - | - | 10684 | 345 | 11029 |
| | **Total** | **191791** | **638** | **1051** | **2045** | **179731** | **213527** | **222030** | **2403** | **72** | **97** | **1897** | **1663** | **967** | **812** | **2779** | **629712** | **13864** | **643576** |

* Data Source: http://nic.in

1101 Lake/Pond
1102 Ox-bow lake/ Cut-off meander
1103 High altitude wetland
1104 Riverine wetland
1105 Waterlogged (Natural)
1106 River/Stream

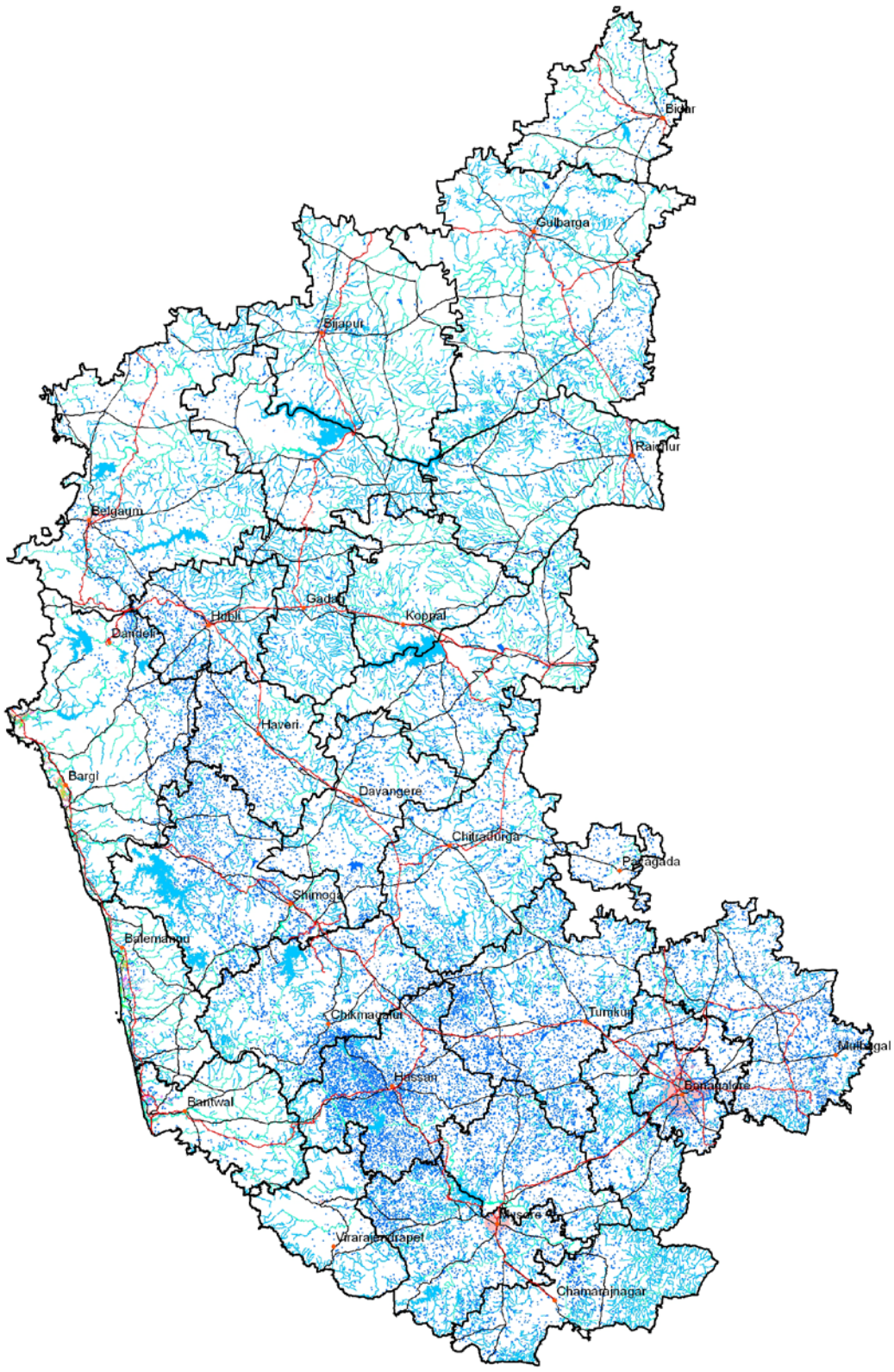
1201 Reservoir/Barrage
1202 Tank/Pond
1203 Waterlogged (Man-made)
1204 Salt pan (Inland)

2101 Lagoon
2102 Creek
2103 Sand/Beach
2104 Intertidal mud flat
2105 Salt Marsh (Coastal)
2106 Mangrove
2107 Coral Reef

2201 Salt pan
2202 Aquaculture pond

State : Karnataka

## WETLAND MAP

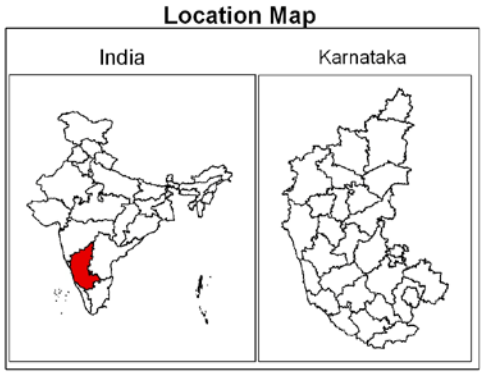



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Riverine wetlands |
| | 1105 | | | Waterlogged |
| | 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
- Canal
- Railway
- Drainage (line)
- Roads
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

**Location Map**




0 30 60 120 Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Karnataka State Remote Sensing Applications Centre (KSRSAC)
Dept. of IT, BT & S&T, GOK, Bangalore, Karnataka

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 52: Wetland map of Karnataka

### 8.1.30 Goa

In the state of Goa 383 wetlands have been delineated. In addition, 167 wetlands smaller than 2.25 ha have also been discerned. Total wetland area estimated is 21337 ha. (Table 93). The major wetland types are river/stream (9362 ha), inter tidal mud flat (3286 ha), salt pan (2929 ha), reservoir/barrage (2363 ha) and mangrove (1752 ha). Graphical distribution of wetland type is shown in Figure 70. Wetland map of the state is shown in Plate 53.

Table 93: Area estimates of wetlands in Goa

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 | Lake/Pond | 20 | 499 | 2.34 | 499 | 499 |
| 2 | 1102 | Ox-bow lake/Cut-off meander | 1 | 6 | 0.03 | 6 | 6 |
| 3 | 1106 | River/Stream | 8 | 9362 | 43.88 | 9362 | 9362 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 4 | 1201 | Reservoir/Barrage | 2 | 2363 | 11.07 | 2363 | 2363 |
| 5 | 1202 | Tank/Pond | 62 | 396 | 1.86 | 396 | 396 |
| 6 | 1203 | Waterlogged | 1 | 17 | 0.08 | 17 | 17 |
| 7 | 1204 | Salt pan | 7 | 41 | 0.19 | 41 | 41 |
| | | **Total - Inland** | **101** | **12684** | **59.45** | **12684** | **12684** |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 8 | 2103 | Sand/Beach | 50 | 519 | 2.43 | - | - |
| 9 | 2104 | Intertidal mud flat | 51 | 3286 | 15.40 | 3286 | 3286 |
| 10 | 2106 | Mangrove | 111 | 1752 | 8.21 | - | - |
| | **2200** | **Coastal Wetlands - Man-made** | | | | | |
| 11 | 2201 | Salt pan | 70 | 2929 | 13.73 | 2929 | 2929 |
| | | **Total - Coastal** | **282** | **8486** | **39.77** | **6215** | **6215** |
| | | **Sub-Total** | **383** | **21170** | **99.22** | **18899** | **18899** |
| | | Wetlands (<2.25 ha) | 167 | 167 | 0.78 | - | - |
| | | **Total** | **550** | **21337** | **100.00** | **18899** | **18899** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 1752 | 1752 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 2363 | 2363 |
| Moderate | 10280 | 10280 |
| High | 6256 | 6256 |

### District-wise wetland area estimates in Goa

The state has two districts. District-wise wetland area estimates is given in Table 94 and graphical distribution of wetlands is shown in Figure 71. District-wise area of wetlands (type-wise) in the state is given in Table 95.

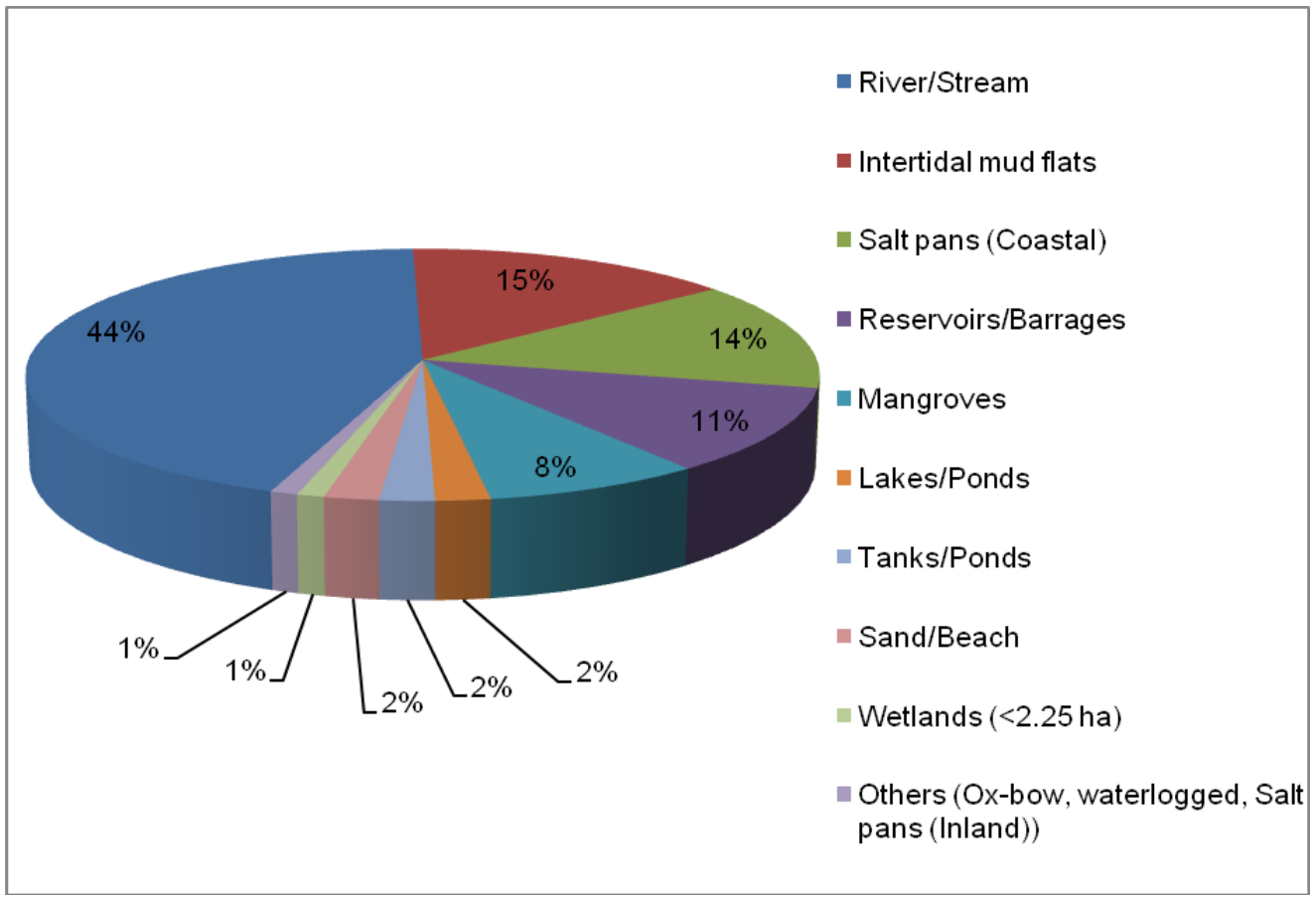



Figure 70: Type-wise wetland distribution in Goa

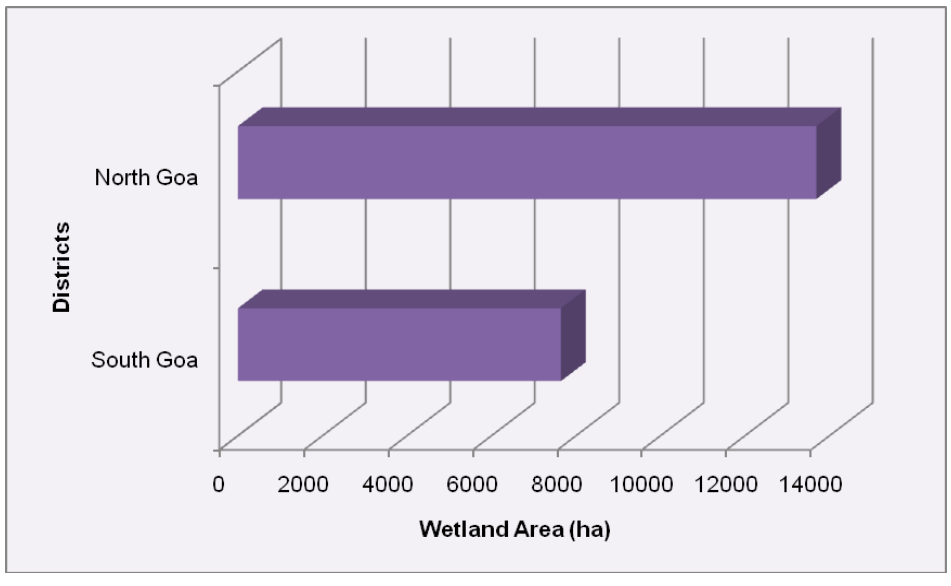



Figure 71: District-wise graphical distribution of wetlands in Goa

Table 94: District-wise area of wetlands in Goa

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | North Goa | 1736 | 13693 | 64.18 | 7.89 | 11682 | 11682 | 1587 | 1587 | 213 | 6953 | 4516 | 213 | 6953 | 4516 |
| 2 | South Goa | 1966 | 7644 | 35.82 | 3.89 | 7217 | 7217 | 165 | 165 | 2150 | 3327 | 1740 | 2150 | 3327 | 1740 |
| | **Total** | **3702** | **21337** | **100.00** | **5.76** | **18899** | **18899** | **1752** | **1752** | **2363** | **10280** | **6256** | **2363** | **10280** | **6256** |

* Data Source: http://nic.in

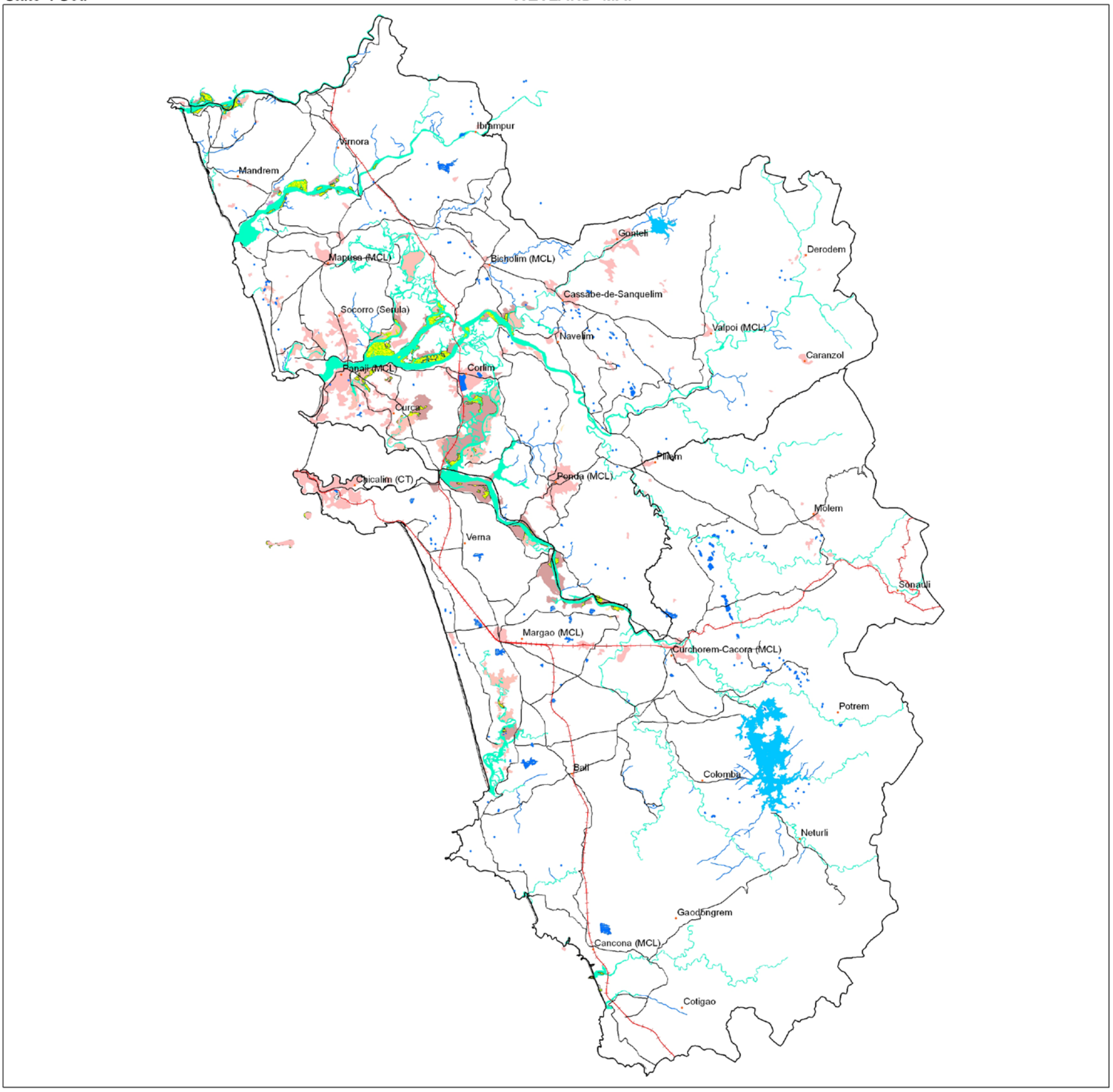
Table 95: District-wise area of wetlands (type-wise) in Goa

| District code | District | Geographic area * | Wetland Type | | | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1102 | 1106 | 1201 | 1202 | 1203 | 1204 | 2103 | 2104 | 2106 | 2201 | | | |
| | | | Lake/ pond | Ox-bow lake/ Cut-off meander | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Waterlogged (Man-made) | Salt pan | Sand/ Beach | Intertidal mud flat | Mangrove | Salt pan | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | North Goa | 1736 | 122 | - | 6636 | 213 | 178 | 17 | 13 | 332 | 2133 | 1587 | 2370 | 13601 | 92 | 13693 |
| 2 | South Goa | 1966 | 377 | 6 | 2726 | 2150 | 218 | - | 28 | 187 | 1153 | 165 | 559 | 7569 | 75 | 7644 |
| | **Total** | **3702** | **499** | **6** | **9362** | **2363** | **396** | **17** | **41** | **519** | **3286** | **1752** | **2929** | **21170** | **167** | **21337** |

* Data Source: http://nic.in

State : Goa

## WETLAND MAP

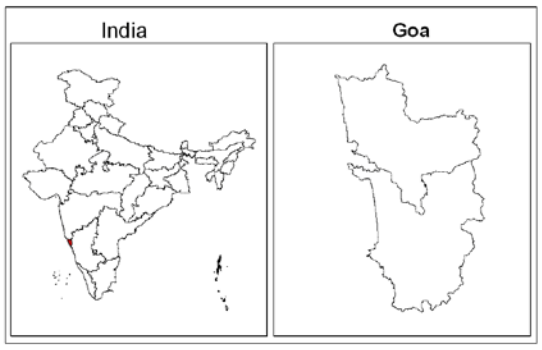



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Riverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 3 6 12 18 24 Kilometers

**Data Source :**

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

**Prepared By :**

Space Applications Centre (ISRO), Ahmedabad
and
Centre for Studies in Resources Engineering(CSRE), Mumbai

**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 53: Wetland map of Goa

### 8.1.31 Lakshadweep

In Lakshadweep 48 wetlands have been delineated. Total wetland area estimated is 79586 ha. Coastal-natural wetlands are the only wetlands in these islands. There are only three wetland types namely; coral, lagoon and sand/beach. The details of type-wise aerial extents of wetland is given in the Table 96 and pictorially depicted in Figure 72. Wetland map of the state is shown in Plate 54.

Table 96: Area estimates of wetlands in Lakshadweep

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 |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 1 | 2101 | Lagoon | 15 | 23674 | 29.75 | 23674 | 23674 |
| 2 | 2103 | Sand/Beach | 18 | 733 | 0.92 | - | - |
| 3 | 2107 | Coral | 15 | 55179 | 69.33 | - | - |
| | | **Sub-Total** | **48** | **79586** | **100.00** | **23674** | **23674** |
| | | Wetlands (<2.25 ha) | - | - | - | - | - |
| | | **Total** | **48** | **79586** | **100.00** | **23674** | **23674** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | - | - |

| | | |
|---|---|---|
| **Area under turbidity levels** | | |
| Low | 23674 | 23674 |
| Moderate | - | - |
| High | - | - |

Corals are the most dominating of the three wetland types and accounts for 55179 ha of area that amounts to 69 % of wetland area in Lakshadweep. Out of the three types of corals; atolls predominate the islands of Lakshadweep. Atolls rest on the summits of submerged volcanoes and usually are oval or circular in shape with a central lagoon. Almost all the atolls of Lakshadweep are oriented northeast-southwest with an island towards the east, a broad, well developed reef to the west and a lagoon in between. There are two uncharted atolls namely; Cheriyapaniyam and Baliyapaniayam which were not shown in the Survey of India topographical maps were mapped. The coral diversity is good comprising 70 species belonging to 26 genera. Of these 36 species were added latter to the inventory of Minicoy. Several types of primary producers may be observed in the coral ecosystem. Benthic macroalgae such as sea grasses are the prolific primary producers on lagoon floor at Karavatti Island.

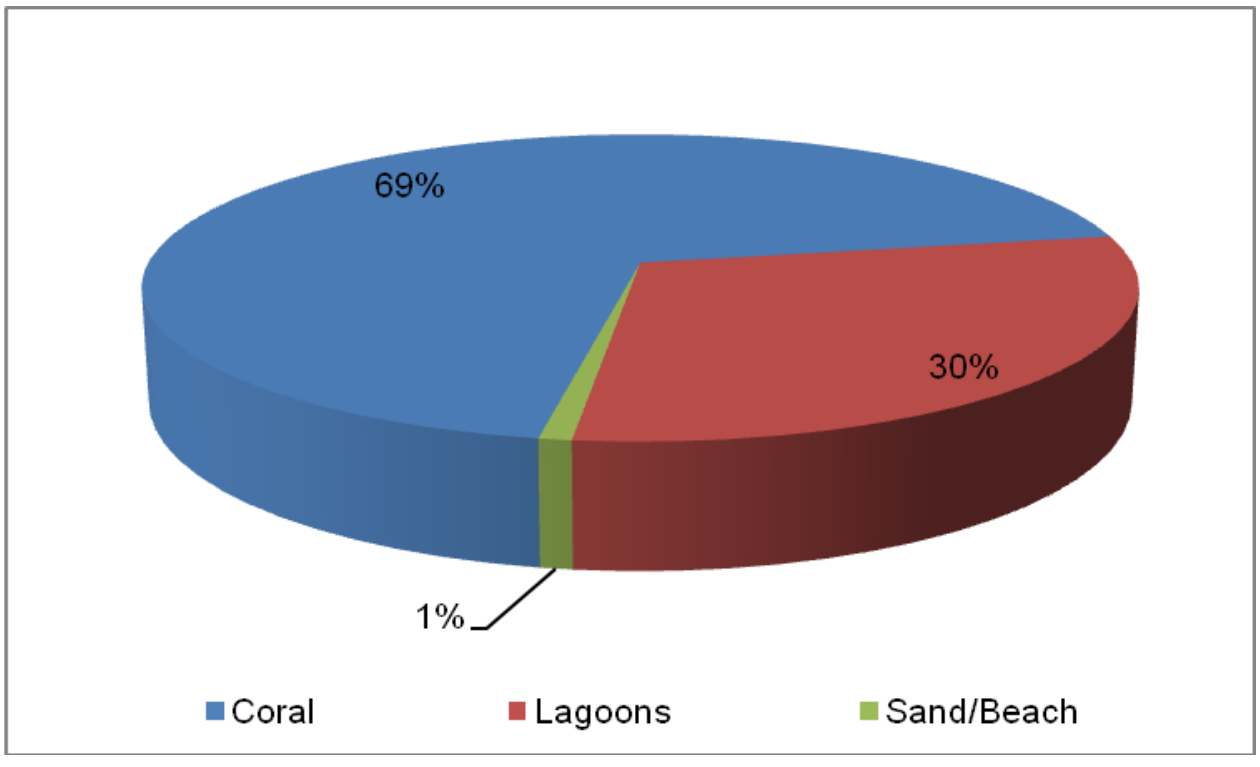


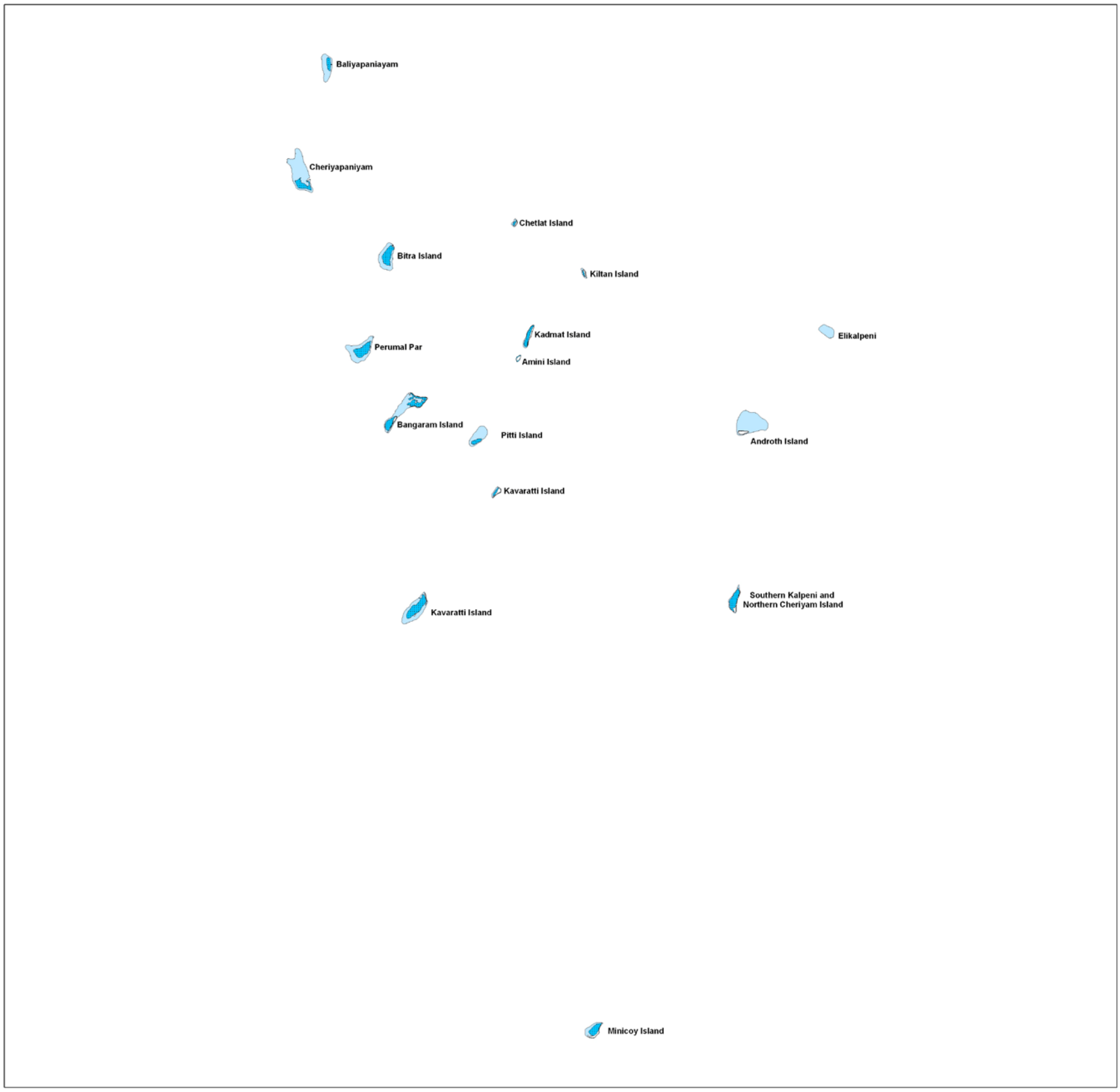

Figure 72: Type-wise wetland distribution in Lakshadweep

Lagoon stands next to coral comprising 23674 ha of area. It accounts for 30 % of wetland area. In Lakshdweep the lagoons are very different from the mainland in the sense that they are actually coral reef lagoons wherein the water body gets enclosed in an atoll or within a barrier reef. The depth of the lagoon is appreciable and available literature indicates that the floor of these lagoons mainly contain the coral debris and calcareous sand (Gazetter of India, 1977; Anon., 1987). The smaller lagoons of Chetlat, Kiltan, Amini and Kadmat are substantially filled with sediments and show an average depth of 1 – 2.5 m while the larger ones like Bangaram, Suheli Par and Minicoy are devoid of sediments and show greater depth ranging from 10-16 m. followed by sand/beach (733 ha). The lagoons are the only category considered for open water spread in pre-monsoon and post-monsoon. The open water spread (23674 ha) of lagoons remained unchanged in both the seasons owing to their contact with the sea, which allows movement water perpetually. The qualitative turbidity remained low in both seasons indicating the tranquility of lagoons on these islands. Further, the absence of aquatic vegetation adds to the clarity of water.

The sand/beach is the third type of wetlands found in the area. In Lakshadweep these sandy beaches are characteristically located on windward side. On the other side the sandy beaches experience the vagaries of monsoon. These beaches comprise vegetation mainly *Ipomea batatas*, *Ipomea pescaprae*, *Cochorus aestuans*, *Eragrostis tenella*, *Digitaria adscandes*, *Dactyloctenium aegyptium* and *Casurina equselifolia*. sand/beach accounts for ~1 % of wetland area comprising 733 ha out of 79586 ha.

UT : Lakshdweep Islands

# WETLAND MAP

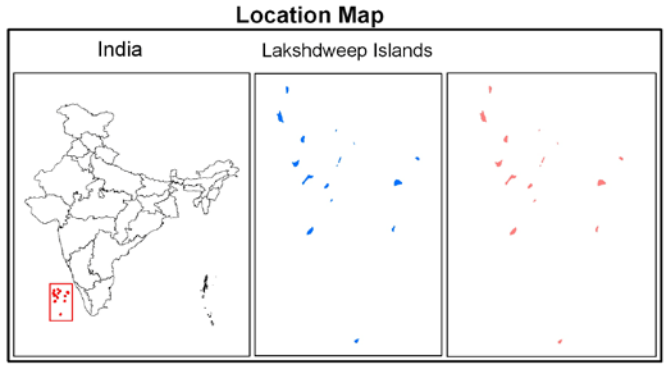



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Roads
- Drainage (line)
- Settlements
- Town/Settlements

**Location Map**




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

**Prepared By :**
Space Applications Centre (ISRO), Ahmedabad

**Sponsored By:**
Ministry of Environment and Forests
Government of India

Plate 54: Wetland map of Lakshadweep

### 8.1.32 Kerala

In the state of Kerala 1762 wetlands have been delineated. In addition, 2592 small wetlands (< 2.25 ha) have also been identified. Total wetland area estimated is 160590 ha (Table 97). The major wetland types are river/stream (65162 ha), lagoon (38442 ha), reservoir/barrage (26167 ha) and waterlogged (20305 ha). Graphical distribution of wetland type is shown in Figure 73. Wetland map of the state is shown in Plate 55.

Analysis of wetland status in terms of open water and aquatic vegetation showed that around 88 and 83 per cent of wetland area is under open water category during post-monsoon and pre-monsoon respectively. Aquatic vegetation (floating/emergent) occupies around 8 and 6 per cent of wetland area during post and pre-monsoon respectively.

Table 97: Area estimates of wetlands in Kerala

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 | Lake/Pond | 3 | 2643 | 1.65 | 2259 | 2125 |
| 2 | 1104 | Riverine wetland | 18 | 410 | 0.26 | 410 | 410 |
| 3 | 1105 | Waterlogged | 922 | 20305 | 12.64 | 11495 | 7771 |
| 4 | 1106 | River/Stream | 172 | 65162 | 40.58 | 61853 | 60338 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 5 | 1201 | Reservoir/Barrage | 39 | 26167 | 16.29 | 24583 | 23421 |
| 6 | 1202 | Tank/Pond | 439 | 2435 | 1.52 | 1466 | 530 |
| | | **Total - Inland** | **1593** | **117122** | **72.93** | **102066** | **94595** |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 7 | 2101 | Lagoon | 39 | 38442 | 23.94 | 36819 | 35796 |
| 8 | 2102 | Creek | 19 | 80 | 0.05 | 77 | 77 |
| 9 | 2103 | Sand/Beach | 111 | 2354 | 1.47 | - | - |
| | | **Total - Coastal** | **169** | **40876** | **25.45** | **36896** | **35873** |
| | | **Sub-Total** | **1762** | **157998** | **98.39** | **138962** | **130468** |
| | | Wetlands (<2.25 ha) | 2592 | 2592 | 1.61 | - | - |
| | | **Total** | **4354** | **160590** | **100.00** | **138962** | **130468** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 13364 | 8925 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 102026 | 94722 |
| Moderate | 36501 | 35119 |
| High | 435 | 627 |

**District-wise wetland area estimates in Kerala**

The state has fourteen districts. District-wise distribution of wetlands showed that four districts can be called as wetland rich. Alappuzha has highest concentration with 26079 ha area under wetland. This is mainly due to the location of the famous Vembnad kol wetland. The other three districts are Ernakulam (25065 ha), Kollam (13703 ha) and Thrissur (13285 ha). Wayanad district has the lowest area under wetland (3866 ha). District-wise wetland area estimate is given in Table 98. Figure 74 shows district-wise graphical distribution of wetlands. District-wise area of wetlands (type-wise) in the state is given in Table 99.

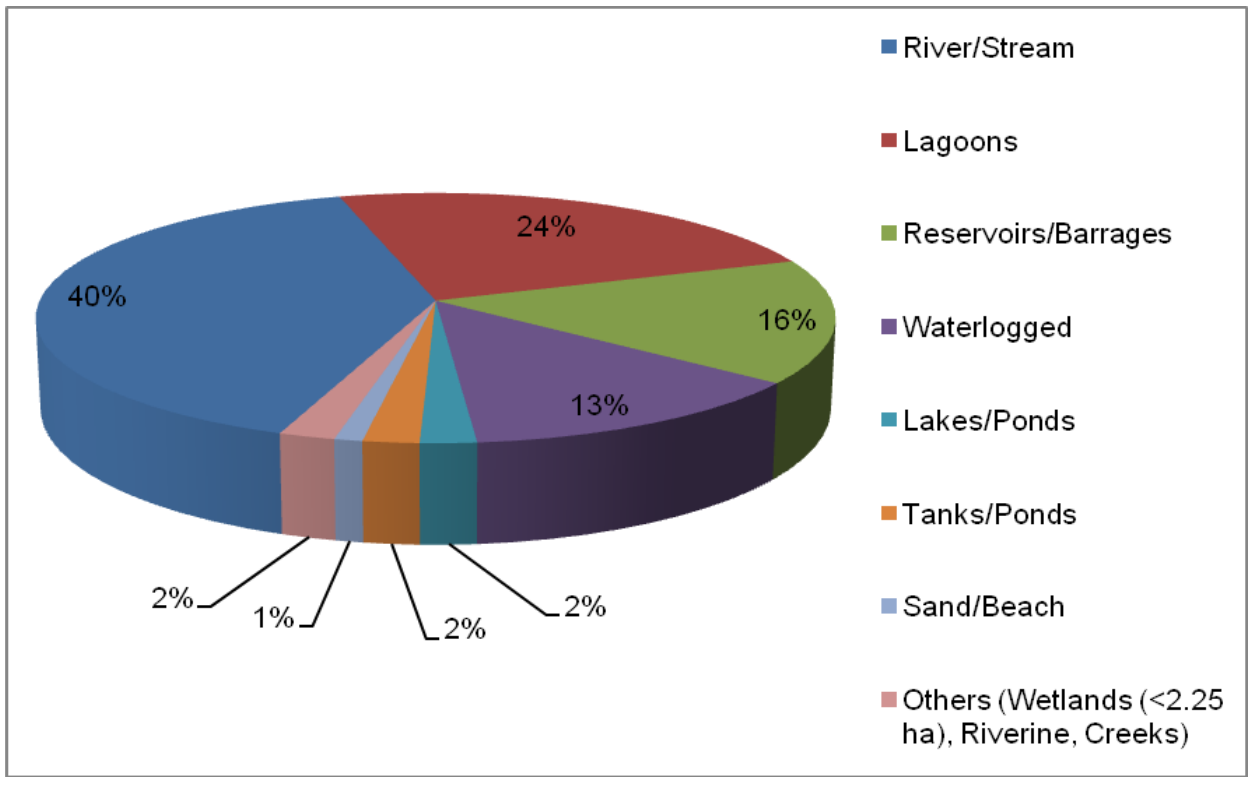



Figure 73: Type-wise wetland distribution in Kerala

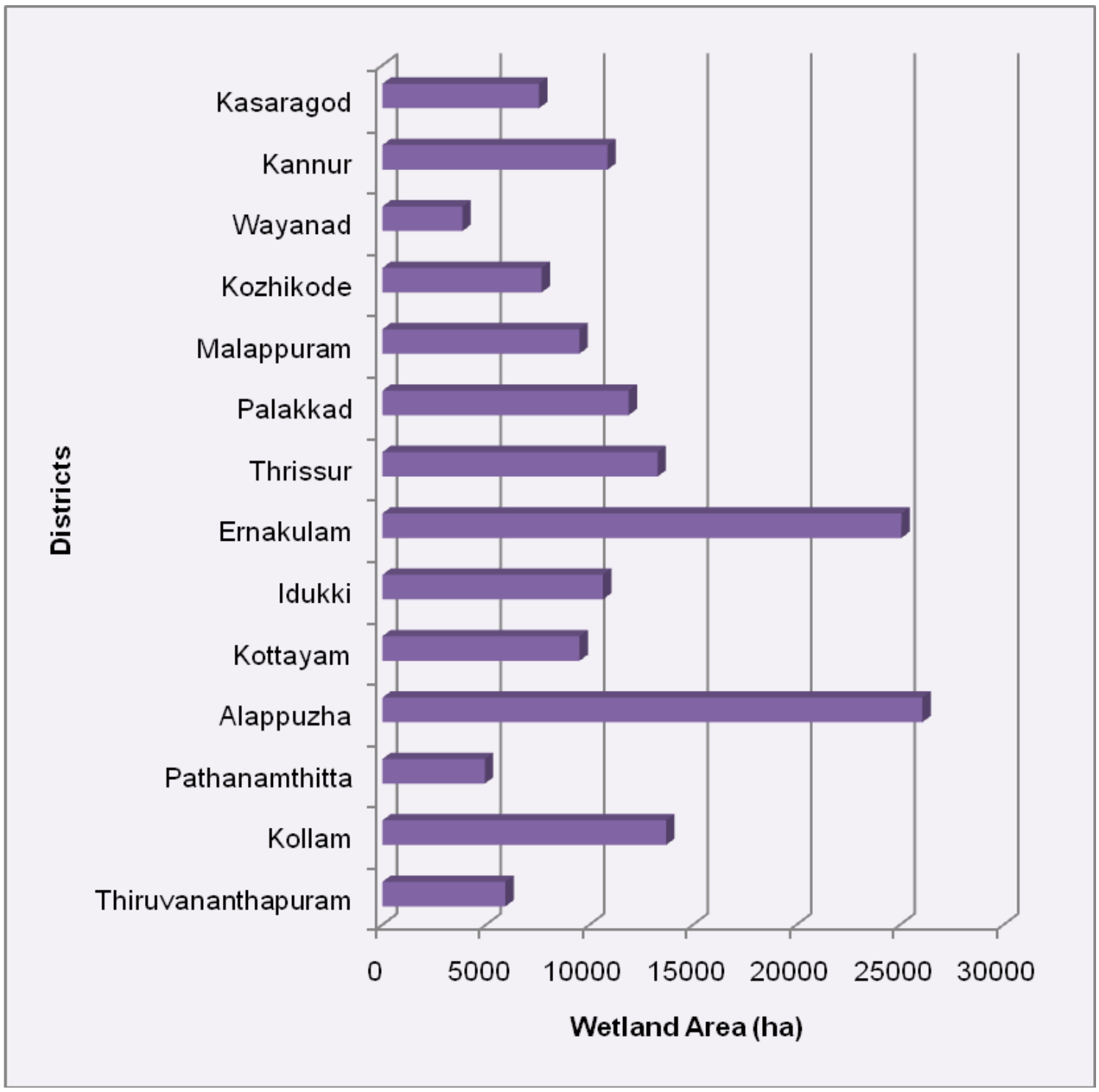



Figure 74: District-wise graphical distribution of wetlands in Kerala

Table 98: District-wise area of wetlands in Kerala

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Kasaragod | 1961 | 7561 | 4.71 | 3.86 | 6441 | 5901 | 159 | 93 | 411 | 6030 | - | 254 | 5647 | - |
| 2 | Kannur | 2997 | 10870 | 6.77 | 3.63 | 9158 | 8948 | 1194 | 639 | 7186 | 1972 | - | 7138 | 1810 | - |
| 3 | Wayanad | 2132 | 3866 | 2.41 | 1.81 | 3508 | 3224 | 328 | 163 | 3502 | 6 | - | 2733 | 491 | - |
| 4 | Kozhikode | 2345 | 7690 | 4.79 | 3.28 | 6901 | 6842 | 388 | 249 | 6699 | 202 | - | 6666 | 176 | - |
| 5 | Malappuram | 3548 | 9511 | 5.92 | 2.68 | 6851 | 5906 | 948 | 1086 | 6293 | 558 | - | 5609 | 297 | - |
| 6 | Palakkad | 4480 | 11892 | 7.41 | 2.65 | 9977 | 9053 | 247 | 161 | 8829 | 948 | 200 | 7847 | 1006 | 200 |
| 7 | Thrissur | 3032 | 13285 | 8.27 | 4.38 | 10948 | 8970 | 1504 | 595 | 8933 | 2015 | - | 7491 | 1479 | - |
| 8 | Ernakulam | 2408 | 25065 | 15.61 | 10.41 | 23331 | 22776 | 1334 | 1450 | 18736 | 4595 | - | 15782 | 6994 | - |
| 9 | Idukki | 4998 | 10655 | 6.63 | 2.13 | 10096 | 9816 | 469 | 133 | 7153 | 2943 | - | 7034 | 2782 | - |
| 10 | Kottayam | 2204 | 9523 | 5.93 | 4.32 | 9086 | 9042 | 401 | 129 | 6894 | 2192 | - | 6852 | 2190 | - |
| 11 | Alappuzha | 1256 | 26079 | 16.24 | 20.76 | 21756 | 19753 | 4182 | 2642 | 11768 | 9988 | - | 11438 | 8315 | - |
| 12 | Pathanamthitta | 2731 | 4948 | 3.08 | 1.81 | 4345 | 4000 | 413 | 246 | 3343 | 1002 | - | 3179 | 821 | - |
| 13 | Kollam | 2579 | 13703 | 8.53 | 5.31 | 12155 | 12157 | 1301 | 1050 | 10174 | 1981 | - | 10260 | 1814 | 83 |
| 14 | Thiruvananthapuram | 2192 | 5942 | 3.70 | 2.71 | 4409 | 4080 | 496 | 289 | 2105 | 2069 | 235 | 2439 | 1297 | 344 |
| | **Total** | **38863** | **160590** | **100.00** | **4.13** | **138962** | **130468** | **13364** | **8925** | **102026** | **36501** | **435** | **94722** | **35119** | **627** |

* Data Source: http://nic.in

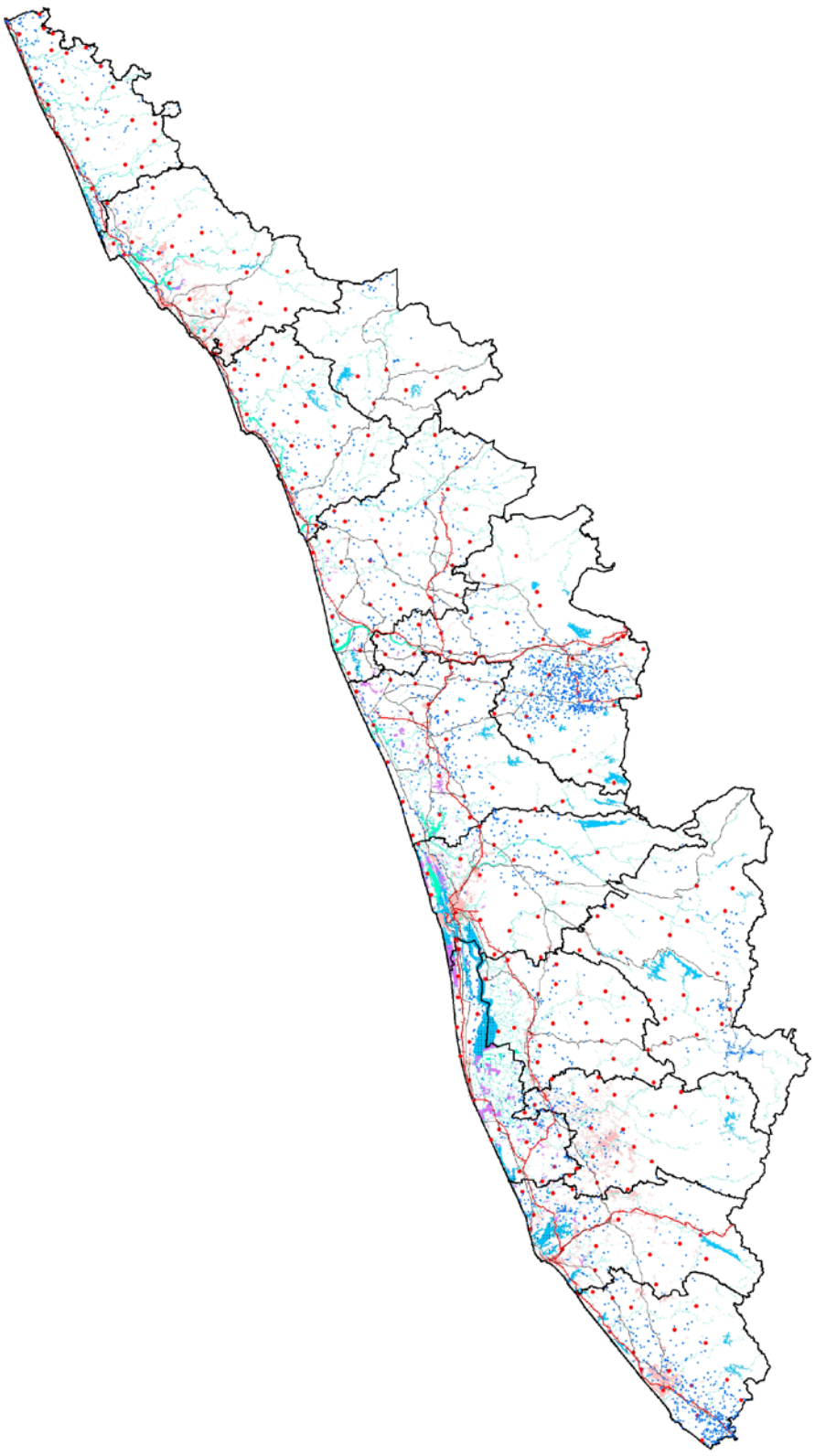
Table 99: District-wise area of wetlands (type-wise) in Kerala

| District code | District | Geographic area * | Wetland Type | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1104 | 1105 | 1106 | 1201 | 1202 | 2101 | 2102 | 2103 | | | |
| | | | Lake/ pond | Riverine wetland | Waterlogged (Natural) | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Lagoon | Creek | Sand/ Beach | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Kasaragod | 1961 | - | - | 155 | 5007 | - | 35 | 1775 | - | 443 | 7415 | 146 | 7561 |
| 2 | Kannur | 2997 | - | 316 | 1544 | 7590 | 553 | 66 | 434 | - | 310 | 10813 | 57 | 10870 |
| 3 | Wayanad | 2132 | - | - | 10 | 1837 | 1946 | 37 | - | - | - | 3830 | 36 | 3866 |
| 4 | Kozhikode | 2345 | - | 94 | 161 | 5514 | 1261 | 277 | - | 18 | 248 | 7573 | 117 | 7690 |
| 5 | Malappuram | 3548 | - | - | 832 | 6979 | - | 232 | 1012 | - | 281 | 9336 | 175 | 9511 |
| 6 | Palakkad | 4480 | - | - | 245 | 5270 | 5477 | 178 | - | - | - | 11170 | 722 | 11892 |
| 7 | Thrissur | 3032 | - | - | 2990 | 6451 | 3027 | 294 | 4 | - | 248 | 13014 | 271 | 13285 |
| 8 | Ernakulam | 2408 | - | - | 4662 | 8729 | 3448 | 84 | 7898 | - | 111 | 24932 | 133 | 25065 |
| 9 | Idukki | 4998 | 2042 | - | 25 | 2776 | 5613 | 107 | - | - | - | 10563 | 92 | 10655 |
| 10 | Kottayam | 2204 | - | - | 405 | 3826 | - | 30 | 5196 | - | - | 9457 | 66 | 9523 |
| 11 | Alappuzha | 1256 | - | - | 7753 | 4558 | - | 476 | 13017 | 62 | 84 | 25950 | 129 | 26079 |
| 12 | Pathanamthitta | 2731 | - | - | 201 | 2955 | 1440 | 223 | - | - | - | 4819 | 129 | 4948 |
| 13 | Kollam | 2579 | 354 | - | 1281 | 2080 | 1901 | 292 | 7575 | - | 86 | 13569 | 134 | 13703 |
| 14 | Thiruvananthapuram | 2192 | 247 | - | 41 | 1590 | 1501 | 104 | 1531 | - | 543 | 5557 | 385 | 5942 |
| | **Total** | **38863** | **2643** | **410** | **20305** | **65162** | **26167** | **2435** | **38442** | **80** | **2354** | **157998** | **2592** | **160590** |

* Data Source: http://nic.in

State : Kerala

## WETLAND MAP

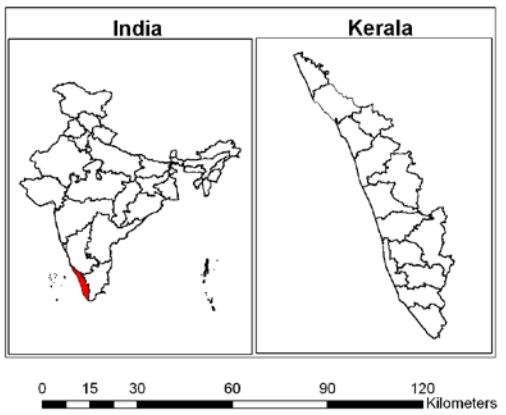


| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Riverine wetlands |
| | 1105 | | | Waterlogged |
| | 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
Kerala State Remote Sensing and Environment Centre, Thiruvananthapuram

**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 55: Wetland map of Kerala

### 8.1.33 Tamil Nadu

Total 24684 wetlands have been mapped at 1:50,000 scale in the state. In addition, 18294 small wetlands (< 2.25 ha) have also been identified. Total wetland area estimated is 902534 ha that is around 6.92 per cent of the geographic area (Table 100). The major wetland types are lake/pond (316091 ha), tank/pond (237613 ha), river/stream (136878 ha), and reservoir/barrage (56419 ha). Area under mangrove is around 7315 ha. Coral Reef (3899 ha) exists mainly in Ramnathpuram district. Graphical distribution of wetland type is shown in Figure 75. Wetland map of the state is shown in Plate 56.

