











NATIONAL WETLAND ATLAS : INDIA

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 remote sensing data from Indian Remote Sensing Satellite: IRS P6- LISS III sensor. The results are organised at 1: 50, 000 scale at district, state and topographic map sheet (Survey of India reference) level using Geographic Information System (GIS). This publication is a part of NWIA work and deals with the wetland status of India, through text, statistical tables, satellite images, maps and ground photographs.

The atlas comprises wetland information arranged in 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 assessment. 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 selected important wetlands of the country. 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 shows 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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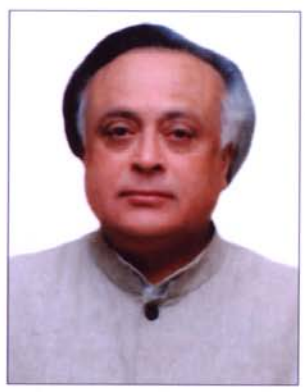
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18th May 2011

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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10	Orissa State Remote Sensing Application Centre, Bhubaneswar
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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 1988, 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.

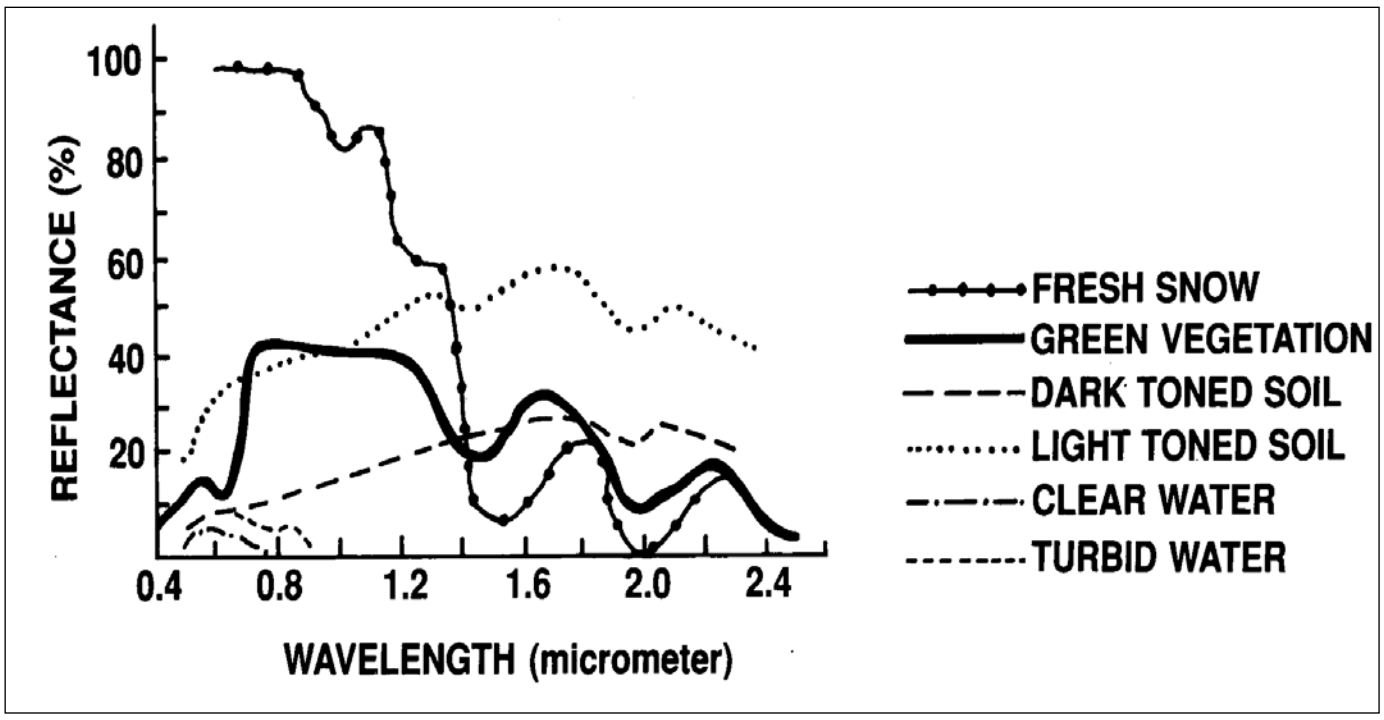


Figure 1: Spectral Signature of various targets

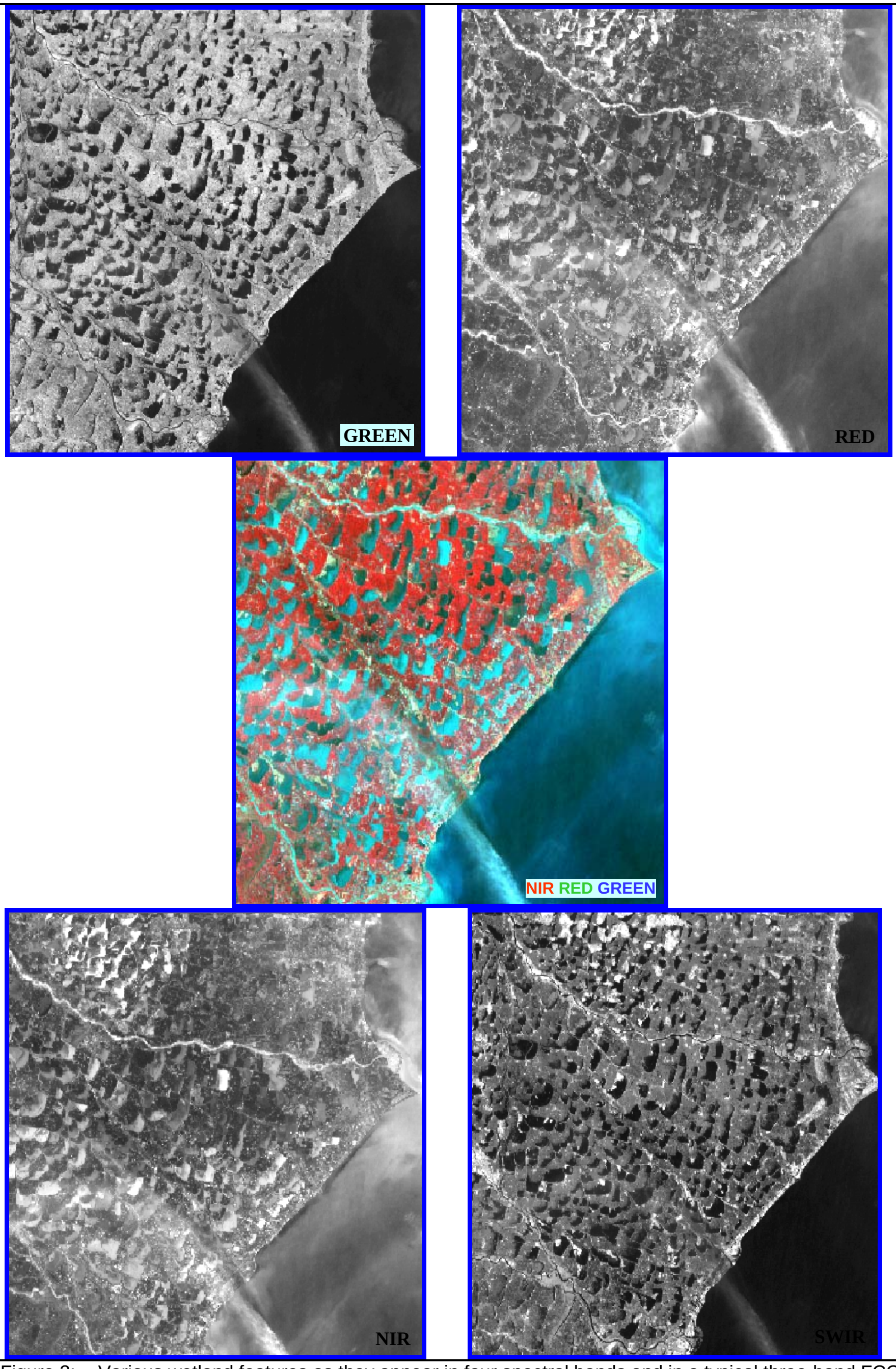


Figure 2: Various wetland features as they appear in four spectral bands and in a typical three-band FCC (part of Tamilnadu)

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.

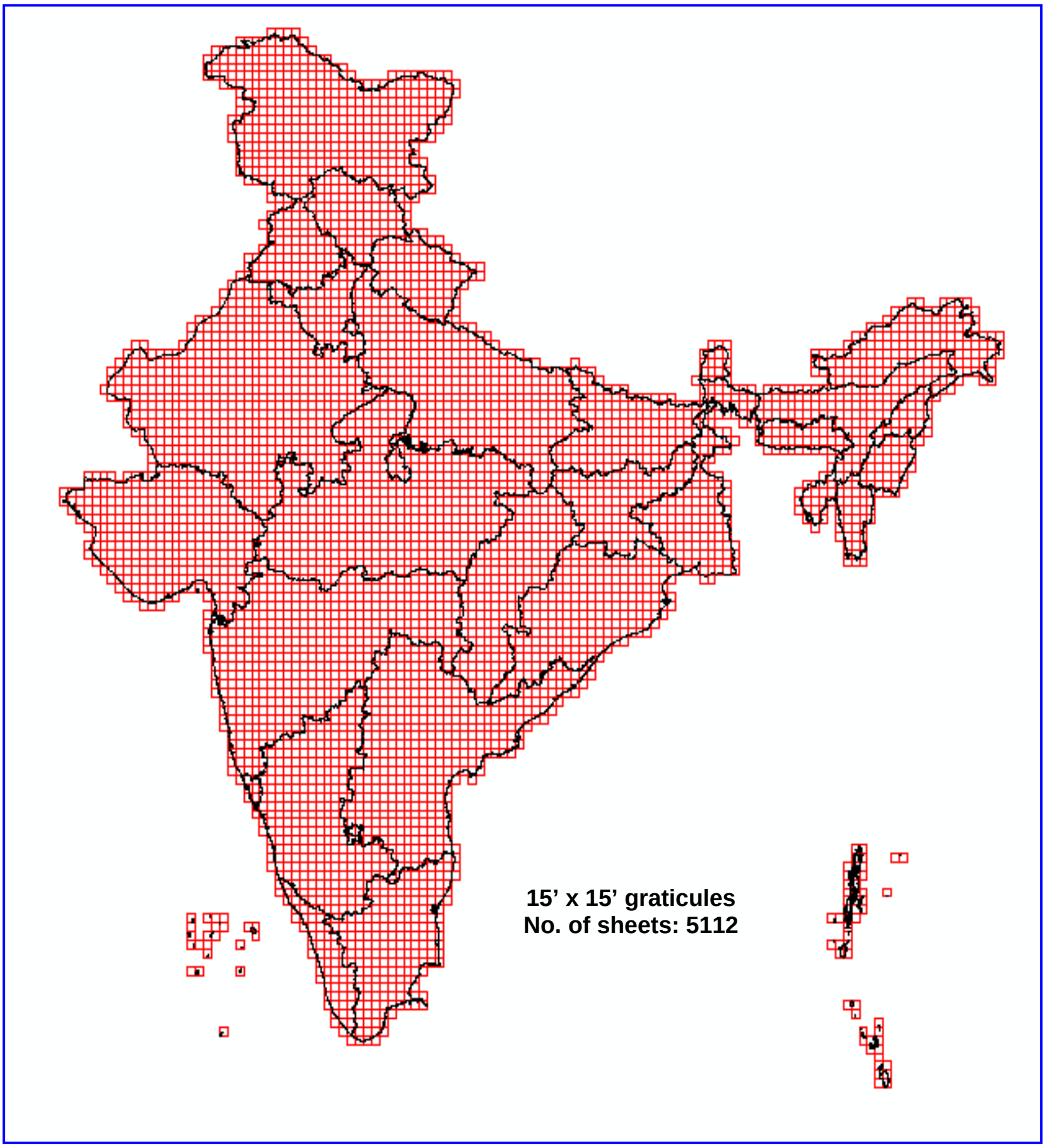


Figure 3: Spatial Framework of India

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.

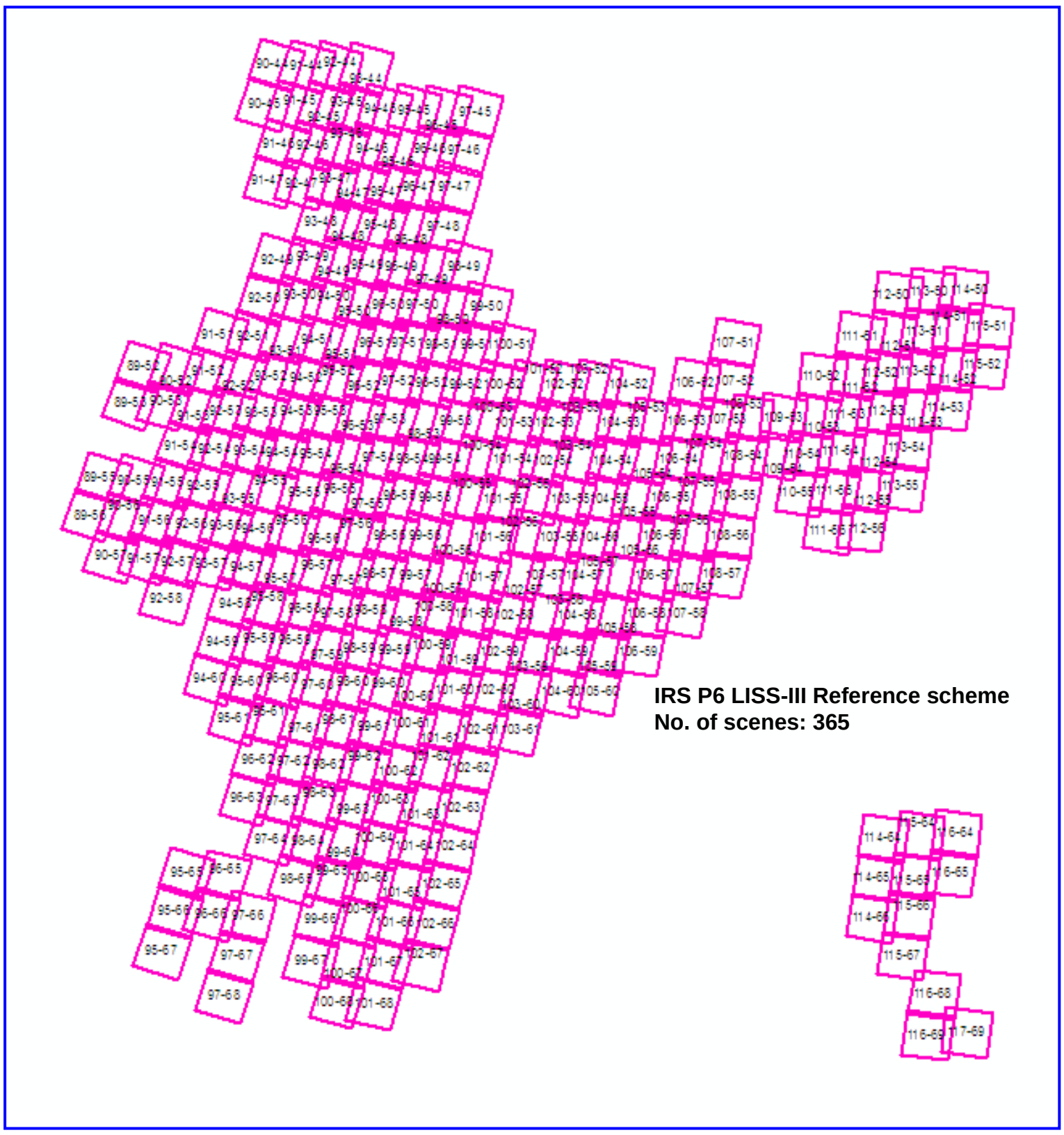


Figure 4: IRS P6 LISS-III coverage (path-row) of India

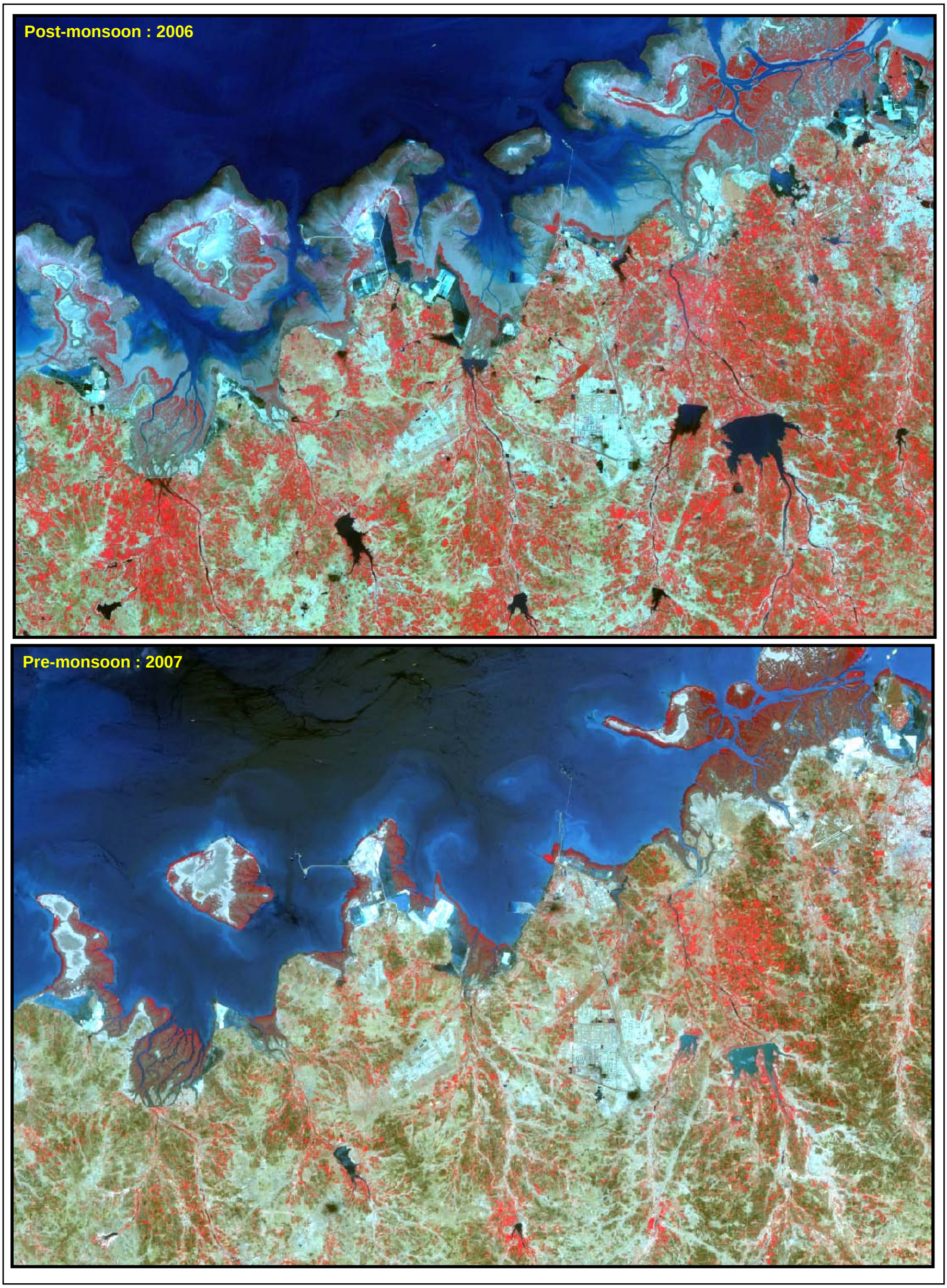


Figure 5: IRS LISS-III FCC (Post-monsoon and Pre-monsoon): Part of Gujarat state

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.

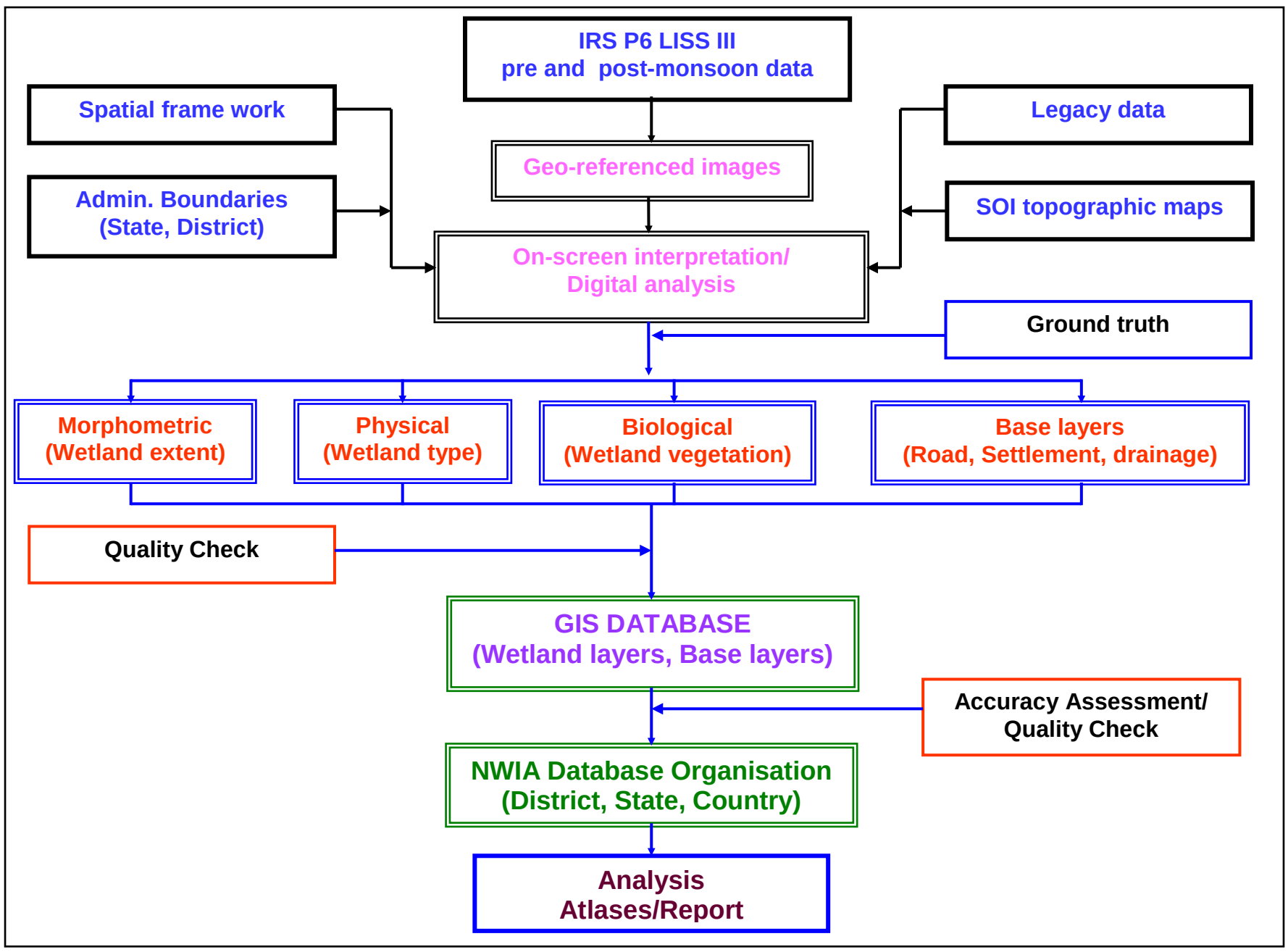


Figure 6: Flow chart of the methodology used

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 σ of MNDWI	Hue on False Colour Composite
1.	Low	> $+1\sigma$	Dark blue/blackish
2.	Moderate	> -1σ to <= $+1\sigma$	Medium blue
3.	High/Bottom reflectance	<= $\mu - 1\sigma$	Light blue/whitish blue

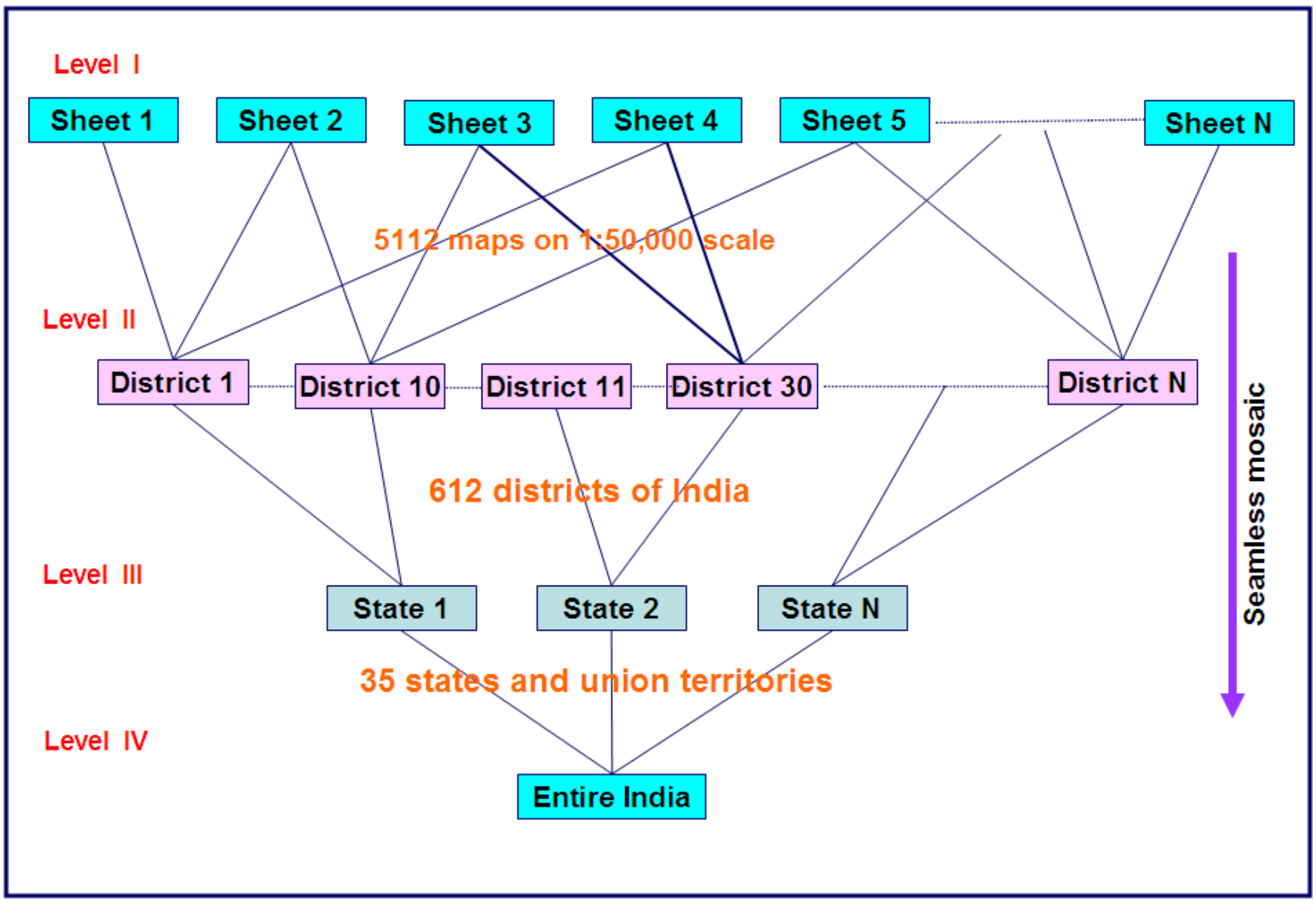


Figure 7: NWIA levels of database organisation

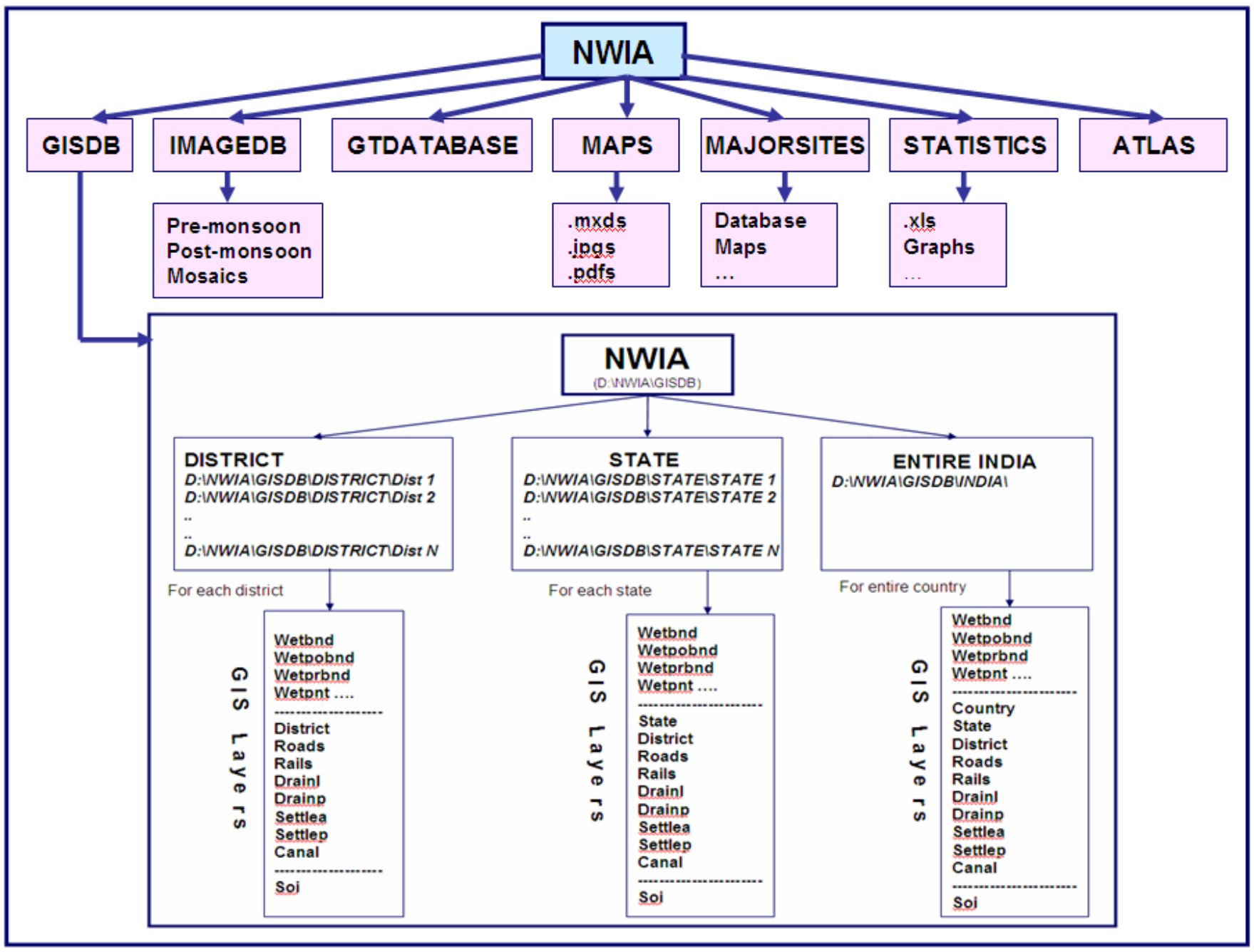


Figure 8: NWIA GIS workspaces and file organisation

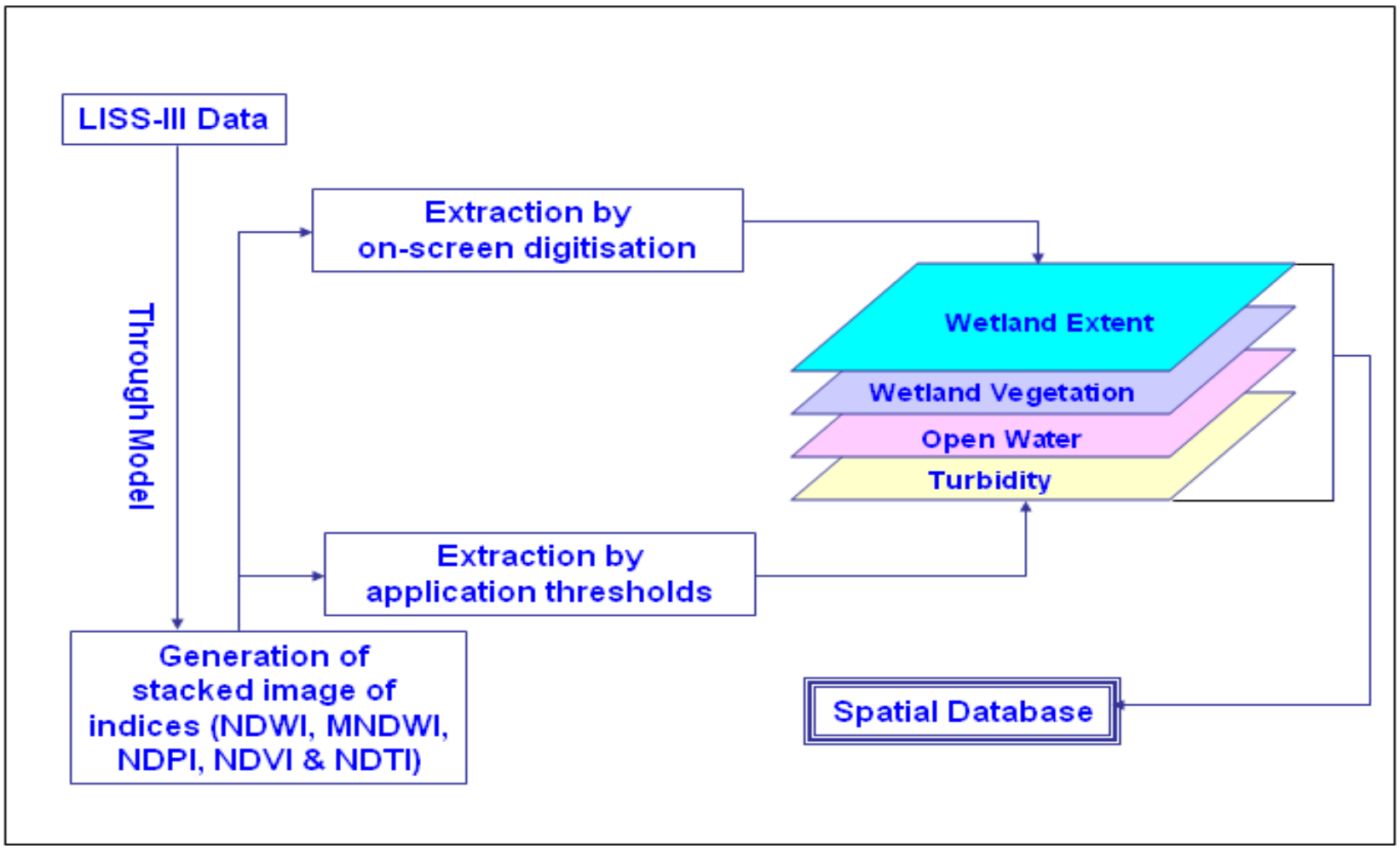


Figure 9: Steps in the extraction of wetland components

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 Wettcode	RS data
2	Wetland pre-monsoon water spread	WETPRBND	Wetcode Wettcode	RS data
3	Wetland post-monsoon water spread	WETPOBND	Wetcode 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 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

In this document, the states and districts are organized as per Census of India (http://nic.in).

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.

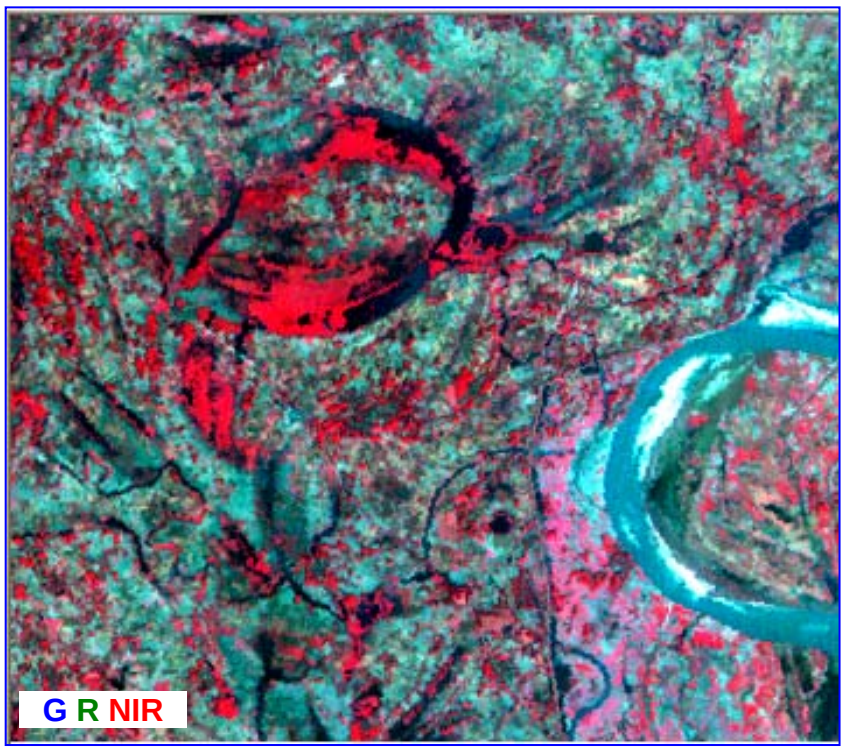
This study used well established, time-tested, fully documented data collection conventions. It employed skilled and trained personnel for image interpretation, processing and digital database creation. All interpreted imageries were reviewed by technical expert team for accuracy and code. The reviewing 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:

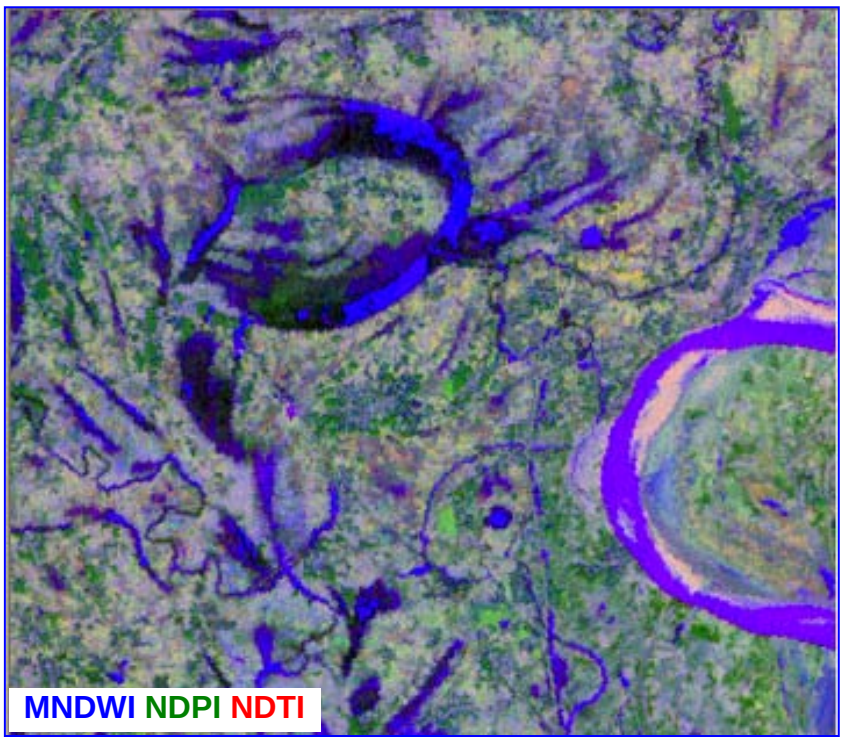
1. Image-to-Image Geo-referencing/Data generation
2. Reference layer preparation using NWIA post monsoon and pre-monsoon LISS-III data.
3. Wetland mapping using visual/digital interpretation techniques.
4. Geo-data base creation and organization
5. Output products.

6.1 Data verification and Quality Assurance of Output Digital Data Files

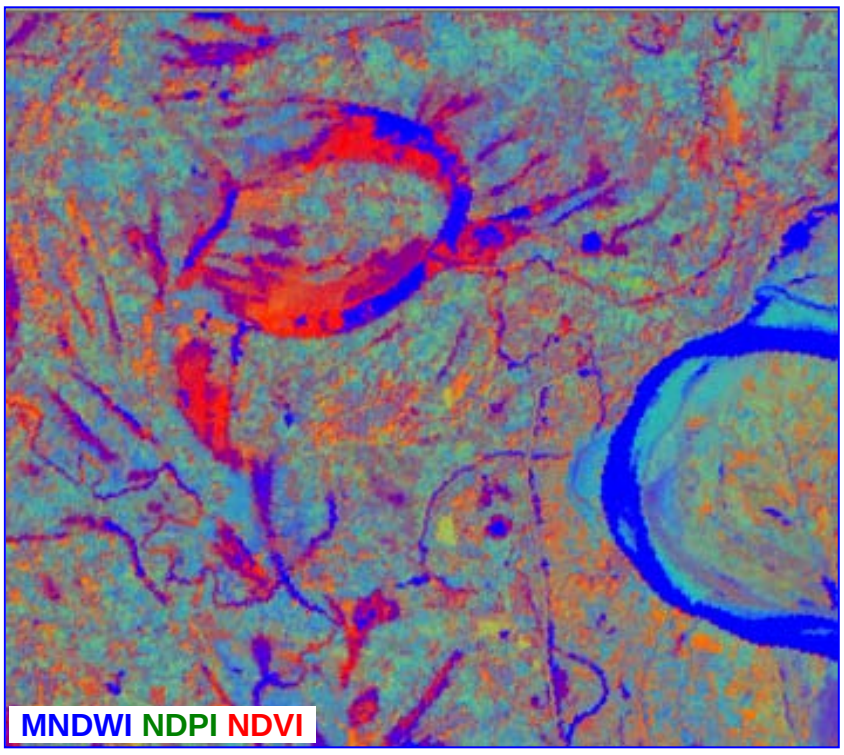
All digital data files were subjected to rigorous quality control inspections. Digital data verification included quality control checks that addressed the geospatial correctness, digital integrity and some cartographic aspects of the data. Implementation of quality checks ensured that the data conformed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

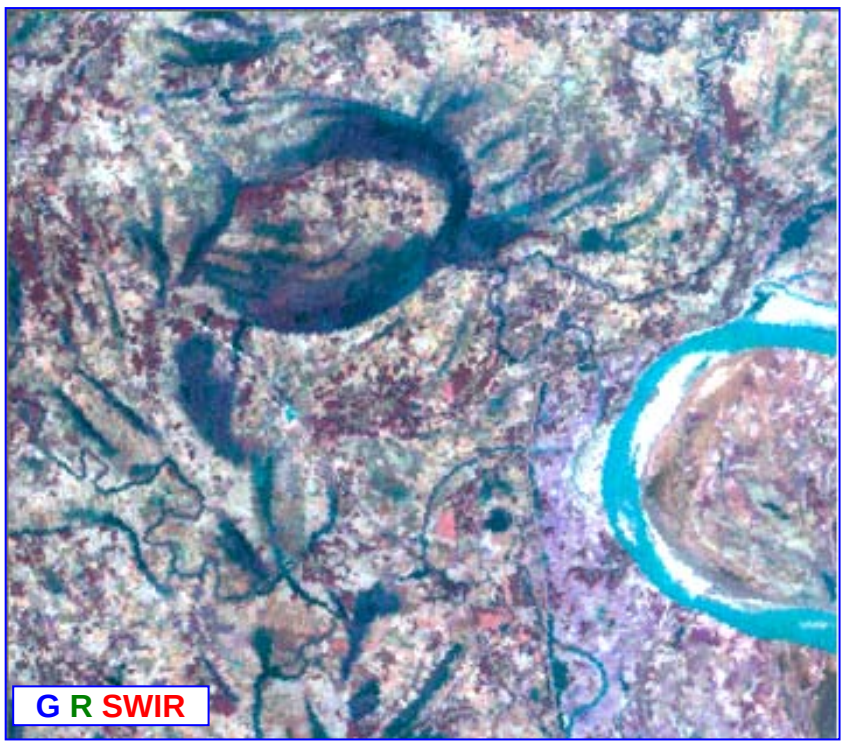


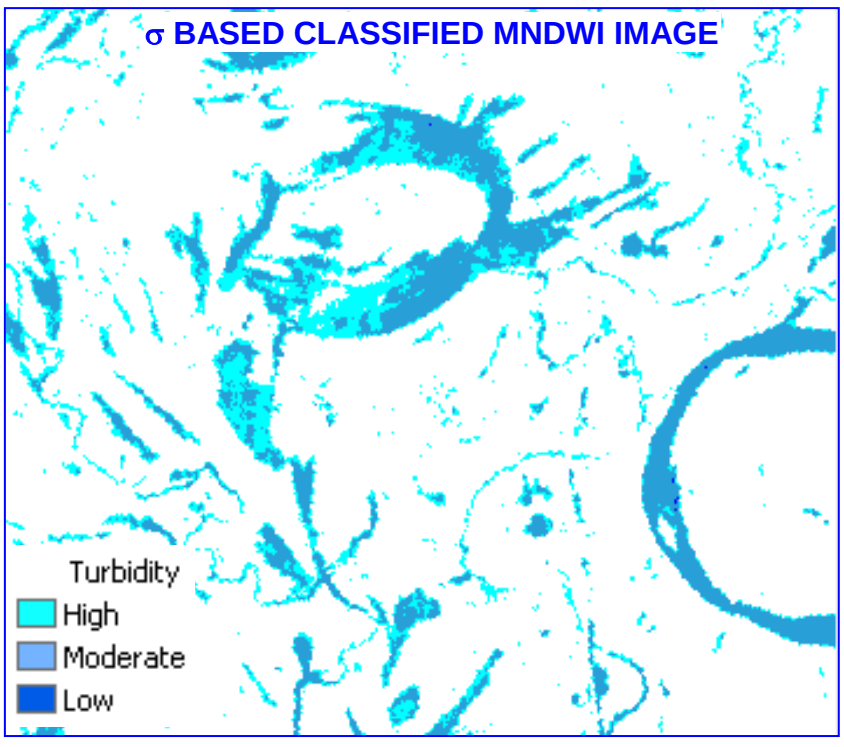


Useful for wetland boundary extraction/delineation



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 Section 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

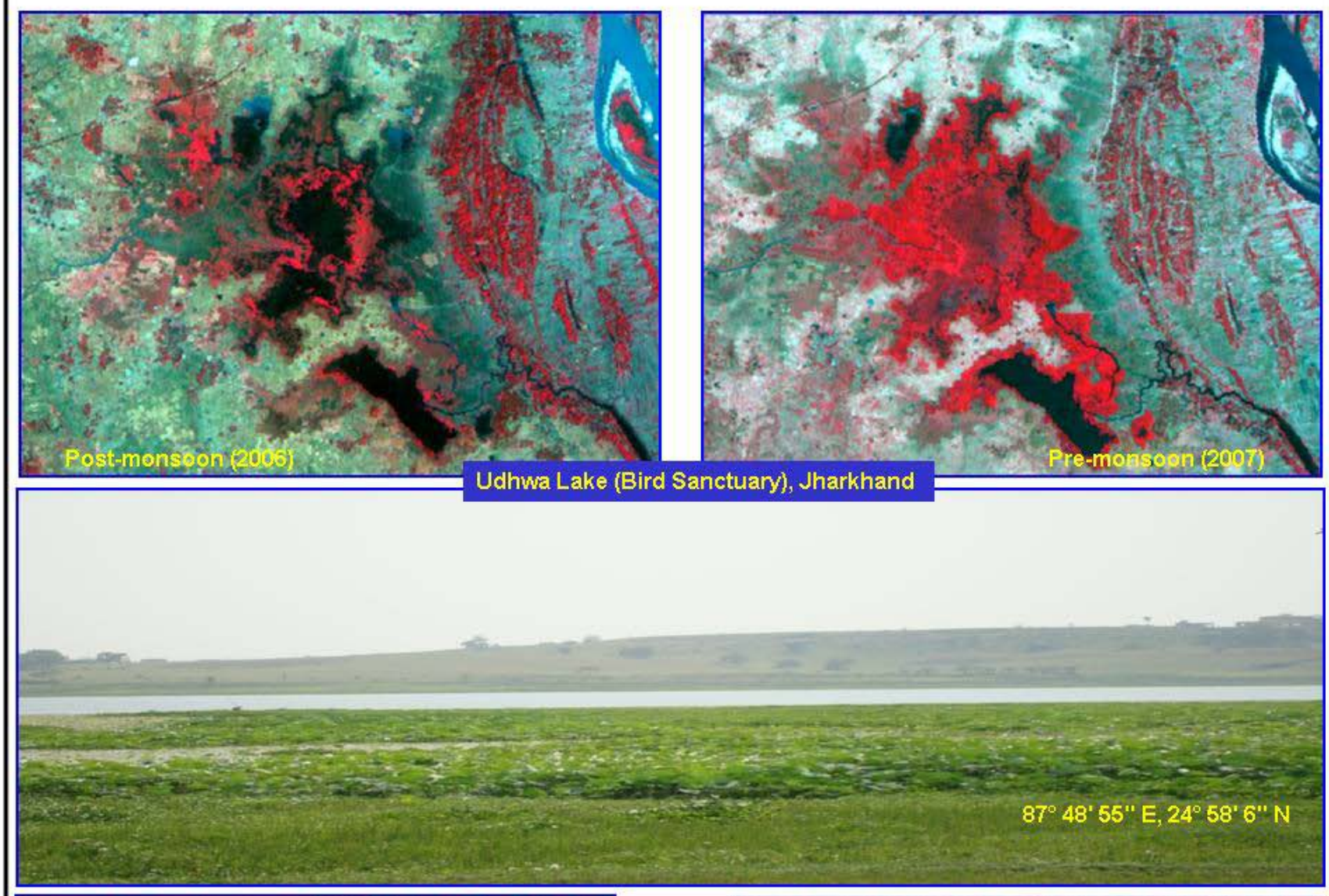


Plate - 2: Inland – Natural – Lake/Pond

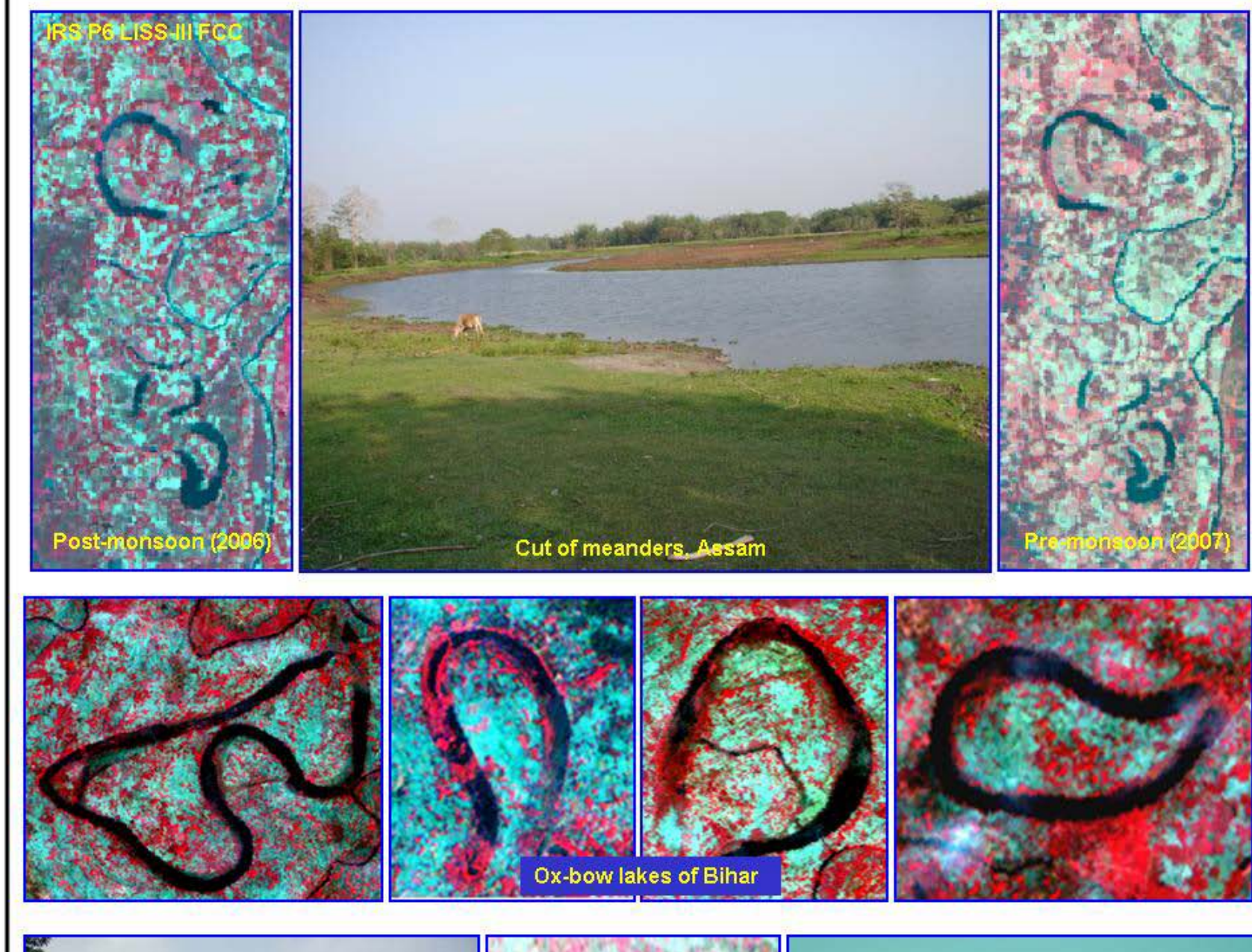
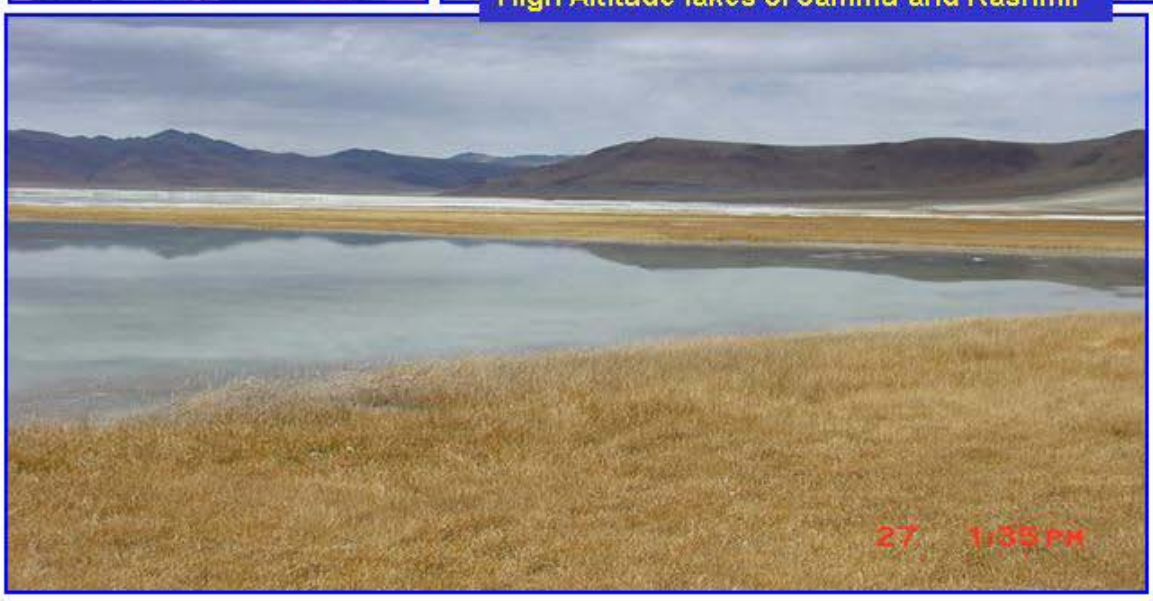


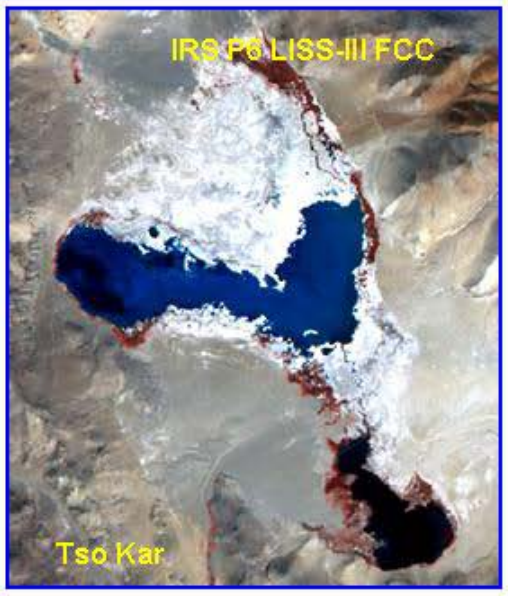
Plate - 3: Inland – Natural – Ox-bow lake/Cut off meander