Aquatic vegetation is observed in lake/pond and tank/pond. The area under aquatic vegetation is more during pre-monsoon (531600 ha) than that of post-monsoon (167273 ha). The open water spread significantly lower during pre-monsoon (296268 ha) compared to post-monsoon (657861 ha).

Table 100: Area estimates of wetlands in Tamil Nadu

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 | Lake/Pond | 4369 | 316091 | 35.02 | 236456 | 45436 |
| 2 | 1104 | Riverine wetland | 2 | 127 | 0.01 | 121 | 41 |
| 3 | 1105 | Waterlogged | 44 | 3928 | 0.44 | 3382 | 2168 |
| 4 | 1106 | River/Stream | 194 | 136878 | 15.17 | 131049 | 131479 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 5 | 1201 | Reservoir/Barrage | 99 | 56419 | 6.25 | 46443 | 31064 |
| 6 | 1202 | Tank/Pond | 19343 | 237613 | 26.33 | 164346 | 23078 |
| 7 | 1203 | Waterlogged | 38 | 10811 | 1.20 | 9353 | 5816 |
| | | **Total - Inland** | **24089** | **761867** | **84.41** | **591150** | **239082** |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 8 | 2101 | Lagoon | 74 | 25057 | 2.78 | 25041 | 22034 |
| 9 | 2102 | Creek | 17 | 3404 | 0.38 | 3339 | 3403 |
| 10 | 2103 | Sand/Beach | 73 | 9798 | 1.09 | - | - |
| 11 | 2104 | Intertidal mud flat | 84 | 33164 | 3.67 | - | - |
| 12 | 2105 | Salt Marsh | 42 | 6108 | 0.68 | 5369 | 2596 |
| 13 | 2106 | Mangrove | 78 | 7315 | 0.81 | - | - |
| 14 | 2107 | Coral Reef | 36 | 3899 | 0.43 | - | - |
| | **2200** | **Coastal Wetlands - Man-made** | | | | | |
| 15 | 2201 | Salt pan | 47 | 22889 | 2.54 | 22505 | 19733 |
| 16 | 2202 | Aquaculture pond | 144 | 10739 | 1.19 | 10457 | 9420 |
| | | **Total - Coastal** | **595** | **122373** | **13.56** | **66711** | **57186** |
| | | **Sub-Total** | **24684** | **884240** | **97.97** | **657861** | **296268** |
| | | Wetlands (<2.25 ha) | 18294 | 18294 | 2.03 | - | - |
| | | **Total** | **42978** | **902534** | **100.00** | **657861** | **296268** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 167273 | 531600 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 314273 | 70189 |
| Moderate | 247677 | 159206 |
| High | 95911 | 66873 |

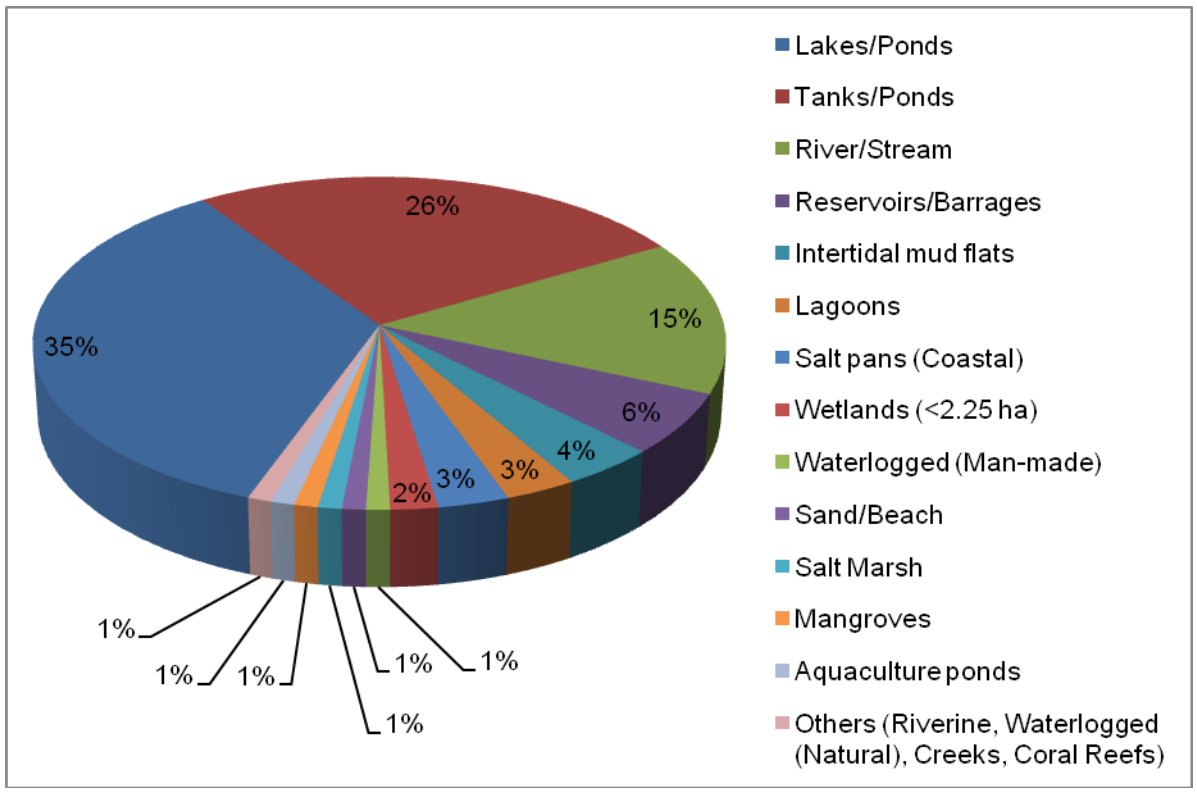



Figure 75: Type-wise wetland distribution in Tamil Nadu

**District-wise wetland area estimates in Tamil Nadu**

There are 30 districts. The geographic area of the districts varies from 178 sq.km (Chennai) to 8162 sq.km (Erode). The wetlands occupy as high as 18.05% of geographic area (Ramnathpuram district), and as low as 1.08% (Coimbatore). In terms of total wetland area (% wetland area), Kancheepuram is the leading district (80445 ha, 8.91%) and Chennai has the least area under wetlands (917 ha, 0.10 %).

District-wise wetland area estimates is given in Table 101 and graphical distribution of wetlands is shown in Figure 76. District-wise area of wetlands (type-wise) in the state is given in Table 102.

Lake/Pond and tank/pond are the dominate wetland types found in all the districts. Pudukkottai district has the highest area under lake/pond (38966 ha) as well as tank/pond ( 26419 ha). In coastal areas, lagoon, inter tidal mudflat and salt pan are the dominating wetland types. Lagoons are observed in eight districts, Thiruvallur district leading in area. Salem district leads in area under reservoir/barrage. Coral Reef is observed only in two districts: Ramanathapuram and Thoothukkudi. Mangrove type is observed in eleven districts, Nagapattinam district having the largest aerial extent. Eleven districts have aquaculture ponds, Nagapattinam district leading with 4129 ha area.

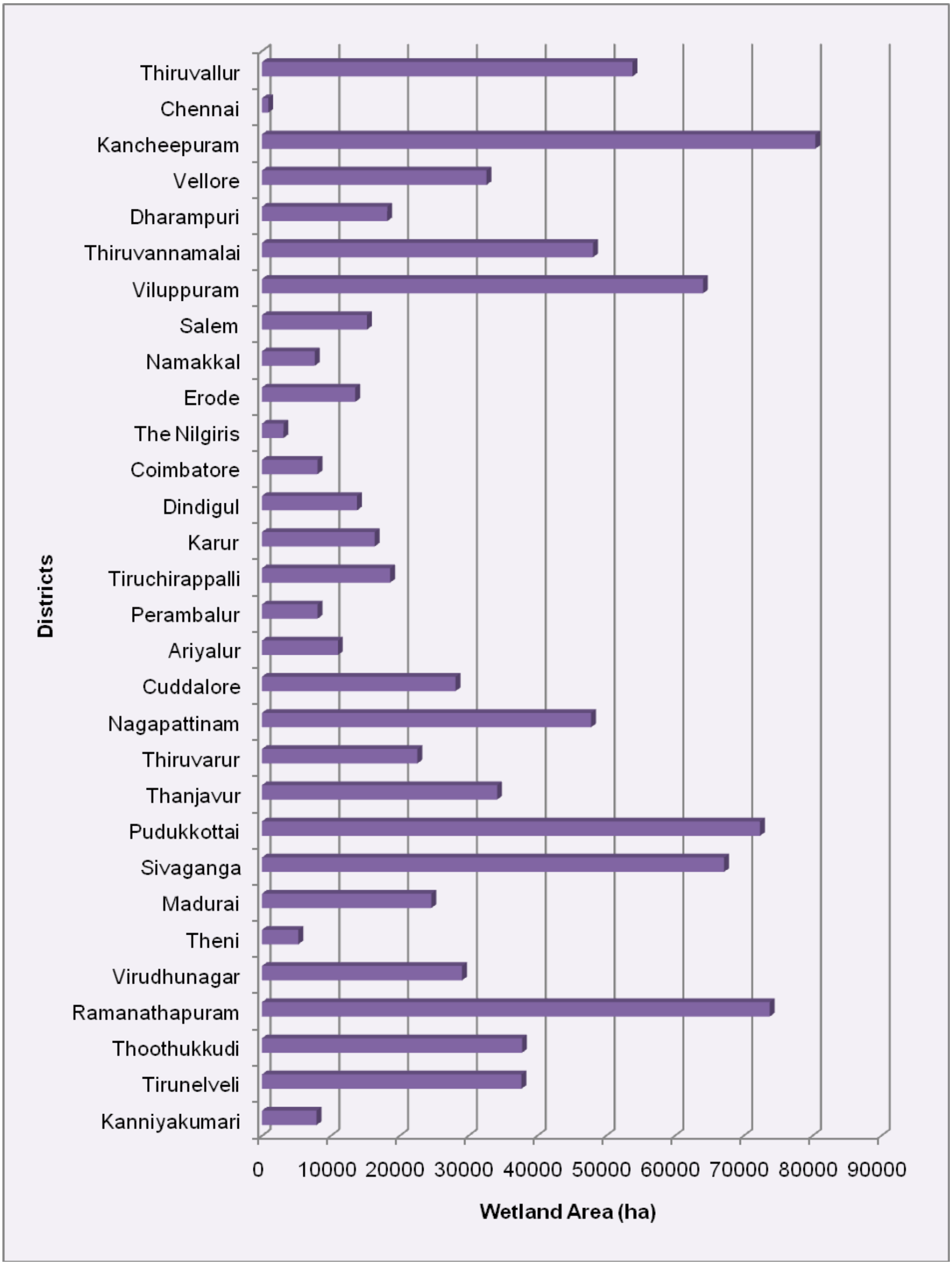



Figure 76: District-wise graphical distribution of wetlands

Table 101: District-wise area of wetlands in Tamil Nadu

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Thiruvallur | 3422 | 53863 | 5.97 | 15.74 | 44224 | 21902 | 7717 | 30091 | 26057 | 3713 | 14454 | 5889 | 4741 | 11272 |
| 2 | Chennai | 178 | 917 | 0.10 | 5.15 | 470 | 348 | 42 | 165 | 157 | 2 | 311 | 38 | - | 310 |
| 3 | Kancheepuram | 7857 | 80445 | 8.91 | 10.24 | 70469 | 29962 | 2965 | 45379 | 48696 | 13397 | 8376 | 11097 | 11403 | 7462 |
| 4 | Vellore | 6077 | 32640 | 3.62 | 5.37 | 26786 | 12958 | 4294 | 18306 | 16976 | 9208 | 602 | 3884 | 8556 | 518 |
| 5 | Dharampuri | 4498 | 18215 | 2.02 | 4.05 | 14718 | 6321 | 2756 | 11357 | 8421 | 6154 | 143 | 1927 | 4341 | 53 |
| 6 | Thiruvannamalai | 6191 | 48130 | 5.33 | 7.77 | 40730 | 9077 | 6896 | 38776 | 35818 | 4815 | 97 | 4451 | 4626 | - |
| 7 | Viluppuram | 7222 | 64105 | 7.10 | 8.88 | 46481 | 10230 | 9134 | 45640 | 37544 | 5689 | 3248 | 1836 | 5688 | 2706 |
| 8 | Salem | 5205 | 15270 | 1.69 | 2.93 | 13490 | 8439 | 1622 | 6710 | 3603 | 9887 | - | 1435 | 7004 | - |
| 9 | Namakkal | 3363 | 7687 | 0.85 | 2.29 | 4814 | 3720 | 2663 | 3800 | 1713 | 3101 | - | 619 | 3101 | - |
| 10 | Erode | 8162 | 13570 | 1.50 | 1.66 | 11490 | 9683 | 1667 | 3408 | 6805 | 4643 | 42 | 5114 | 4559 | 10 |
| 11 | The Nilgiris | 2453 | 3127 | 0.35 | 1.27 | 2721 | 2527 | 331 | 511 | 2127 | 594 | - | 1968 | 559 | - |
| 12 | Coimbatore | 7469 | 8070 | 0.89 | 1.08 | 5418 | 4729 | 2310 | 2941 | 3087 | 2156 | 175 | 2776 | 1879 | 74 |
| 13 | Dindigul | 6267 | 13815 | 1.53 | 2.20 | 9552 | 2899 | 3195 | 9944 | 2565 | 5028 | 1959 | 684 | 2126 | 89 |
| 14 | Karur | 2896 | 16383 | 1.82 | 5.66 | 13355 | 11348 | 2414 | 4432 | 1438 | 11619 | 298 | 144 | 11181 | 23 |
| 15 | Tiruchirappalli | 4404 | 18626 | 2.06 | 4.23 | 13941 | 8551 | 3815 | 9233 | 2273 | 10613 | 1055 | 346 | 8135 | 70 |
| 16 | Perambalur | 3690 | 8070 | 0.89 | 2.19 | 4291 | 1180 | 3137 | 6437 | 3593 | 692 | 6 | 367 | 813 | - |
| 17 | Ariyalur * | 1942 | 11042 | 1.22 | 5.69 | 7900 | 4533 | 1918 | 5647 | 3570 | 4231 | 99 | 335 | 4185 | 13 |
| 18 | Cuddalore | 3678 | 28135 | 3.12 | 7.65 | 21073 | 14436 | 5522 | 12219 | 8578 | 7751 | 4744 | 2885 | 7752 | 3799 |
| 19 | Nagapattinam | 2716 | 47833 | 5.30 | 17.61 | 29968 | 25697 | 983 | 4723 | 5501 | 9333 | 15134 | 4708 | 6570 | 14419 |
| 20 | Thiruvarur | 2097 | 22591 | 2.50 | 10.77 | 12919 | 11907 | 1043 | 2392 | 1395 | 6021 | 5503 | 825 | 5677 | 5405 |
| 21 | Thanjavur | 3348 | 34184 | 3.79 | 10.21 | 27669 | 19795 | 3809 | 12632 | 3642 | 16235 | 7792 | 255 | 12818 | 6722 |
| 22 | Pudukkottai | 4663 | 72402 | 8.02 | 15.53 | 54383 | 7057 | 15254 | 62692 | 22437 | 25650 | 6296 | 1637 | 5228 | 192 |
| 23 | Sivaganga | 4189 | 67172 | 7.44 | 16.04 | 46795 | 5573 | 18627 | 60063 | 16259 | 26282 | 4254 | 542 | 4889 | 142 |
| 24 | Madurai | 3742 | 24614 | 2.73 | 6.58 | 15868 | 4058 | 7485 | 19561 | 5671 | 8067 | 2130 | 973 | 2741 | 344 |
| 25 | Theni | 3242 | 5293 | 0.59 | 1.63 | 3764 | 2048 | 1428 | 3160 | 1895 | 1716 | 153 | 557 | 1449 | 42 |
| 26 | Virudhunagar | 4232 | 29071 | 3.22 | 6.87 | 14973 | 6707 | 13166 | 21771 | 5600 | 8155 | 1218 | 1569 | 4849 | 289 |
| 27 | Ramanathapuram | 4090 | 73808 | 8.18 | 18.05 | 49941 | 8629 | 15907 | 56011 | 23881 | 20456 | 5604 | 825 | 5283 | 2521 |
| 28 | Thoothukkudi | 4621 | 37810 | 4.19 | 8.18 | 24378 | 22001 | 10420 | 12525 | 4822 | 10243 | 9313 | 4987 | 8539 | 8475 |
| 29 | Tirunelveli | 6823 | 37709 | 4.18 | 5.53 | 19671 | 16404 | 16229 | 18575 | 6123 | 11025 | 2523 | 5397 | 9428 | 1579 |
| 30 | Kanniyakumari | 1672 | 7937 | 0.88 | 4.75 | 5609 | 3549 | 524 | 2499 | 4026 | 1201 | 382 | 2119 | 1086 | 344 |
| | **Total** | **130409** | **902534** | **100.00** | **6.92** | **657861** | **296268** | **167273** | **531600** | **314273** | **247677** | **95911** | **70189** | **159206** | **66873** |

* Data Source: http://nic.in

Table 102: District-wise area of wetlands (type-wise) in Tamil Nadu

| District code | District | Geographic area * | Wetland Type | | | | | | | | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1104 | 1105 | 1106 | 1201 | 1202 | 1203 | 2101 | 2102 | 2103 | 2104 | 2105 | 2106 | 2107 | 2201 | 2202 | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Thiruvallur | 3422 | 18068 | - | 328 | 5032 | 5678 | 11825 | 269 | 8037 | - | 805 | - | - | 1148 | - | 1043 | 1040 | 53273 | 590 | 53863 |
| 2 | Chennai | 178 | 79 | - | 44 | 124 | - | 76 | - | - | 186 | 380 | - | 3 | 10 | - | - | - | 902 | 15 | 917 |
| 3 | Kancheepuram | 7857 | 35421 | - | 120 | 9669 | 3781 | 18372 | 103 | - | 1385 | 1601 | 3725 | 646 | 115 | - | 4215 | 805 | 79958 | 487 | 80445 |
| 4 | Vellore | 6077 | 15687 | - | - | 8511 | 115 | 7973 | - | - | - | - | - | - | - | - | - | - | 32286 | 354 | 32640 |
| 5 | Dharampuri | 4498 | 2263 | - | - | 2072 | 6329 | 7069 | - | - | - | - | - | - | - | - | - | - | 17733 | 482 | 18215 |
| 6 | Thiruvannamalai | 6191 | 21448 | - | - | 3371 | 2204 | 20661 | 176 | - | - | - | - | - | - | - | - | 8 | 47868 | 262 | 48130 |
| 7 | Viluppuram | 7222 | 19272 | - | - | 7310 | 1890 | 25850 | 237 | - | - | 528 | 7048 | - | 8 | - | 690 | 676 | 63509 | 596 | 64105 |
| 8 | Salem | 5205 | 2071 | - | - | 1553 | 8687 | 2849 | - | - | - | - | - | - | - | - | - | - | 15160 | 110 | 15270 |
| 9 | Namakkal | 3363 | 1326 | - | - | 3102 | - | 3096 | - | - | - | - | - | - | - | - | - | - | 7524 | 163 | 7687 |
| 10 | Erode | 8162 | 462 | - | - | 4654 | 6968 | 1055 | 34 | - | - | - | - | - | - | - | - | - | 13173 | 397 | 13570 |
| 11 | The Nilgiris | 2453 | 120 | - | - | - | 2773 | 217 | - | - | - | - | - | - | - | - | - | - | 3110 | 17 | 3127 |
| 12 | Coimbatore | 7469 | 1202 | - | - | 2373 | 3421 | 770 | - | - | - | - | - | - | - | - | - | - | 7766 | 304 | 8070 |
| 13 | Dindigul | 6267 | 3481 | - | - | 1787 | 1217 | 6366 | - | - | - | - | - | - | - | - | - | - | 12851 | 964 | 13815 |
| 14 | Karur | 2896 | 2068 | - | - | 11096 | 219 | 2166 | 121 | - | - | - | - | - | - | - | - | 122 | 15792 | 591 | 16383 |
| 15 | Tiruchirappalli | 4404 | 4247 | - | - | 7848 | 346 | 5395 | - | - | - | - | - | - | - | - | - | - | 17836 | 790 | 18626 |
| 16 | Perambalur | 3690 | 2016 | - | - | 811 | 42 | 4517 | 232 | - | - | - | - | - | - | - | - | - | 7618 | 452 | 8070 |
| 17 | Ariyalur * | 1942 | 2657 | - | - | 4177 | 101 | 3470 | - | - | - | - | - | - | - | - | - | - | 10405 | 637 | 11042 |
| 18 | Cuddalore | 3678 | 6260 | 127 | 29 | 8810 | 1612 | 4590 | 257 | - | 1168 | 723 | 248 | 1425 | 590 | - | - | 1824 | 27663 | 472 | 28135 |
| 19 | Nagapattinam | 2716 | 1184 | - | 79 | 4646 | - | 538 | 8499 | 6362 | 665 | 1851 | 11868 | 246 | 2813 | - | 4577 | 4129 | 47457 | 376 | 47833 |
| 20 | Thiruvarur | 2097 | 854 | - | 1028 | 5669 | - | 901 | 31 | 4786 | - | - | 6924 | - | 843 | - | 529 | - | 21565 | 1026 | 22591 |
| 21 | Thanjavur | 3348 | 6117 | - | 178 | 12738 | 7 | 5555 | - | 3935 | - | - | 305 | 173 | 1210 | - | 3046 | 27 | 33291 | 893 | 34184 |
| 22 | Pudukkottai | 4663 | 38966 | - | 31 | 4255 | - | 26419 | - | 30 | - | - | 588 | 5 | 60 | - | 367 | - | 70721 | 1681 | 72402 |
| 23 | Sivaganga | 4189 | 35770 | - | - | 4956 | - | 24972 | - | - | - | - | - | - | - | - | - | - | 65698 | 1474 | 67172 |
| 24 | Madurai | 3742 | 11942 | - | - | 1708 | 248 | 9732 | - | - | - | - | - | - | - | - | - | - | 23630 | 984 | 24614 |
| 25 | Theni | 3242 | 1136 | - | - | 1123 | 1957 | 994 | - | - | - | - | - | - | - | - | - | - | 5210 | 83 | 5293 |
| 26 | Virudhunagar | 4232 | 13893 | - | - | 3668 | 2031 | 8889 | - | - | - | - | - | - | - | - | - | - | 28481 | 590 | 29071 |
| 27 | Ramanathapuram | 4090 | 42061 | - | 1410 | 4696 | - | 12036 | - | 1487 | - | 1493 | 1329 | 2052 | 118 | 3638 | 1787 | 469 | 72576 | 1232 | 73808 |
| 28 | Thoothukkudi | 4621 | 10612 | - | 681 | 6005 | 963 | 5642 | 852 | 417 | - | 992 | 720 | 1558 | 400 | 261 | 6635 | 1496 | 37234 | 576 | 37810 |
| 29 | Tirunelveli | 6823 | 15049 | - | - | 4315 | 2083 | 14509 | - | - | - | 711 | - | - | - | - | - | - | 36667 | 1042 | 37709 |
| 30 | Kanniyakumari | 1672 | 359 | - | - | 799 | 3747 | 1109 | - | 3 | - | 714 | 409 | - | - | - | - | 143 | 7283 | 654 | 7937 |
| | **Total** | **130409** | **316091** | **127** | **3928** | **136878** | **56419** | **237613** | **10811** | **25057** | **3404** | **9798** | **33164** | **6108** | **7315** | **3899** | **22889** | **10739** | **884240** | **18294** | **902534** |

* Data Source: http://nic.in

1101 Lake/Pond
1102 Ox-bow lake/ Cut-off meander
1103 High altitude wetland
1104 Riverine wetland
1105 Waterlogged (Natural)
1106 River/Stream

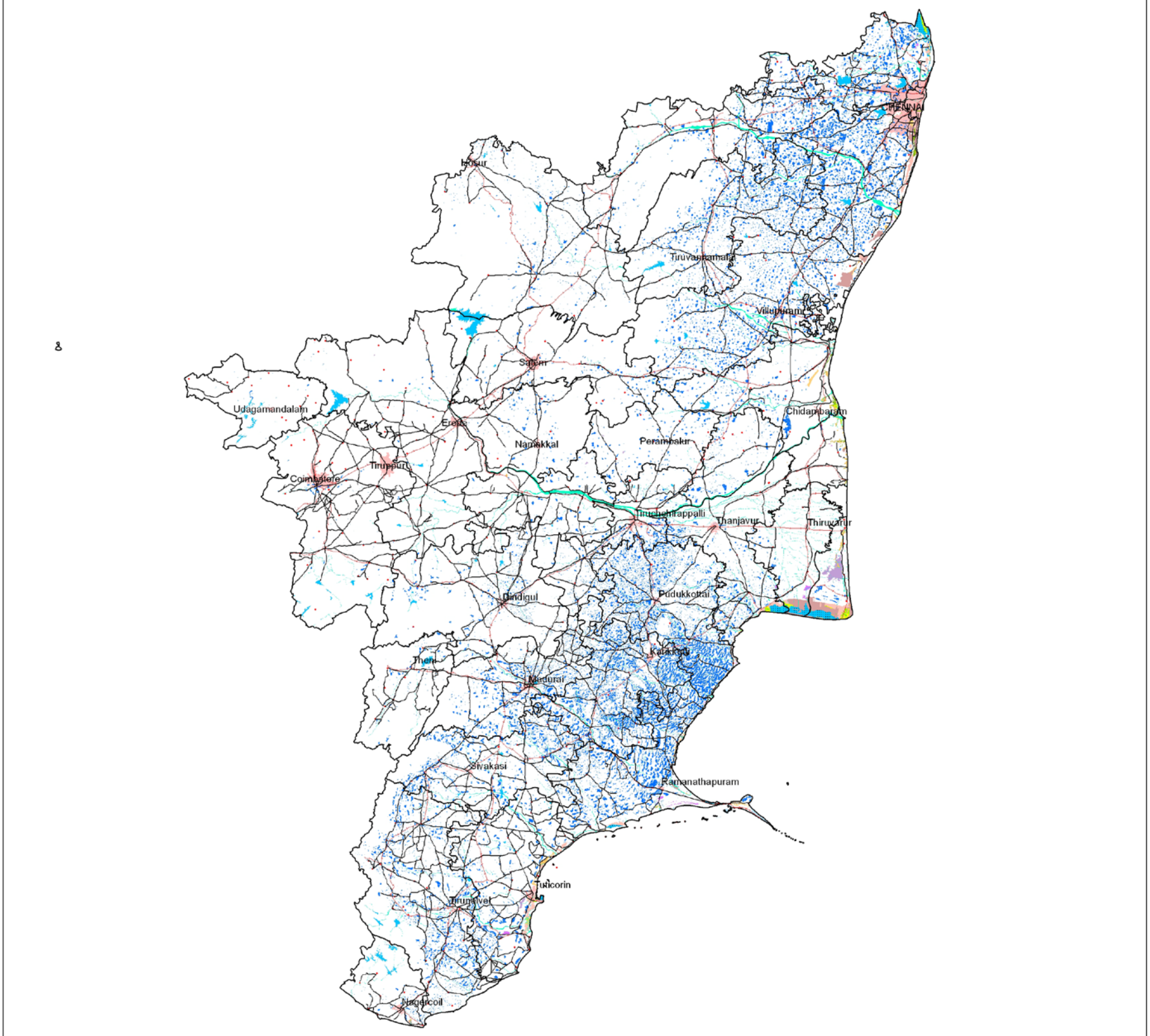
1201 Reservoir/Barrage
1202 Tank/Pond
1203 Waterlogged (Man-made)
1204 Salt pan (Inland)

2101 Lagoon
2102 Creek
2103 Sand/Beach
2104 Intertidal mud flat
2105 Salt Marsh (Coastal)
2106 Mangrove
2107 Coral Reef

2201 Salt pan
2202 Aquaculture pond

State : Tamil Nadu

# WETLAND MAP

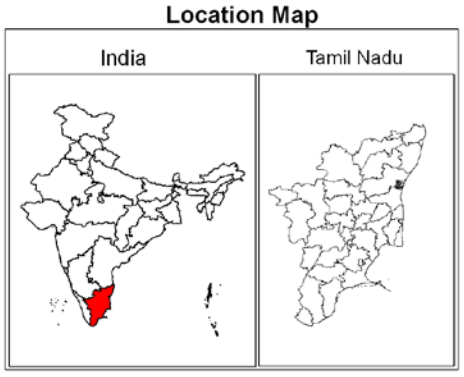



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Drainage (line)
- Major Roads
- Railway
- Settlements
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

**Location Map**




50 25 0 50 100 Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Institute of Remote Sensing, Anna University, Chennai

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 56 : Wetland map of Tamil Nadu

### 8.1.34 Puducherry (Pondicherry)

Total 259 wetlands are mapped including 144 small wetlands (< 2.25 ha) with 6335 ha area**.** River/Stream contributed 33.35% to the total wetland area. The lake/pond with 1120 ha (17.68% area) is the second major wetland category, followed by tank/pond with 867 ha area i.e. 13.69 %. Thus, the Puducherry is dominated by inland wetlands. Details of wetland statistics is given in Table 103. Graphical distribution of wetland type is shown in Figure 77. Wetland map of Yanam, Pondicherry, Mahe and Karaikal are shown in Plates 57-60 respectively.

Open water spread of the wetlands is significantly higher in post-monsoon (4028 ha) than during pre-monsoon (2535 ha), indicating the rainfall dependence of the wetlands. Aquatic vegetation is almost double during pre-monsoon (1753 ha) than in post-monsoon (622 ha). The qualitative turbidity of water is moderate both the seasons.

There are four districts in Union territory of Puducherry. District-wise wetland summary is given in Table 104 and graphical distribution of wetlands is shown in Figure 78. District-wise area of wetlands (type-wise) in the state is given in Table 105.

Table 103: Area estimates of wetlands in Puducherry

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 | Lake/Pond | 19 | 1120 | 17.68 | 943 | 305 |
| 2 | 1105 | Waterlogged | 1 | 20 | 0.32 | 13 | 2 |
| 3 | 1106 | River/Stream | 15 | 2113 | 33.35 | 2040 | 1790 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 4 | 1201 | Reservoir/Barrage | - | - | - | - | - |
| 5 | 1202 | Tank/Pond | 45 | 867 | 13.69 | 705 | 232 |
| | | **Total - Inland** | **80** | **4120** | **65.04** | **3701** | **2329** |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 6 | 2102 | Creek | 6 | 212 | 3.35 | 212 | 194 |
| 7 | 2103 | Sand/Beach | 7 | 809 | 12.77 | - | - |
| 8 | 2104 | Intertidal mud flat | 10 | 505 | 7.97 | - | - |
| 9 | 2105 | Salt marsh | 1 | 66 | 1.04 | - | - |
| 10 | 2106 | Mangrove | 6 | 285 | 4.50 | - | - |
| | **2200** | **Coastal Wetlands - Man-made** | | | | | |
| 11 | 2201 | Salt pan | - | - | - | - | - |
| 12 | 2202 | Aquaculture pond | 5 | 194 | 3.06 | 115 | 12 |
| | | **Total - Coastal** | **35** | **2071** | **32.69** | **327** | **206** |
| | | **Sub-Total** | **115** | **6191** | **97.73** | **4028** | **2535** |
| | | Wetlands (<2.25 ha) | 144 | 144 | 2.27 | - | - |
| | | **Total** | **259** | **6335** | **100.00** | **4028** | **2535** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 622 | 1753 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 1186 | 515 |
| Moderate | 2748 | 1968 |
| High | 94 | 52 |

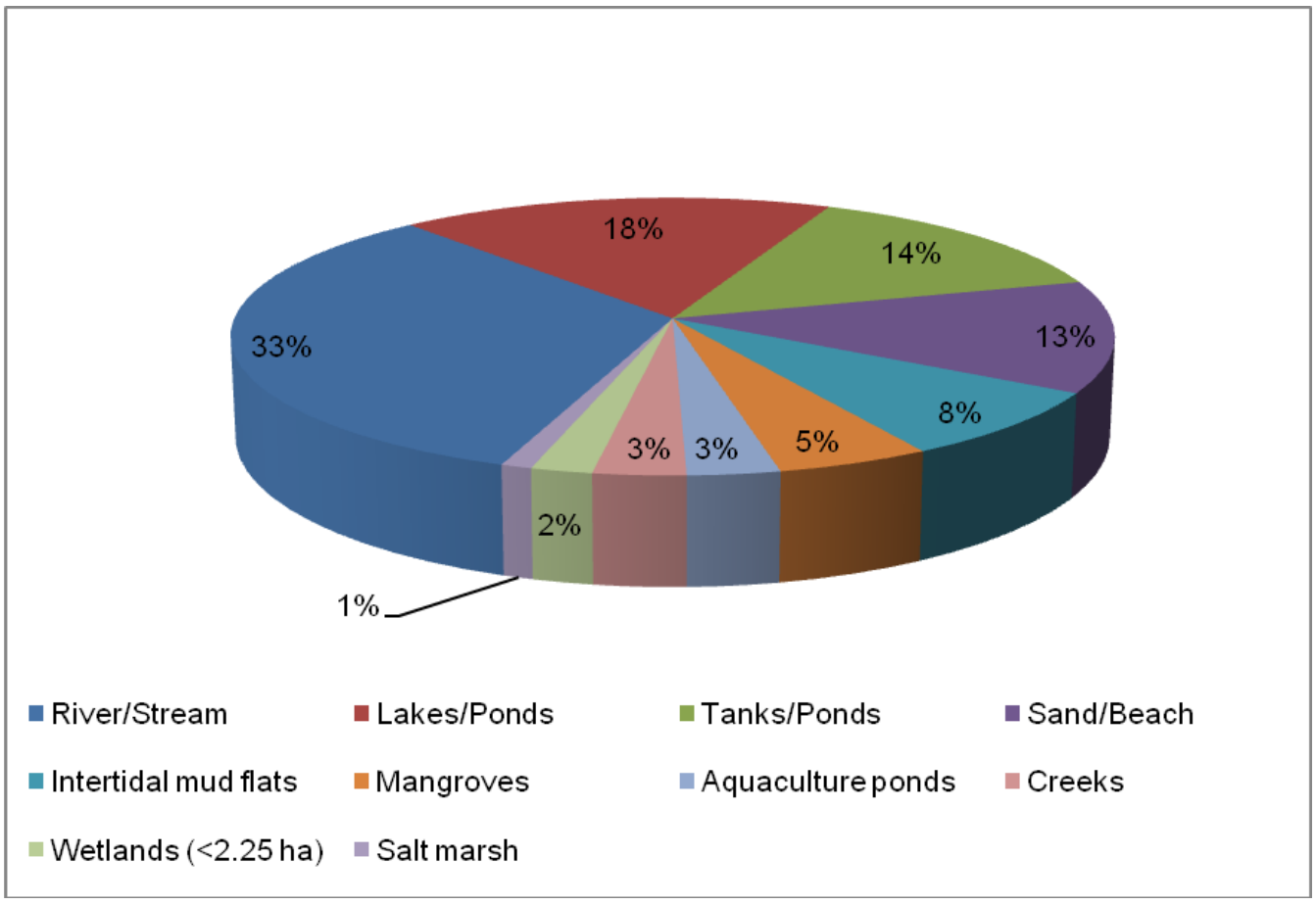



Figure 77: Type-wise wetland distribution in Puducherry

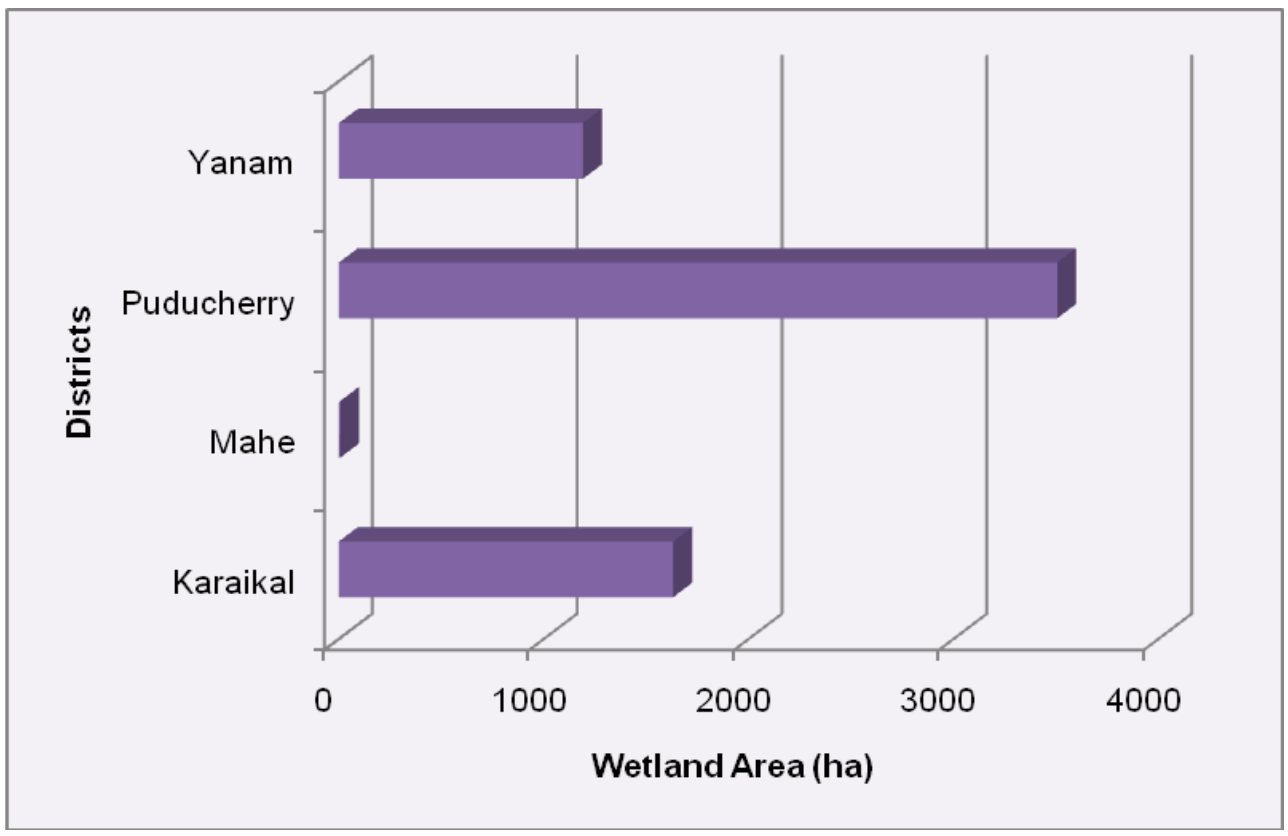



Figure 78: District-wise graphical distribution of wetlands in Puducherry

Table 104: District-wise area of wetlands in Puducherry

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Yanam | 30 | 1191 | 18.80 | 39.70 | 802 | 630 | 294 | 289 | - | 796 | 6 | - | 619 | 11 |
| 2 | Puducherry | 293 | 3506 | 55.34 | 11.97 | 2659 | 1553 | 328 | 1442 | 1131 | 1509 | 19 | 485 | 1066 | 2 |
| 3 | Mahe | 9 | 6 | 0.09 | 0.67 | 3 | - | - | - | 3 | - | - | - | - | - |
| 4 | Karaikal | 160 | 1632 | 25.76 | 10.20 | 564 | 352 | - | 22 | 52 | 443 | 69 | 30 | 283 | 39 |
| | **Total** | **492** | **6335** | **100.00** | **12.88** | **4028** | **2535** | **622** | **1753** | **1186** | **2748** | **94** | **515** | **1968** | **52** |

* Data Source: http://nic.in

Table 105: District-wise area of wetlands (type-wise) in Puducherry

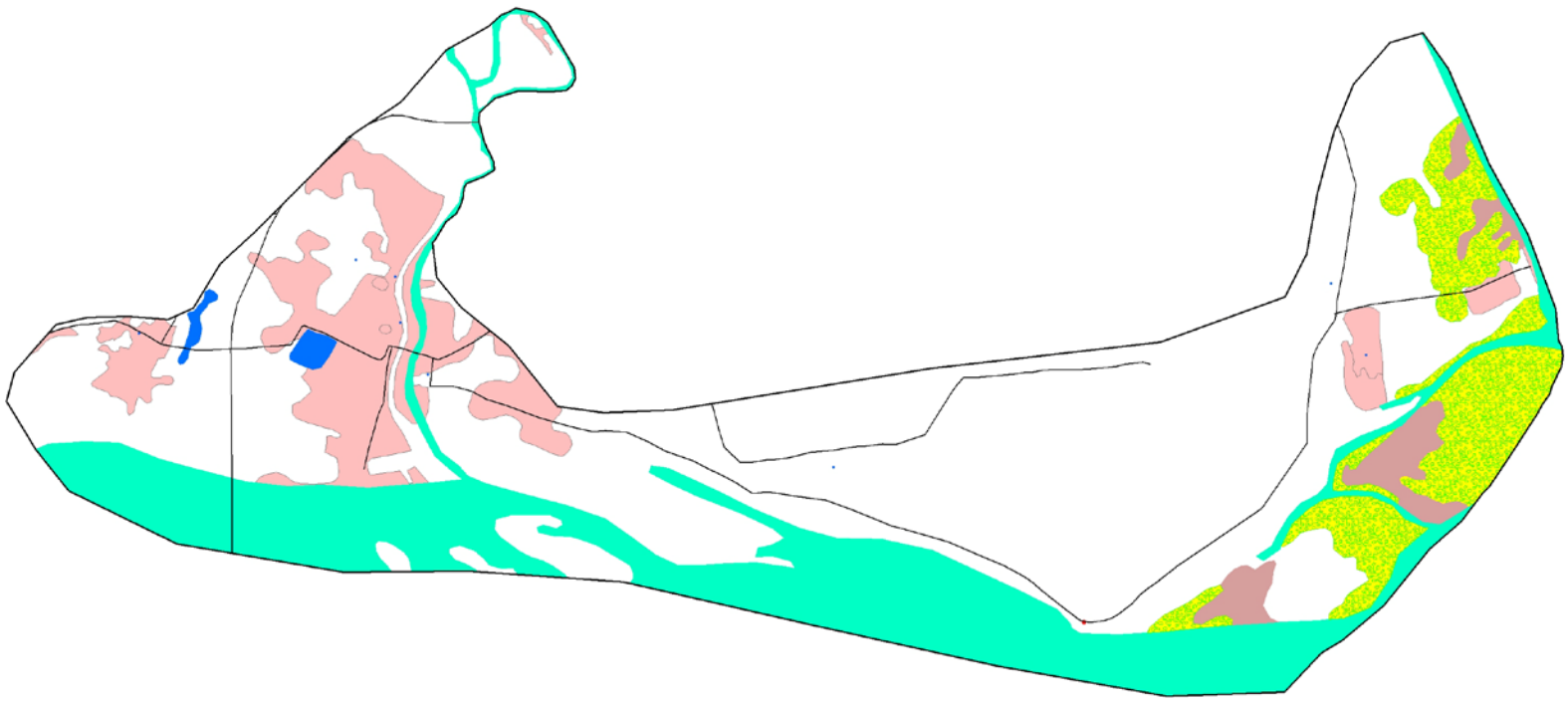
| District code | District | Geographic area * | Wetland Type | | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1105 | 1106 | 1202 | 2102 | 2103 | 2104 | 2105 | 2106 | 2202 | | | |
| | | | Lake/ pond | Waterlogged (Natural) | River/ Stream | Tank/ Pond | Creek | Sand/ Beach | Intertidal mud flat | Salt Marsh | Mangrove | Aquaculture pond | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Yanam | 30 | - | - | 796 | 15 | - | - | 87 | - | 285 | - | 1183 | 8 | 1191 |
| 2 | Puducherry | 293 | 1120 | 20 | 893 | 787 | 173 | 377 | 29 | 66 | - | 2 | 3467 | 39 | 3506 |
| 3 | Mahe | 9 | - | - | 3 | - | - | - | - | - | - | - | 3 | 3 | 6 |
| 4 | Karaikal | 160 | - | - | 421 | 65 | 39 | 432 | 389 | - | - | 192 | 1538 | 94 | 1632 |
| | **Total** | **492** | **1120** | **20** | **2113** | **867** | **212** | **809** | **505** | **66** | **285** | **194** | **6191** | **144** | **6335** |

* Data Source: http://nic.in

State : Pondicherry

# WETLAND MAP

District : Yanam

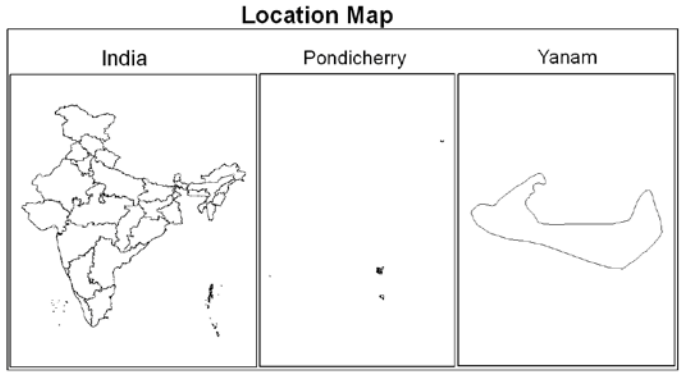


| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 0.250.5 1 1.5 2 Kilometers

**Data Source :**

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

**Prepared By :**

Space Applications Centre (ISRO), Ahmedabad

**Sponsored By :**

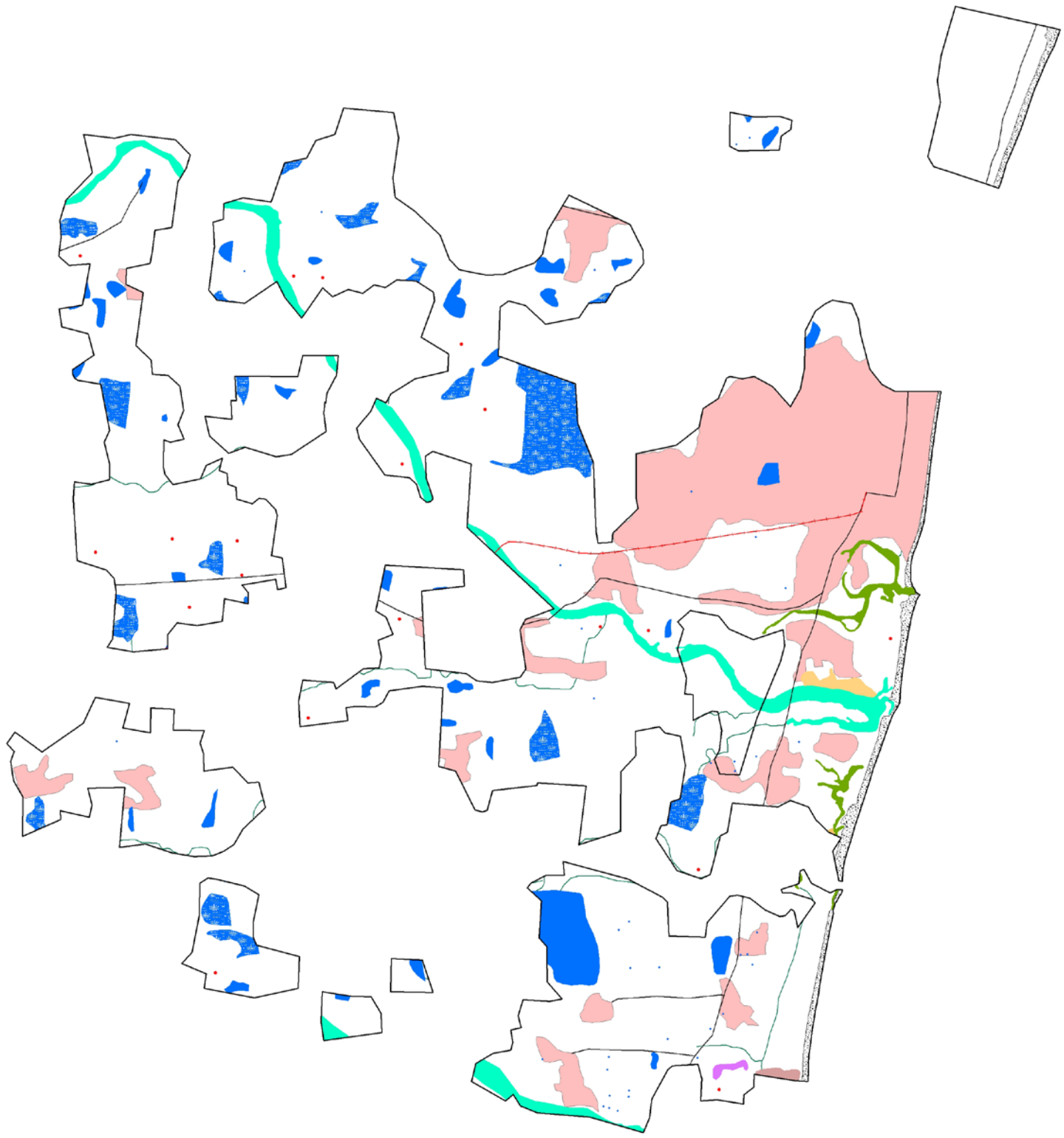
Ministry of Environment and Forests
Government of India

Plate 57: Wetland map of Yanam (Puducherry)

State : Pondicherry

# WETLAND MAP

District : Pondicherry

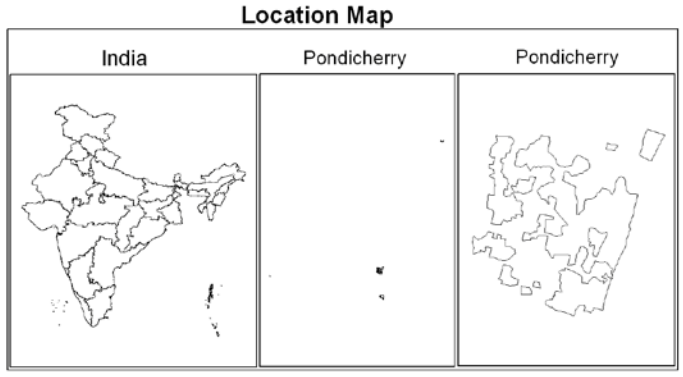


| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 4 Kilometers

**Data Source :**

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

**Prepared By :**

Space Applications Centre (ISRO), Ahmedabad

**Sponsored By :**

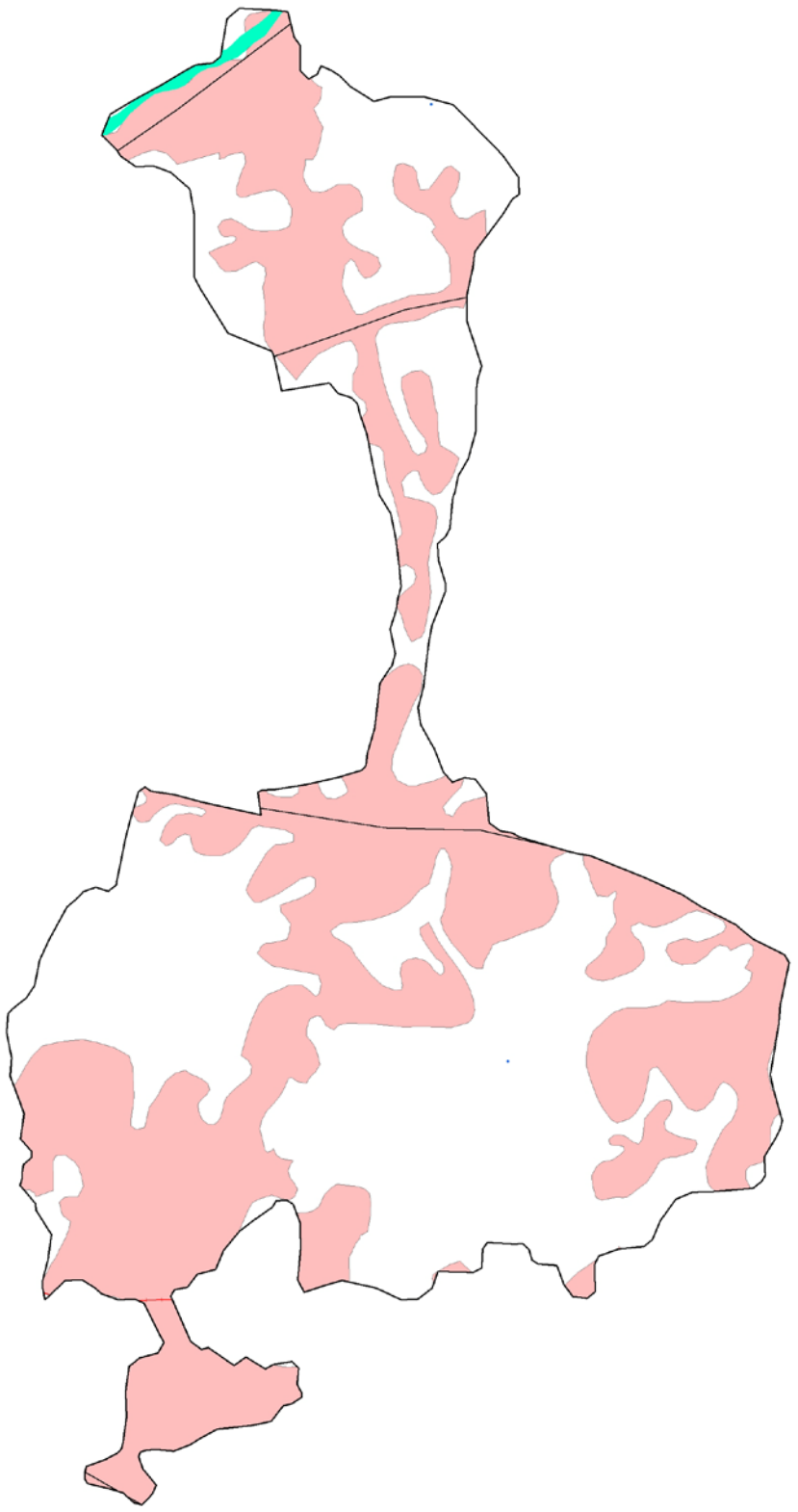
Ministry of Environment and Forests
Government of India

Plate 58 : Wetland map of Pondicherry (Puducherry)

State : Pondicherry

# WETLAND MAP

District : Mahe

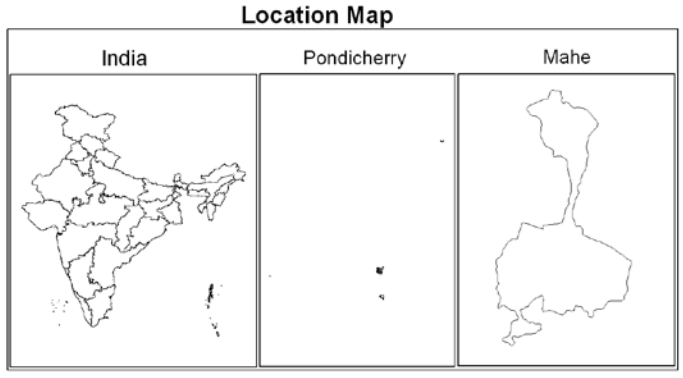


| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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

**Sponsored By :**

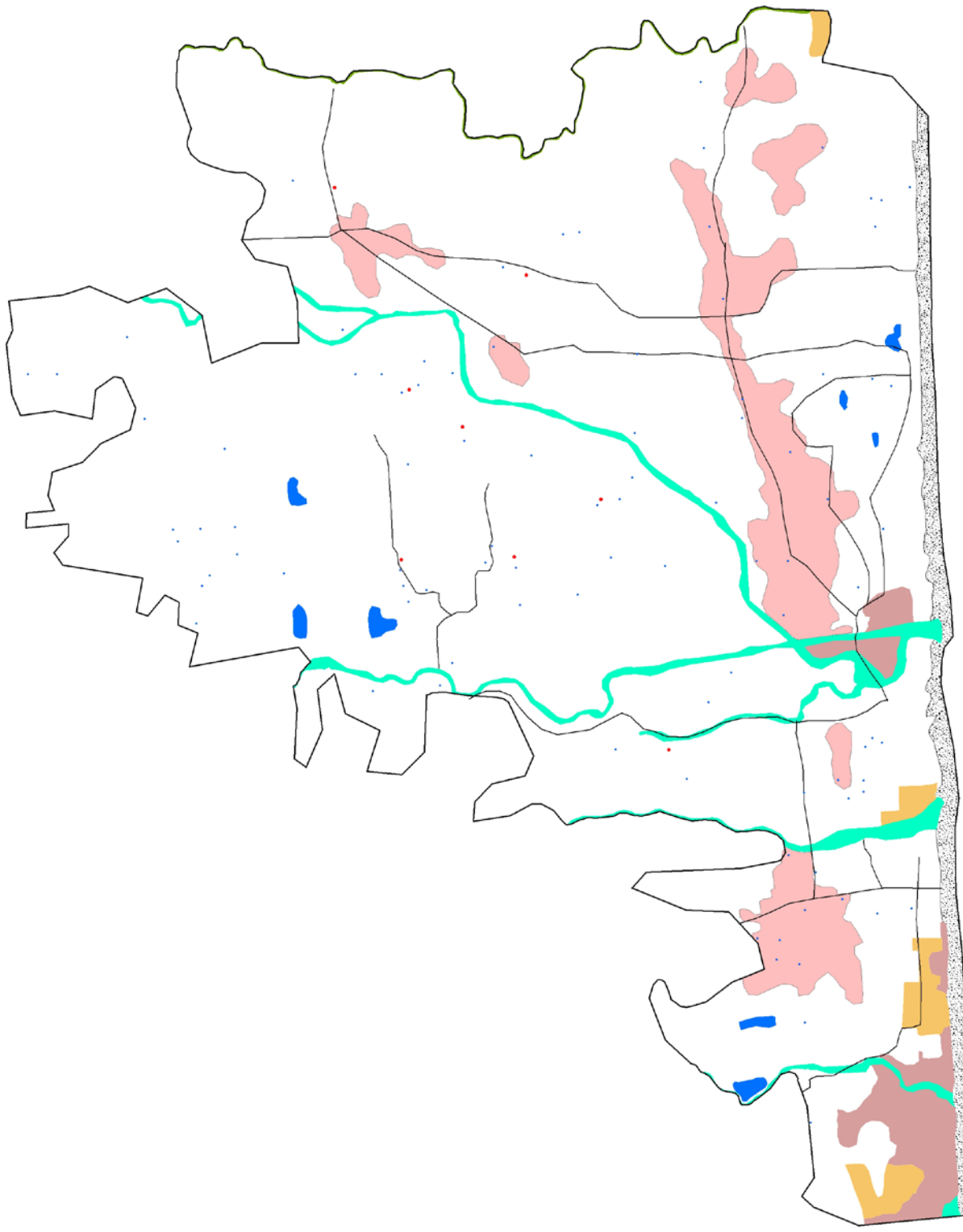
Ministry of Environment and Forests
Government of India

Plate 59 : Wetland map of Mahe (Puducherry)

State : Pondicherry

# WETLAND MAP

District : Karaikal

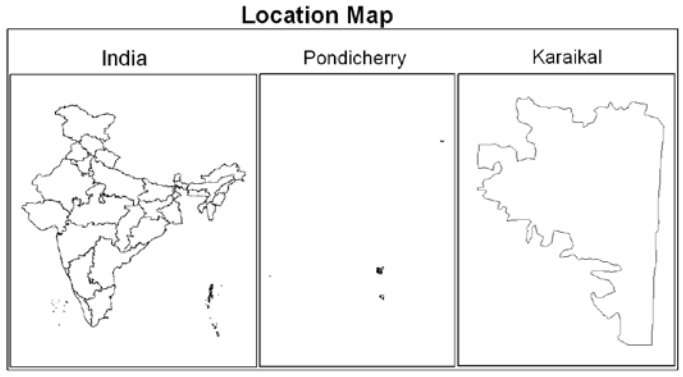


| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 4 Kilometers

**Data Source :**

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

**Prepared By :**

Space Applications Centre (ISRO), Ahmedabad

**Sponsored By :**

Ministry of Environment and Forests
Government of India

Plate 60 : Wetland map of Karaikal (Puducherry)

### 8.1.35 Andaman & Nicobar Islands

In the Union Territory of Andaman and Nicobar 2459 wetlands have been delineated in addition to 94 wetlands smaller than 2.25 ha. Total wetland area estimated is 152809 ha. Coastal-natural wetlands are dominant in the islands which account for 95.47 % of wetland area. Even though the inland wetlands comprise about 4.5 % of wetland area, singularly the river/stream accounts for 95.07 % area (6571 ha out of 6912 ha) of inland wetlands. The details of type-wise aerial extents of wetland is given in the Table 106. Graphical distribution of wetland type is shown in Figure 79. Wetland map of Andaman and Nicobar Islands is shown in Plate 61.

The major wetland types are mangrove (66101 ha) followed by coral (49378 ha), intertidal mud-flat (12399 ha). Sand/Beach accounts for 10063 ha. In terms of open water area, the inland wetlands dominated with 6519 ha in post-monsoon and 6736 ha in pre-monsoon seasons compared to 1822 ha and 1844 ha respectively for coastal wetlands.

Salt Marsh and mangrove are the only wetland types that have vegetation. Together the two classes comprise 68269 ha in post-monsoon season while it has shown an increase to 68352 ha in pre-monsoon. Of the two wetland types with vegetation, mangrove account for 66101 ha and remained unchanged in both post- as well pre-monsoon seasons. However, due to receding flooding in pre-monsoon the salt marsh had shown a substantial increase in the area from 2168 ha (post-monsoon) to 2251 ha.

Table 106: Area estimates of wetlands in Andaman and Nicobar Islands

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 | Lake/Pond | 6 | 45 | 0.03 | 41 | 45 |
| 2 | 1106 | River/Stream | 46 | 6571 | 4.30 | 6359 | 6571 |
| | **1200** | **Inland Wetlands -Man-made** | | | | | |
| 3 | 1201 | Reservoir/Barrage | 7 | 280 | 0.18 | 103 | 104 |
| 4 | 1202 | Tank/Pond | 11 | 16 | 0.01 | 16 | 16 |
| | | **Total - Inland** | **70** | **6912** | **4.52** | **6519** | **6736** |
| | **2100** | **Coastal Wetlands - Natural** | | | | | |
| 5 | 2101 | Lagoon | 3 | 56 | 0.04 | 56 | 56 |
| 6 | 2102 | Creek | 119 | 1777 | 1.16 | 1766 | 1788 |
| 7 | 2103 | Sand/Beach | 367 | 10063 | 6.59 | - | - |
| 8 | 2104 | Intertidal mud flat | 395 | 12399 | 8.11 | - | - |
| 9 | 2105 | Salt Marsh | 322 | 6029 | 3.95 | - | - |
| 10 | 2106 | Mangrove | 678 | 66101 | 43.26 | - | - |
| 11 | 2107 | Coral | 505 | 49378 | 32.31 | - | - |
| | | **Total - Coastal** | **2389** | **145803** | **95.42** | **1822** | **1844** |
| | | **Sub-Total** | **2459** | **152715** | **99.94** | **8341** | **8580** |
| | | Wetlands (<2.25 ha) | 94 | 94 | 0.06 | - | - |
| | | **Total** | **2553** | **152809** | **100.00** | **8341** | **8580** |

| | | |
|---|---|---|
| **Area under Aquatic Vegetation** | 68269 | 68352 |

| **Area under turbidity levels** | | |
|---|---|---|
| Low | 965 | 1898 |
| Moderate | 6749 | 6006 |
| High | 627 | 676 |

For assessment of qualitative turbidity based on signature statistics of MNDWI image for open water features has been considered as explained in the methodology. Accordingly, wetlands where open water features have not been manifested on satellite data were excluded in spite of the fact that these wetlands are associated with water. Overall six wetland types are assessed for turbidity namely lake/pond, river/stream, reservoir/barrage, tank/pond, lagoon and creak. The extent of open water in post-monsoon of 2006 is 8341 ha which comprised 965 ha of low, 6749 ha of moderate and 627 ha of high turbidity classes. The extent under turbidity classes changed considerably in the pre-monsoon of 2007 which is estimated as 1898 ha of low, 6006 ha of moderate and 676 ha of high turbidity out of 8580 ha of open water features. The open water features dominated by Moderate turbidity in both the seasons appears to be mainly because of river/stream and creek as inferred from Table 103. This could be because unsettled sediments, due to rainfall runoff during south-westerly as well as north-easterly monsoon pattern of the area.

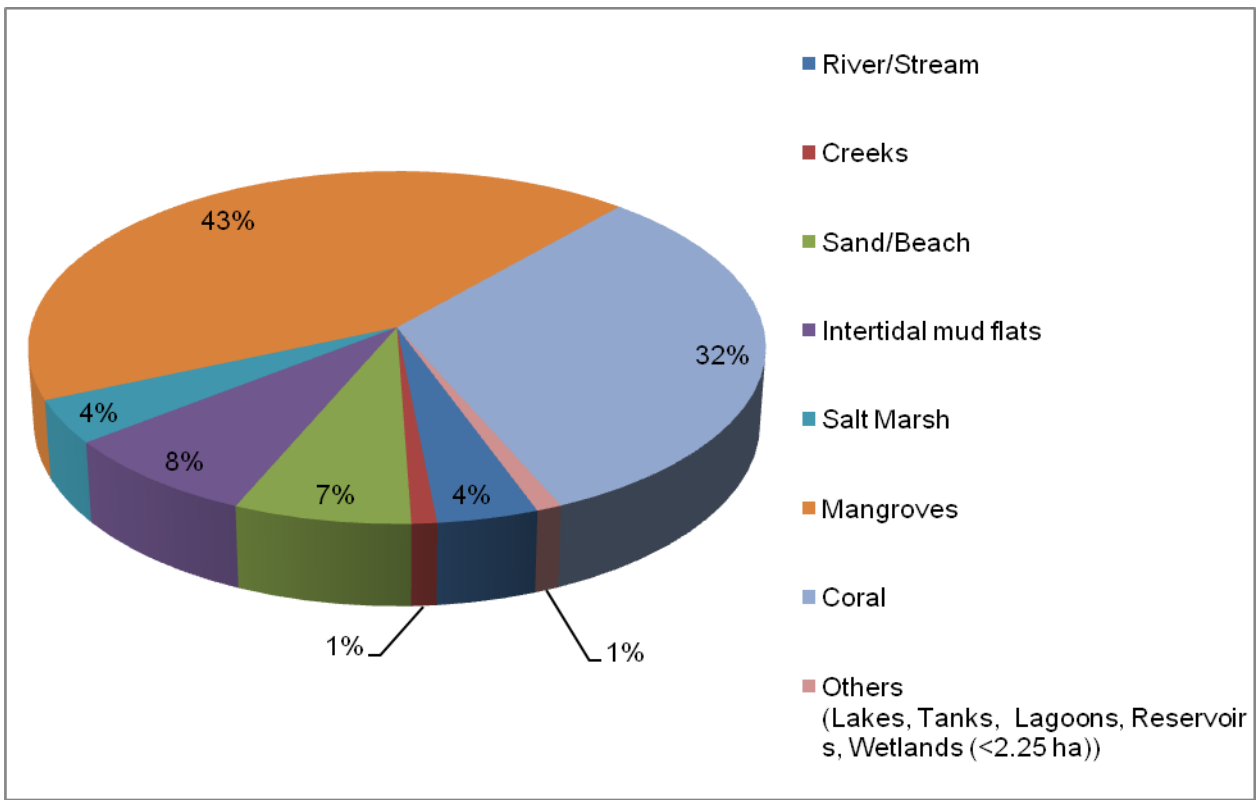



Figure 79: Type-wise wetland distribution in Andaman and Nicobar

**District-wise wetland area estimates in Andaman and Nicobar Islands**

The Union Territory has two districts Andaman and Nicobar. They are separated by a channel of 145 km wide known as 10 degree channel. The district-wise wetland area estimates is shown in Table 107 and graphical distribution of wetlands is shown in Figure 80. District-wise area of wetlands (type-wise) in the state is given in Table 108.

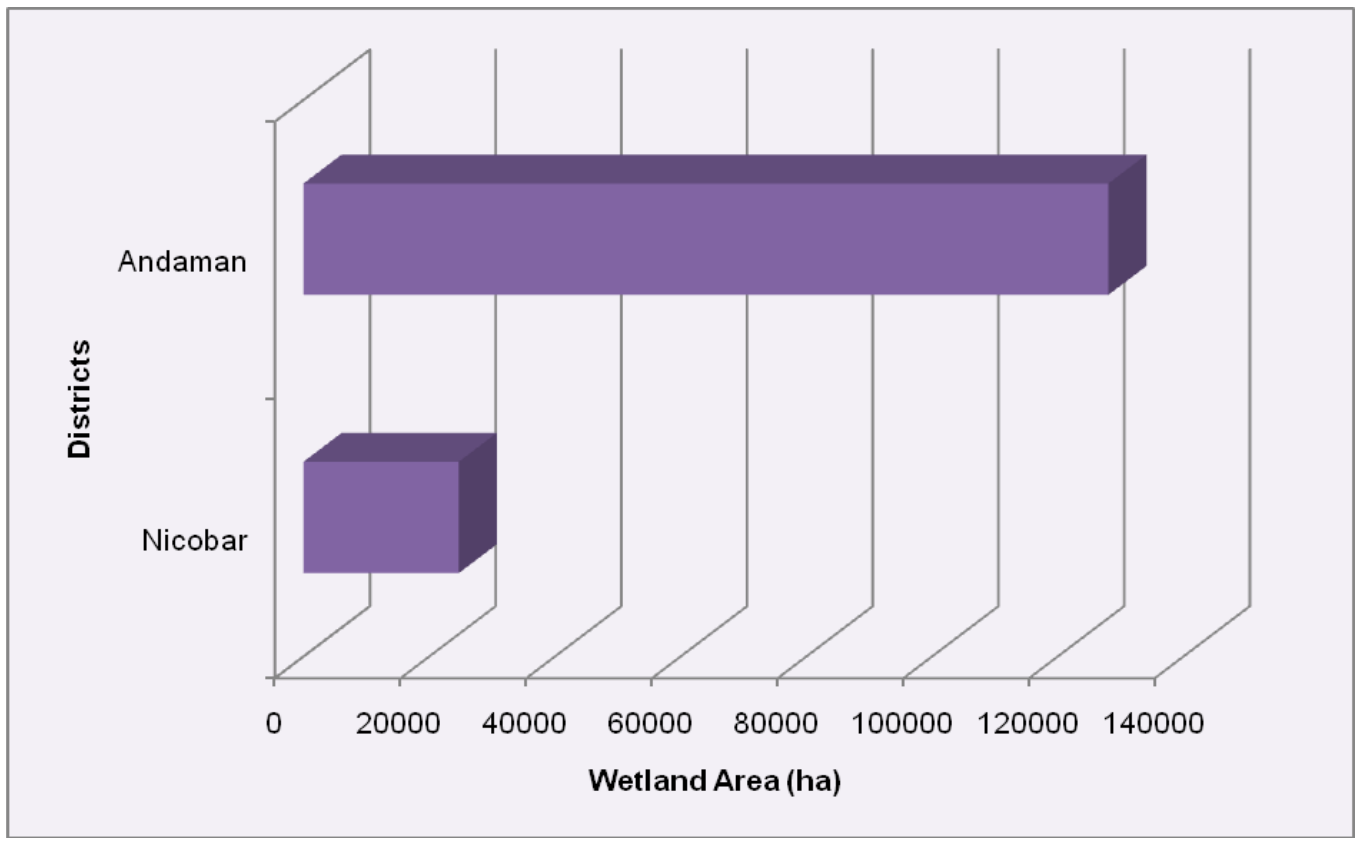



Figure 80: District-wise graphical distribution of wetlands in Andaman and Nicobar

Table 107: District-wise area of wetlands in Andaman and Nicobar Islands

| District code | District | Geographic area * | Wetland area | % of total wetland area | % of district geographic area | Open water | | Aquatic Vegetation | | Turbidity (Post-monsoon) | | | Turbidity (Pre-monsoon) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | Low | Moderate | High | Low | Moderate | High |
| | | (sq. km) | (ha) | | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Andaman | 6408 | 128088 | 83.82 | 19.99 | 8077 | 8104 | 66434 | 66481 | 944 | 6681 | 452 | 1898 | 5732 | 474 |
| 2 | Nicobar | 1841 | 24721 | 16.18 | 13.43 | 264 | 476 | 1835 | 1871 | 21 | 68 | 175 | - | 274 | 202 |
| | **Total** | **8249** | **152809** | **100** | **18.52** | **8341** | **8580** | **68269** | **68352** | **965** | **6749** | **627** | **1898** | **6006** | **676** |

* Data Source: http://nic.in

Table 108: District-wise area of wetlands (type-wise) in Andaman and Nicobar Islands

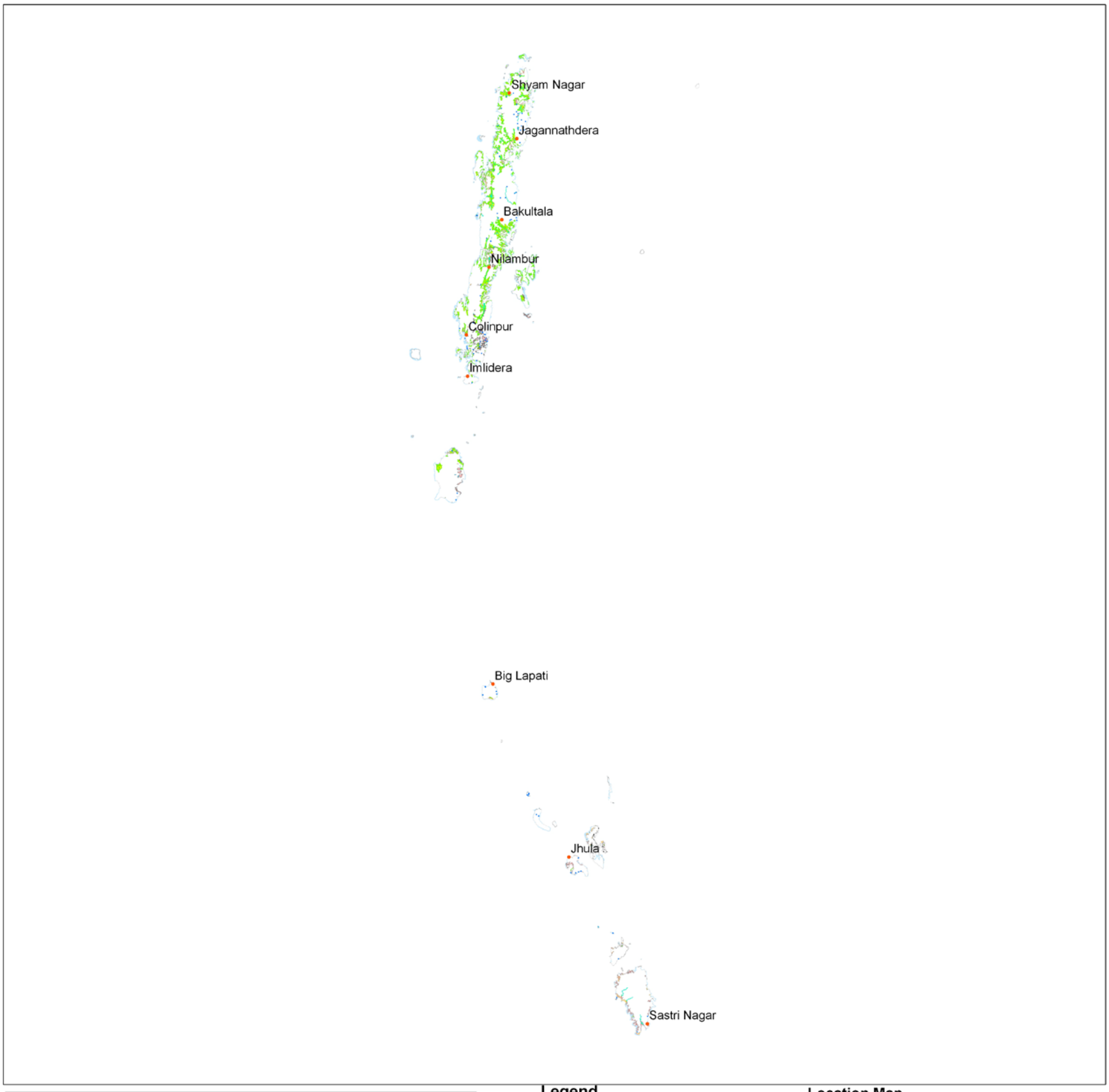
| District code | District | Geographic area * | Wetland Type | | | | | | | | | | | Sub-total | Wetlands (<2.25 ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1101 | 1106 | 1201 | 1202 | 2101 | 2102 | 2103 | 2104 | 2105 | 2106 | 2107 | | | |
| | | | Lake/ pond | River/ Stream | Reservoir/ Barrage | Tank/ Pond | Lagoon | Creek | Sand/ Beach | Intertidal mud flat | Salt Marsh | Mangrove | Coral Reef | | | |
| | | (sq. km) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| 1 | Andaman | 6408 | 13 | 6204 | 280 | 16 | 54 | 1702 | 3205 | 5858 | 3575 | 65892 | 41220 | 128019 | 69 | 128088 |
| 2 | Nicobar | 1841 | 32 | 367 | - | - | 2 | 75 | 6858 | 6541 | 2454 | 209 | 8158 | 24696 | 25 | 24721 |
| | **Total** | **8249** | **45** | **6571** | **280** | **16** | **56** | **1777** | **10063** | **12399** | **6029** | **66101** | **49378** | **152715** | **94** | **152809** |

* Data Source: http://nic.in

UT : Andaman and Nicobar Islands

# WETLAND MAP

District :Andaman & Nicobar

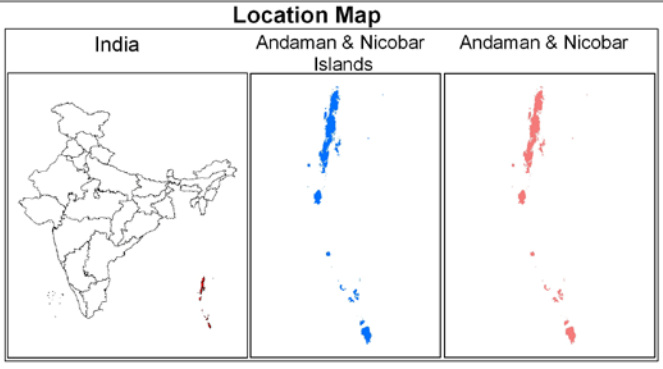



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Roads
- Drainage (line)
- Settlements
- Town/Settlements

**Location Map**




0 45 90 180 Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 61 : Wetland map of Andaman and Nicobar Islands

# IMPORTANT WETLANDS OF INDIA
# (Selected)

## 9.0 IMPORTANT WETLANDS OF INDIA

The Wetland Ecosystem in India is spread over a wide range of varied climatic conditions, which is ranging from the wetlands in cold and humid Jammu and Kashmir to hot and humid conditions in Peninsular India, thus there is a great diversity of these Wetlands. Many of these wetlands are unique from the point of biodiversity, scenic beauty, shelter of migratory birds, resident avifauna etc.

Under the conservation of Wetlands in India, numbers of wetlands have been recognized that are a part of national Parks and sanctuaries. Twenty-five wetlands have been declared as Ramsar Sites. Various types of sanctuaries and parks like bird, wildlife, marine, and education have been notified in the country.

This Atlas highlights the status of some of the important wetlands of India. List of some of the important wetlands with location details is given in Table 109. Area estimates and status of Water-spread and Aquatic vegetation in important wetland sites of India is given in Table 110.

Wetland maps have been prepared for 5km buffer area of each wetland sites. Wetland maps of 5 km buffer area are shown in the following plates.

Table 109: List of important wetland sites of India (selected)

| Sr. No. | Wetland name | State | Wetland Description | Location | |
|---|---|---|---|---|---|
| | | | | Latitude | Longitude |
| 1 | Ashtamudi Wetland | Kerala | Coastal – Natural – Lagoon | 8° 56’ 58” | 76° 34’ 53” |
| 2 | Bakhira Wildlife Sanctuary | Uttar Pradesh | Inland - Natural – Lake/Pond | 26° 54’30’’ | 83° 08’46’’ |
| 3 | Bhoj Wetland | Madhya Pradesh | Inland – Man-made – Reservoir | 23° 14’ 46” | 77° 20’ 31” |
| 4 | Chilika Lagoon | Orissa | Coastal – Natural - Lagoon | 19° 42’ 24” | 85° 20’ 53” |
| 5 | Deepor Beel | Assam | Inland - Natural – Lake | 26° 07’ 24” | 91° 38’ 20” |
| 6 | Kolleru Lake | Andhra Pradesh | Inland - Natural – Lake | 16° 37’ 04” | 81° 11’ 47” |
| 7 | Loktak Lake | Manipur | Inland - Natural – Lake | 24° 33’ 03” | 93° 48’ 47” |
| 8 | Nalsarovar | Gujarat | Inland - Natural – Lake | 22° 46’ 21” | 72° 03’ 13” |
| 9 | North Reef Island Sanctuary | Andaman and Nicobar Islands | Coastal – Natural – Coral Reefs | 13° 04’ 30” | 92° 42’ 05” |
| 10 | Point Calimere Wildlife and Bird Sanctuary | Tamil Nadu | Coastal – Natural - Lagoon, Inter-tidal mudflats, Mangrove | 10° 19’ 16” | 79° 37’ 53” |
| 11 | Pong Dam Lake | Himachal Pradesh | Inland – Man-made - Reservoir | 32° 00’ 14” | 76° 02’ 18” |
| 12 | Sambhar Lake | Rajasthan | Inland - Natural – Lake | 26° 56’ 08” | 75° 04’ 32” |
| 13 | Sundarbans | West Bengal | Coastal - Natural - Mangrove | 21˚ 56′ 00’’ | 88˚ 51′ 00’’ |
| 14 | Tawa Reservoir | Madhya Pradesh | Inland - Man-made - Reservoir | 22° 28’ 38” | 78° 06‘ 10” |
| 15 | Tso Moriri | Jammu & Kashmir | Inland-Natural–High Altitude Wetland | 32° 54’ 00” | 78° 19’ 03” |
| 16 | Udhwa Lake (Bird Sanctuary) | Jharkhand | Inland - Natural - Lake | 24° 58' 06" | 87° 48' 55" |
| 17 | Wular Lake | Jammu & Kashmir | Inland - Natural – Lake | 34 ° 21’ 09” | 74 ° 33’ 20” |
| 18 | Wandur Marine National Park | Andaman and Nicobar Islands | Coastal - Natural - Mangrove, Coral Reefs, Inter tidal mud flats, Sand/Beach, Creek | 11° 29' 12" | 92° 35’ 05" |

Table 110: Area estimates and status of Water-spread and Aquatic vegetation in important wetland sites of India (selected)

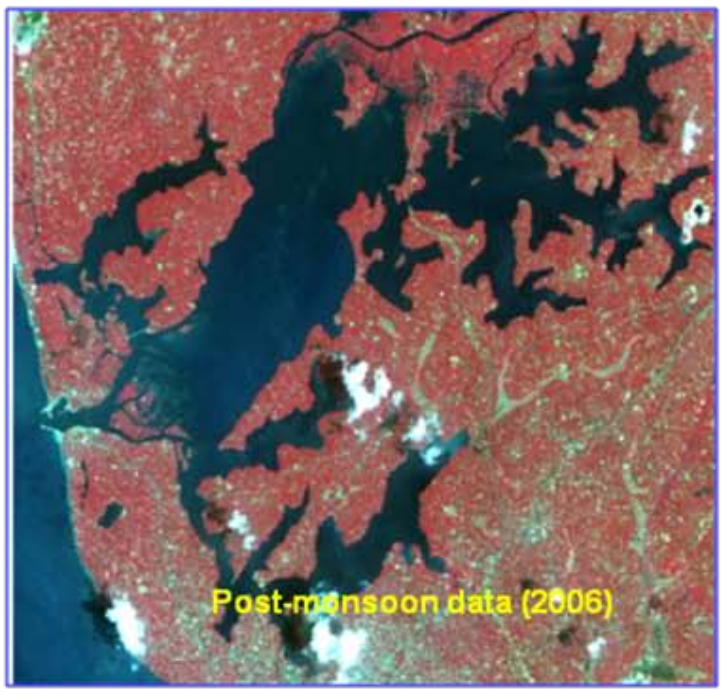
Area in ha

| Sr. No. | Wetland name | Area | Open Water | | Aquatic Vegetation | | Turbidity |
|---|---|---|---|---|---|---|---|
| | | | Post-monsoon | Pre-monsoon | Post-monsoon | Pre-monsoon | |
| 1 | Ashtamudi Wetland | 5598 | 5458 | 5458 | 1219 | 1219 | Low |
| 2 | Bakhira Wildlife Sanctuary | 4174 | 1860 | 957 | 1948 | 3957 | Low |
| 3 | Bhoj Wetland | 3420 | 3420 | 1666 | - | 1425 | Moderate |
| 4 | Chilika Lake | 89023 | 60699 | 52384 | 28432 | 37225 | Moderate |
| 5 | Deepor Beel | 589 | 353 | 105 | 335 | 591 | Low |
| 6 | Kolleru Lake | 83502 | 58973 | 44997 | 15305 | 31028 | Low |
| 7 | Loktak Lake | 24672 | 15260 | 14854 | 10212 | 10754 | Moderate |
| 8 | Nalsarovar | 14673 | 2618 | 424 | 12056 | 2865 | Low |
| 9 | North Reef Island Sanctuary | 1208 | - | - | - | - | - |
| 10 | Point Calimere Wildlife and Bird Sanctuary | 32010 | 22522 | 22627 | 509 | 1772 | Moderate |
| 11 | Pong Dam Lake | 24532 | 24508 | 20307 | - | 3731 | Low |
| 12 | Sambhar Lake | 24294 | 16165 | 14807 | - | - | High |
| 13 | Sundarbans | 210316 | - | - | 210316 | 210316 | - |
| 14 | Tawa Reservoir | 19715 | 19674 | 6476 | 41 | 677 | Moderate |
| 15 | Tso Moriri | 14530 | 14524 | 14524 | 0 | 6 | Low |
| 16 | Udhwa Lake (Bird Sanctuary) | 1605 | 434 | 139 | 803 | 789 | Moderate |
| 17 | Wular Lake | 11277 | 1712 | 4965 | 9481 | 6384 | High |
| 18 | Wandur Marine National Park | 28200 | - | - | - | - | - |

## 9.1 Ashtamudi Wetland

**Name: Ashtamudi Wetland**

**Location**:
Latitude: 8º 53′ 14" N to 9º 0′ 57" N
Longitude: 76º 31′ 54" E to 76º 40′ 2" E
1 km north of Kollam Town
**Area**: 5598 ha
**Wetland type**: Lagoon
**Average Annual Rainfall**:
2400 mm, mostly occurring during June to September
Declared as Ramsar site on *19/08/02*. An extensive estuarine system, the second largest in Kerala State, which is of extraordinary importance for its hydrological functions, its biodiversity, and its support for fish. The site supports a number of mangrove species as well as over 40 associated plant species, and 57 species of birds have been observed, including six that are migratory. Nearly 100 species of fish sustain a lively fishing industry, with thousands of fishermen depending directly upon the estuary for their livelihood. Population density and urban pressures pose threats to the site, including pollution from oil spills from thousands of fishing boats and from industries in the surrounding area and conversion of natural habitat for development purposes.
**Principal Vegetation**:
Ashtamudi Estuary has mangroves *Avicennia officinalis*, *Brugiera gymnorrhiza* and *Sonneratia caseolaris* as also 43 species of marshy and mangrove associates including two endangered species *Syzygium travancoricum* (endangered species according to the Red Data Book of Indian Plants) and *Calamus rotang* in the Terrestrial system. These species offer excellent scope for development of marine bioreserve to promote eco-tourism in the estuarine of the lake.
**Fauna**:
The lake supports 57 species of avifauna, of which 6 are migratory and 51 resident species. Terns, plovers, cormorants, and herons are most abundant birds in the lake.