High Altitude lakes of Jammu and Kashmir











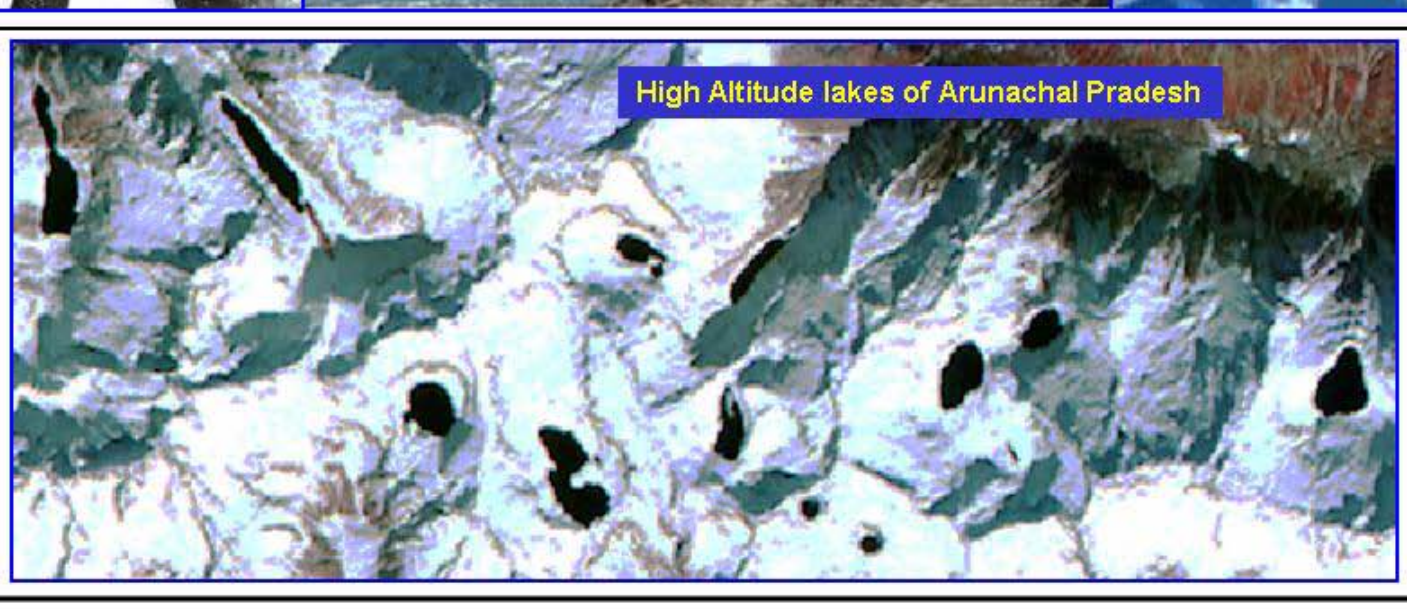


Plate - 4: Inland – Natural – High Altitude Wetland



Plate - 5: Inland – Natural – Riverine Wetland



Plate - 6: Inland – Natural – River/Stream

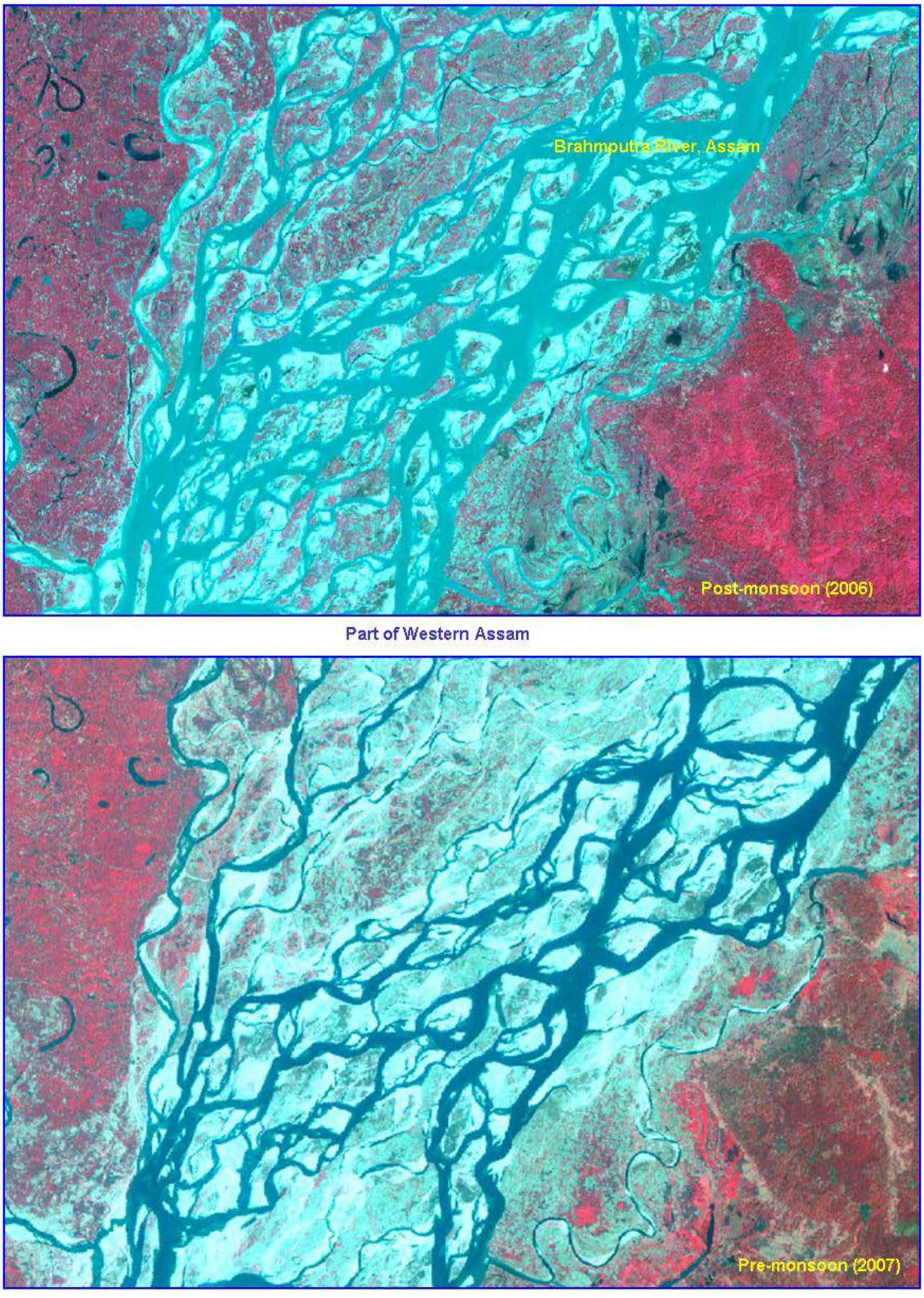


Plate - 7: Inland – Natural – River/Stream

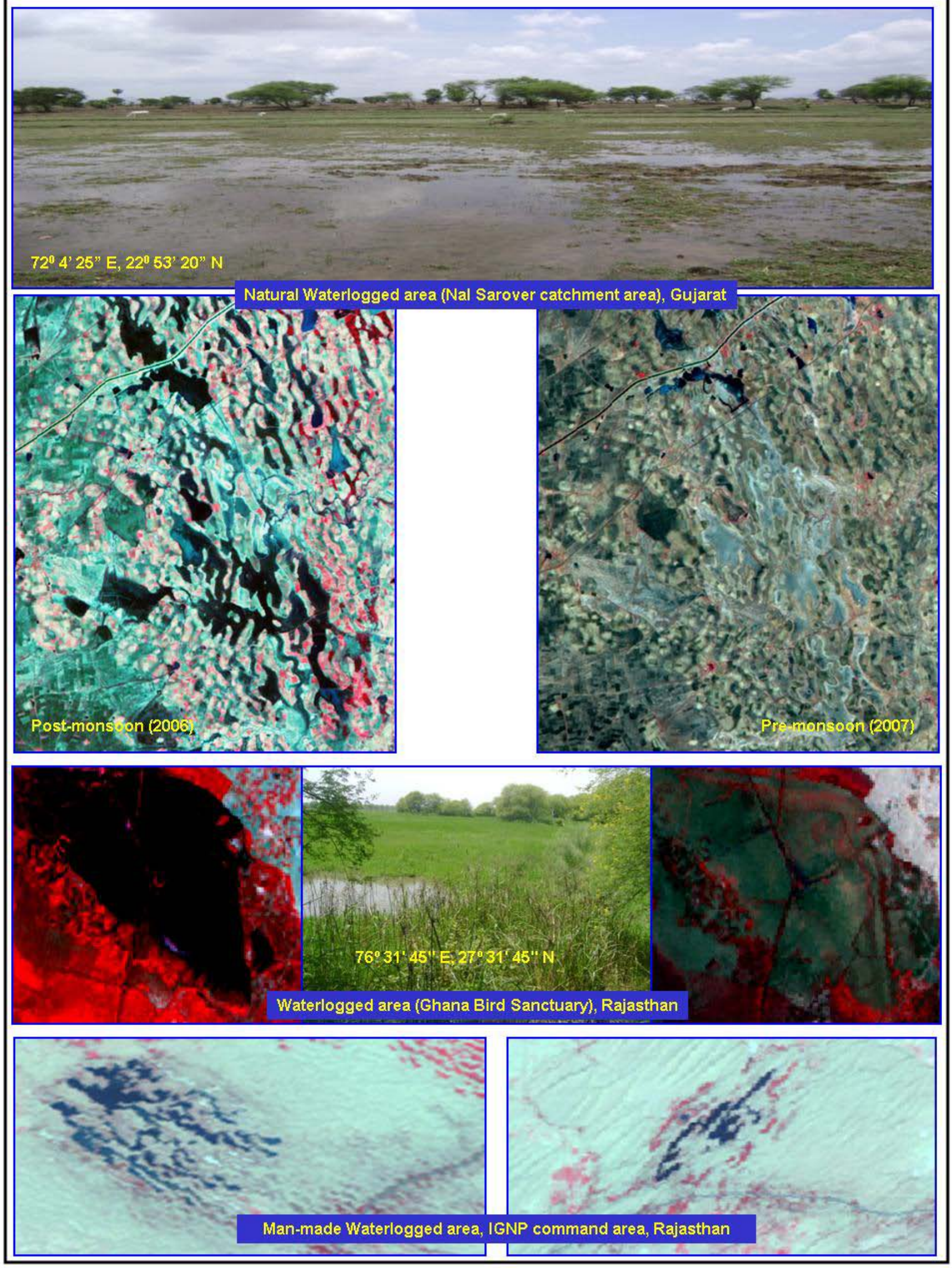


Plate - 8: Inland – Natural and Man-made – Waterlogged

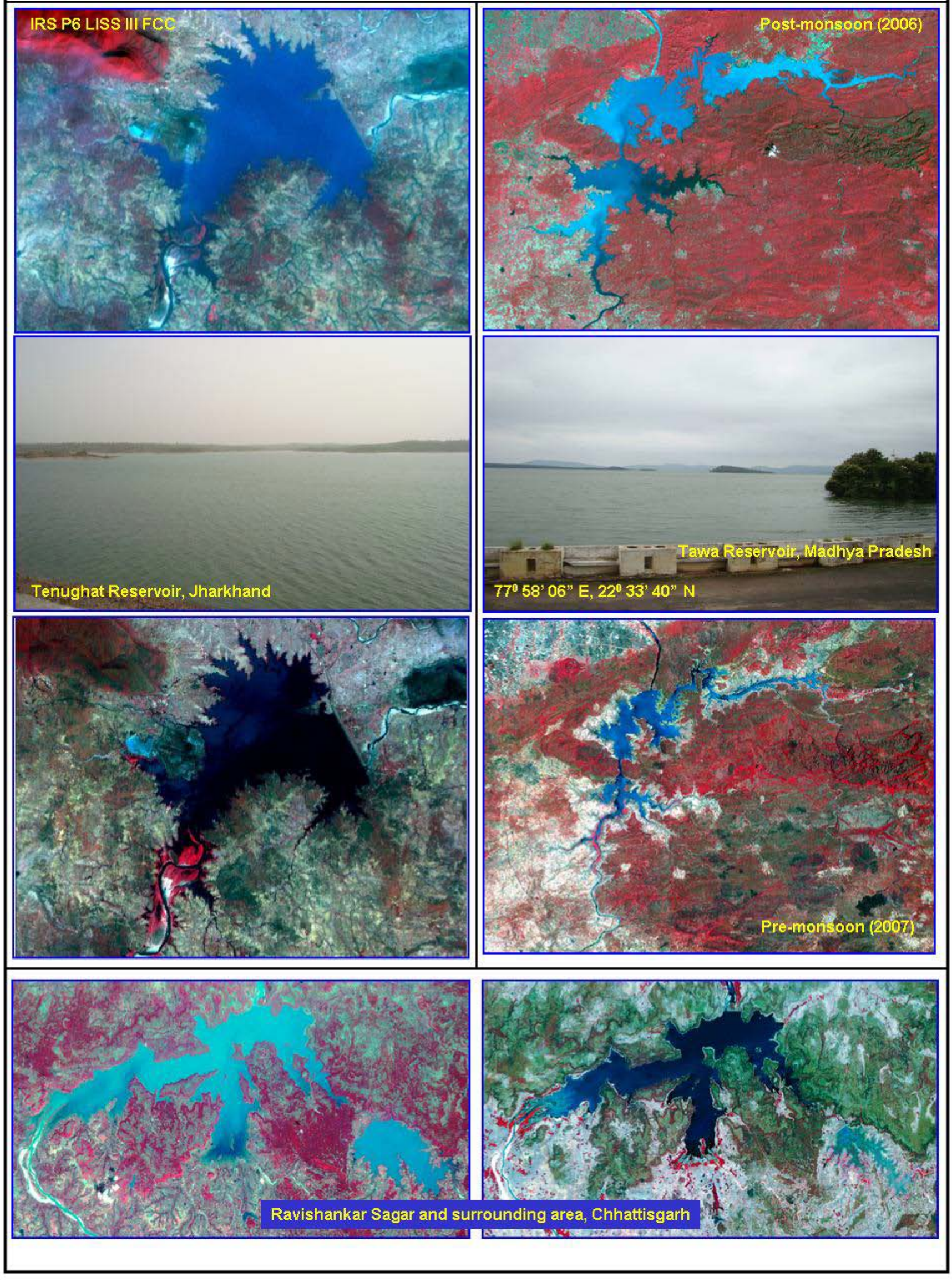


Plate - 9: Inland – Man-made – Reservoir/Barrage

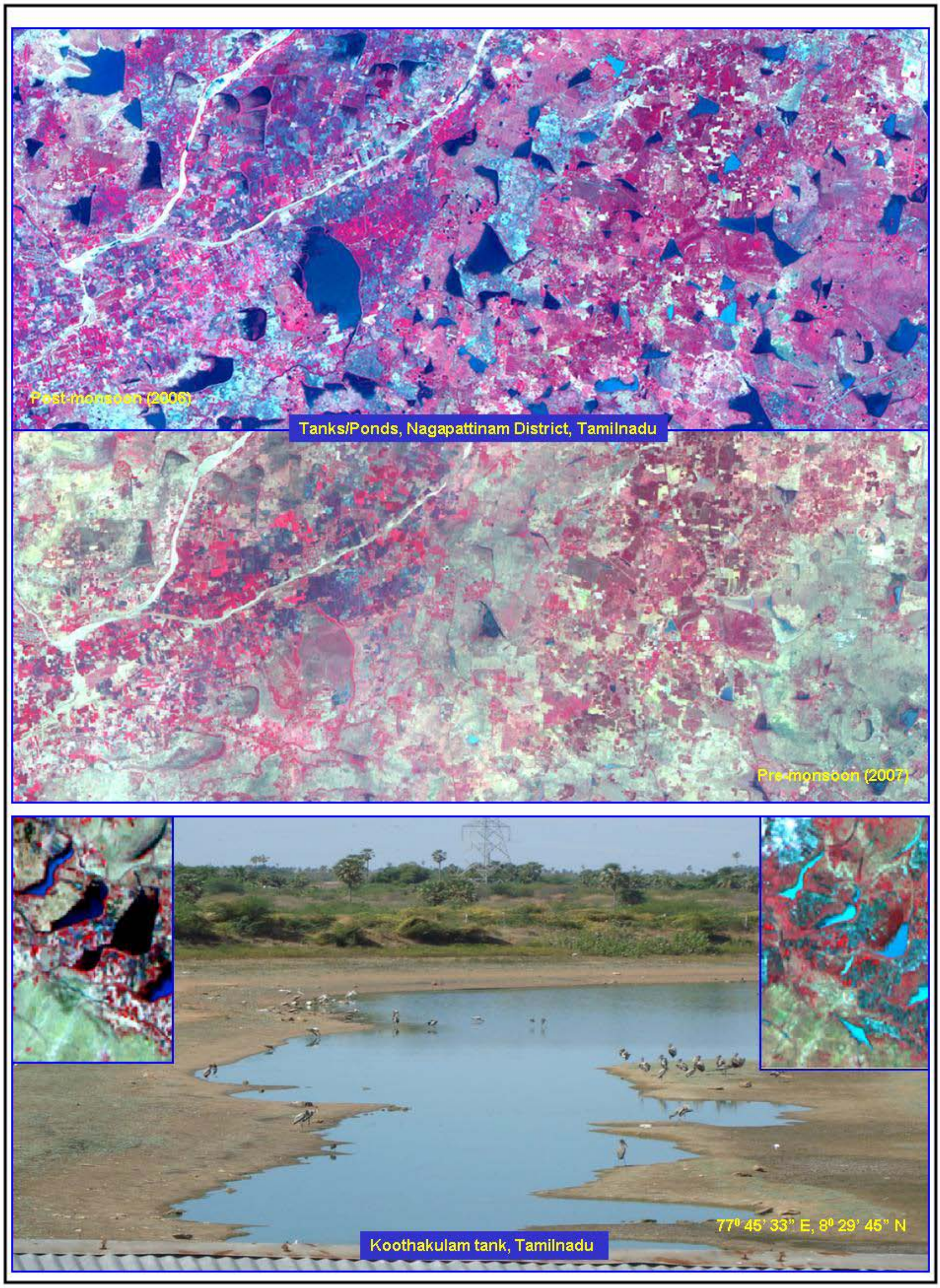


Plate - 10: Inland – Man-made – Tank/Pond

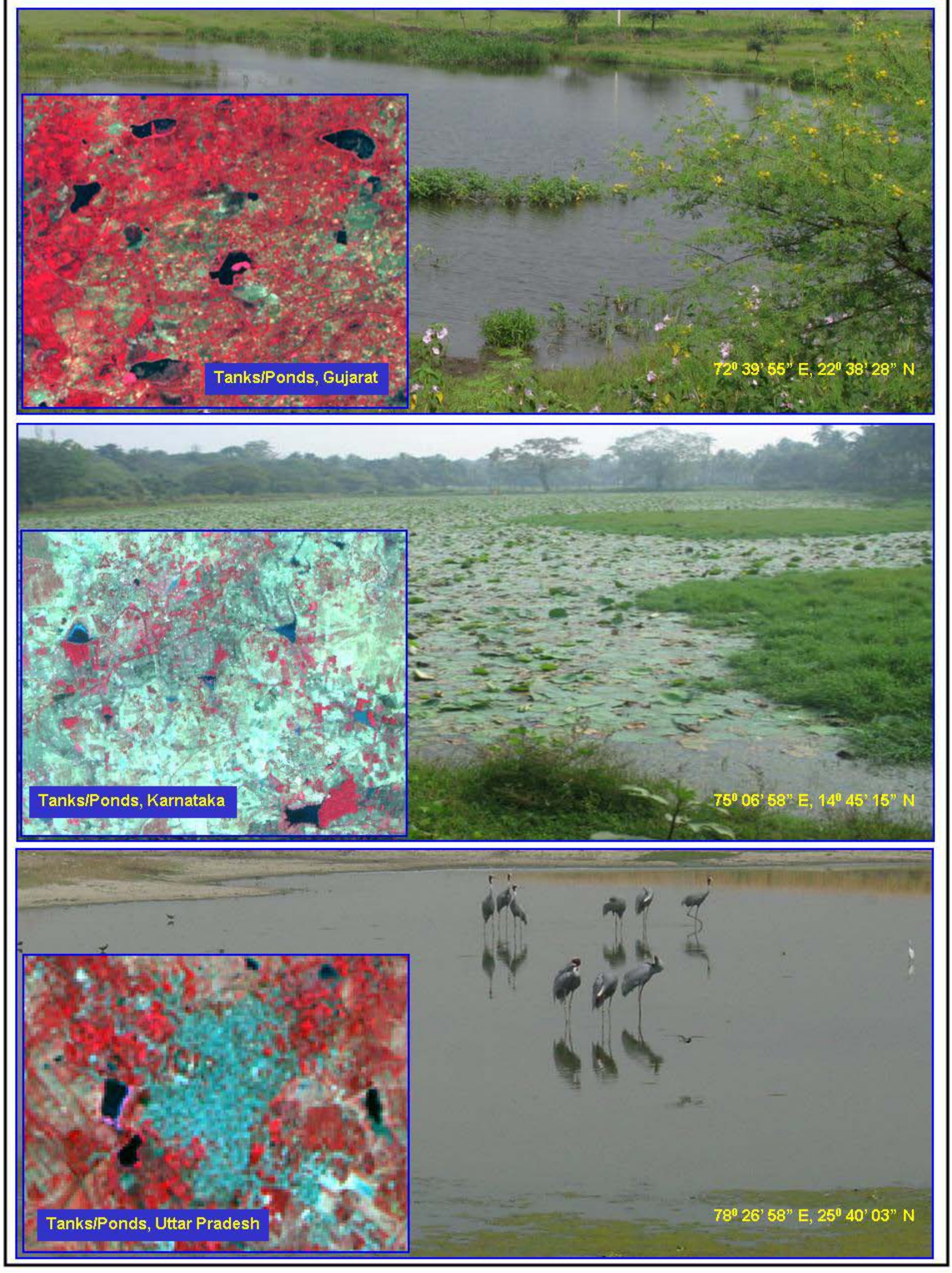


Plate - 11: Inland – Man-made – Tank/Pond

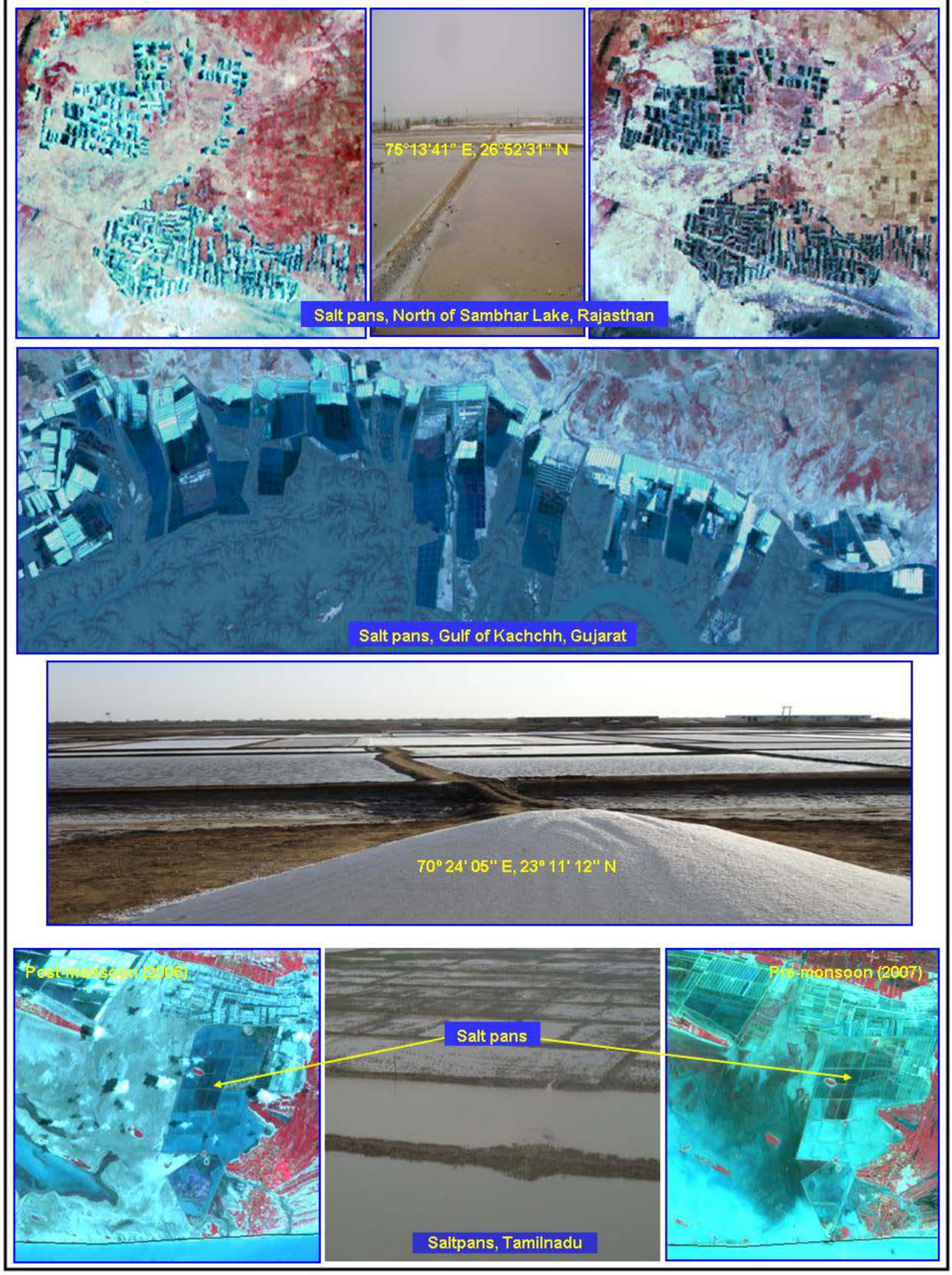


Plate - 12: Inland – Man-made – Salt pans and Coastal – Man-made – Salt pan









Lagoons, Kerala

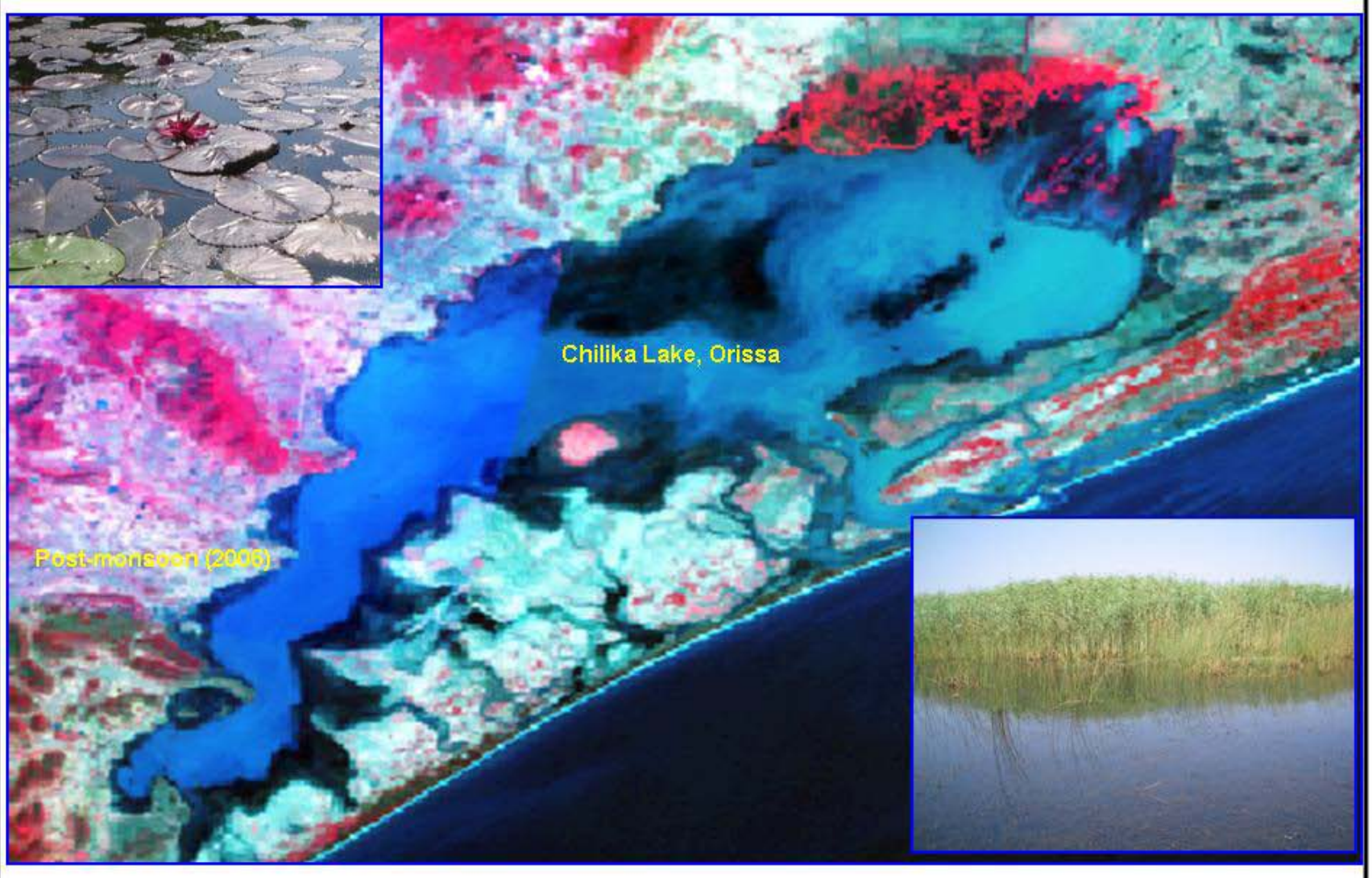
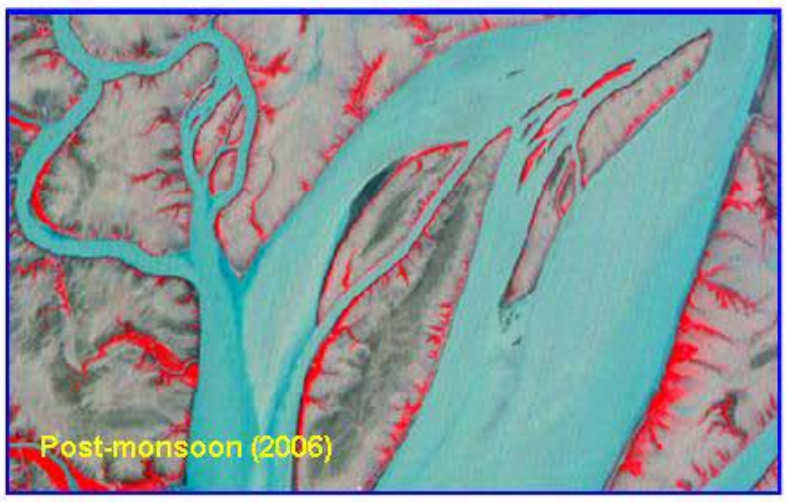


Plate - 13: Coastal – Natural – Lagoon







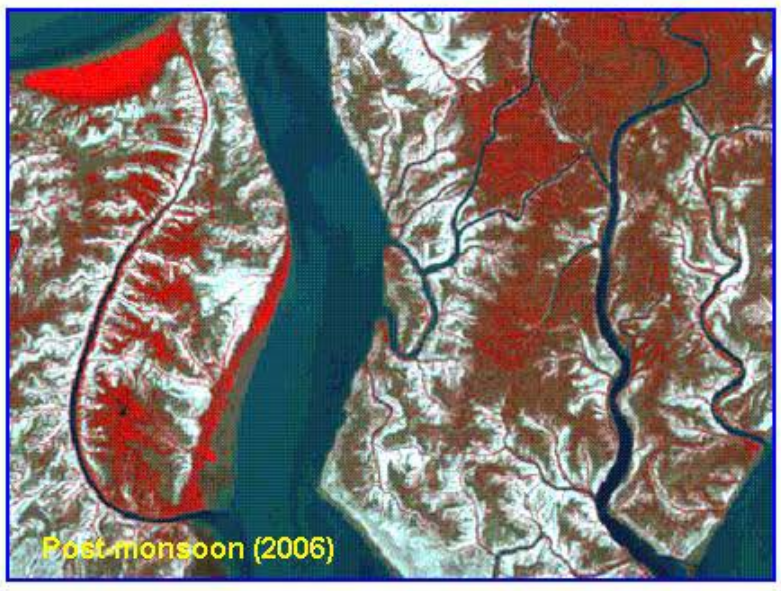




Plate - 14: Coastal – Natural – Creek



Plate - 15: Coastal – Natural – Sand/Beach

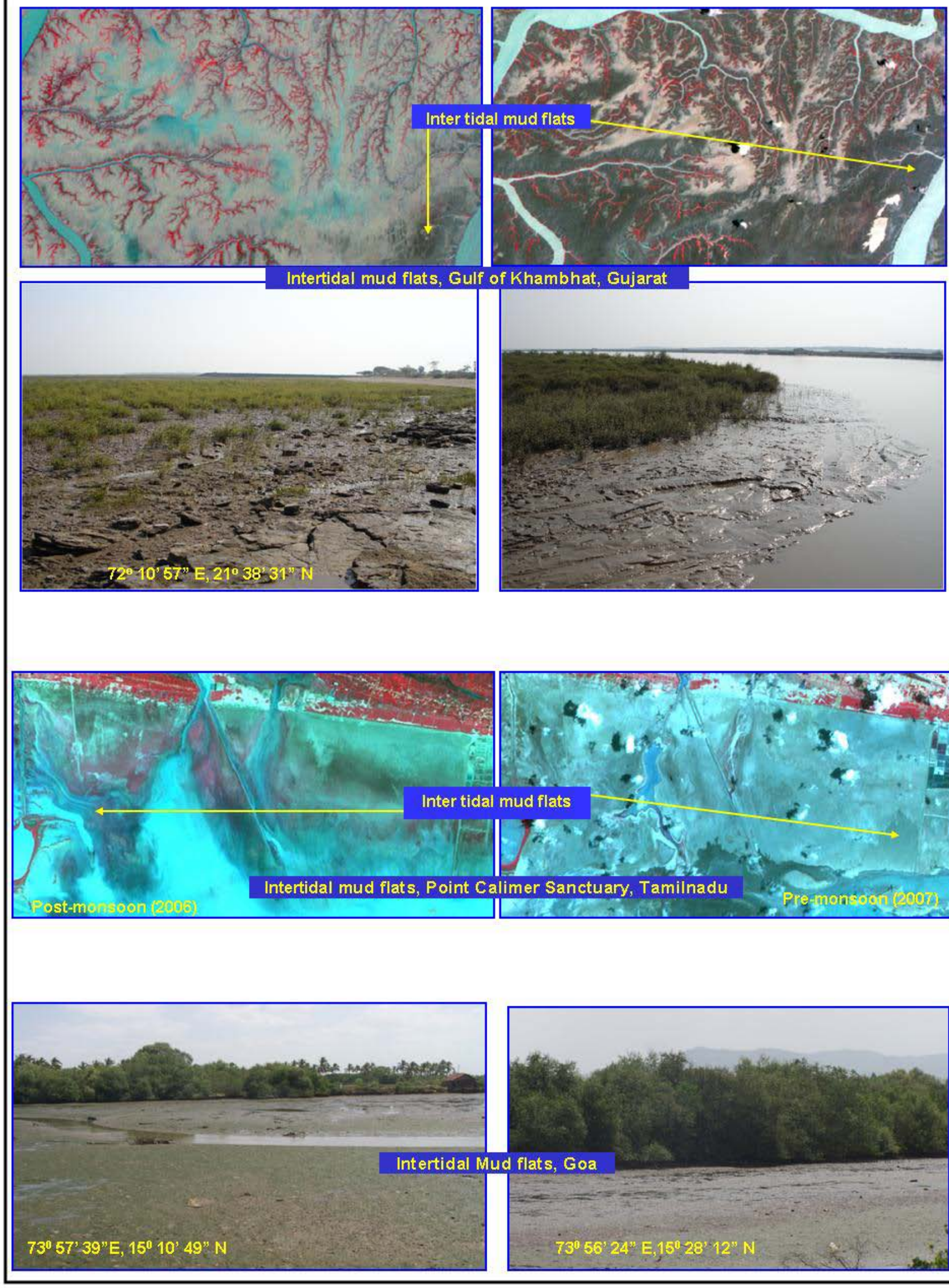
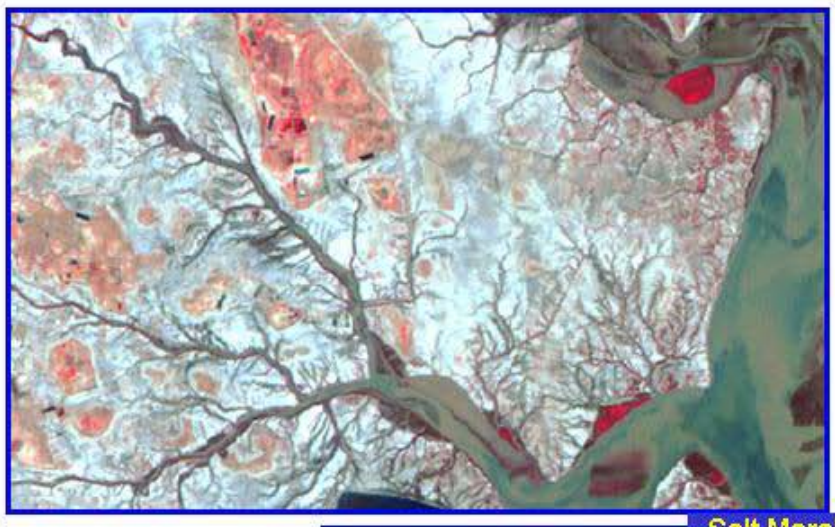
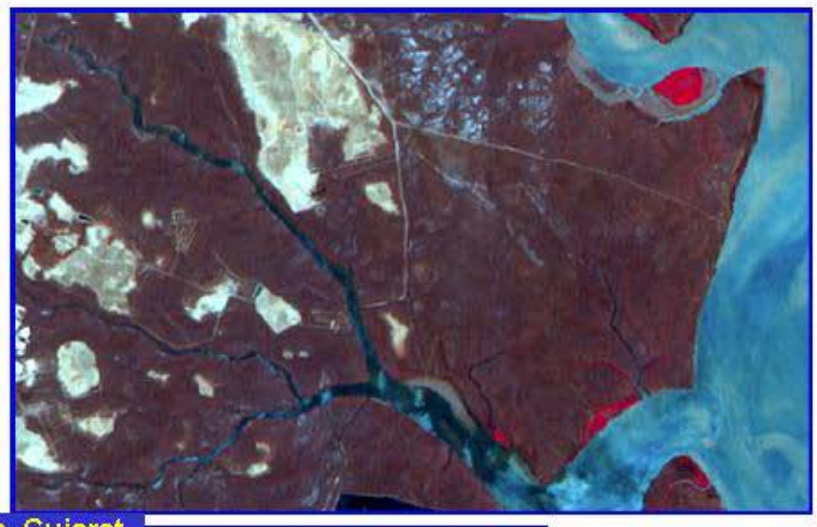


Plate - 16: Coastal – Natural – Inter-tidal mud flat



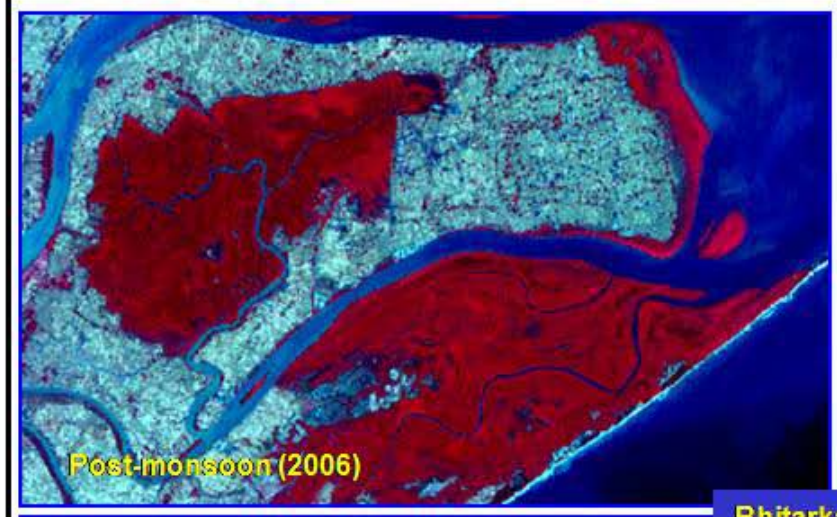


Salt Marsh, Gujarat





Plate - 17: Coastal – Natural – Salt Marsh



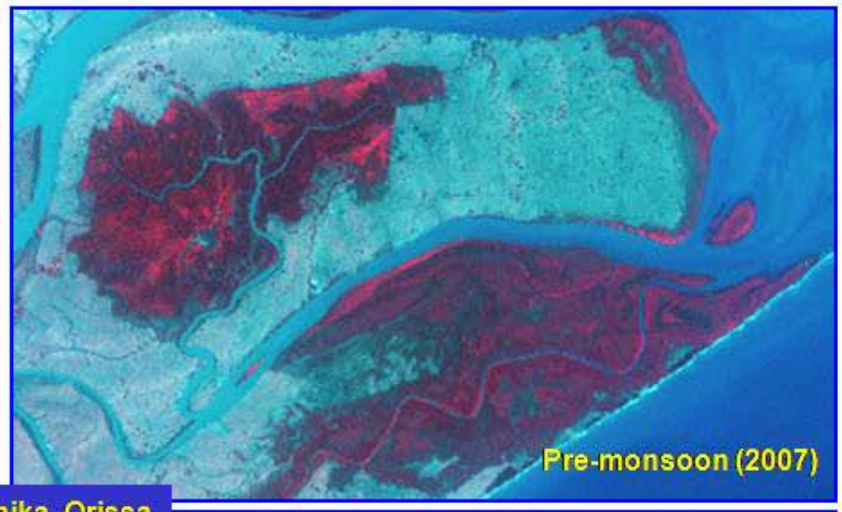










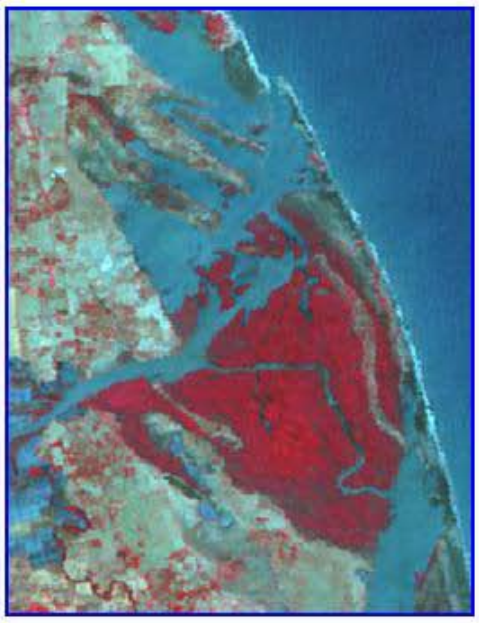




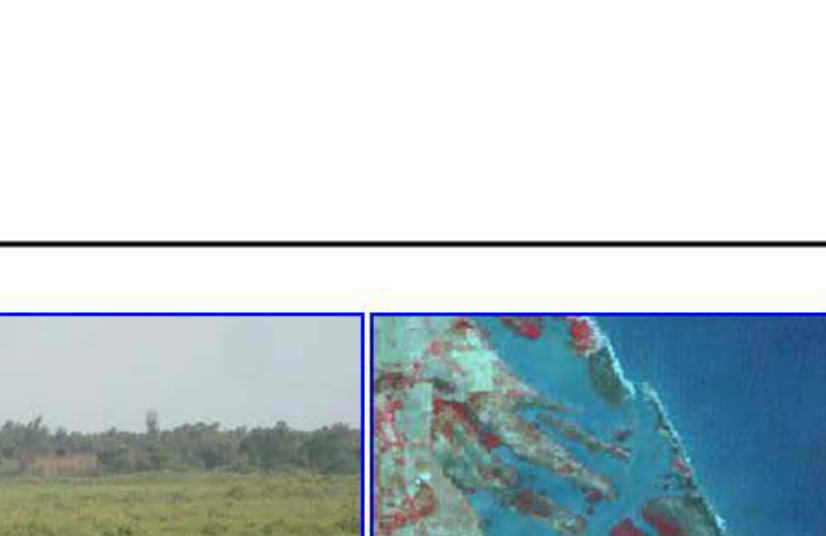
Plate - 18: Coastal – Natural – Mangrove











Jamnagar Mangroves, Gujarat

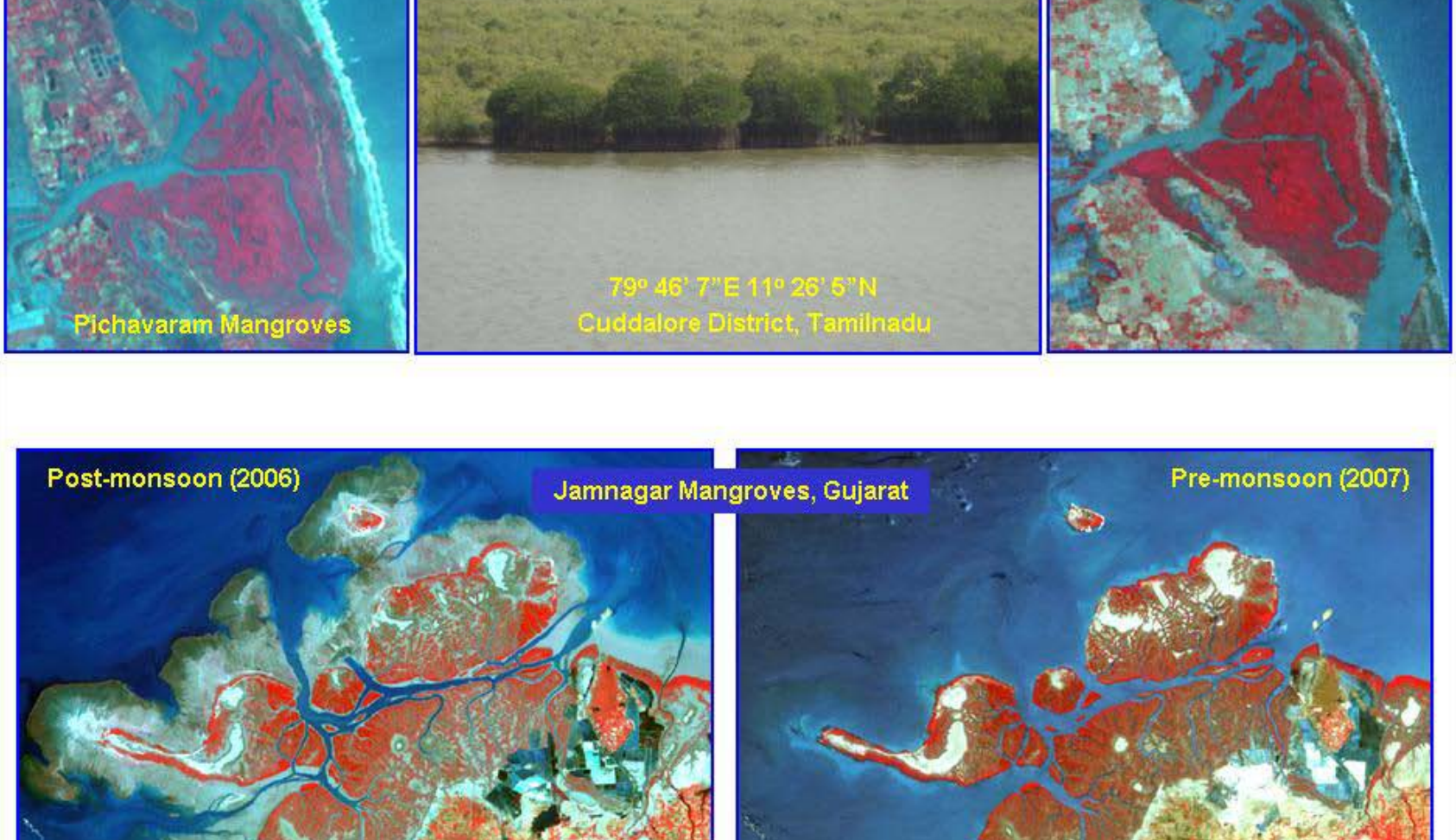


Plate - 19: Coastal – Natural – Mangrove

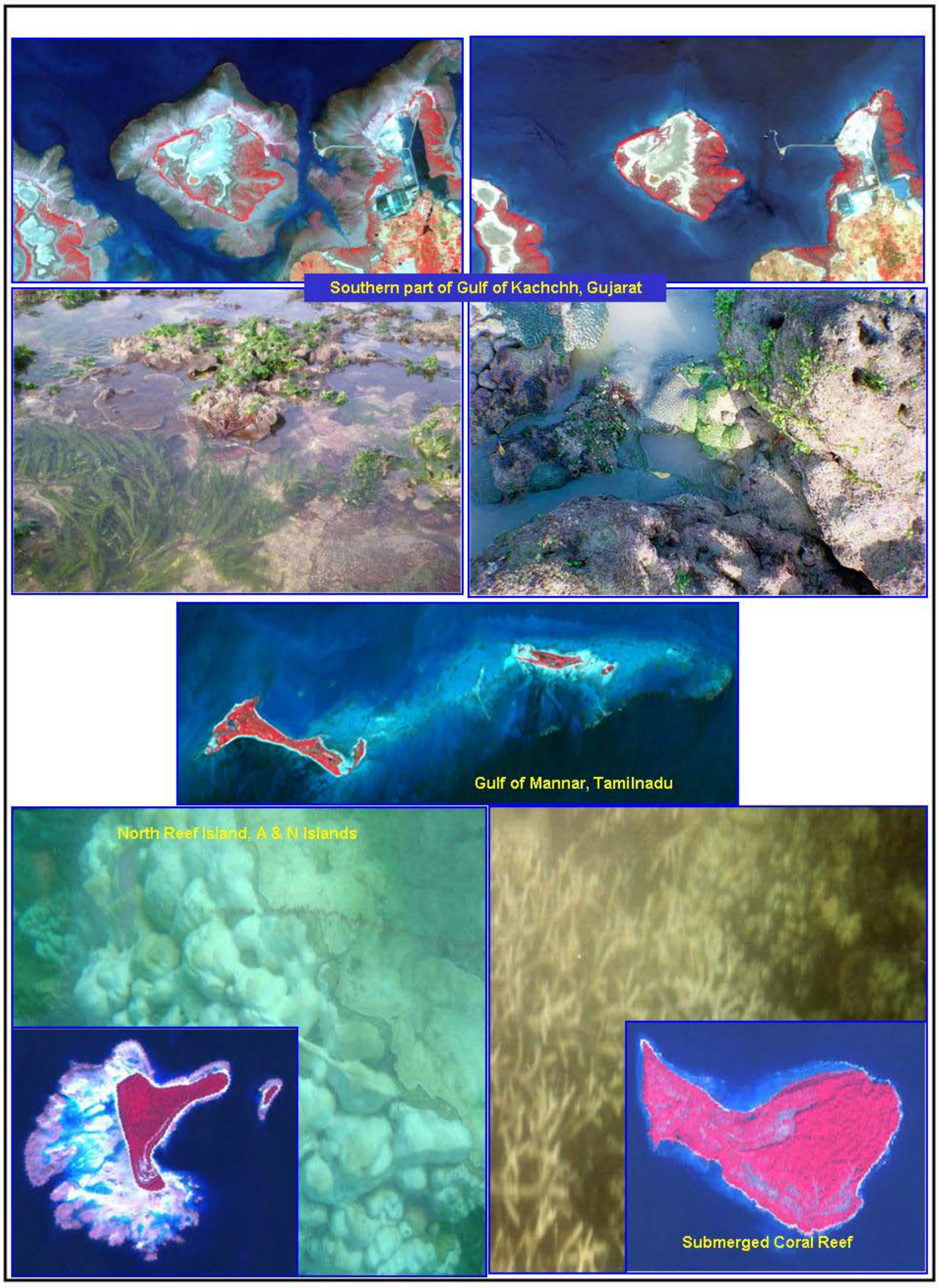
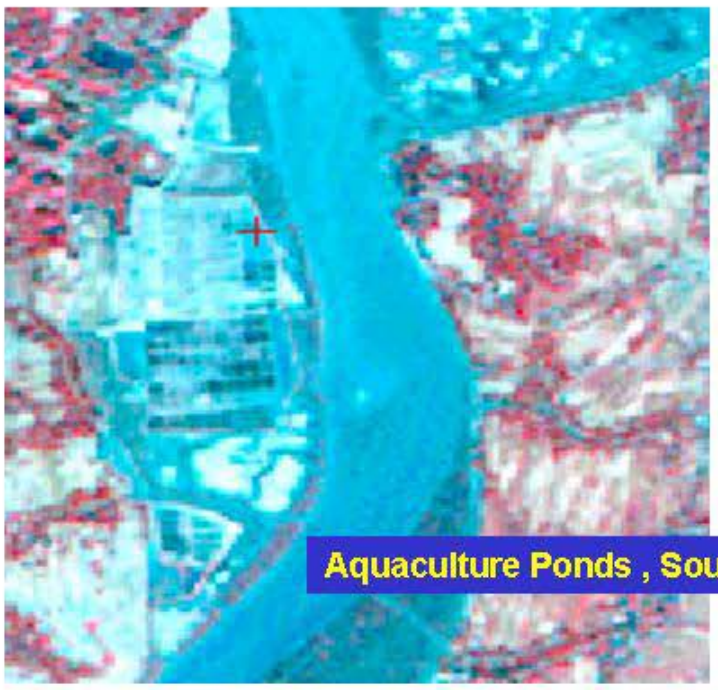
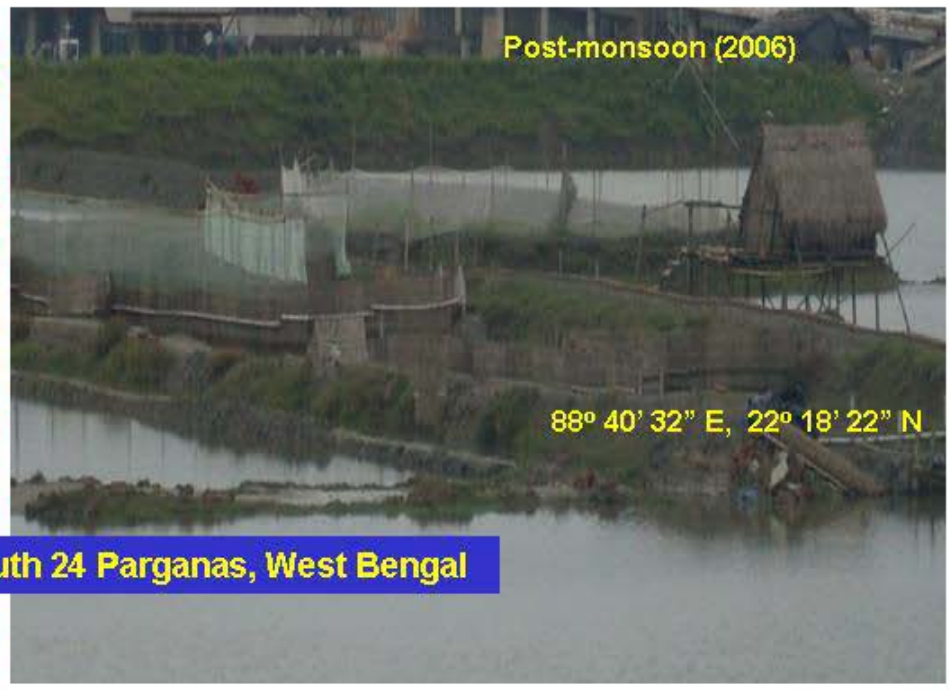
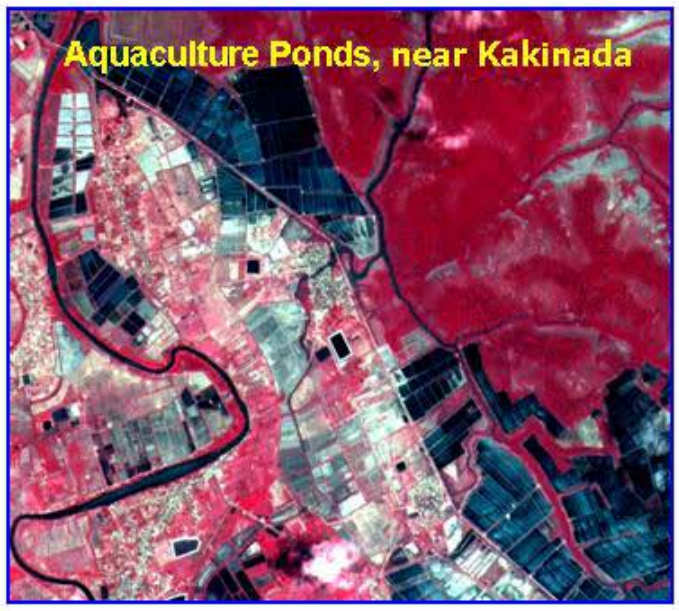


Plate - 20: Coastal – Natural – Coral Reef





Aquaculture Ponds , South 24 Parganas, West Bengal



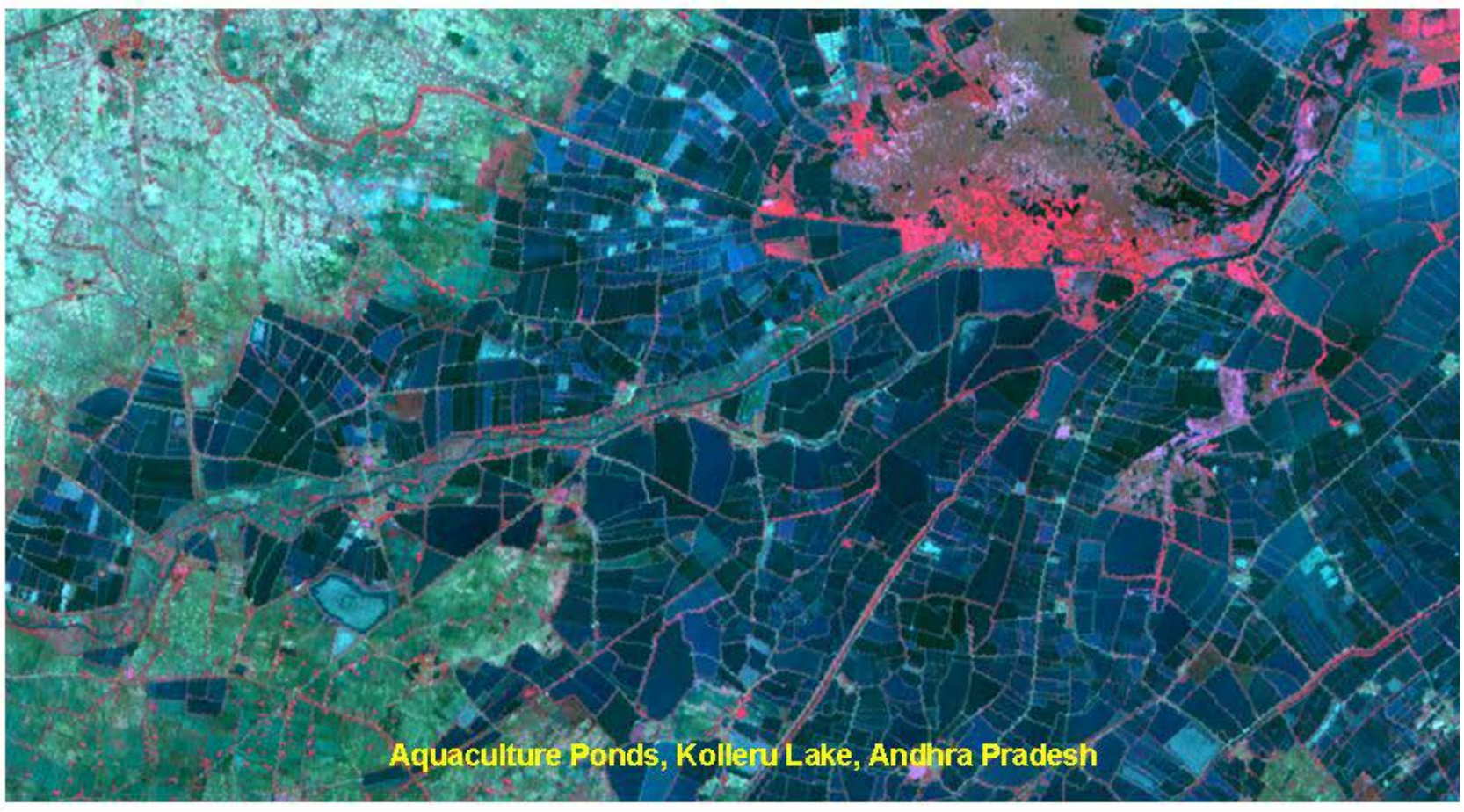


Plate - 21: Coastal – Man-made – Aquaculture pond

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

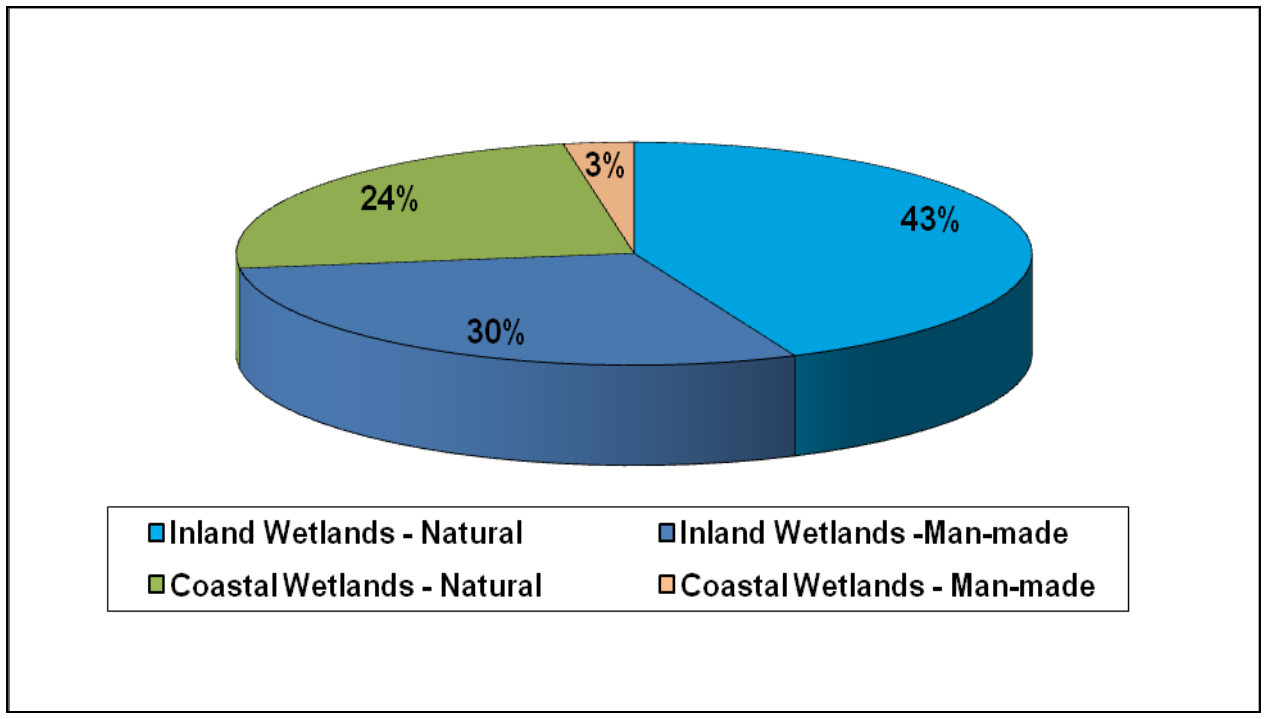


Figure 11: Type-wise (Level-II) wetland distribution in India

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

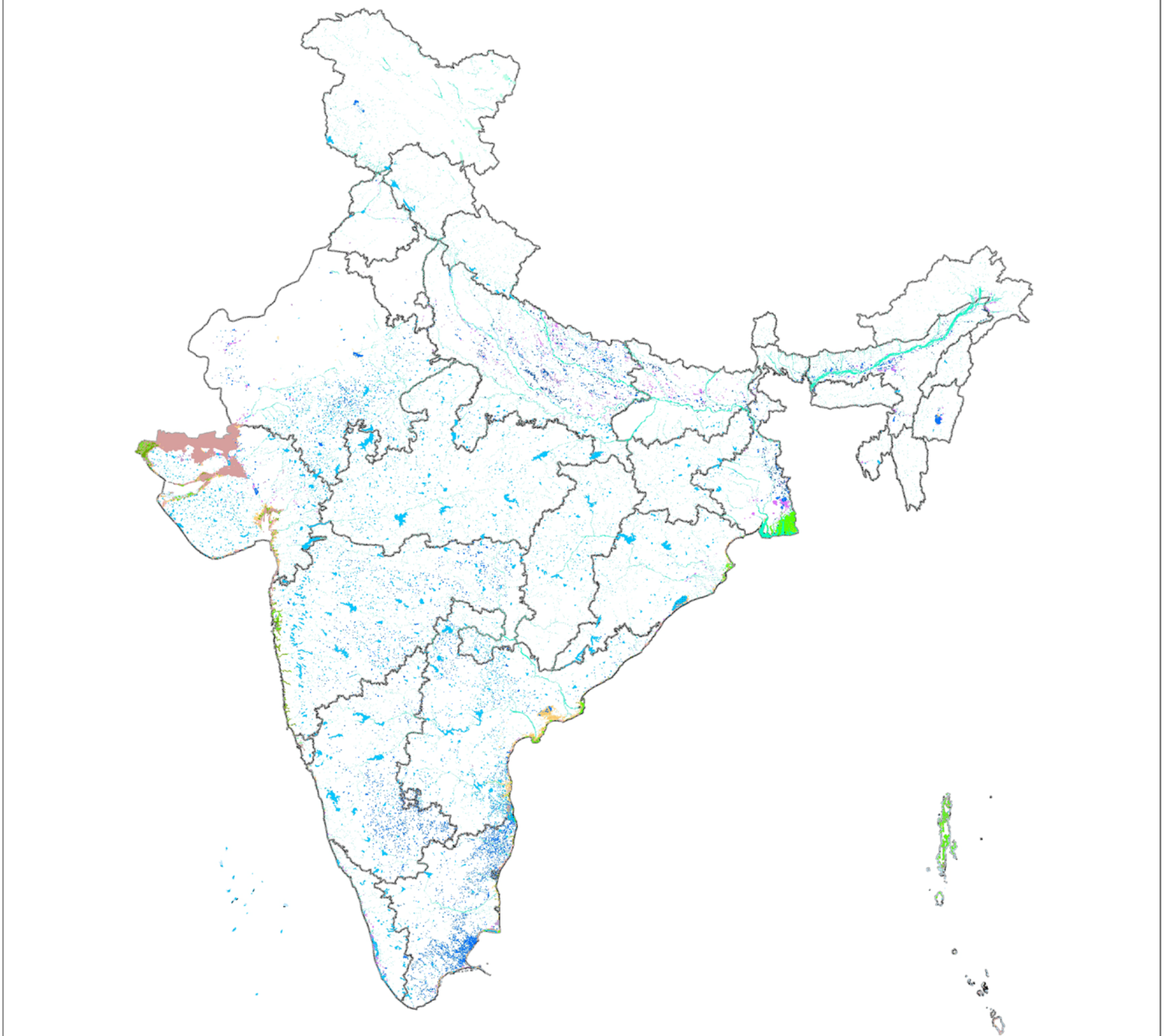
Area in ha

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).

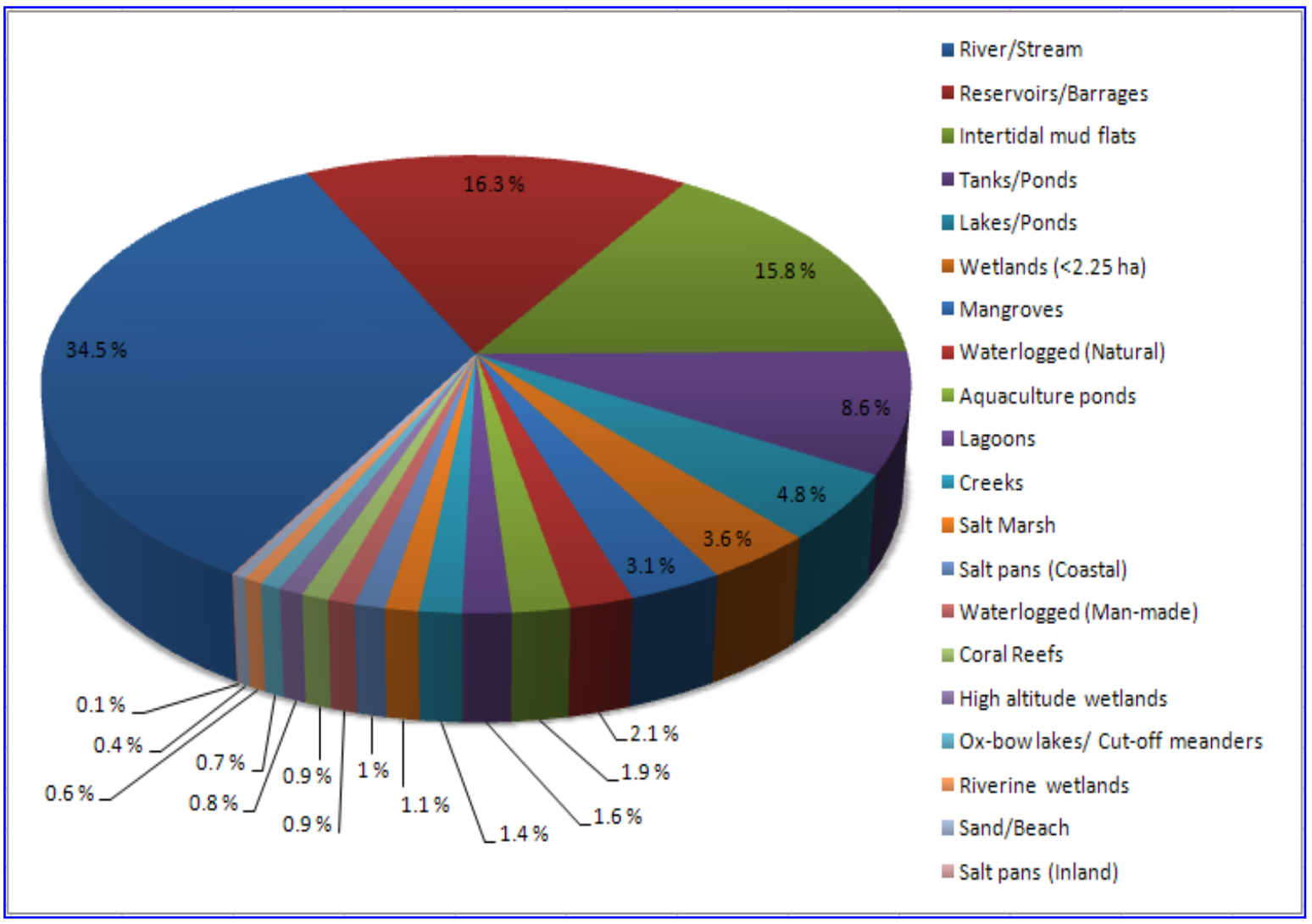


Figure 12: Type-wise (Level-III) wetland distribution in India

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.

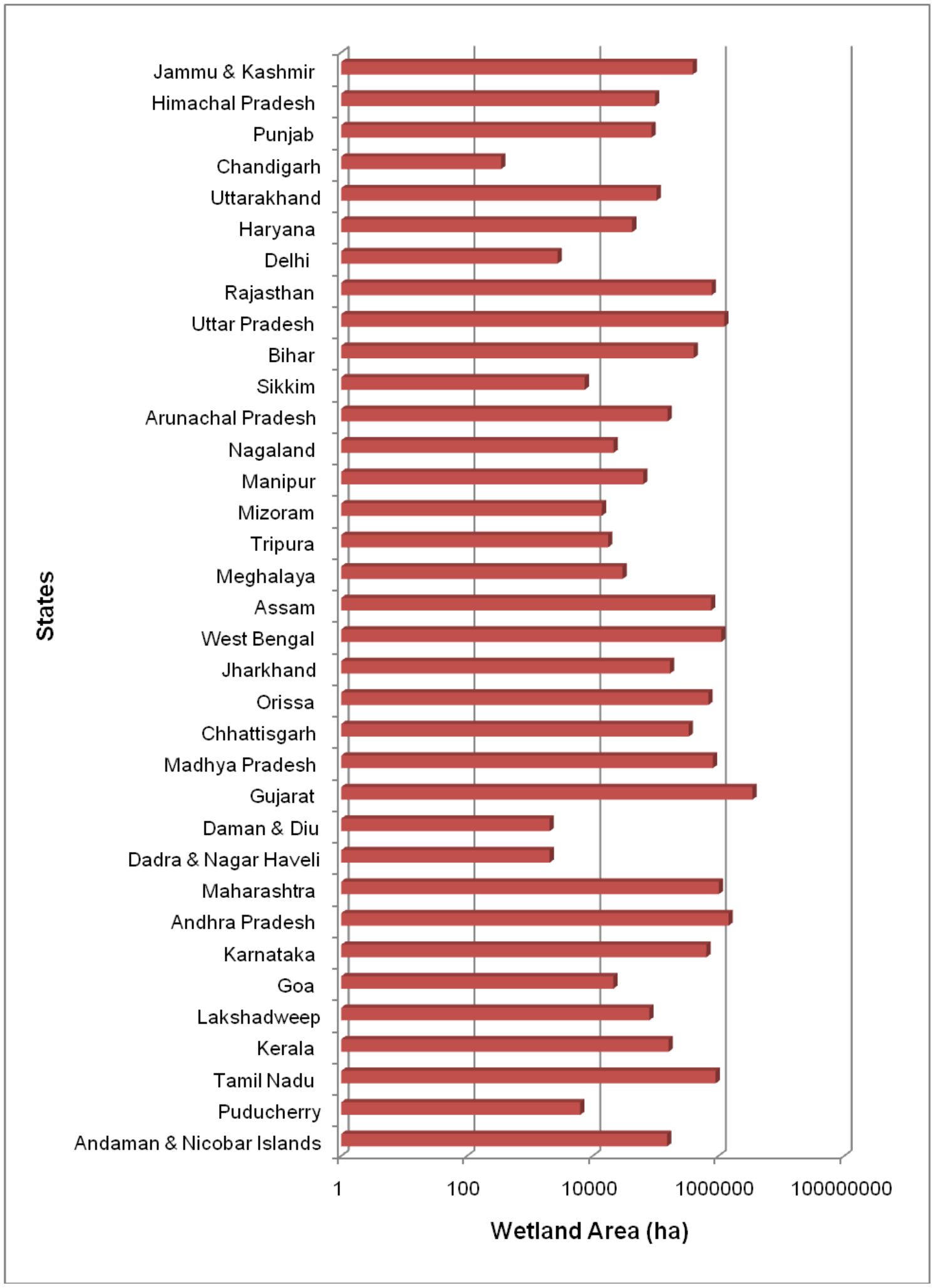


Figure 13: State-wise graphical distribution of wetlands

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

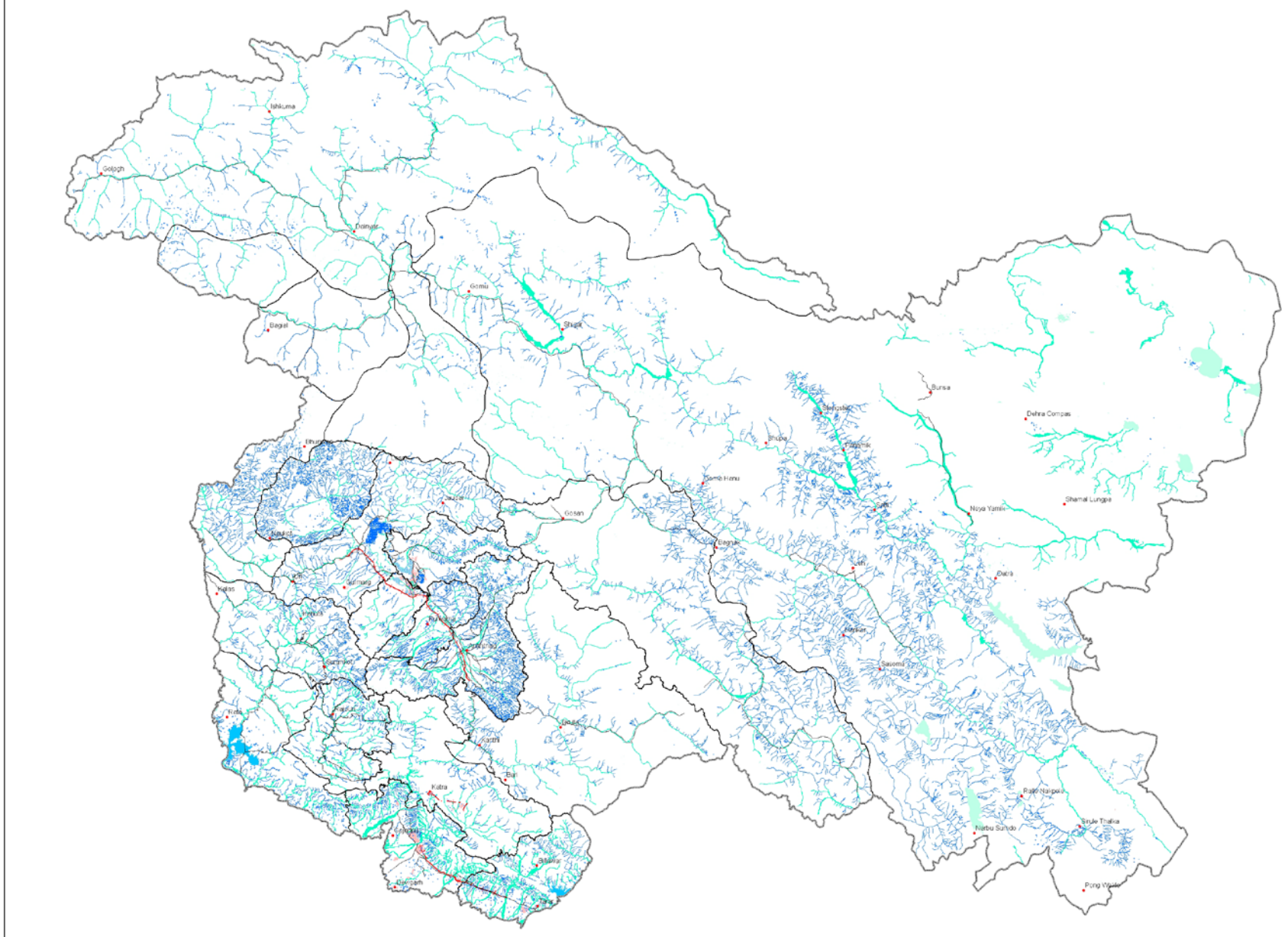
The total numbers of districts in the state are twenty, with Leh having largest geographic area and Budgam, the lowest. Leh has the highest area under wetlands (51.9%). This is mainly due to the large number of high altitude wetlands found in the area. Konu has the lowest wetland share (0.40%). Baramula, 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.

For details, refer National Wetland Atlas: Jammu and Kashmir, SAC/RESA/AFEG/NWIA/ATLAS/16/2010, Space Applications Centre, ISRO, Ahmedabad, India, 176p.

State : Jammu and Kashmir

WETLAND MAP

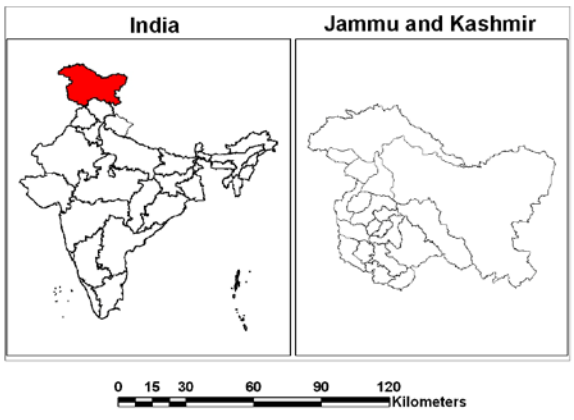


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverine wetland
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	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

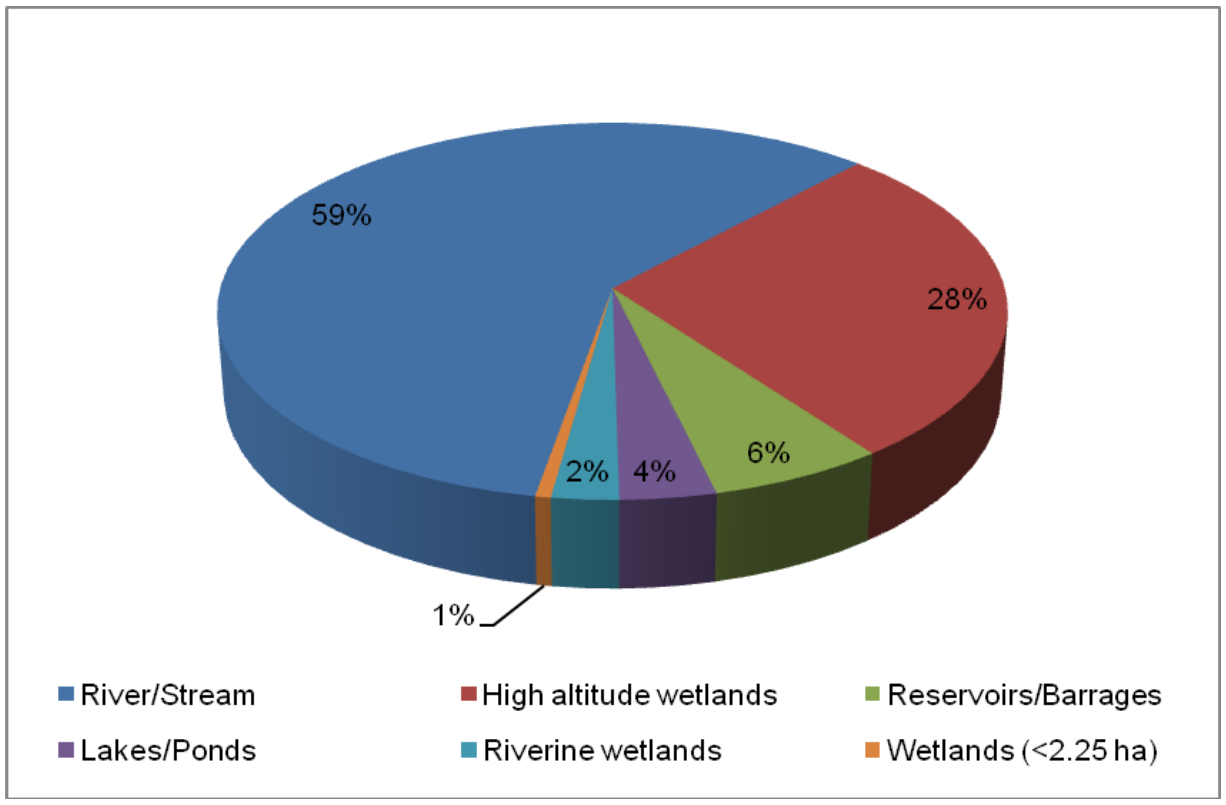


Figure 14: Type-wise wetland distribution in Jammu and Kashmir

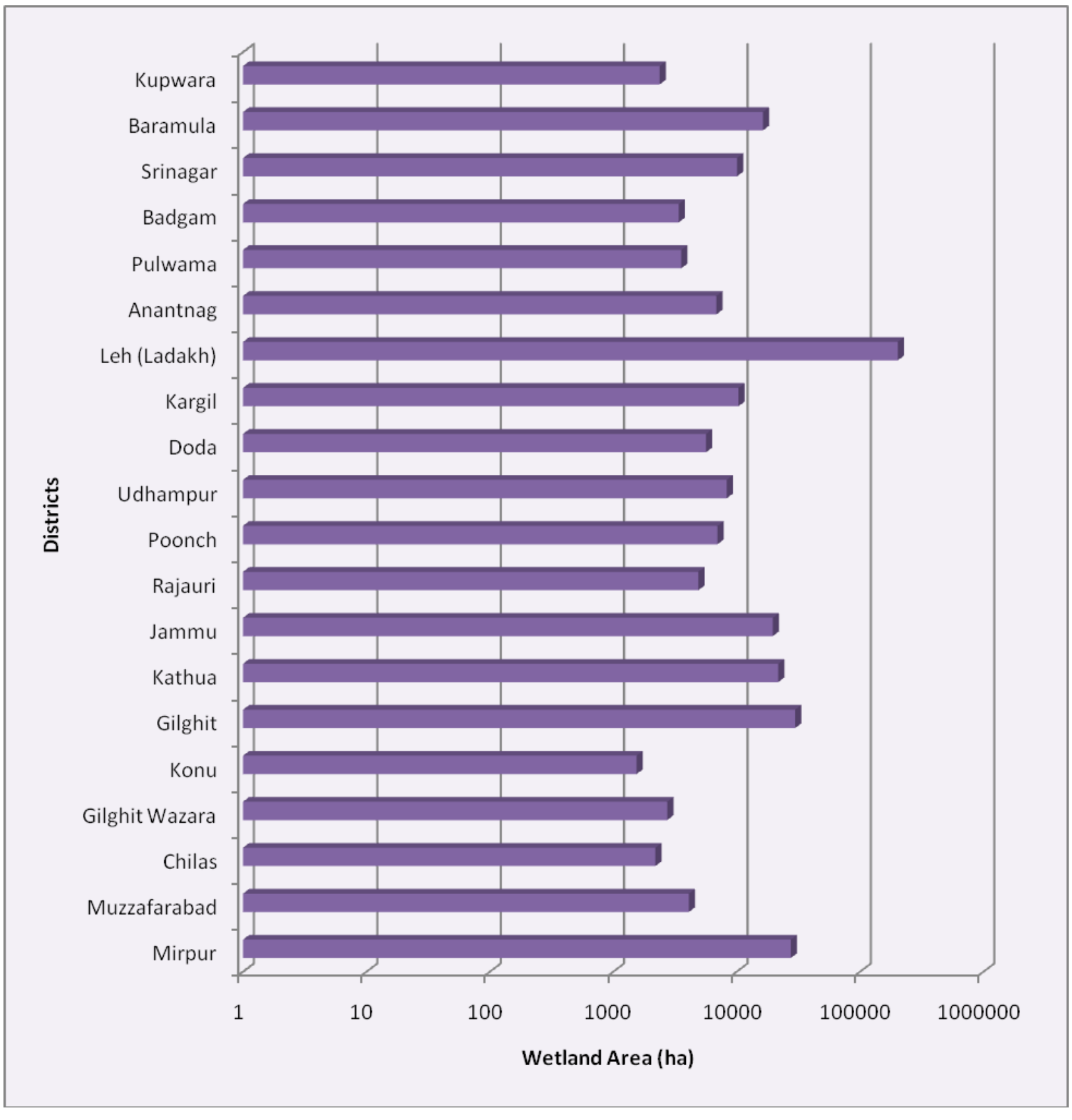


Figure 15: District-wise graphical distribution of wetlands in Jammu and Kashmir

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	-	-	-	-	-
		Sub - Total	**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.

For details, refer National Wetland Atlas: Himachal Pradesh, SAC/EPSA/ABHG/NWIA/ATLAS/27/2010 Space Applications Centre (ISRO), Ahmedabad, India, 126p.

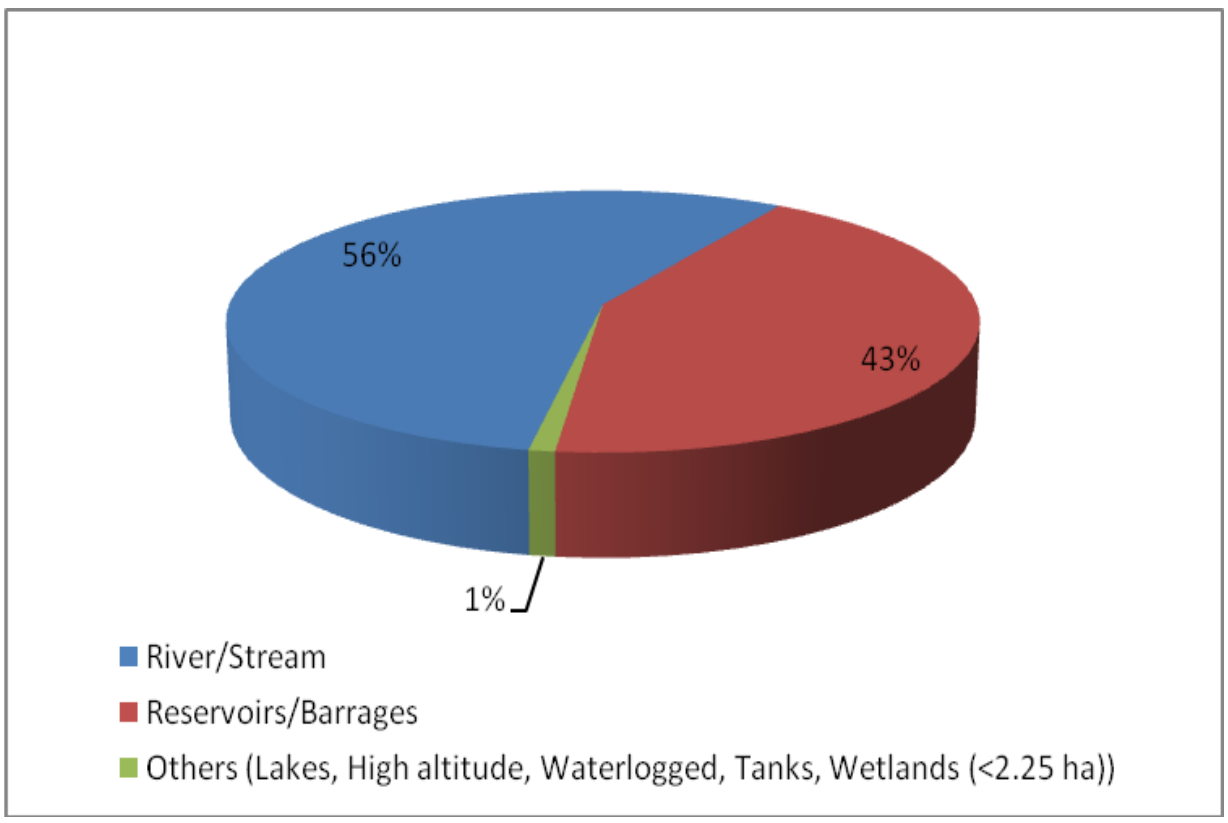


Figure 16: Type-wise wetland distribution in Himachal Pradesh

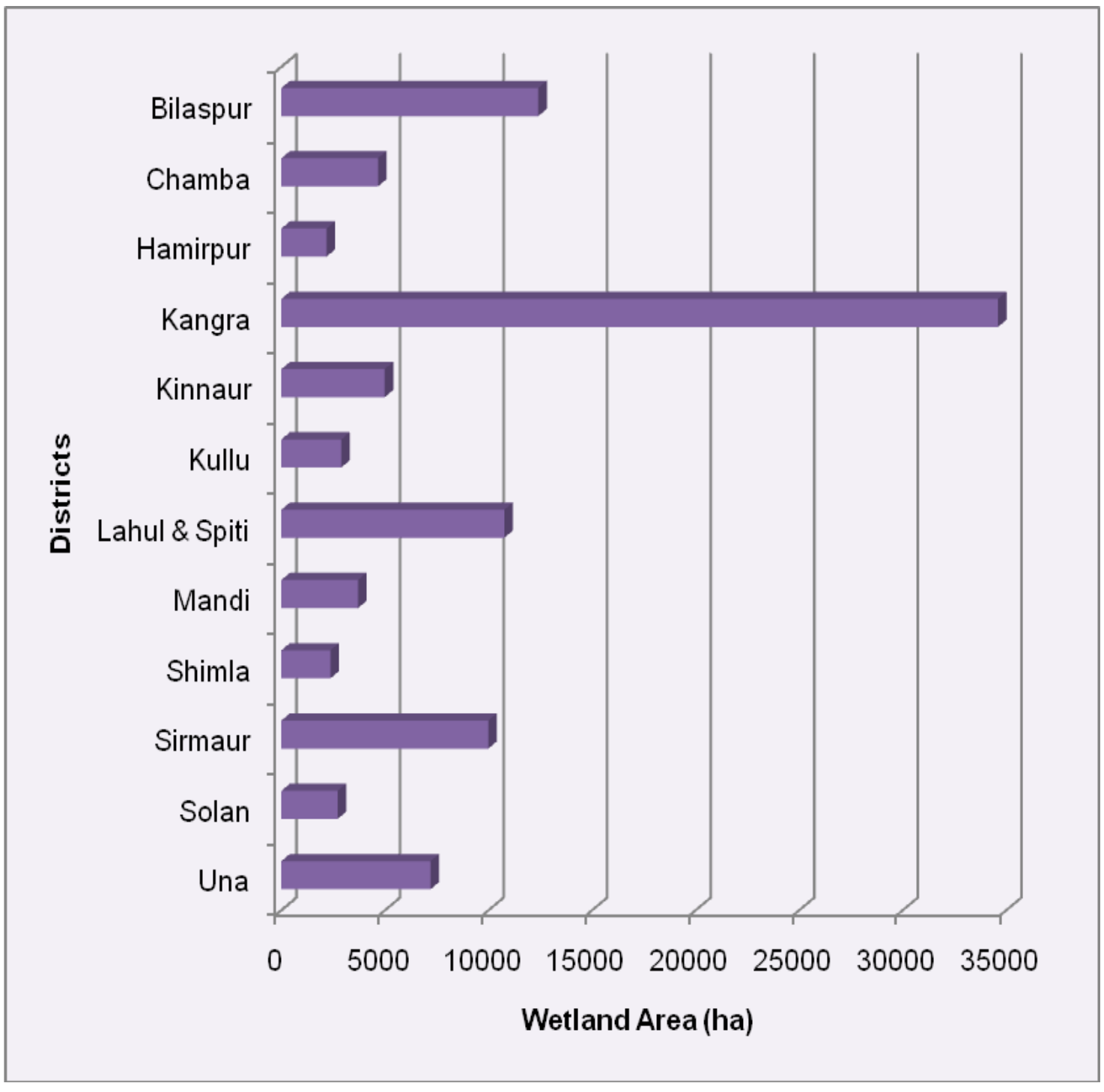


Figure 17: District-wise graphical distribution of wetlands in Himachal Pradesh

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

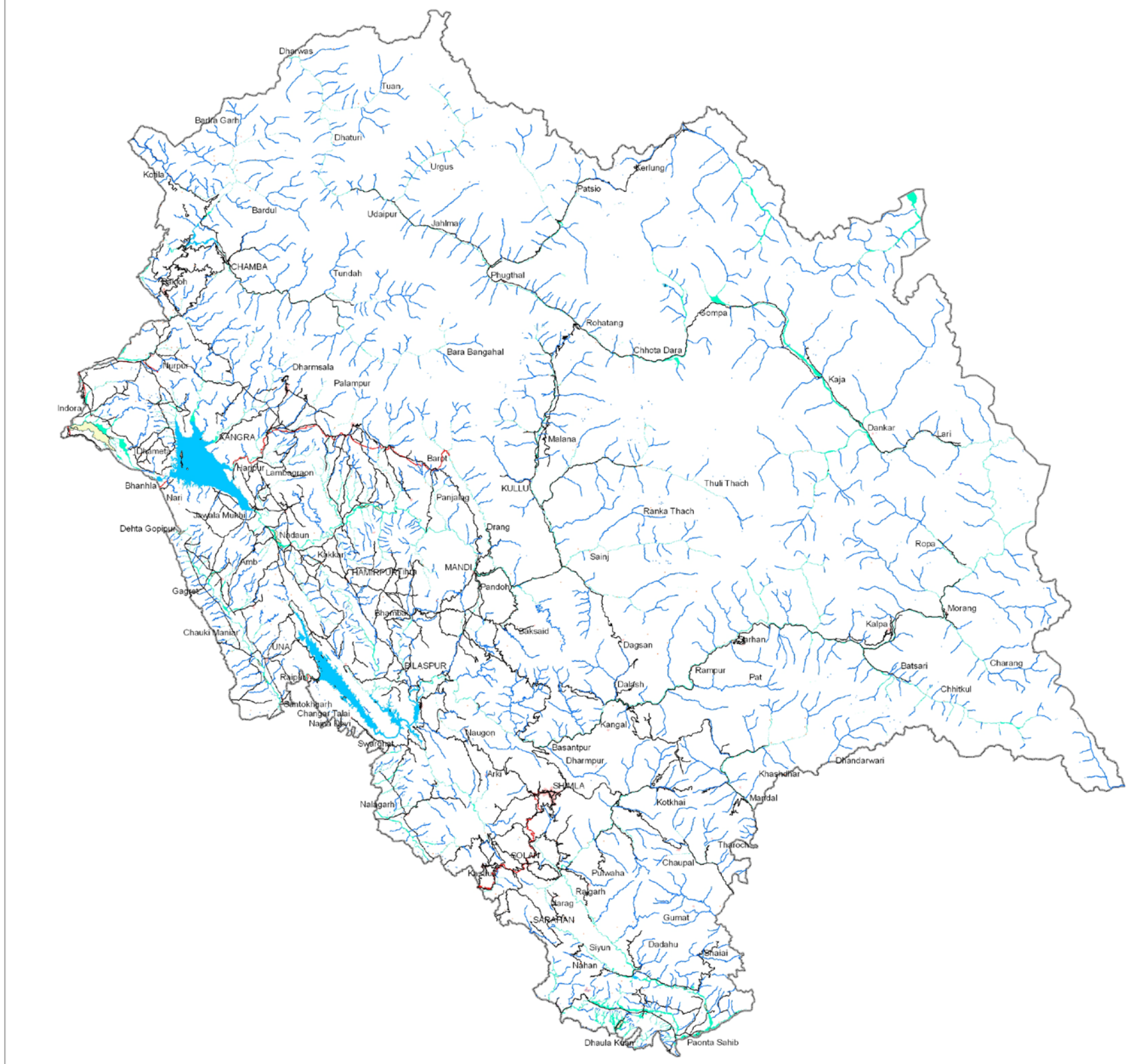
Table 15: District-wise area of wetlands (type-wise) in Himachal Pradesh

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

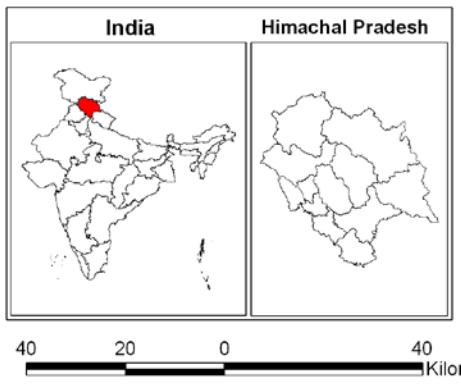


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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	1104	Riverine wetland	9	306	0.35	13	13
4	1105	Waterlogged	43	2032	2.36	151	35
5	1106	River/Stream	151	59864	69.38	25748	15955
	1200	**Inland Wetlands -Man-made**					
6	1201	Reservoir/Barrage	31	11858	13.74	6220	5488
7	1202	Tank/Pond	878	3526	4.09	2196	1937
8	1203	Waterlogged	58	1341	1.55	812	75
9	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

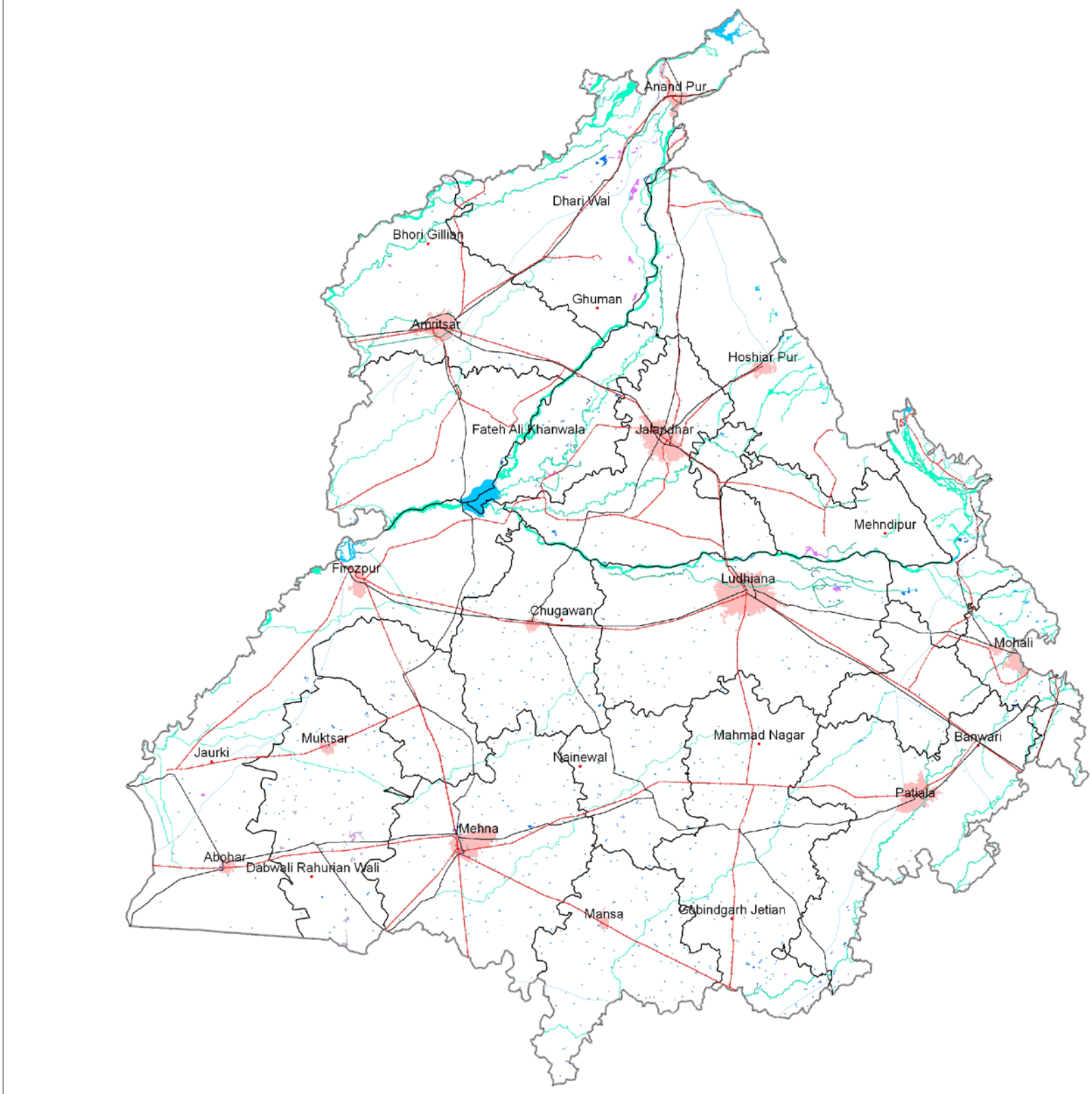
District-wise wetland area estimates in Punjab

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.

For details, refer National Wetland Atlas: Punjab, SAC/EPSA/ABHG/NWIA/ATLAS/25/2010, Space Applications Centre (ISRO), Ahmedabad, India, 152p.

State : Punjab

WETLAND MAP

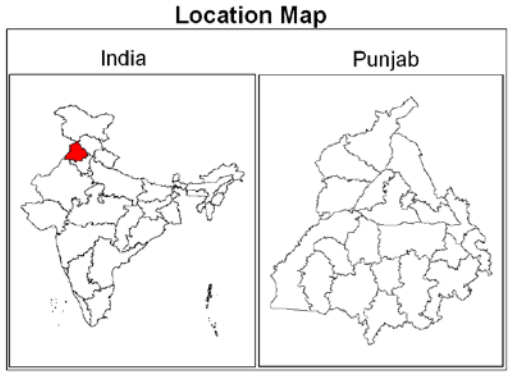


Symbol Typecode	Level I	Level II	Level III
	Inland Wetlands		
		Natural	
1101			Lakes/Ponds
1102			Ox-bow lakes/ Cut-off meanders
1103			High altitude wetlands
1104			Reverine wetlands
1105			Waterlogged
1106			River/Stream
		Man-made	
1201			Reservoirs/Barrages
1202			Tanks/Ponds
1203			Waterlogged
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

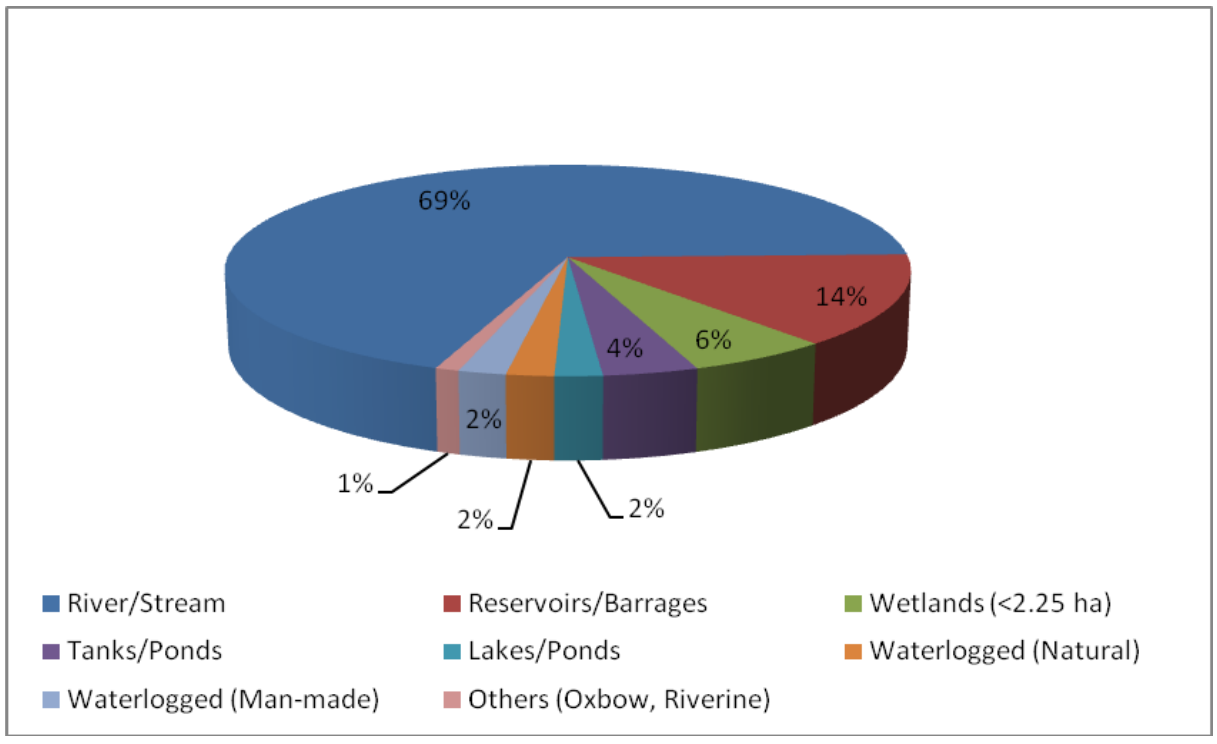


Figure 18: Type-wise wetland distribution in Punjab

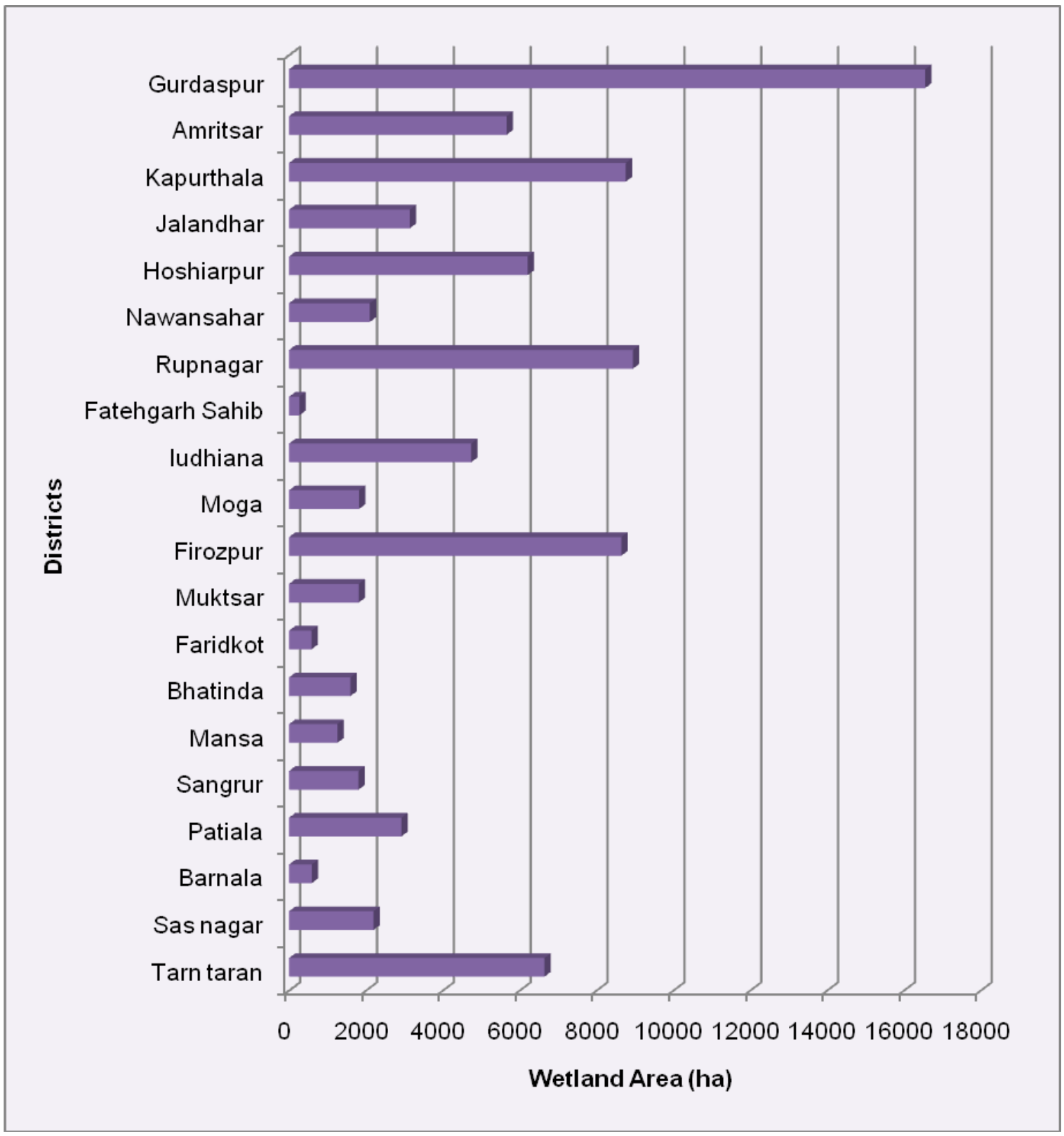


Figure 19: District-wise graphical distribution of wetlands in Punjab

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.

For details, refer National Wetland Atlas: Union Territories, SAC/EPSA/AFEG/NWIA/ATLAS/29/2010 Space Applications Centre (ISRO), Ahmedabad, India, 112p.

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	-	-

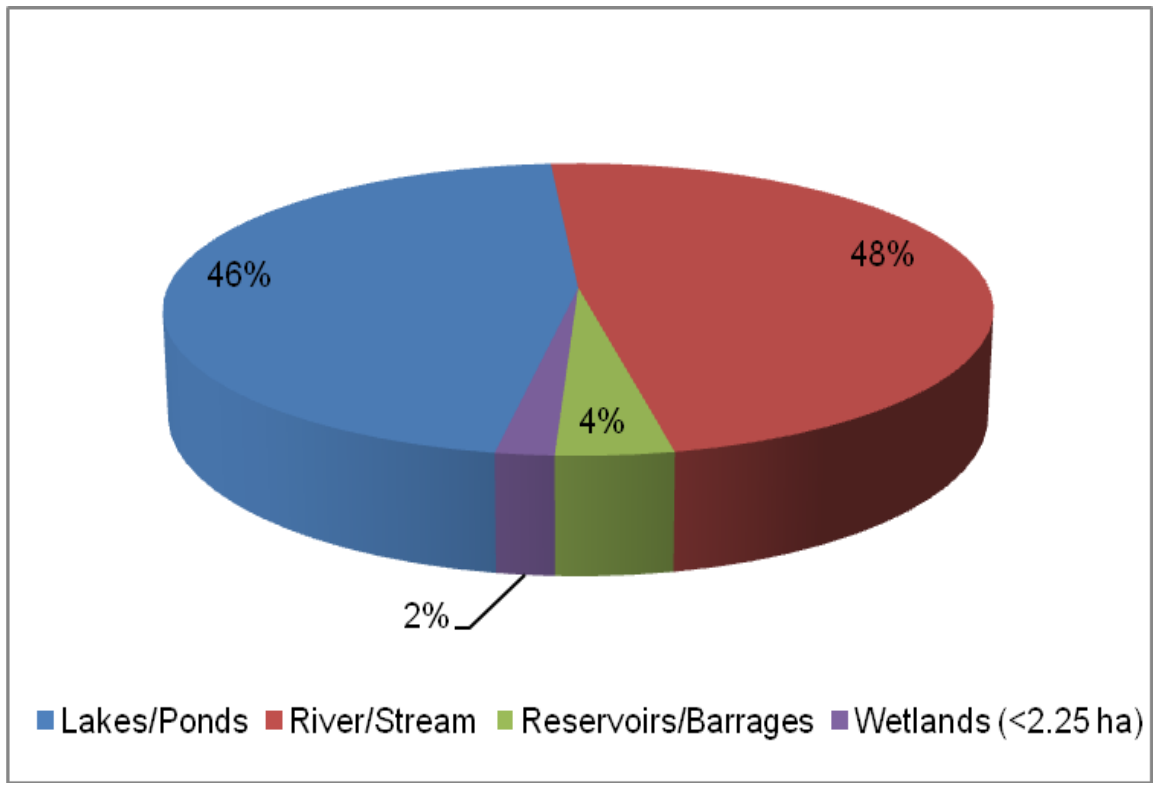
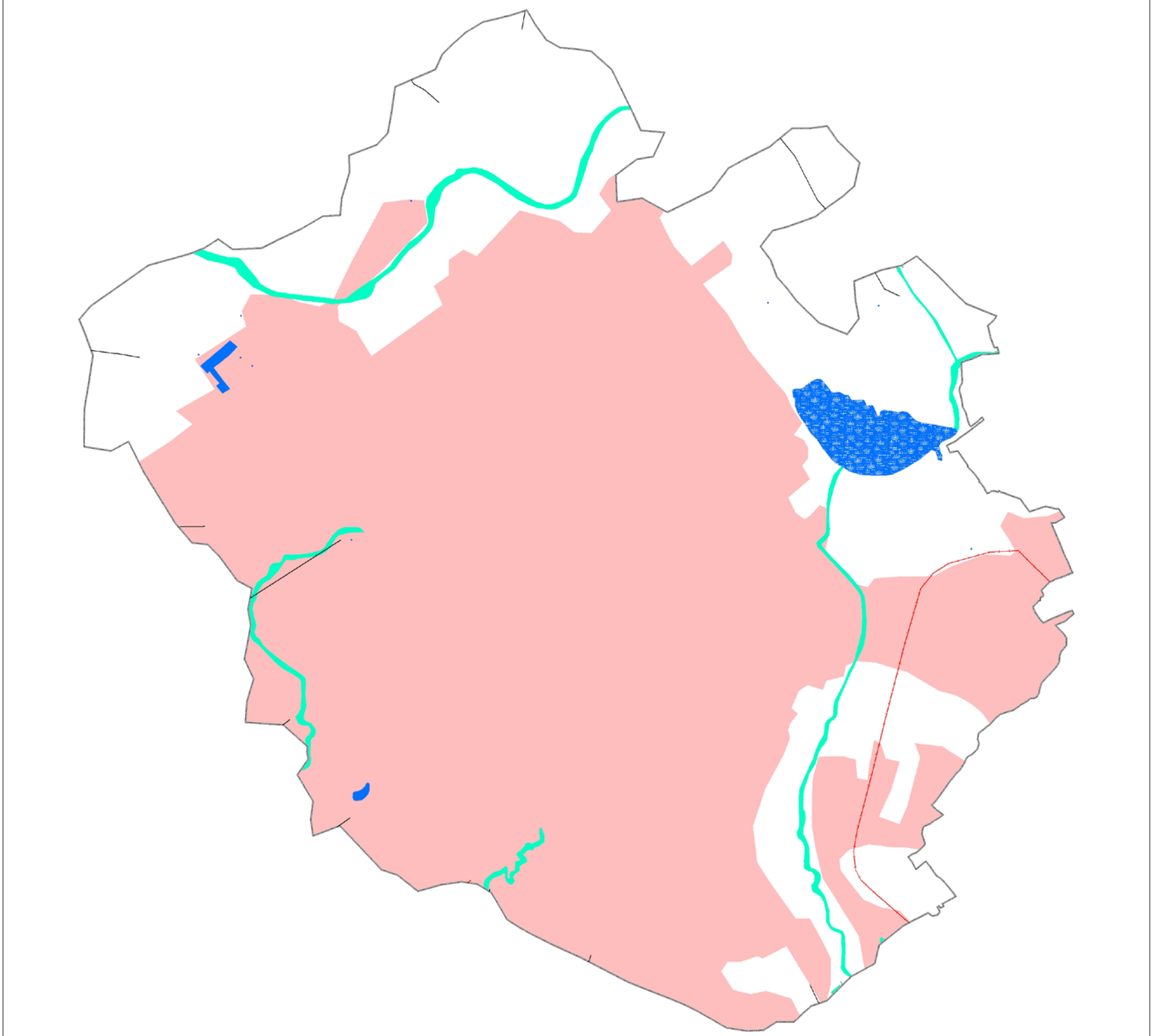


Figure 20: Type-wise wetland distribution in Chandigarh

State : Chandigarh

WETLAND MAP

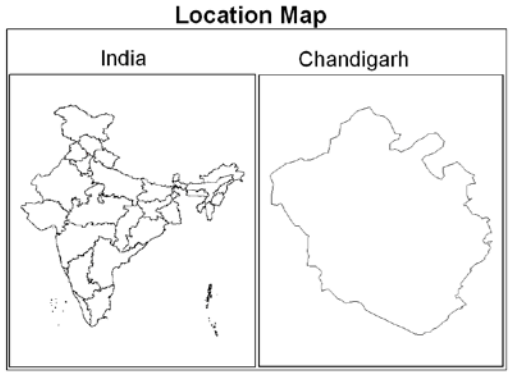


Symbol Typecode	Level I	Level II	Level III
	Inland Wetlands		
		Natural	
1101			Lakes/Ponds
1102			Ox-bow lakes/ Cut-off meanders
1103			High altitude wetlands
1104			Reverine wetlands
1105			Waterlogged
1106			River/Stream
		Man-made	
1201			Reservoirs/Barrages
1202			Tanks/Ponds
1203			Waterlogged
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.

For details, refer National Wetland Atlas: Uttarakhand, SAC/EPSA/ABHG/NWIA/ATLAS/24/2010, Space Applications Centre (ISRO), Ahmedabad, India, 130p.

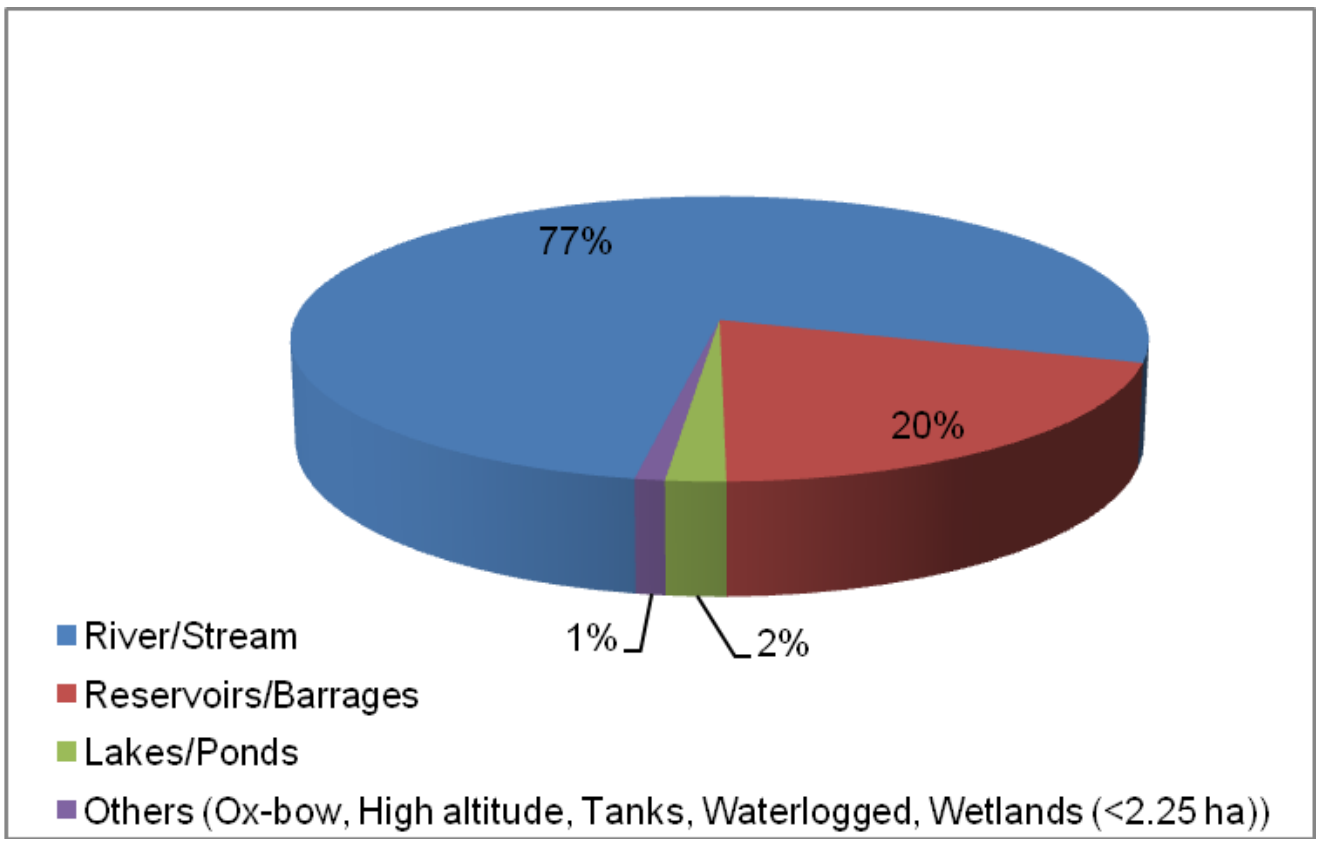


Figure 21: Type-wise wetland distribution in Uttarakhand

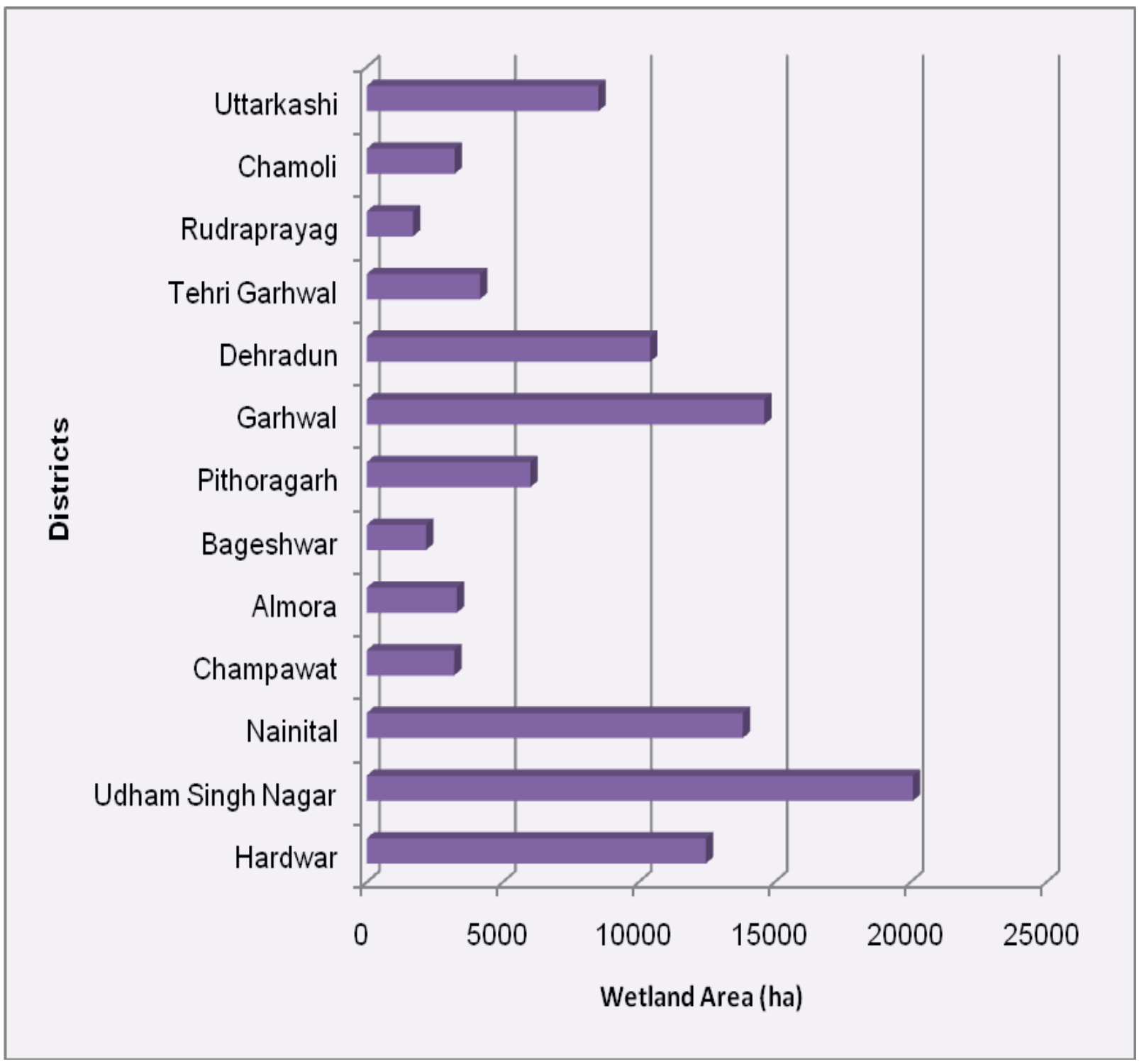


Figure 22: District-wise graphical distribution of wetlands in Uttarakhand

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

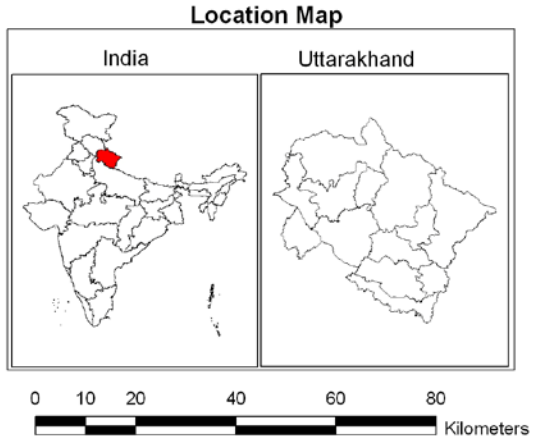


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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



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
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

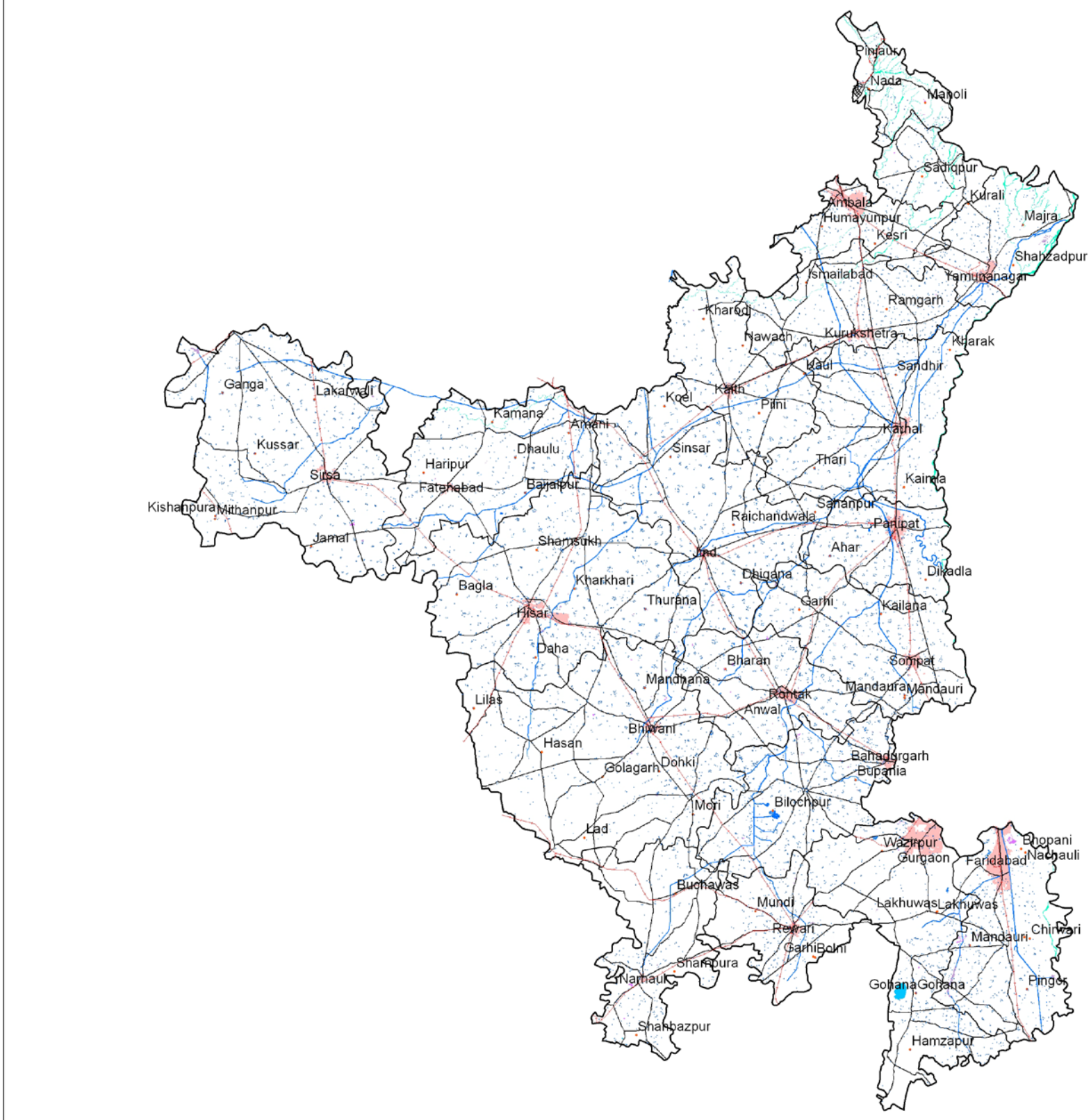
Area under turbidity levels		
Low	6953	6423
Moderate	3295	9481
High	3968	3008

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

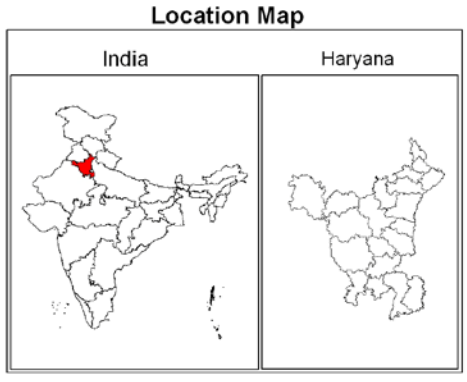


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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 Haryana

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.

For details, refer National Wetland Atlas: Haryana, SAC/RESA/AFEG/NWIA/ATLAS/15/2010, Space Applications Centre (ISRO), Ahmedabad, India, 148p.

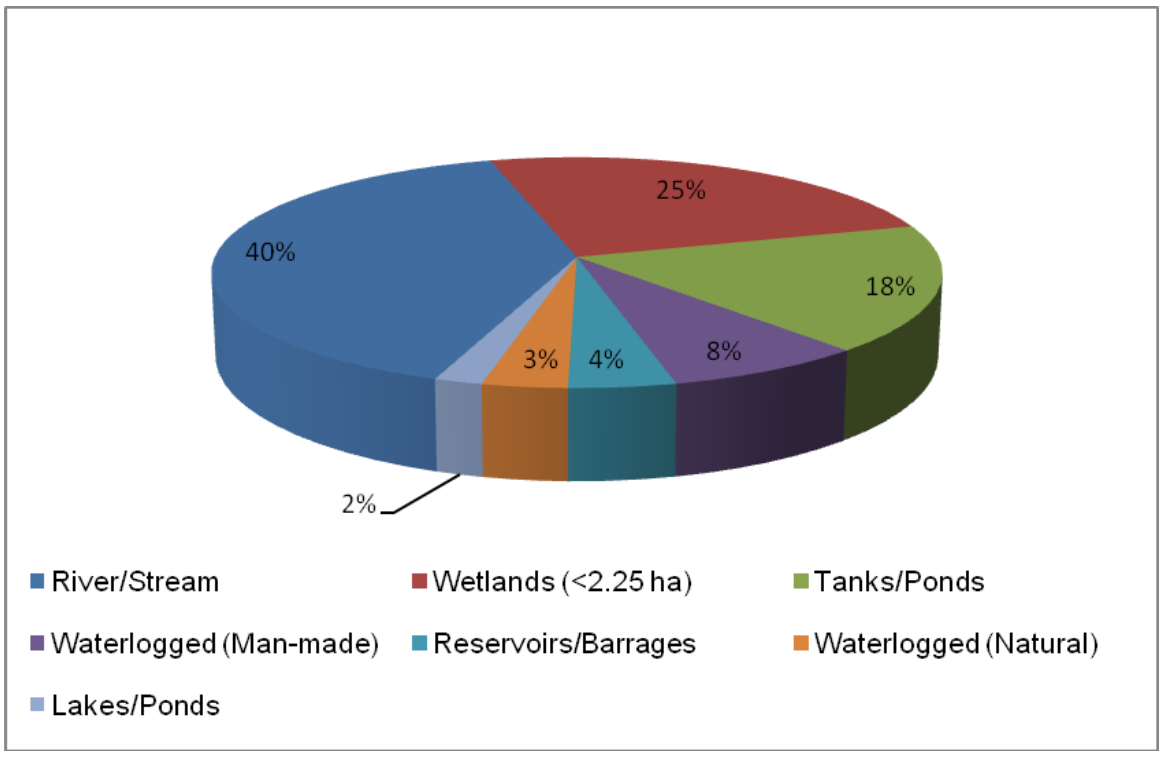


Figure 23: Type-wise wetland distribution in Haryana

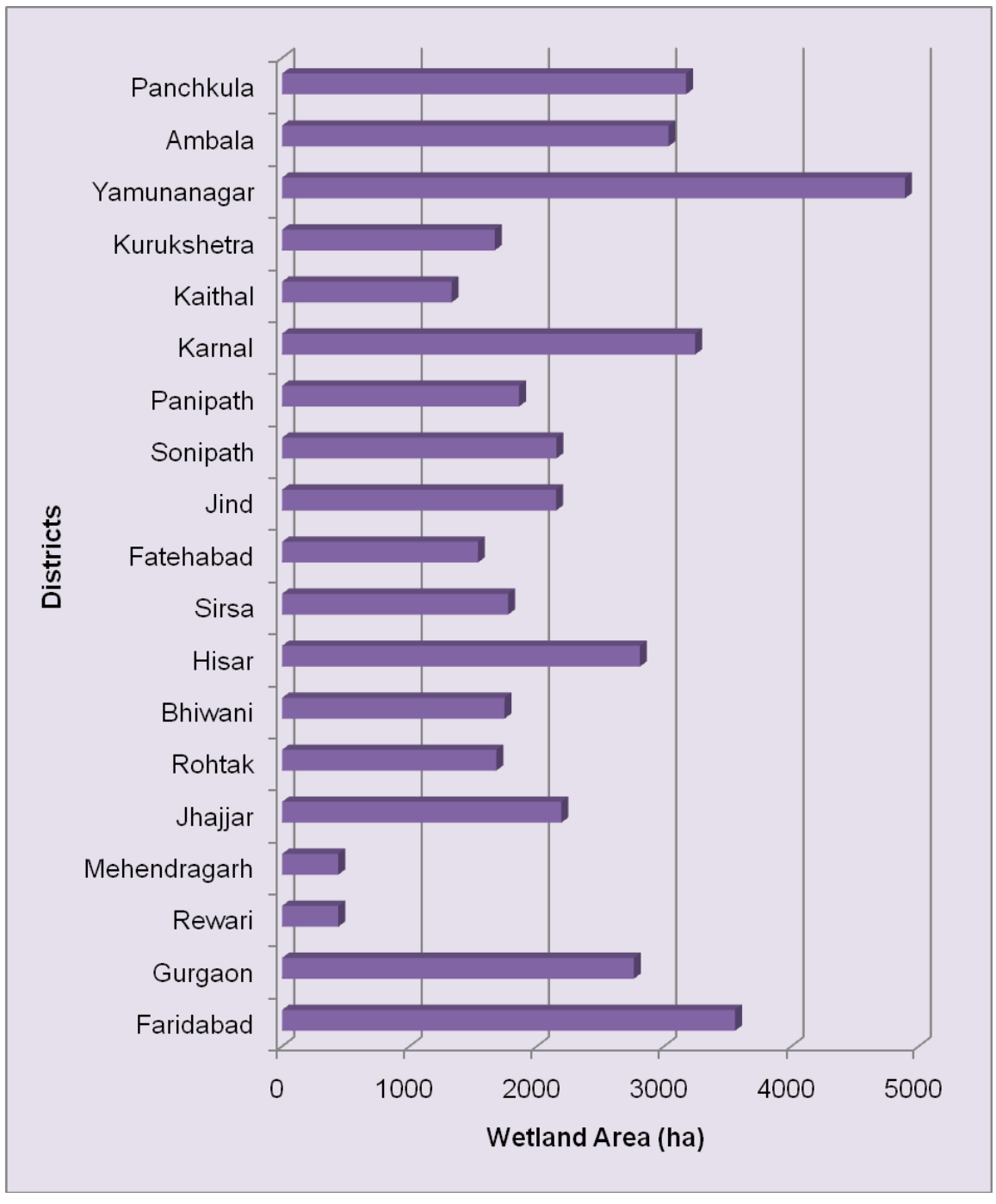


Figure 24: District-wise graphical distribution of wetlands in Haryana

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.

For details, refer National Wetland Atlas: Delhi, SAC/RESA/AFEG/NWIA/ATLAS/07/2009, Space Applications Centre (ISRO), Ahmedabad, India, 92p.

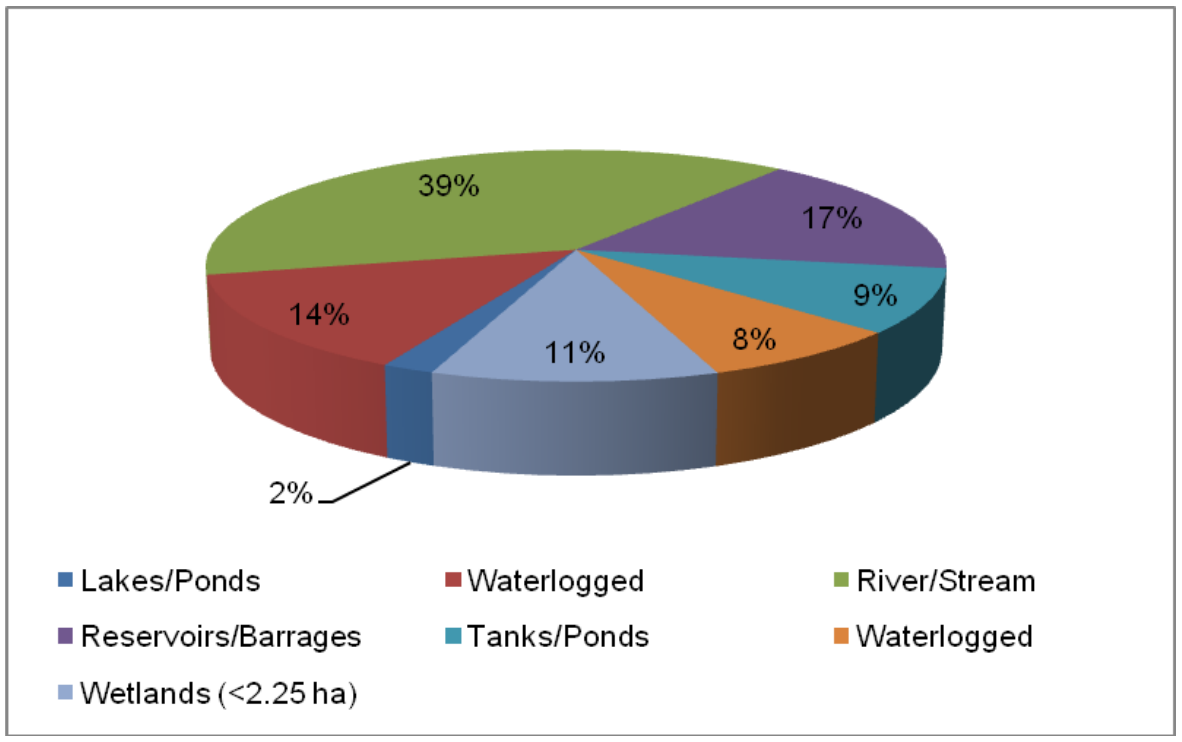


Figure 25: Type-wise wetland distribution in Delhi

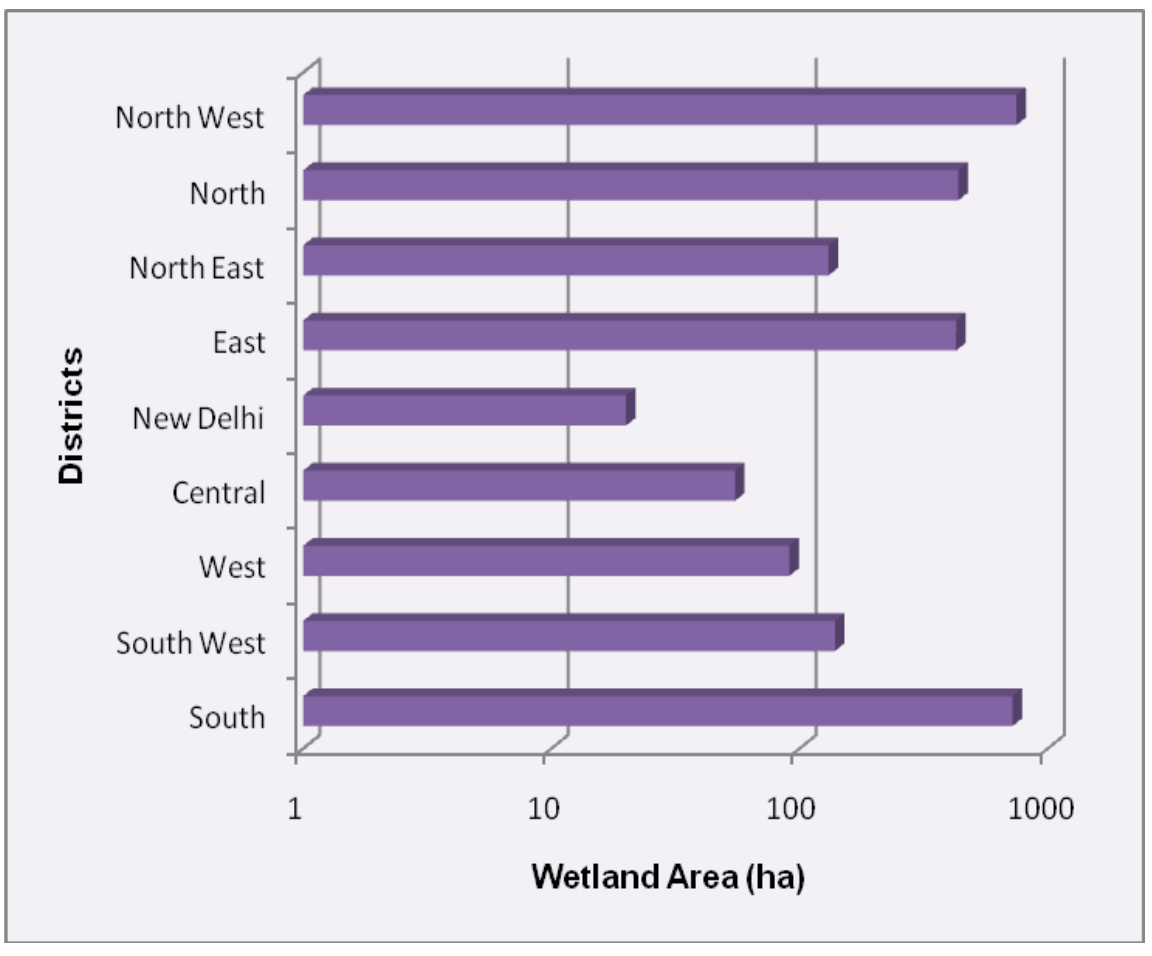


Figure 26: District-wise graphical distribution of wetlands in Delhi

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

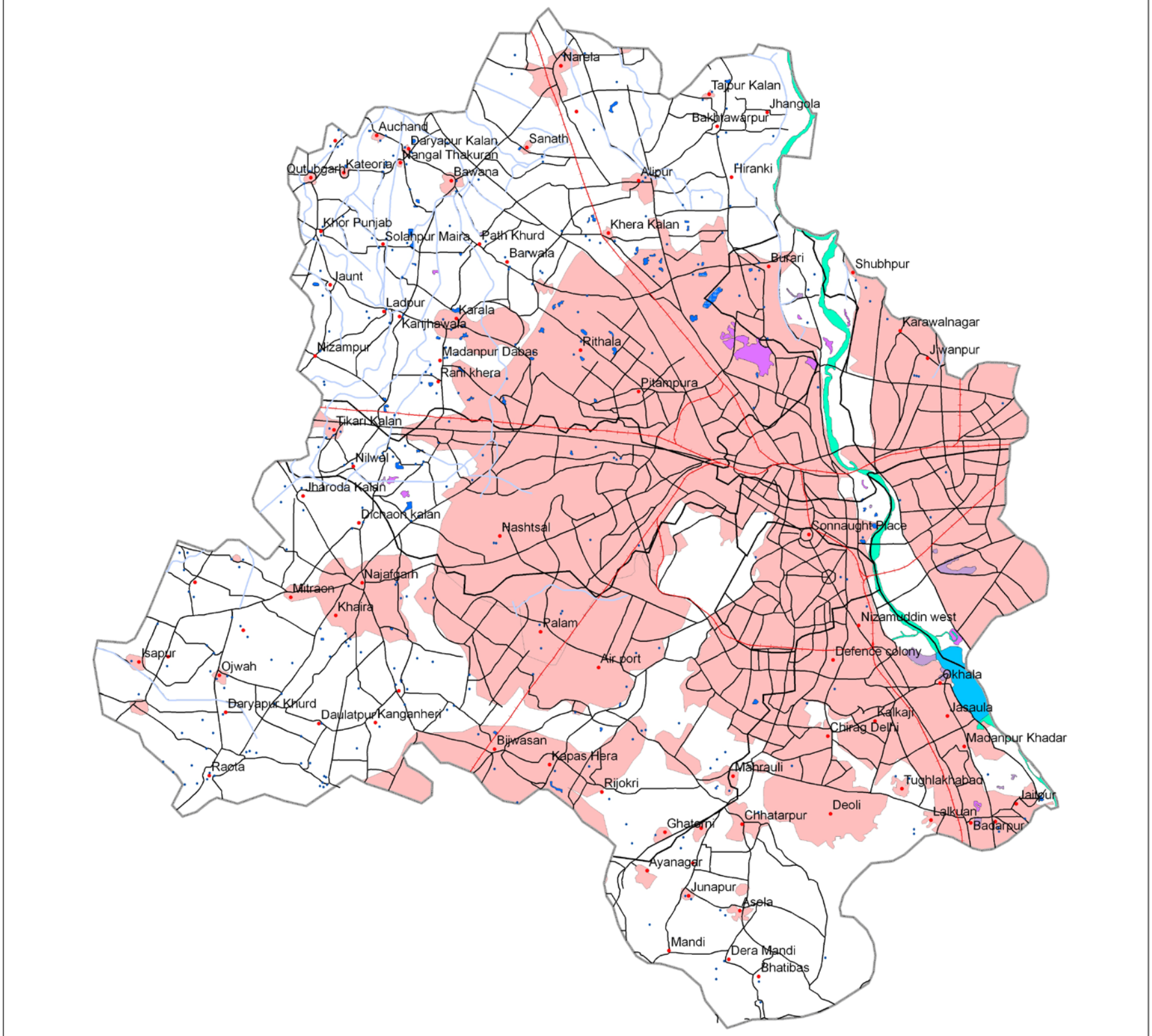
Table 28: District-wise area of wetlands (type-wise) in Delhi

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

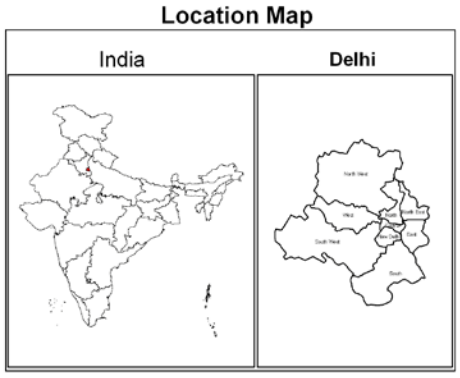


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

For details, refer National Wetland Atlas: Rajasthan, SAC/EPSA/AFEG/NWIA/ATLAS/31/2010, Space Applications Centre (ISRO), Ahmedabad, India, 214p.