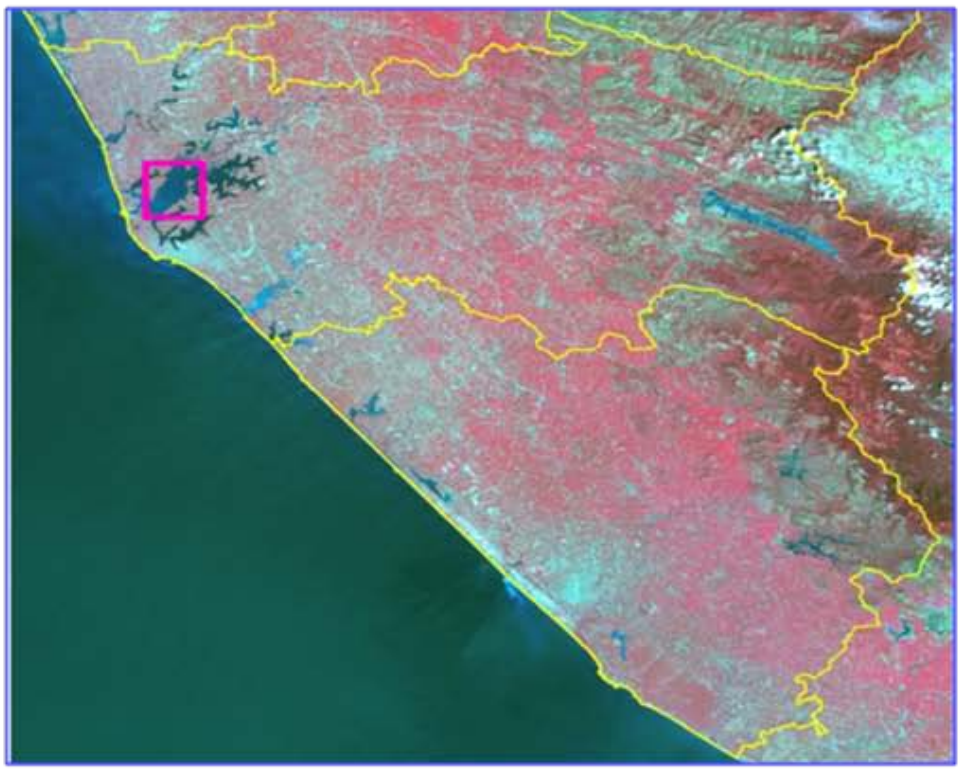
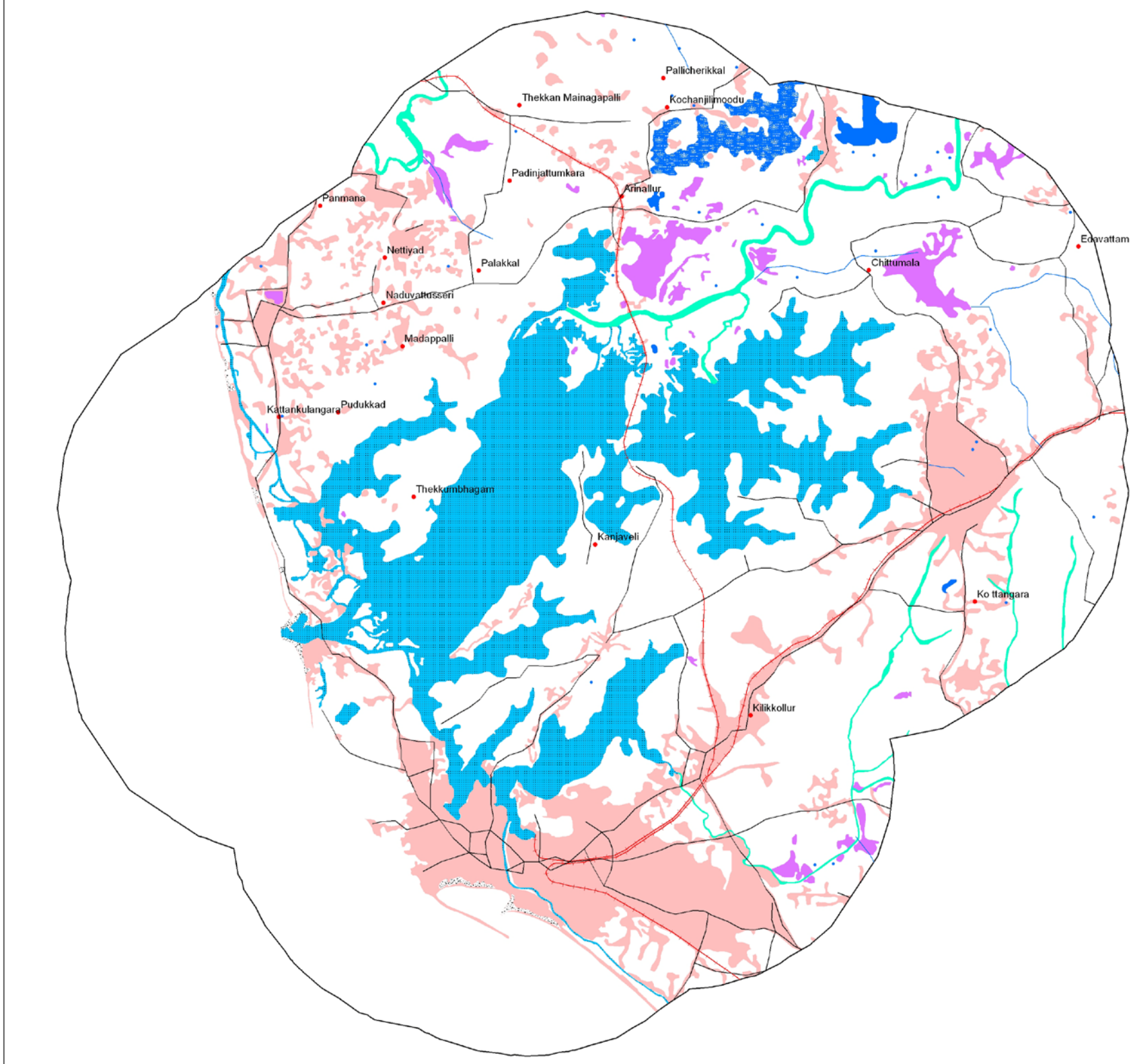




Plate 62: Ashtamudi wetland

State : Kerala

# WETLAND MAP

Ashtamudi Wetland




| 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 (<2.25ha)
- Roads
- Railway
- Drainage (line)
- Settlements
- Town/Settlements
- District boundary
- State boundary
- 5 km buffer area

## 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
Kerala State Remote Sensing and Environment Centre, Thiruvananthapuram

**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 63: Wetland map - 5 km buffer area of Ashtamudi wetland

State : Kerala

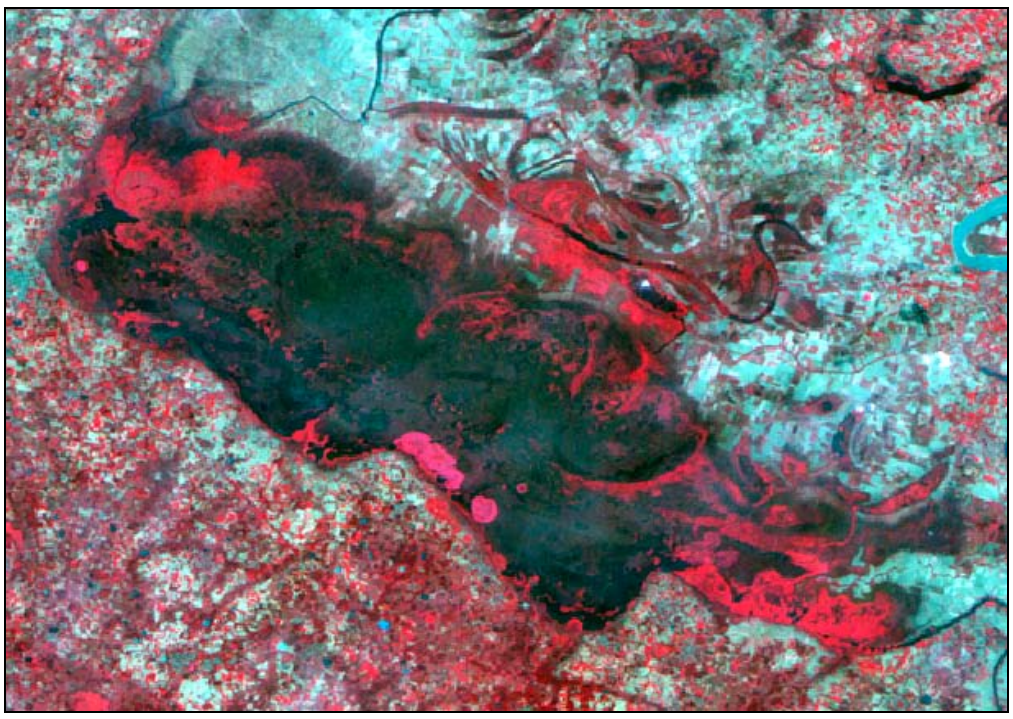
Ashtamudi Wetland

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

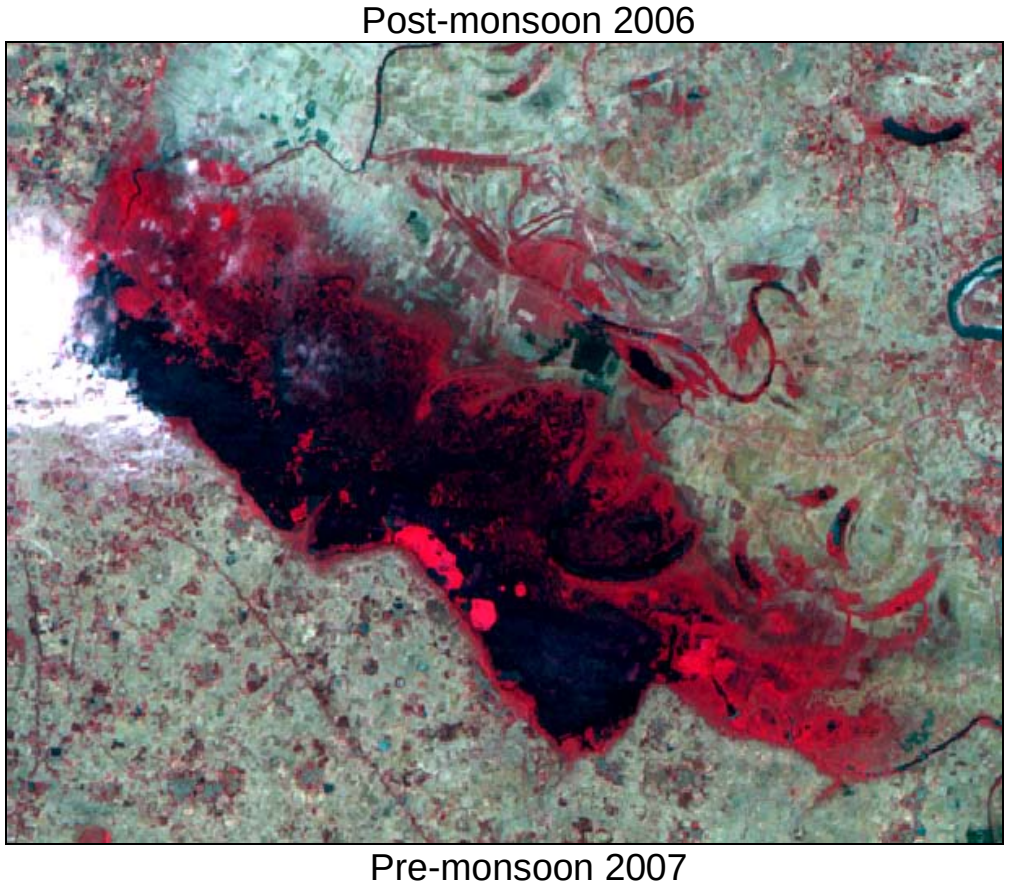
Plate 64: IRS LISS-III FCC - 5 km buffer area of Ashtamudi wetland

## 9.2 Bakhira Wildlife Sanctuary

| **Name** | **Bakhira Wildlife Sanctuary** |
|---|---|
| Location | Between $26^0$52'10'' N and $26^0$56'38'' N latitudes and $83^0$05'16'' E and $83^0$12'18'' E longitudes |
| Area | 3905 ha |
| Salient features | Bakhira Wildlife Sanctuary is situated in Sant Kabir Nagar district. The sanctuary is named after the village Bakhira located adjacent to the lake. The sanctuary was established in 1990 and is situated 44 km east of Gorakhpur city. Poaching, hunting, shooting of birds are common threat to this wetlands. Fishing is also very common. |
| Turbidity | Moderate |
| Vegetation | Dense aquatic vegetation occurs along the margins and within the lake are *Ipomoea aquatica, Ipomoea purpures, Nymphaea sp., Pistia stratiotes, Eichhornia crassipes, Trapa bispinosa, Nelumbo nucifera, Hydrillia sp., Lemna paucicostata, Wolftic, Spirodela, Azolla* etc. |
| Fauna | Migratory and resident birds visiting this sanctuary are Pintail, Graylag Goose, Bareheaded Goose, Teals, Mallard, Wigeon, Garganey, Shoveller, Red Crested Pochard, Tufted duck, Comb duck, Goosander, Darter, Spoon Bill, Herons, Egrets, White Ibis, Painted stork, The Brahminy kite, Hawk Eagle, Indian Moorhen, Water hen, Purple Moorhen, Bronze Winged Jacauna, Plover, Koel, Parrot, Peacock, Cuckoo, Cormorant etc. |



Post-monsoon 2006



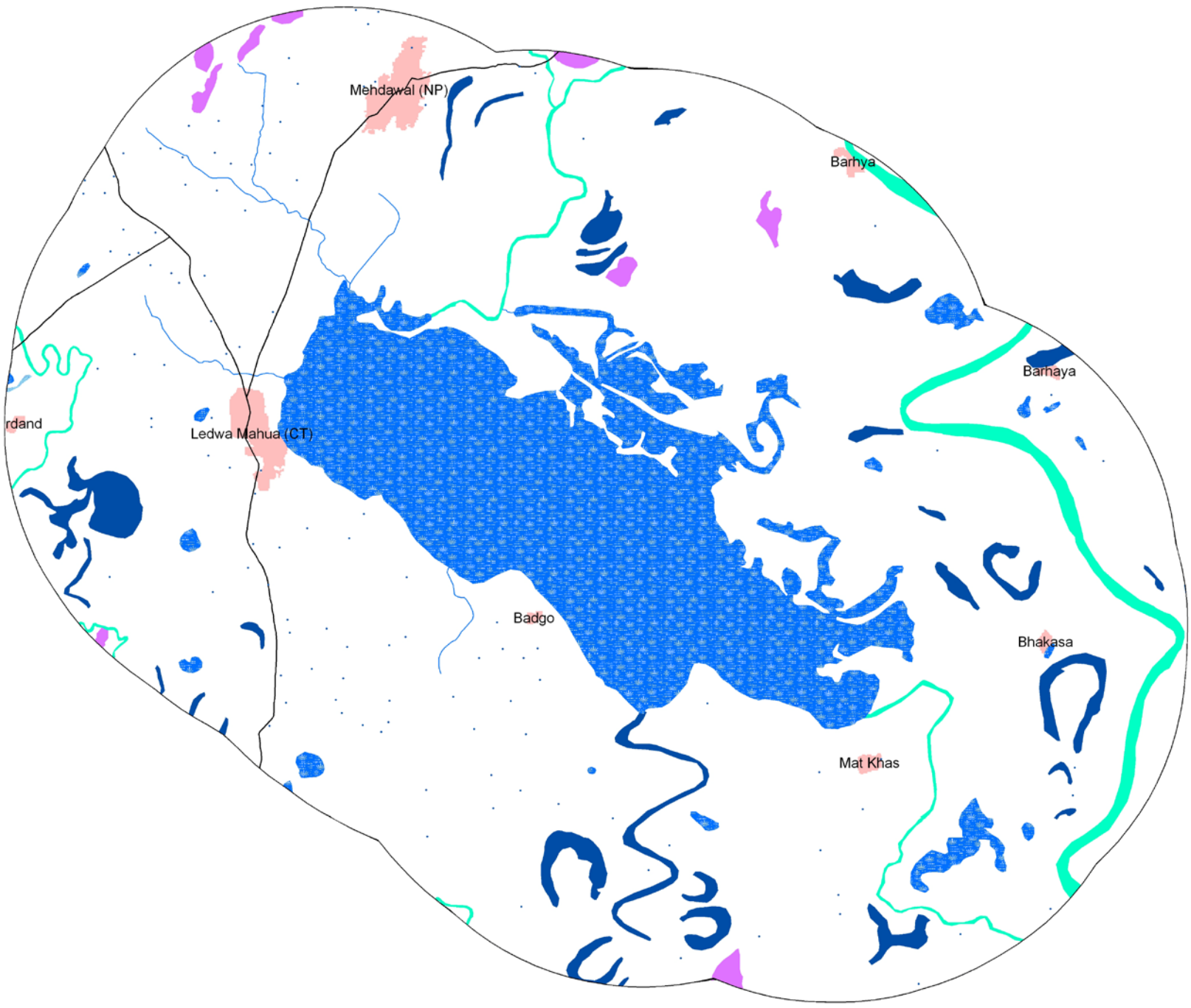
Pre-monsoon 2007

Plate 65: Bakhira Wildlife Sanctuary

State : Uttar Pradesh

# WETLAND MAP

Bakhira Wildlife Sanctuary

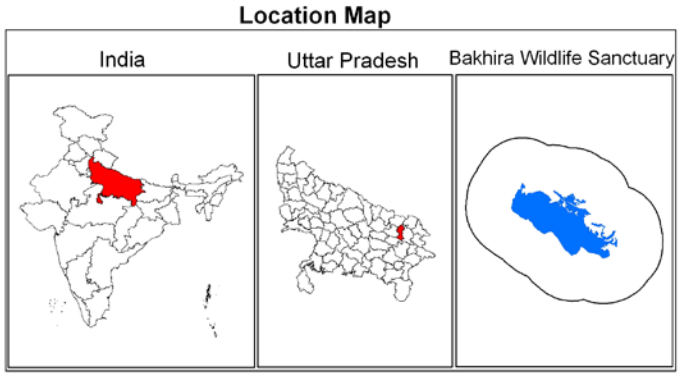



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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**

Remote Sensing Applications Centre, Uttar Pradesh, Lucknow
and
Space Applications Centre (ISRO), Ahmedabad

**Sponsored by**

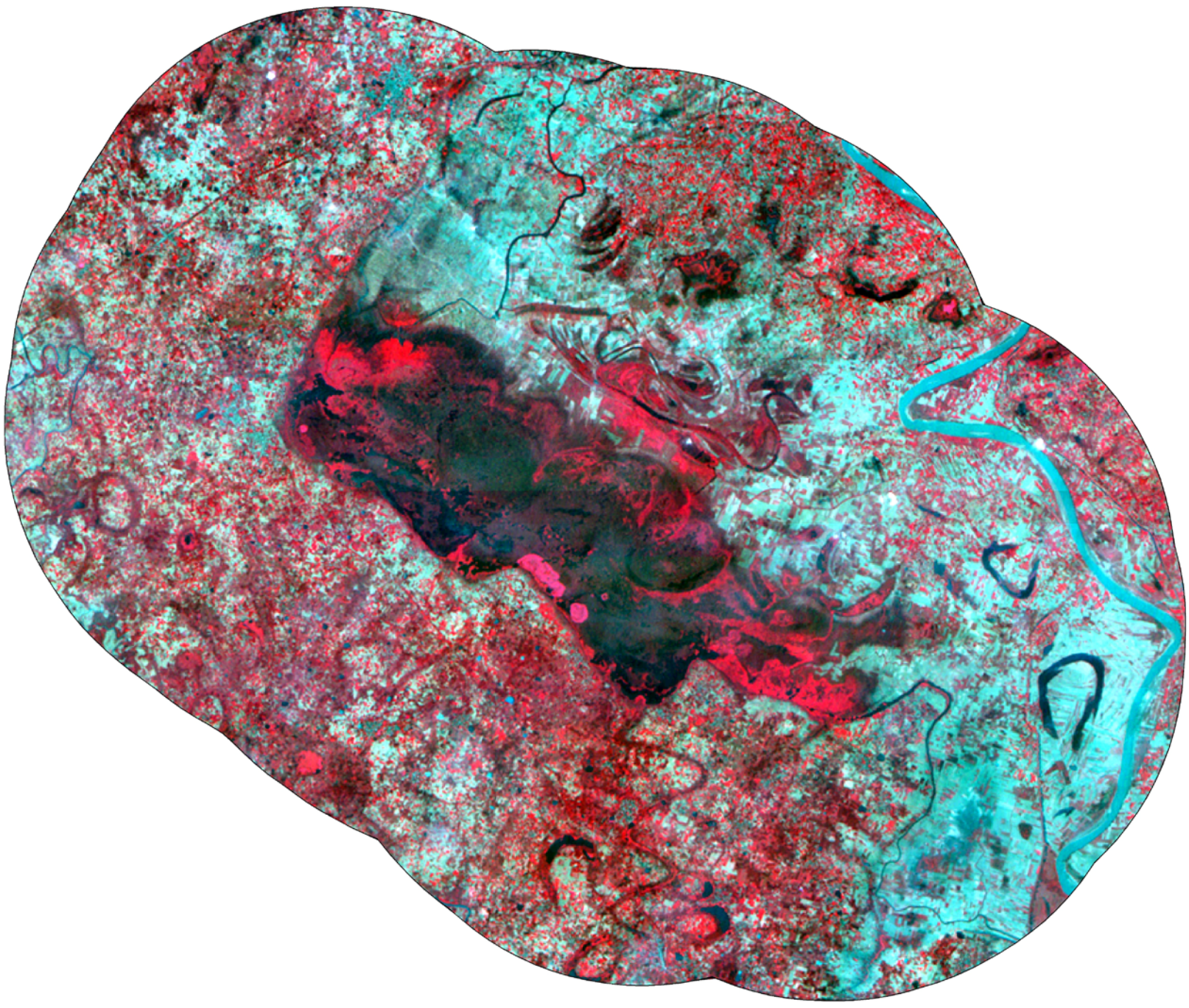
Ministry of Environment and Forests
Government of India

Plate 66: Wetlands map- 5 km buffer area Bakhira Wildlife Sanctuary

State : Uttar Pradesh

**WETLAND MAP**

Bakhira Wildlife Sanctuary

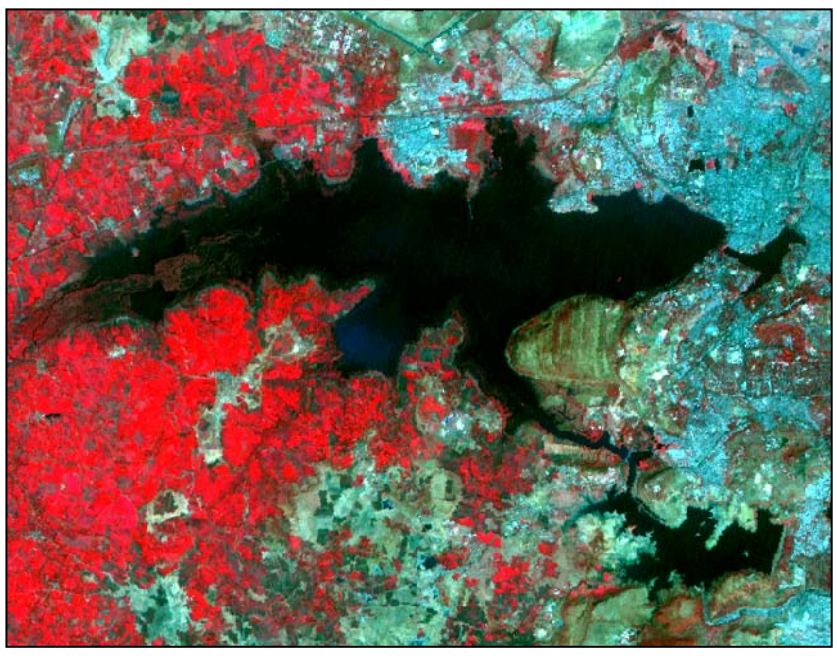


IRS P6 LISS-III post monsoon data (2006)

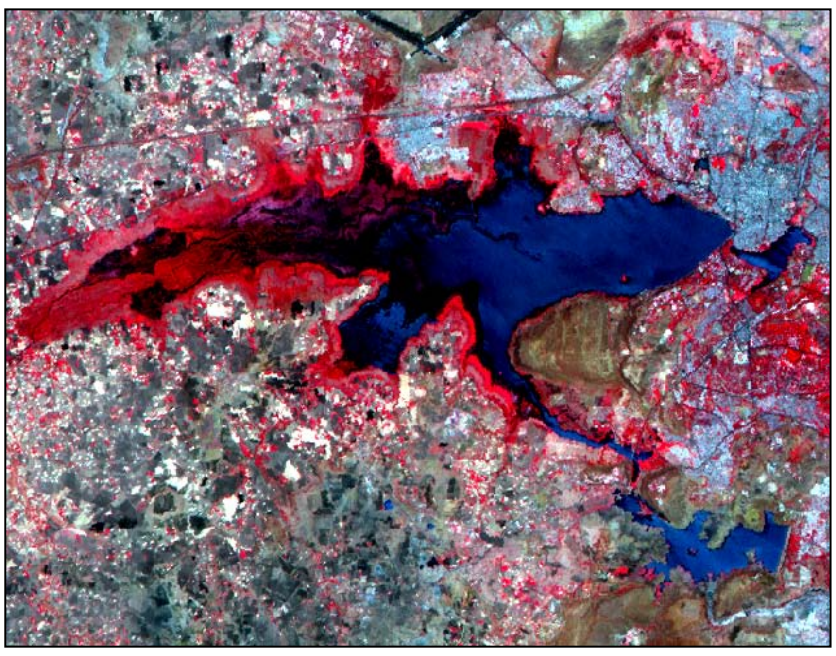
Plate 67: IRS LISS-III FCC – 5 km buffer area of Bakhira Wildlife Sanctuary

## 9.3 Bhoj Lake

| Name | Bhoj Lake (Bhoj wetland) |
|---|---|
| Location | Between $23^0$ 11' 16" N and $23^0$ 16' 28" N latitudes and $77^0$ 16' 15" E and $77^0$ 24' 35" E longitudes |
| Area | 3419 ha |
| Climate | Tropical monsoon climate. Water temperature ranged from 19.3 to $30.4^0$ C in Upper Lake and 18.6 to $37^0$ C in Lower Lake. |
| Salient features | Upper lake was constructed by Raja Bhoj of Dhar (1000-1055). There are mainly 22 inflow points which brings untreated human wastes and allocthonous material, agricultural residues from the village areas etc., from the residential and commercial areas find their way into the lake. The major problems associated with this wetland are sedimentation, eutrophication, growth of aquatic weeds and depletion of fish. During summer anaerobic conditions are common and fish mortality observed on regular basis. Some times the lake dries up and forms ideal play ground and also create scarcity of drinking water supply to industrial areas such as, railways and BHEL. |
| Turbidity | Moderate to High |
| Vegetation | Species of Hydrilla verticillata, Myriophyllum spathulatum, and Potamogeton pectinatus, Najas minor, Vallisneria spralis, Trapa bispinosa, Eichhornia crassipes, Azolla pinnata and Polygonum glabrum. |
| Fauna | About 26 species of birds have been recorded from the lake. Some of these are coot, red-headed pochard, wigeon, spotbill, shoveller, common teal, white-eyed pochard, dabchick, comb duck, common gallinule, purple moorhen, common snipe, black winged stilt, red-wattled lapwing, reef heron, grey heron, cattle egret, little egret, pond heron, white ibis, sarus crane, little cormorant, pied kingfisher, white-breasted king-fisher and darter. |



Post-monsoon 2006



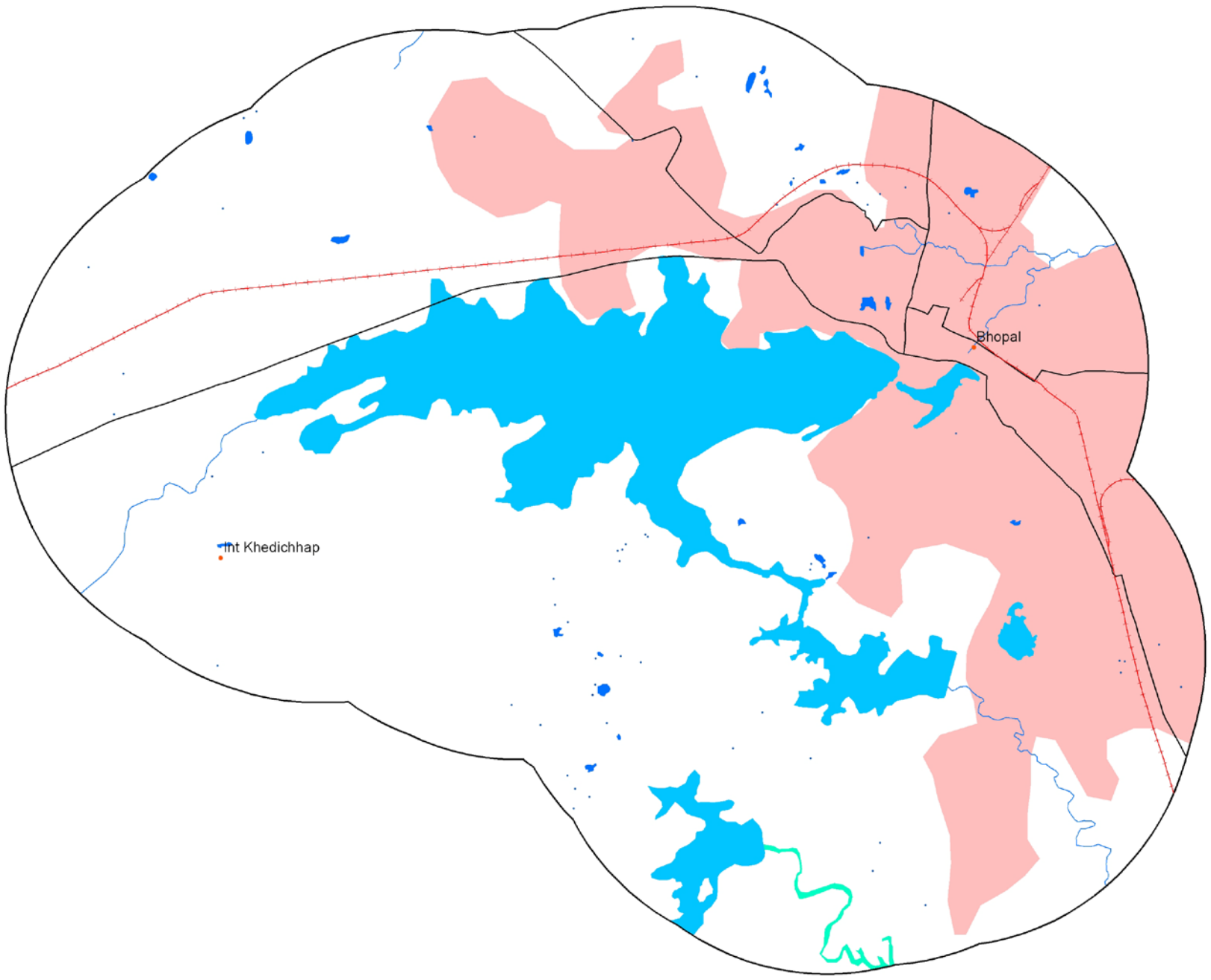
Pre-monsoon 2007

Plate 68: Bhoj Lake

State : Madhya Pradesh

# WETLAND MAP

Bhoj Reservoir

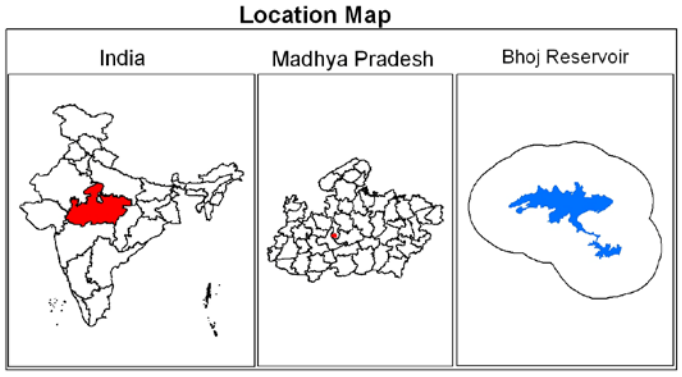



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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**




Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Remote Sensing Applications Centre, (MPCST), Bhopal, M.P.

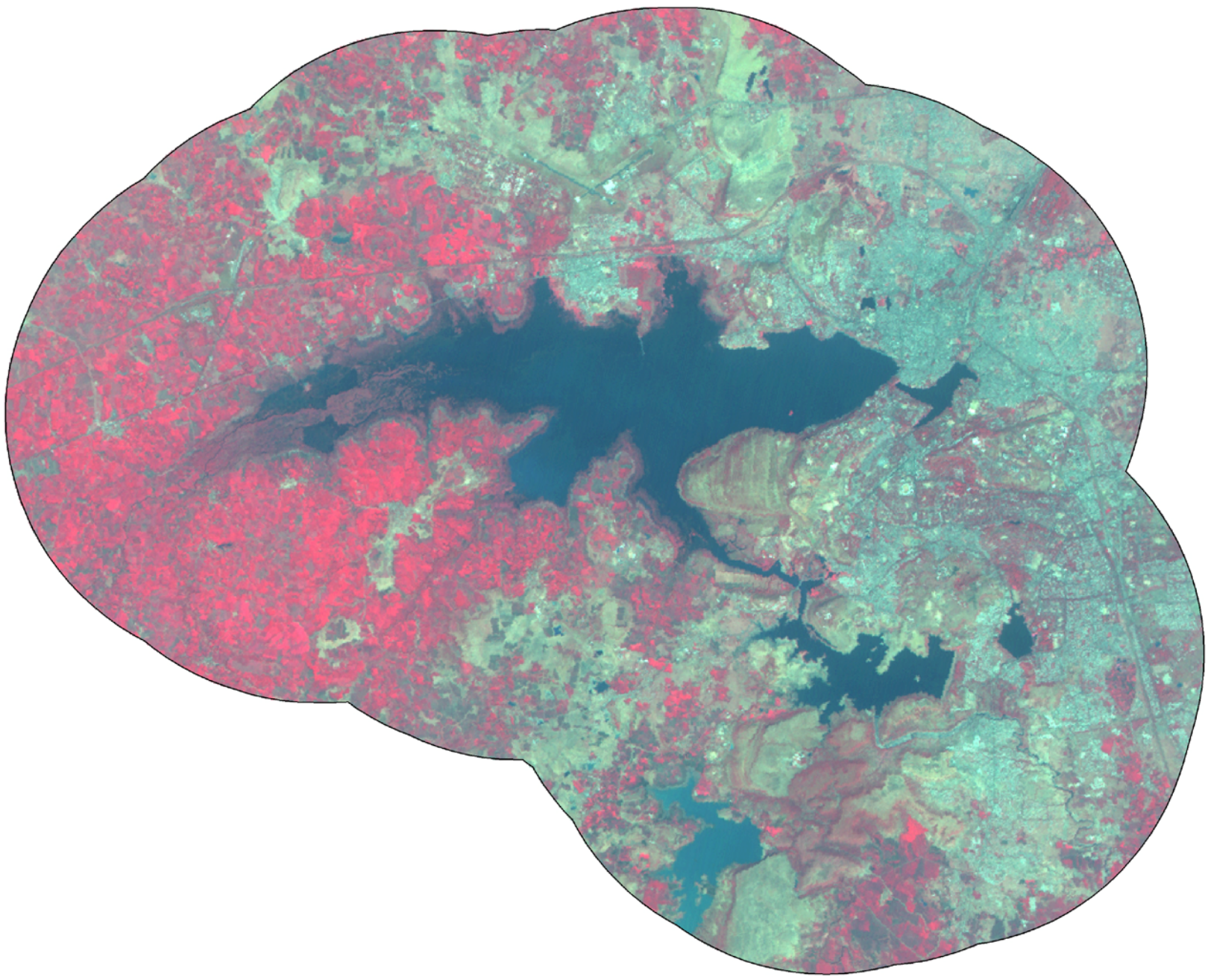
Sponsored By:

Ministry of Environment and Forests
Government of India

Plate 69: Wetland map - 5 km buffer area of Bhoj Lake

State : Madhya Pradesh

Bhoj Reservoir



IRS P6 LISS-III post monsoon data (2006)

Plate 70: IRS LISS III FCC - 5 km buffer area of Bhoj Lake

## 9.4 Chilika Lagoon

**Name:** Chilika

**Location:** 85°04'14" - 85°49'13" E

19°26'31" - 20°05'35" N

**Wetland Type:** Lagoon

**Area**: 89023 ha

Chilika lagoon is situated in Puri and Ganjam districts of Orissa on east coast. Chilika is the largest brackish-water lagoon in India and perhaps the second largest in the world. It was declared as a sanctuary in 1973 and latter designated as Wetland of International Importance under Ramsar Convention in 1981.

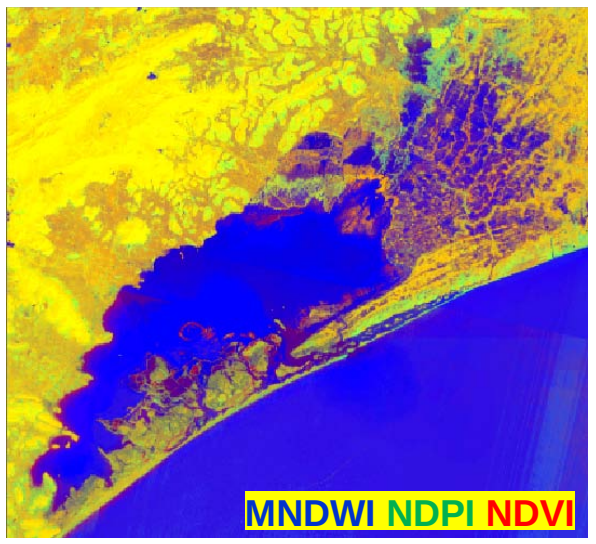
The lagoon experiences a typical tropical monsoon climate with temperatures ranging from 17.5°C to 32.5°C. The variation in salinity between 0.1 to 36 %. The pH varies between 6.8 to 9.7. The Bhargavi and Daya rivers in the north are the main besides other eight rivers that bring in an estimated 375,000 cusecs of monsoon fresh water in to the lagoon. The annual sediment load due this inflow water is estimated to be about 13 Mmt. The lake is connected to the Bay of Bengal by channel through a sand ridge in the north-east.

**Flora:** 22 species algae,150 species of vascular plants are recorded in the lagoon. The dominant emergent plants are *Pragmites karka*, *Typha angustata*, *Cyperus sp*. and *Kailinga triceps*. Submerged vegetation is dominated by *Enteromorpha sp*., *Gracillaria sp*., *Cladophora sp*., *Polysiphonia sp*., *Najas sp*., *Chara sp*., *Hydrilla sp*. and *Potomageton sp*.

**Fauna:** It has 267 species of fishes, 35 species of crabs and 29 species of shrimp and prawns. Nearly 225 bird species in the peak winter season. The lagoon hosts over one million migratory birds with flocks of ducks (Anatinae), Geese (Anserinae), Flamingos (*Phoenicopterus sp*.), Pelican (*Pelecanus sp.*), Plover (*Charadrius sp.*), Gulls (*Larus sp.*) and Terns (*Sterna sp.*). It is home to seven species of amphibians mainly frogs and toads. It also forms a habitat to 24 species of reptiles comprising soft-shelled turtles, lizards, snakes. It shelters the largest population (158) of endangered Irrawaddy dolphin.

**Threats:** Sediment load, proliferation of emergent vegetation, pollution from domestic and industrial waste.


**IRS P6 LISS-III FCC (12/10/2006)**



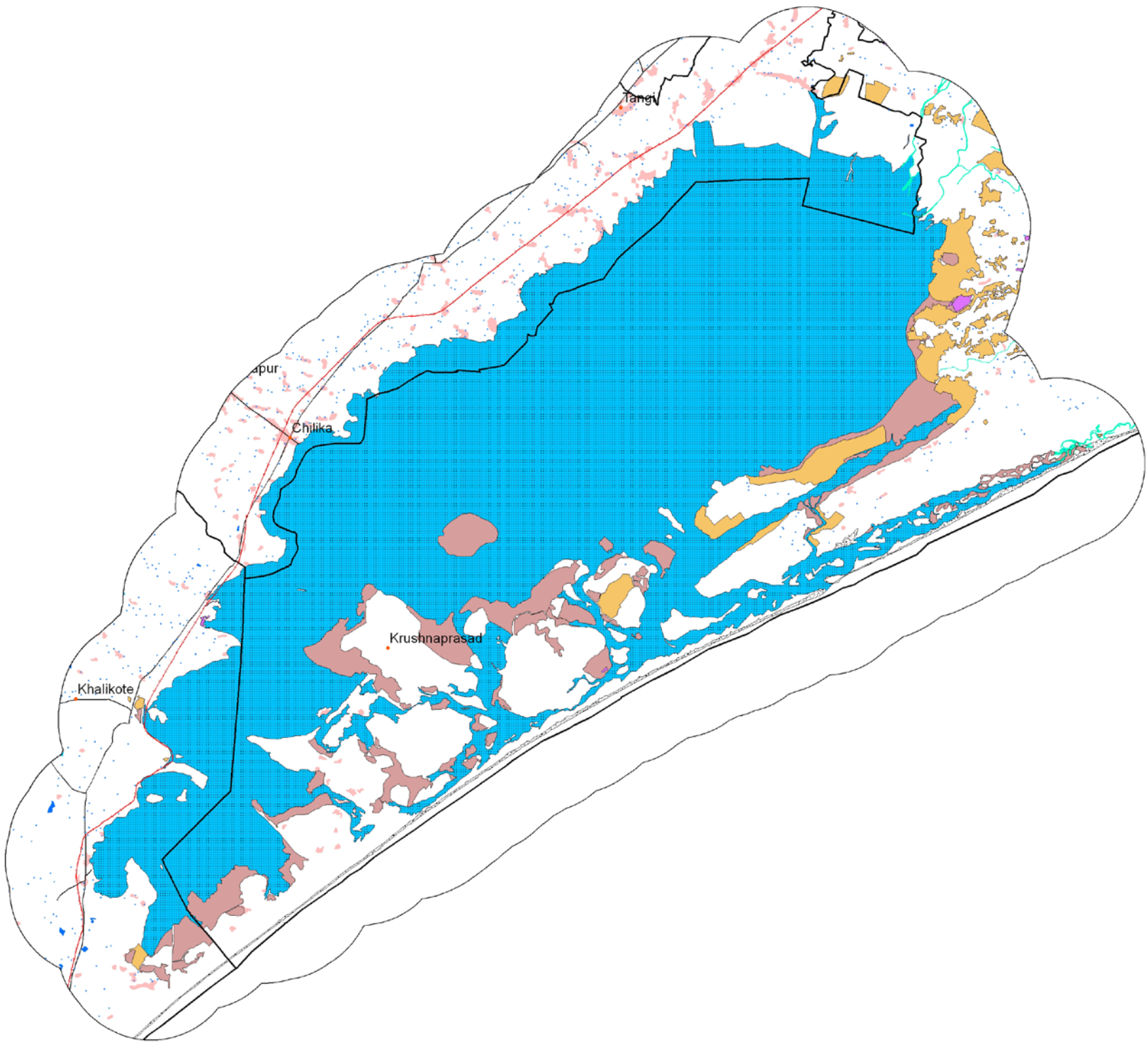

**FCC OF INDICES (12/10/2006)**

Plate – 71: Chilika Lagoon

State : Orissa

# WETLAND MAP

Chilika Lagoon

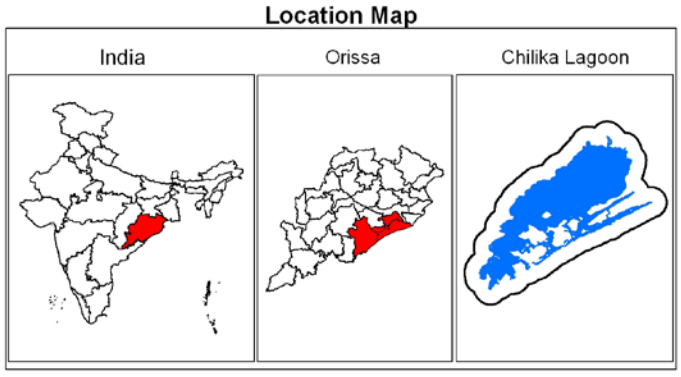



| Symbol Typecode | Level I | Level II | Level III |
|---|---|---|---|
| | Inland Wetlands | | |
| | | Natural | |
| 1101 | | | Lakes/Ponds |
| 1102 | | | Ox-bow lakes/ Cut-off meanders |
| 1103 | | | High altitude wetlands |
| 1104 | | | Riverine wetlands |
| 1105 | | | Waterlogged |
| 1106 | | | River/Stream |
| | | 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
- Canal
- Railway
- Drainage (line)
- Roads
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

**Location Map**




0 3 6 12 Kilometers

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

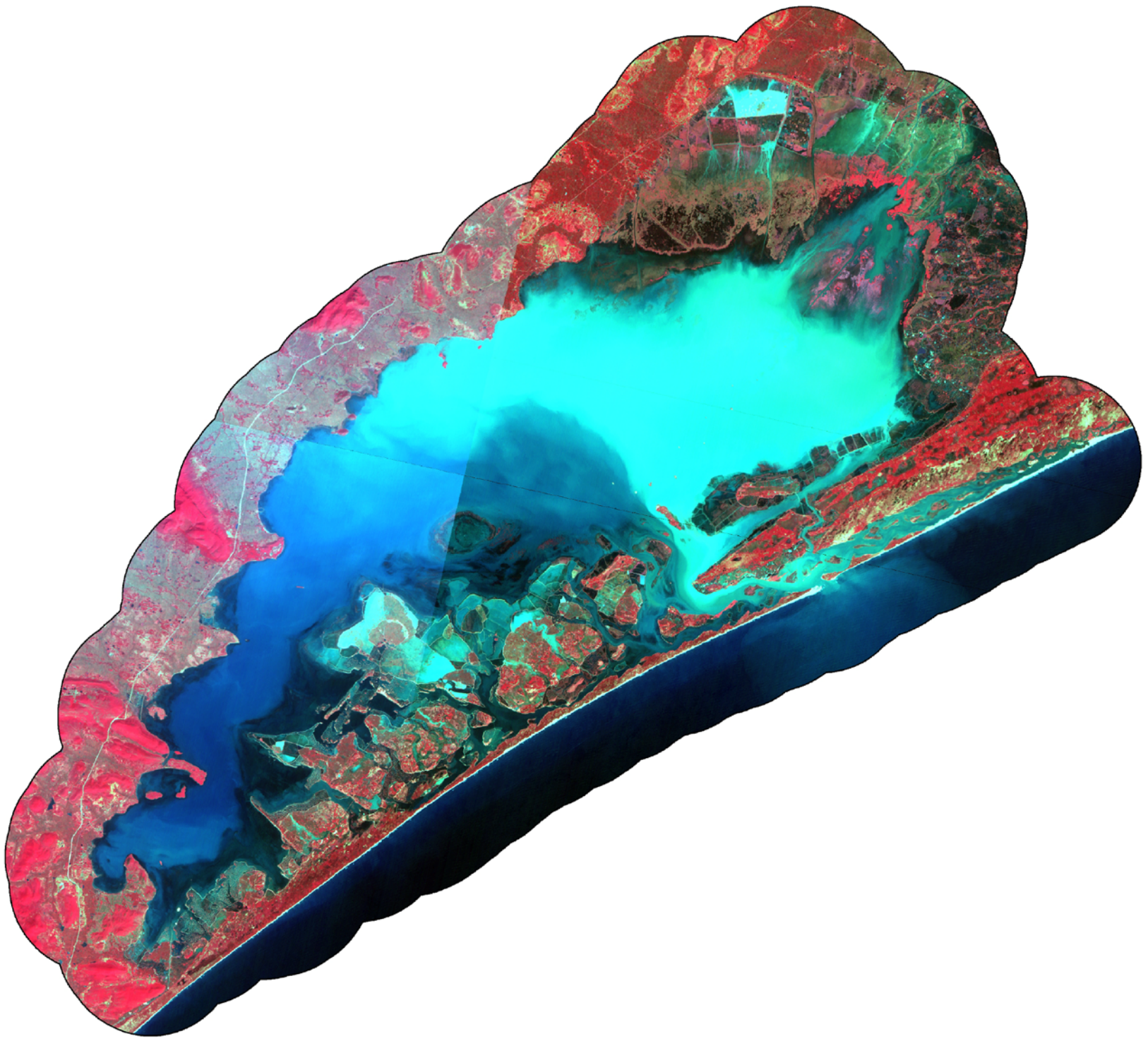
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Orissa Space Applications Centre, Bhubaneswar