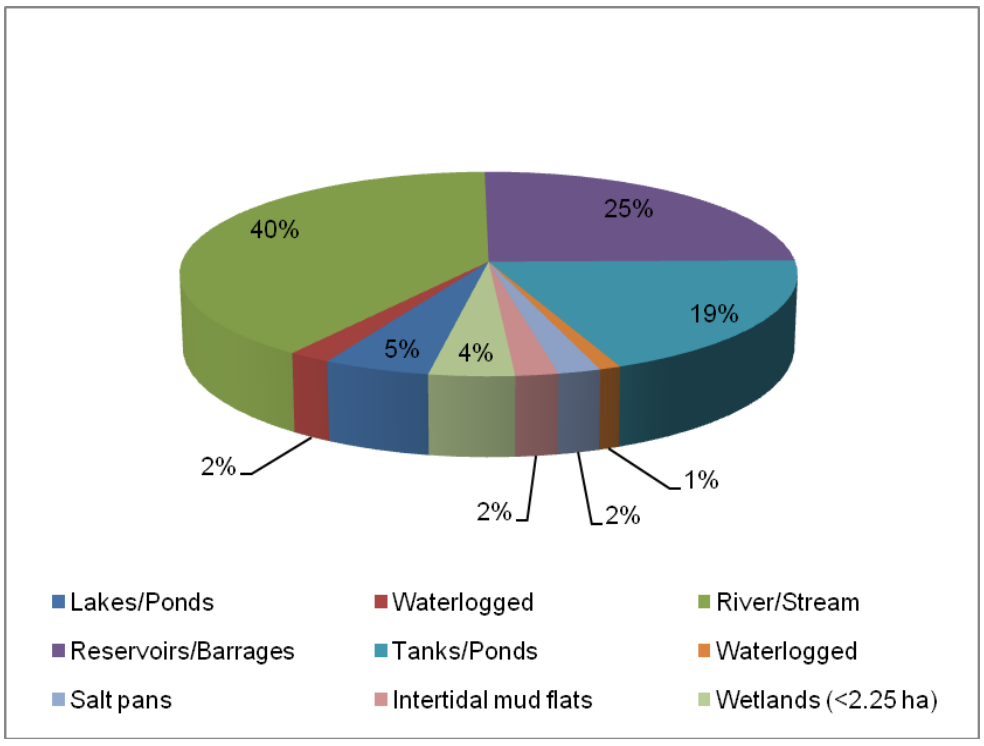


Figure 27: Type-wise wetland distribution in Rajasthan

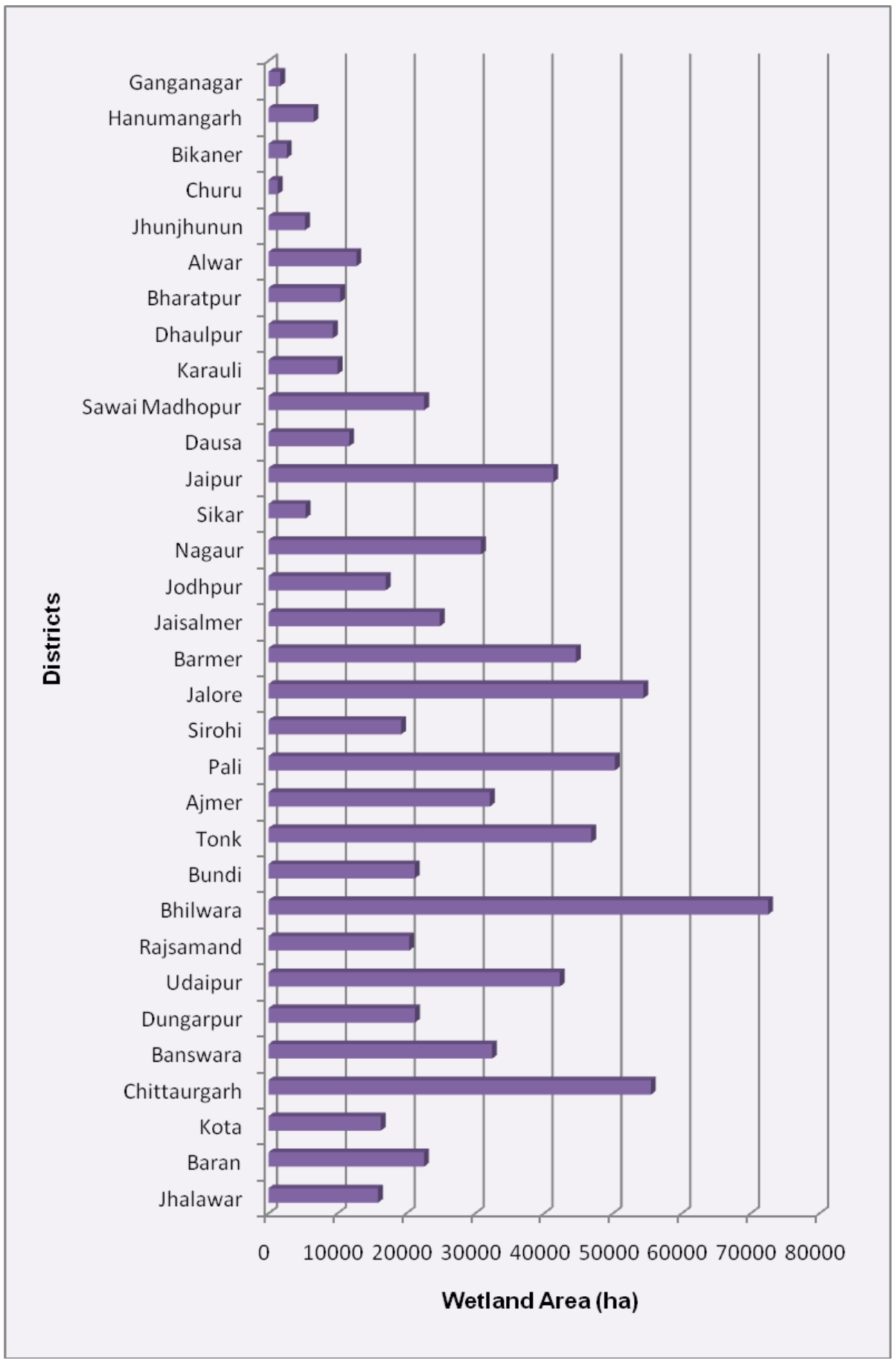


Figure 28: District-wise graphical distribution of wetlands in Rajasthan

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

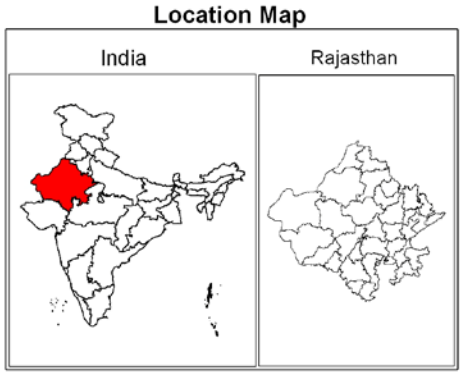


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

For details, refer National Wetland Atlas: Uttar Pradesh, SAC/RESA/AFEG/NWIA/ATLAS/12/2010, Space Applications Centre, ISRO, Ahmedabad, India, 372p.

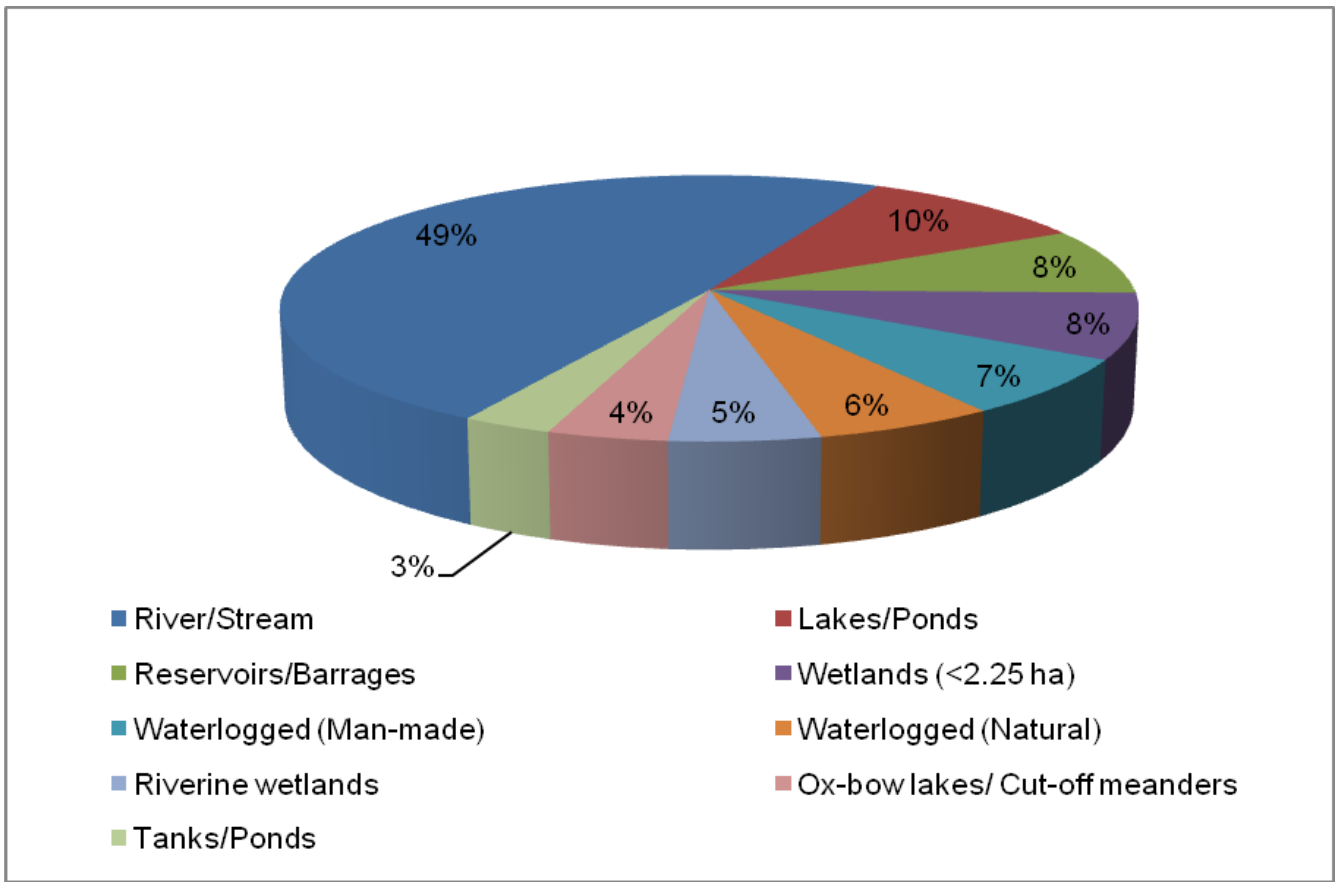


Figure 29: Type-wise wetland distribution in Uttar Pradesh

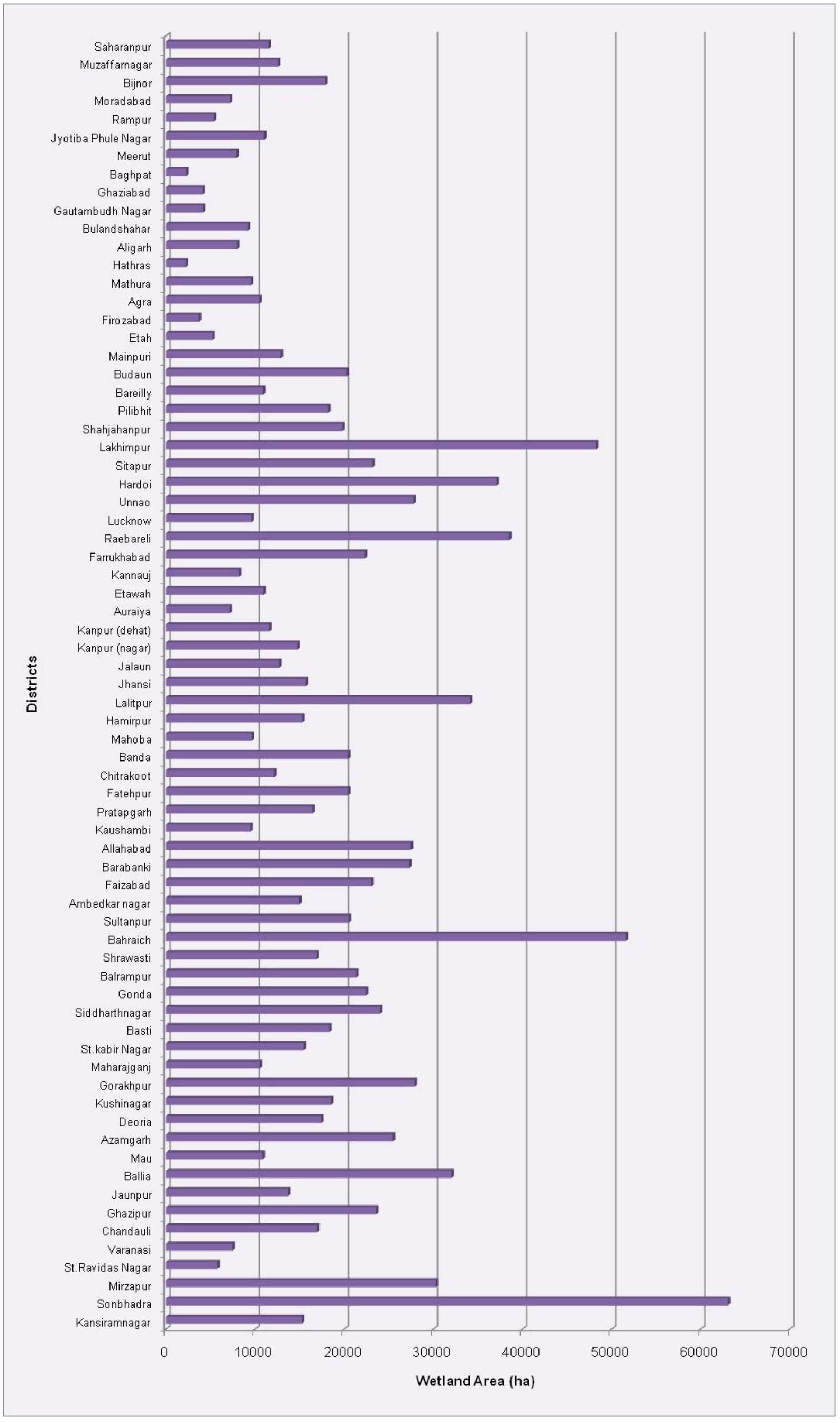


Figure 30: District-wise graphical distribution of wetlands in Uttar Pradesh

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

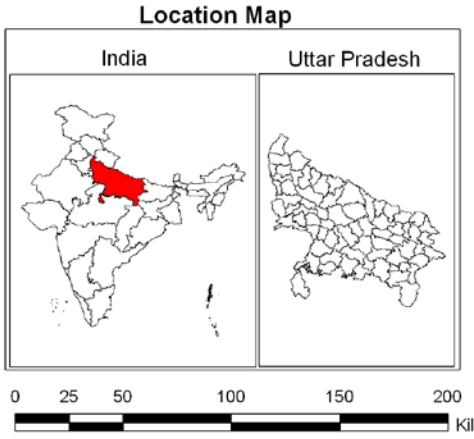


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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

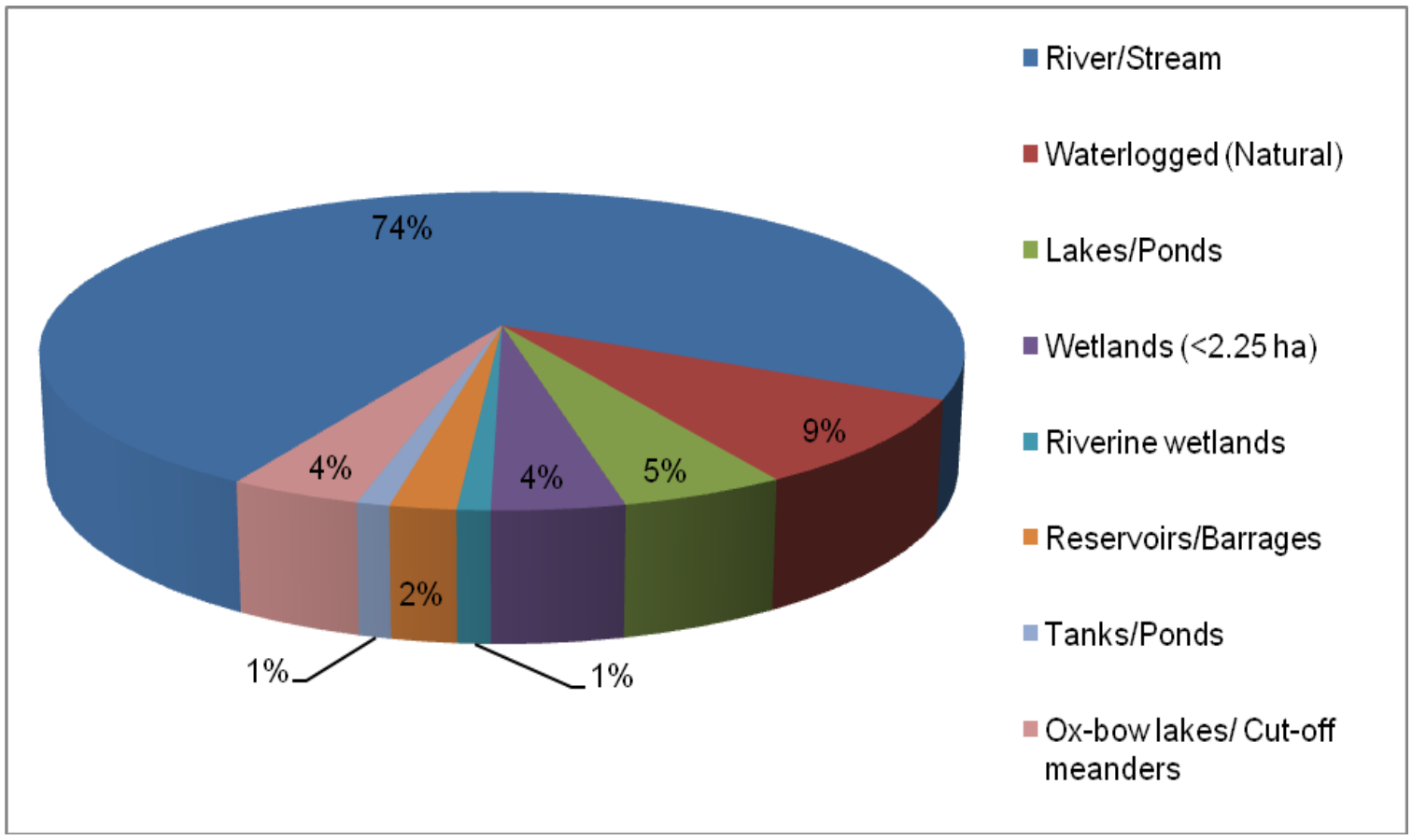


Figure 31: Type-wise wetland distribution in Bihar

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.

For details, refer National Wetland Atlas: Bihar, SAC/RESA/AFEG/NWIA/ATLAS/23/2010, Space Applications Centre (ISRO), Ahmedabad, India, 222p.

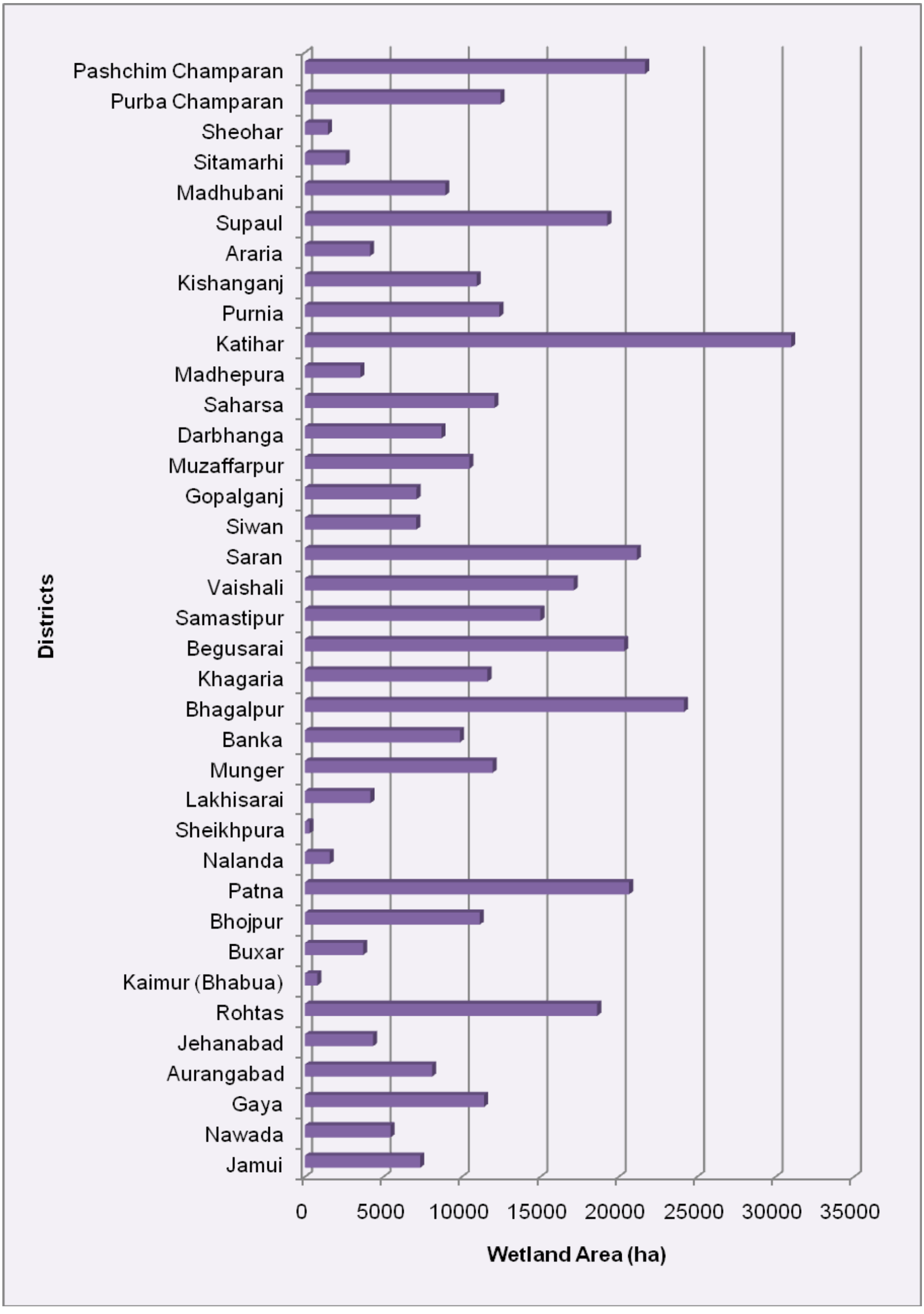


Figure 32: District-wise graphical distribution of wetlands in Bihar

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

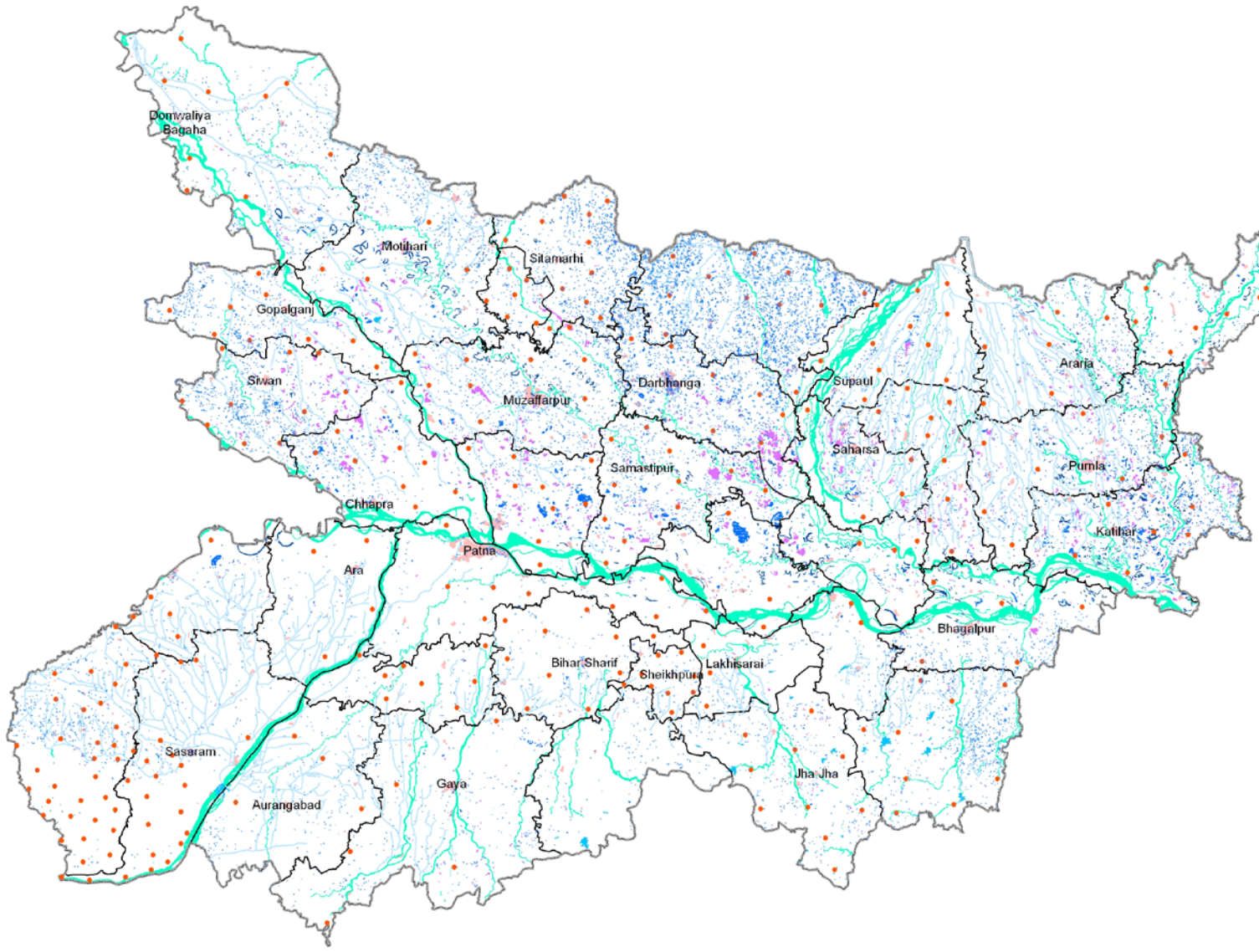
Table 37: District-wise area of wetlands (type-wise) in Bihar

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	
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	1105			Waterlogged
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			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
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	2105			Salt marsh
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	2107			Coral reefs
			Man-made	
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	2202			Aquaculture ponds

Legend

- Wetlands (<2.25 ha)
- Settlements
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- Railway
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- International Boundary

Location Map



Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
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.

For details, refer National Wetland Atlas: Sikkim, SAC/RESA/AFEG/NWIA/ATLAS/13/2010 Space Applications Centre (ISRO), Ahmedabad, India, 88p.

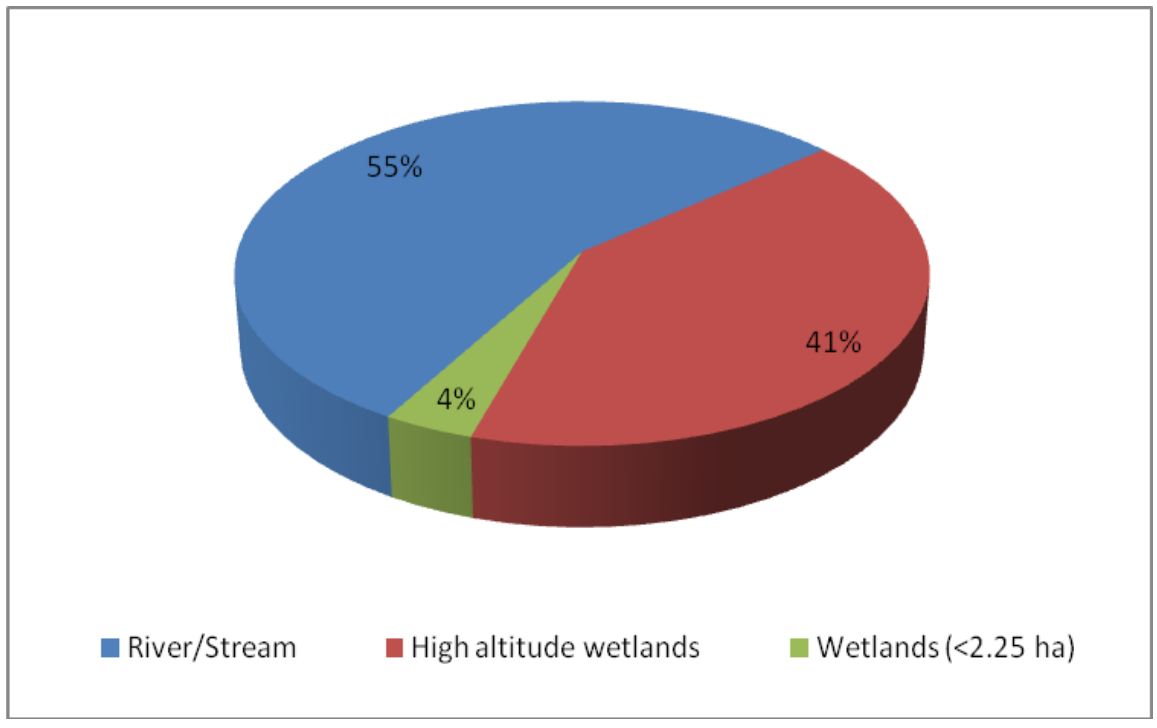


Figure 33: Type-wise wetland distribution in Sikkim

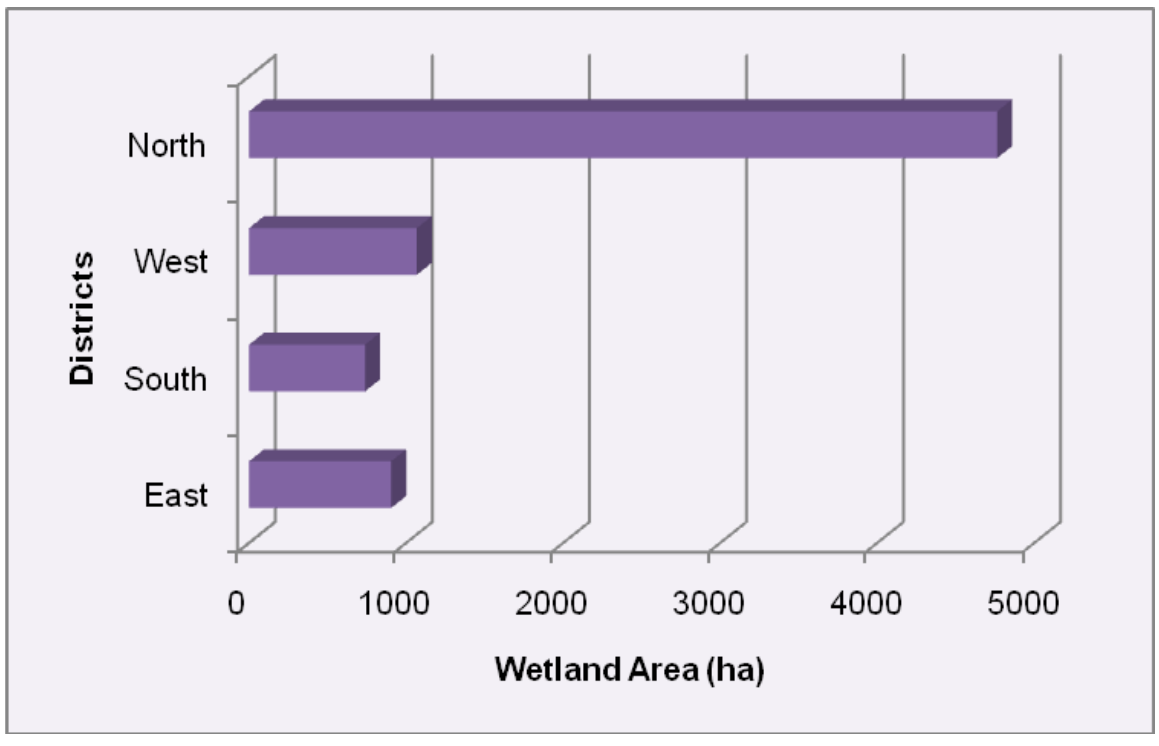


Figure 34: District-wise graphical distribution of wetlands in Sikkim

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

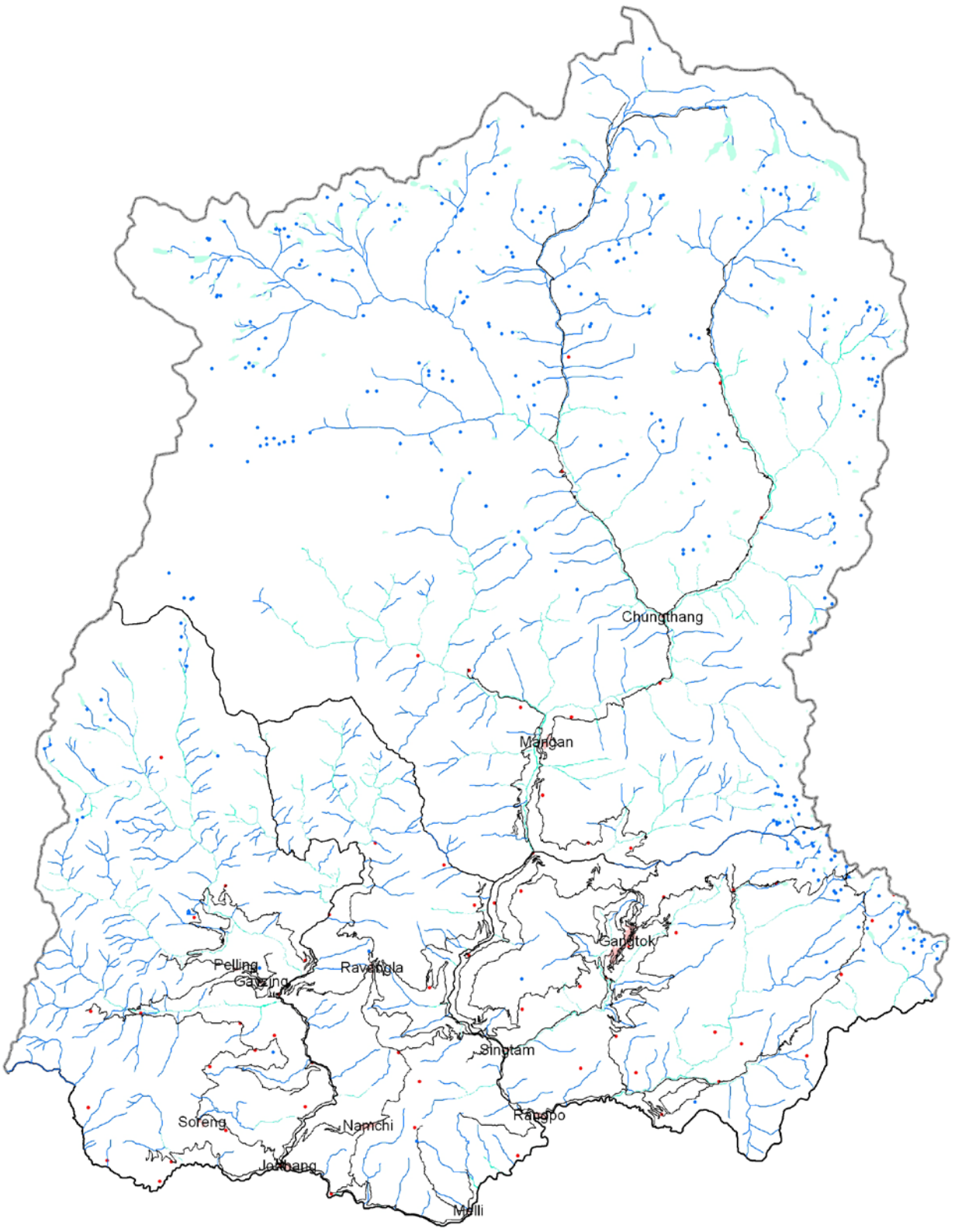
Table 40: District-wise area of wetlands (type-wise) in Sikkim

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.

For details, refer National Wetland Atlas: North-Eastern States, SAC/EPSA/ABHG/NWIA/ATLAS/35/2011 Space Applications Centre (ISRO), Ahmedabad, India, 318p.

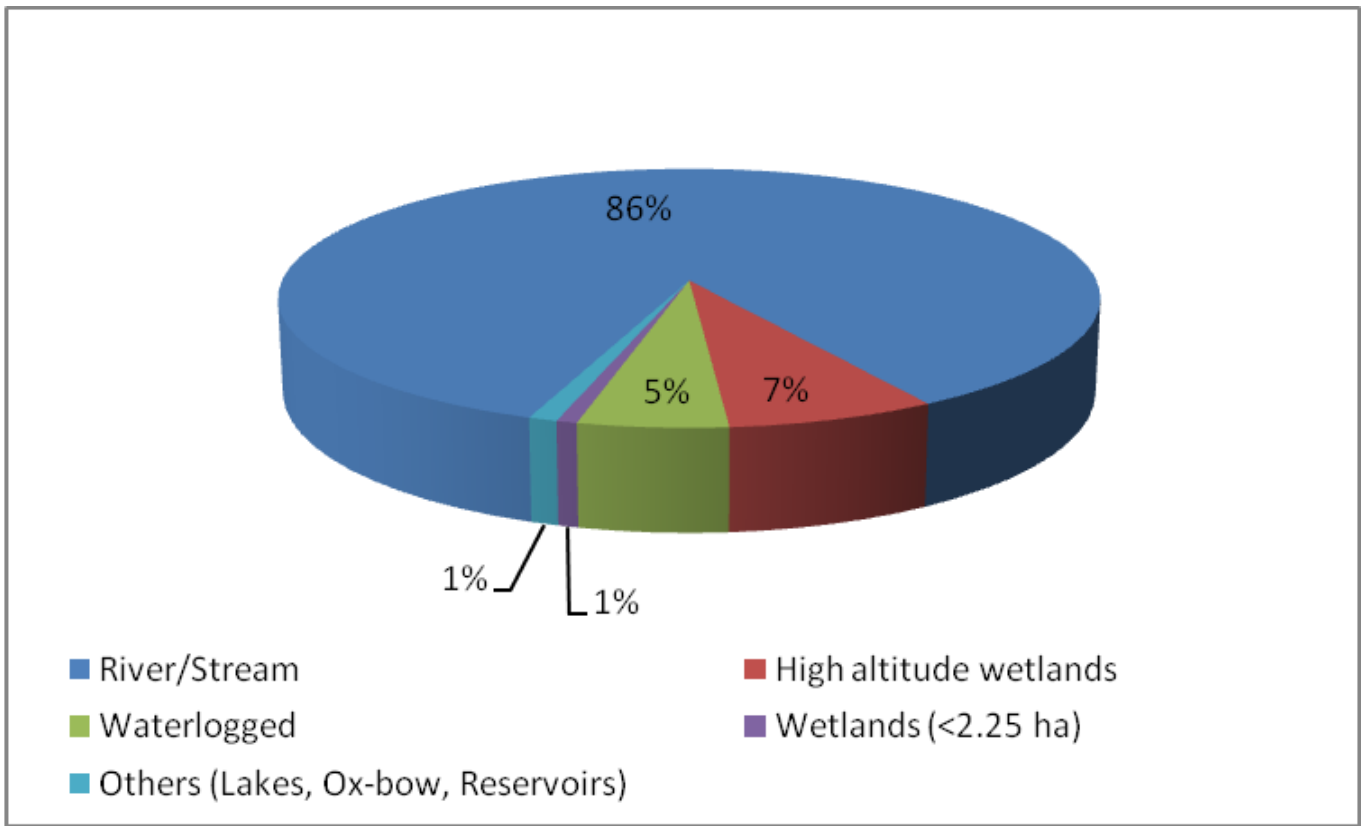


Figure 35: Type-wise wetland distribution in Arunachal Pradesh

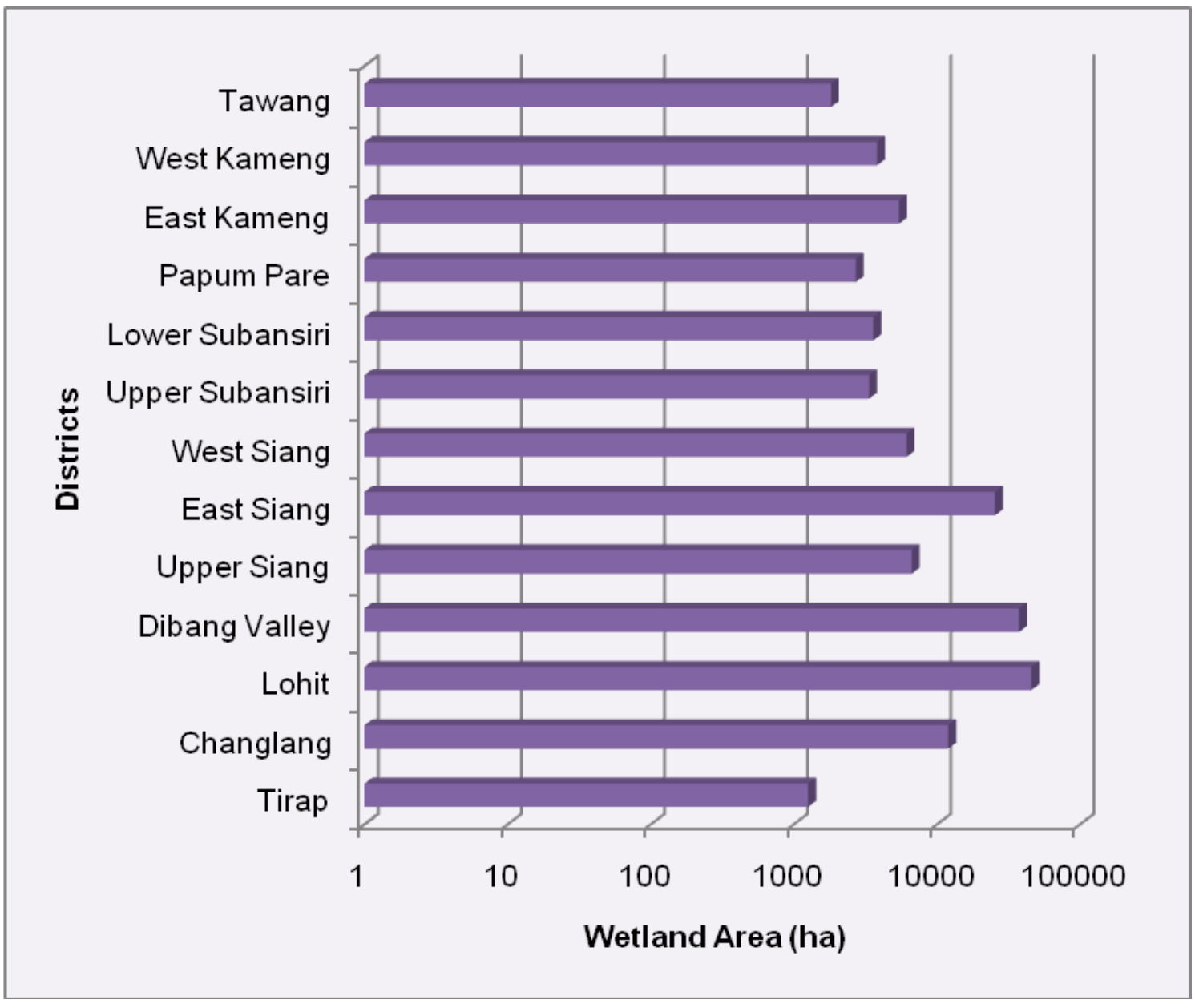


Figure 36: District-wise graphical distribution of wetlands in Arunachal Pradesh

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

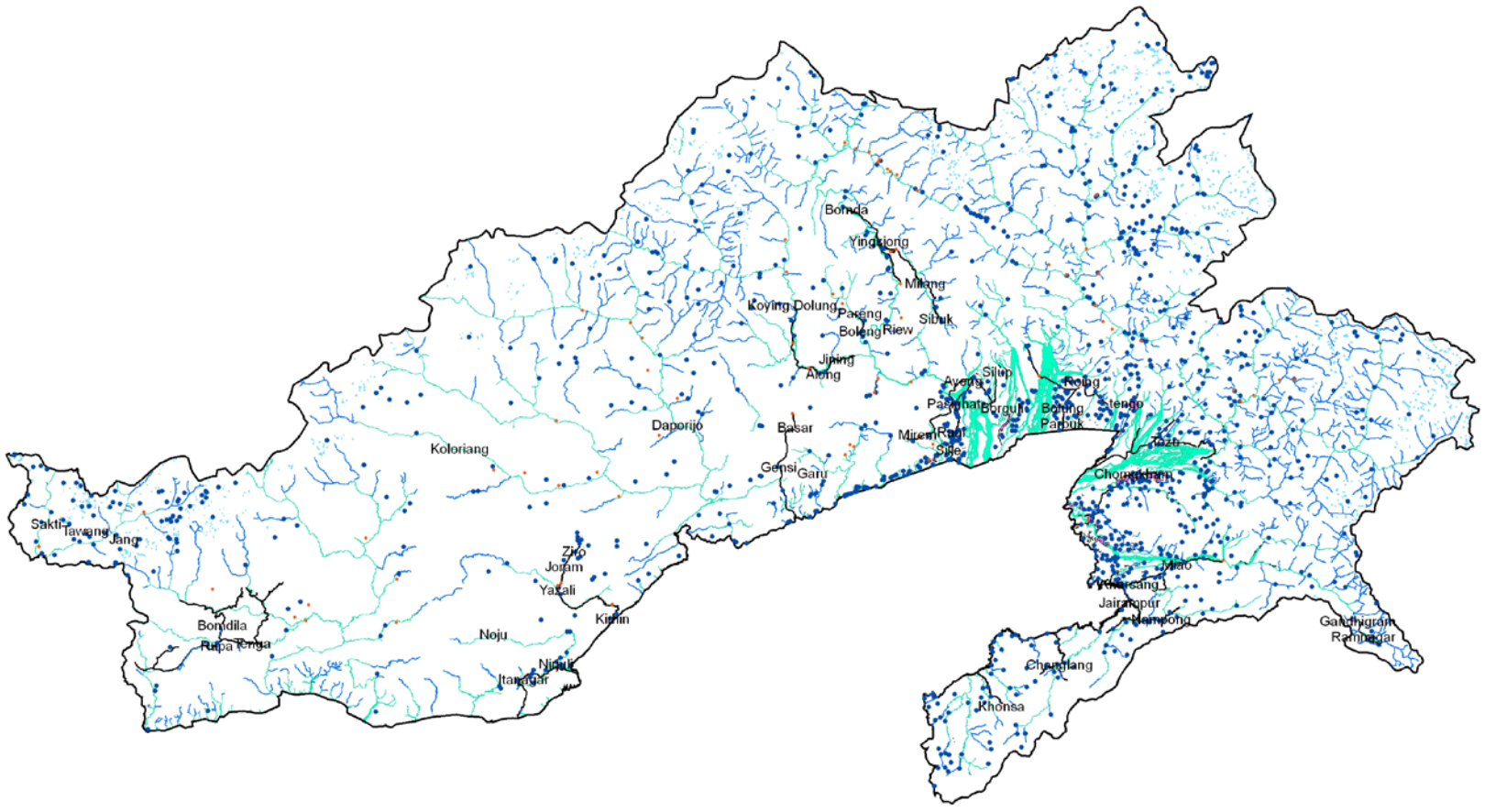
Table 43: District-wise area of wetlands (type-wise) in Arunachal Pradesh

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

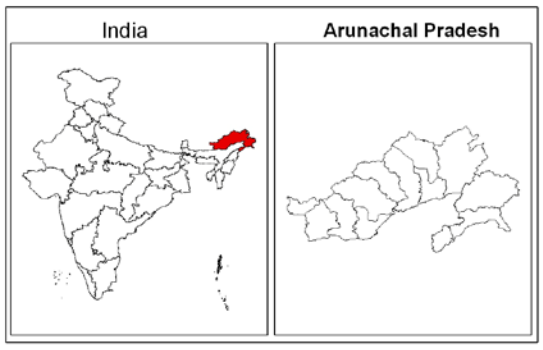


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

For details, refer National Wetland Atlas: North-Eastern States, SAC/EPSA/ABHG/NWIA/ATLAS/35/2011 Space Applications Centre (ISRO), Ahmedabad, India, 318p.

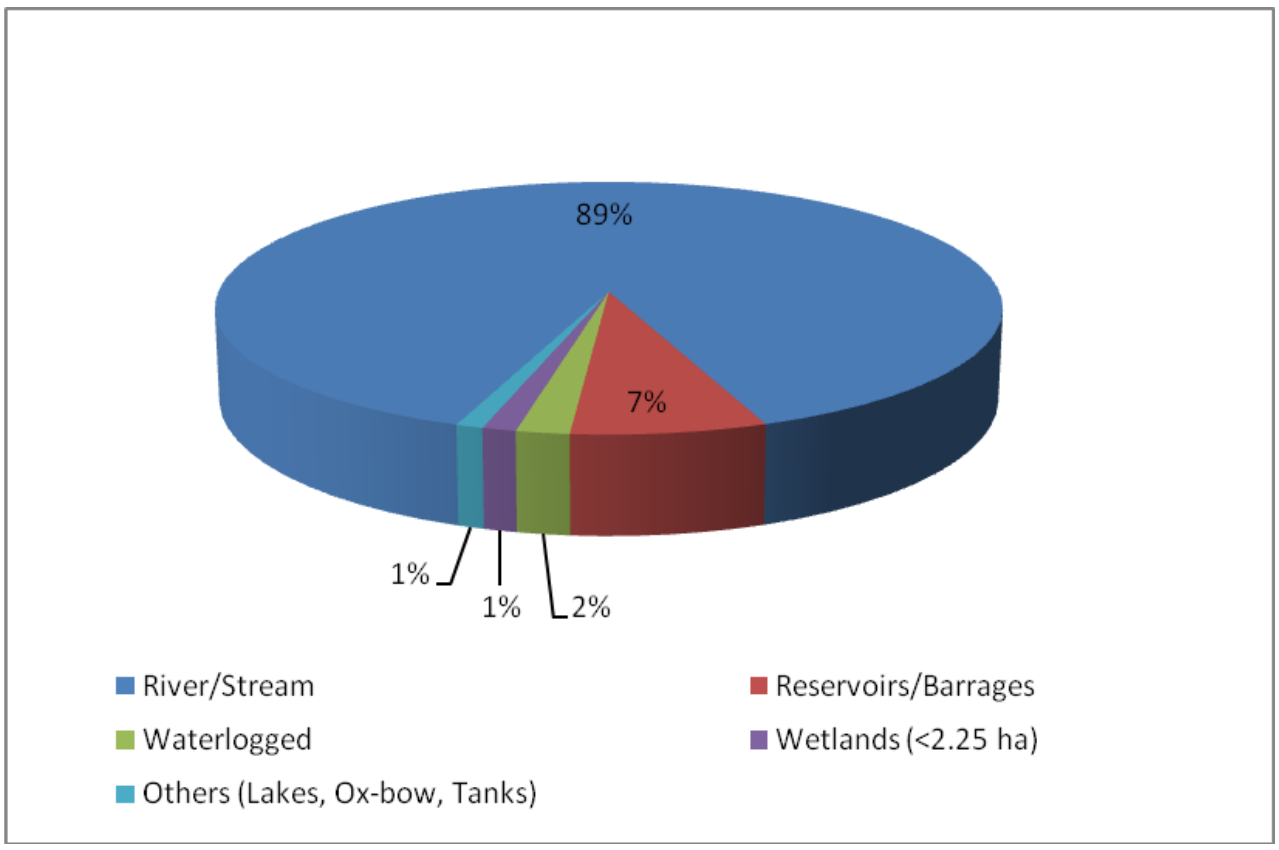


Figure 37: Type-wise wetland distribution in Nagaland

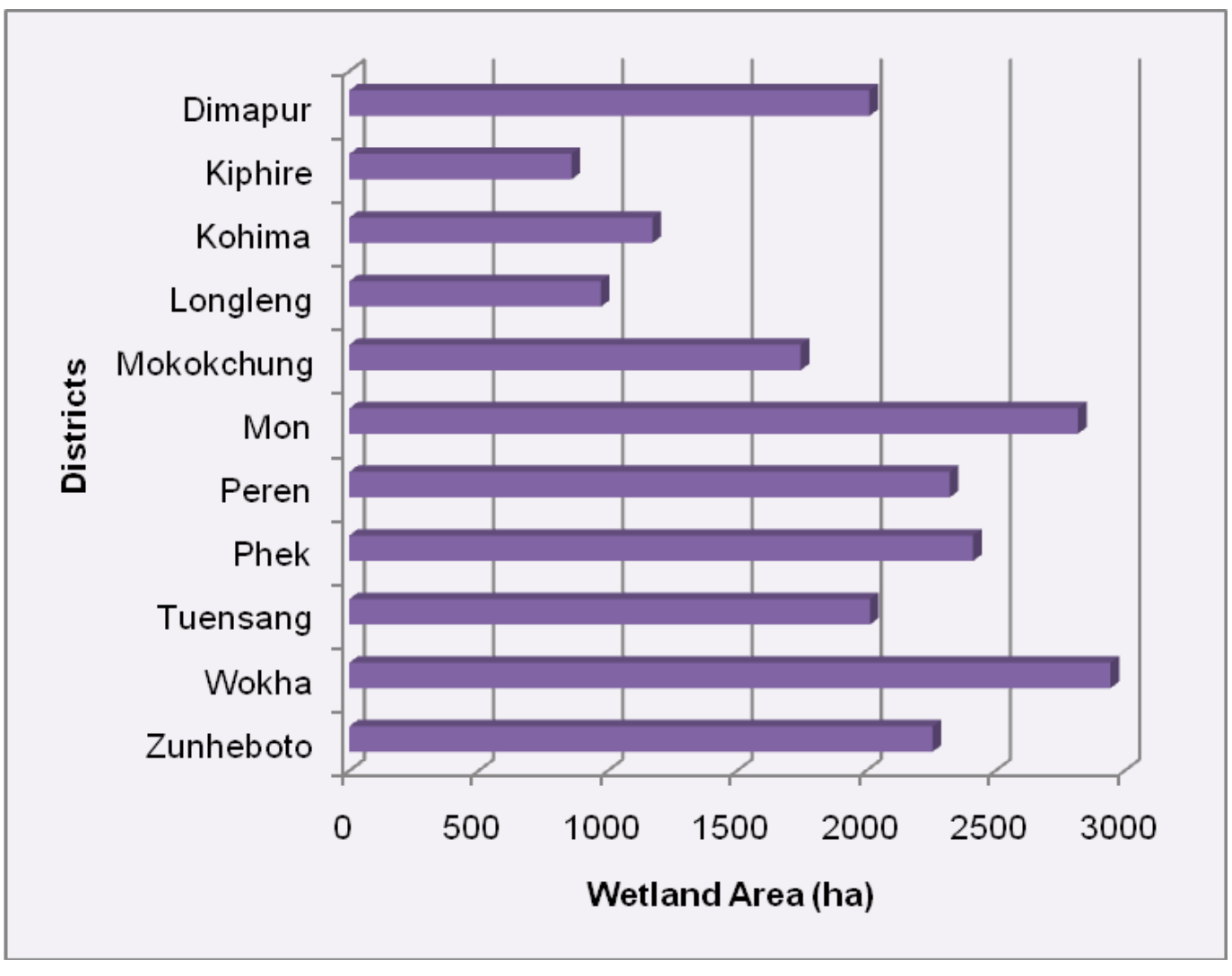


Figure 38: District-wise graphical distribution of wetlands in Nagaland

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

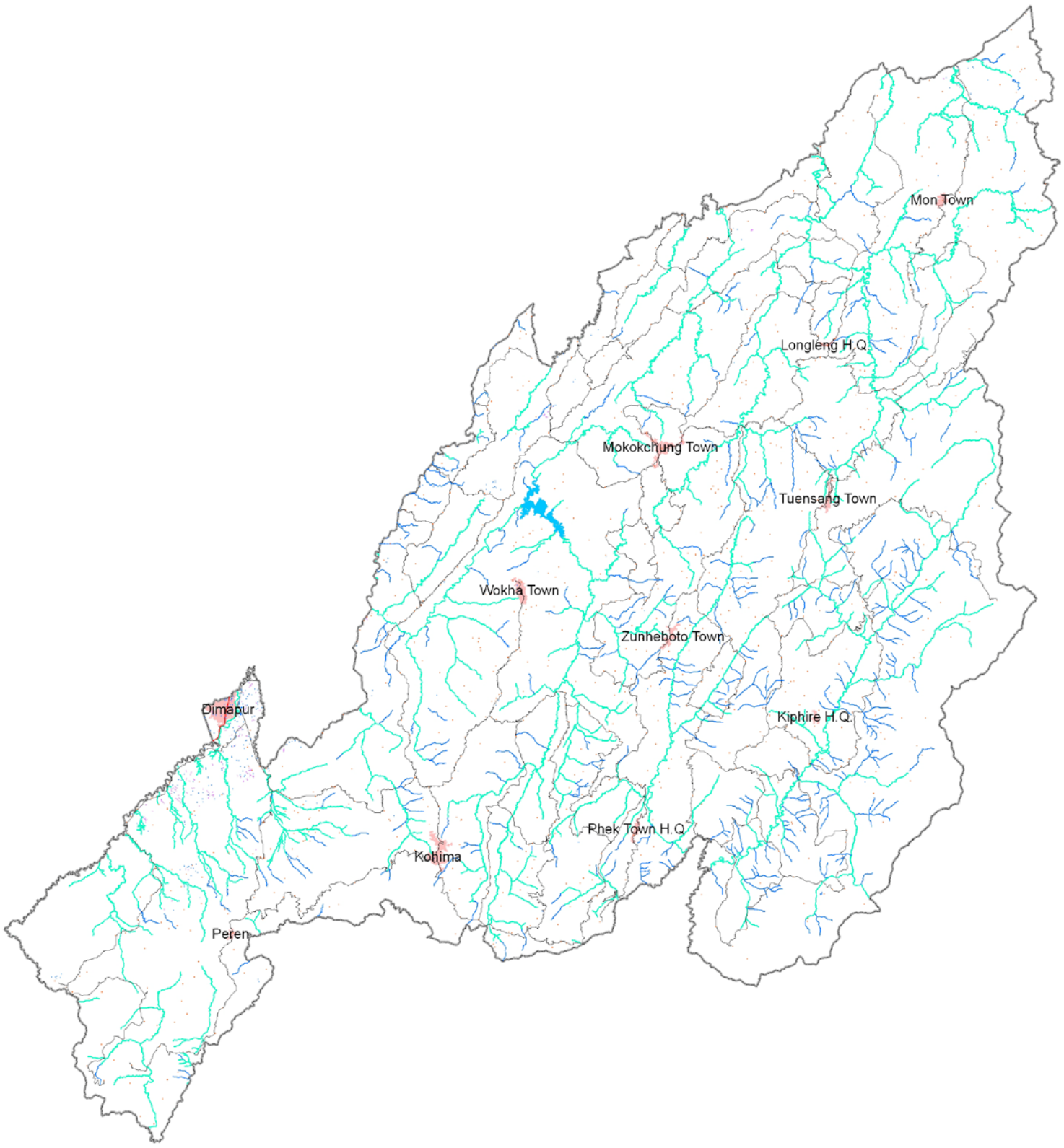
Table 46: District-wise area of wetlands (type-wise) in Nagaland

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

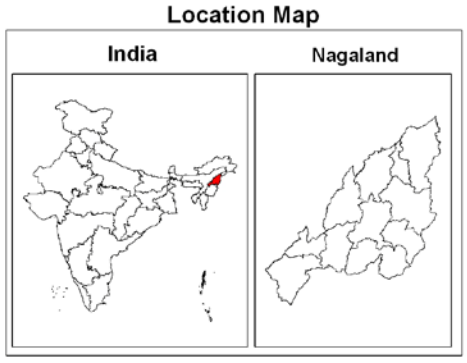


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverline wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

For details, refer National Wetland Atlas: North-Eastern States, SAC/EPSA/ABHG/NWIA/ATLAS/35/2011 Space Applications Centre (ISRO), Ahmedabad, India, 318p.

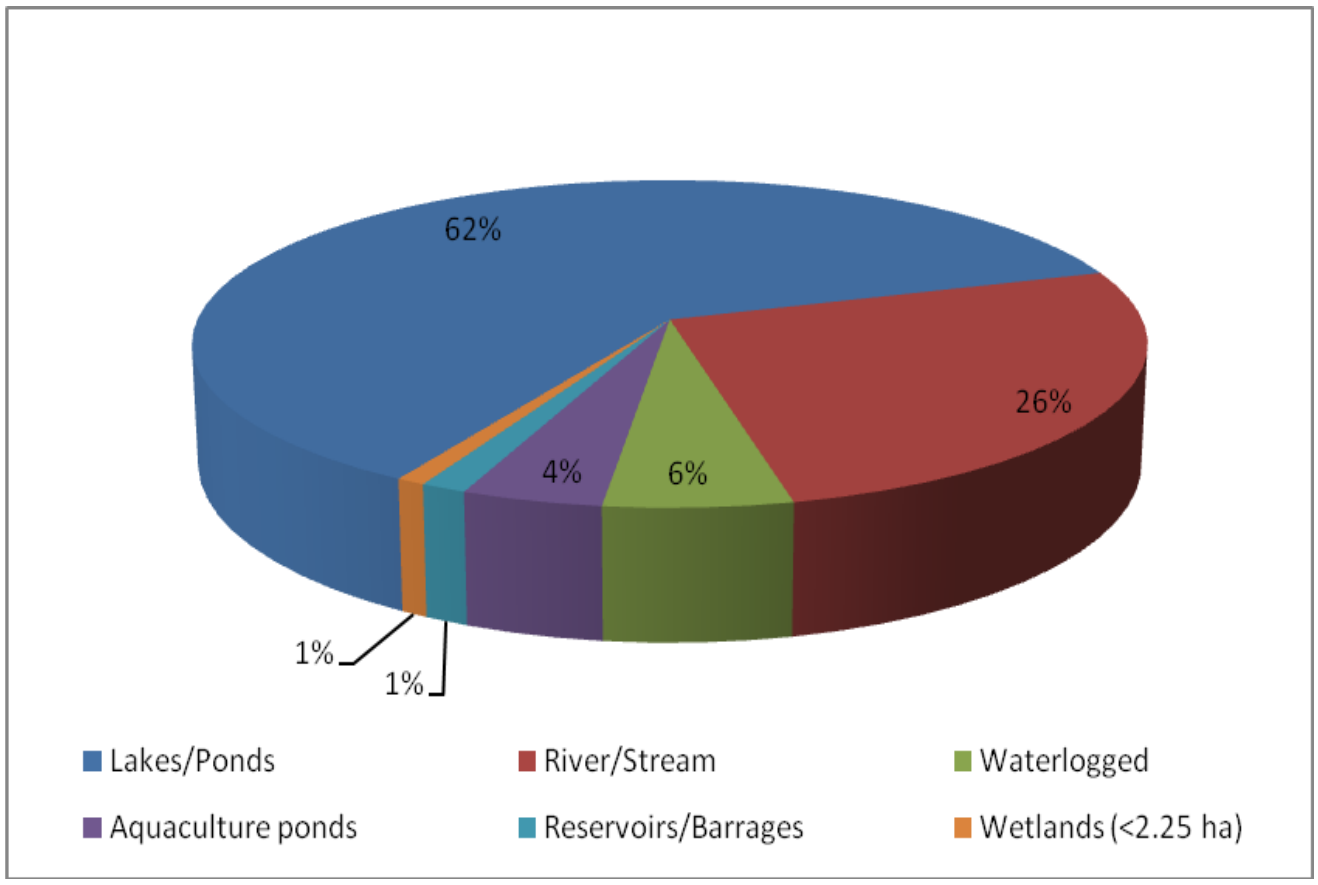


Figure 39: Type-wise wetland distribution in Manipur

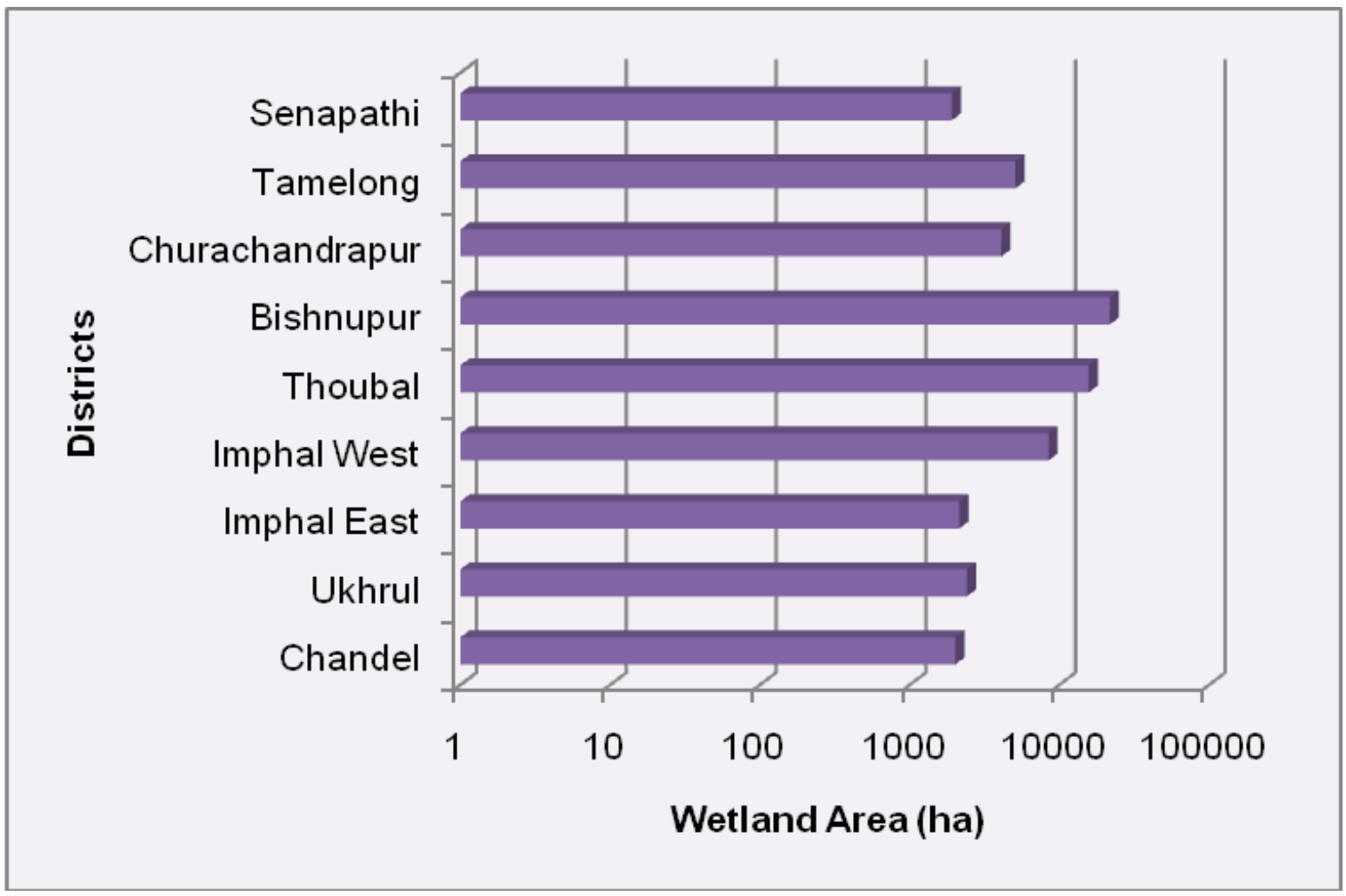


Figure 40: District-wise graphical distribution of wetlands in Manipur

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

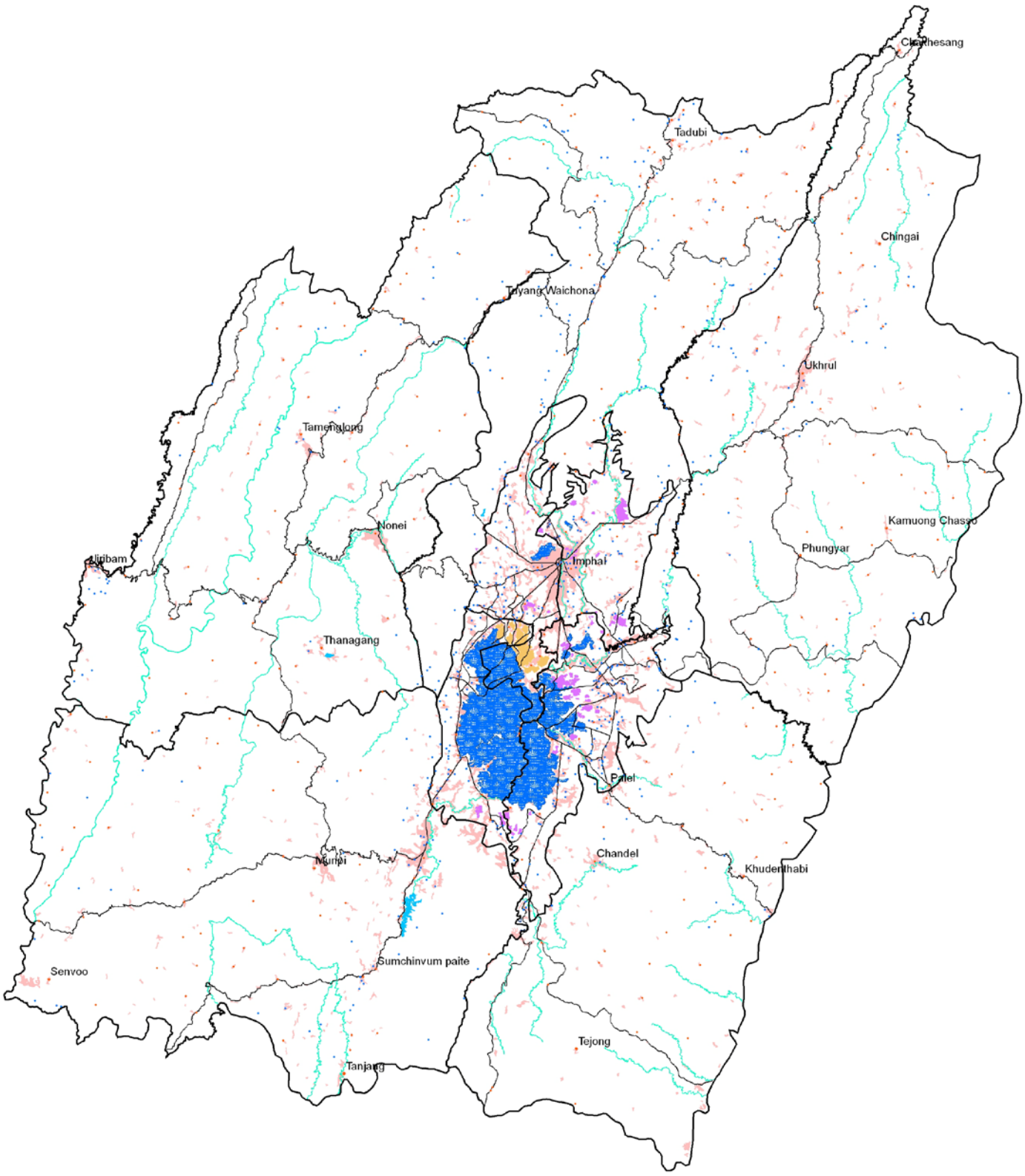
Table 49: District-wise area of wetlands (type-wise) in Manipur

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

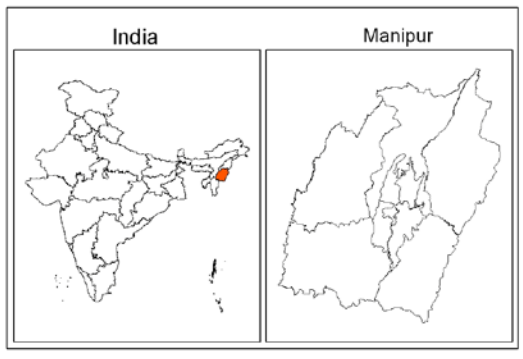


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

For details, refer National Wetland Atlas: North-Eastern States, SAC/EPSA/ABHG/NWIA/ATLAS/35/2011 Space Applications Centre (ISRO), Ahmedabad, India, 318p.

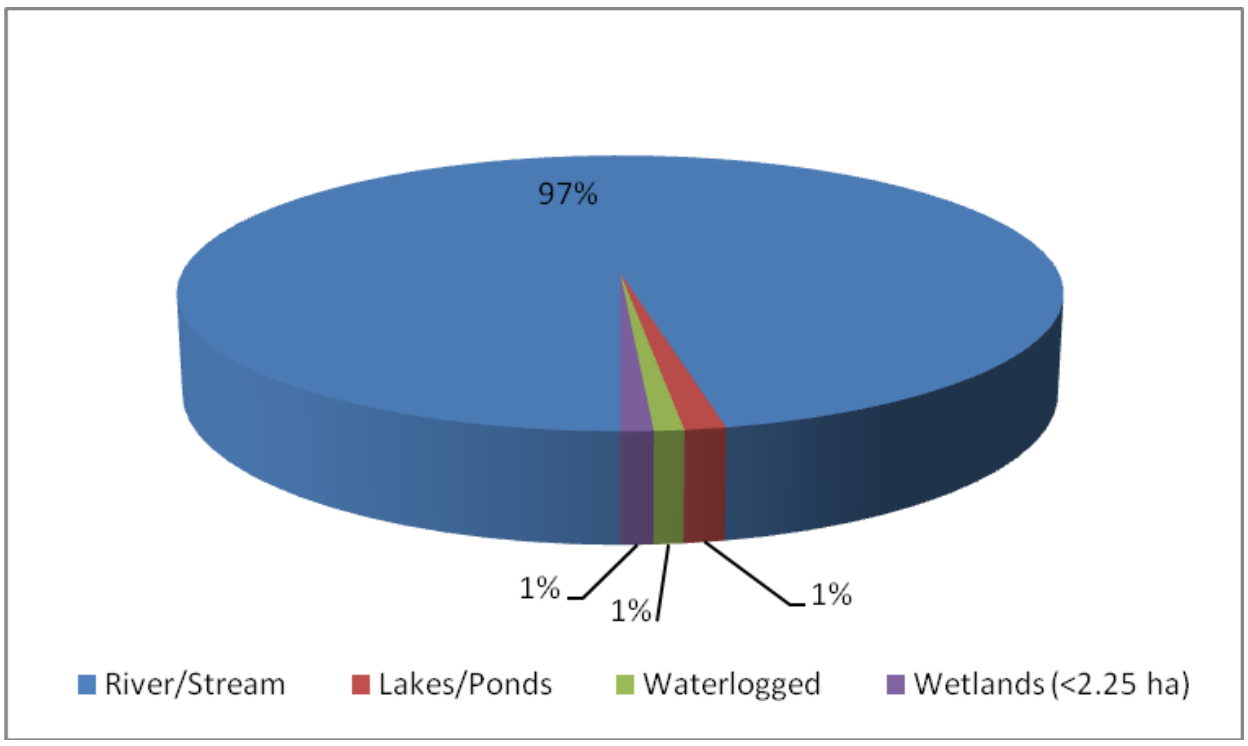


Figure 41: Type-wise wetland distribution in Mizoram

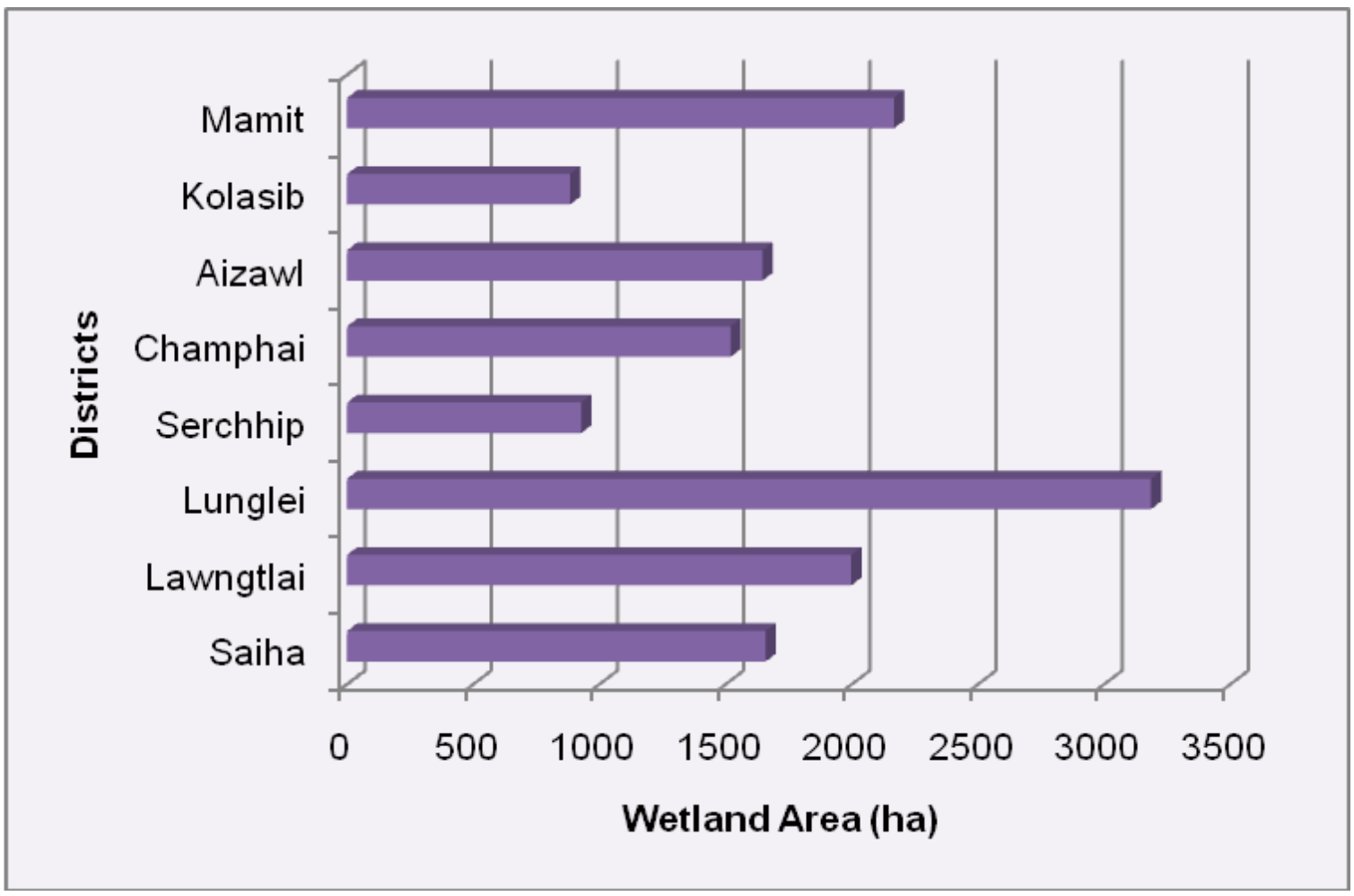


Figure 42: District-wise graphical distribution of wetlands in Mizoram

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

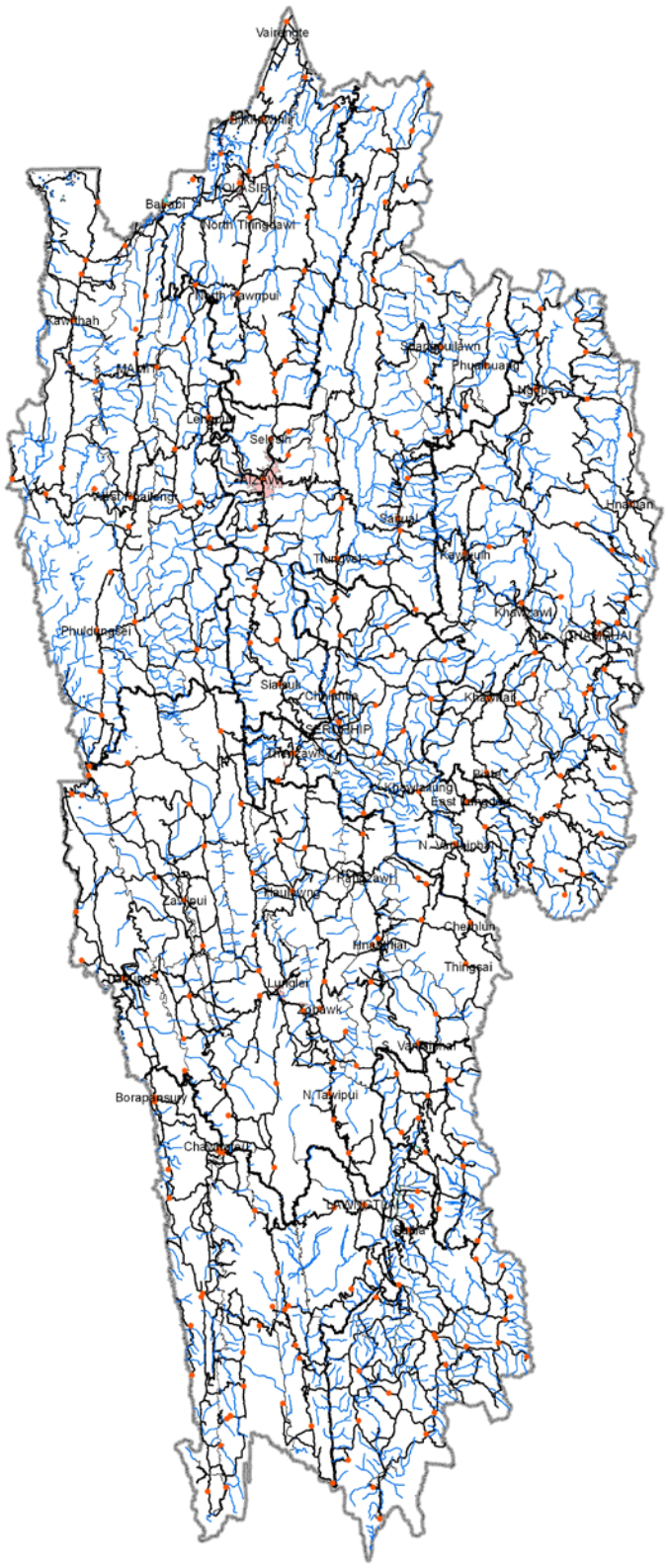
Table 52: District-wise area of wetlands (type-wise) in Mizoram

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

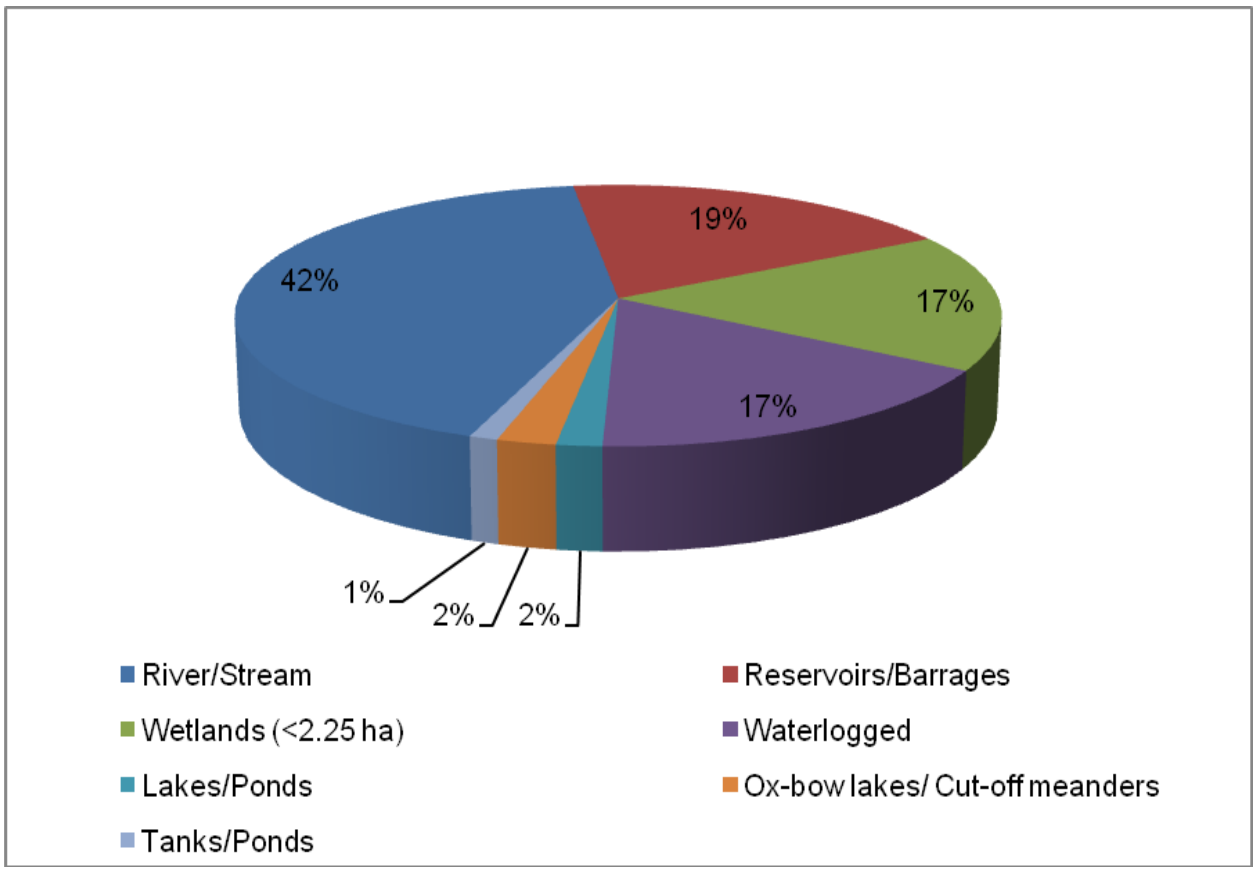


Figure 43: Type-wise wetland distribution in Tripura

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.

For details, refer National Wetland Atlas: North-Eastern States, SAC/EPSA/ABHG/NWIA/ATLAS/35/2011 Space Applications Centre (ISRO), Ahmedabad, India, 318p.

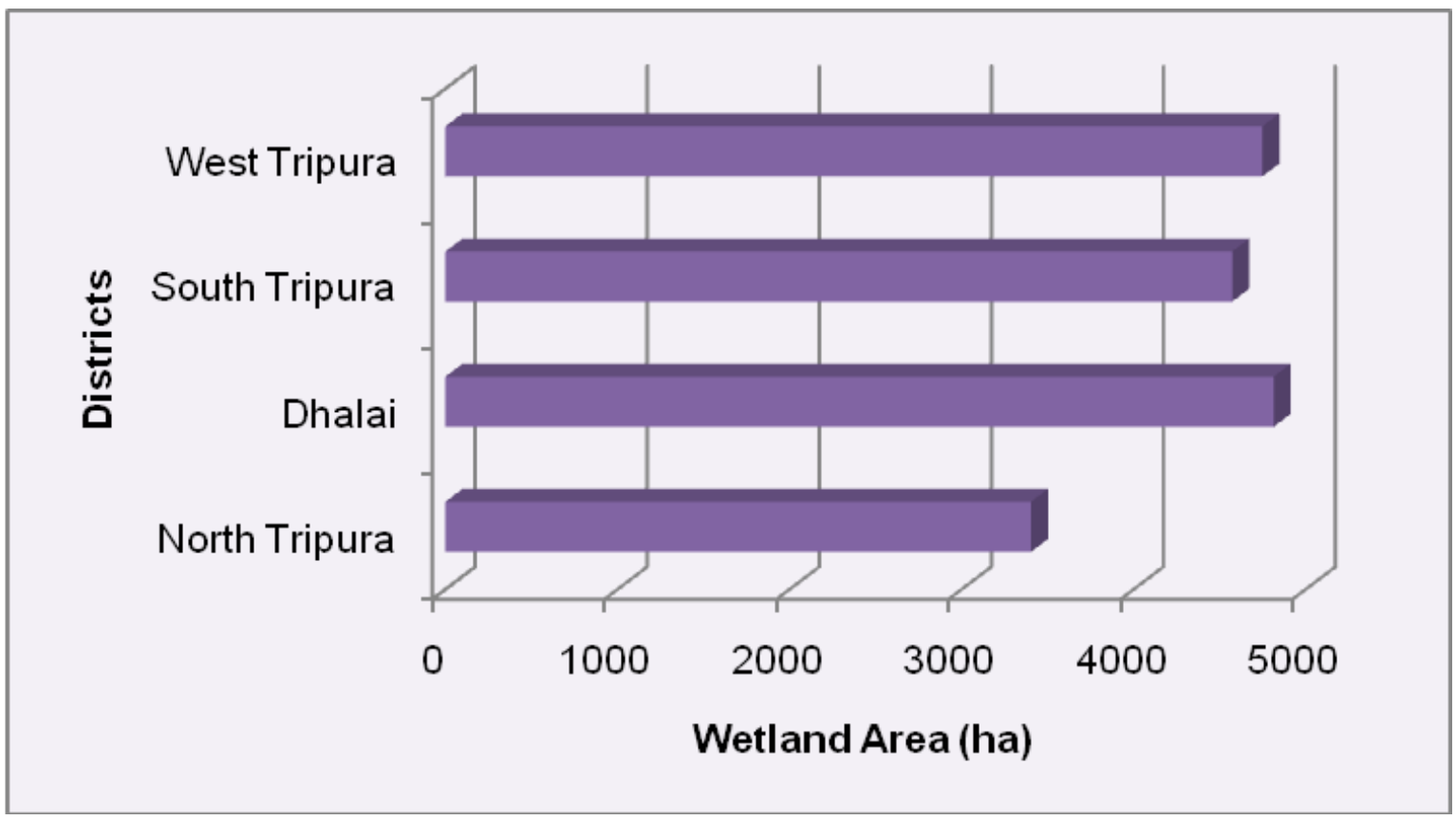


Figure 44: District-wise graphical distribution of wetlands Tripura

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

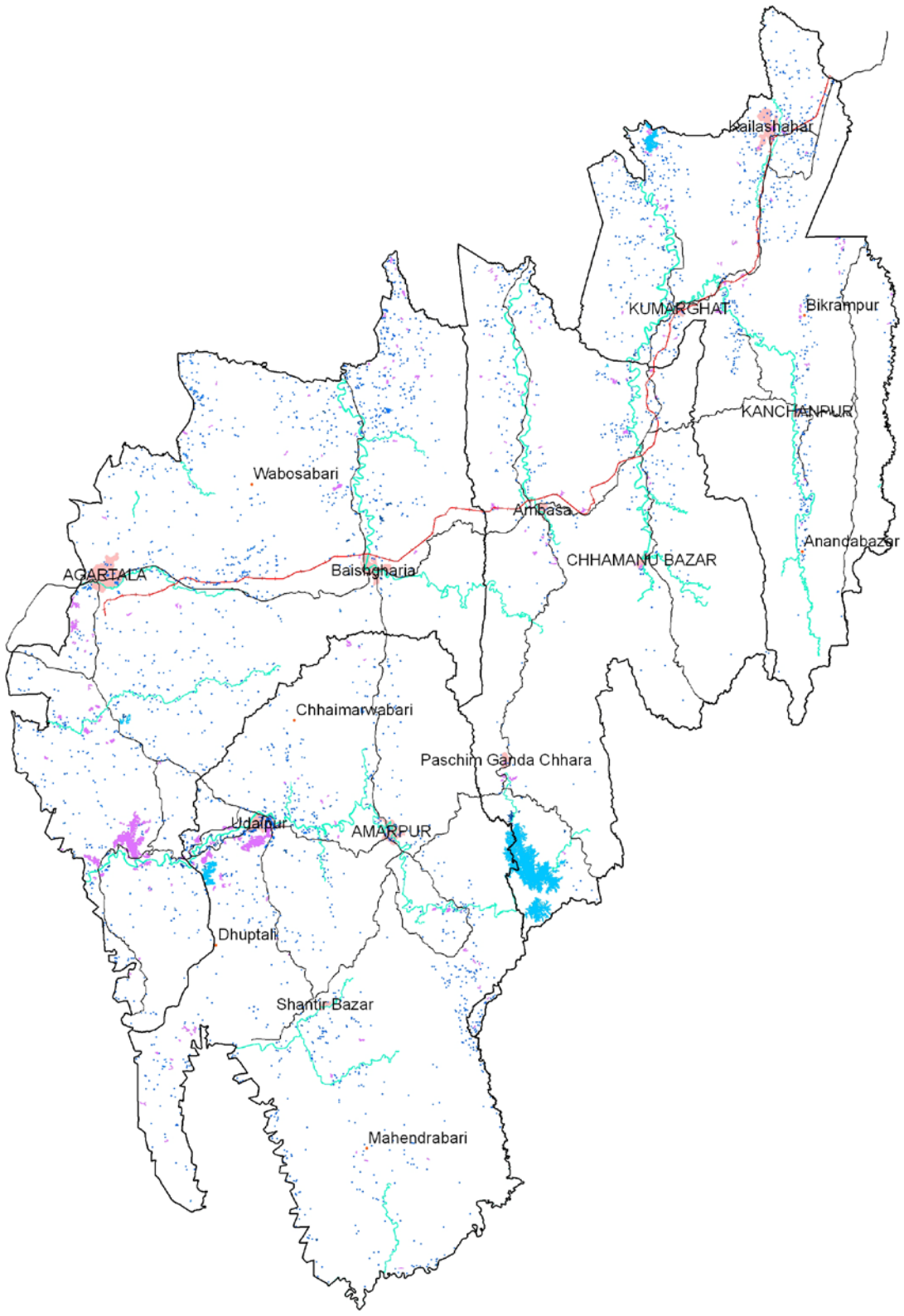
Table 55: District-wise area of wetlands (type-wise) in Tripura

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

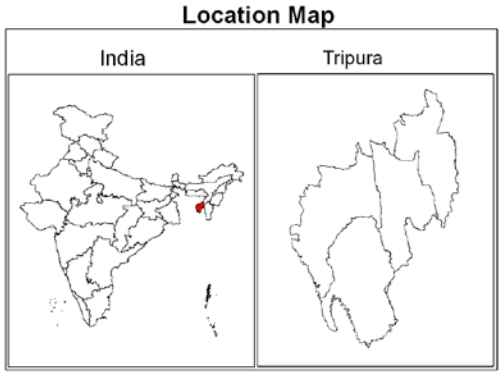


Symbol Typecode	Level I	Level II	Level III
	Inland Wetlands		
		Natural	
1101			Lakes/Ponds
1102			Ox-bow lakes/ Cut-off meanders
1103			High altitude wetlands
1104			Reverine wetlands
1105			Waterlogged
1106			River/Stream
		Man-made	
1201			Reservoirs/Barrages
1202			Tanks/Ponds
1203			Waterlogged
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.

For details, refer National Wetland Atlas: North-Eastern States, SAC/EPSA/ABHG/NWIA/ATLAS/35/2011 Space Applications Centre (ISRO), Ahmedabad, India, 318p.

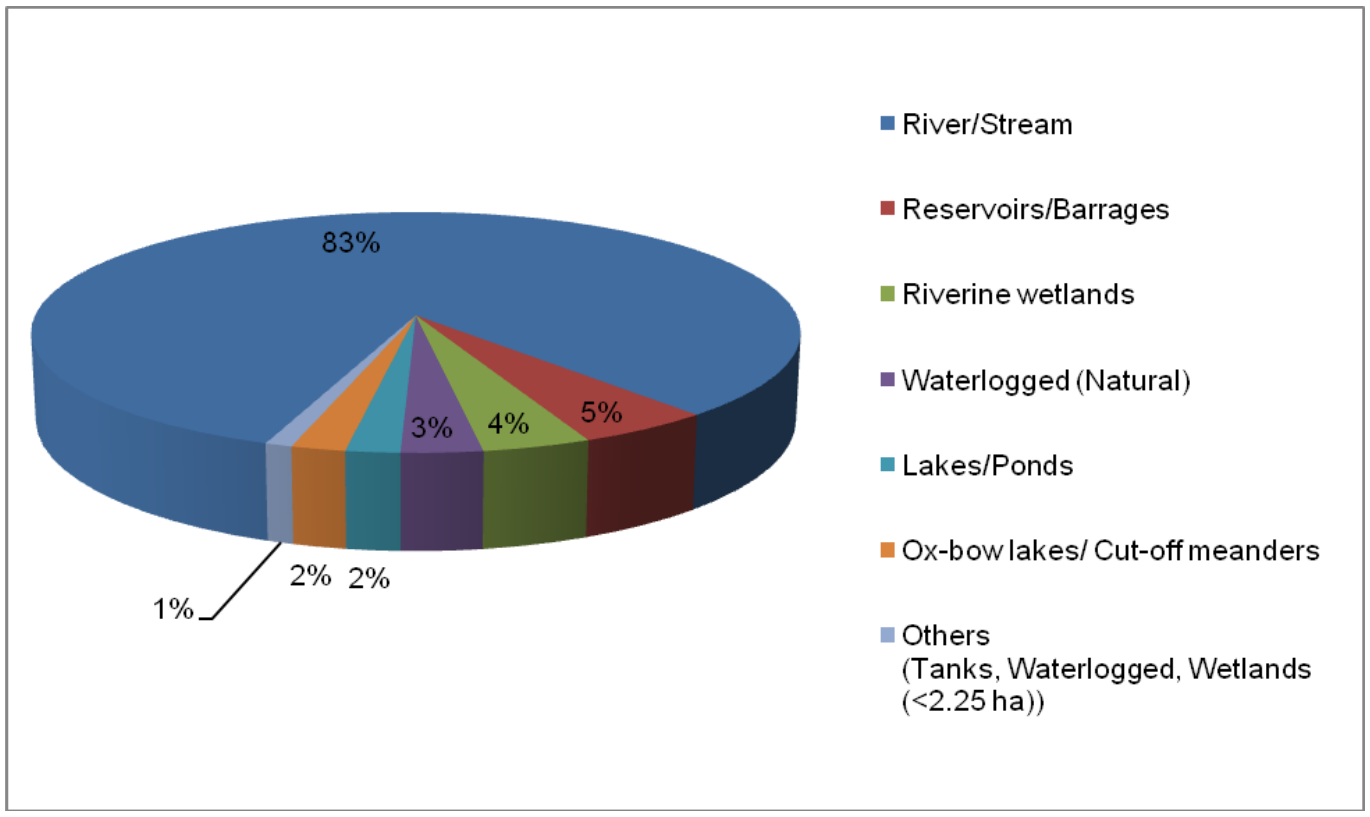


Figure 45: Type-wise wetland distribution in Meghalaya

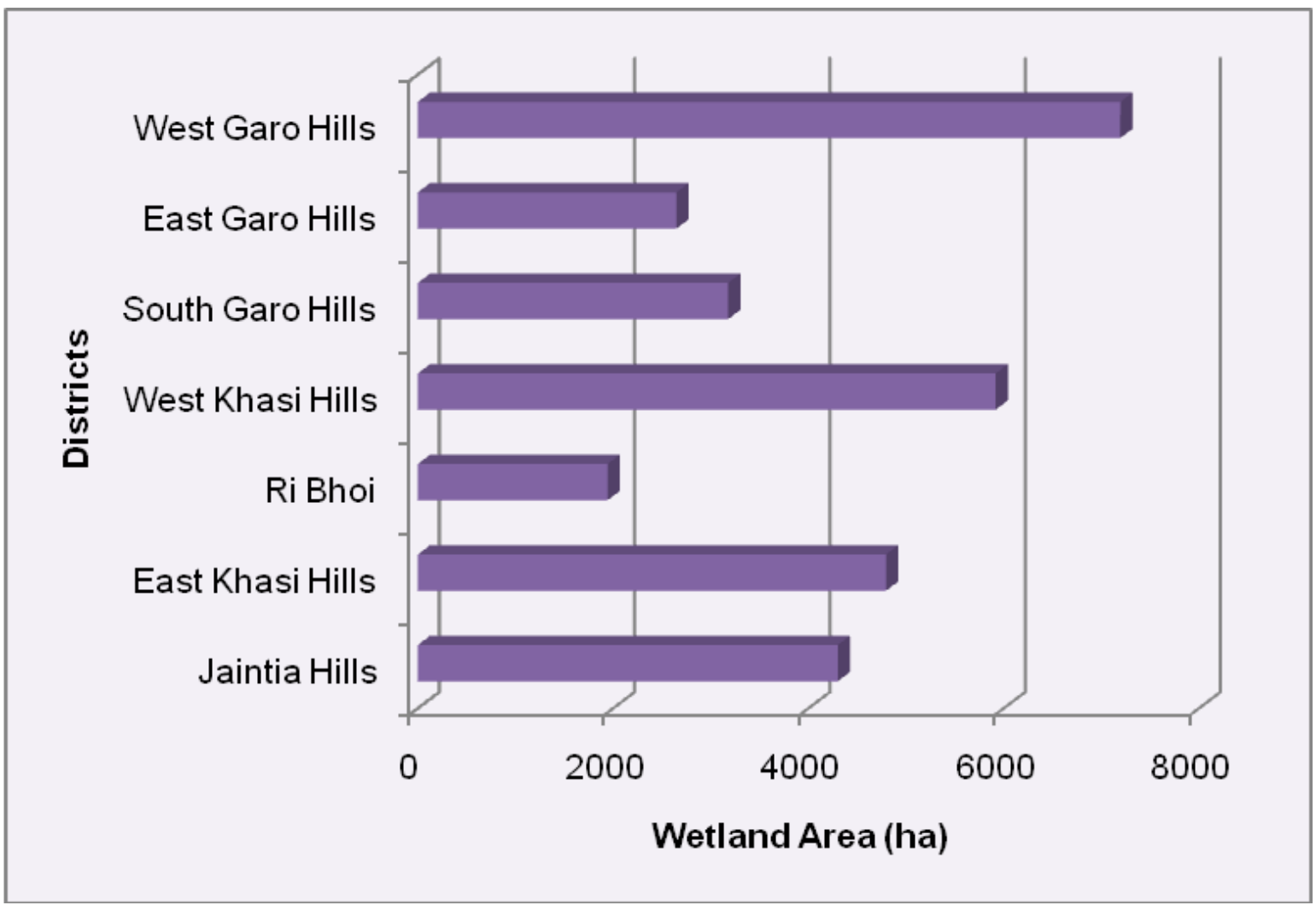


Figure 46: District-wise graphical distribution of wetlands in Meghalaya

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

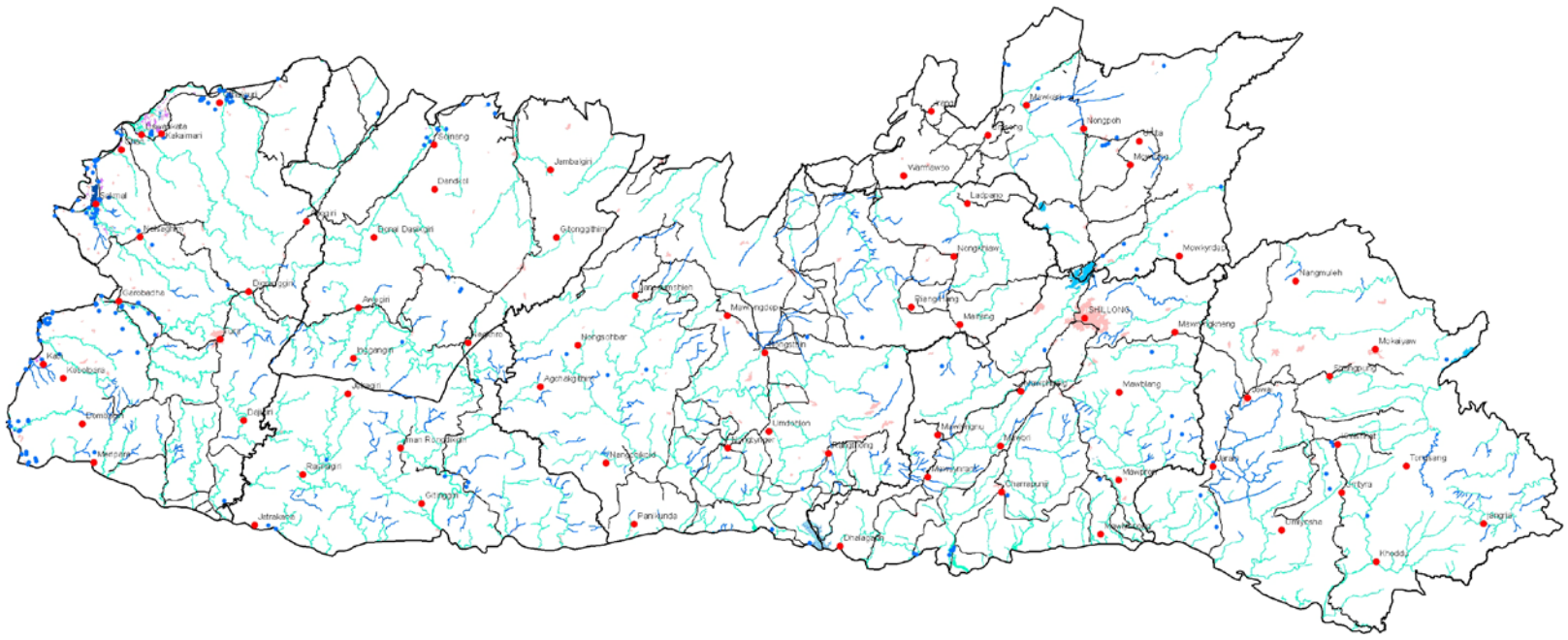
Table 58: District-wise area of wetlands (type-wise) in Meghalaya

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

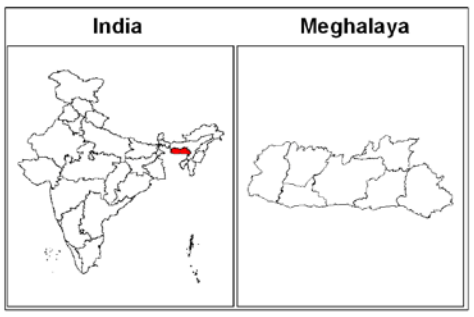


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverine wetland
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	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.

For details, refer National Wetland Atlas: North-Eastern States, SAC/EPSA/ABHG/NWIA/ATLAS/35/2011 Space Applications Centre (ISRO), Ahmedabad, India, 318p.

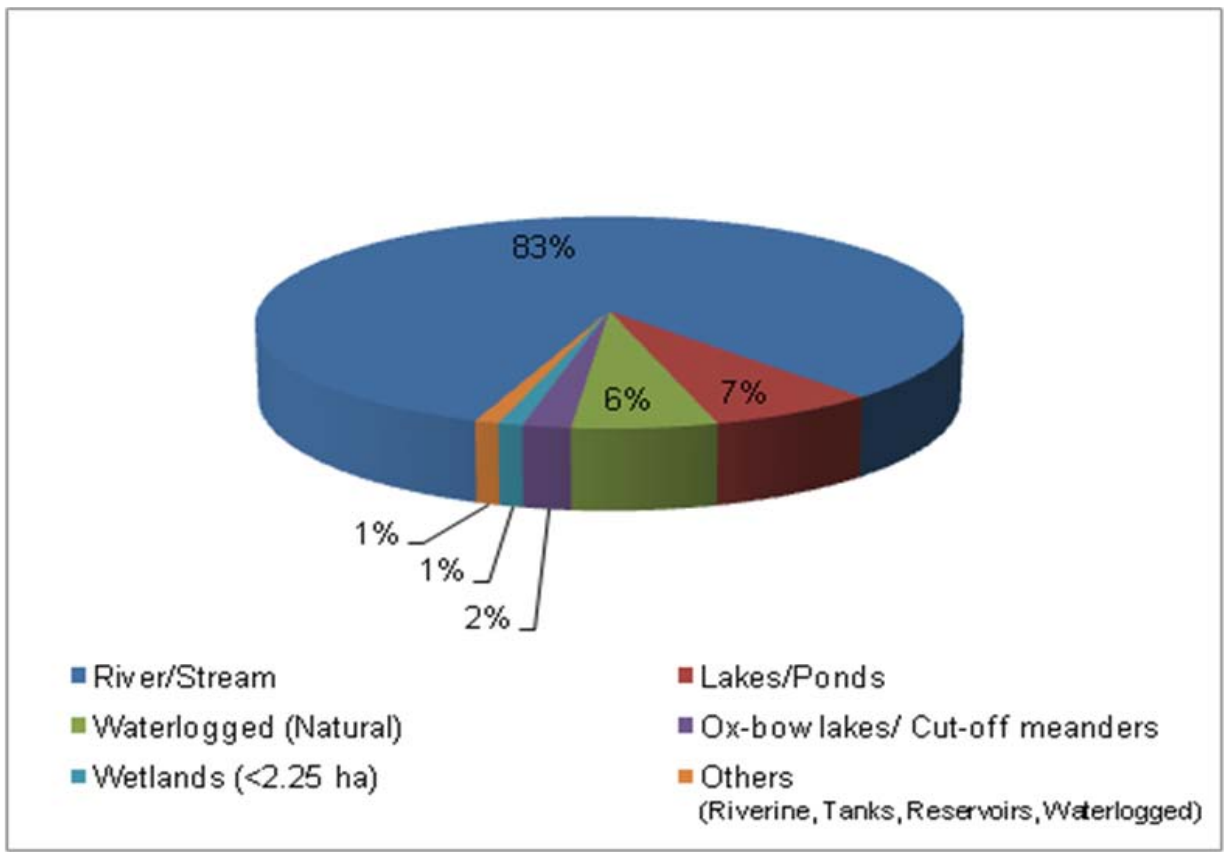


Figure 47: Type-wise wetland distribution in Assam

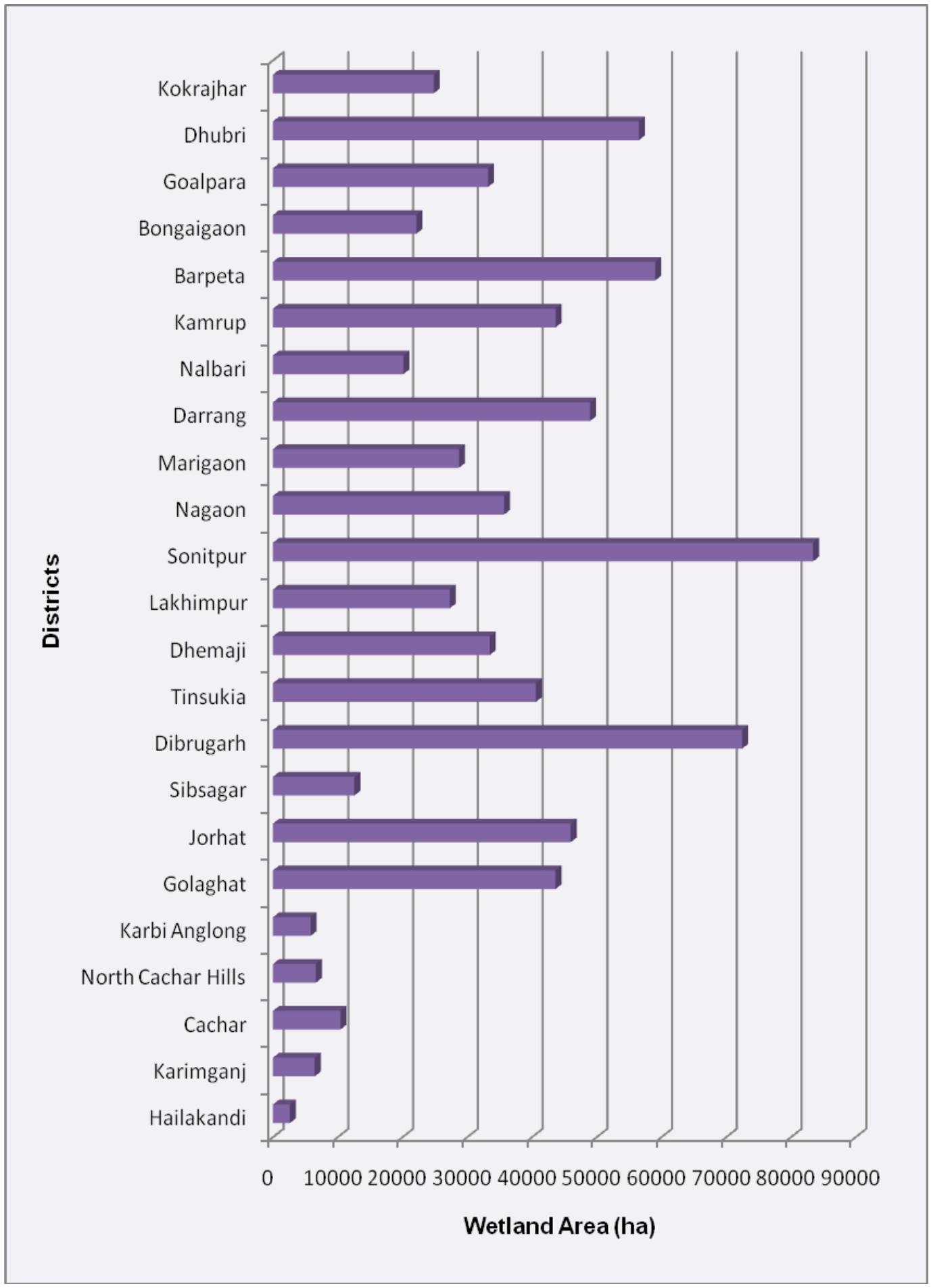


Figure 48: District-wise graphical distribution of wetlands

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

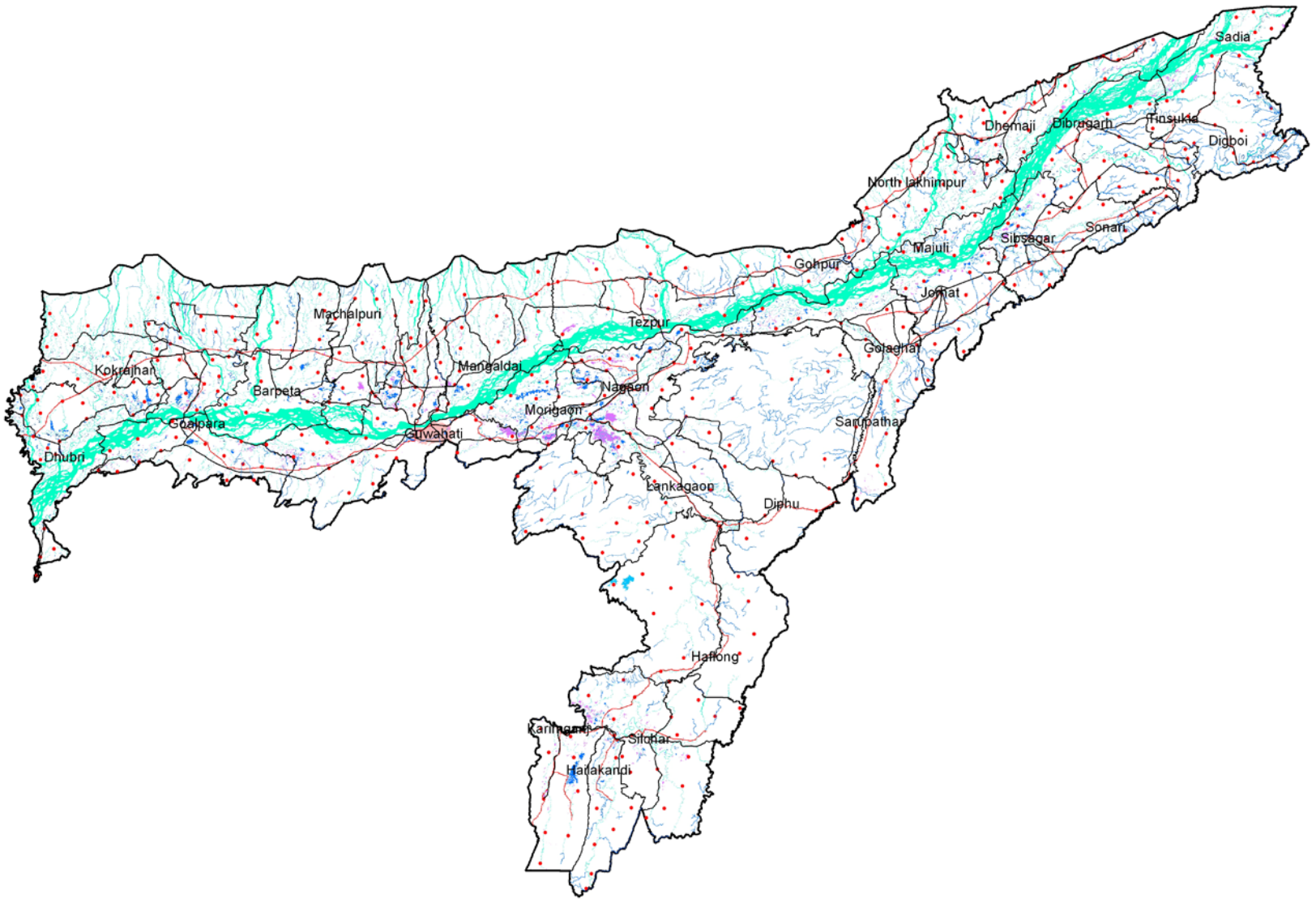
Table 61: District-wise area of wetlands (type-wise) in Assam

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

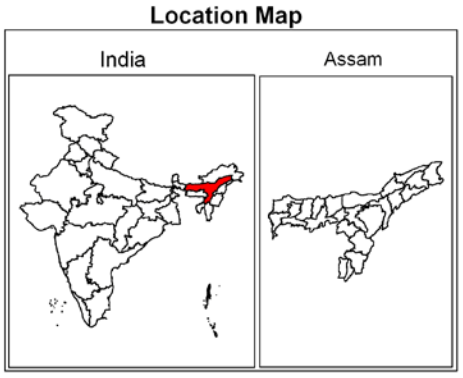


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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

Sponsored By:
Ministry of Environment and Forests
Government of India

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	-	-
	2200	**Coastal Wetlands - Man-made**					
14	2201	Salt pan	14	4866	0.44	4865	4865
15	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.

For details, refer National Wetland Atlas: West Bengal, SAC/RESA/AFEG/NWIA/ATLAS/09/2010, Space Applications Centre (ISRO), Ahmedabad, India, 150p.

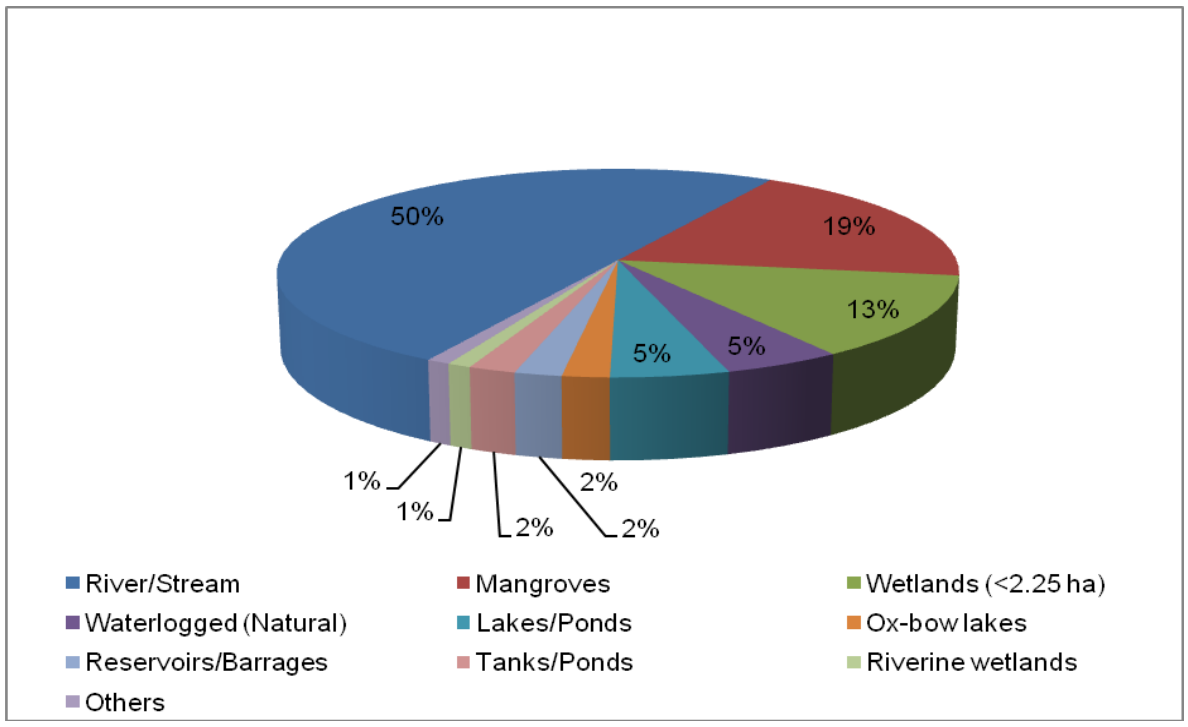


Figure 49: Type-wise wetland distribution in West Bengal

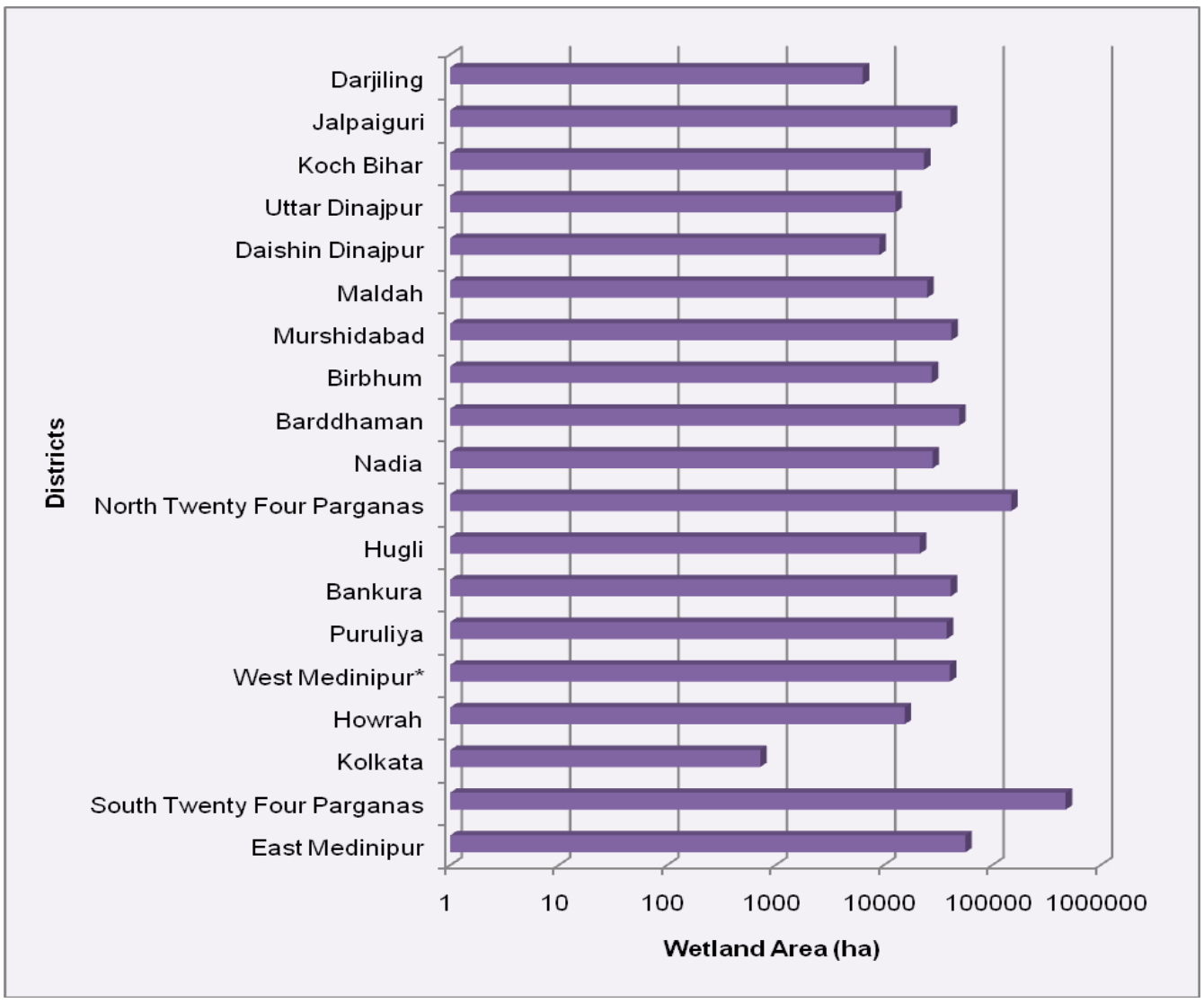


Figure 50: District-wise graphical distribution of wetlands West Bengal

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

[#] Area of East Medinipur is included in West Medinipur

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

[#] Area of East Medinipur is included in West Medinipur

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

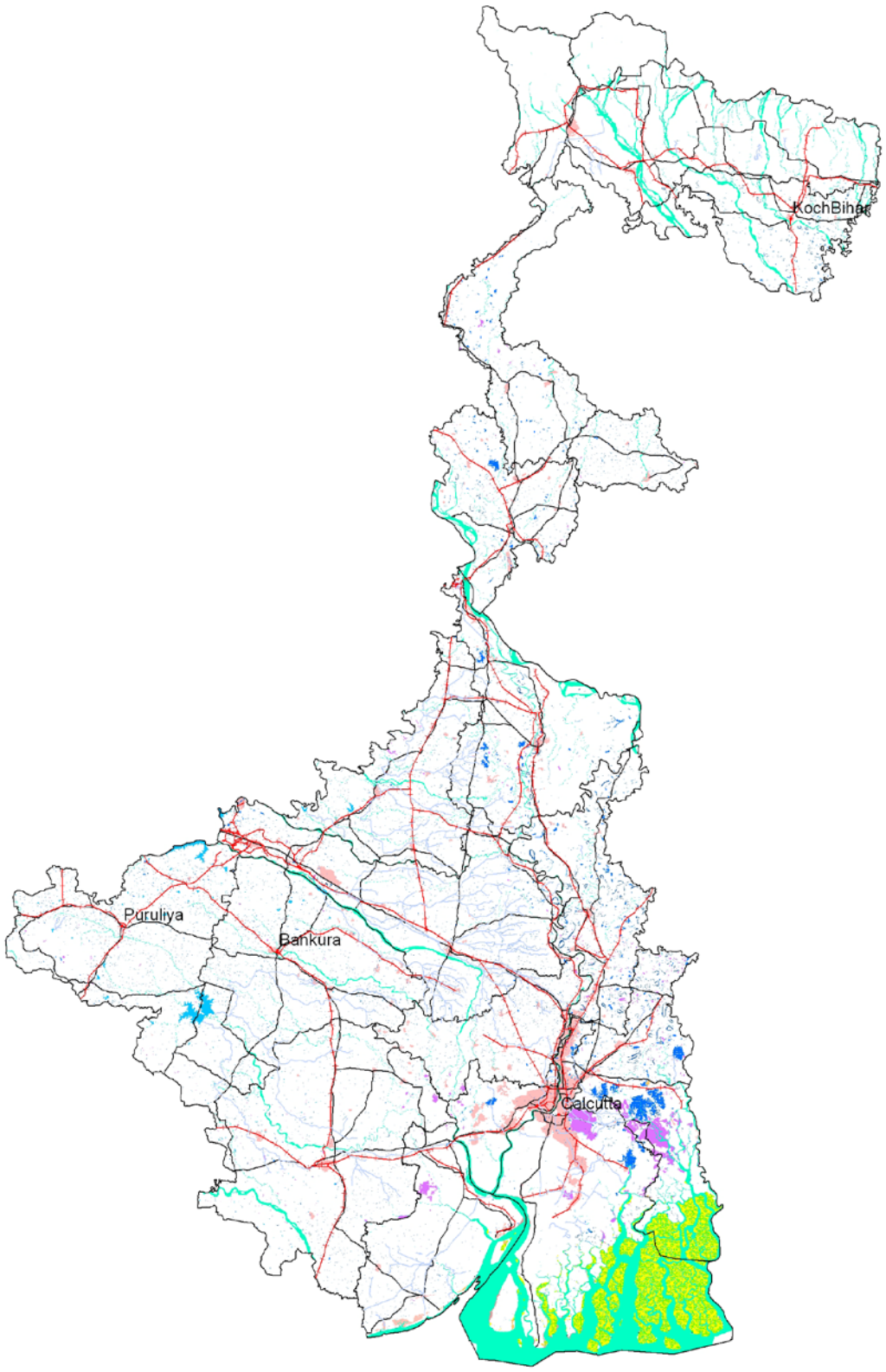
1201 Reservoir/Barrage
1202 Tank/Pond
1203 Waterlogged (Man-made)
1204 Salt pan (Inland)

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	1104	Riverine wetland	42	1629	0.96	781	552
4	1105	Waterlogged	58	231	0.14	231	16
5	1106	River/Stream	344	97743	57.48	97743	63442
	1200	**Inland Wetlands -Man-made**					
6	1201	Reservoir/Barrage	1062	48177	28.33	47386	34476
7	1202	Tank/Pond	910	5688	3.34	5266	4241
8	1203	Waterlogged	11	61	0.04	50	35
9	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.

For details, refer National Wetland Atlas: Jharkhand, SAC/RESA/AFEG/NWIA/ATLAS/11/2010, Space Applications Centre, ISRO, Ahmedabad, India, 152p.