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 72: Wetland map - 5 km buffer area of Chilika lagoon

State : Orissa

Chilika Lagoon

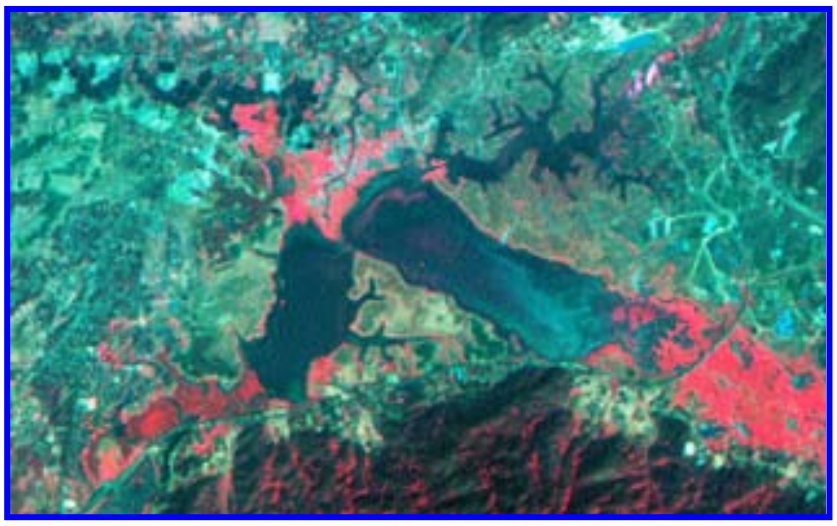


IRS P6 LISS III post-monsoon data (2006)

Plate 73: IRS P6 LISS-III image - 5 km buffer area of Chilika lagoon

## 9.5 Deepor Beel

| Name | Deepor Beel |
|---|---|
| Location | 26° 07' 30" N, 91° 38' 35" E<br>District: Kamrup<br>Ownership: State, Fishery Department |
| Area | 589 ha |
| Wetland Type | Freshwater Swamp, Lake |
| Climate | Rainfall : >2000 mm<br>Temperature: 7 °C to 37 °C |
| Status | Wildlife Sanctuary, established in January 1989. Presently it is a Ramsar Site (designated in November 2002). |
| Description | This is a fresh water lake, on the southern bank of the Brahmaputra River, covering an area of about 900 ha. The main source of water of this lake is from rainfall runoff and from the Basistha and Kalamoni rivers. The *Beel* drains into the Brahmaputra River, located about 5 km away through a small rivulet called Khanajan. The southern side of the lake is contiguous with Rani Reserve Forest. About half of the *Beel* dries out during the winter and the exposed shores are converted into paddy fields. At maximum flooding, it is *c*. 4 m deep, while during the dry season, the depth drops to about 1.0 m.. |
| Bio-diversity | A large variety of aquatic flora of tropical wetland is found in Deepor *Beel* and its adjoining areas. The dominant aquatic plants include *Azolla pinnata, Nymphaea rubra, Ottelia alismoides, Eleocharis plantaginea, Pistia stratiotes ,Hydrilla verticillata, Potamogeton crispus, Ipomoea reptans, Sagittaria sagittifolia, Nymphaea albea, Vallisneria spiralis.* The giant water lily (*Euryale ferox*) also grows here. *Eichhornia crassipes is the dominate weed.*<br><br>The diversity and concentration of indigenous fresh water fish species in this lake is very high (around50 species under 19 families). It harbors many species of migratory birds in winter as well as resident birds. Around 150 species of birds have been recorded so far in and around the Sanctuary, including nine threatened species. The wetland is used for fishery, domestic water supply, collection of natural products, fodder and food supply, transport, and recreation. |
| Current Status | Current status: Heavy siltation, pollution from city/industry effluents, poaching and unregulated fishing, encroachment**.** |
| | As observed in the image, the beel is fragmented, surrounded with waterlogged areas in the 5 km buffer zone. The intensive growth of the weed water hyacinth is very prominent. The field photograph shows the shallowness of water, growth of vegetation in and around the lake. |



IRS LISS-III Post monsoon data (November 1, 2006)

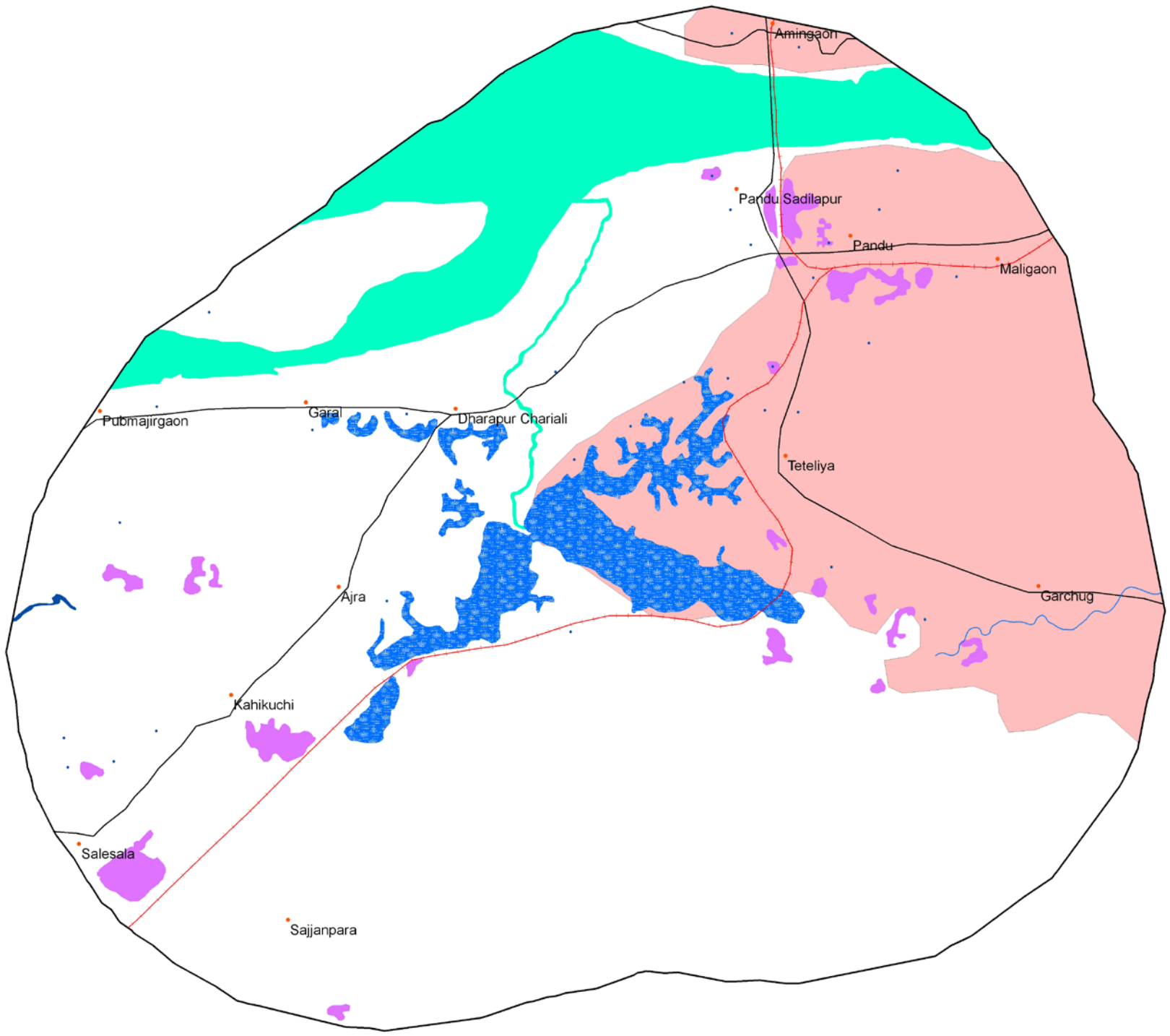
IRS LISS-III Pre-monsoon data (May 27, 2007)

Plate 74: Deepor Beel

State : Assam

# WETLAND MAP

Deepor Beel

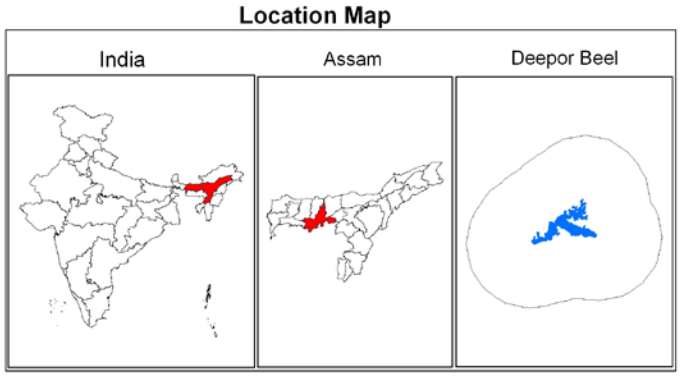



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

**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
Assam Remote Sensing Applications Centre, Guwahati

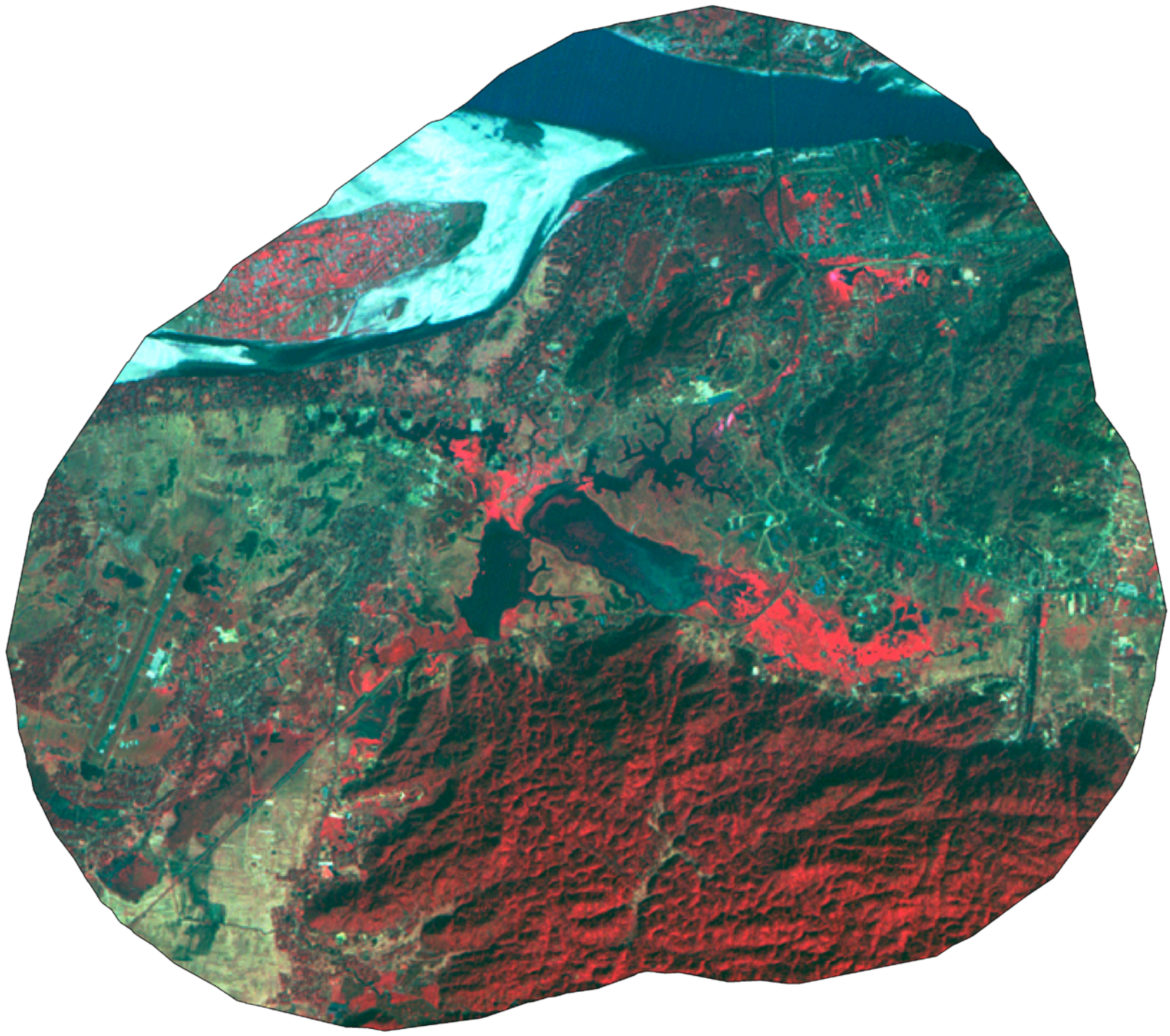
**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 75: Wetland map - 5 km buffer area of Deepor Beel

State : Assam

Deepor Beel



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

Plate 76: IRS LISS III FCC - 5 km buffer area of Deepor Beel

## 9.6 Kolleru Lake

Kolleru Lake:

Kolleru Lake is located 60-km away from Vijayawada near Eluru, West Godavari district. It is the largest fresh Water Lake in the country. The lake is extends over 83501 ha (depending on water spread) of wetland and marshes surrounding the Kolleru Lake, between the Krishna and Godavari deltas. It is described as "Peerless Fisherman's Paradise and Birds heaven" in the Imperial Gazetteer. Geologically the lake is said to be formed by siltation from Krishna and Godavari Rivers the water spread of the lake is purely dependent upon the intensity of monsoon runoff. The maximum depth of lake is 3 m during monsoon period and the water spread in the lake goes upto 90,000 ha; at 2 m contour the water spread will be about 13,500 ha; over thirty canals and streams enter the lake from the adjoining cultivated farm lands. Major streams that contribute fresh water to the lake are (a) Budameru, (b) Thammileru, and (c) Ramileru. Upputeru is the only outlet which drains the lake waters into Bay of Bengal. The lake shows high values of total alkalinity, hardness, and nitrates as compared to similar water bodies located elsewhere in India.

The flora mainly consists of aquatic weeds like *Ipomoea aquatica, Scripus sp., Pharagmites sp., Ottelia sp., Typha sp.* etc. and certain trees species like Albezzia, Rain tree, Palmyrah, Prosopis and coconut. The lake supports a rich biodiversity and high biomass of fish, plankton that forms the source of food for birds.

Pelicans arrive here during the nesting season to raise their young. In winter great activity can be seen here. The babble of Pelicans can be heard a quarter of a mile away. Apart from pelicans, one can find grey herons, white ibis, pond herons, egrets and many migratory ducks and water birds. Birds like Teals and Pintails are the main species. Other species include painted storks, open bill storks, grey Herons, cormorants, white Ibises, glossy Ibises, egrets, Reef Herons, Ducks, Coots, Shovellers, Terns, Jacanas, Moorhens etc can be seen here. Migratory Birds from Australia, Siberia, Egypt and Philippines assemble near the Kolleru Lake in search of a suitable place for their survival. These birds include some of the exclusive varieties like the Open Billed Stork, Shovellers, Painted Stork, Pintails, Glossy Ibises, Teals and Red Chested Podchards. Numerous other varieties of birds are also found in the Kolleru Lake Bird Sanctuary.

Principal threat to the lake is from increased expansion of agriculture and aquaculture activities in the area. Further the lake is also being used as a dumping yard for industrial pollutants also, and a spurt in this activity is observed leading to severe eutrophication conditions in the lake. Bunding of water inlets into the lake are reducing the inflows during summer and when water requirements for agriculture purpose are high and the availability of water has become low.

Field photographs of Kolleru lake

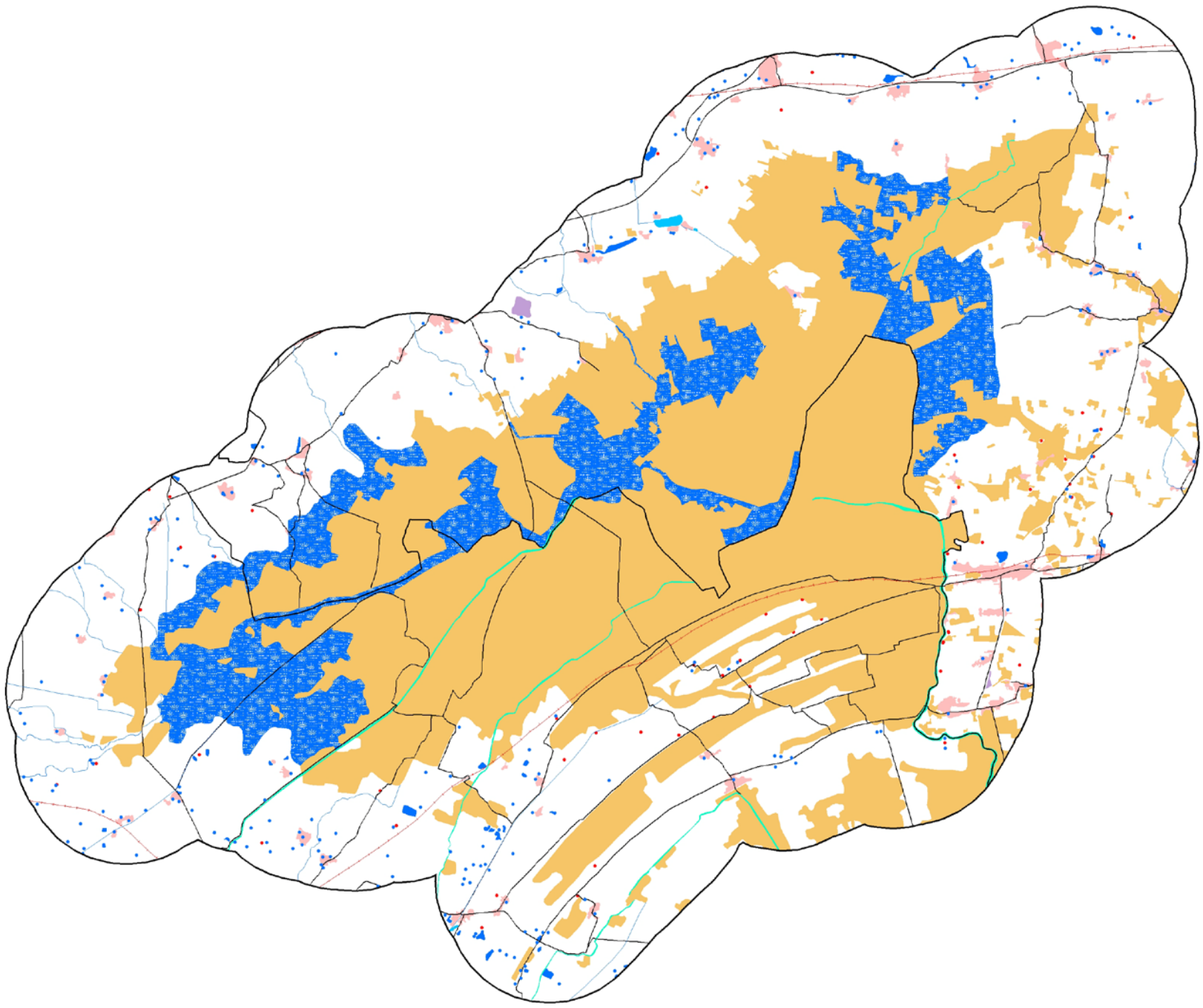
IRS P6 LISS-III image: Part of Kolleru lake

Plate 77: Kolleru Lake

State : Andhra Pradesh

# WETLAND MAP

Kolleru Lake

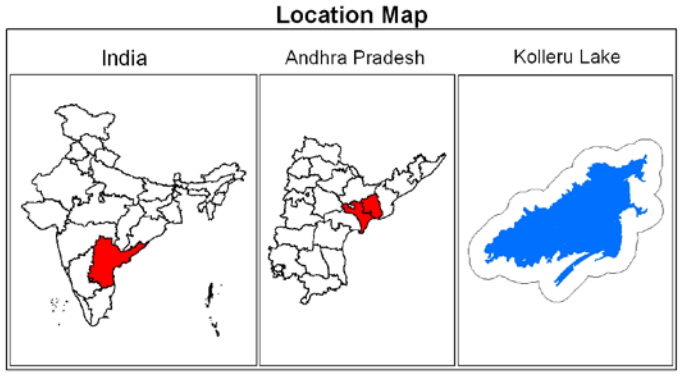


| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Drainage (line)
- Major Roads
- Railway
- Settlements
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

**Location Map**




4 2 0 4 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
A.P. State Remote Sensing Applications Centre, Hyderabad

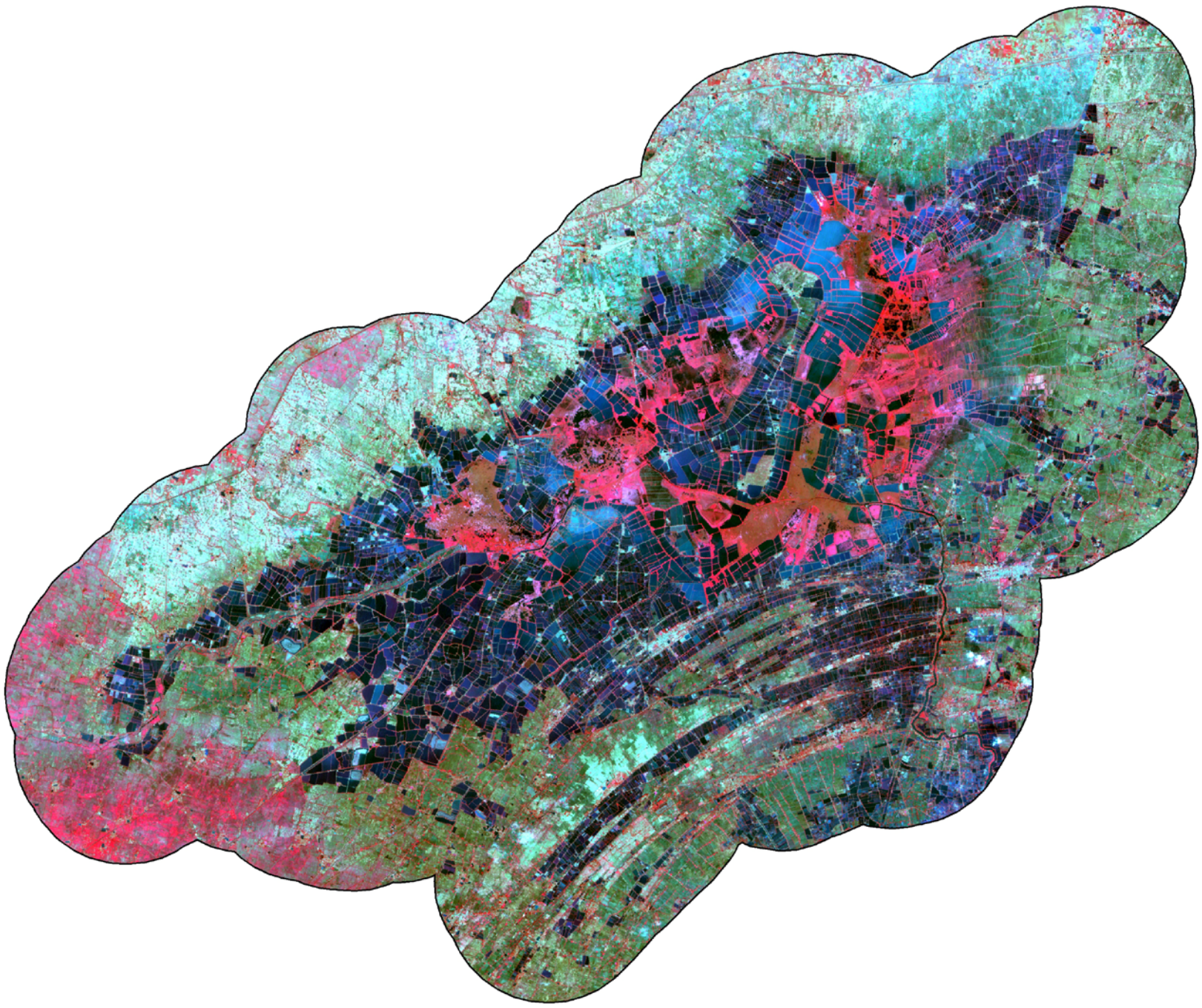
**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 78: Wetland map - 5 km buffer area of Kolleru Lake

State : Andhra Pradesh

Kolleru Lake

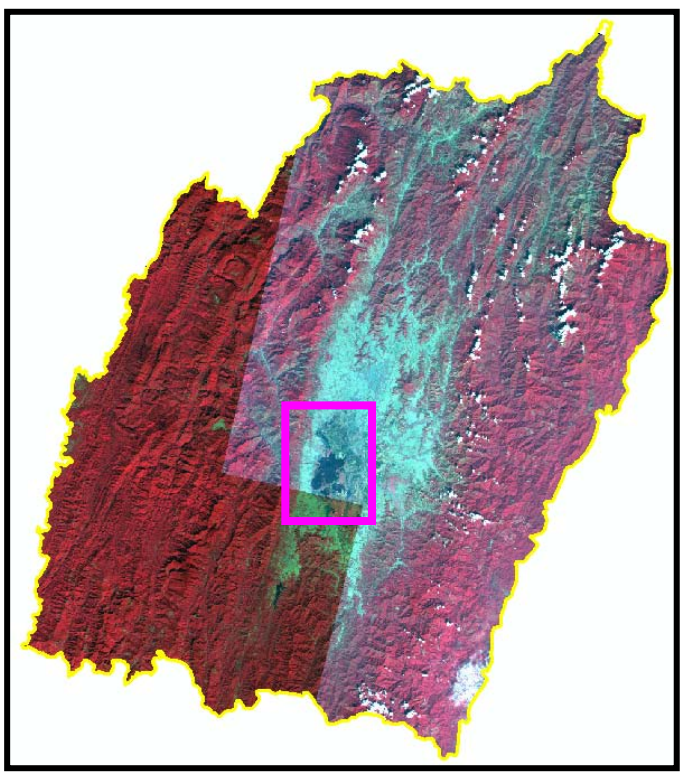


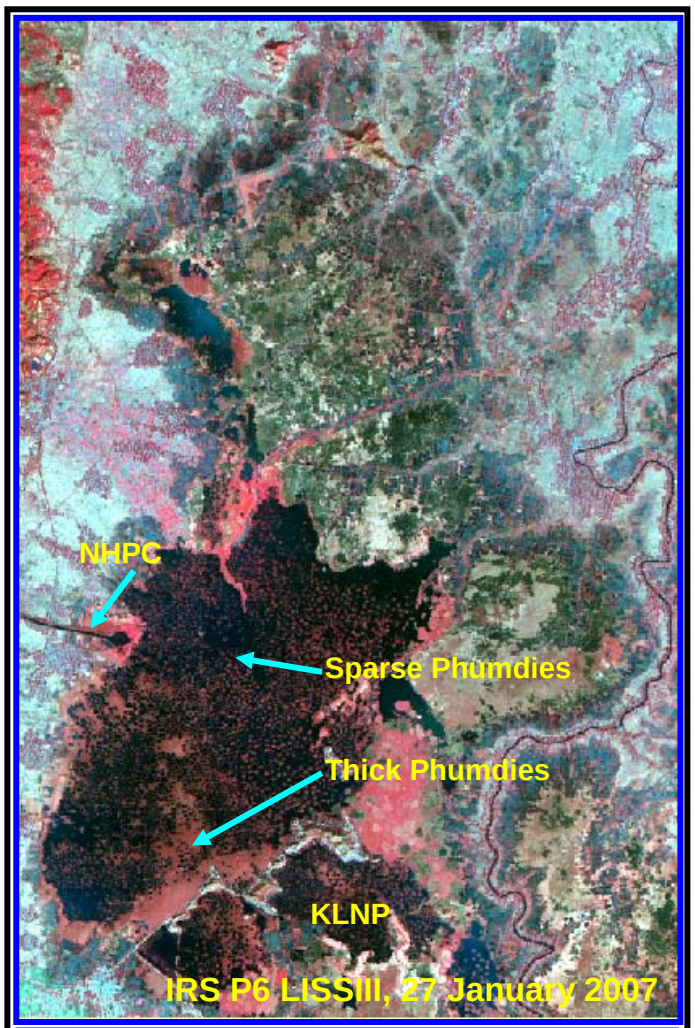
IRS P6 LISS-III Post-monsoon data (2006)

Plate 79: IRS LISS-III FCC - 5 km buffer area of Kolleru Lake

## 9.7 Loktak Lake

| | |
|---|---|
| Name | **Loktak Lake** |
| Location | Between $24^0$ 25 ’ N and $24^0$ 41’ N latitudes and $93^0$ 46 ‘ E and $93^0$ 55 ‘ E longitudes |
| Area | 246.72 sq km |
| Altitude | 770 m |
| | The lake has no definite shoreline; the expanse of water and its depth varies with the season. There are 54 villages along the periphery, including five towns. |
| Climate | Average annual rainfall : 1183 mm<br>Temperature: $0^o$ to $35^o$ C. |
| Morphometric features | Maximum length: 26 km<br>Maximum breadth: 13 km<br>Maximum depth: 4.58 m<br>Average depth: 2.07 m |
| Turbidity | Moderate |
| Vegetation | The Important vegetation of the phumdis recorded are Eichornia crassipes, Phragmites karka, Oryza sativa, Zizania latifolia, Cynodon spp., Limnophila spp., Sagitlaria spp., Saccharum latifolium, Erianthus pucerus, Erianthus ravennae, Lersi hexandra, Carex spp.; Phragmites karka is reported to be the dominant specie. In the habitat patch with rooted floating plants, vegetation comprises the a) Nelumbo nucifera, b) Trapa natans, c) Euryale ferox, d) Nymphaea alba, e) N. nouchali, N. stellata and f) Nymphoides indica |
| Fauna | A great diversity of invertebrate and vertebrate fauna are associated with Loktak. |
| | Southern part of Loktak lake is declared as Keibul Lamjao National Park(KLNP) |
| | Due to its rich biodiversity & socio-economic importance, the Loktak Lake has been designated as one of the Ramsar Site for the identifying wetlands of international importance under the Ramsar Convention in 1990. |





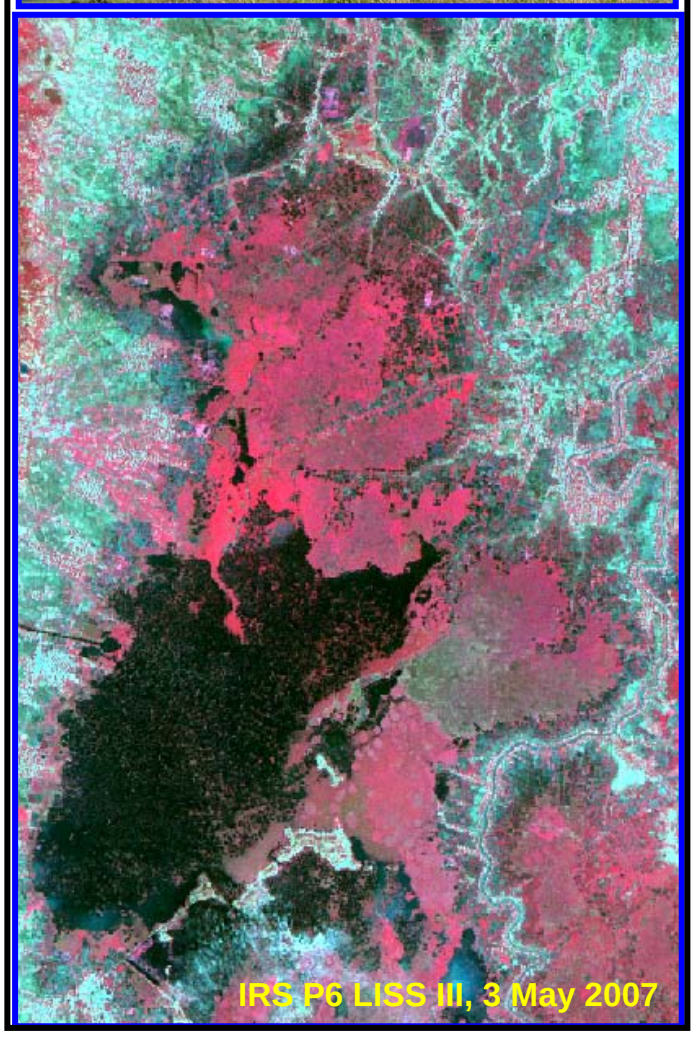
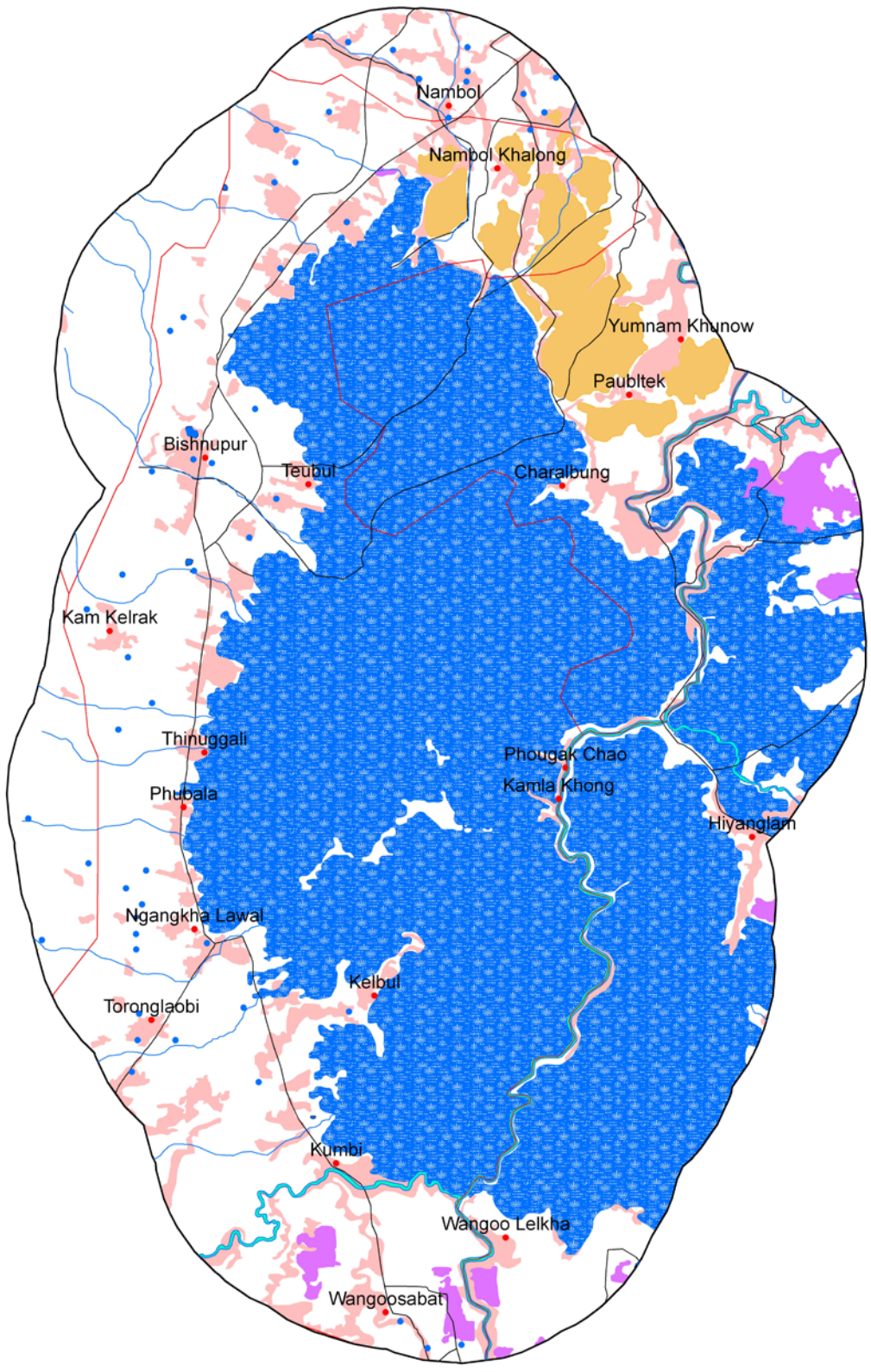




Plate 80: Loktak lake

State : Manipur

# WETLAND MAP

Loktak Lake

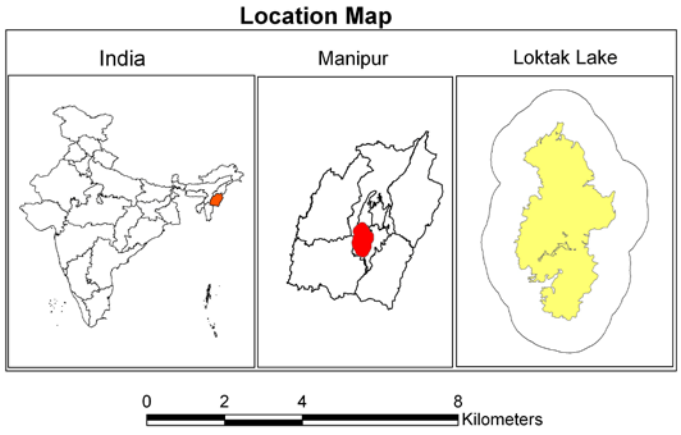



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Roads
- Drainage (line)
- Settlements
- Town/Settlements
- District Boundary

**Location Map**




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

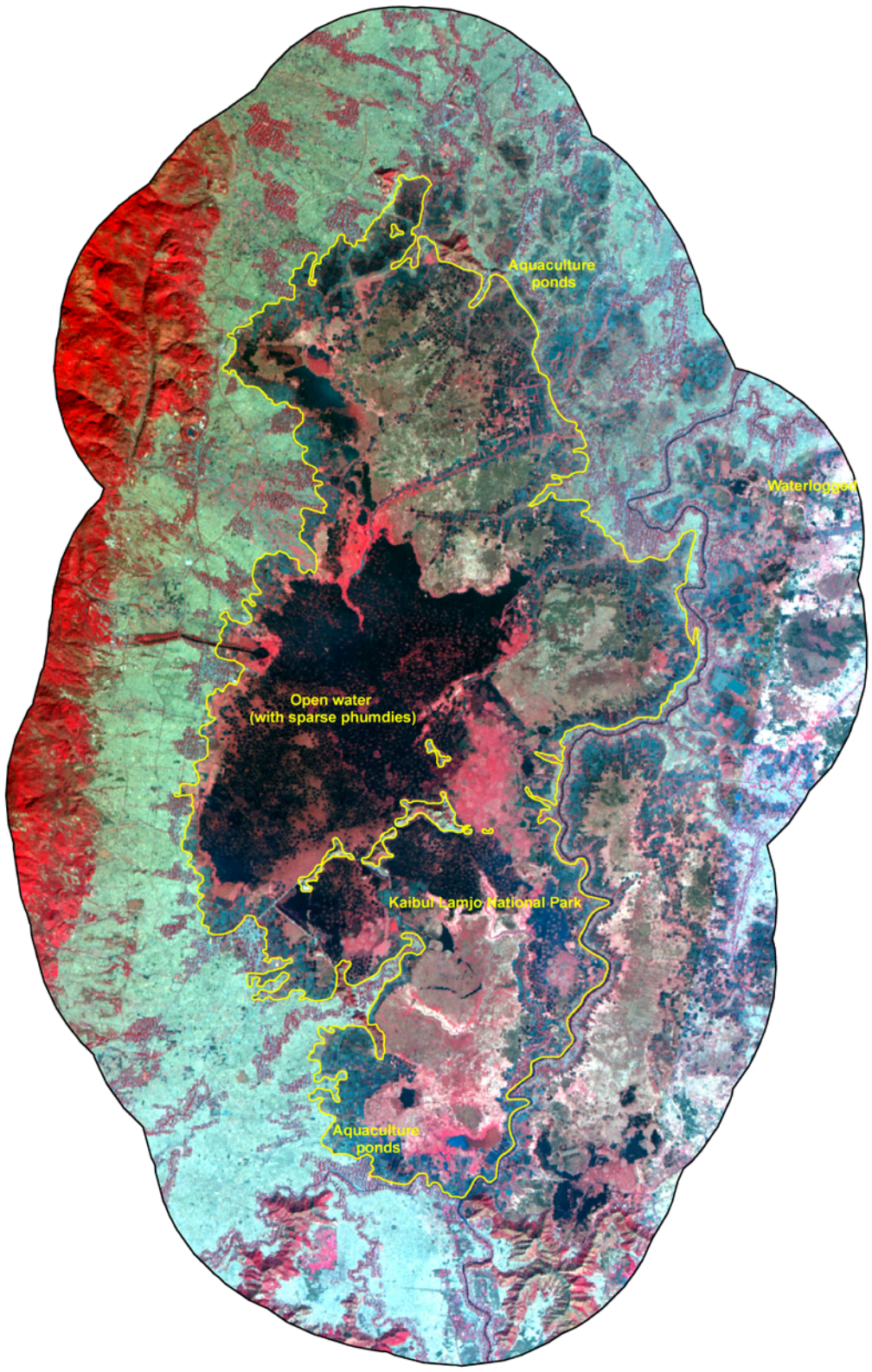
**Prepared By :**
Space Applications Centre (ISRO), Ahmedabad

**Sponsored By:**
Ministry of Environment and Forests
Government of India

Plate 81: Wetland map - 5 km buffer area of Loktak lake

State : Manipur

Loktak Lake




IRS P6 LISS-III post monsoon data (2006)

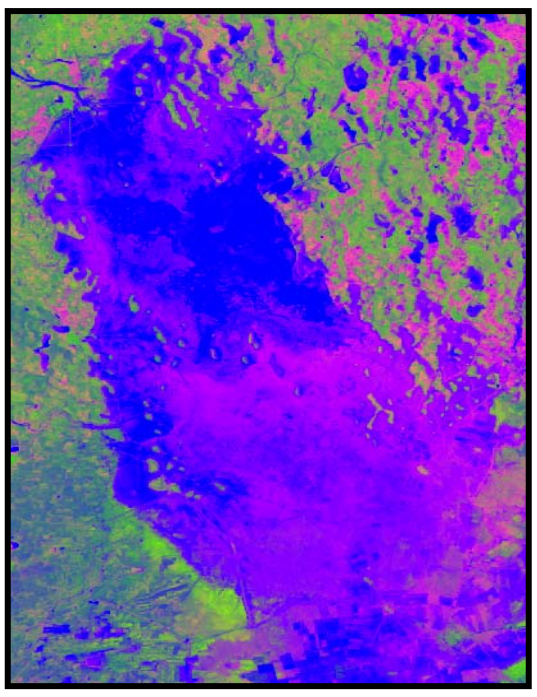
Plate 82: IRS LISS III FCC - 5 km buffer area of Loktak lake

## 9.8 Nasarovar

| Name | Nalsarovar |
|---|---|
| Location | 22$^{o}$ 40’ 21” to 22$^{o}$ 52’ 00” N Latitude and 71$^{o}$ 58’ 55” to 72$^{o}$ 06’ 43” E Longitude |
| Area | 14673 ha |
| Wetland Type | Lake/Pond |
| Climate | Dry, tropical monsoon climate, with rainfall from the southwest monsoon concentrated in July, August and September. Average annual rainfall is about 400 mm |
| Description | Nalsarovar represents a typical wetland, an ideal bird sanctuary, and also a notified wetland declared by the Ministry of Environment and Forests, Govt. of India. The lake is a shallow, natural lake. Geologically it is a shallow basin which was once a part of the sea during the Miocene period of the Quaternary era. The soil is medium black. The average depth is 3 meters in the monsoon while in pre-monsoon it becomes very shallow (< 100 cm). A large part of the lake dry up during summer. The water spread changes seasonally depending on rainfall and the consequent climatic conditions. The larger part of the lake has other vegetation on fringes which provides shelter for migratory birds. |
| Vegetation | Hydrophytes include species of *Chara, Potamogeton, Najas, Vallisneria, Nymphaea, Limnanthemum, Lemna, Wolfia, and Hydrilla.* Major part of the lake is characterised by a rich growth of *Xanthium strumarium, Solarnum surattense, and Tephrosia purpurea.* The semi-aquatic and marsh-land zones hold *Ammania bacciferu, A. multiflora, Bergia sp., Alternanthera sessilesis, Cyperus sp,Scirpus sp., Polygonum plebeium, and Marsilea aegyptiaca.* Surrounding agricultural land supports crops of cotton, cereals, pulses and groundnuts. The few trees in the region include *Prosopis juliflora, P.spicigera, Salvadora persica, S. oleoides, and Acacia nilotica* among others. |
| Fauna | Nal Sarovar is an important winter habitat for thousands of migratory birds like Flamingos, Pelicans, cranes, ducks, spoonbill, herons etc., from Siberia, Central Asia and Europe. |
| Turbidity | Low |

**Post-monsoon data (2006)**

**Pre-monsoon data (2007)**



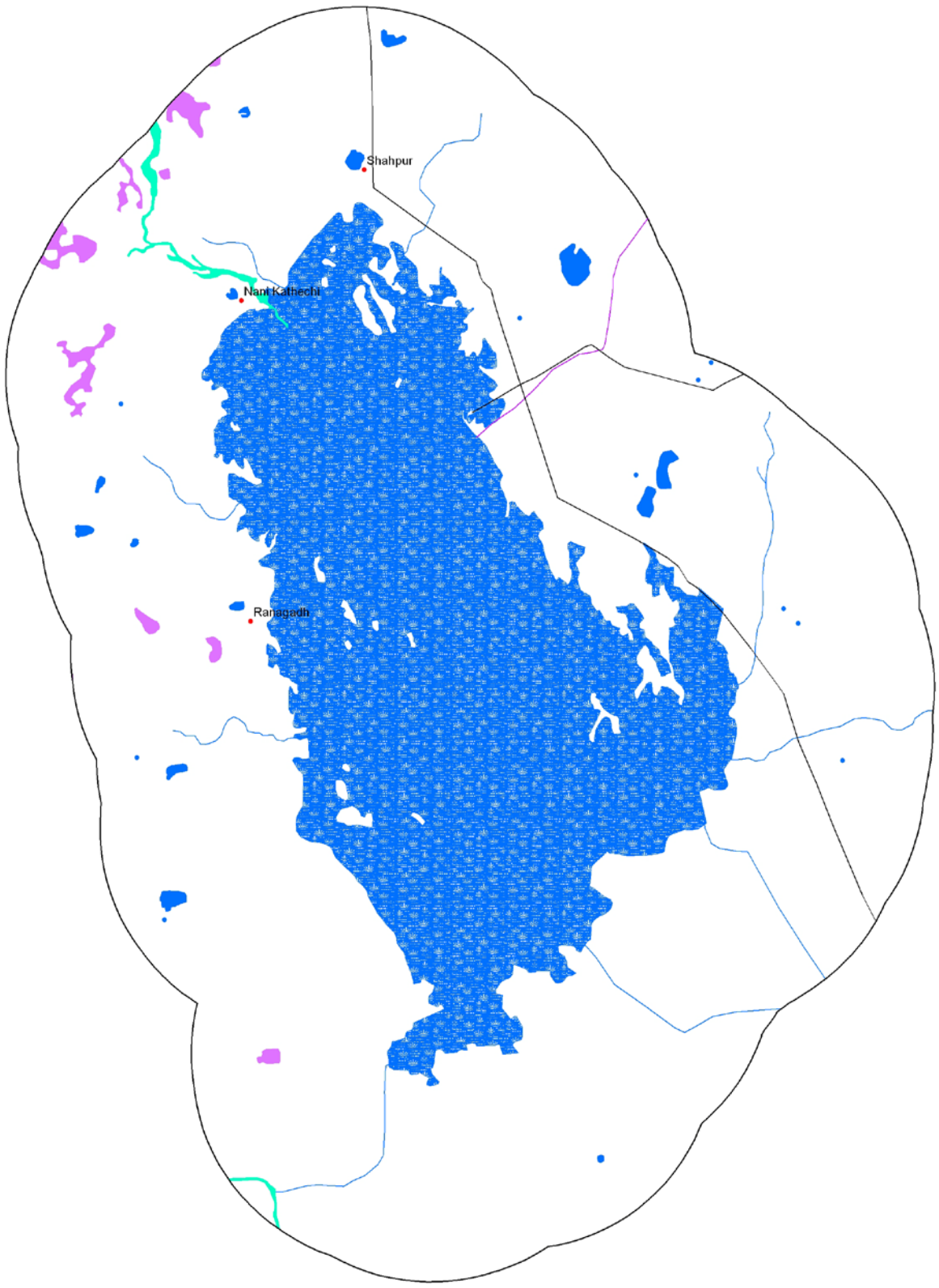
**Indices (MNDWI NDPI NDVI)**
**Post-monsoon data (2006)**

Plate 83: Nalsarovar

State : Gujarat

# WETLAND MAP

Nal Sarover

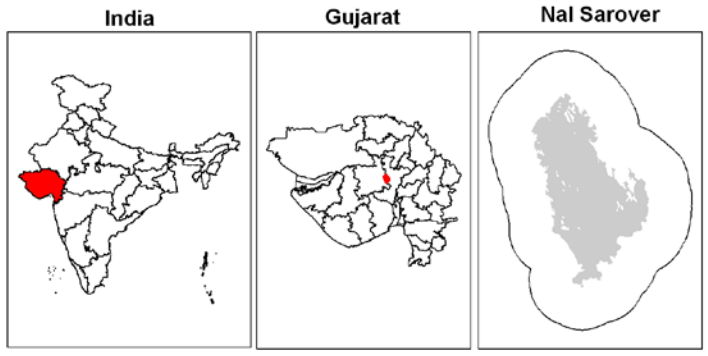



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Settlements
- Roads
- Railway
- Canals
- Drainage (line)
- Town/Settlements
- District 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
Bhaskaracharya Institute for Space Applications and Geo-informatics, Gandhinagar

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 84: Wetland map - 5 km buffer area of Nal Sarovar

State : Gujarat

Nal Sarover

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

Plate 85: IRS LISS III FCC - 5 km buffer area of Nalsarovar

## 9.9 North Reef Island Sanctuary

This sanctuary bounded by 92° 41’ to 92° 43’ E Longitudes and 13° 04’ to 13° 05’ N Latitudes was declared in 1977 as prime habitat for Andaman Teal and Nicobar Pigeon besides a vast expanse of Coral reef.