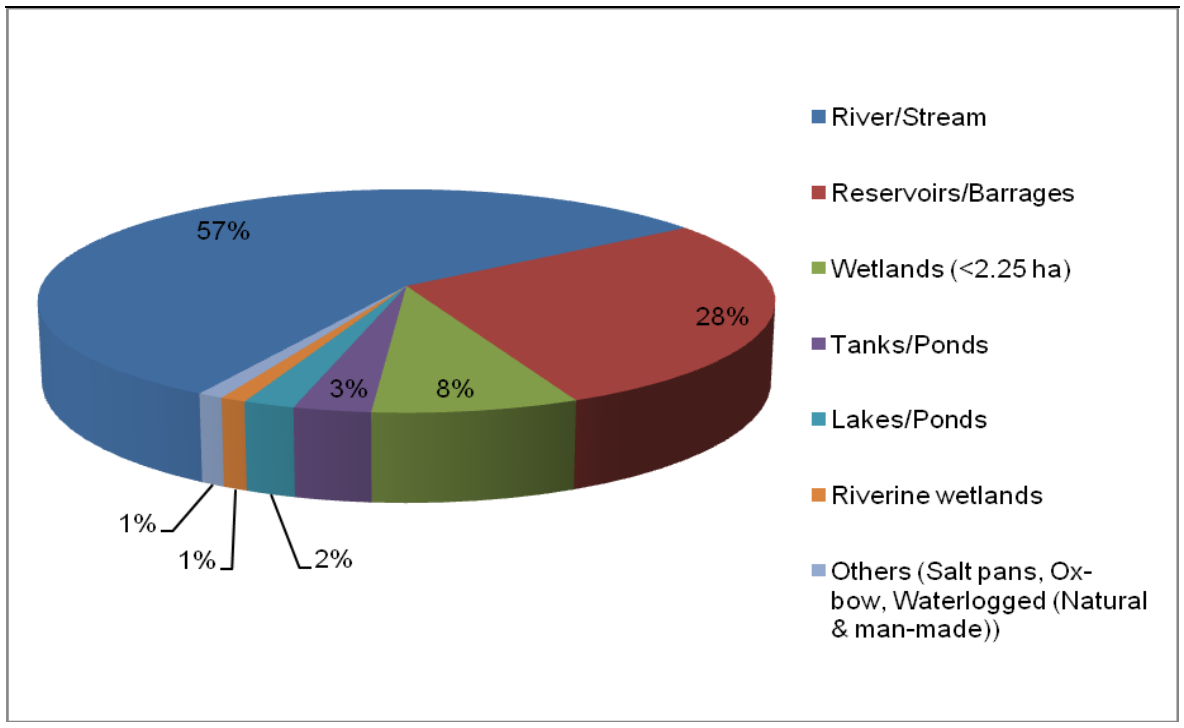


Figure 51: Type-wise wetland distribution in Jharkhand

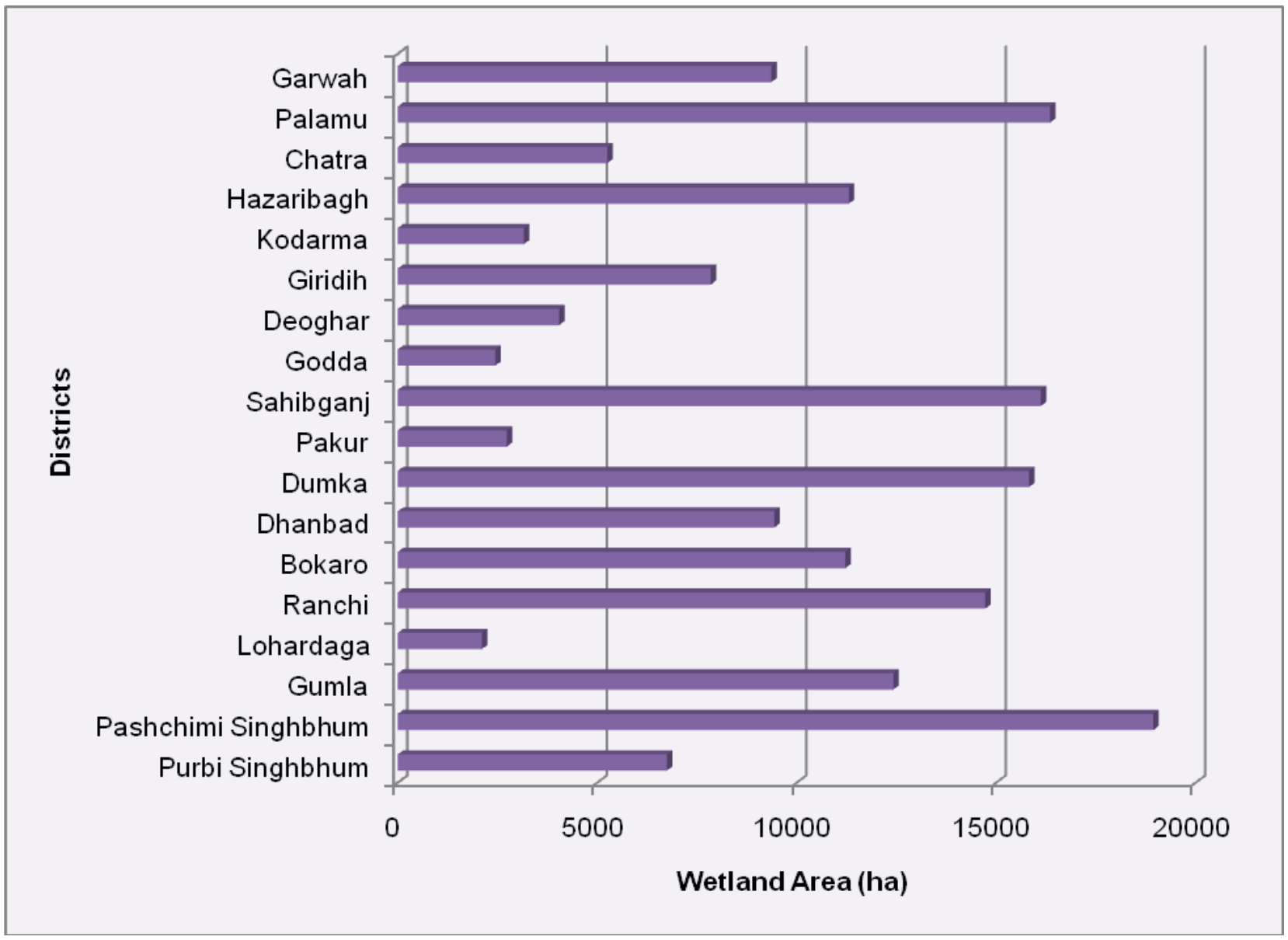


Figure 52: District-wise graphical distribution of wetlands Jharkhand

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

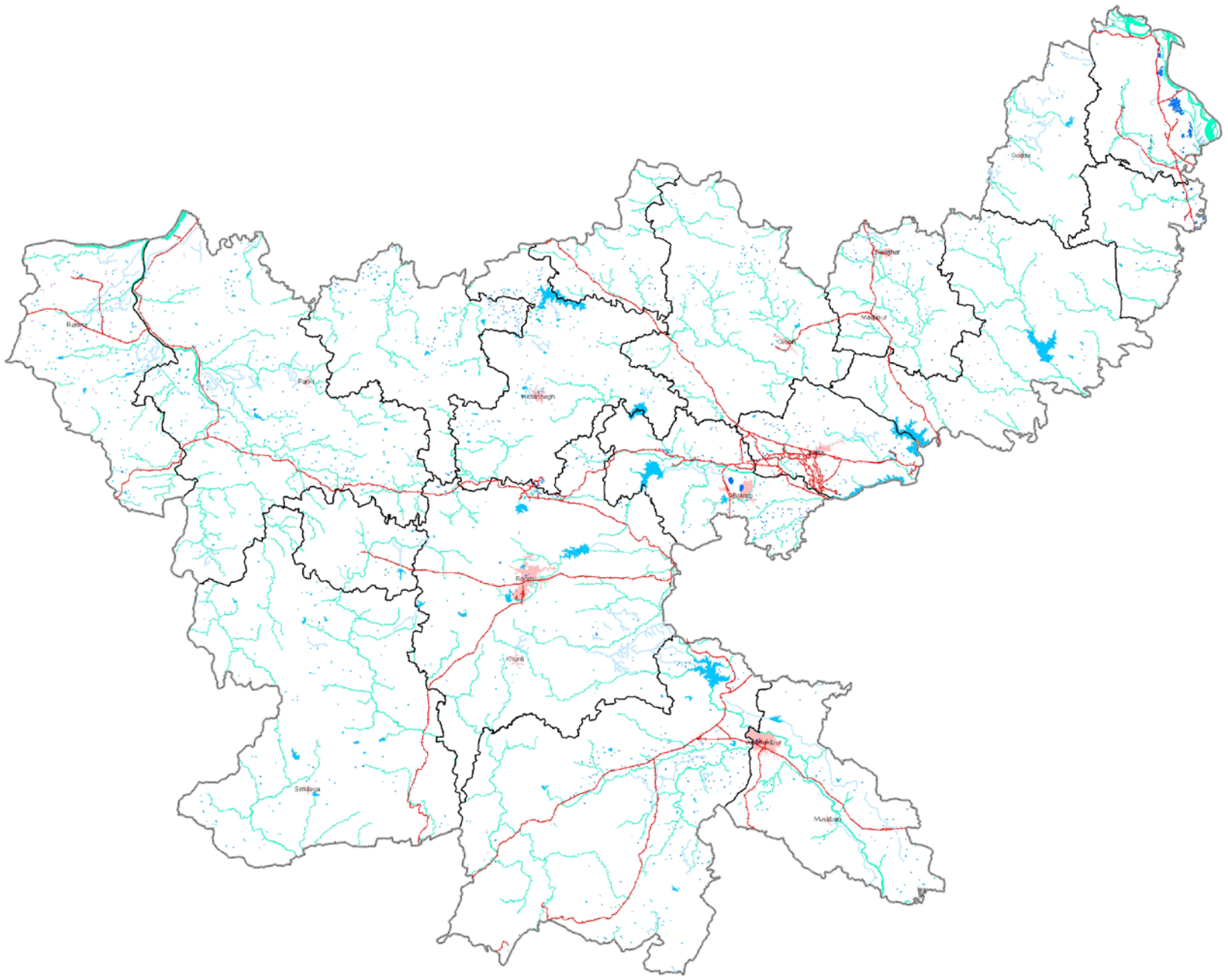
Table 67: District-wise area of wetlands (type-wise) in Jharkhand

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

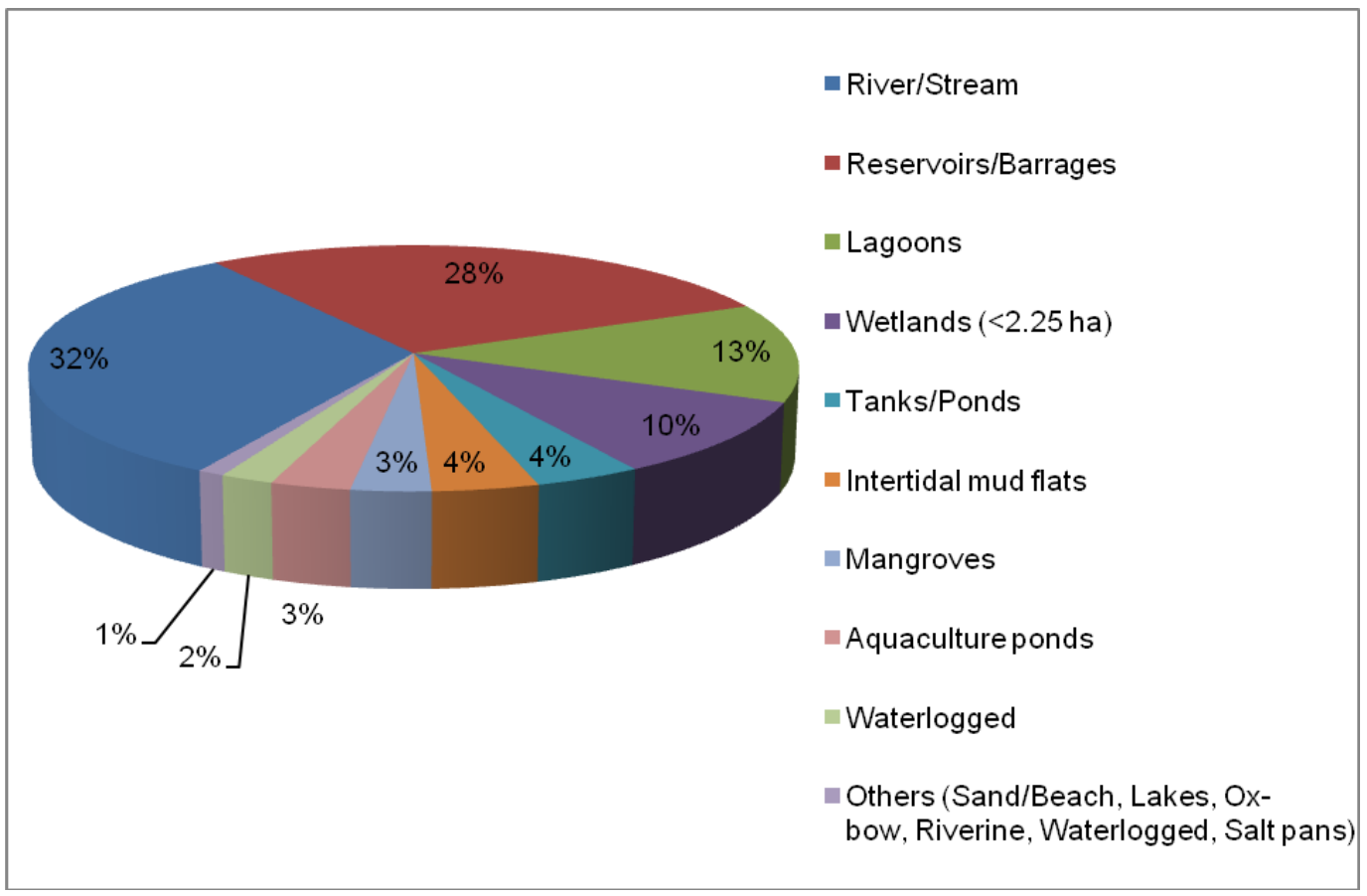


Figure 53: Type-wise wetland distribution in Orissa

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.

For details, refer National Wetland Atlas: Orissa, SAC/RESA/AFEG/NWIA/ATLAS/28/2010, Space Applications Centre (ISRO), Ahmedabad, India, 204p.

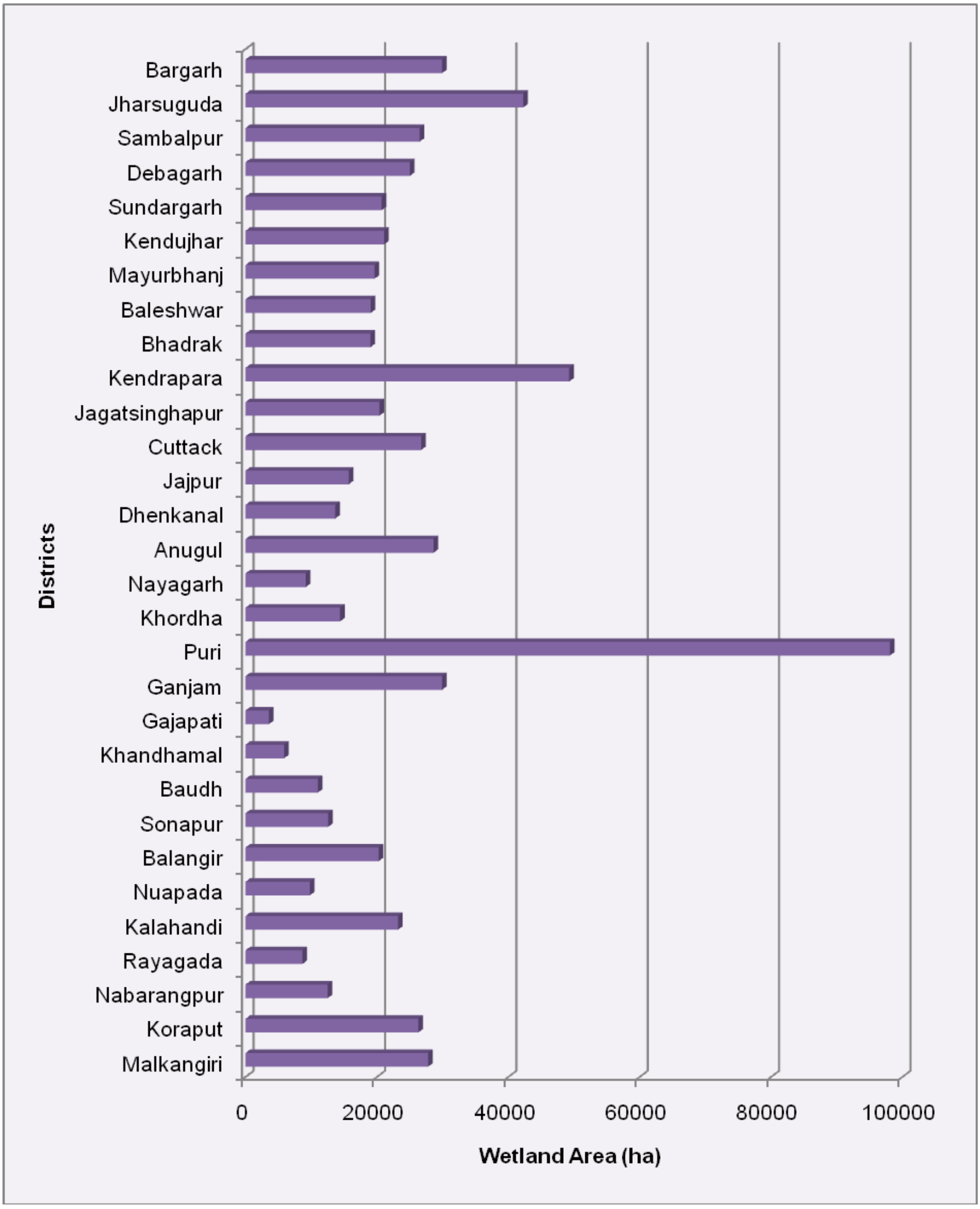


Figure 54: District-wise graphical distribution of wetlands in Orissa

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

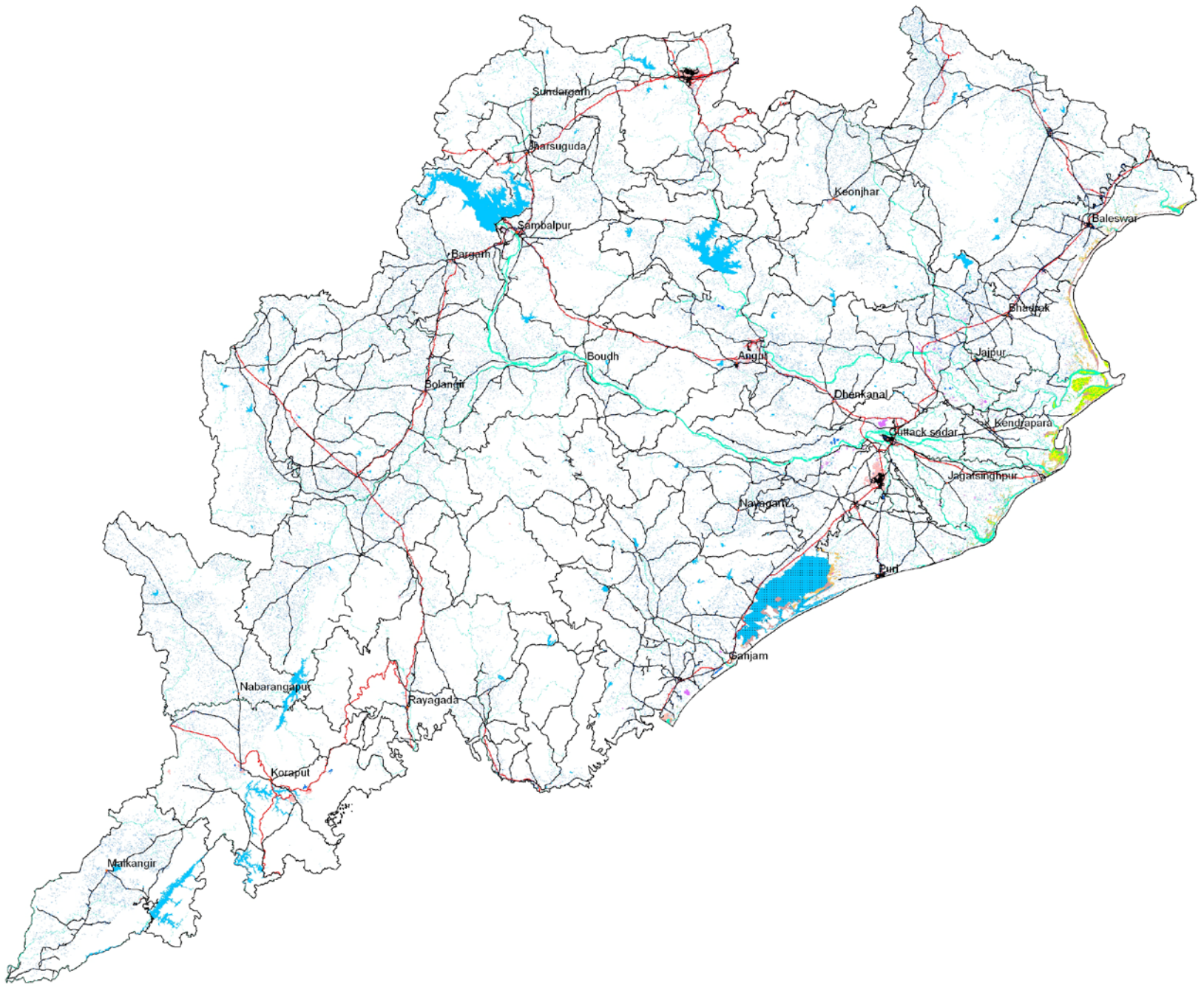
1201 Reservoir/Barrage
1202 Tank/Pond
1203 Waterlogged (Man-made)
1204 Salt pan (Inland)

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

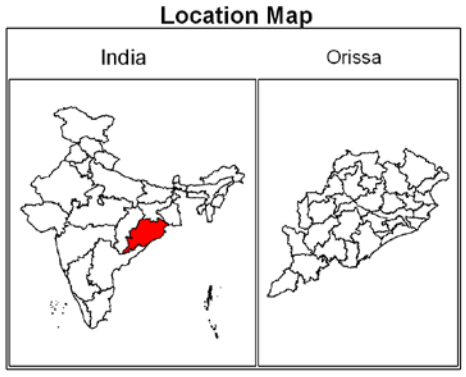


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

For details, refer National Wetland Atlas: Chhattisgarh, SAC/EPSA/AFEG/NWIA/ATLAS/32/2010, Space Applications Centre (ISRO), Ahmedabad, India, 138p.

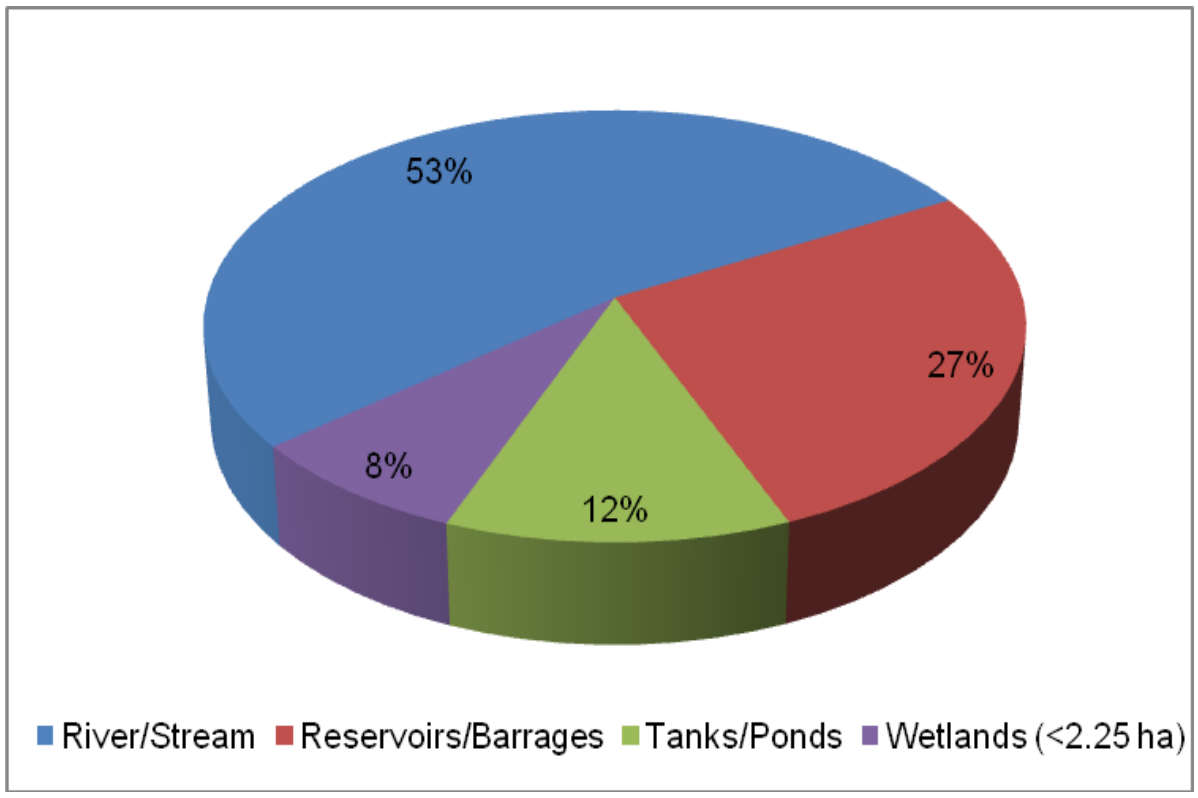


Figure 55: Type-wise wetland distribution in Chhattisgarh

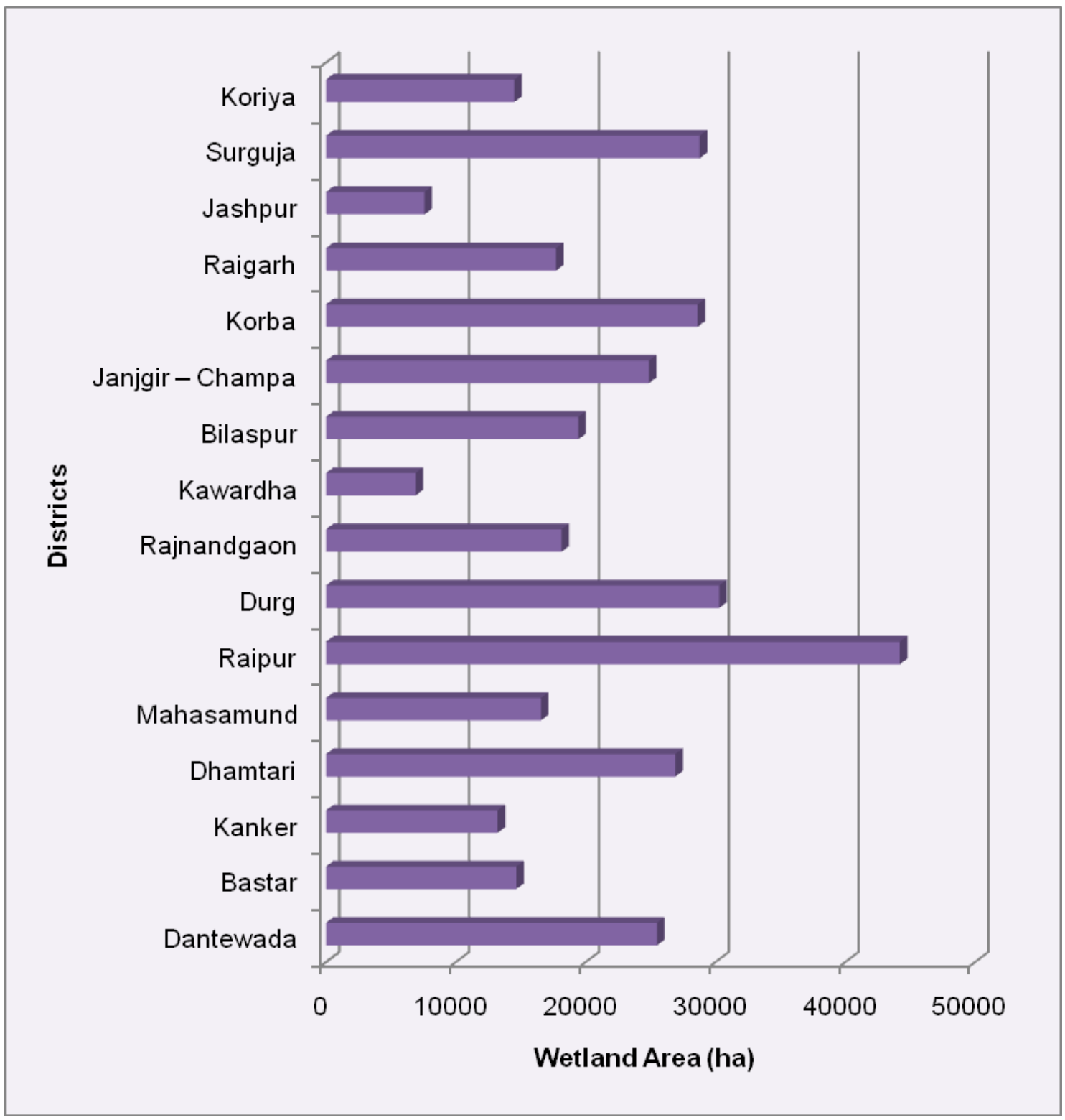


Figure 56: District-wise graphical distribution of wetlands in Chhattisgarh

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

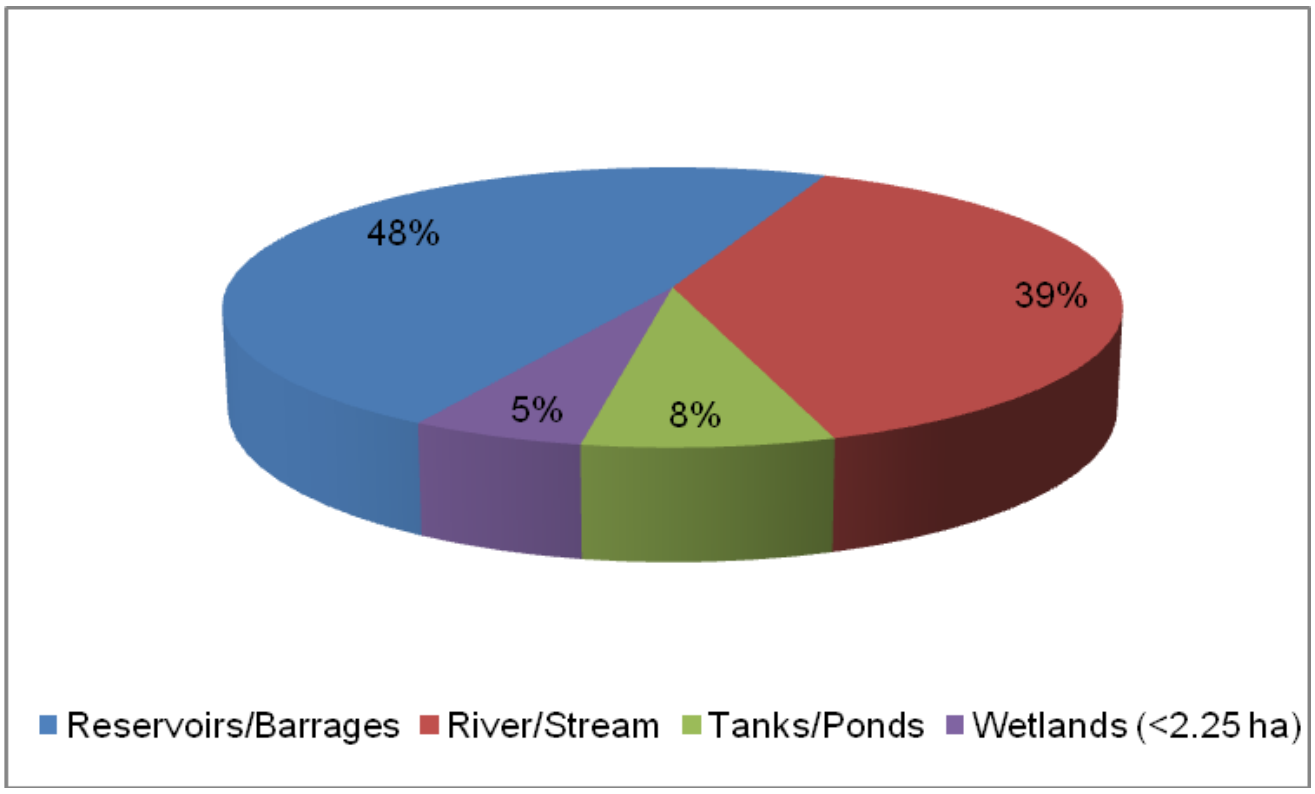


Figure 57: Type-wise wetland distribution in Madhya Pradesh

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.

For details, refer National Wetland Atlas: Madhya Pradesh, SAC/EPSA/ABHG/NWIA/ATLAS/26/2010, Space Applications Centre (ISRO), Ahmedabad, India, 284p.

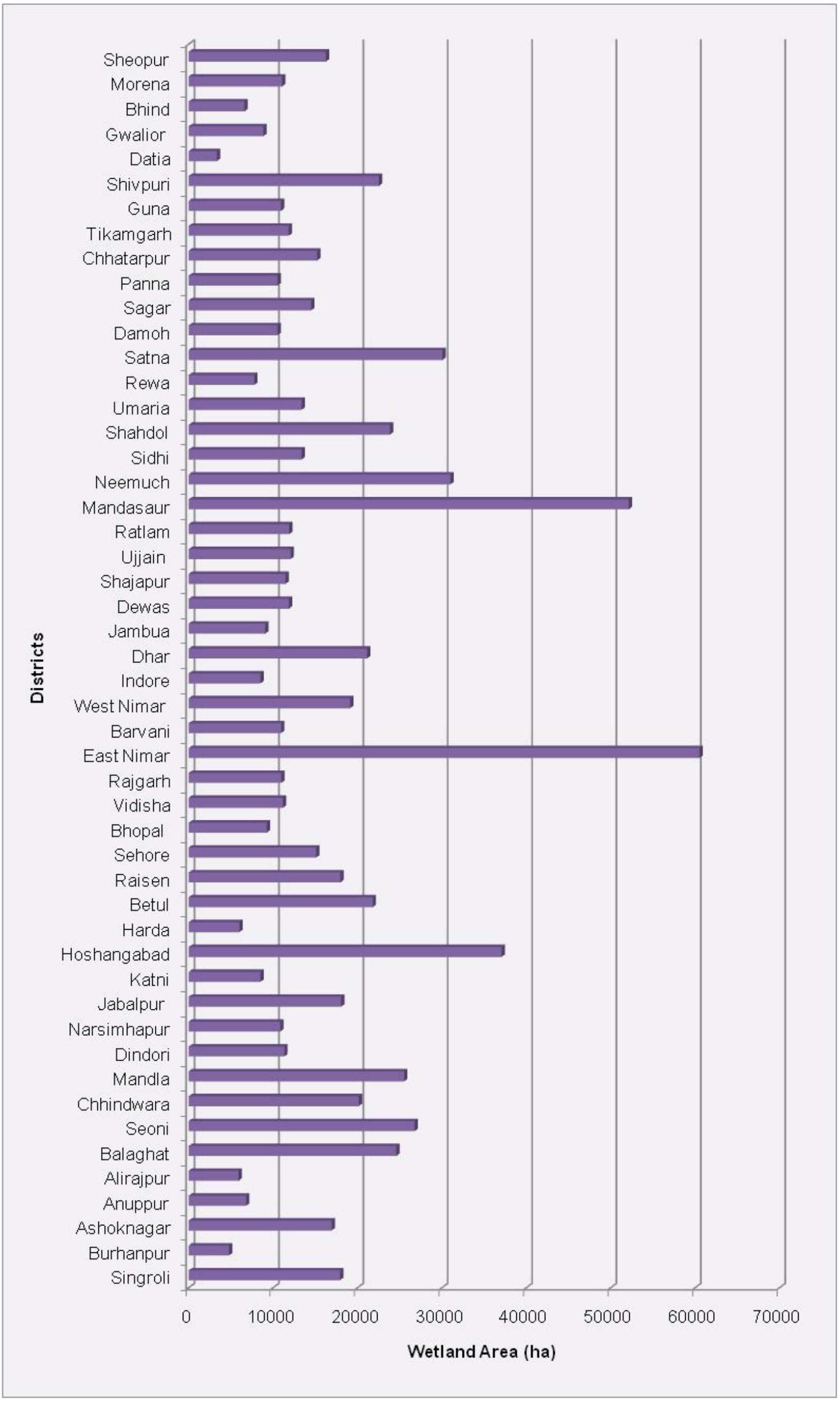


Figure 58: District-wise graphical distribution of wetlands in Madhya Pradesh

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

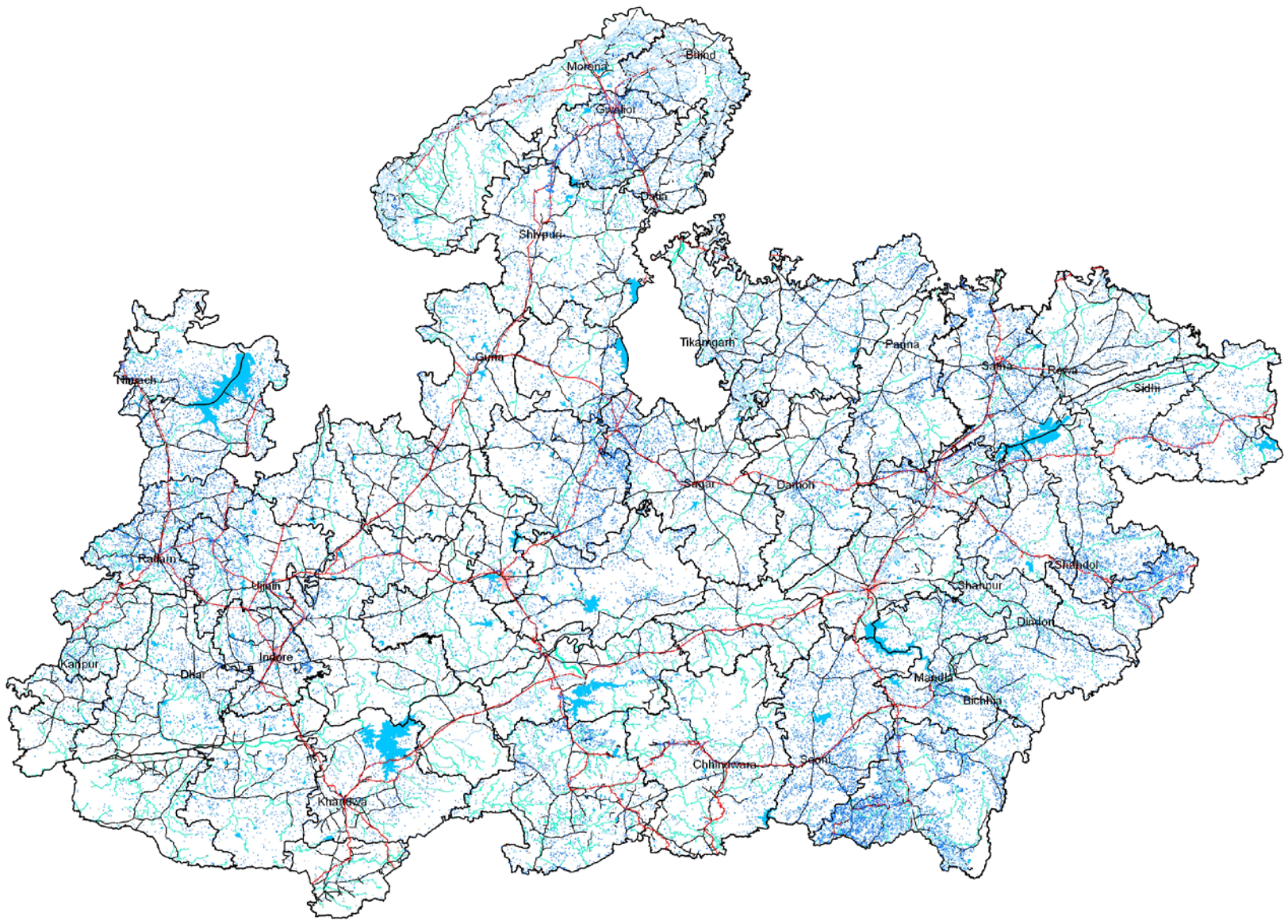
Cont...

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

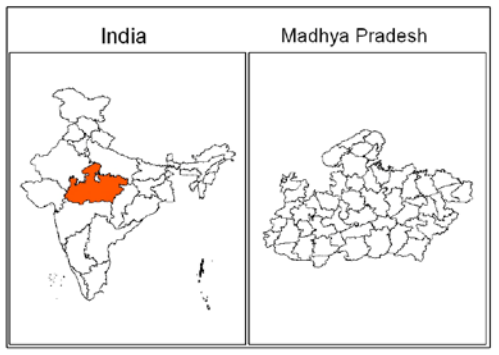


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

For details, refer National Wetland Atlas: Gujarat, SAC/RESA/AFEG/NWIA/ATLAS/21/2010 Space Applications Centre (ISRO), Ahmedabad, India, 198p.

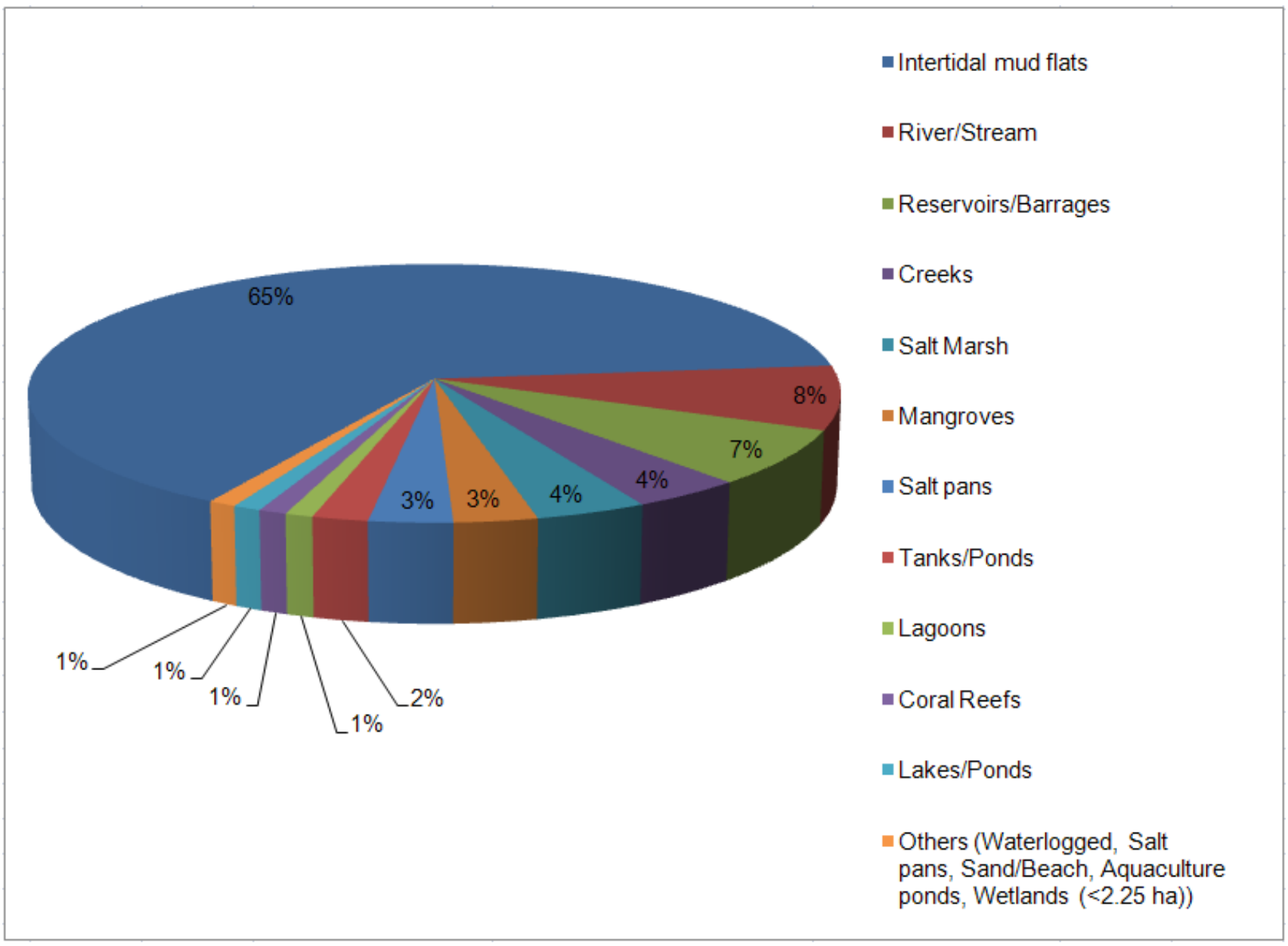


Figure 59: Type-wise wetland distribution in Gujarat

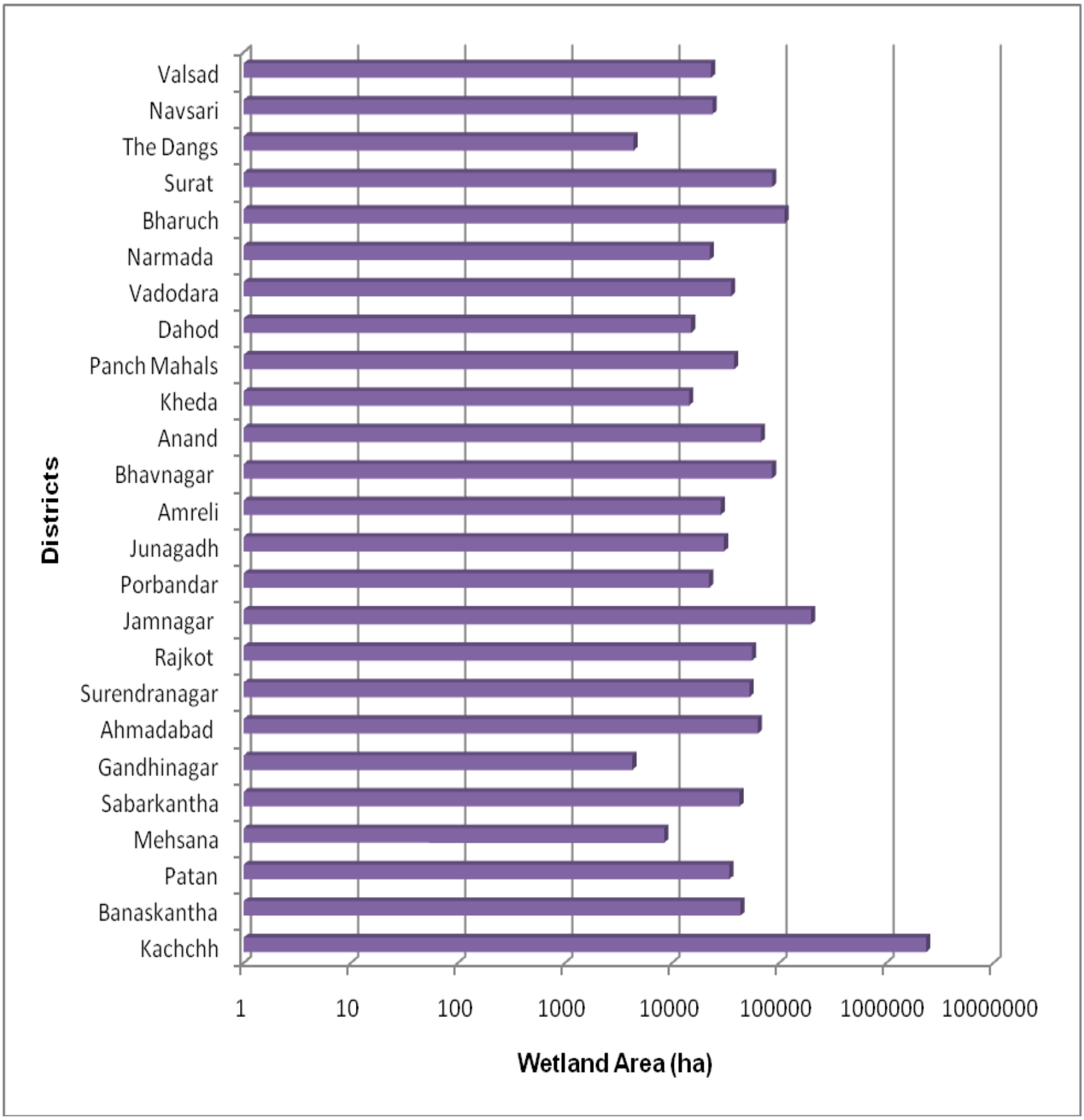


Figure 60: District-wise graphical distribution of wetlands in Gujarat

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

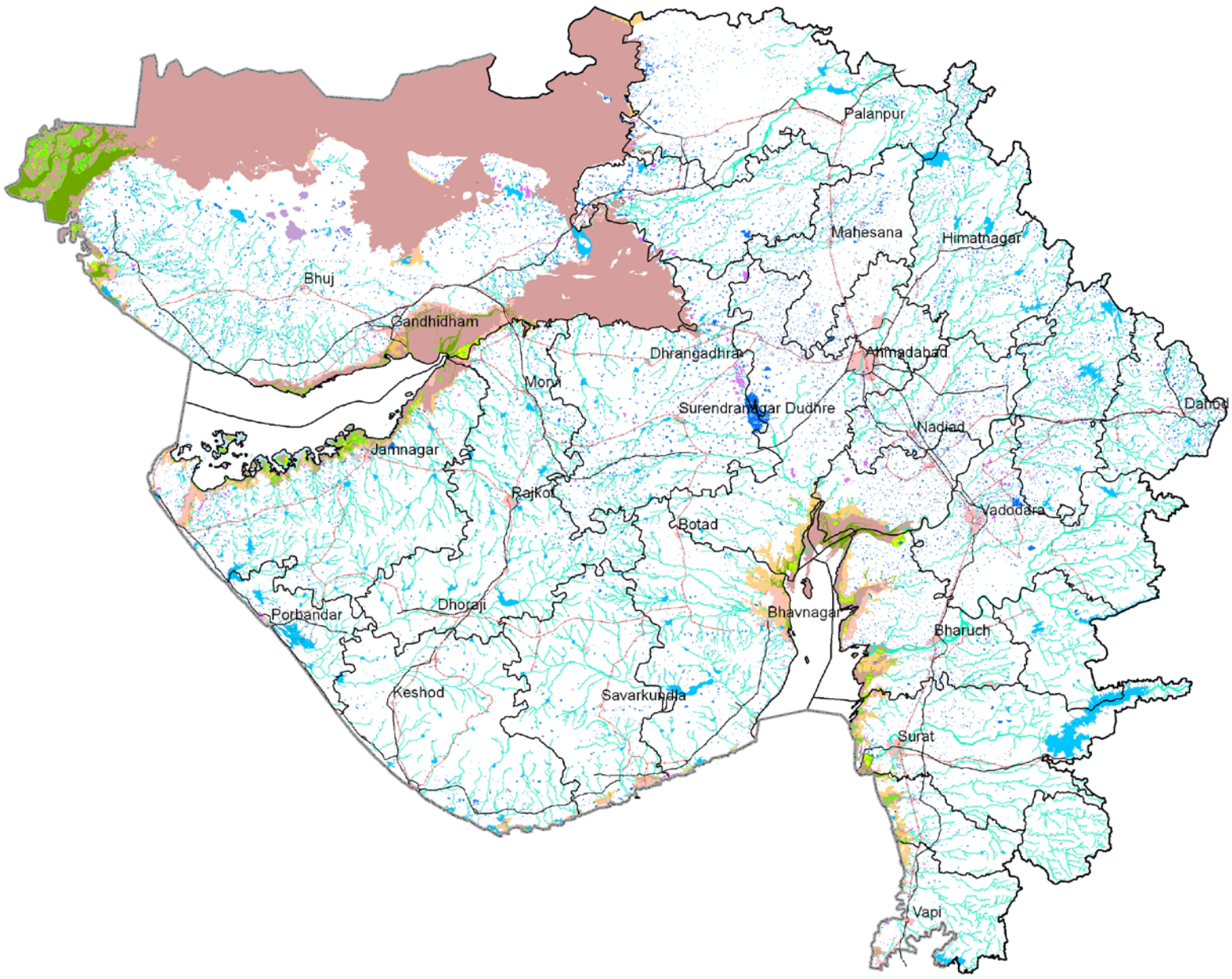
1201 Reservoir/Barrage
1202 Tank/Pond
1203 Waterlogged (Man-made)
1204 Salt pan (Inland)

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

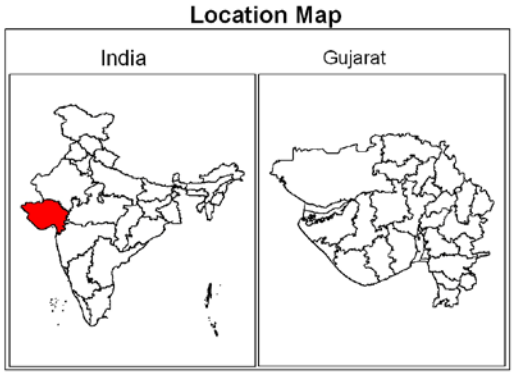


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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



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.

For details, refer National Wetland Atlas: Union Territories, SAC/EPSA/AFEG/NWIA/ATLAS/29/2010 Space Applications Centre (ISRO), Ahmedabad, India, 112p.

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

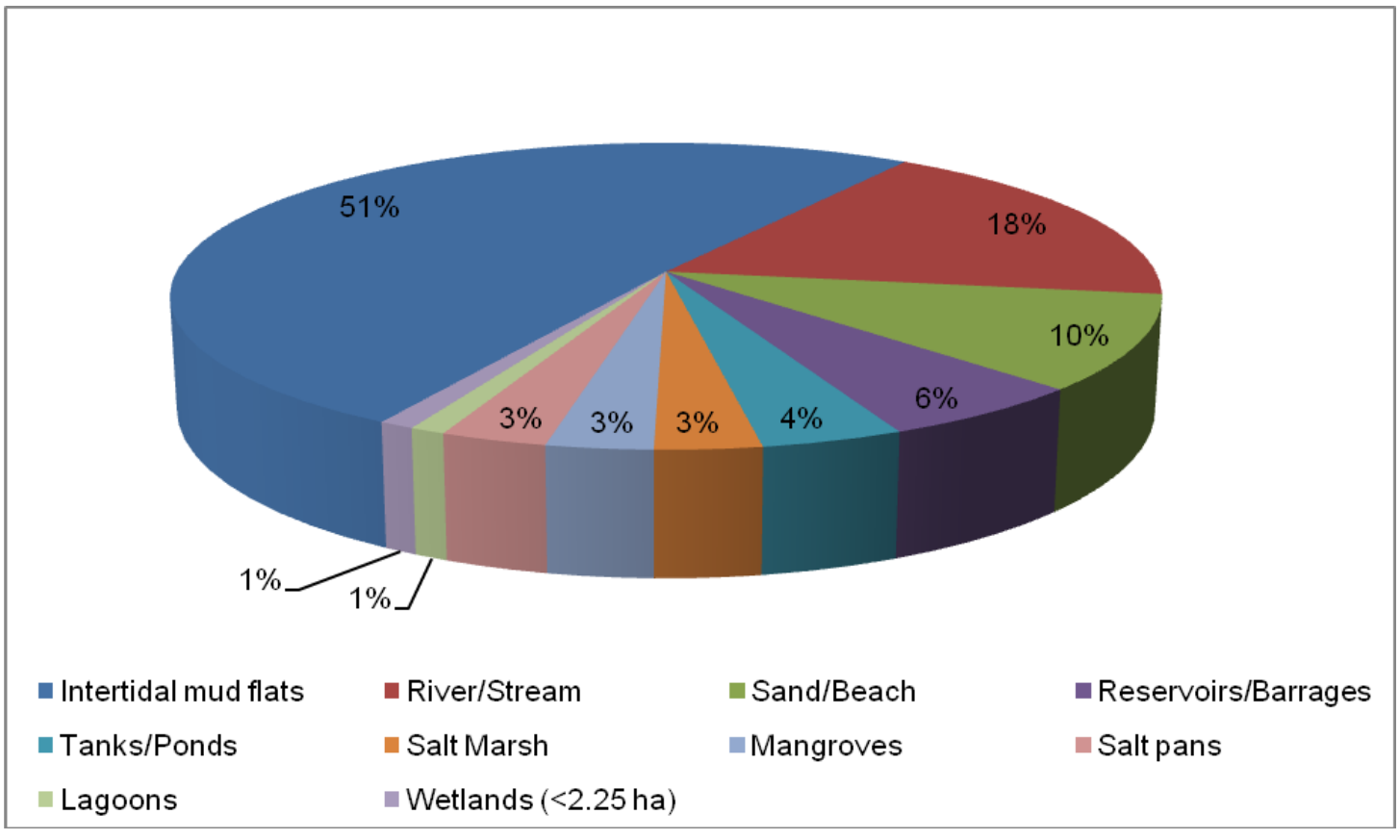


Figure 61: Type-wise wetland distribution in Daman & Diu

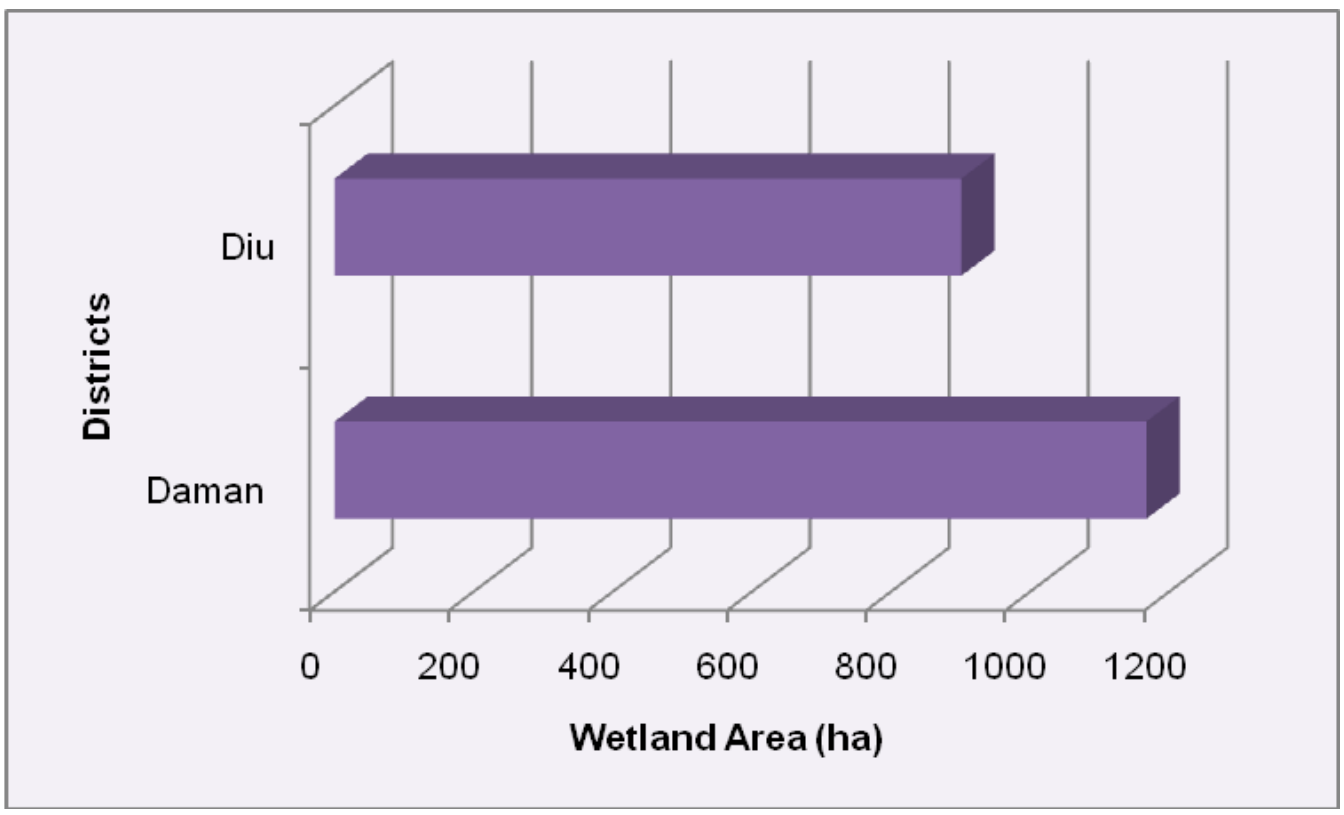


Figure 62: District-wise graphical distribution of wetlands

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

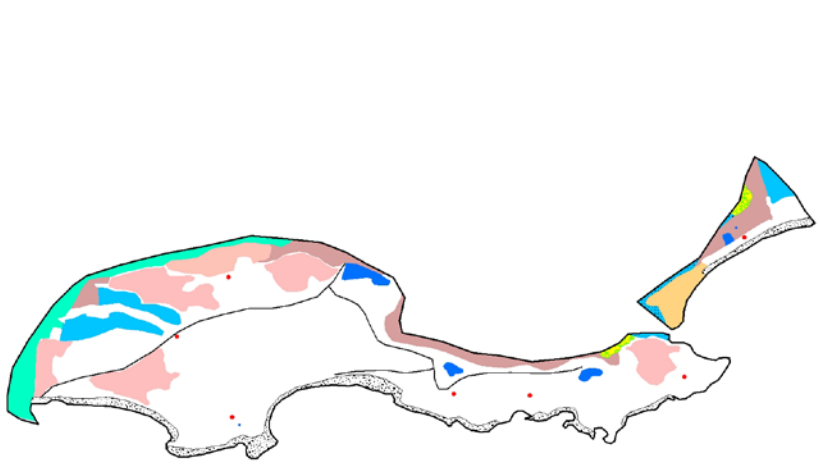
District code	District	Geographic area *	Wetland Type									Sub-total	Wetlands (<2.25 ha)	Total
			1106	1201	1202	2101	2103	2104	2105	2106	2201			
			River/ Stream	Reservoir/ Barrage	Tank/ Pond	Lagoon	Sand/ Beach	Intertidal mud flat	Salt Marsh	Mangrove	Salt pan			
		(sq. km)	(ha)	(ha)	(ha)	(ha)	(ha)	(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

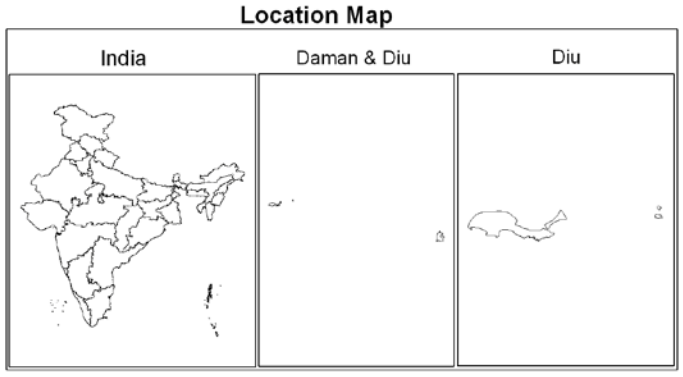


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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

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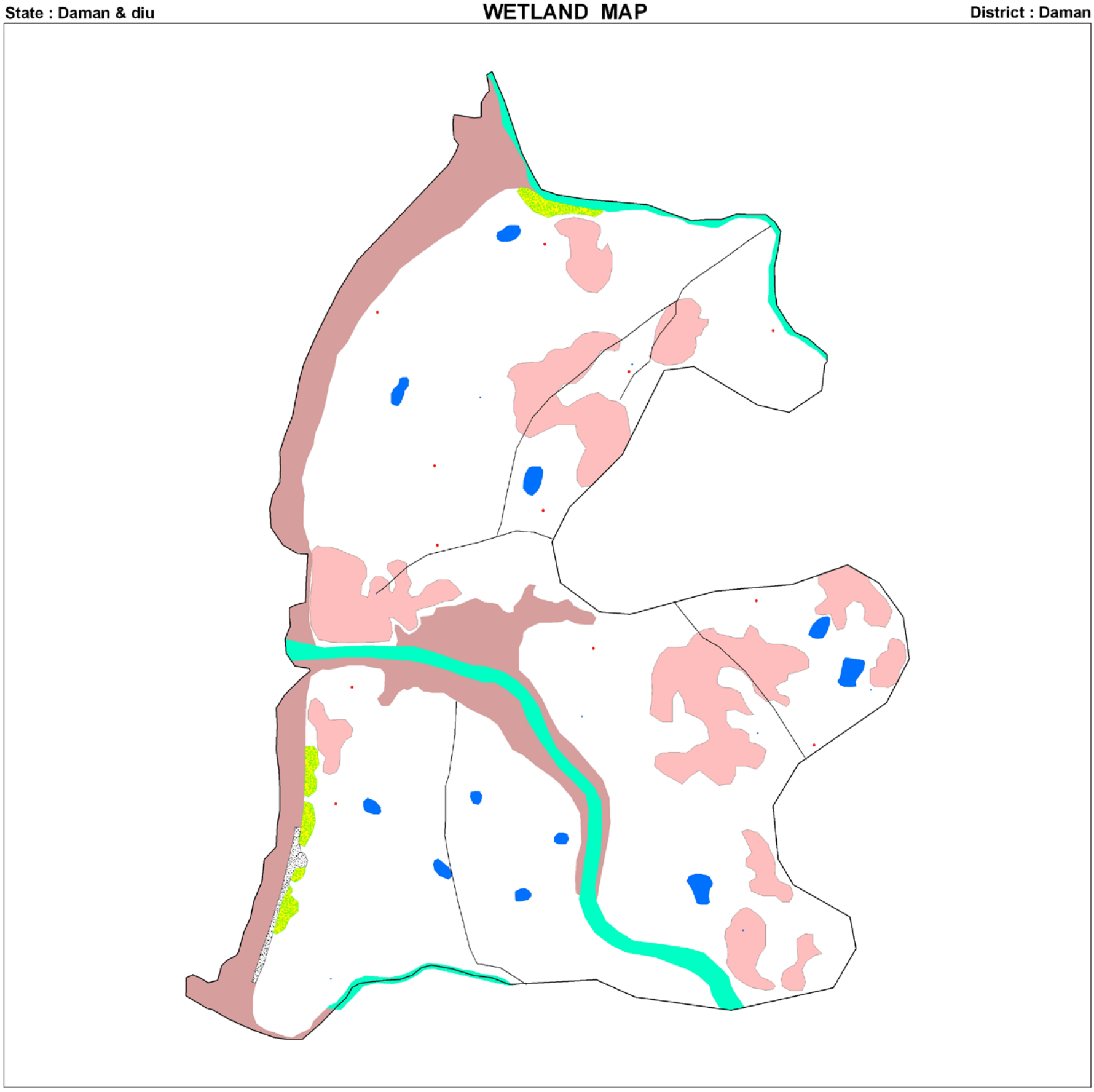
Ministry of Environment and Forests
Government of India

Plate 47: Wetland map of Diu

State : Daman & diu

WETLAND MAP

District : Daman

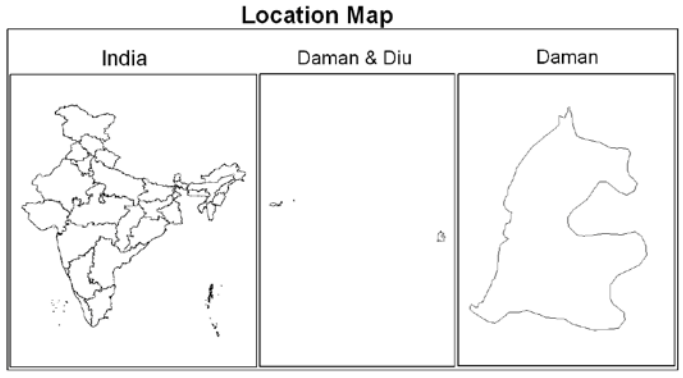


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

For details, refer National Wetland Atlas: Union Territories, SAC/EPSA/AFEG/NWIA/ATLAS/29/2010 Space Applications Centre (ISRO), Ahmedabad, India, 112p.

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	-	-

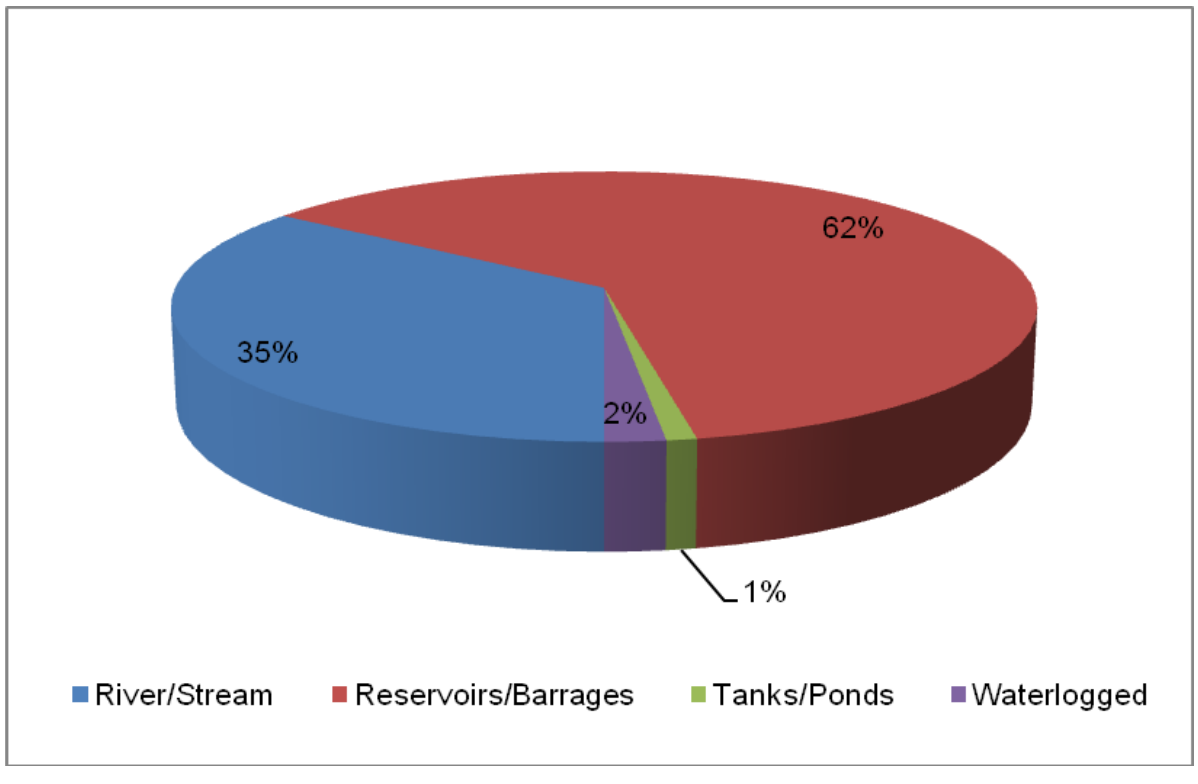
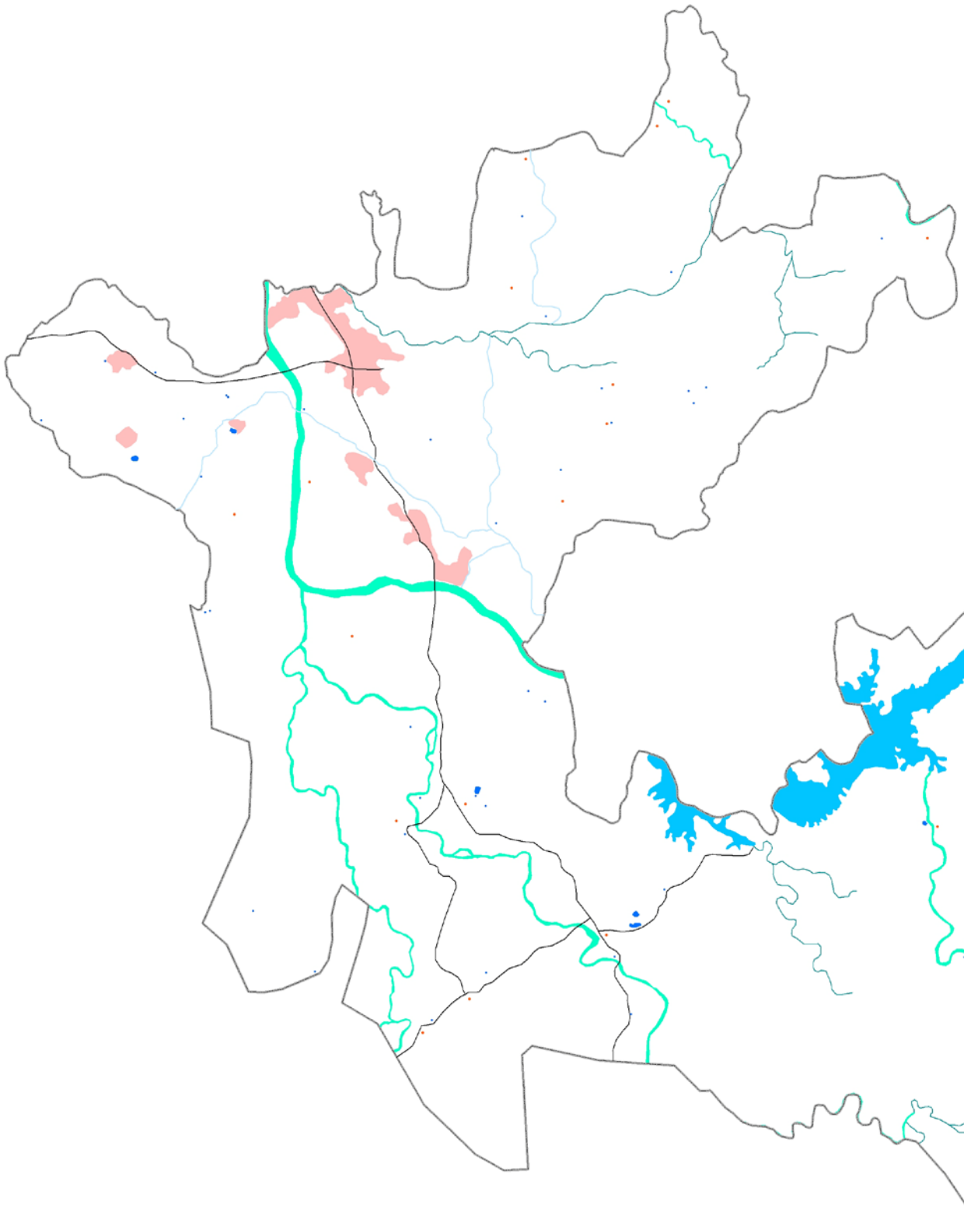


Figure 63: Type-wise wetland distribution in Dadra & Nagar Haveli

State : Dadra & Nagar Haveli

WETLAND MAP

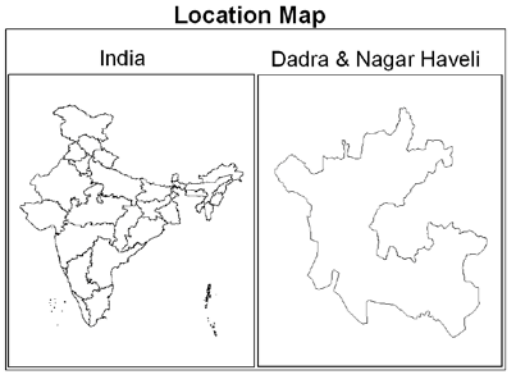


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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).

For details, refer National Wetland Atlas: Maharashtra, SAC/RESA/AFEG/NWIA/ATLAS/19/2009, Space Applications Centre (ISRO), Ahmedabad, India, 222p.

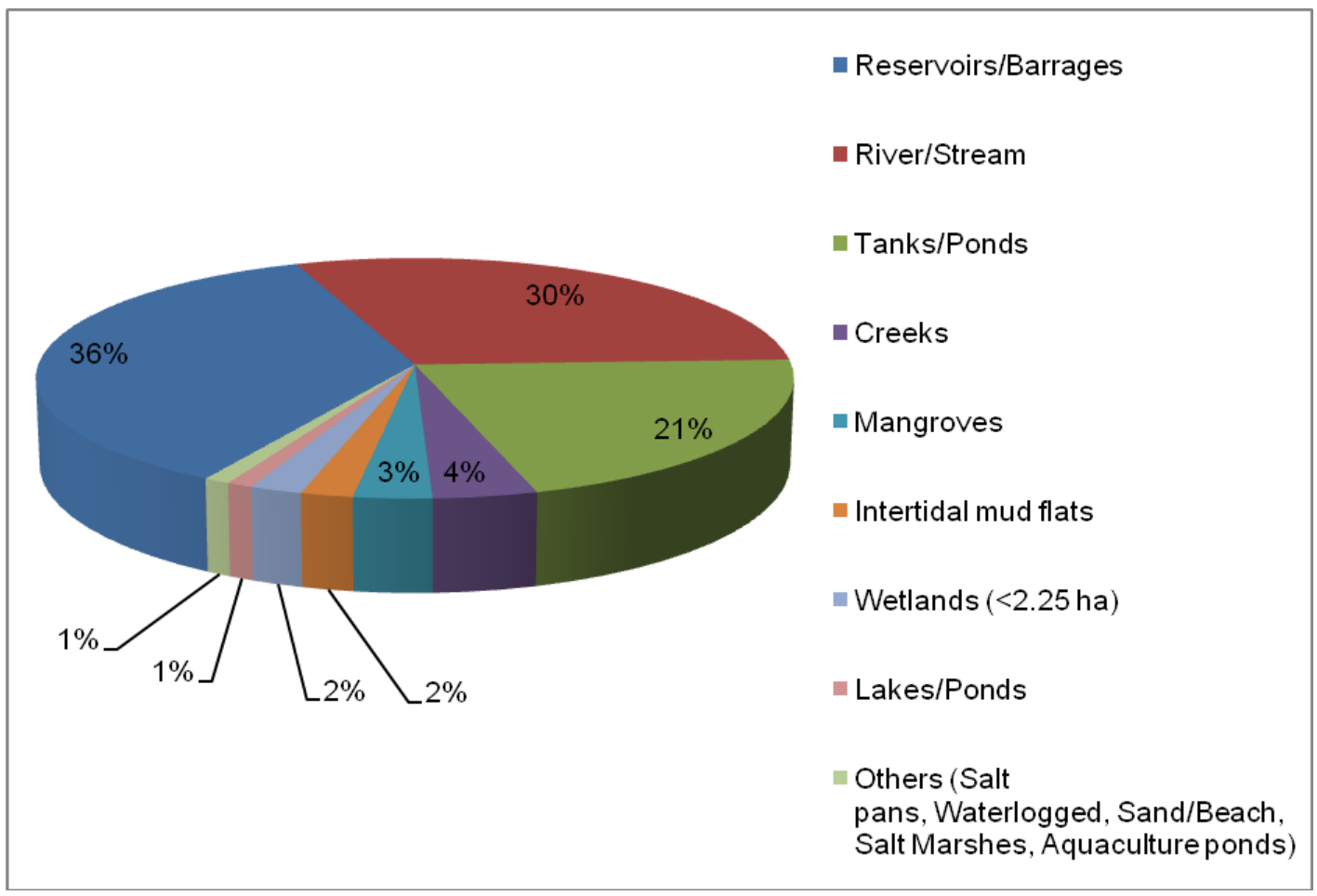


Figure 64: Type-wise wetland distribution in Maharashtra

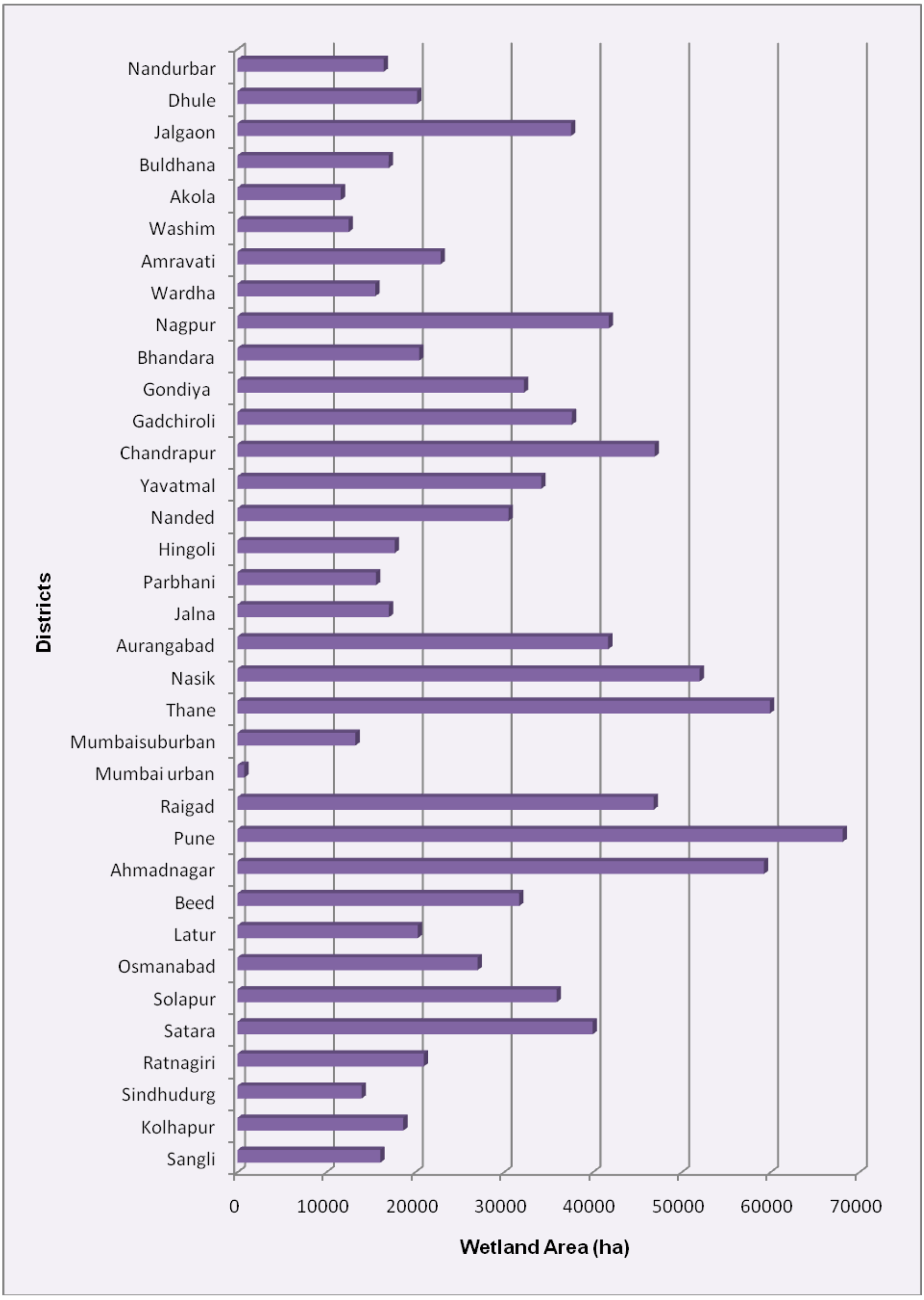


Figure 65: District-wise graphical distribution of wetlands in Maharashtra

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

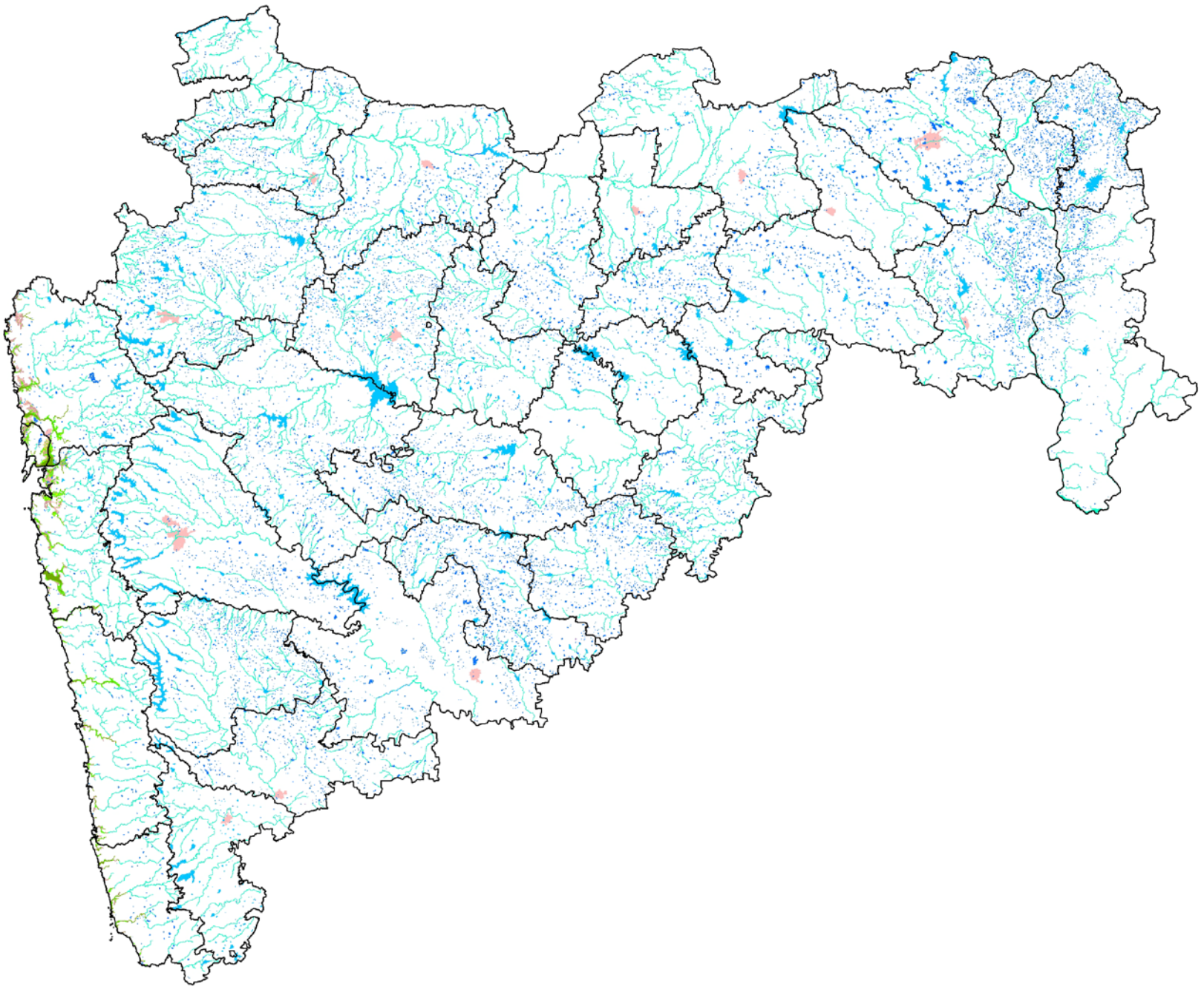
1201 Reservoir/Barrage
1202 Tank/Pond
1203 Waterlogged (Man-made)
1204 Salt pan (Inland)

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

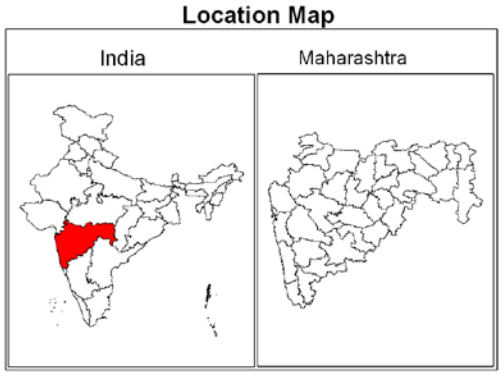


Symbol Typecode	Level I	Level II	Level III
	Inland Wetlands		
		Natural	
1101			Lakes/Ponds
1102			Ox-bow lakes/ Cut-off meanders
1103			High altitude wetlands
1104			Riverine wetlands
1105			Waterlogged
1106			River/Stream
		Man-made	
1201			Reservoirs/Barrages
1202			Tanks/Ponds
1203			Waterlogged
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

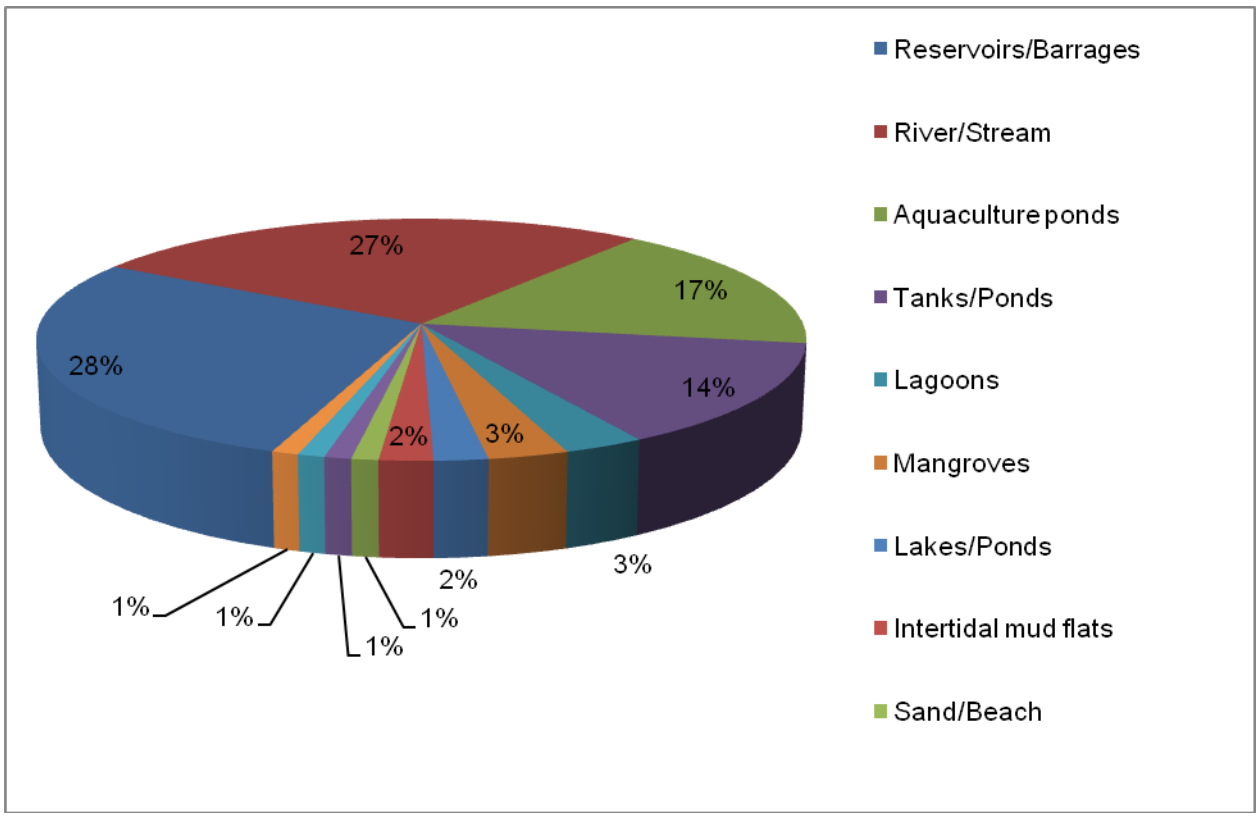


Figure 66: Type-wise wetland distribution in Andhra Pradesh

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.

For details, refer National Wetland Atlas: Andhra Pradesh, SAC/EPSA/AFEG/NWIA/ATLAS/33/2010, Space Applications Centre (ISRO), Ahmedabad, India, 172p.

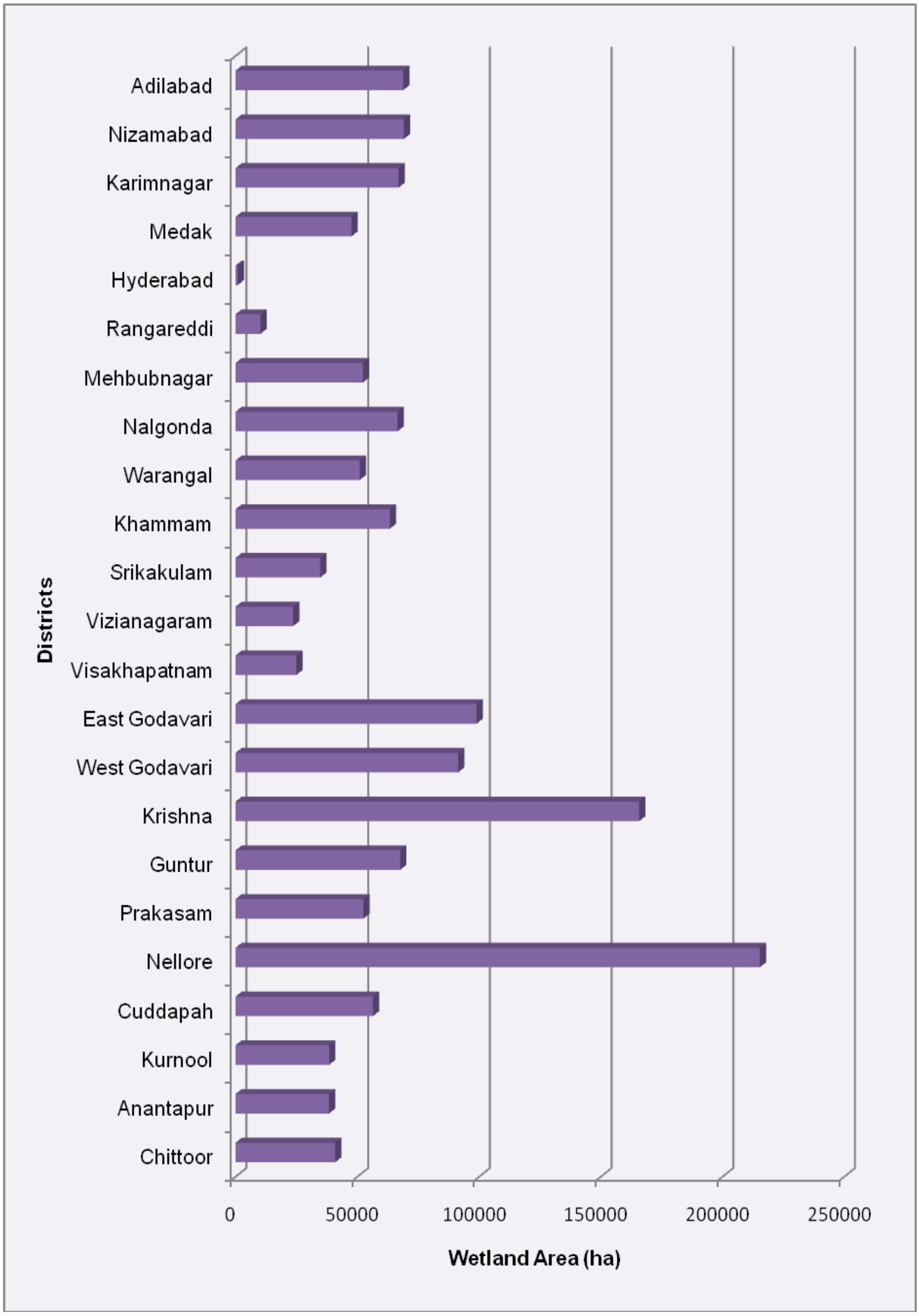


Figure 67: District-wise graphical distribution of wetlands

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

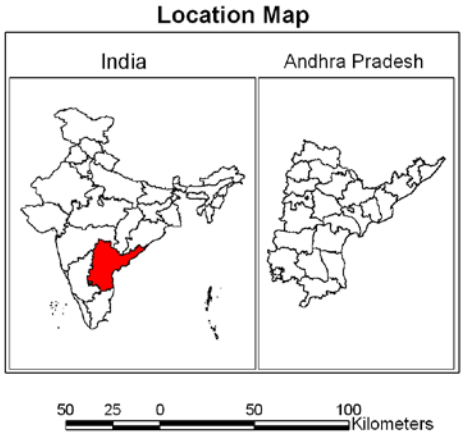


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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	1104	Riverine wetland	61	1051	0.16	558	319
3	1105	Waterlogged	93	2045	0.32	1132	925
4	1106	River/Stream	334	179731	27.93	148113	109240
	1200	**Inland Wetlands -Man-made**					
5	1201	Reservoir/Barrage	70	213527	33.18	187002	92834
6	1202	Tank/Pond	10386	222030	34.50	86679	54147
7	1203	Waterlogged	53	2403	0.37	844	563
		Total - Inland	**11024**	**621425**	**96.56**	**424642**	**258300**
	2100	**Coastal Wetlands - Natural**					
8	2101	Lagoon	2	72	0.01	68	61
9	2102	Creek	13	97	0.02	80	45
10	2103	Sand/Beach	61	1897	0.29	-	-
11	2104	Intertidal mud flat	97	1663	0.26	175	1222
12	2106	Mangrove	140	967	0.15	-	-
	2200	**Coastal Wetlands - Man-made**					
13	2201	Salt pan	4	812	0.13	812	812
14	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 %).

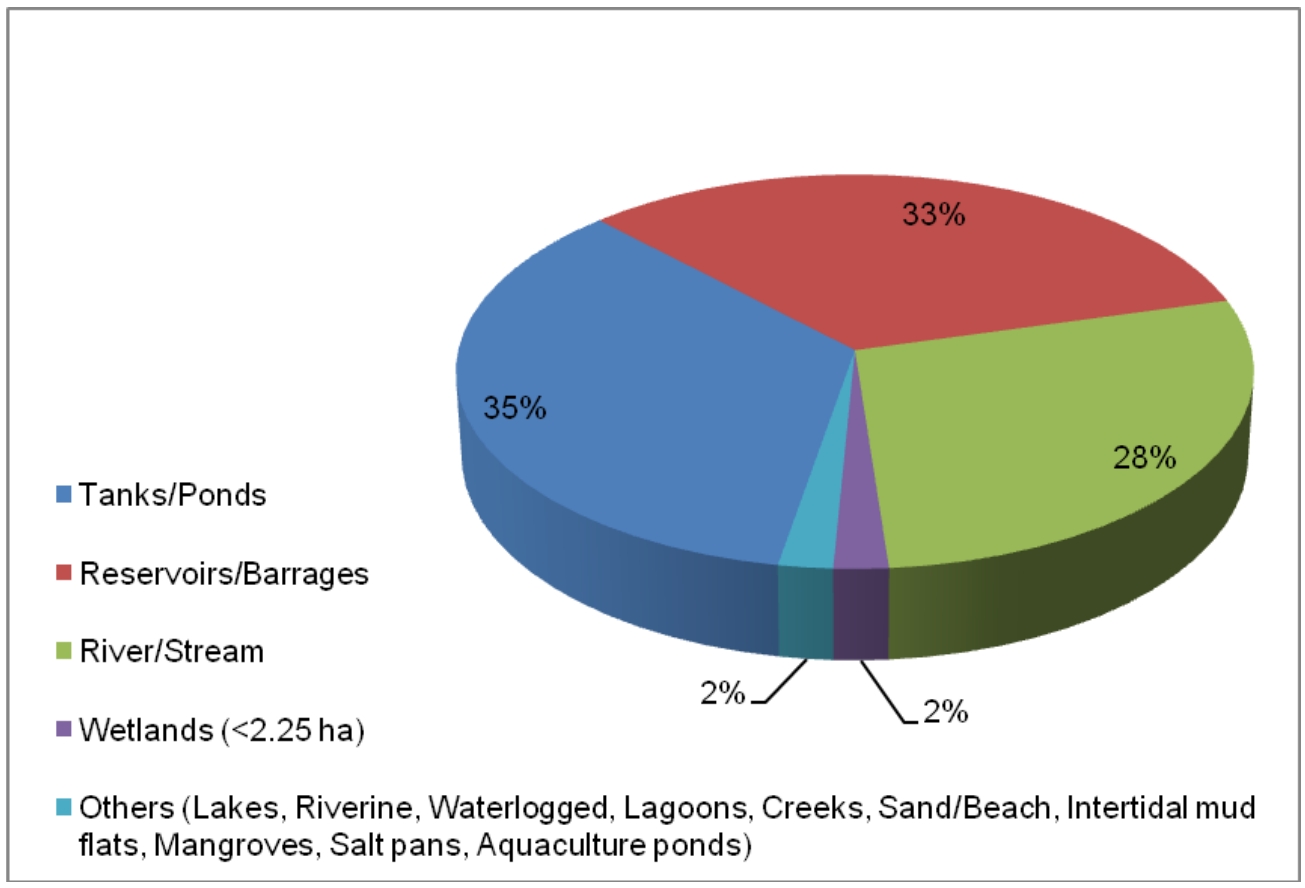


Figure 68: Type-wise wetland distribution in Karnataka

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.

For details, refer National Wetland Atlas: Karnataka, SAC/EPSA/AFEG/NWIA/ATLAS/30/2010, Space Applications Centre (ISRO), Ahmedabad, India, 204p.

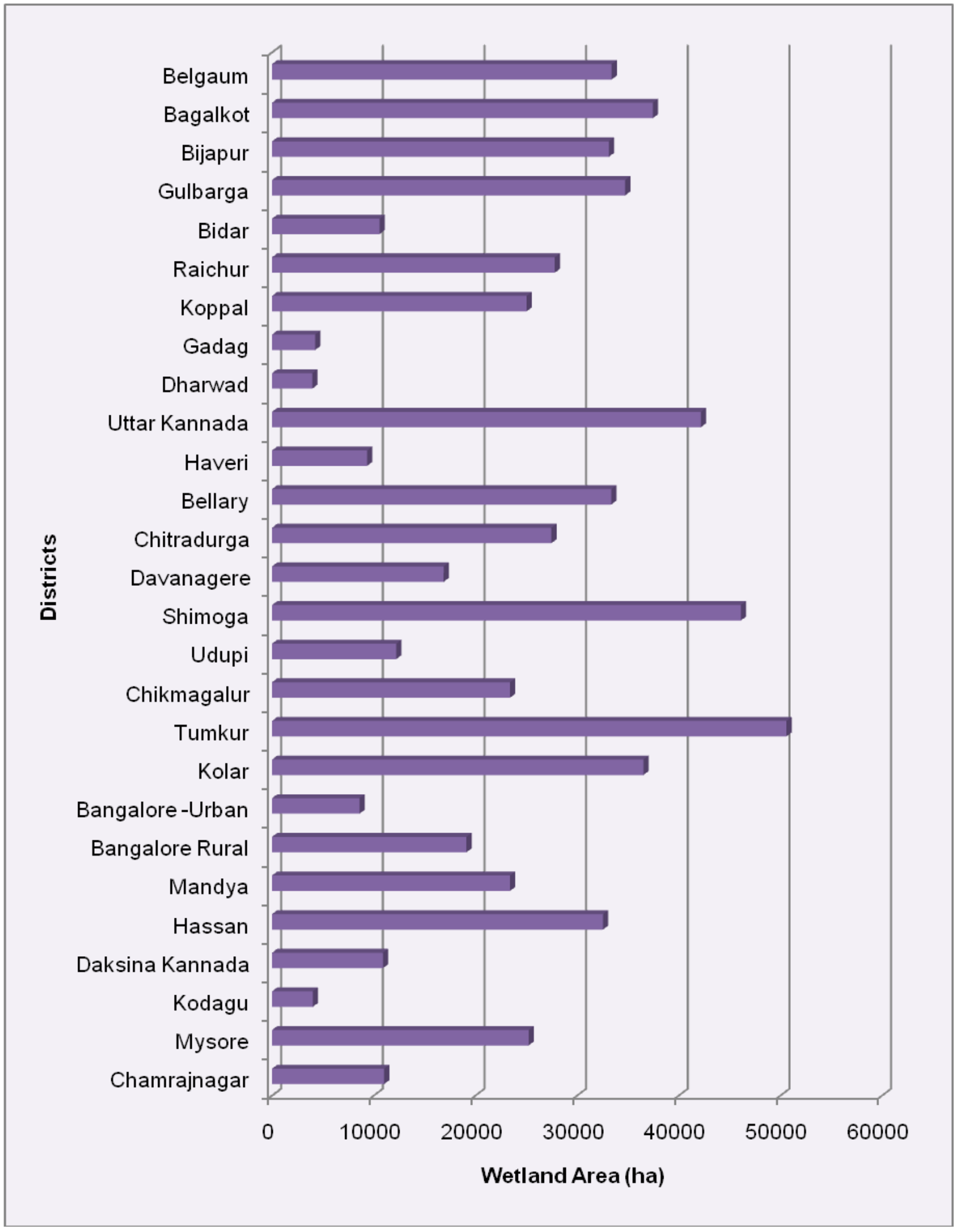


Figure 69: District-wise graphical distribution of wetlands in Karnataka

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

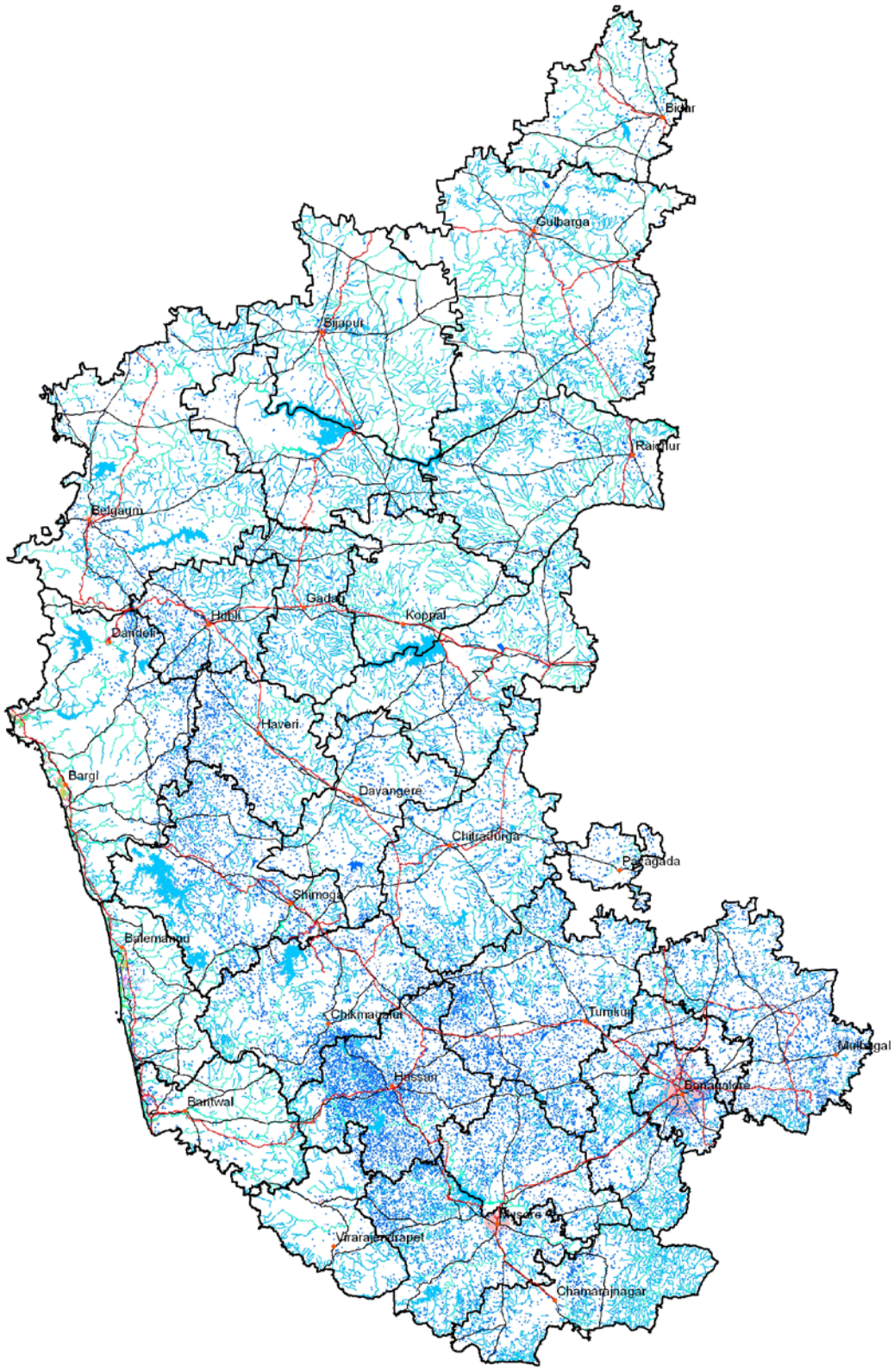
1201 Reservoir/Barrage
1202 Tank/Pond
1203 Waterlogged (Man-made)
1204 Salt pan (Inland)

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2102 Creek
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2104 Intertidal mud flat
2105 Salt Marsh (Coastal)
2106 Mangrove
2107 Coral Reef

2201 Salt pan
2202 Aquaculture pond

State : Karnataka

WETLAND MAP

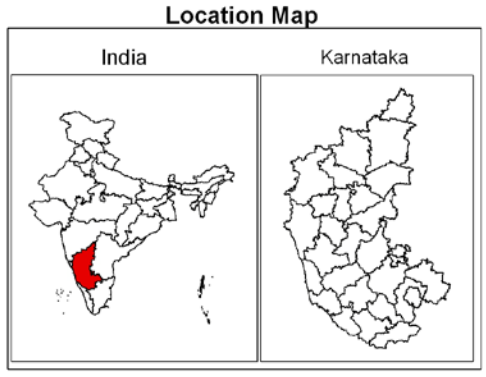


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

For details, refer National Wetland Atlas: Goa, SAC/RESA/AFEG/NWIA/ATLAS/01/2009, Space Applications Centre (ISRO), Ahmedabad, India, 72p.

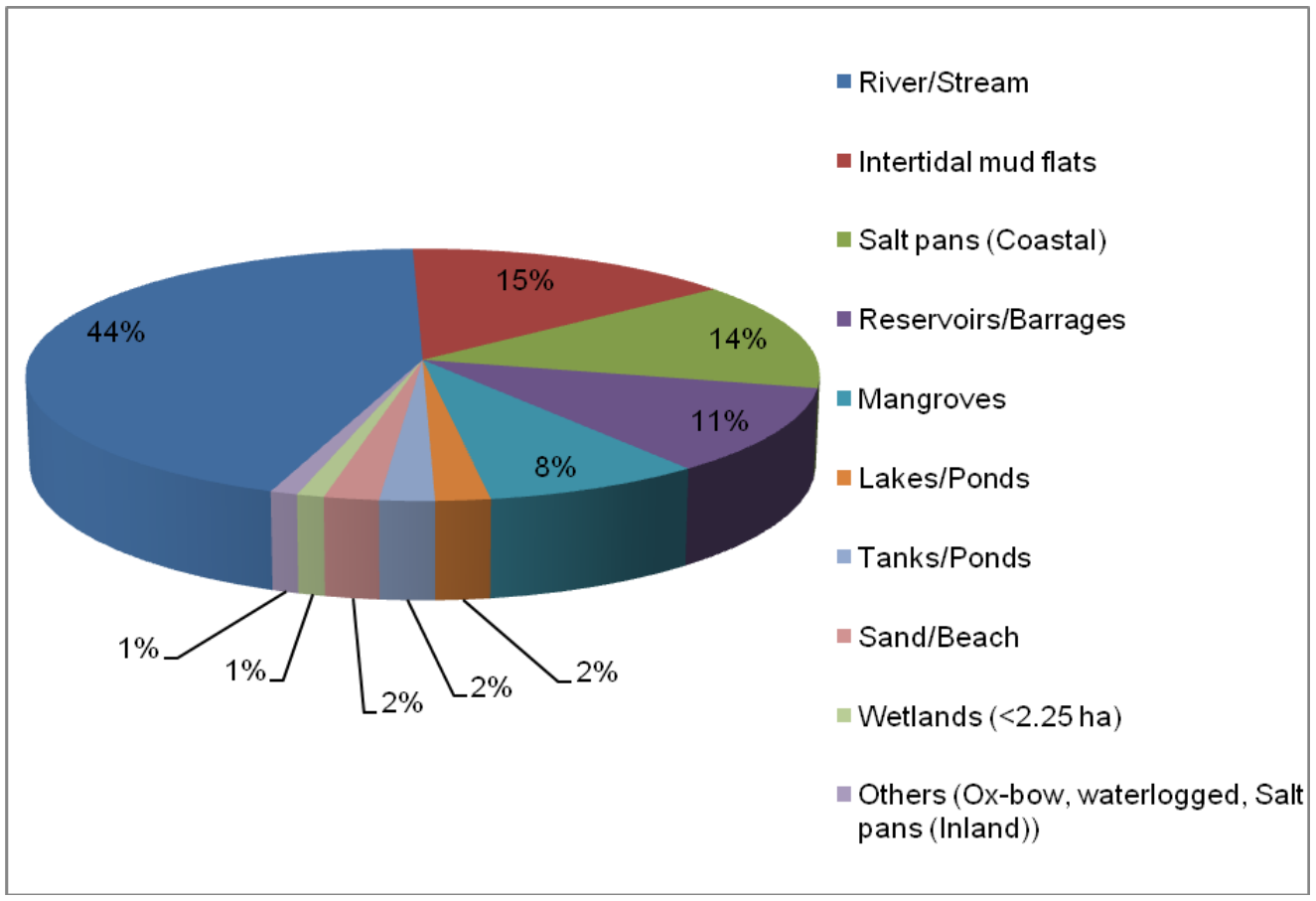


Figure 70: Type-wise wetland distribution in Goa

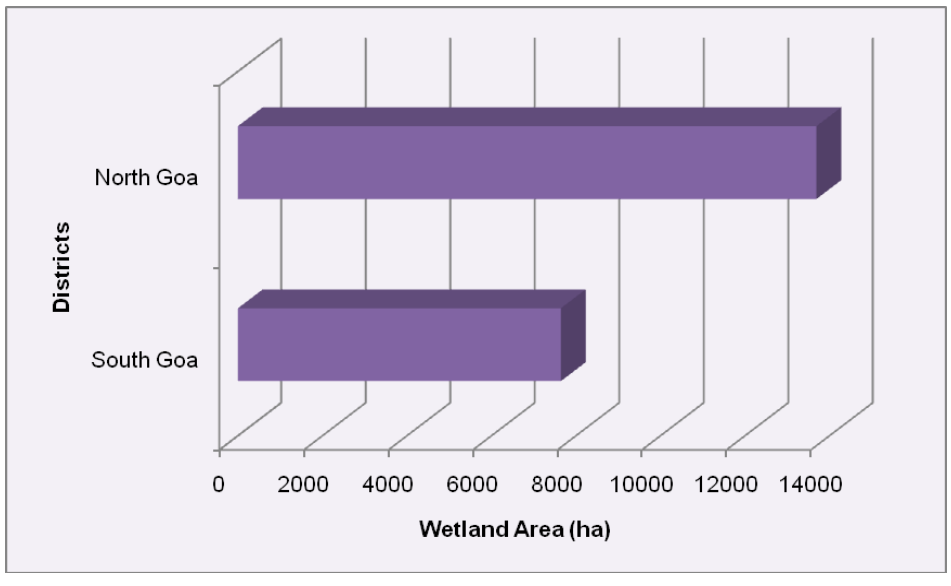


Figure 71: District-wise graphical distribution of wetlands in Goa

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

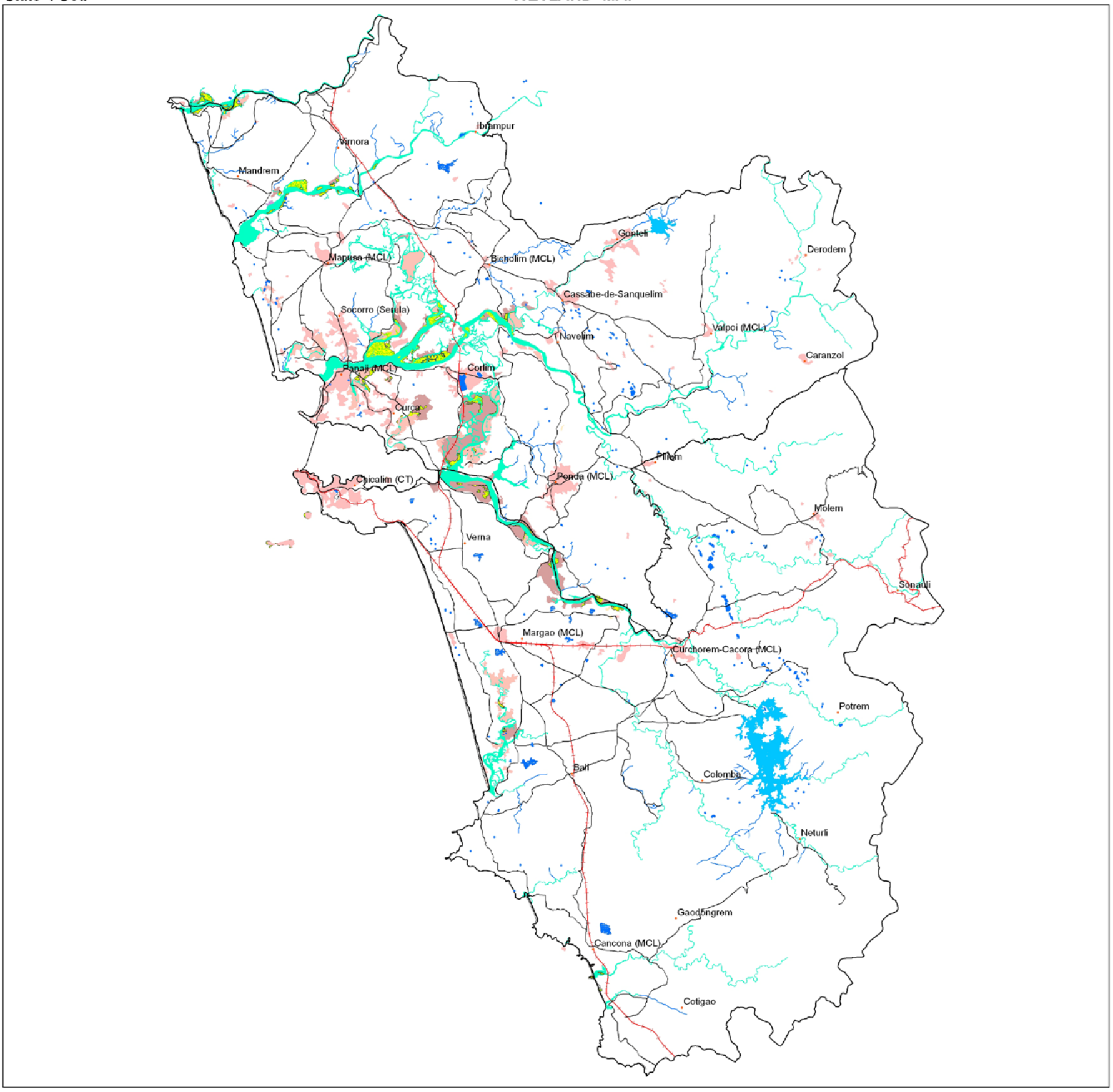
Table 95: District-wise area of wetlands (type-wise) in Goa

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

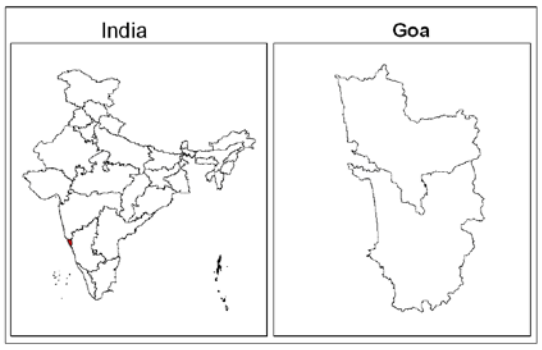


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

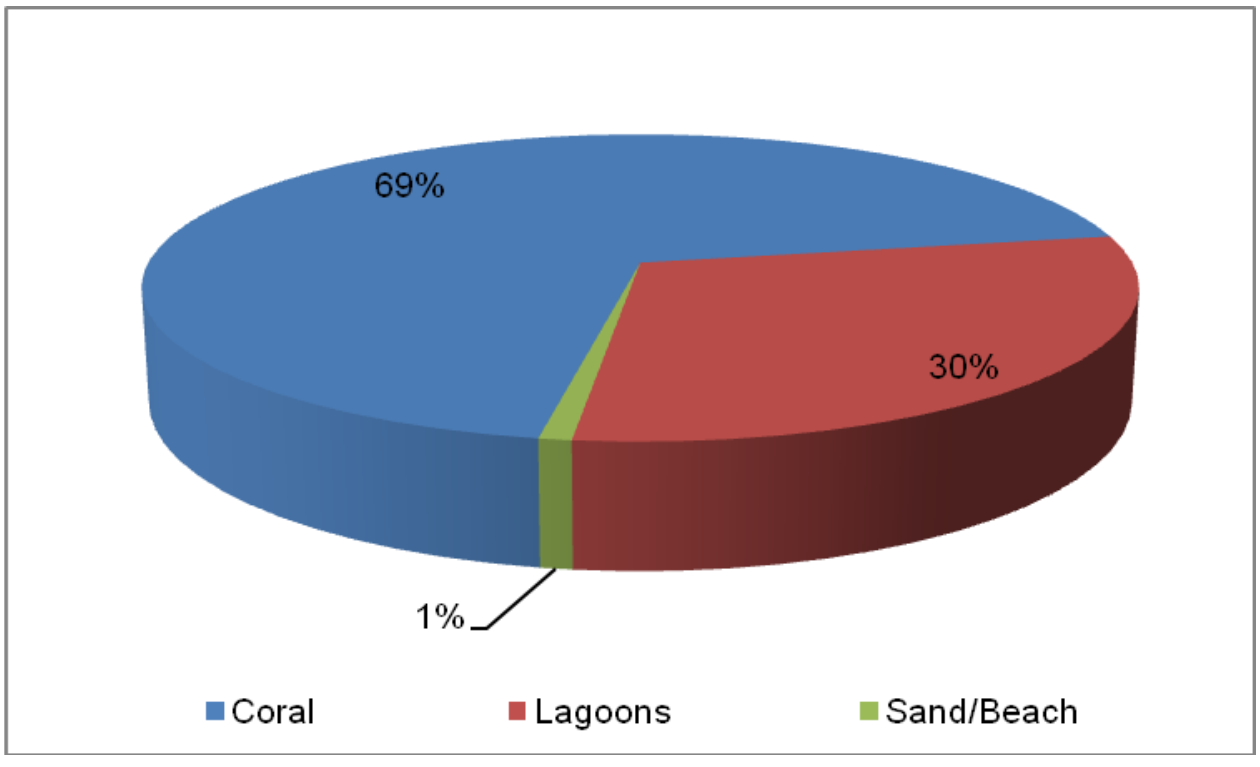


Figure 72: Type-wise wetland distribution in Lakshadweep

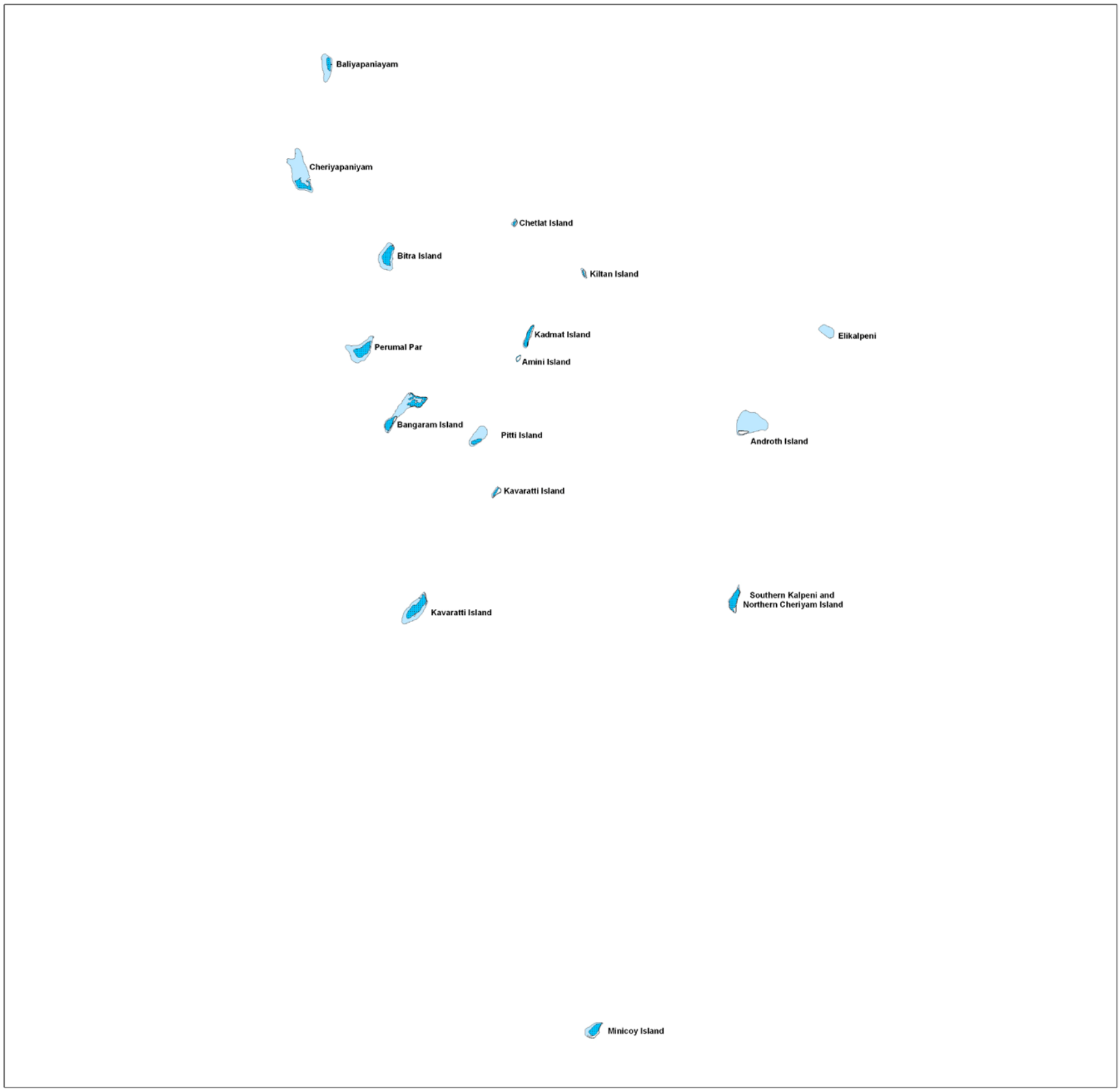
Lagoon stands next to coral comprising 23674 ha of area. It accounts for 30 % of wetland area. In Lakshdweep the lagoons are very different from the mainland in the sense that they are actually coral reef lagoons wherein the water body gets enclosed in an atoll or within a barrier reef. The depth of 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.

For details, refer National Wetland Atlas: Lakshadweep, SAC/RESA/AFEG/NWIA/ATLAS/05/2009, Space Applications Centre (ISRO), Ahmedabad, India, 88p.

UT : Lakshdweep Islands

WETLAND MAP

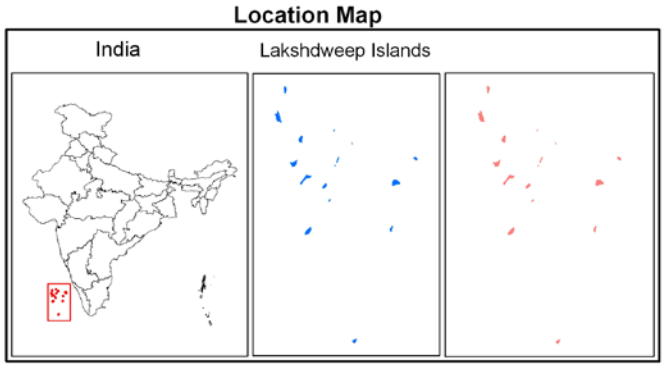


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

For details, refer National Wetland Atlas: Kerala, SAC/RESA/AFEG/NWIA/ATLAS/14/2010, Space Applications Centre(ISRO), Ahmedabad, India, 130p.

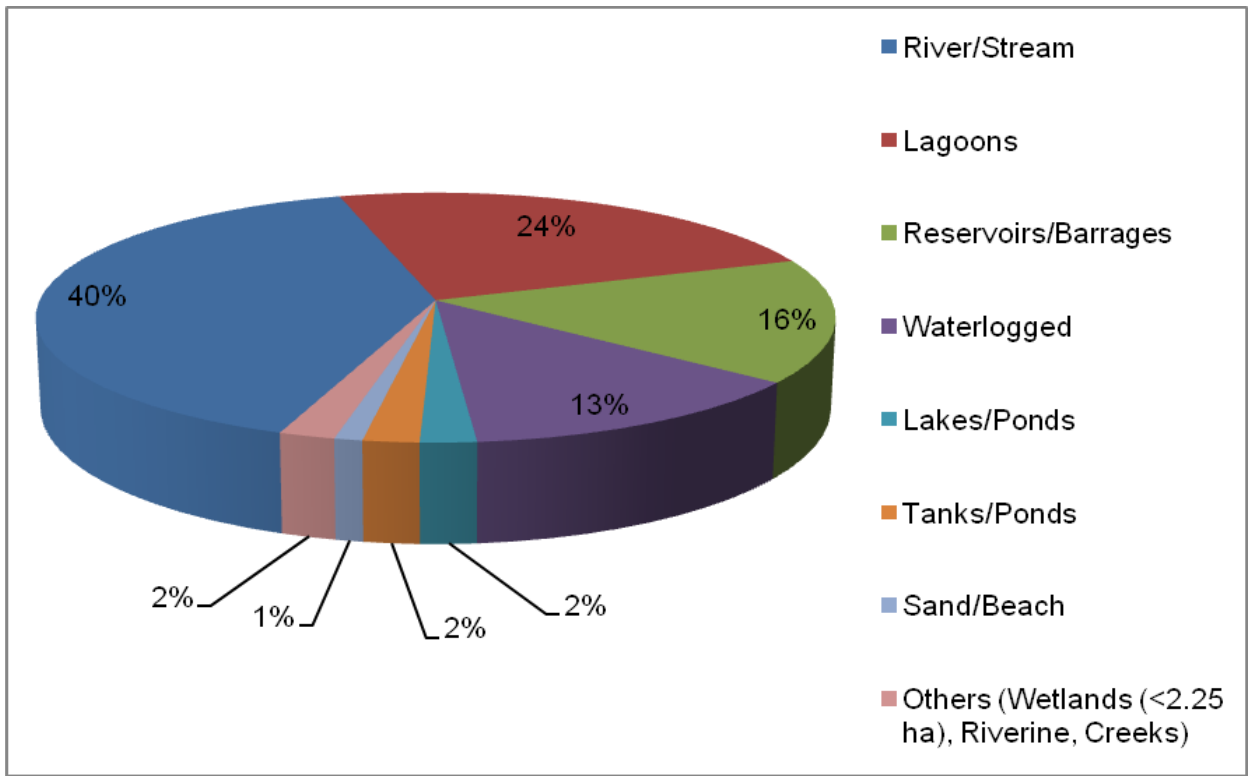


Figure 73: Type-wise wetland distribution in Kerala

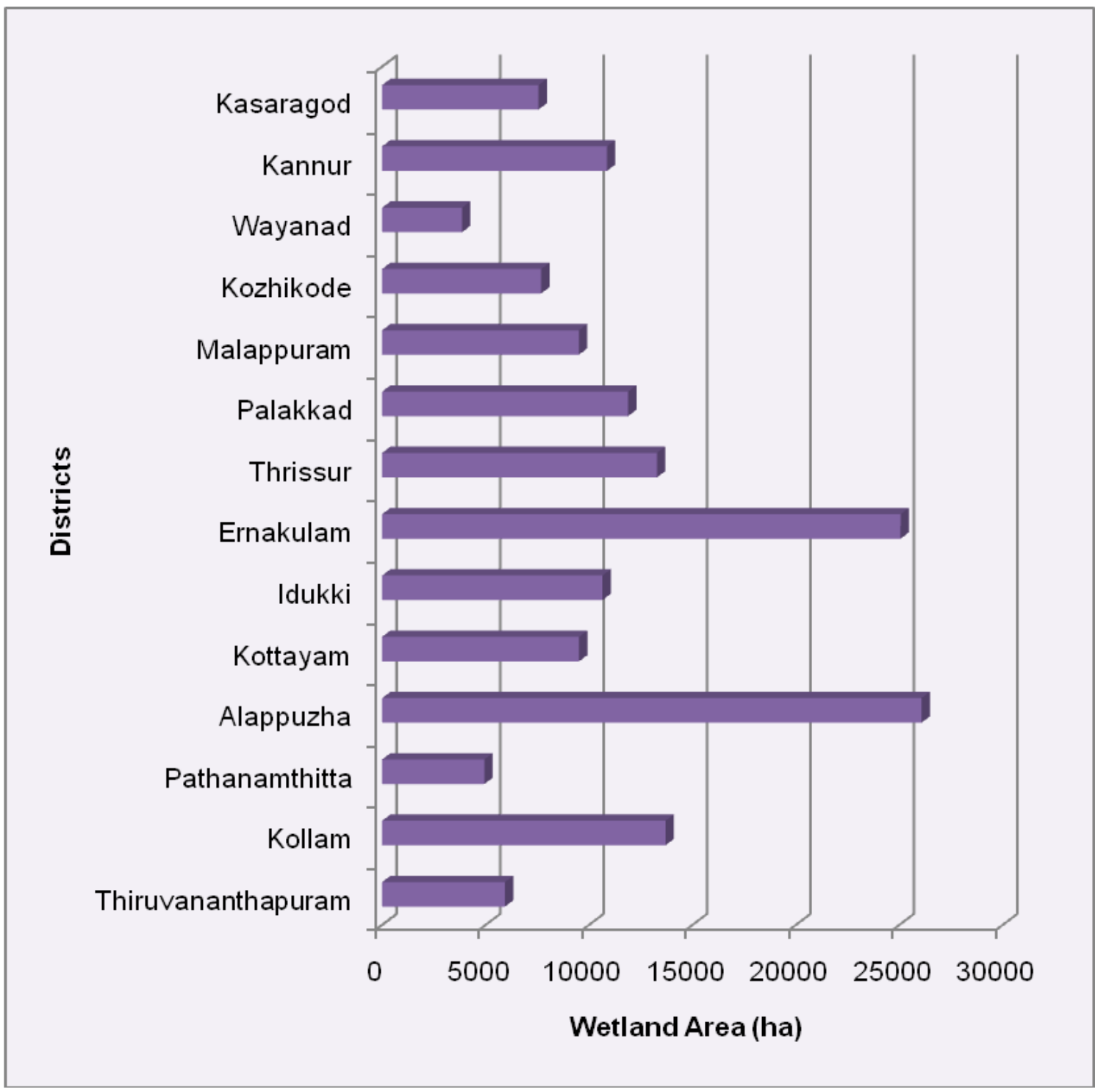


Figure 74: District-wise graphical distribution of wetlands in Kerala

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

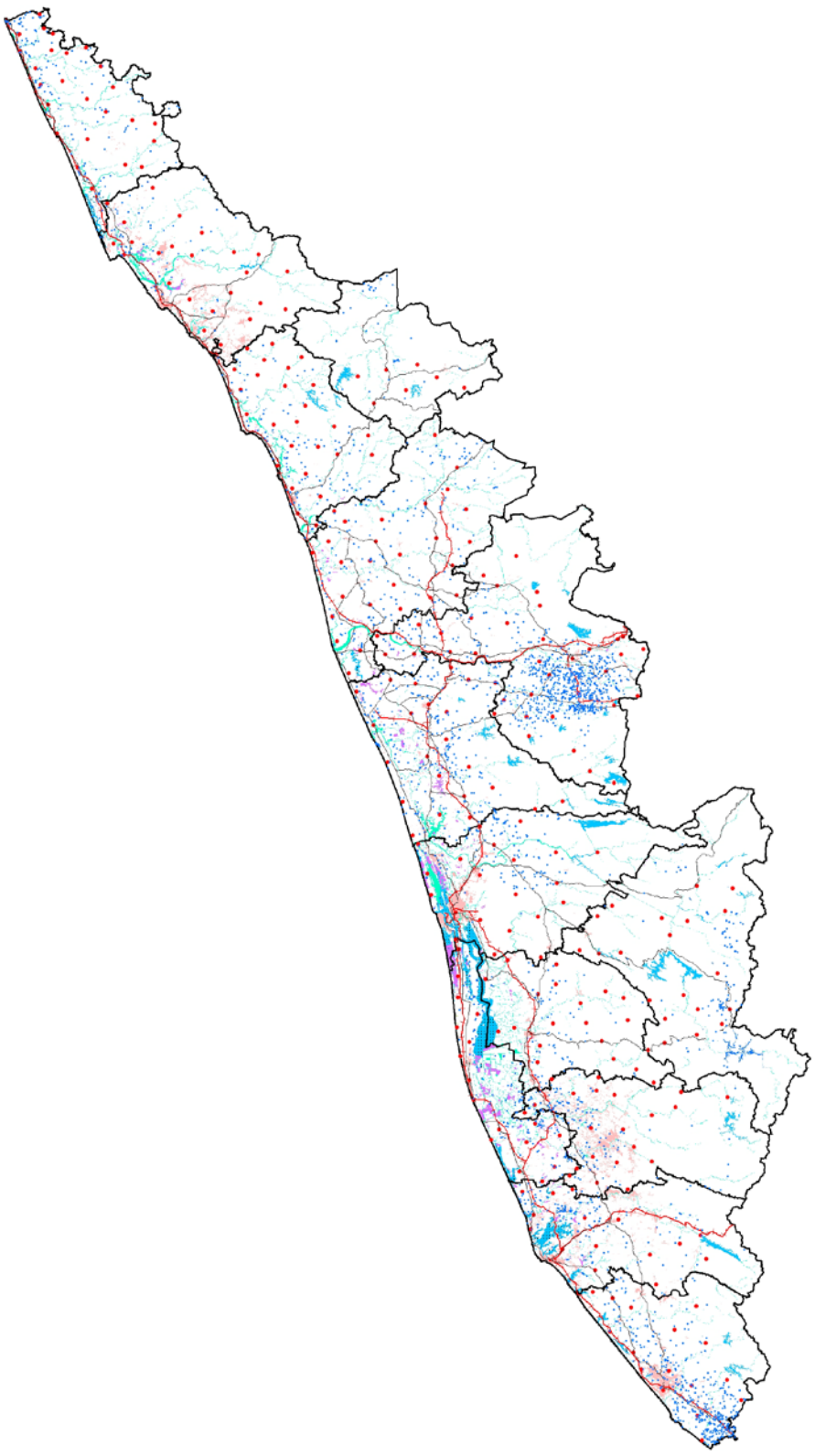
Table 99: District-wise area of wetlands (type-wise) in Kerala

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

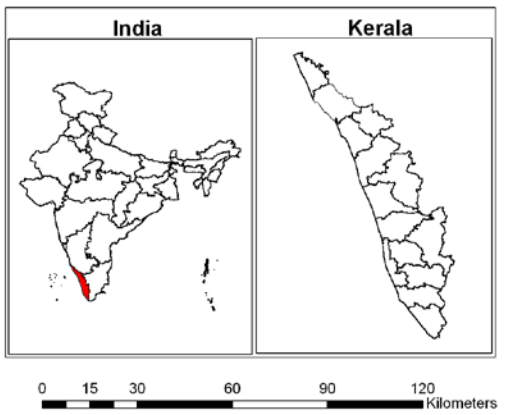


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Riverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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

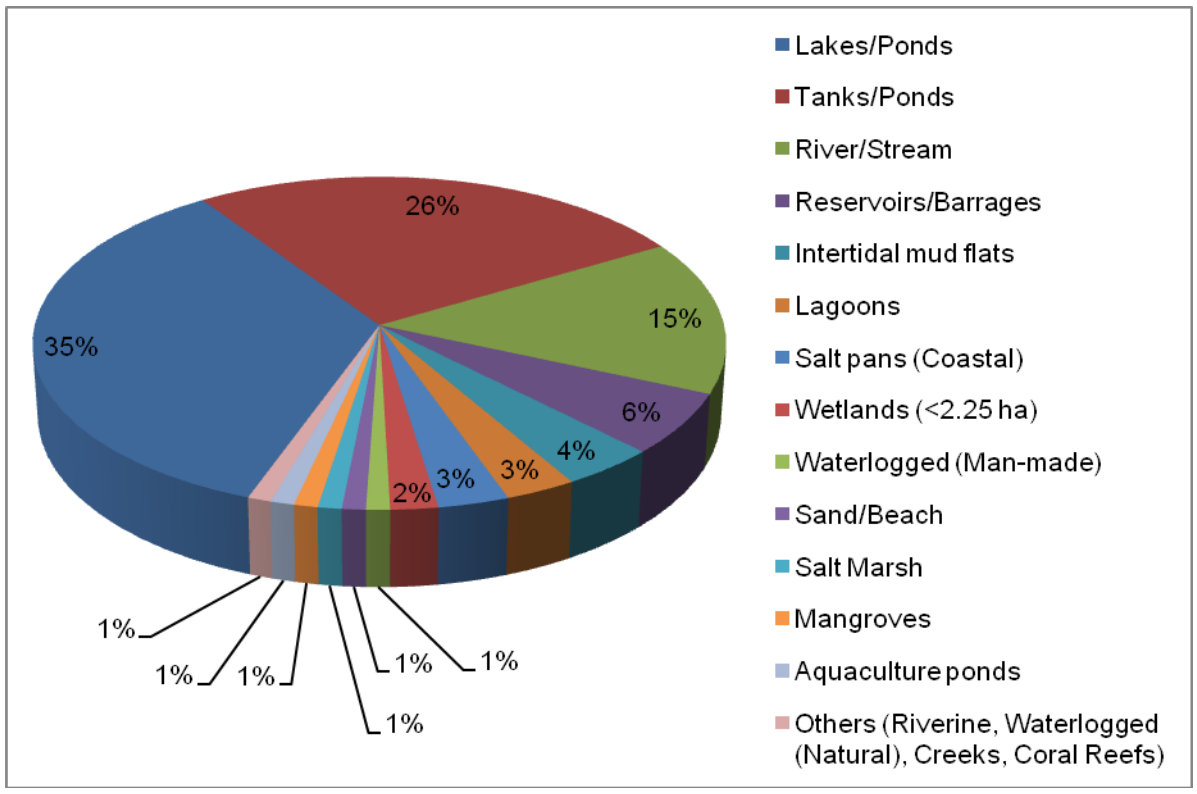


Figure 75: Type-wise wetland distribution in Tamil Nadu

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.