Dolphins and whales are important marine animals besides many species of mammals and turtles. Coral reef is the largest category of wetlands, which constitutes 1154 ha (95.53 %) out of the total wetland area of 1208 ha. An area estimate of wetlands in North Reef Island Sanctuary is given below.

Area estimates of wetlands in North Reef Island Sanctuary

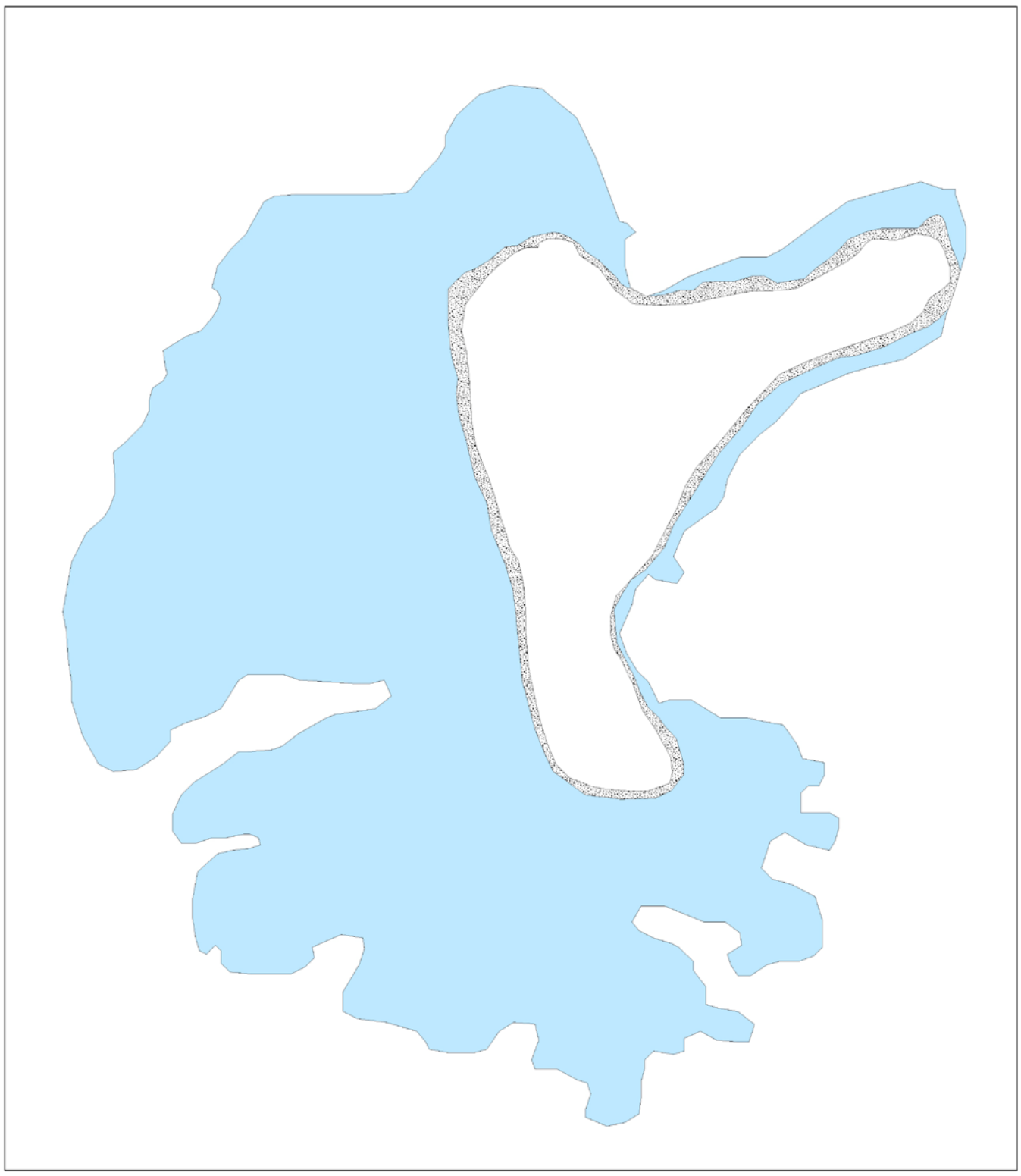
Area in ha

| Sr. No. | Wetland code | Wetland Category | Wetland Area | % of wetland area |
|---|---|---|---|---|
| 1 | 2103 | Sand/Beach | 54 | 4.47 |
| 2 | 2107 | Coral | 1154 | 95.53 |
| | | **Total** | **1208** | **100.00** |

UT : Andaman and Nicobar Islands

# WETLAND MAP

North Reef Island Sanctuary

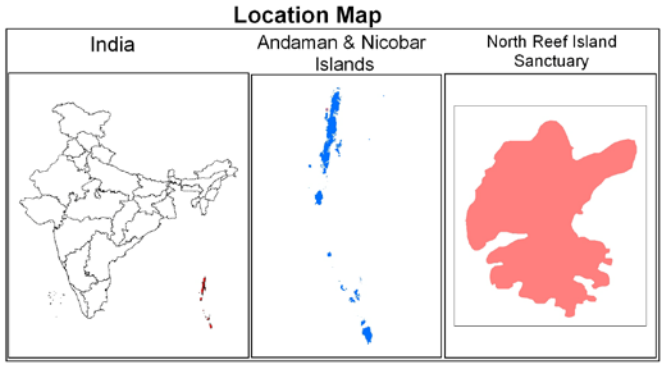


| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Roads
- Drainage (line)
- Settlements
- Town/Settlements

**Location Map**



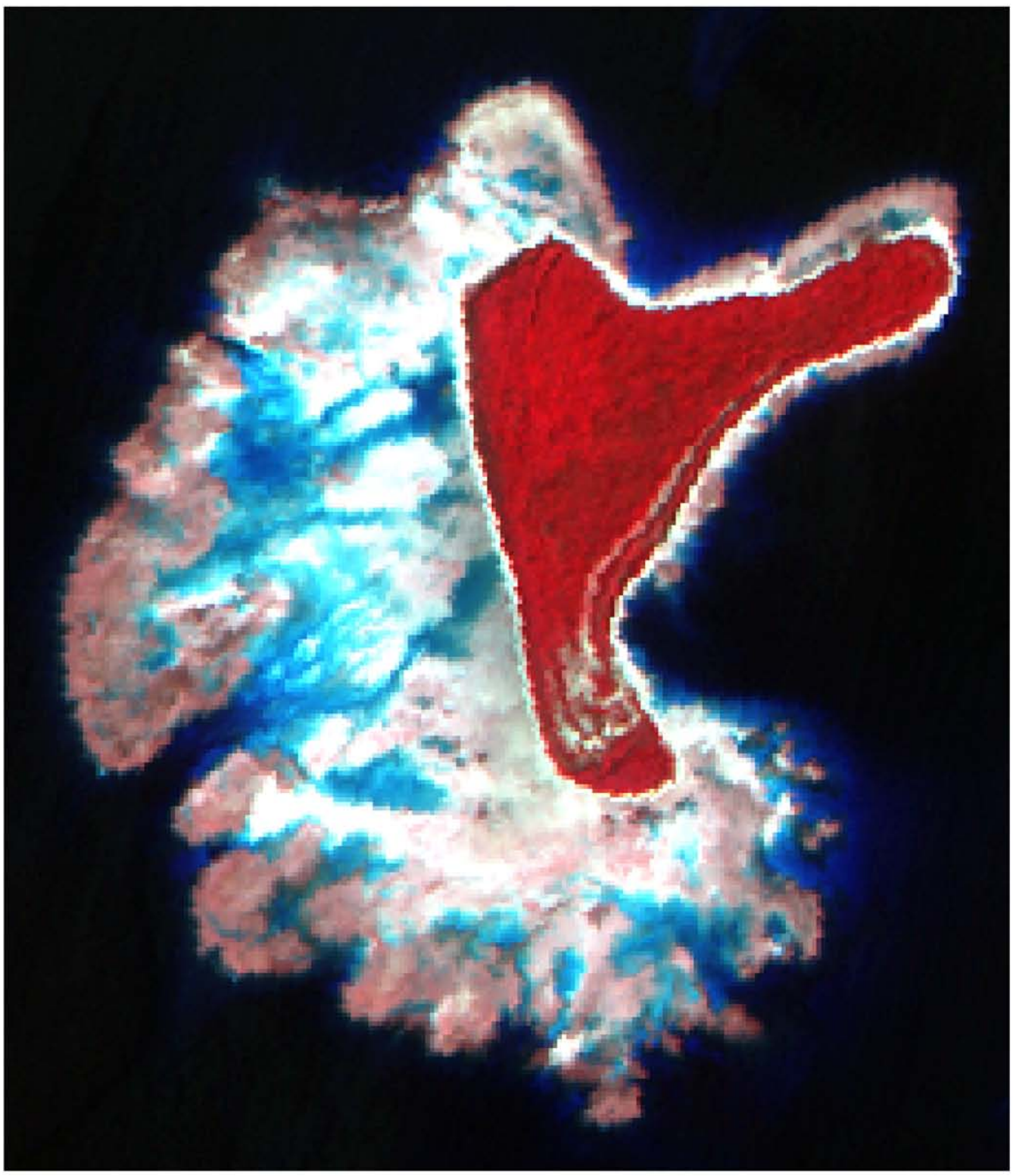

0 0.25 0.5 1 Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 86: Wetland map of North Reef Island Sanctuary



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

Plate 87: IRS LISS III FCC of North Reef Island Sanctuary

## 9.10 Point Calimere Wildlife and Bird Sanctuary

| Name | Point Calimere Wildlife and Bird Sanctuary |
|---|---|
| Location | $79^{o}$ 21' E to $79^{o}$ 53' E longitude and<br>$10^{o}$ 17' N to $10^{o}$ 25' N latitude |
| Area | 32010 ha (Lagoon : 15084 ha, Inter tidal mud flats:15626 ha, Salt marsh:454 ha, Mangroves:3433 ha and Salt pans:6972 ha, Others:441 ha) |
| Wetland Type | Lagoon, Inter tidal mud flats, Mangroves and Salt Pans |
| Climate | Average annual rainfall 1300 mm.<br>The temperature varied from 25 to 34°C |
| Vegetation | The dominant trees of the forest are *Manilkara hexandra (*locally called Palai, is the most important dry evergreen species) and *Salvadora persica* in the open areas*.* Insectivorous plants such as *Drosera burmanii* and *D. indica* are also present in the grassland habitat.<br>*Avicennia marina* is the dominant mangrove species in the area. The shrub layer is made up of *Suaeda maritima* and *S. monoica. Excoecaria agallocha* occurs on the river banks, and *Aegiceras corniculatum* and *Acanthus ilicifolius* at the edges, where the tidal influence is pronounced. *Suaeda maritima* and *Excoecharia agallocha* dominate in the back-mangrove areas*.* |
| Fauna | Wetland is the spawning and / or nursing ground for commercially important prawns (mainly White Prawn *Penaeus indicus* and Tiger Prawn *P. monodon*), crabs (Marsh Crab *Scylla serrata*) and fishes.<br>Number of species of mammals have been reported from the Sanctuary. The larger mammals are the Blackbuck *Antilope cervicapra*, Spotted Deer *Axis axis,* Wild Boar (*Sus scrofa)* and Jackal (*Canis aureus).* The Flying Fox (*Pteropus giganteus*roosts) in large flocks on trees in the Point Calimere forest and the mangrove forest at Muthupet. The Common Dolphin (*Delphinus delphis)* is seen near the shore during the monsoon. |
| | Point Calimere is well known for wide variety of resident and migratory birds. |

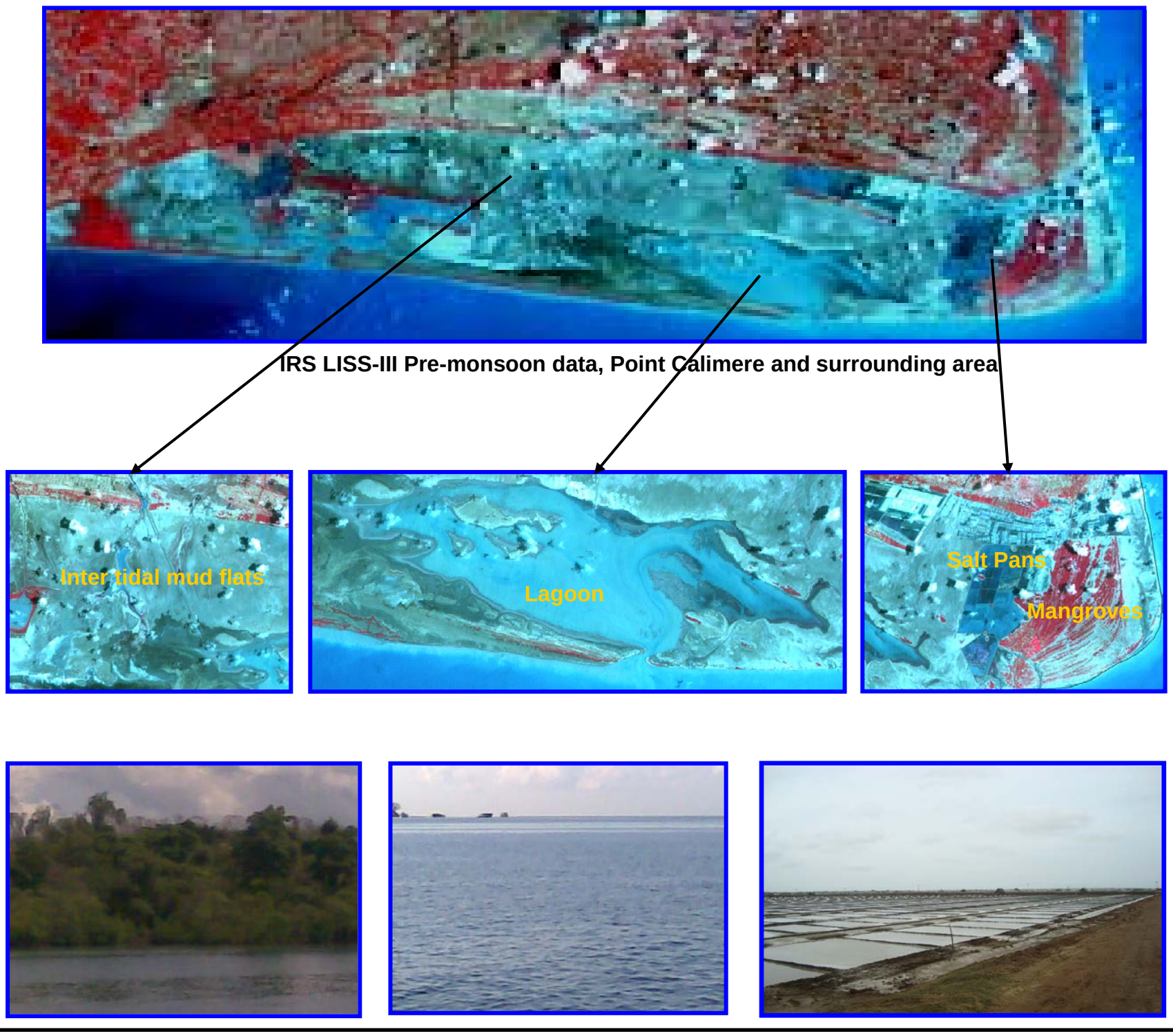
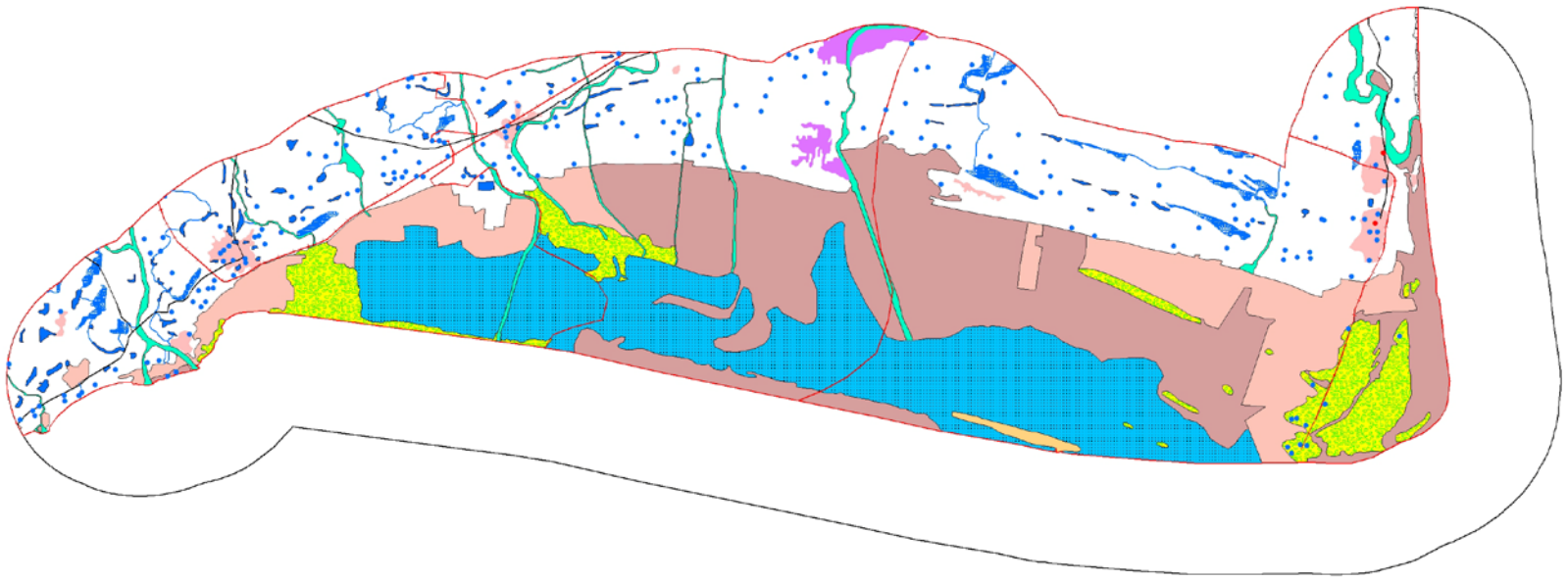



Plate 88: Point Calimere Wildlife and Bird Sanctuary

State : Tamil Nadu

# WETLAND MAP

Point Calimere Wildlife and Bird Sanctuary

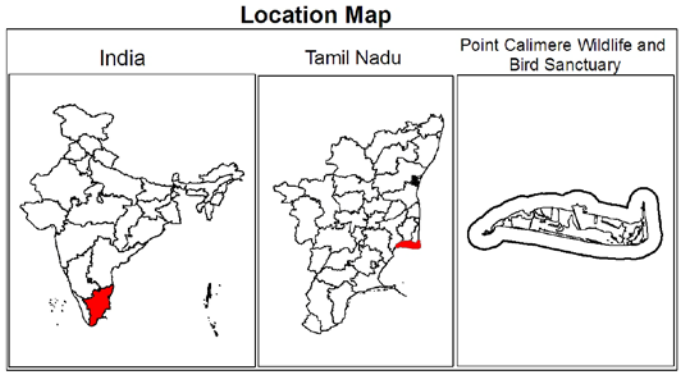


| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Roads
- Railway
- Drainage (line)
- Settlements
- Town/Settlements
- District Boundary

**Location Map**




10 5 0 10 Kilometers

Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Institute of Remote Sensing, Anna University, Chennai

Sponsored By:

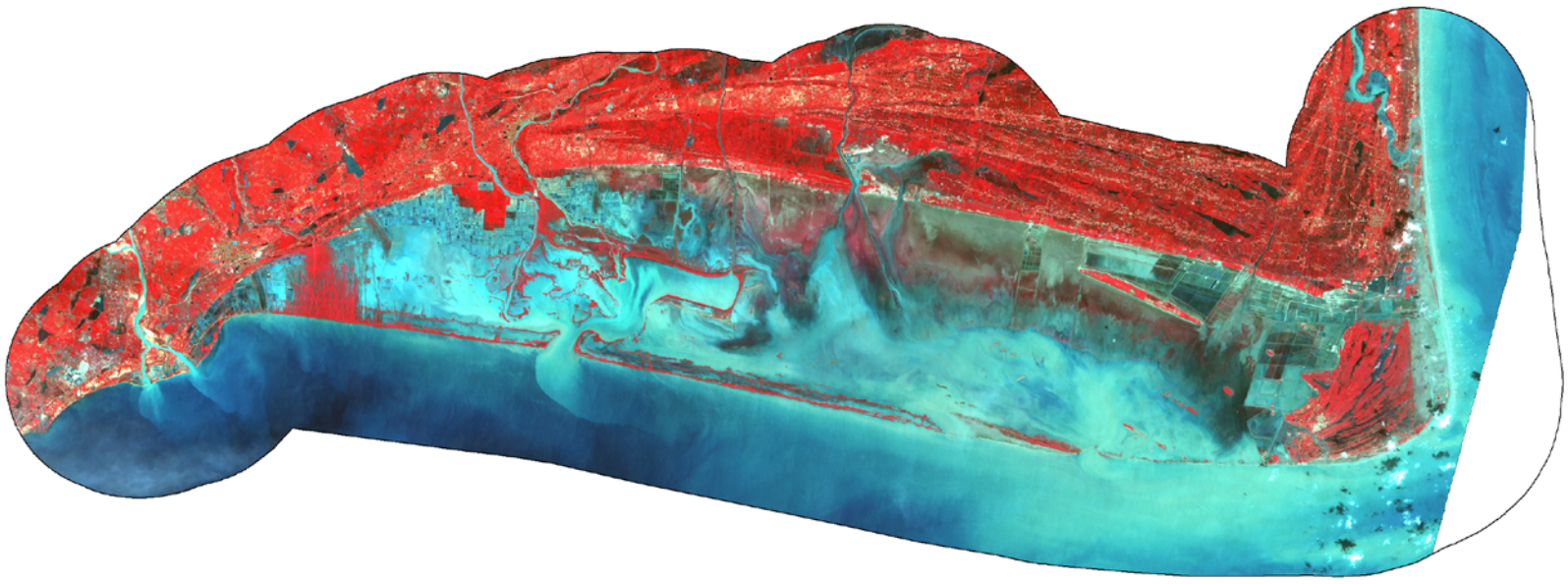
Ministry of Environment and Forests
Government of India

Plate 89: Wetland map - 5 km buffer area of Point Calimere Wildlife and Bird Sanctuary

State : Tamil Nadu

**WETLAND MAP**

Point Calimere Wildlife and Bird Sanctuary



IRS LISS-III Post-monsoon data (2005)

Plate 90: IRS LISS III FCC - 5 km buffer area of Point Calimere Wildlife and Bird Sanctuary

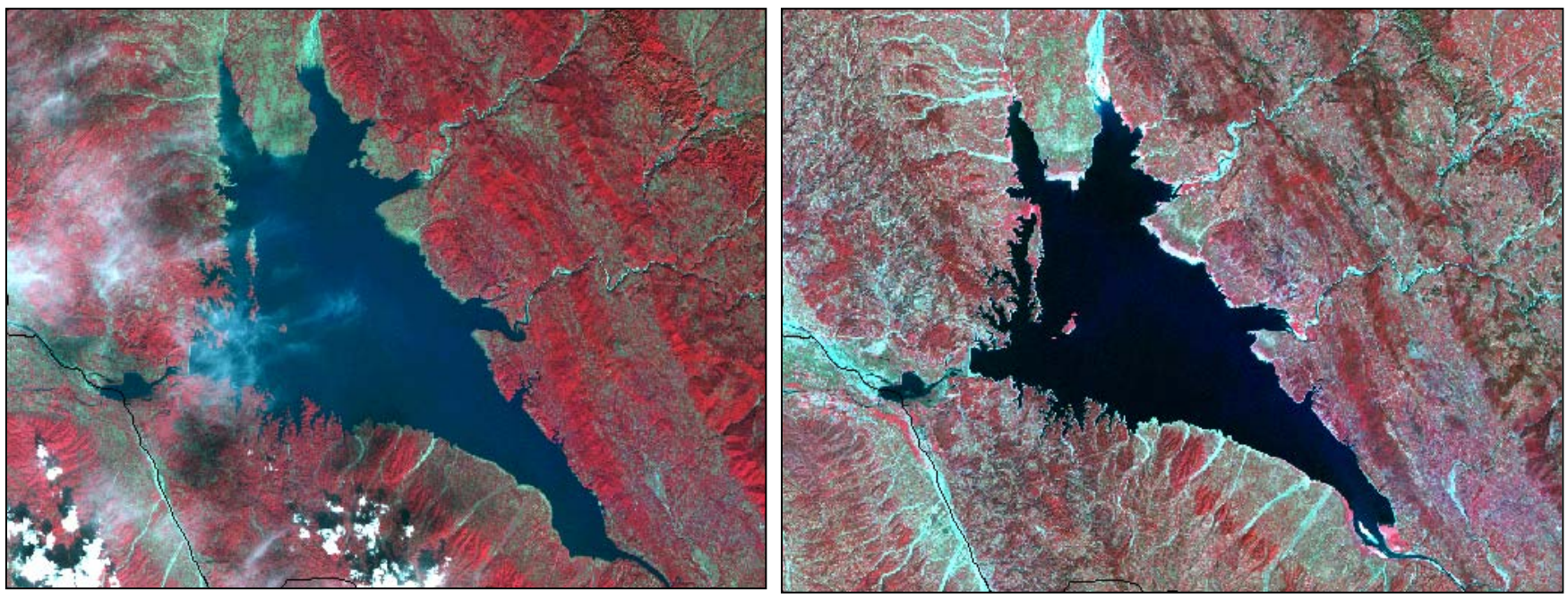
## 9.11 Pong Dam

**Pond Dam**

Pong is a recently created reservoir on the Beas River in the plains of Sansarpur Terrace, district Kangra (between 310 52' 14" N and 320 07' 31" N latitudes and 750 53' 04" E and 760 13' 36" E longitudes). Located at an elevation of 450 m amsl, it has a length of 41.80 km, width of 13.73 km and sprawls over an area of 24532 hectares. The dam is an important source of electricity and irrigation. There is some submerged vegetation in the reservoir, but because of the pronounced seasonal changes in water level, the shoreline does not support extensive areas of emergent vegetation. The surrounding hill sides have mixed deciduous and pine *(Pinus roxburghii*) forest.

Zoological Survey of India has recorded 447 faunal species in wetland area. 220 bird species (i.e. Bar headed geese, Northern lapwing, Pintail, Common teal, Mallard and Coot) belonging to 54 families have been recorded. The Black headed gull, Great black headed gull and herring gull species which are fairly uncommon in India away from the coast, visit the reservoir each winter.

A total of 27 fish species belonging to six families have been encountered in the Pong reservoir. Mahseer (*Tor putitora*) is highly precious and sought - after fish of the Pong reservoir. The Cat fish (*Mystus seenghala*) has been showing constant increase during the last 10 years, therefore Pong reservoir may be categorized as a cat fish reservoir.



IRS LISS III FCC showing the status of Pong dam during post- and pre-monsoon ( 2006)

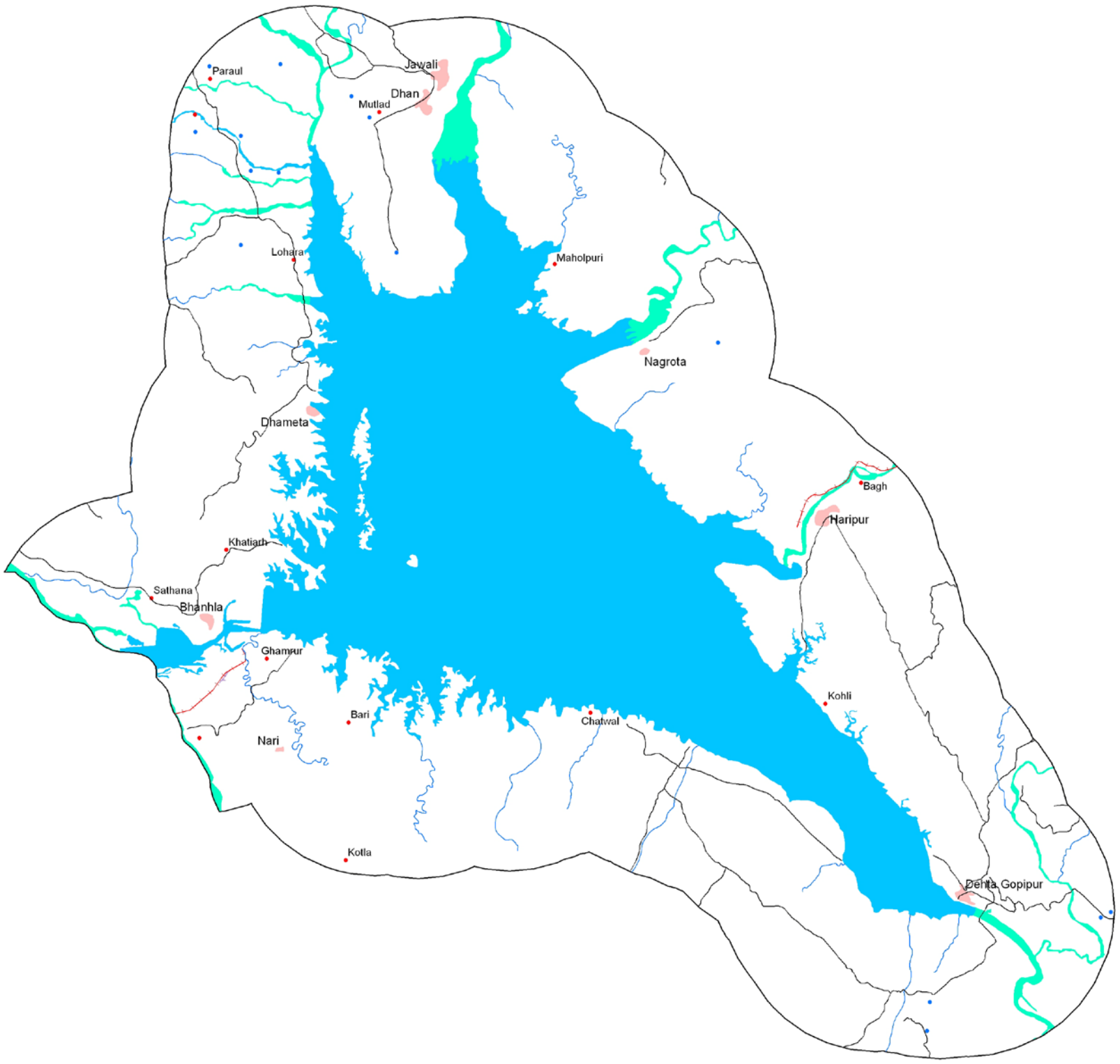
Views of the Pong Reservoir

Plate 91: Pong Dam Lake

State : Himachal Pradesh

# WETLAND MAP

Pong Dam Lake

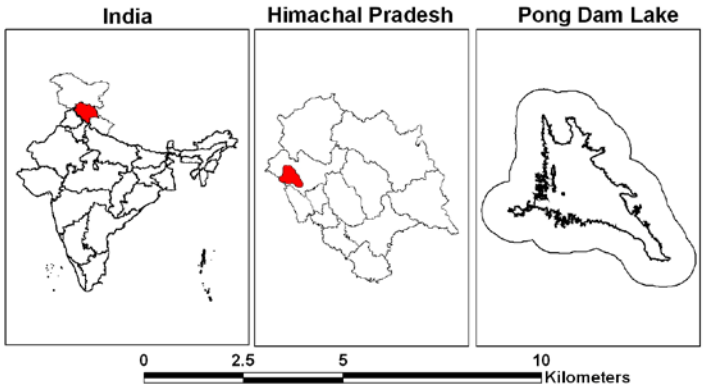



| Symbol Typecode | Level I | Level II | Level III |
|---|---|---|---|
| | Inland Wetlands | | |
| | | Natural | |
| 1101 | | | Lakes/Ponds |
| 1102 | | | Ox-bow lakes/ Cut-off meanders |
| 1103 | | | High altitude wetlands |
| 1104 | | | Reverine wetlands |
| 1105 | | | Waterlogged |
| 1106 | | | River/Stream |
| | | 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 (<2.25ha)
- Settlements
- Roads
- Railway
- Drainage (line)
- Town/Settlements
- District boundary
- State boundary
- International boundary

**Location Map**




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

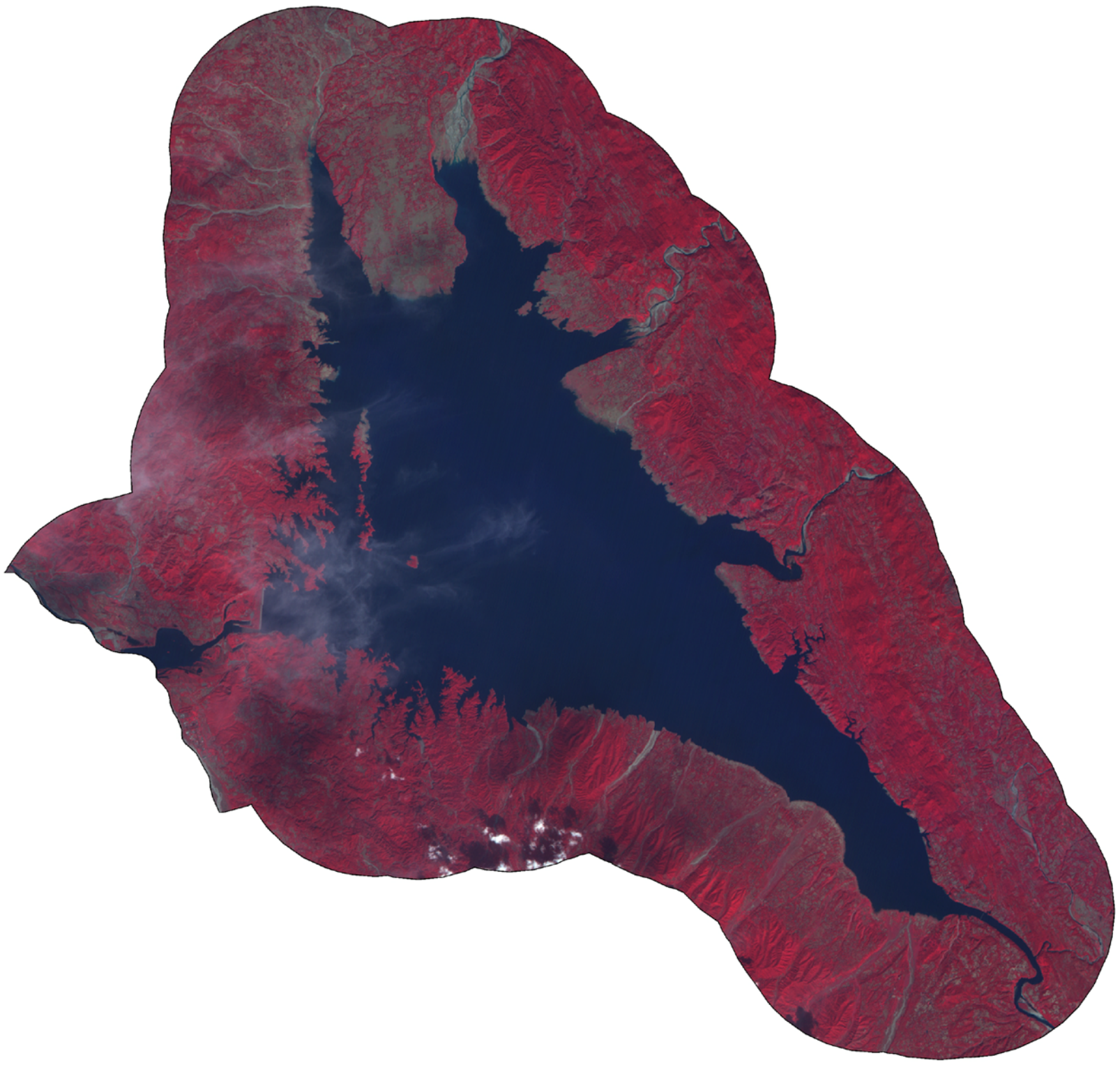
**Prepared by:**
Space Applications Centre (ISRO), Ahmedabad
and
HP Remote Sensing Cell
State Council for Science, Technology & Environment, Shimla

**Sponsored by:**
Ministry of Environment and Forests
Government of India

Plate 92: Wetland map - 5 km buffer area of Pong Dam Lake

State : Himachal Pradesh

Pong Dam Lake

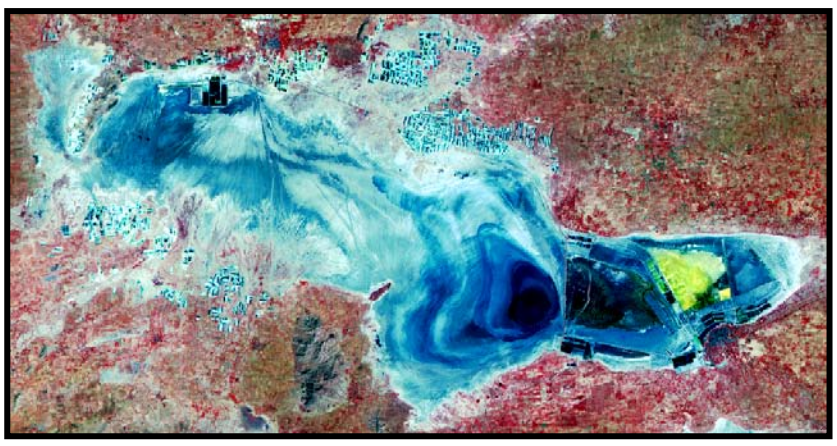


IRS-P6 LISS-III Post-monsoon data(2006-2007)

Plate 93: IRS LISS III FCC - 5 km buffer area of Pong Dam Lake

## 9.12 Sambhar Lake (Ramsar Site)

| **Name** | **Sambhar Lake** |
|---|---|
| Location | 26°52'31" to 27°01'57" N Latitude and<br>74°53'47" to 75°13'41" E Longitude |
| Area | 24294 ha (Wetland Area) |
| Wetland Type | Lake |
| Climate | Average annual rainfall : 500 mm<br>Average annual temperature range from a maximum of 36.7$^{o}$ C and a minimum of 11.7$^{o}$ C. |
| Description | Sambhar lake is a Ramsar site and it is a typical shallow saline wetland of Rajasthan located near Sambhar village. The average depth is 3 meters in the monsoon while in pre-monsoon it becomes very shallow (< 100 cm). During monsoon season it receives rain water from its catchments. The flora and fauna mainly represent of fresh water during monsoon season while season proceeds the water becomes saline. Fresh water flora of monsoon season will be replaced by fresh water flora and fauna mainly plankton population. A large part of the lake dry up during summer to accelerate mining activity of ground water for manufacturing of salt . There are thousands of salt plan constructed at the periphery of the Sambar Lake. |
| Vegetation | The vegetation present in the catchment area in mostly *xerophytic* type. Shoreline vegetation includes the halophytes *Suaeda fruticosa, Solsola baryosma* and *Cressa cretica*. The most dominant algae in Sambhar lake and the salt pans are *Dunaliella salina* (dominant saline algae of the lake), *Chlmydomonas sp., Anabaena sp*., and *Aphanothece halophytica.* |
| Fauna | Zooplankton studies are limited. In depth studies were made to record avifauna of the lake. Every year thousands of migratory birds visit the lake and feed on plankton and fish fry. Some of the common birds recorded are: lesser flamingo, greater flamingo, tufted duck, pochard, white pelican, brown-headed gull, black-headed gull, herring gull, redshank, greenshank, common sandpiper, blackwinged stilt, pintail, shoveler, dabchick, purple moorhen, demoiselle crane, large Indian pratincole, and avocet. |
| Turbidity | Low - High |



**Post-monsoon data (2006)**

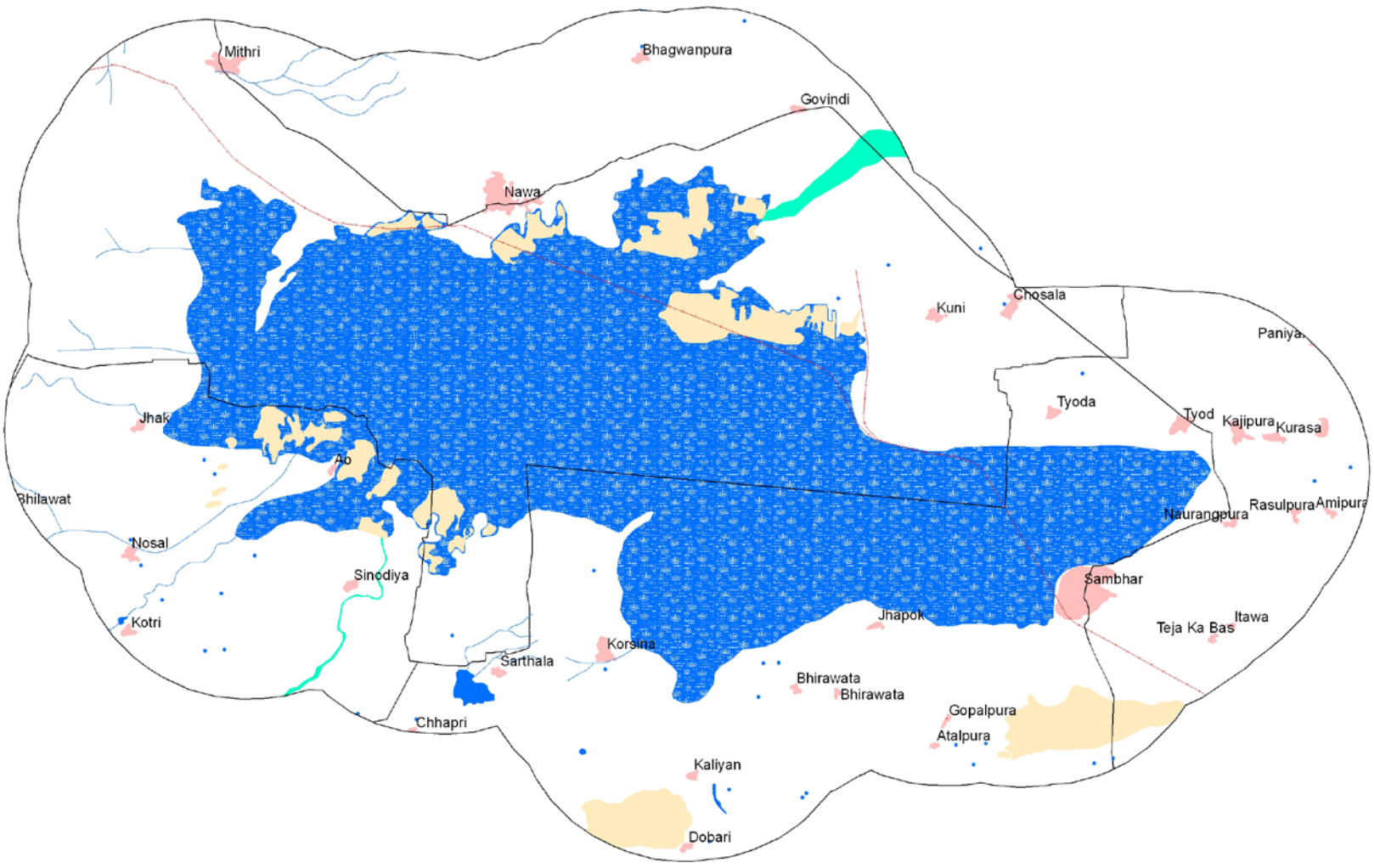
**Pre-monsoon data (2007)**

Plate 94: Sambhar Lake

State : Rajasthan

# WETLAND MAP

Sambhar Lake

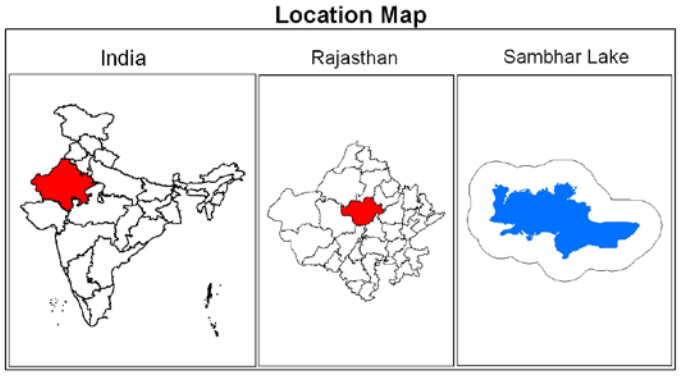



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Drainage (line)
- Major Roads
- Railway
- Settlements
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

**Location Map**




4 2 0 4 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
State Remote Sensing Application Centre, Jodhpur

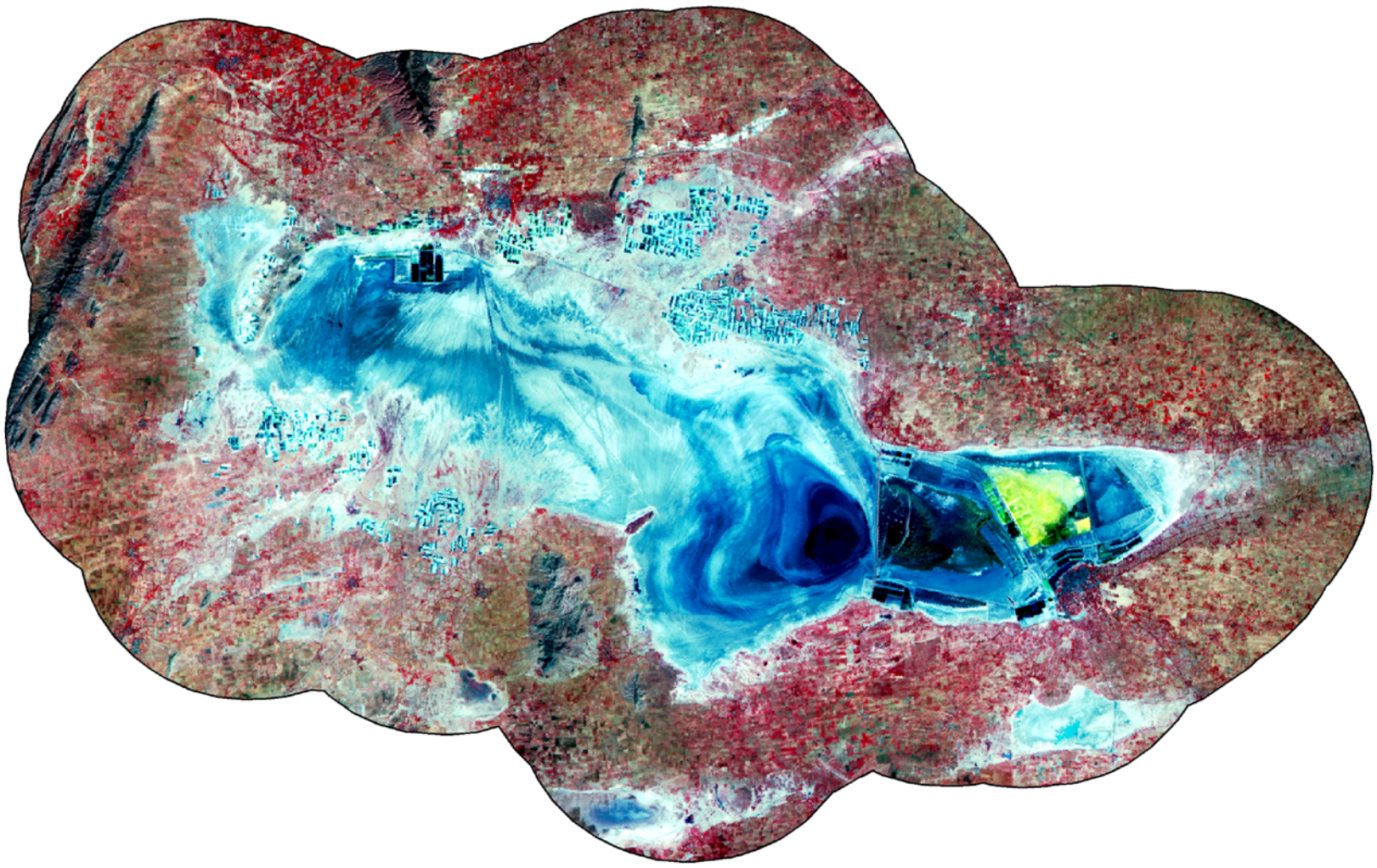
**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 95: Wetland map - 5 km buffer area of Sambhar Lake

State : Rajasthan

Sambhar Lake



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

Plate 96: IRS LISS III FCC - 5 km buffer area of Sambhar Lake

## 9.13 Sundarbans

| | | |
|---|---|---|
| | **Name** | **:** Sundarbans |
| 1 | **Location** | **:** Latitude: 21˚56′00’’ N; Longitude: 88˚51′00’’ E.<br><br>The Sunderbans consist of flat alluvial plains in which the process of land making is still going on. This land is mostly covered with forests and swamps, intersected from north to south by wide tidal rivers or estuaries and from west to east by narrow tidal creeks. All of these estuaries carry saline water. There is no current down them except tidal inflows and outflows. They are connected with each other by an intricate mesh of channels, so that the whole tract is a tangled network of estuaries, rivers and watercourses which enclose a large number of islands of various shapes and sizes. Most of these islands are mere swampy morasses covered with low forest and scrubwood jungle. Due to its huge ecological importance it has been designated as a UNESCO World Heritage Site in 1997 and as a Ramsar Site on May 21, 1992. |
| 2 | **Area** | **:** 209330 ha |
| 3 | **Wetland type** | **:** Mangrove |
| 4 | **Floral Diversity** | **:**Sunderbans is the largest single block of tidal halophytic mangrove forest in the world. The freshwater swamps are composed of tropical moist broad-leaved forest characterized by *Heritiera fomes*, locally known as ‘sundari’, *H. minor, Xylocarpus molluccensis, X. mekongensis, X. granatum, Bruguiera conjugata, B. gymnorrhiza, Cereops decandra, Sonneratia apetala, Avicennia officinalis, Aegiceras corniculatum, Rhizophora mucronata and Sonneratia caseolaris, Pandanus tectorius, Hibiscus tiliaceus and Nypa fruticans.* |
| 5 | **Faunal Diversity** | **:**The mangroves provide critical habitat for numerous species of fishes, birds, reptiles, crustaceans and mammals among which are the crocodiles (*Crocodylus porosus and Crocodylus palustris),* the Gangetic gavial (*Gavialis gangeticus*), the water monitor lizard (*Varanus salvator*) sharks, the Gangetic freshwater dolphins (*Platanista gangetica*), mudskippers, crabs, hermit crabs and shrimps. The Royal Bengal tigers (*Panthera tigris*) are the most significant mammal of the Sunderbans. They prey upon chital deer (*Cervus axis*), barking deer (*Muntiacus muntjak*), wild pig (*Sus scrofa*) and macaques (*Macaca mulatta*). Some threatened mammal species like the capped langur (*Semnopithecus pileatus*), smooth-coated otter (*Lutrogale perspicillata*), oriental small-clawed otter (*Aonyx cinerea*), and great Indian civet (*Viverra zibetha*) are also found in the waterbodies. The region also contains leopard (*Panthera pardus*) and several smaller predators such as the jungle cat (*Felis chaus*), fishing cat (*Prionailurus viverrinus*), and leopard cat (*Prionailurus bengalensis*). |

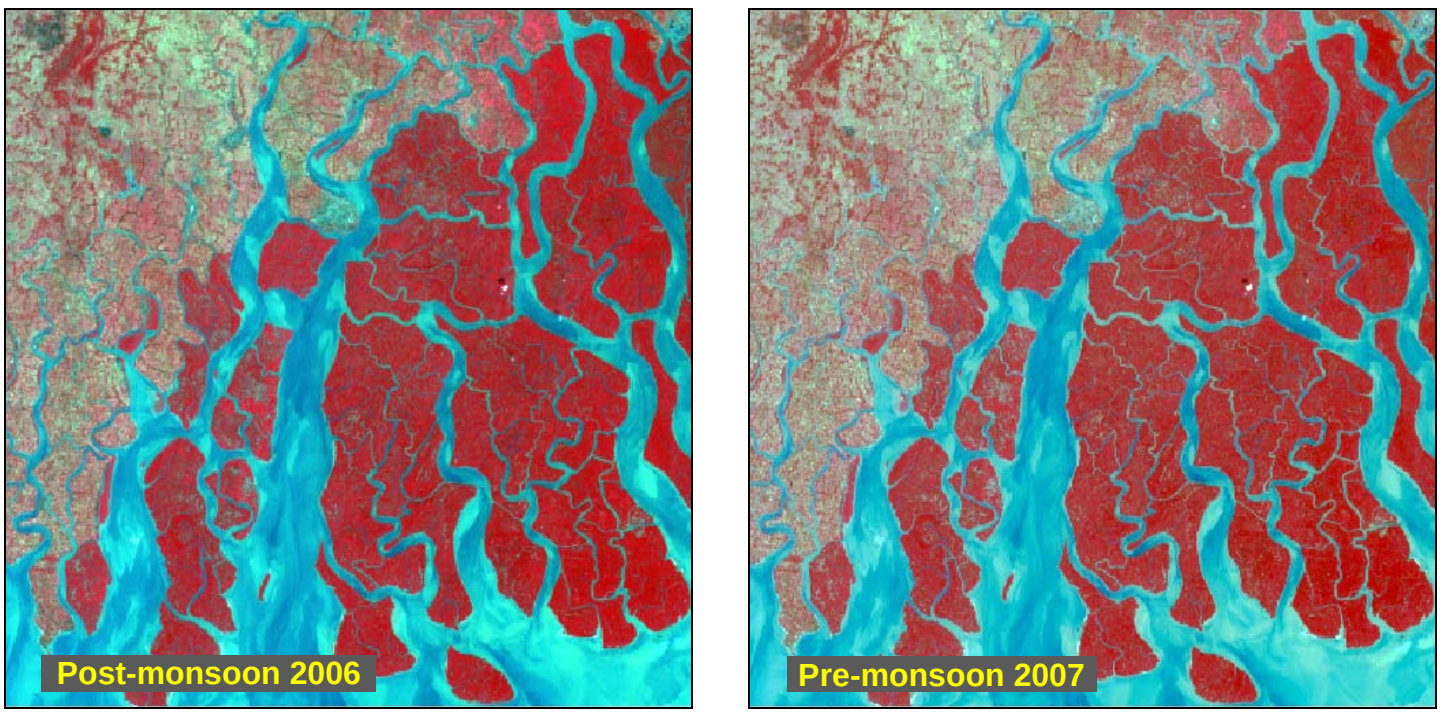
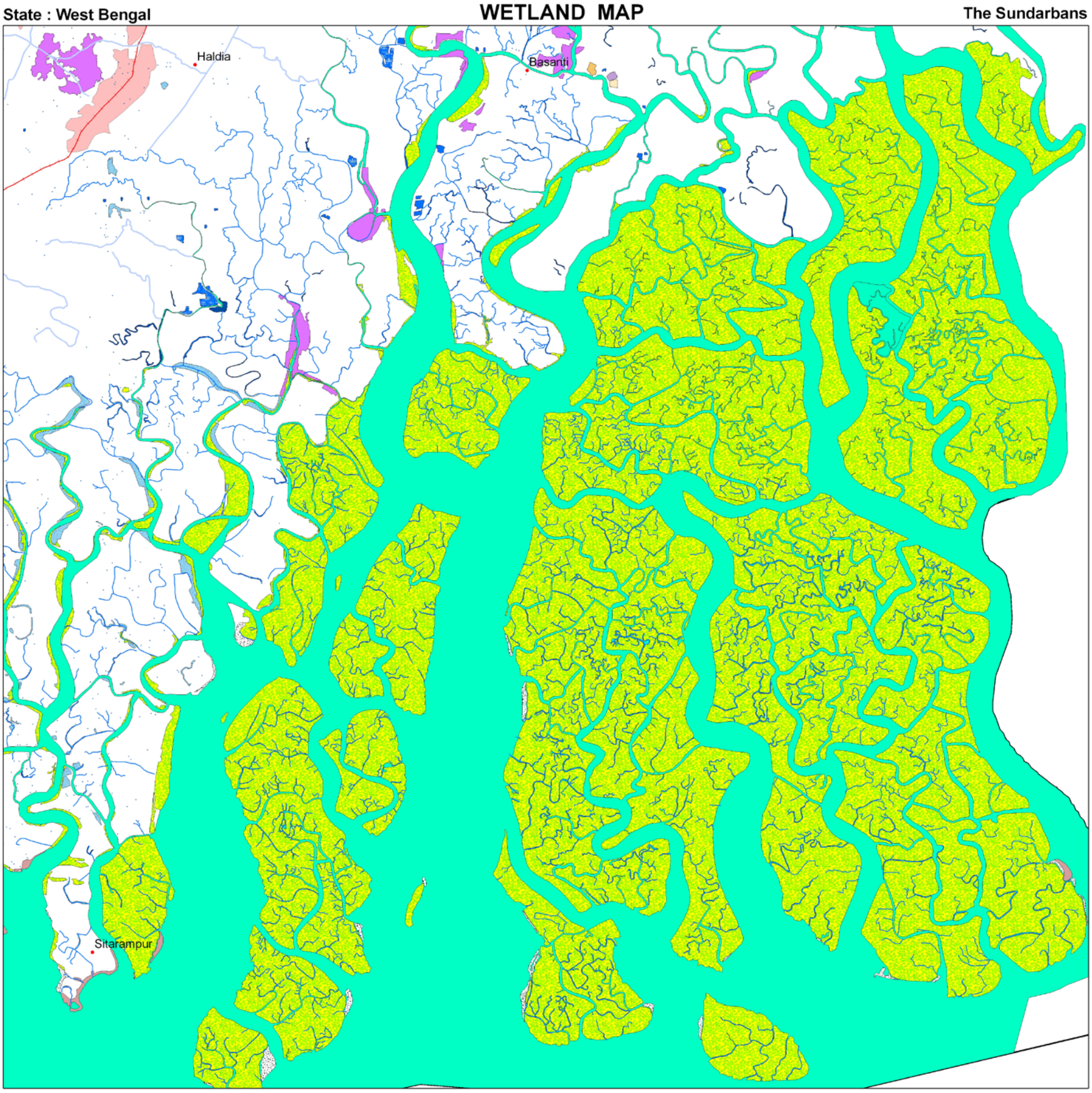



Plate 97: The Sundarbans

State : West Bengal

# WETLAND MAP

The Sundarbans

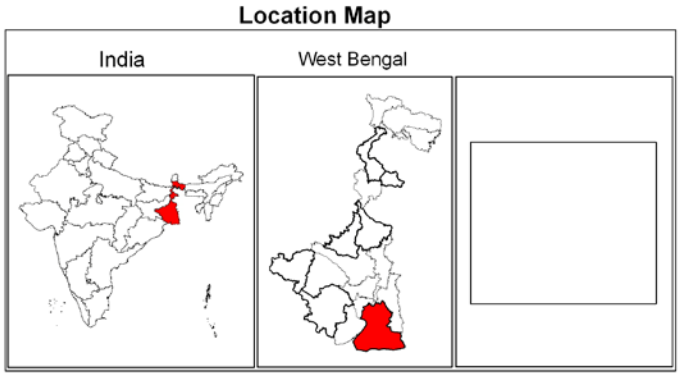



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

**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
Institute of Environmental Studies and Wetland Management, Kolkata

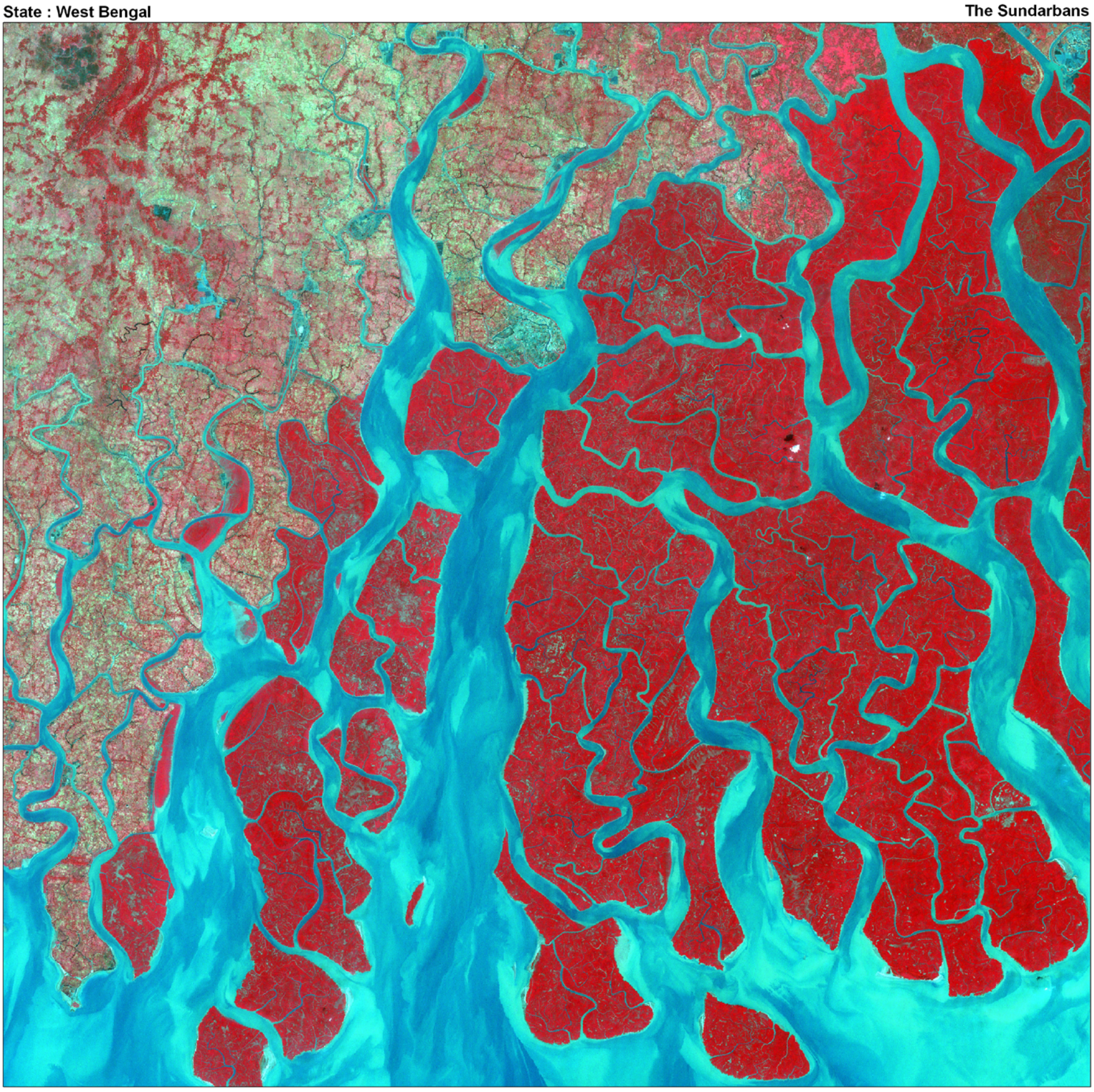
**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 98: Wetland map - The Sundarbans

State : West Bengal

The Sundarbans

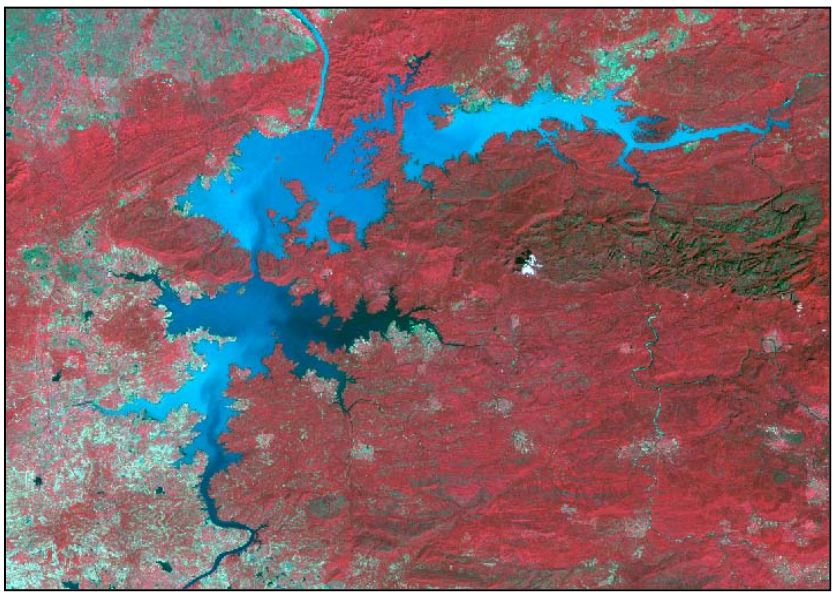


IRS P6 LISS-III post-monsoon data (2006)

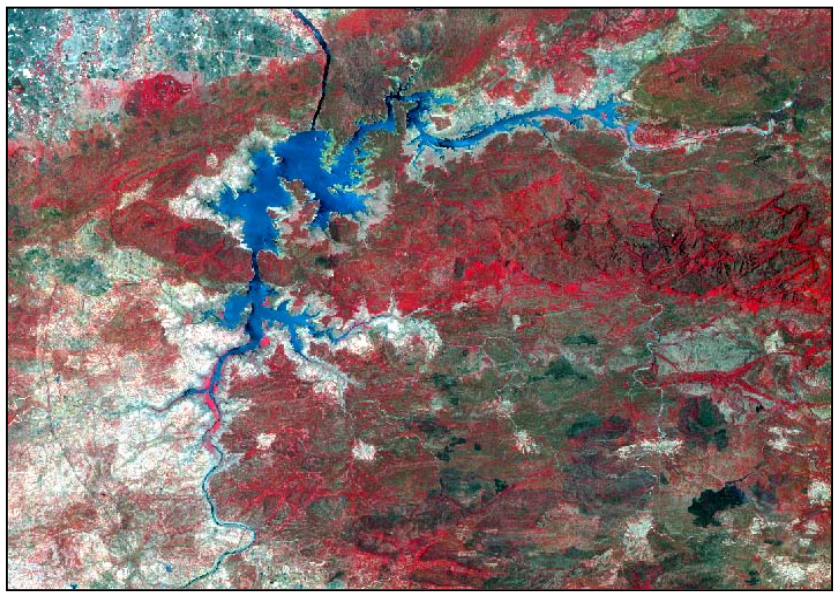
Plate 99: IRS LISS-III FCC of the Sunderbans

## 9.14 Tawa Reservoir

| Name | Tawa Reservoir |
|---|---|
| Location | Between $22^0$ 19' 38" N and $22^0$ 36' 25" N latitudes and $77^0$ 49' 44" E and $78^0$ 16' 18" E longitudes |
| Area | 19715 ha |
| Climate | Temperature: $22^o$ to $33^o$ C. |
| Salient features | Tawa is one of the large reservoir of Madhya Pradesh having water spread of 20,055 ha and extending 32km in length and having maximum of 22 km breadth. It has a moderate mean depth 11 m and maximum depth of 45m. |
| Turbidity | Moderate |
| Vegetation | Phytplakton sp. are *Pediastrum simplex, Pediastrum duplex, Chlorella sp., Closterium sp., Scenedesmus sp., Volvox sp.,* and major hydrophytes are *Hydrilla verticillata, Vallisneria spiralis* and *Polygonum glabrum* |
| Fauna | *Zooplankton sp. includes Brachionus falcatus, Keratella sps., Cyclops* and *Eucyclops.* Major fishes are *Catla catla, Cirrhinus mrigala, Channa marulius* and *Mastacembelus armatus.* Birds includes coot, red-headed pochard, wigeon, spotbill, shoveller, common teal, white-eyed pochard, dabchick, comb duck, common gallinule, purple moorhen, common snipe, black winged stilt, red-wattled lapwing, reef heron, grey heron, cattle egret, little egret, pond heron, white ibis, sarus crane, little cormorant, pied kingfisher, white-breasted king-fisher and darter. |



Post-monsoon 2006



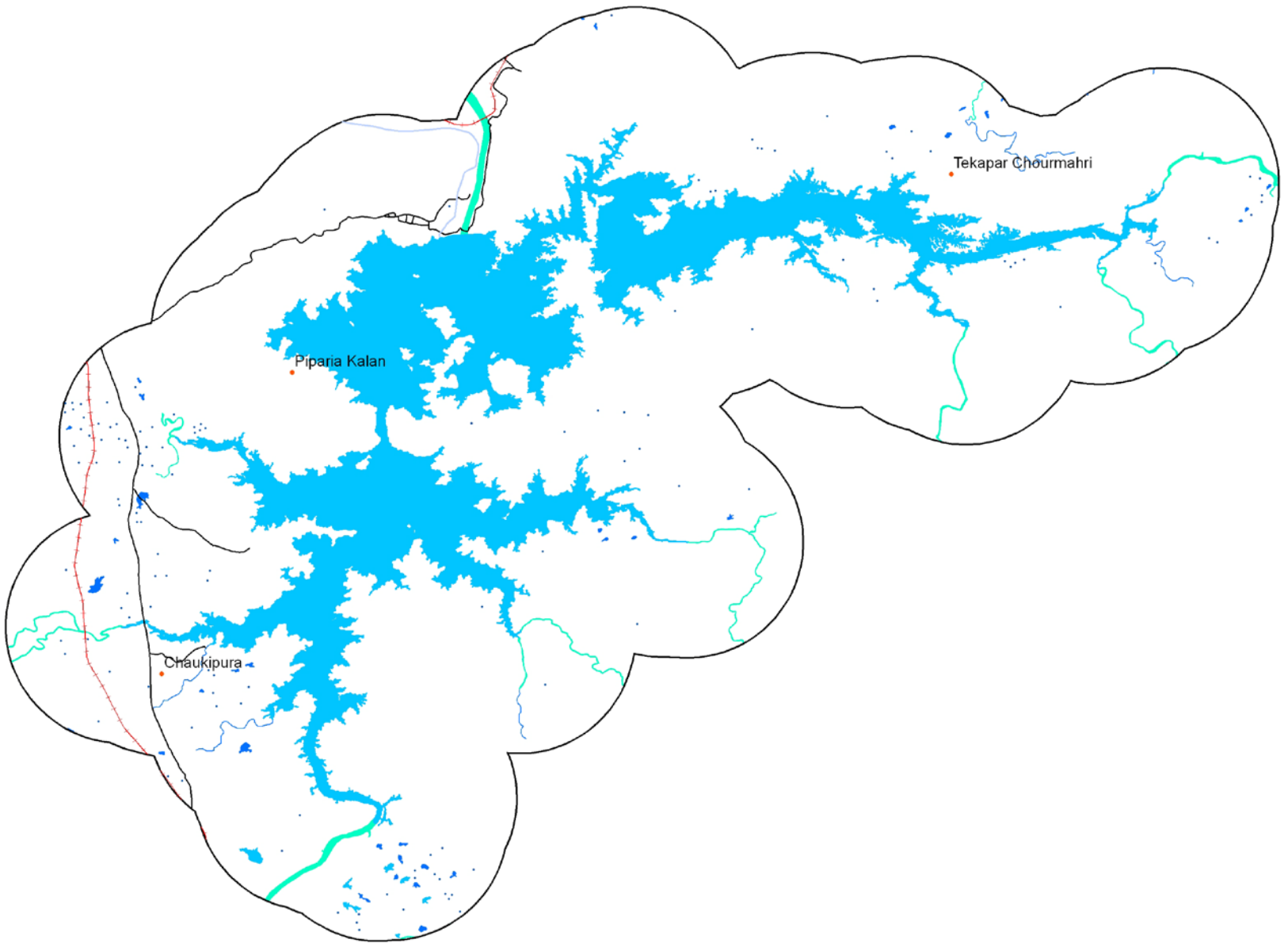
Pre-monsoon 2007

Plate 100: Tawa Reservoir

State : Madhya Pradesh

# WETLAND MAP

Tawa Reservoir

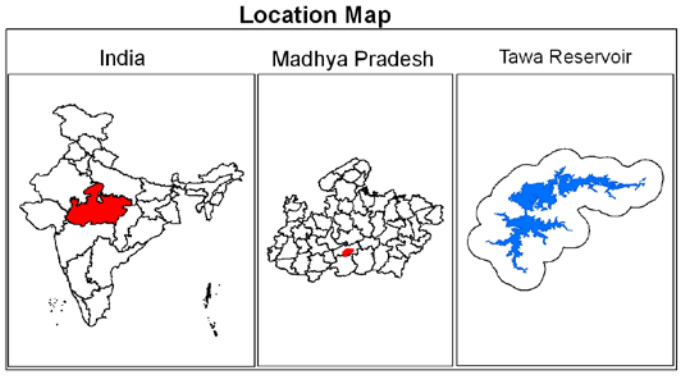



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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




**Data Source :**

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

**Prepared By :**

Space Applications Centre (ISRO), Ahmedabad
and
Remote Sensing Applications Centre, (MPCST), Bhopal, M.P.

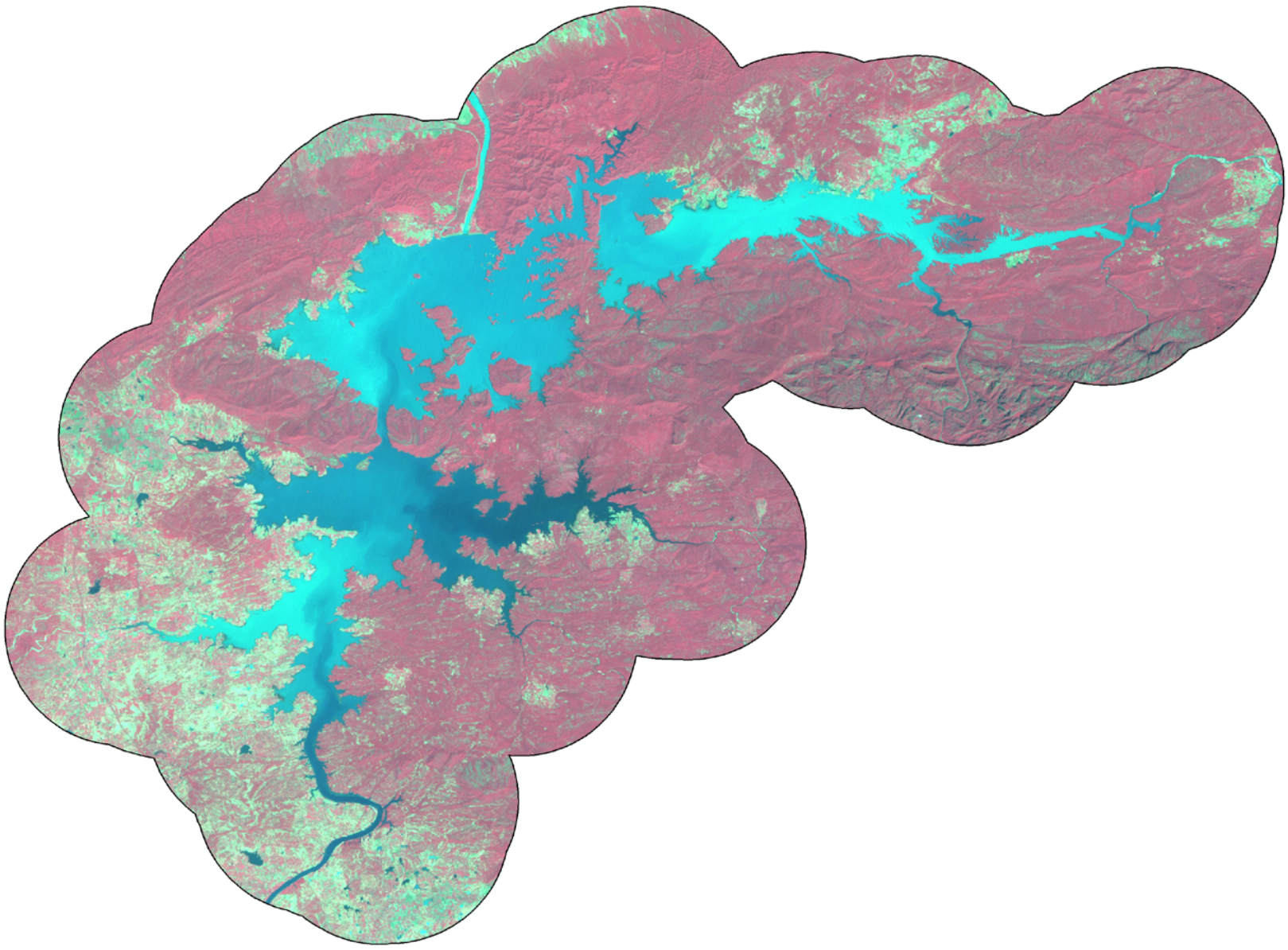
**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 101: Wetland map - 5 km buffer area of Tawa Reservoir

State : Madhya Pradesh

Tawa Reservoir



IRS P6 LISS-III post monsoon data (2006)

Plate 102: IRS LISS III FCC - 5 km buffer area of Tawa Reservoir

## 9.15 Tso Moriri

| Name | Tso Moriri |
|---|---|
| Location | Between $32^0$ 45 ’ N and $33^0$ 00’ N latitudes and $78^0$ 15 ‘ E and $78^0$ 22‘ E longitudes |
| Area | 14,530 ha |
| Altitude | 4,650 m |
| Climate | Average annual rainfall : 75 mm<br>Temperature: $0^o$ to $30^o$ C during summer and $-40^o$ to $-10^o$ C during winter |
| Salient features | Tso Moriri the largest (length 30 km; average width 9 km) of the high altitude trans-Himalayan lakes situated entirely within Indian territory. It is an oligotrophic in nature and its waters are alkaline. The lake formerly had an outlet to the south, but it has contracted considerably and has become land locked; as a result; the water is now brackish to saline. The lake is fed by springs and snow-melt in two major stream systems, one entering the lake from the north, the other from the southwest. Both stream systems create extensive marshes where they enter the lake. |
| Turbidity | Low |
| Vegetation | There does not appear to be any vegetation in the deeper parts of the lake, but the shallower areas have some *Potamogeton sp*. Various species of sedge and rush grow in the marshes, notably *Carex sp.* Species of Caragana and Astragalus are typical of the surrounding arid steppe vegetation. |
| Fauna | Tso Morari is an important breeding locality for waterfowl in Ladakh, The lake has the largest breeding colony of bar-headed geese (*Anser indicus*) in Indian territory, and supports significant breeding populations of great crested grebe, brahminy duck, ruddy sheduck, lesser sand plover, brown- headed gull, and common tern. |

Post-monsoon 2007

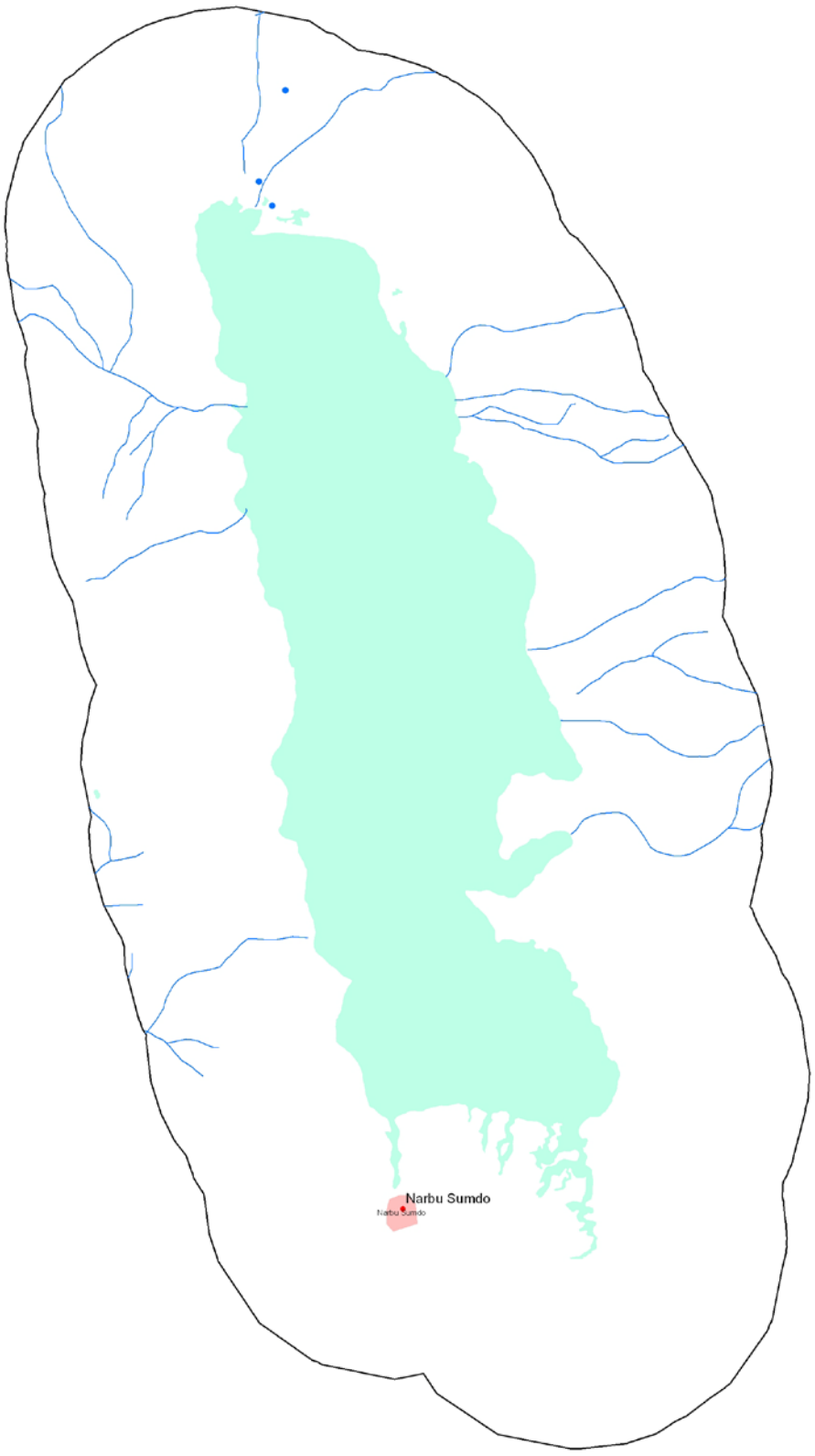
Pre-monsoon 2007

Plate 103: Tso Moriri

State : Jammu and Kashmir

**WETLAND MAP**

Tso_Morari




| 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 (<2.25ha)
- Settlements
- Roads
- Railway
- Drainage (line)
- Town/Settlements
- District boundary
- State boundary
- International boundary

**Location Map**

India | Jammu and Kashmir | Tso_Morari

0 2.5 5 10 Kilometers

Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

Plate 104: Wetland map - 5 km buffer area of Tso Moriri

State : Jammu and Kashmir

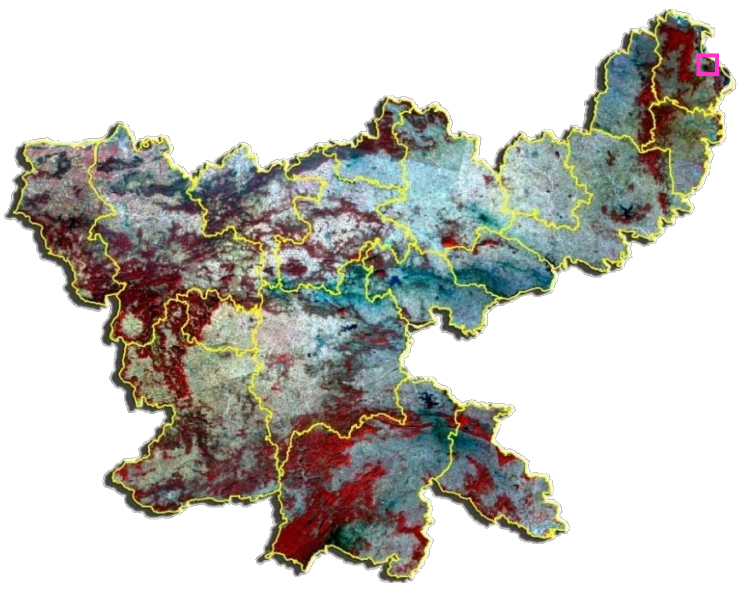
Tso_Morari

IRS P6 LISS-III pre-monsoon 2007 data

Plate 105: IRS LISS III FCC - 5 km buffer area of Tso Moriri

## 9.16 Udhwa Lake ( Bird Sanctuary)

| | |
|---|---|
| | **Name** : Udhwa Lake ( Bird Sanctuary) |
| **1** | **Location** : 87° 48' 55.500" E, 24° 58' 6.400" N<br>Sahibganj declared as “Udhwa Lake Bird Sanctuary” in the year 1991. The Sanctuary is situated at about 42 km from sahibganj . It is situated on the bank of the Ganga about 10 km southeast of Rajmahal. Two water bodies, namely Pataura and Barhale constitute the 5.65 $km^2$ Udhwa lake bird Sanctuary. |
| **2** | **Area:** 1605 ha |
| **3** | **Wetland type** : Lake (Bird Sanctuary) |
| **4** | **Flora:** The lake is infested with aquatic macrophytes comprising emergent, free floating and submerged forms. Water hyacinth was found to be the dominant form. Over all 50% of the lake surface was covered with aquatic weeds. |
| **5** | **Fauna:** It is a home to a variety of birds including different mynas, kites, Cattle Egret, Pond Heron, Purple Heron, Open Billed stock, White Ibis, Dab chick or little Grebe, fishing eagles, hose swifts and palm swifts flying at dizzying speeds. A specialty of the sanctuary is Siberian birds flocking from different parts of the world. |
| **6** | **Major fish species:** Udhwa lake seems to be rich in fish and fish spawn. Some common fishes of the lake are Rohu (*Labeo rohita*), Catla (*Catla catla*) , Tengra (*Mystus cavasius*), Bata (*L. bata*), reba(*C. retra*) , Mirka (*Cirrihinus mrigala*) etc. |



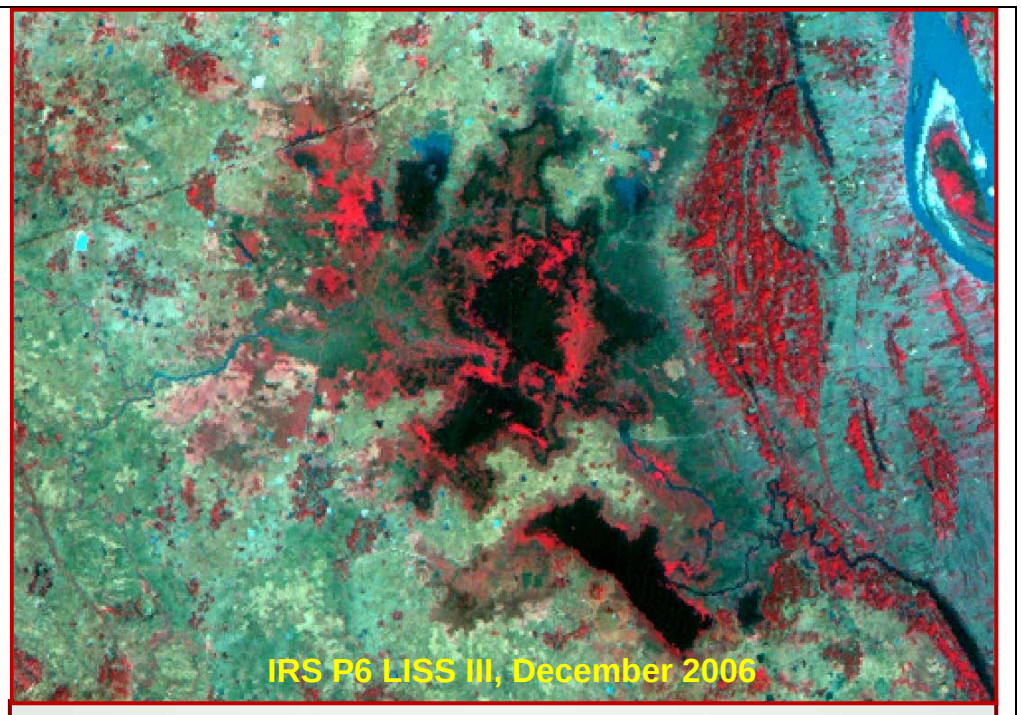
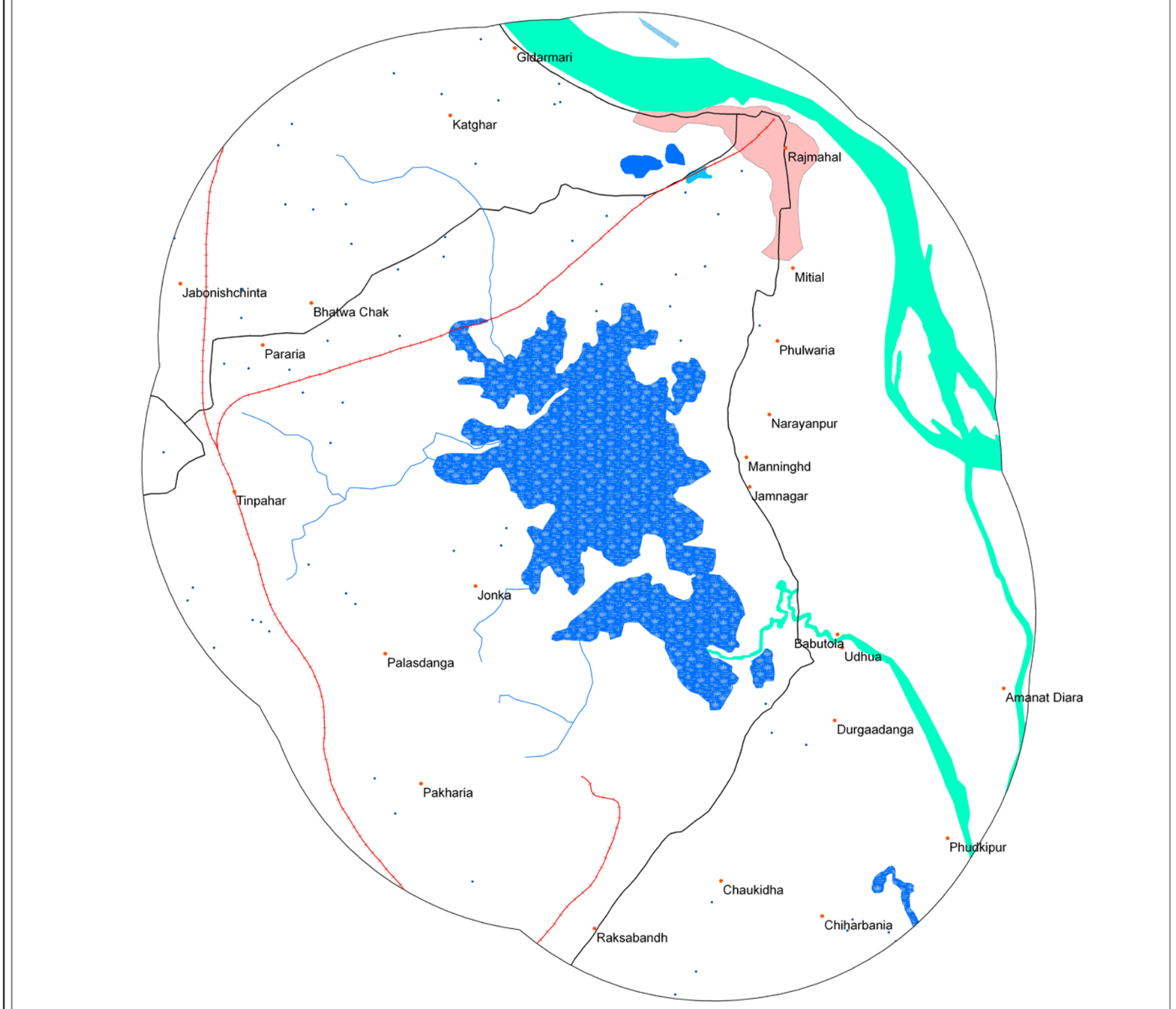



Plate 106: Udhwa Lake (Bird Sanctuary)

State : Jharkhand

# WETLAND MAP

Udhwa Lake

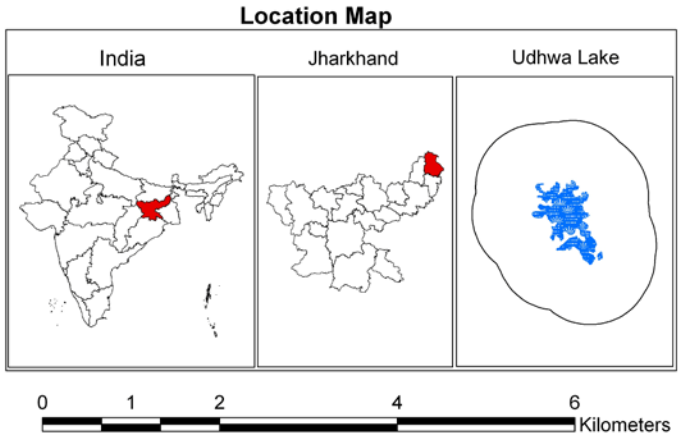



| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

**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
Jharkhand Space Applications Centre, Ranchi

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 107: Wetland map - 5 km buffer area of Udhwa Lake (Bird Sanctuary)

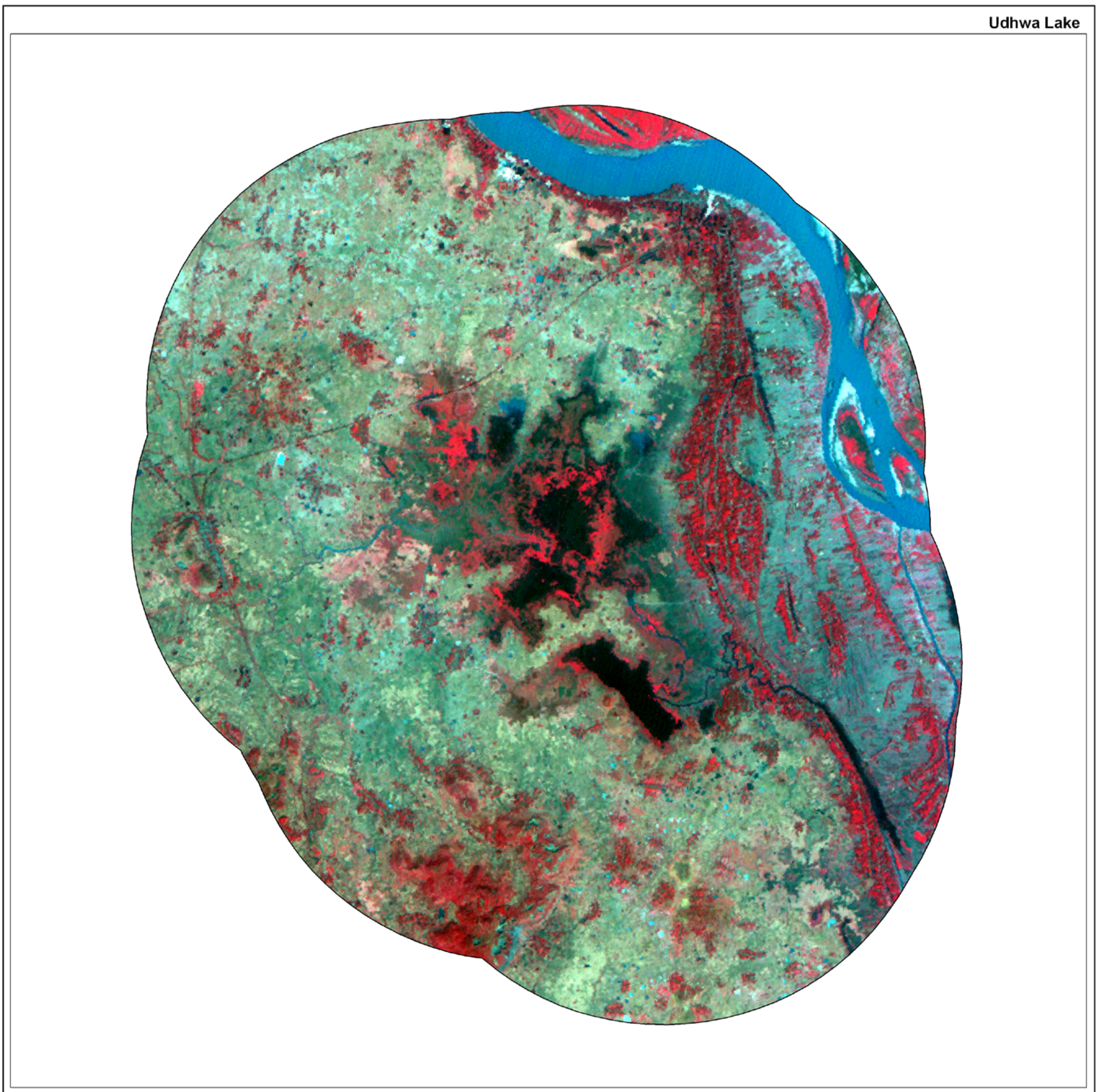
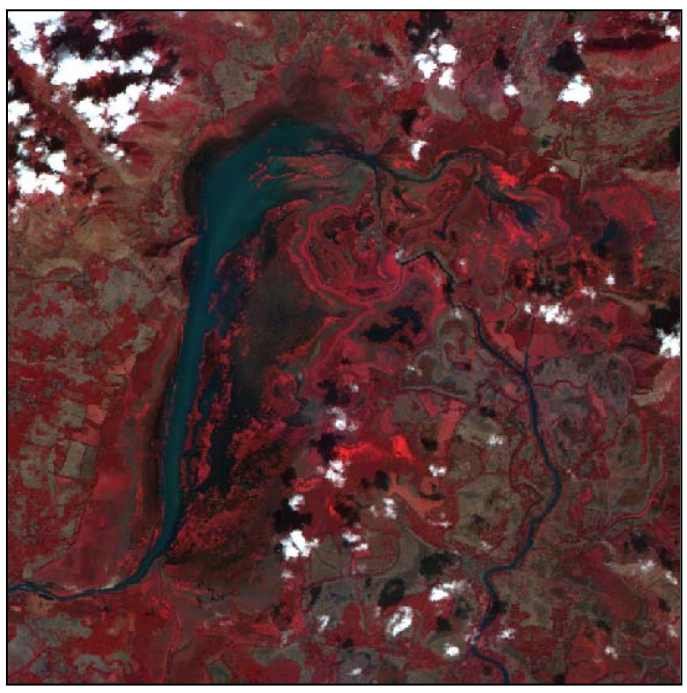


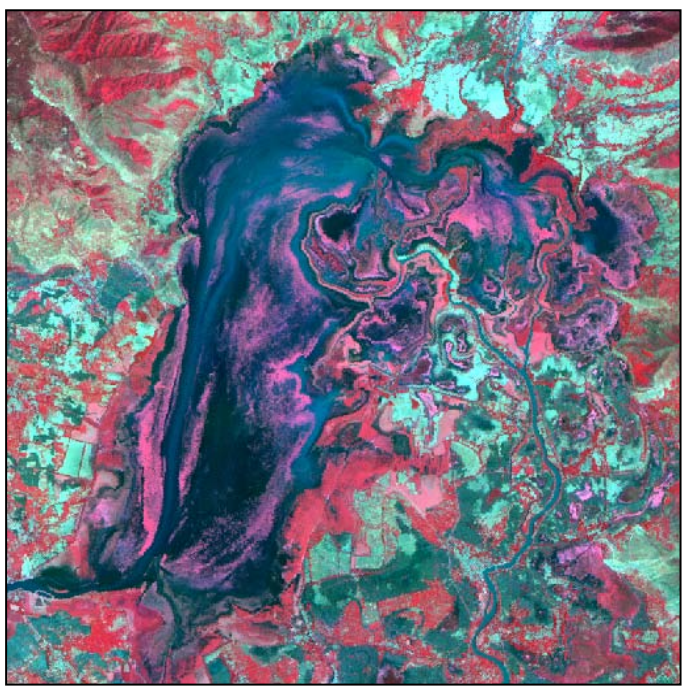

Plate 108: IRS LISS-III FCC – 5 km buffer area of Udhwa Lake (Bird Sanctuary)

## 9.17 Wular Lake

| Name | Wular Lake |
|---|---|
| Location | Between $34^0$ 16' N and $34^0$ 25' N latitudes and $74^0$ 29' E and $74^0$ 40' E longitudes |
| Area | 11,277 ha |
| Altitude | 1,580 m |
| Climate | Average annual rainfall : 678 mm, Temperature: $-5^o$ C to $37^o$ C. |
| Salient features | A large freshwater lake of India and associated marshes on the floodplains. Valley, considerably larger and deeper than the other lakes in the region. Originally occupying an area of 20,000 ha, it has now shrunk to a mere 2400 ha. Sudden and furious storms frequently sweep across the lake which is bound by hills in the northeast and north-west. Jhelum river drains the lake westwards, through the Pir Panjal Range into the Indus. It is a recreational place and attracts large number of tourists. The lake is as source of livelihood for a large human population living along its fringes. The catchment area of the lake supports magnificent coniferous forests, alpine pastures and orchards, adding to the natural beauty and biodiversity of the wetland area. |
| Turbidity | High |
| Vegetation | Extensive areas of submerged, floating, and emergent macrophytes of species such as *Ceratophyllum demersum, Myriophyllum spicatum, Nymphoides peltata, Nelumbo nucifera, Trapa bispinosa,* and *Phragmites communies* on the southeastern margin of the lake where the Jhelum river forms a large deltaic tract. Phytoplankton includes more than 72 taxa representing six classes of algae, dominated by Bacillariophyceae. Shallow areas are covered with willow (*Salix alba*) plantations. Macrophytes are relatively sparse in the deeper zones. *Trapa Sps*. is very common in this area and it is a staple food of villagers. |
| Fauna | The Lake was known to be an important staging and wintering area for migratory ducks, particularly *Aythya fuligul during* 1960s but no recent information is available. The lake, along with the extensive marshes surrounding, is an important natural habitat for wildlife. It is also an important habitat for fish, accounting for 60 percent of the total fish production within the State of Jammu and Kashmir. |



Post-monsoon 2007



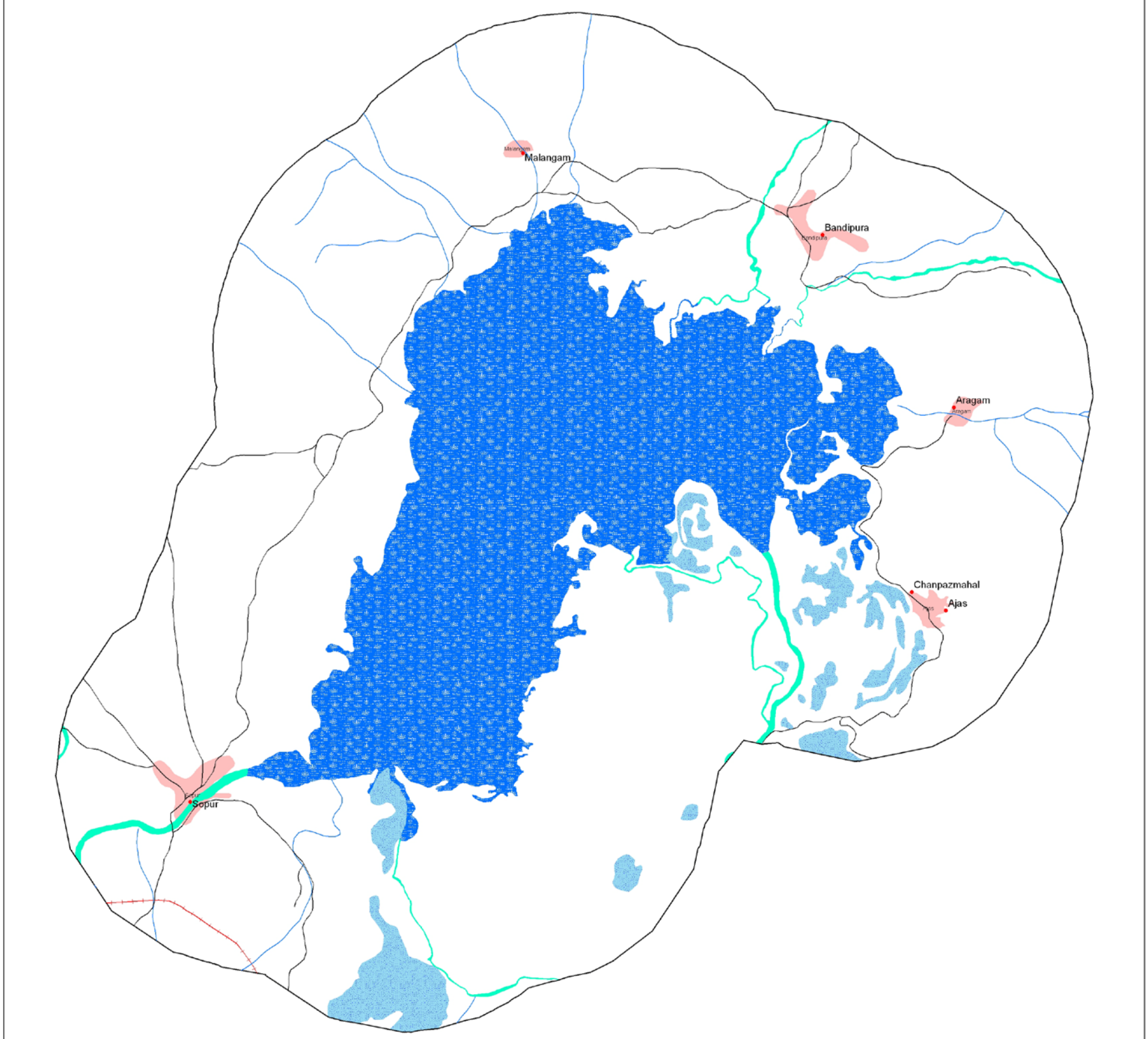
Pre-monsoon 2007

Plate 109: Wular Lake

State : Jammu and Kashmir

# WETLAND MAP

Wular_Lake



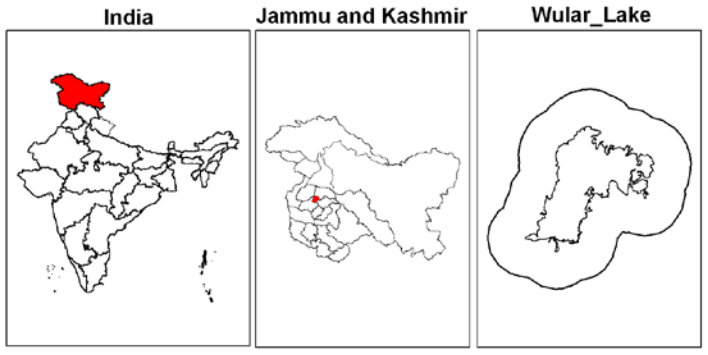

| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Settlements
- Roads
- Railway
- Drainage (line)
- Town/Settlements
- District boundary
- State boundary
- International boundary

## Location Map

India | Jammu and Kashmir | Wular_Lake



0 1.5 3 6 Kilometers

**Data Source :**

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

**Prepared By :**

Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

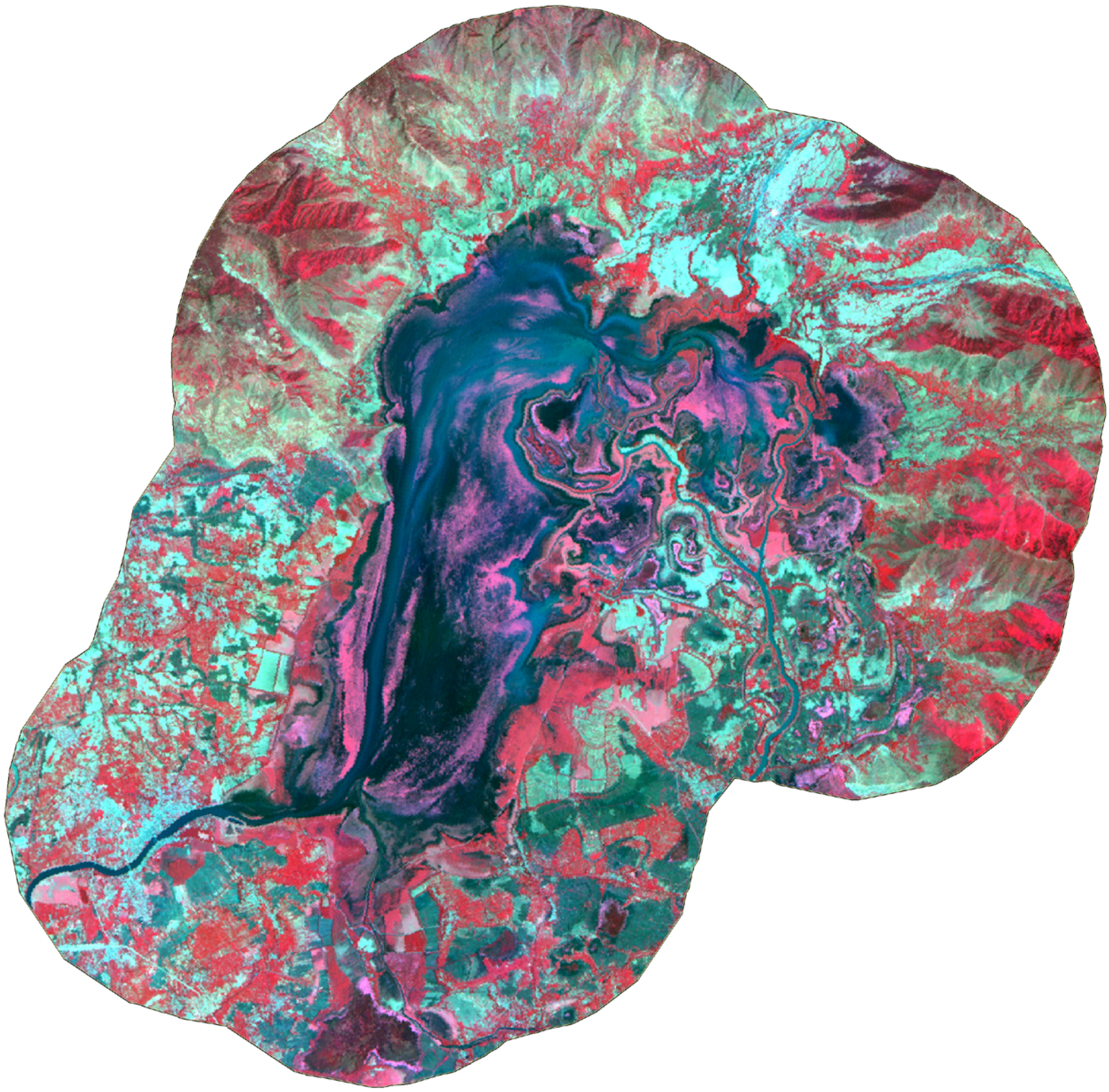
**Sponsored By:**

Ministry of Environment and Forests
Government of India

Plate 110: Wetland map - 5 km buffer area of Wular Lake

State : Jammu and Kashmir

Wular_Lake



IRS P6 LISS-III Pre-monsoon 2007 data

Plate 111: IRS LISS III FCC - 5 km buffer area of Wular Lake

## 9.18 Wandur Marine National Park

Wandur Marine National Park (MNP) in 1986 encompasses area between 92° 30’ to 92° 40 E Longitudes and 11° 22 to 11° 36 N Latitudes accounting for an area of 282 Sq. km falling along the south-west coast of South Andaman immediately north of Rutland Island. This is perhaps the least disturbed group of islands that includes Tarmugli, Alexandra, Red skin, Hobday, Boat, Malay, Jolly Boys islands and islets of Pluto, Snob, Belle, Chester and Grub comprising coastal tracts lying between 0 to 85 m above MSL and also sea. The importance attached to this MNP is due to the submerged coral reefs and many marine species. Larger area is considered for the extraction of wetland estimates for this MNP. Coral is the most dominating category in the MNP comprising 68.79 % accounts for 4480 ha of area out of 6513 ha of total. Coral is followed by Mangrove (10.53 ha) and Inter-tidal Mud-flat (519 ha). The detail of type-wise wetland area estimation is given below

Area estimates of wetlands in Wandur Marine National Park

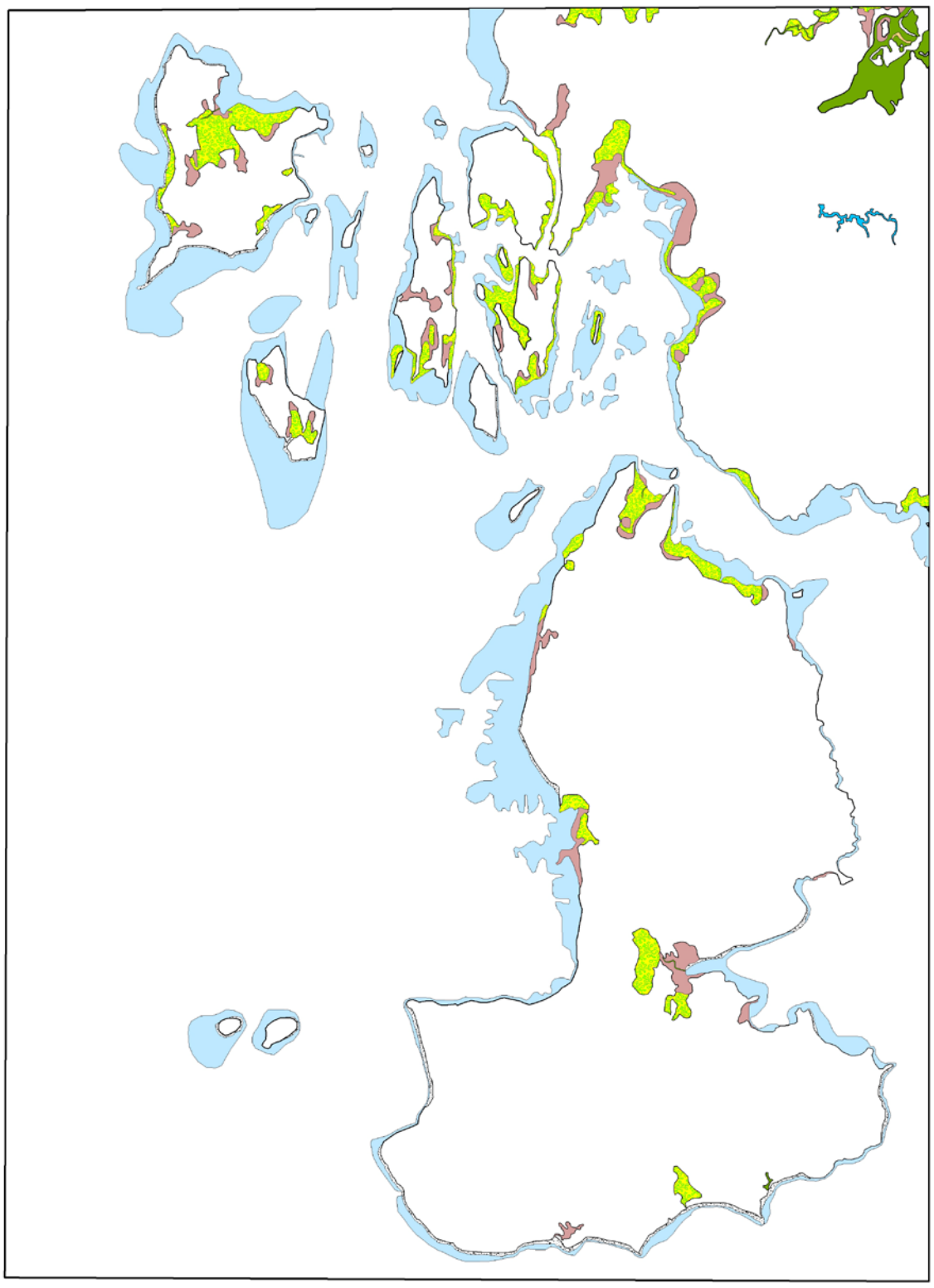
Area in ha

| Sr. No. | Wetland code | Wetland Category | No. of wetlands | Wetland Area | % of wetland area |
|---|---|---|---|---|---|
| | **1200** | **Inland Wetlands -Man-made** | | | |
| 1 | 1201 | Reservoir/Barrage | 1 | 20 | 0.31 |
| | | **Sub-total** | **1** | **20** | 0.31 |
| | **2100** | **Coastal Wetlands - Natural** | | | 0.00 |
| 2 | 2102 | Creek | 8 | 226 | 3.47 |
| 3 | 2103 | Sand/Beach | 20 | 212 | 3.26 |
| 4 | 2104 | Intertidal Mud-flat | 48 | 519 | 7.97 |
| 5 | 2105 | Salt Marsh | 1 | 3 | 0.05 |
| 6 | 2106 | Mangrove | 48 | 1053 | 16.17 |
| 7 | 2107 | Coral | 47 | 4480 | 68.79 |
| | | **Sub-total** | **172** | **6493** | 99.69 |
| | | **Total** | **173** | **6513** | **100.00** |

UT : Andaman and Nicobar Islands

# WETLAND MAP

Wandur Marine National Park

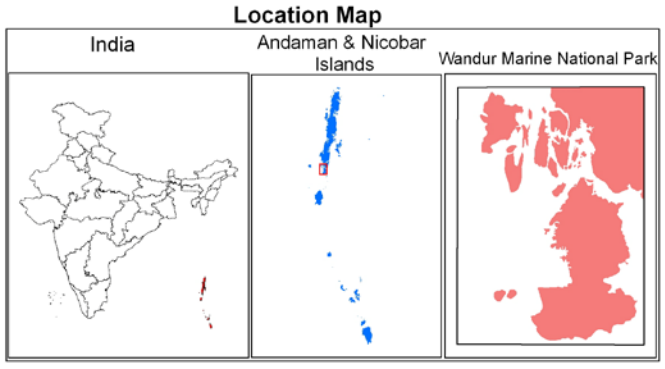


| Symbol | Typecode | Level I | Level II | Level III |
|---|---|---|---|---|
| | | Inland Wetlands | | |
| | | | Natural | |
| | 1101 | | | Lakes/Ponds |
| | 1102 | | | Ox-bow lakes/ Cut-off meanders |
| | 1103 | | | High altitude wetlands |
| | 1104 | | | Reverine wetlands |
| | 1105 | | | Waterlogged |
| | 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 (<2.25ha)
- Roads
- Drainage (line)
- Settlements
- Town/Settlements

**Location Map**




0 1 2 4 Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 112: Wetland map of Wandur Marine National Park

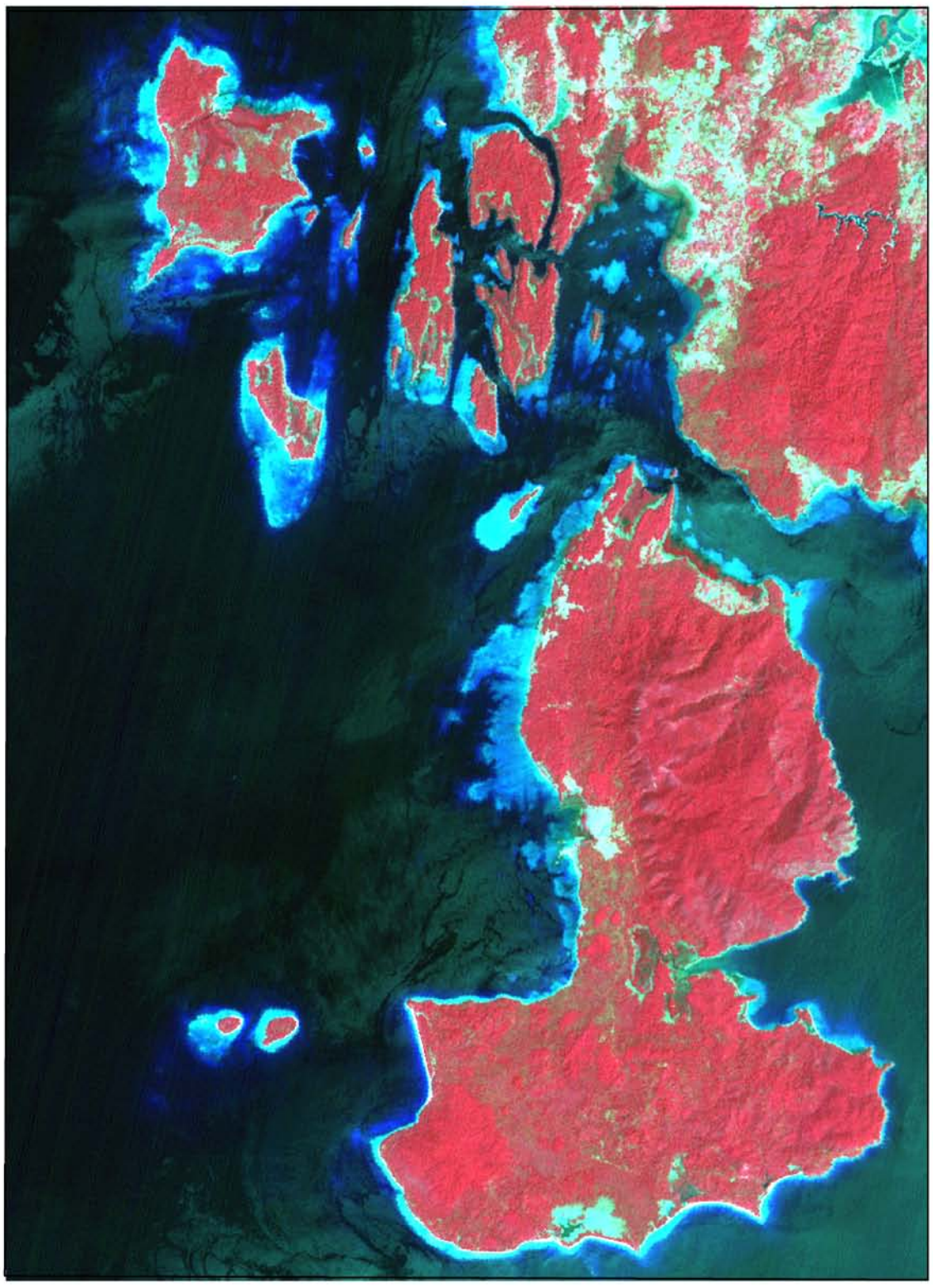



Plate 113: IRS LISS III FCC - 5 km buffer area of Wandur Marine National Park

# REFERENCES


1. Anon. 2005, NNRMS Standards. A National Standards for EO images, thematic & cartographic maps, GIS databases and spatial outputs. ISRO:NNRMS: TR:112:2005. A Committee Report: National Natural Resources Management System, Bangalore
2. Anon. 1993. Directory of Indian Wetlands, 1993. WWF India, New Delhi and AWB Kuala Limpur, xvi+264pp., 32 maps.
3. Clark, John R. (1977). *Coastal Ecosystem Management,* A Wiley Interscience Publication, John Wiley & Sons, New York,.
4. Cowardin, L.M., Carter, V., Golet, E.C. and La Roe (1979). *Classification of wetlands and deep water habitats*. USFWS/085-79/31, Office of the Biological Services, U.S. Fish and Wildlife Service, Washington, D.C.
5. *Encyclopaedic Directory of Environment (1*988). (Ed. By G.R. Chatwal, D.K. Pandey, and K.K. Nanda). Vol. I-IV, Anmol Publications, New Delhi.
6. Garg, J.K., Singh, T.S. and Murthy, T.V.R. (1998). *Wetlands of India*. Project Report: RSAM/sac/resa/pr/01/98, June 1998, 240 p. Space Applications Centre, Ahmedabad,
7. Garg J.K. and Patel J. G., 2007. National Wetland Inventory and Assessment, Technical Guidelines and Procedure Manual, Technical Report, SAC/EOAM/AFEG/NWIA/TR/01/2007, June 2007, Space Applications Centre, Ahmedabad,
8. *Glossary of Geology* (1974). (Ed. By Margarate G., Robbert, M. Jr. and Wolf, C.L), American Geological Institute, Washington, D.C..
9. Jensen, J.R. (1986). *Introductory Digital Image Processing: A Remote Sensing Perspective,* Prentice Hall, Englewoods Cliff, NJ.
10. Lacaux, J.P., Tourre, Y.M., Vignolles, C., Ndione, J.A. and Lafaye, M. 2007. Classification of ponds from high-spatial resolution remote sensing: Application to Rift valley fever epidemics in Senegal. *Remote Sensing of Environment*, 106, pp. 66-74
11. Lillesand, T.M. and Keifer, R.W. 1987. Remote Sensing and Image Interpretation. John Wliey and Sons, New York.
12. *Manorama Yearbook 2007*
13. *McGraw - Hill Encyclopaedia of Environmental Science* (1974). (Ed. Sybil P. Parkar), McGraw-Hill Book Company, New York.
14. McFeeters, S.K. 1996. The use of Normalised Difference Water Index (NDWI) in the delineation of open water features. *International Journal of remote Sensing*, 7, pp. 1425-1432.
15. Millennium Ecosystem Assessment. 2005, Ecosystems and Human Well-being: A Framework for Assessment, http://www.MAweb.org
16. Mitsch, William J. and Gosselink, James G. (1986). *Wetlands*, Van Nostrand Reinhold Company, New York.
17. Navalgund, R.R., Nayak, S.R., Sudarshana, R., Nagaraja, R. and Ravindran, S. 2002. Proceedings of the ISPRS Commission VII. Symposium on Resource and Environmental Monitoring, IAPRS & SIS, Vol.35, Part-7, NRSA, Hyderabad.
18. Patel J.G., Singh T.S., Garg J.K. et al, Wetland Information System, West Bengal, SAC/RSAM/RESA/FLPG/WIS/01/2003, A Technical report: Space Applications Centre, Ahmedabad
19. Ramsar Convention (2007). www.ramsar.org
20. Reid, George K and Wood, Richard D. (1976). *Ecology of Inland Waters and Estuaries*. D. Van Nostrand Company, New York.
21. SACON, 2004, Inland Wetlands of India : Conservation Atlas. Coimbatore, Salim Ali Centre for Ornithology and Natural History, 2004, ISBN 81-902136-1-X. ,Vedams eBooks (P) Ltd. Vardhaman Charve Plaza IV, Building # 9, K.P Block, Pitampura,
22. Singh T.S., Patel J.G., Garg J.K. et al. Loktak Lake Resources Information System (LRIS), SAC/RSAM/RESIPA/FLPG/WIS/02/2003, A Technical report: Space Applications Centre, Ahmedabad
23. Townshend, J.R., and Justice, C.O. 1986. Analysis of dynamics of African vegetation using the Normalised difference Vegetation Index. *International Journal of Remote Sensing, 7, pp. 1435-1445.*
24. Tucker, C.J. and Sellers, P.J. 1986. Satellite remote sensing of primary productivity. *International Journal of Remote Sensing, 7, pp. 1395-1416.*
25. Xu Hanqiu, 2006. Modification of normalised difference water index (NDWI) to enhance open water features in remotely sensed imagery. *International Journal of Remote Sensing, 7, pp. 3025-3033.*
26. National Wetland Atlas: Goa, SAC/RESA/AFEG/NWIA/ATLAS/01/2009, Space Applications Centre (ISRO), Ahmedabad, India, 72p.
27. National Wetland Atlas: Meghalaya, SAC/RESA/AFEG/NWIA/ATLAS/02/2009, Space Applications Centre(ISRO), Ahmedabad, India, 88p.
28. National Wetland Atlas: Manipur, SAC/RESA/AFEG/NWIA/ATLAS/03/2009, Space Applications Centre(ISRO), Ahmedabad, India, 96p.
29. National Wetland Atlas: Andaman & Nicobar Islands, SAC/RESA/AFEG/NWIA/ATLAS/04/2009, Space Applications Centre (ISRO), Ahmedabad, India, 190P.

30. National Wetland Atlas: Lakshadweep, SAC/RESA/AFEG/NWIA/ATLAS/05/2009, Space Applications Centre (ISRO), Ahmedabad, India, 88p.National Wetland Atlas: Arunachal Pradesh, SAC/RESA/AFEG/NWIA/ATLAS/06/2009, Space Applications Centre (ISRO), Ahmedabad, India, 98p.
31. National Wetland Atlas: Delhi, SAC/RESA/AFEG/NWIA/ATLAS/07/2009, Space Applications Centre (ISRO), Ahmedabad, India, 92p.
32. National Wetland Atlas: West Bengal, SAC/RESA/AFEG/NWIA/ATLAS/09/2010, Space Applications Centre (ISRO), Ahmedabad, India, 150p.
33. National Wetland Atlas: Mizoram, SAC/RESA/AFEG/NWIA/ATLAS/10/2010, Space Applications Centre(ISRO), Ahmedabad, India, 90p.
34. National Wetland Atlas: Jharkhand, SAC/RESA/AFEG/NWIA/ATLAS/11/2010, Space Applications Centre, ISRO, Ahmedabad, India, 152p.
35. National Wetland Atlas: Uttar Pradesh, SAC/RESA/AFEG/NWIA/ATLAS/12/2010, Space Applications Centre, ISRO, Ahmedabad, India, 372p.
36. National Wetland Atlas: Sikkim, SAC/RESA/AFEG/NWIA/ATLAS/13/2010 Space Applications Centre (ISRO), Ahmedabad, India, 88p.
37. National Wetland Atlas: Kerala, SAC/RESA/AFEG/NWIA/ATLAS/14/2010, Space Applications Centre(ISRO), Ahmedabad, India, 130p.
38. National Wetland Atlas: Haryana, SAC/RESA/AFEG/NWIA/ATLAS/15/2010, Space Applications Centre (ISRO), Ahmedabad, India, 148p.
39. National Wetland Atlas: Jammu and Kashmir, SAC/RESA/AFEG/NWIA/ATLAS/16/2010, Space Applications Centre, ISRO, Ahmedabad, India, 176p.
40. National Wetland Atlas: Tripura, SAC/RESA/AFEG/NWIA/ATLAS/17/2010, Space Applications Centre(ISRO), Ahmedabad, India, 88p.
41. National Wetland Atlas: Assam, SAC/RESA/AFEG/NWIA/ATLAS/18/2010, Space Applications Centre(ISRO), Ahmedabad, India, 174p.
42. National Wetland Atlas: Maharashtra, SAC/RESA/AFEG/NWIA/ATLAS/19/2009, Space Applications Centre (ISRO), Ahmedabad, India, 222p.
43. National Wetland Atlas: Nagaland, SAC/RESA/AFEG/NWIA/ATLAS/20/2010, Space Applications Centre (ISRO), Ahmedabad, India, 116p.
44. National Wetland Atlas: Gujarat, SAC/RESA/AFEG/NWIA/ATLAS/21/2010 Space Applications Centre (ISRO), Ahmedabad, India, 198p.
45. National Wetland Atlas: Tamilnadu, SAC/RESA/AFEG/NWIA/ATLAS/22/2009, Space Applications Centre (ISRO), Ahmedabad, India, 222p.
46. National Wetland Atlas: Bihar, SAC/RESA/AFEG/NWIA/ATLAS/23/2010, Space Applications Centre (ISRO), Ahmedabad, India, 222p.
47. National Wetland Atlas: Uttarakhand, SAC/EPSA/ABHG/NWIA/ATLAS/24/2010, Space Applications Centre (ISRO), Ahmedabad, India, 130p.
48. National Wetland Atlas: Punjab, SAC/EPSA/ABHG/NWIA/ATLAS/25/2010, Space Applications Centre (ISRO), Ahmedabad, India, 152p.
49. National Wetland Atlas: Madhya Pradesh, SAC/EPSA/ABHG/NWIA/ATLAS/26/2010, Space Applications Centre (ISRO), Ahmedabad, India, 284p.
50. National Wetland Atlas: Himachal Pradesh, SAC/EPSA/ABHG/NWIA/ATLAS/27/2010 Space Applications Centre (ISRO), Ahmedabad, India, 126p.
51. National Wetland Atlas: Karnataka, SAC/RESA/AFEG/NWIA/ATLAS/28/2010, Space Applications Centre (ISRO), Ahmedabad, India, 204p.
52. National Wetland Atlas: Union Territories, SAC/EPSA/AFEG/NWIA/ATLAS/29/2010 Space Applications Centre (ISRO), Ahmedabad, India, 112p.
53. National Wetland Atlas: Karnataka, SAC/EPSA/AFEG/NWIA/ATLAS/30/2010, Space Applications Centre (ISRO), Ahmedabad, India, 204p.
54. National Wetland Atlas: Rajasthan, SAC/EPSA/AFEG/NWIA/ATLAS/31/2010, Space Applications Centre (ISRO), Ahmedabad, India, 214p.
55. National Wetland Atlas: Chhattisgarh, SAC/EPSA/AFEG/NWIA/ATLAS/32/2010, Space Applications Centre (ISRO), Ahmedabad, India, 138p.
56. National Wetland Atlas: Andhra Pradesh, SAC/EPSA/AFEG/NWIA/ATLAS/33/2010, Space Applications Centre (ISRO), Ahmedabad, India, 172p.
57. National Wetland Atlas, SAC/EPSA/ABHG/NWIA/ATLAS/34/2010, Space Applications Centre (ISRO), Ahmedabad, India, 306p.
58. National Wetland Atlas: North-Eastern States, SAC/EPSA/ABHG/NWIA/ATLAS/35/2011 Space Applications Centre (ISRO), Ahmedabad, India, 318p.

## 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).<br><br>**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.<br><br>**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.*<br><br>**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.<br>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).<br>**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 (Encyclopaedic Directory of Environment, 1988). Aquaculture ponds are geometrical in shape usually square or rectangular. Tone is blue. |

## Annexure – II
## Details of State information followed in the atlas

**INDIA**

### State Boundary Map


**List of States/Union Territories**

| State Code | State |
|---|---|
| 1 | Jammu & Kashmir |
| 2 | Himachal Pradesh |
| 3 | Punjab |
| 4 | Chandigarh |
| 5 | Uttarakhand |
| 6 | Haryana |
| 7 | Delhi |
| 8 | Rajasthan |
| 9 | Uttar Pradesh |
| 10 | Bihar |
| 11 | Sikkim |
| 12 | Arunachal Pradesh |
| 13 | Nagaland |
| 14 | Manipur |
| 15 | Mizoram |
| 16 | Tripura |
| 17 | Meghalaya |

| State Code | State |
|---|---|
| 18 | Assam |
| 19 | West Bengal |
| 20 | Jharkhand |
| 21 | Orissa |
| 22 | Chhattisgarh |
| 23 | Madhya Pradesh |
| 24 | Gujarat |
| 25 | Daman & Diu |
| 26 | Dadra & Nagar Haveli |
| 27 | Maharashtra |
| 28 | Andhra Pradesh |
| 29 | Karnataka |
| 30 | Goa |
| 31 | Lakshadweep |
| 32 | Kerala |
| 33 | Tamil Nadu |
| 34 | Puducherry |
| 35 | Andaman & Nicobar Islands |

**Legend**

State Boundary

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

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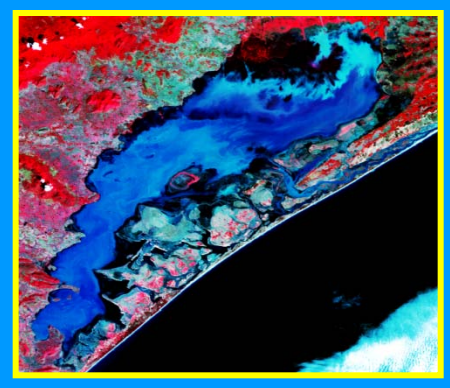
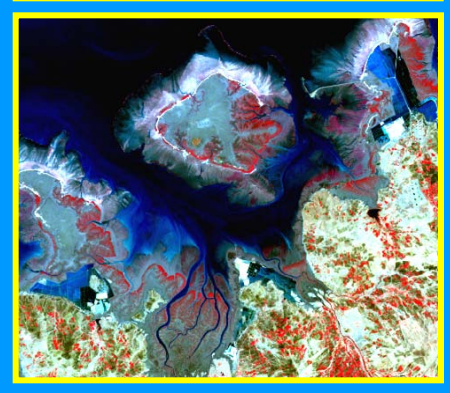
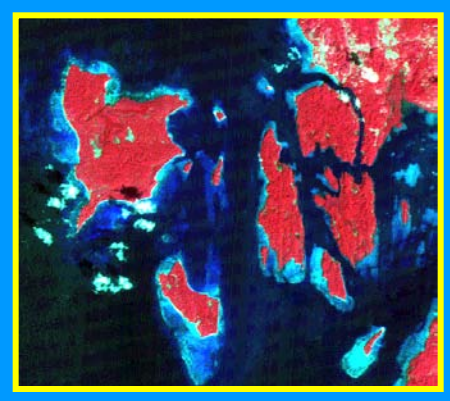
**http://www.isro.org**







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