For details, refer National Wetland Atlas: Tamil Nadu, SAC/RESA/AFEG/NWIA/ATLAS/22/2009, Space Applications Centre (ISRO), Ahmedabad, India, 222p.

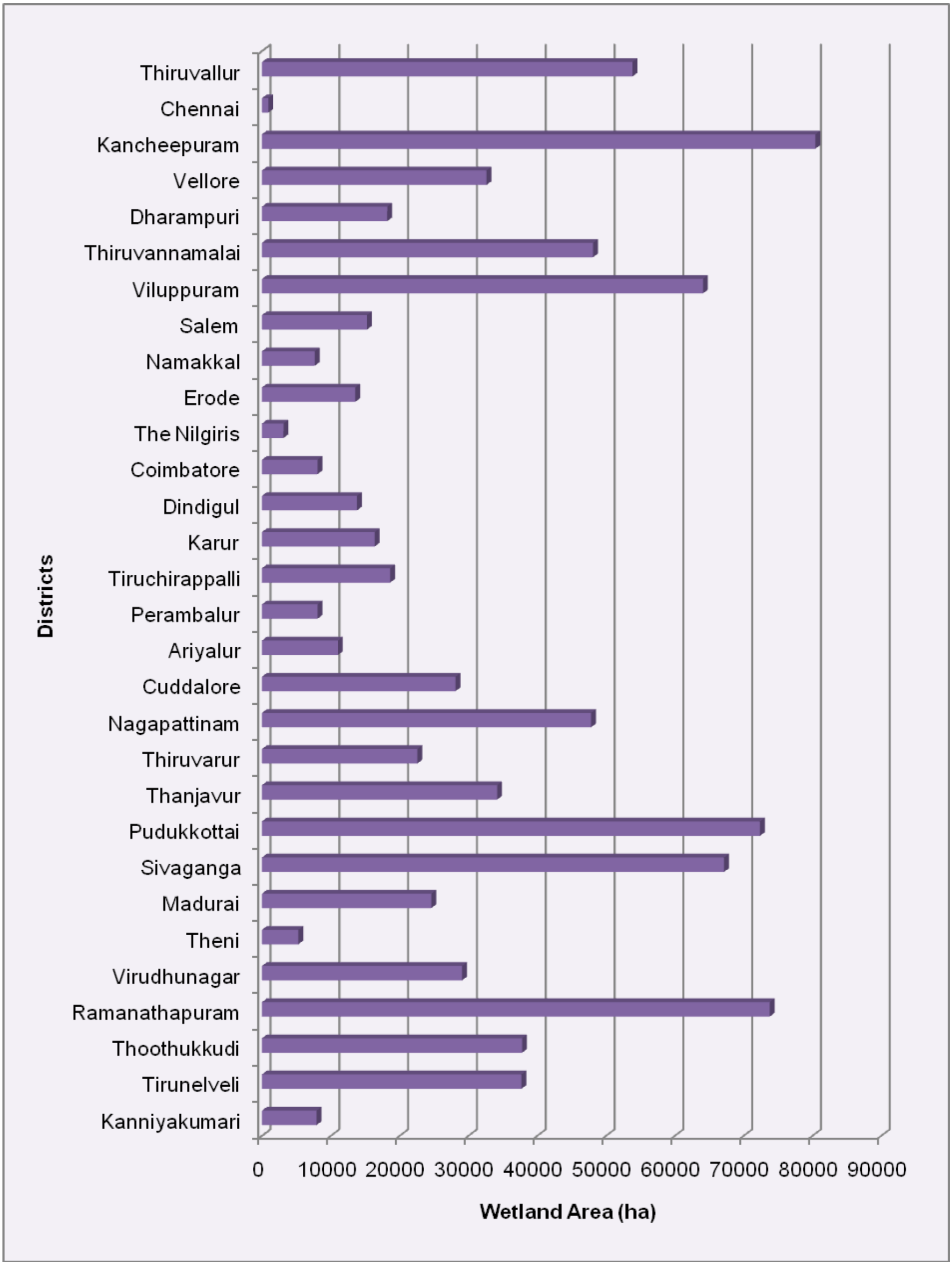


Figure 76: District-wise graphical distribution of wetlands

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

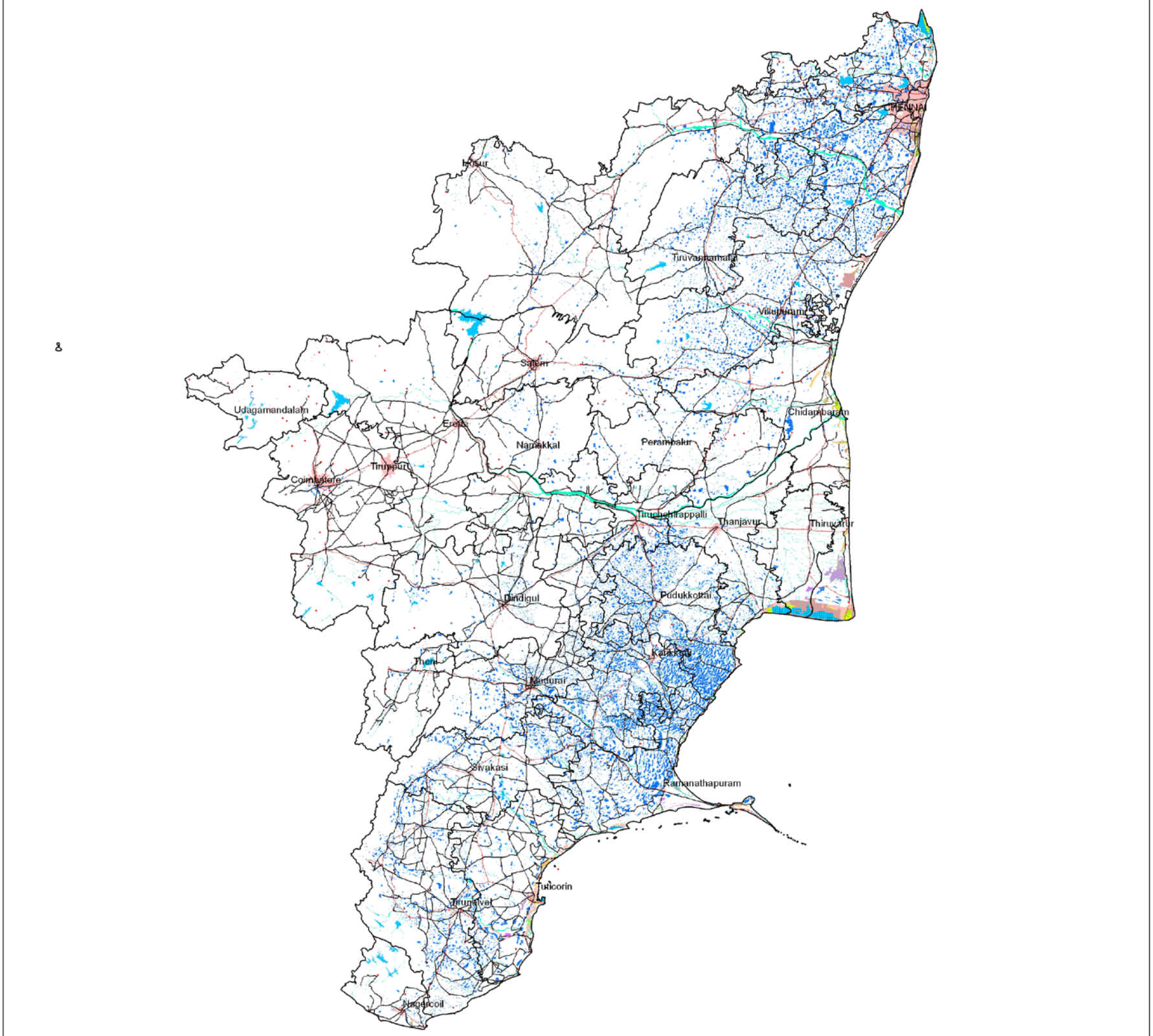
1201 Reservoir/Barrage
1202 Tank/Pond
1203 Waterlogged (Man-made)
1204 Salt pan (Inland)

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

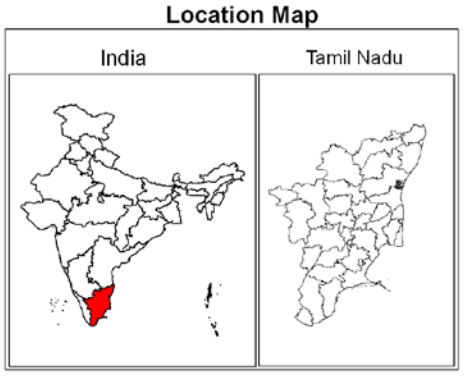


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

For details, refer National Wetland Atlas: Union Territories, SAC/EPSA/AFEG/NWIA/ATLAS/29/2010 Space Applications Centre (ISRO), Ahmedabad, India, 112p.

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

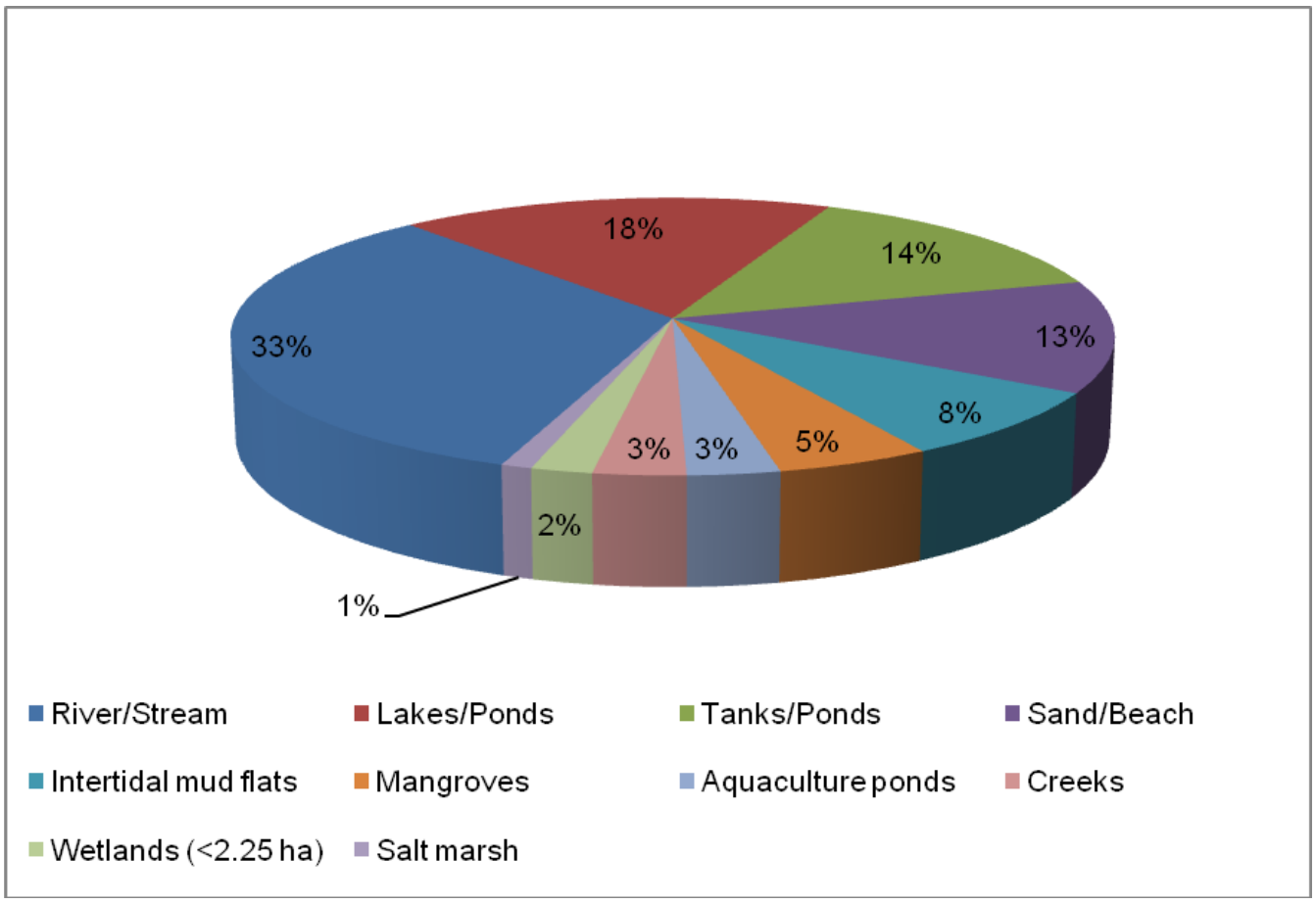


Figure 77: Type-wise wetland distribution in Puducherry

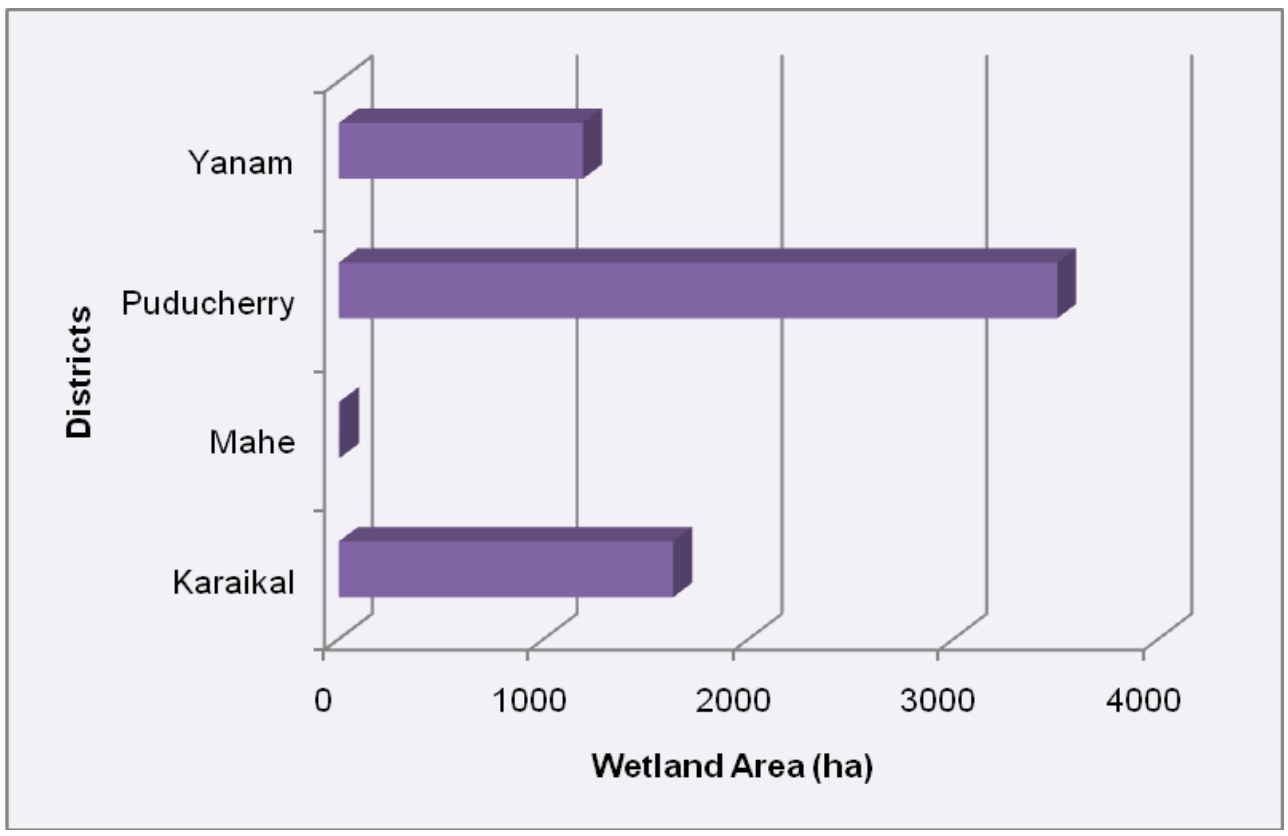


Figure 78: District-wise graphical distribution of wetlands in Puducherry

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

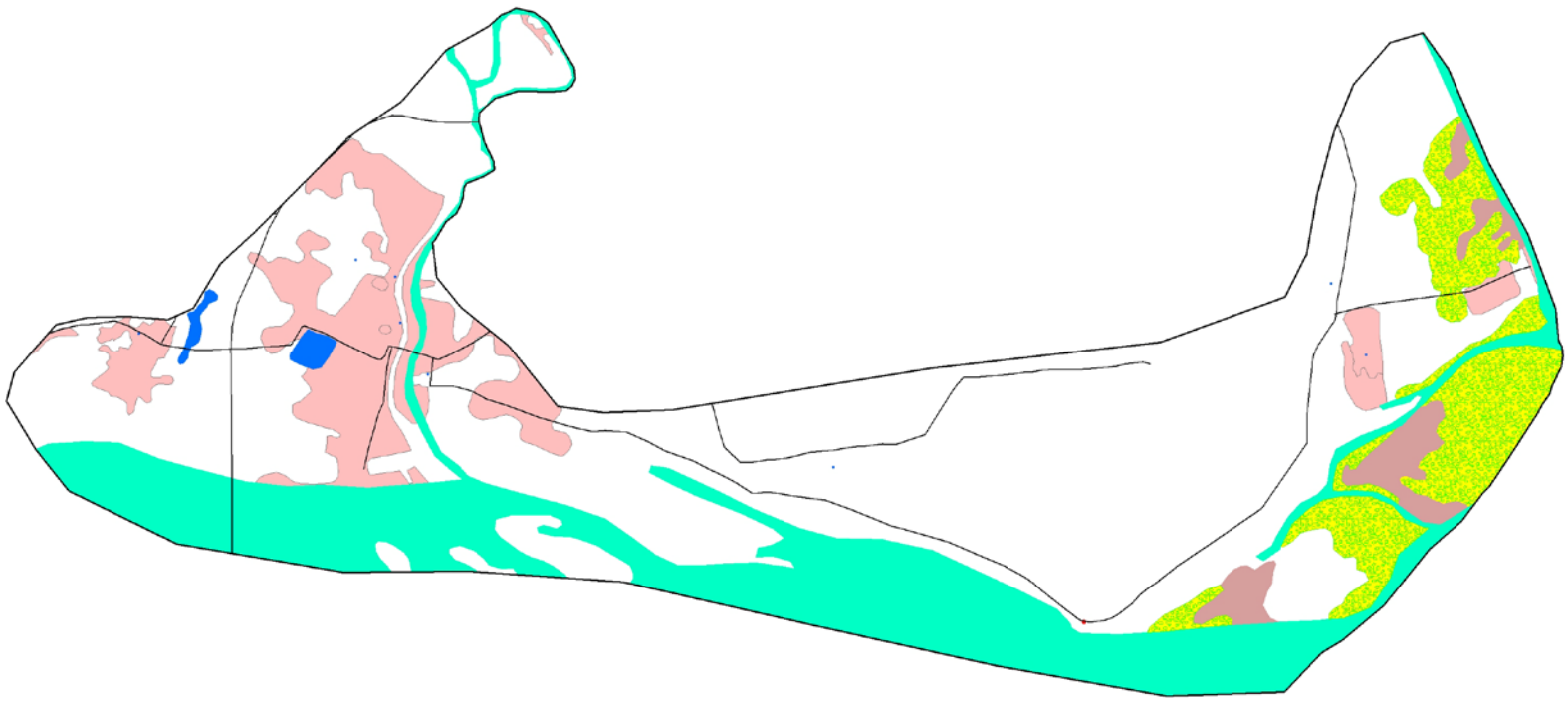
District code	District	Geographic area *	Wetland Type										Sub-total	Wetlands (<2.25 ha)	Total
			1101	1105	1106	1202	2102	2103	2104	2105	2106	2202			
			Lake/ pond	Waterlogged (Natural)	River/ Stream	Tank/ Pond	Creek	Sand/ Beach	Intertidal mud flat	Salt Marsh	Mangrove	Aquaculture pond			
		(sq. 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

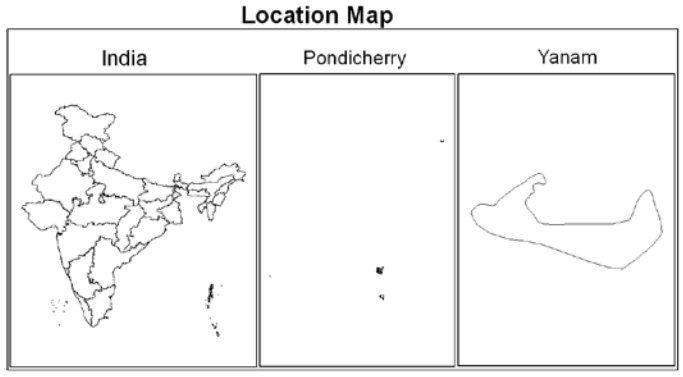


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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 :

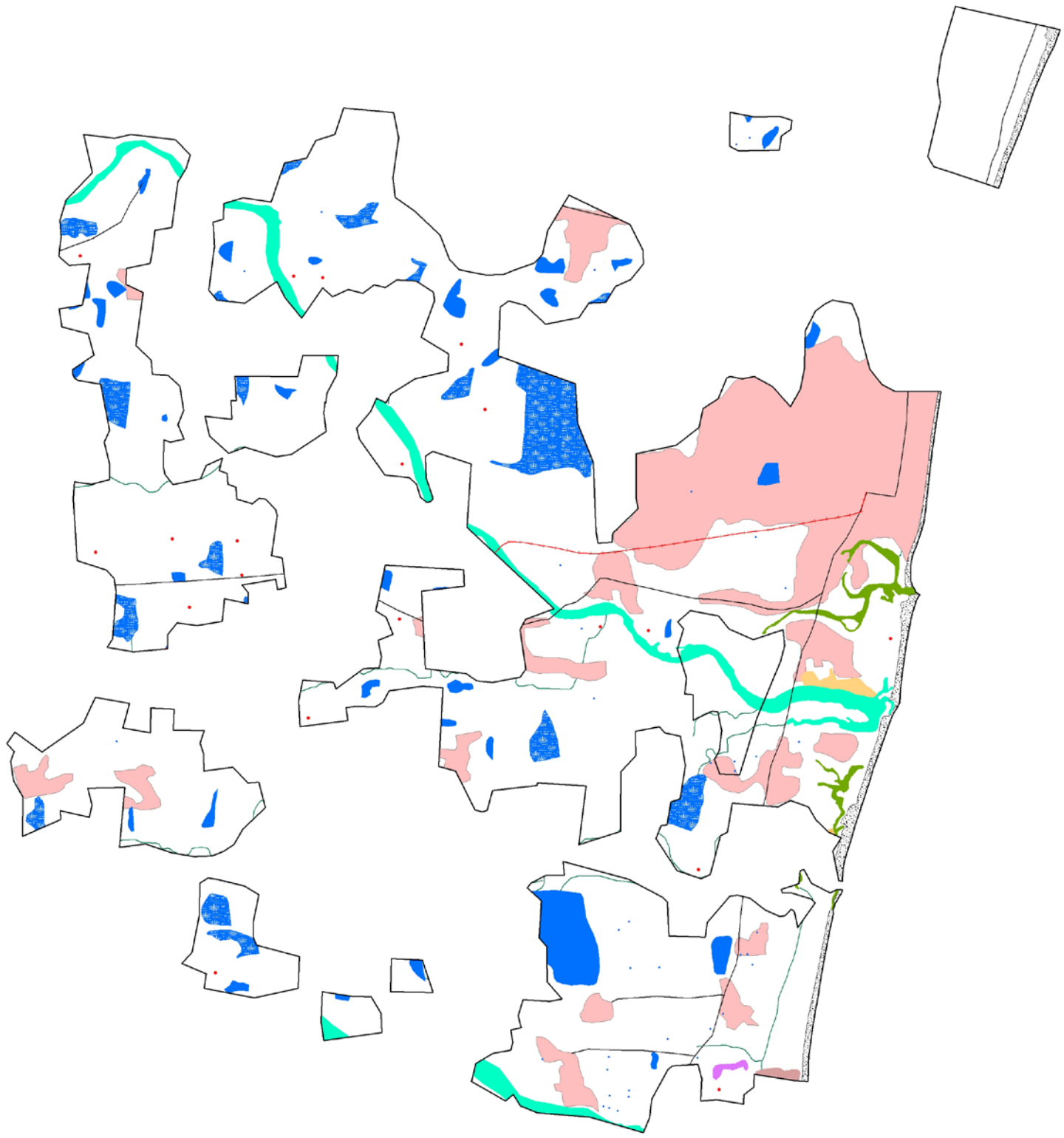
Ministry of Environment and Forests
Government of India

Plate 57: Wetland map of Yanam (Puducherry)

State : Pondicherry

WETLAND MAP

District : Pondicherry

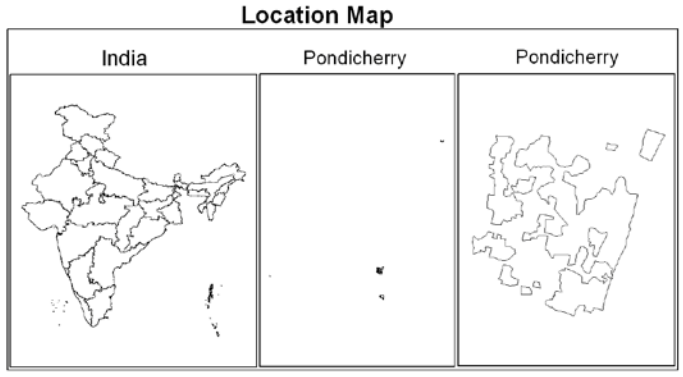


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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

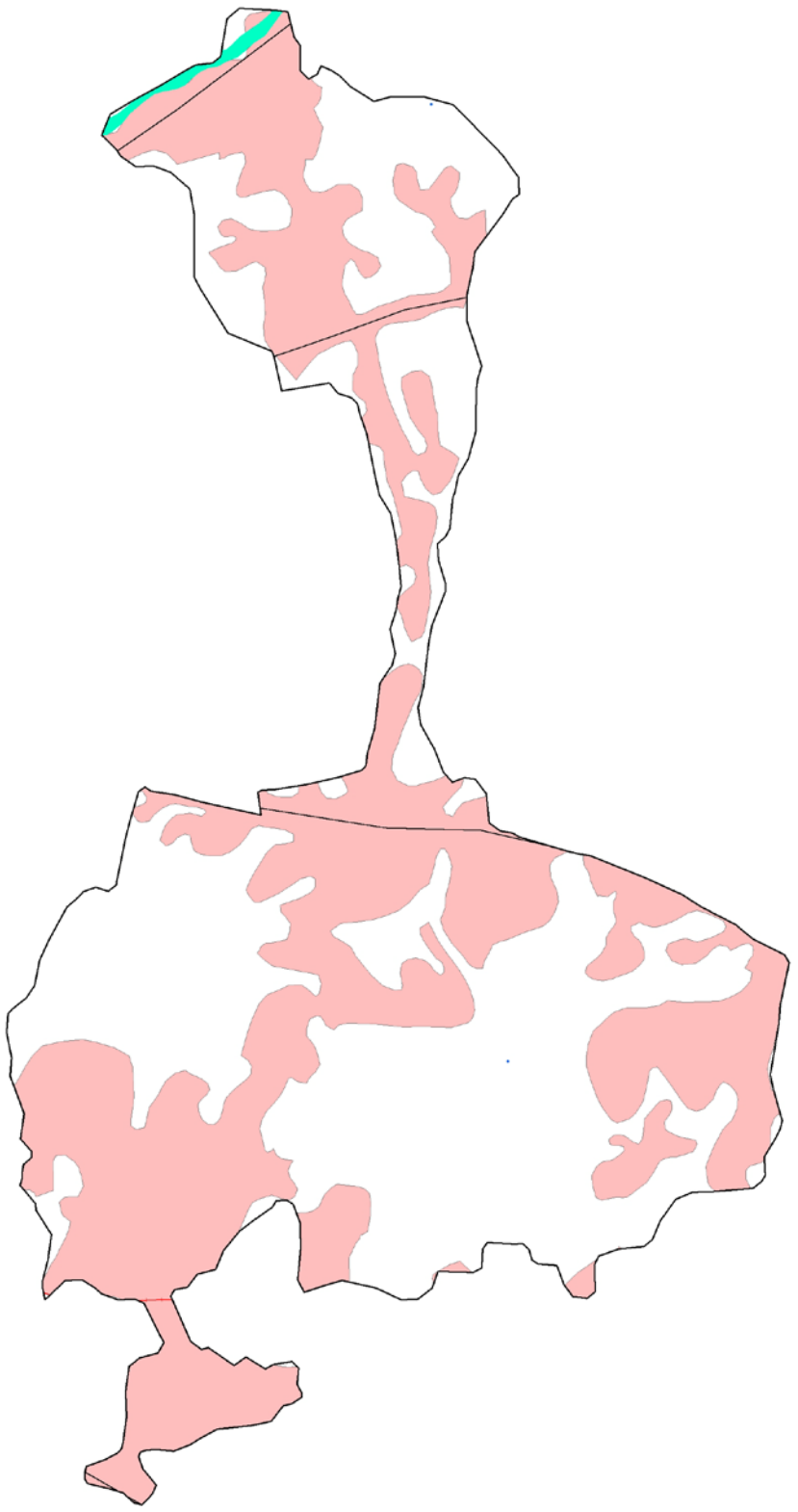
Sponsored By :
Ministry of Environment and Forests
Government of India

Plate 58 : Wetland map of Pondicherry (Puducherry)

State : Pondicherry

WETLAND MAP

District : Mahe

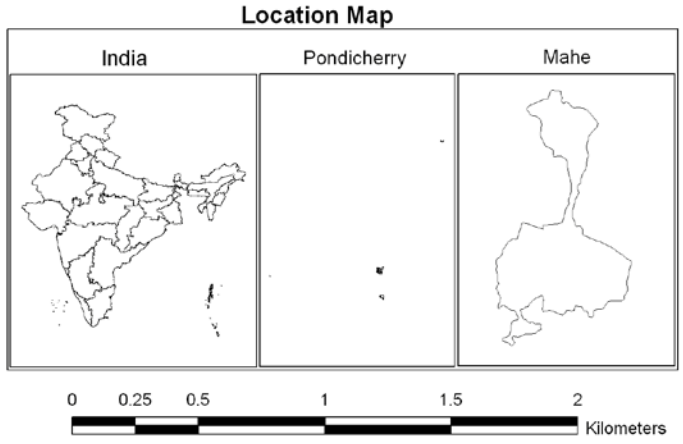


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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 :

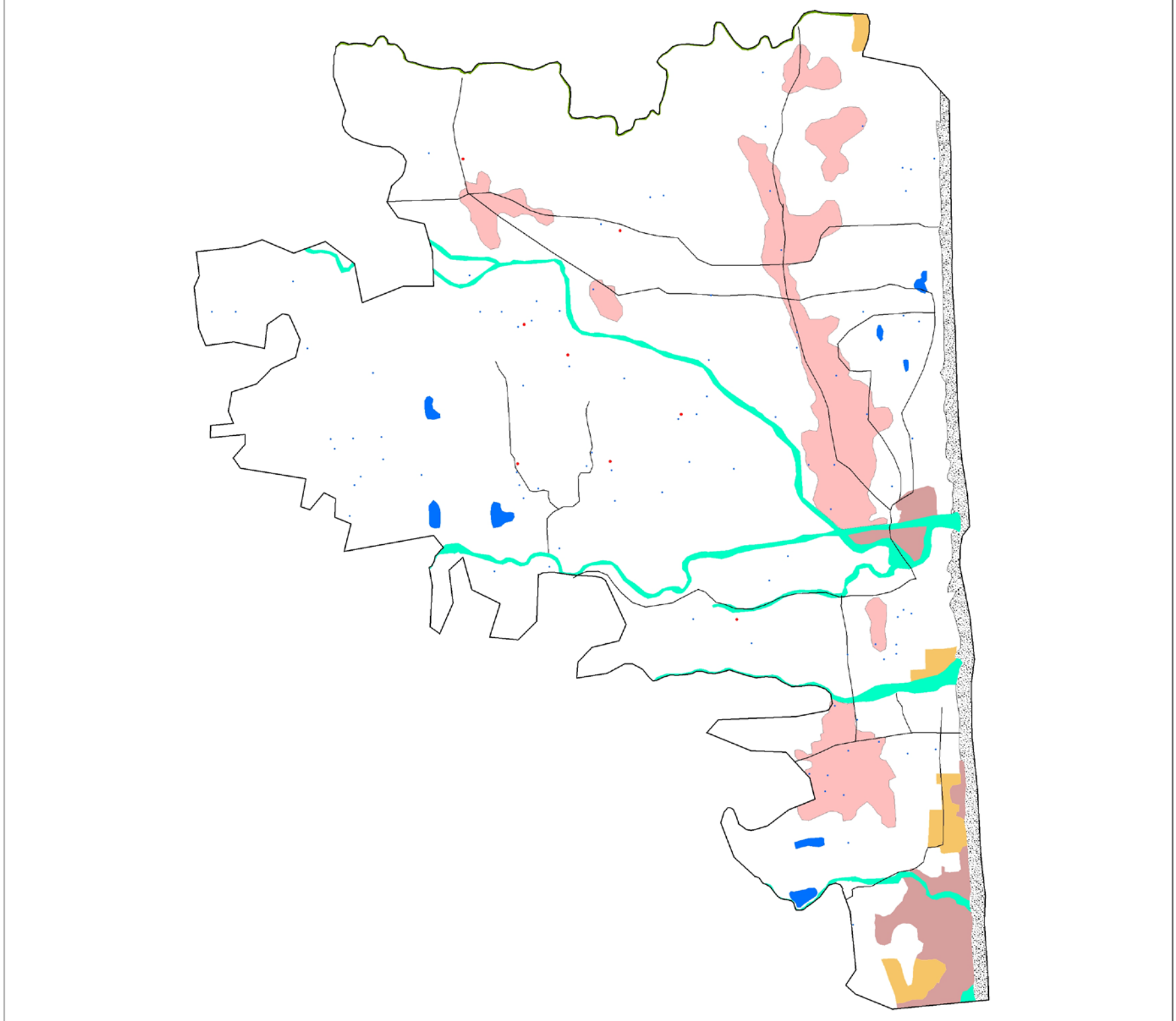
Ministry of Environment and Forests
Government of India

Plate 59 : Wetland map of Mahe (Puducherry)

State : Pondicherry

WETLAND MAP

District : Karaikal

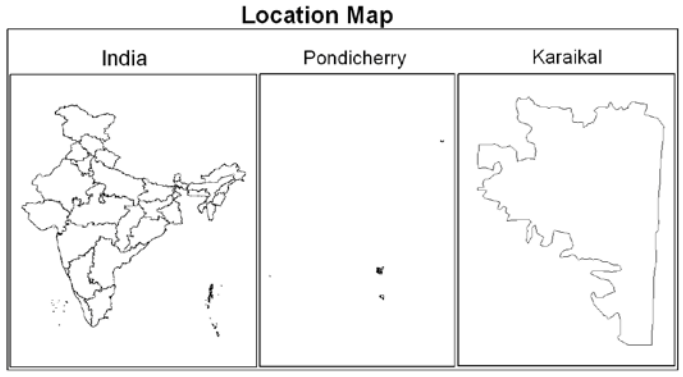


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

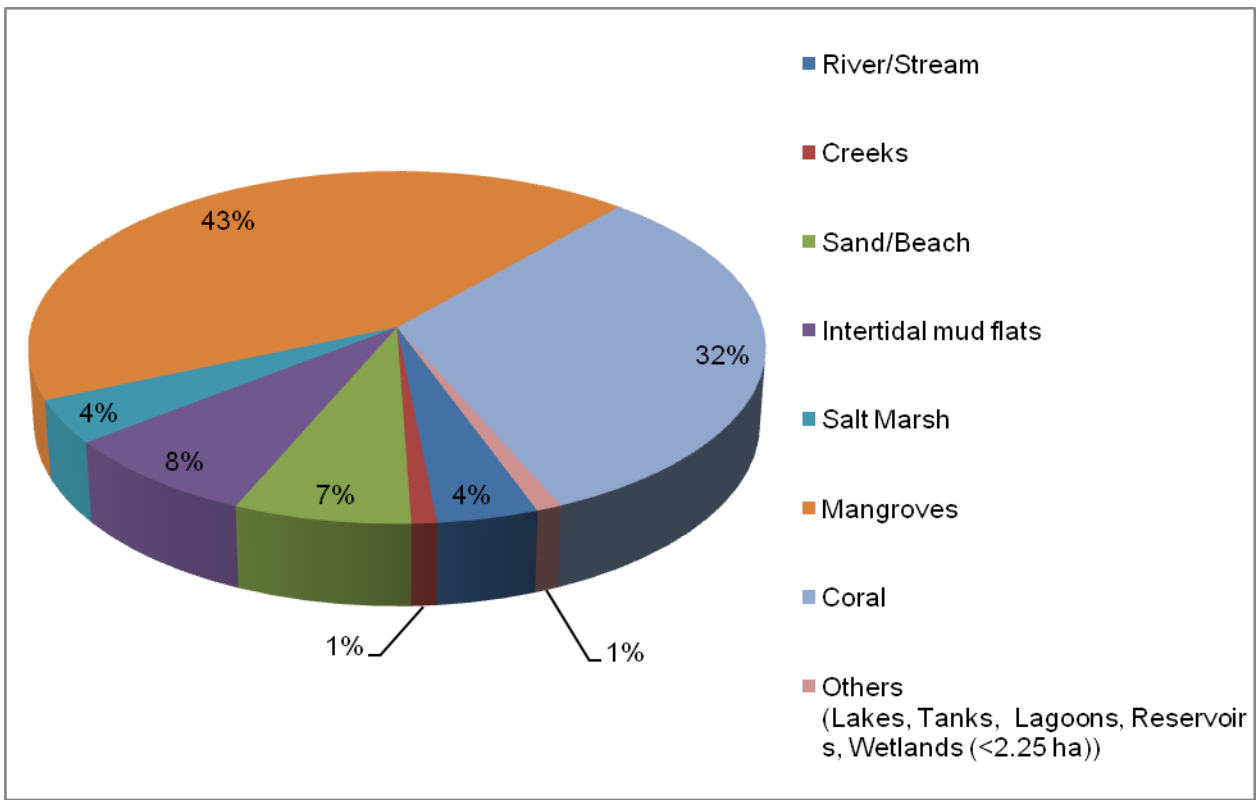


Figure 79: Type-wise wetland distribution in Andaman and Nicobar

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.

For details, refer National Wetland Atlas: Andaman & Nicobar Islands, SAC/RESA/AFEG/NWIA/ATLAS/04/2009, Space Applications Centre (ISRO), Ahmedabad, India, 190P.

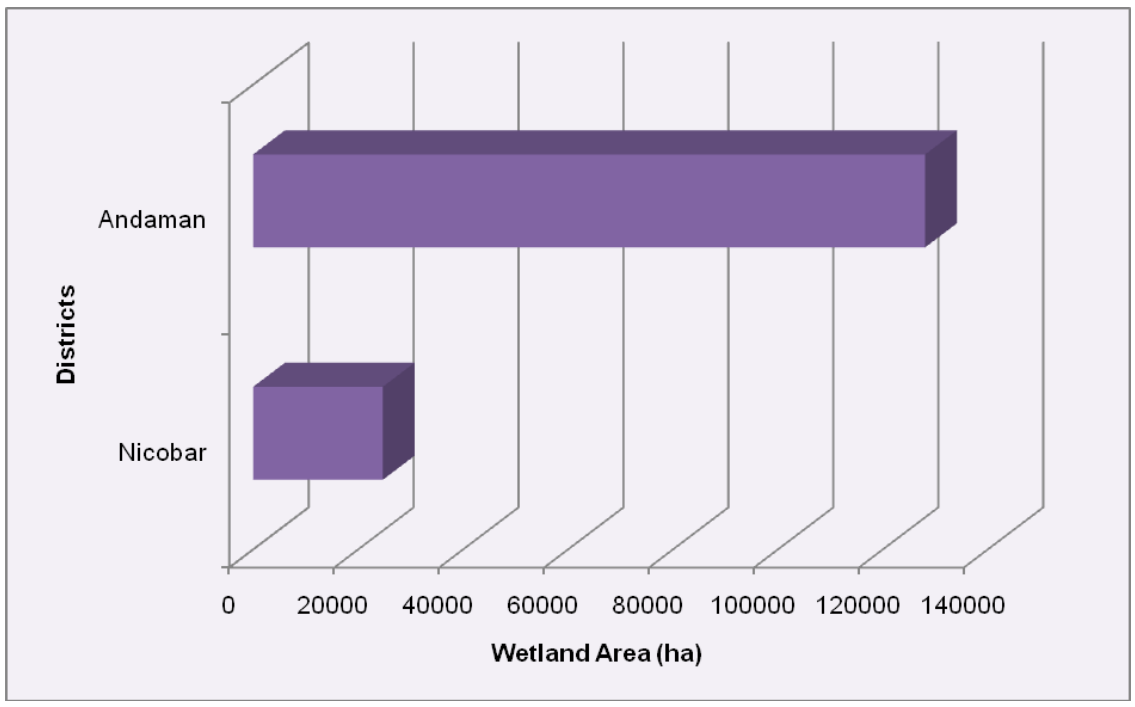


Figure 80: District-wise graphical distribution of wetlands in Andaman and Nicobar

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

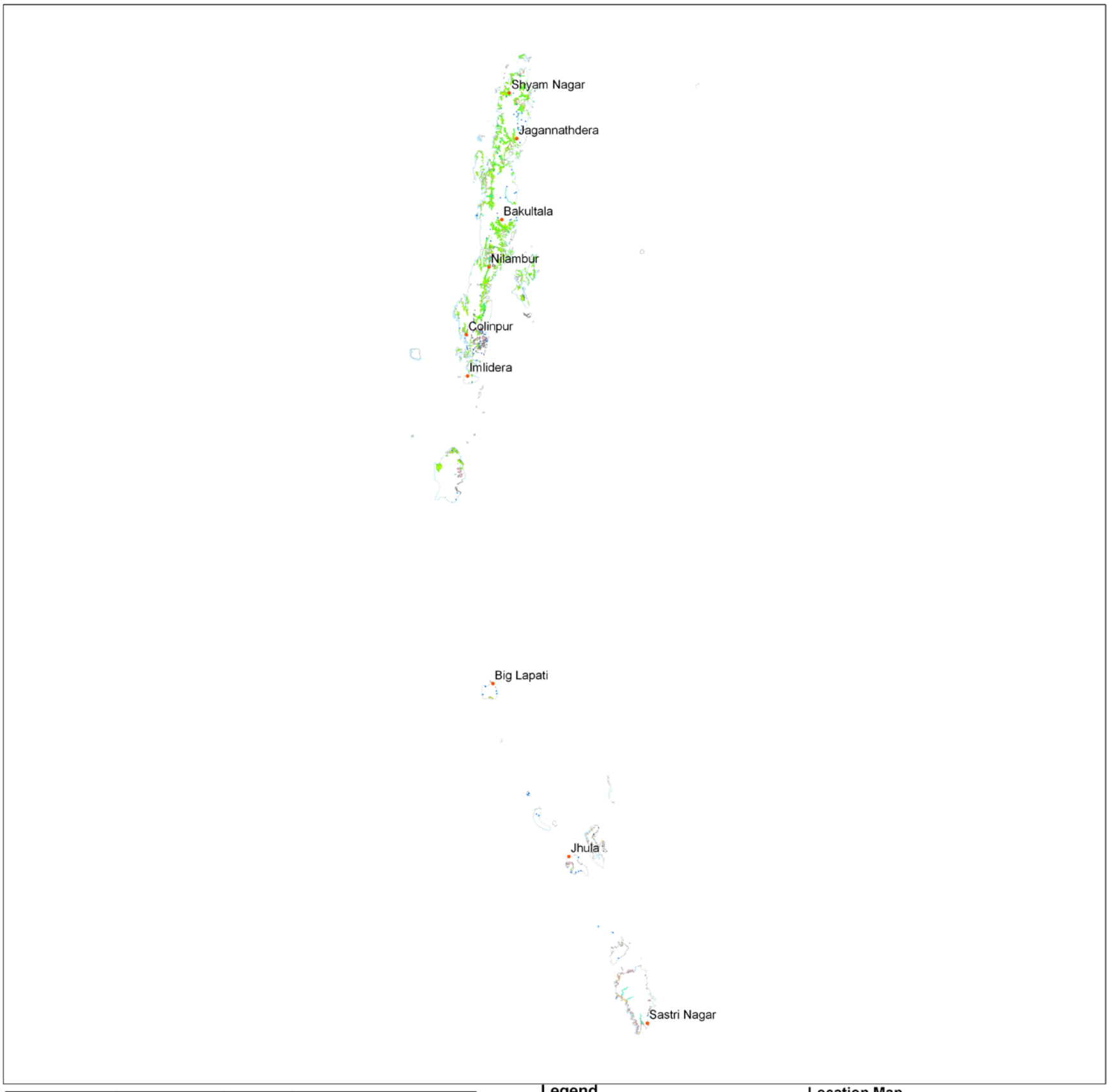
District code	District	Geographic area *	Wetland Type											Sub-total	Wetlands (<2.25 ha)	Total
			1101	1106	1201	1202	2101	2102	2103	2104	2105	2106	2107			
			Lake/ pond	River/ Stream	Reservoir/ Barrage	Tank/ Pond	Lagoon	Creek	Sand/ Beach	Intertidal mud flat	Salt Marsh	Mangrove	Coral Reef			
		(sq. 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

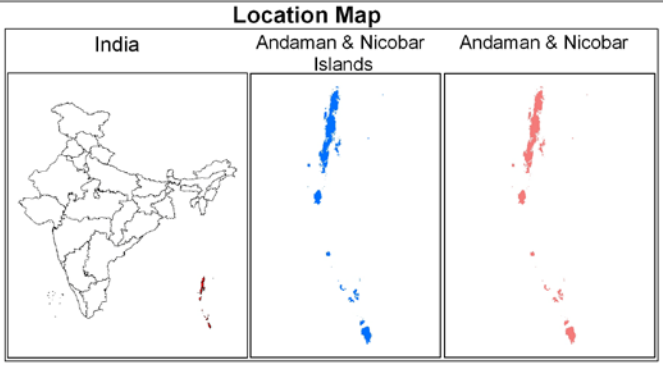


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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 climatic conditions, encompassing 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. Some of these have been given different protection status as well as recognised as Ramsar sites, National Parks, bird Sanctuaries, Notified wetlands etc. Conservation and management of these wetlands will require not only the details about the wetlands status, but also the surroundings.

An attempt has been made to map the wetlands and its environs (a buffer of 5 km). Full details of such wetlands are available in respective state-wise atlases. Examples of some of the wetlands are given in the following pages as per Table-109. Area estimates and status of Water-spread and Aquatic vegetation is given in Table 110.

Table 109: List of few selected wetlands with 5 km buffer

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	Nal Sarovar	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 few selected wetlands

Area in ha

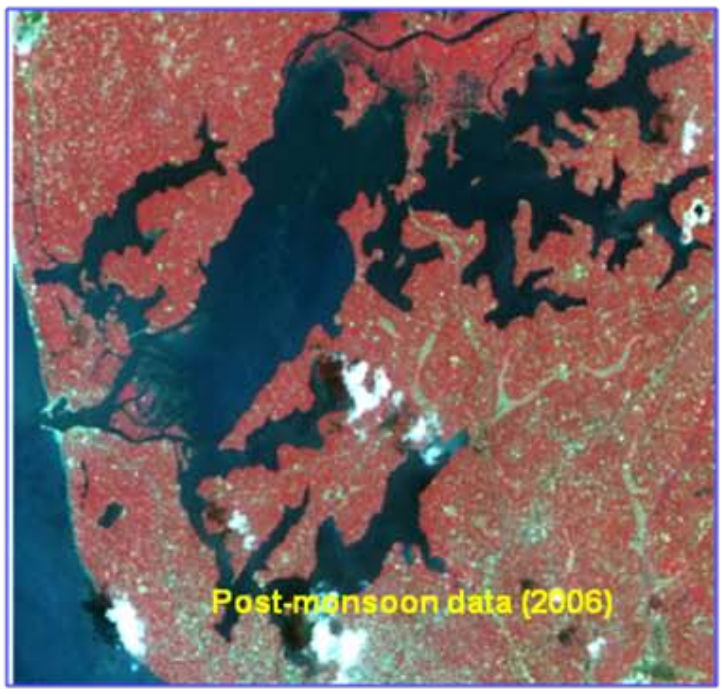
Sr. No.	Wetland name	Area	Open Water		Aquatic Vegetation		Turbidity
			Post-monsoon	Pre-monsoon	Post-monsoon	Pre-monsoon	
1	Ashtamudi Wetland	5598	5458	5458	1219	1219	Low
2	Bakhira Wildlife Sanctuary	4174	1860	957	1948	3957	Low
3	Bhoj Wetland	3420	3420	1666	-	1425	Moderate
4	Chilika Lake	89023	60699	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	-	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	-	-	-	-	-

Wetland description, wetland map and corresponding satellite image of 5 km buffer area are shown in the plates 62 - 113.

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.







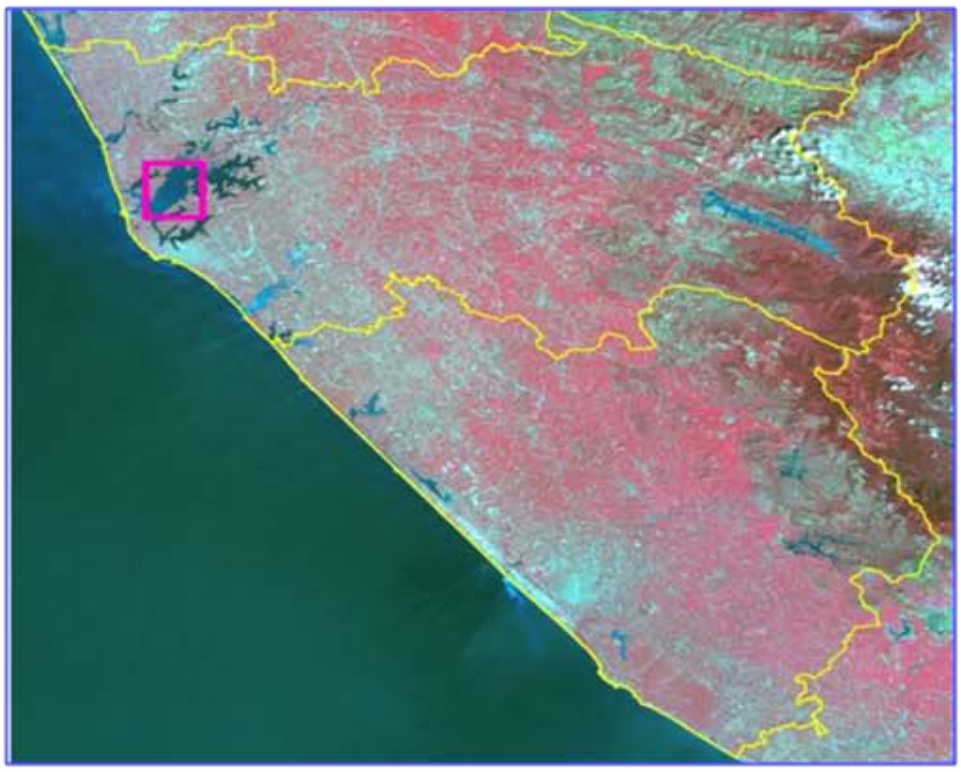


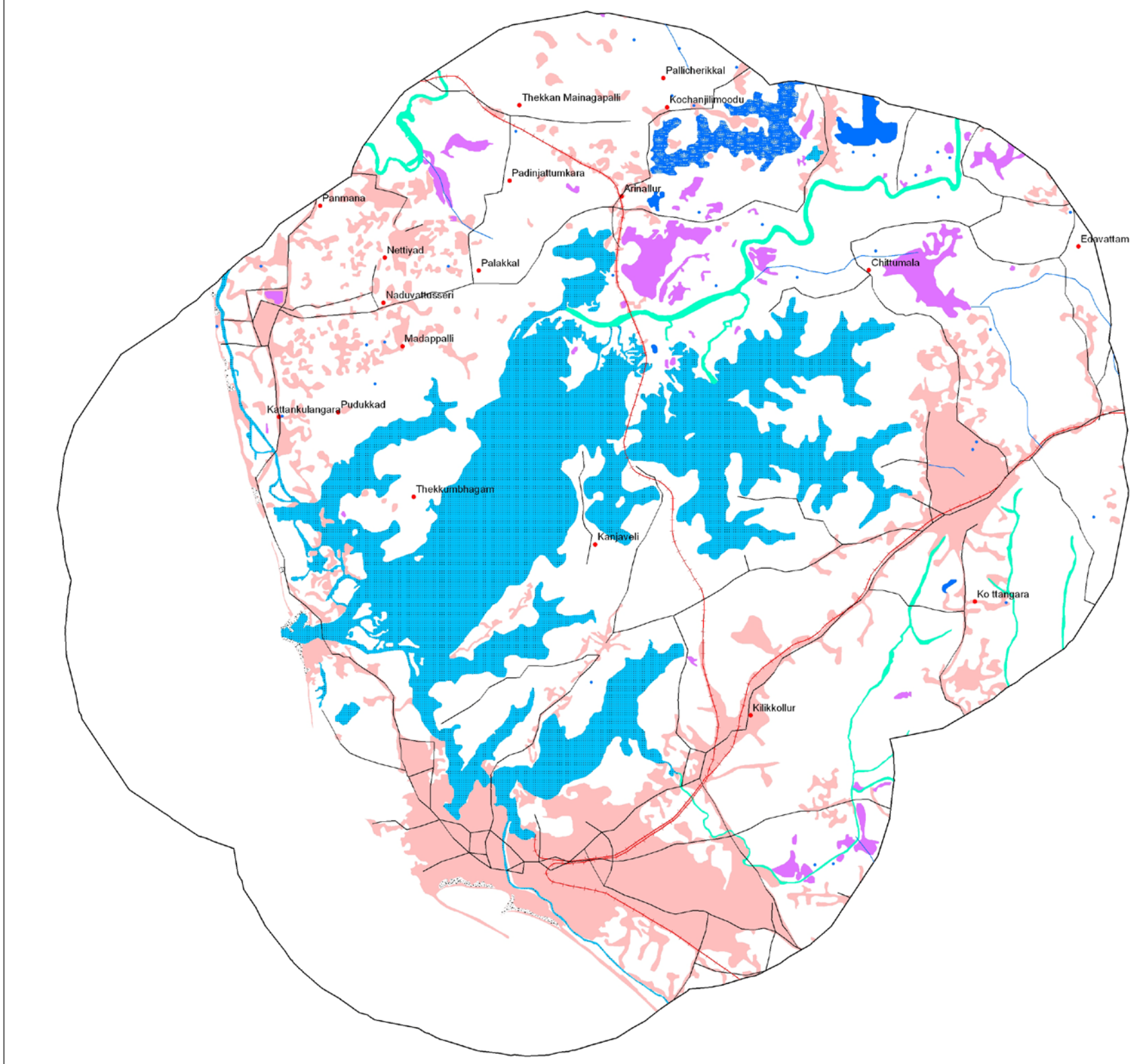


Plate 62: Ashtamudi wetland

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



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
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

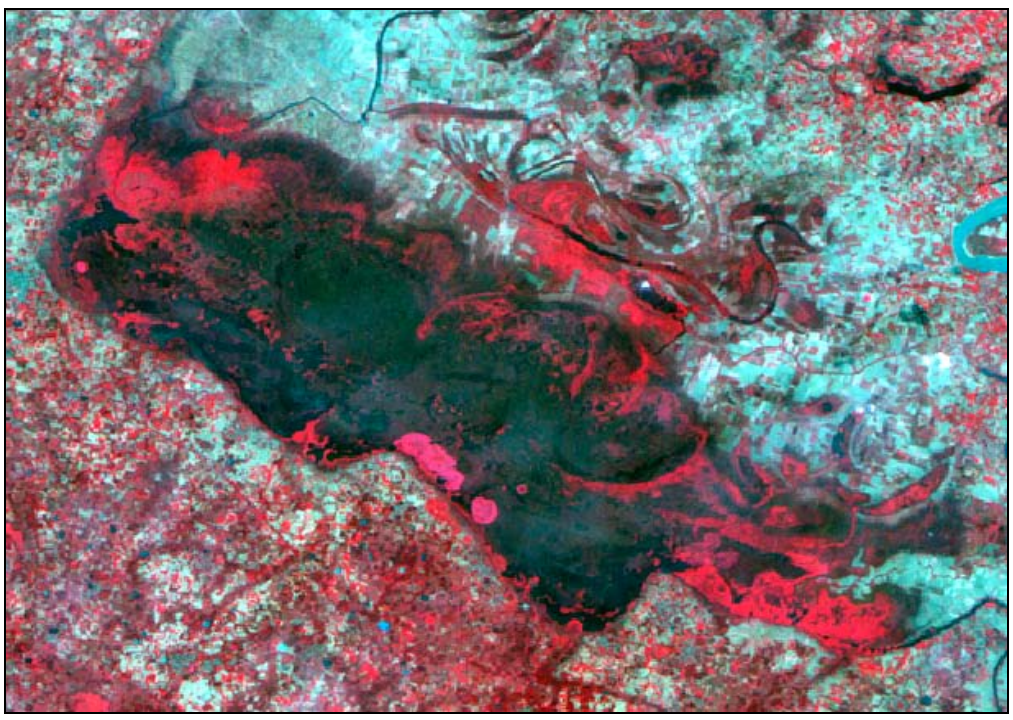


IRS P6 LISS-III post-monsoon data (2006)

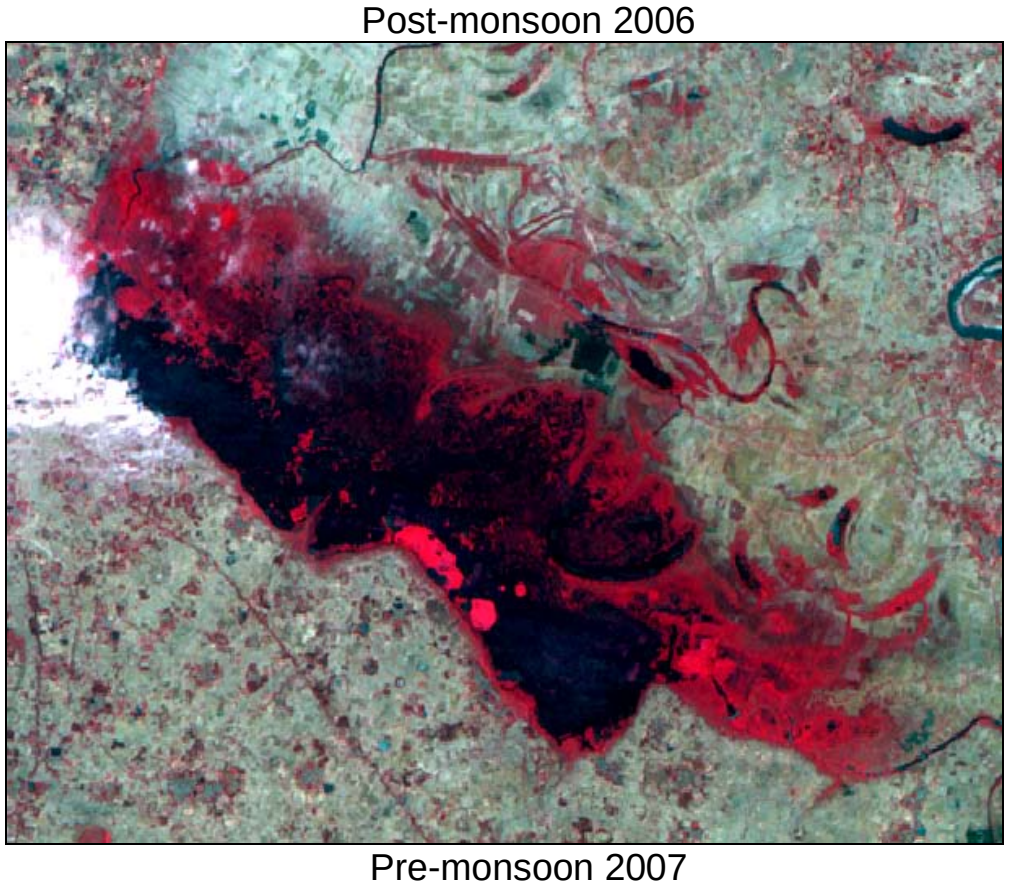
Plate 64: IRS LISS-III FCC - 5 km buffer area of Ashtamudi wetland

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



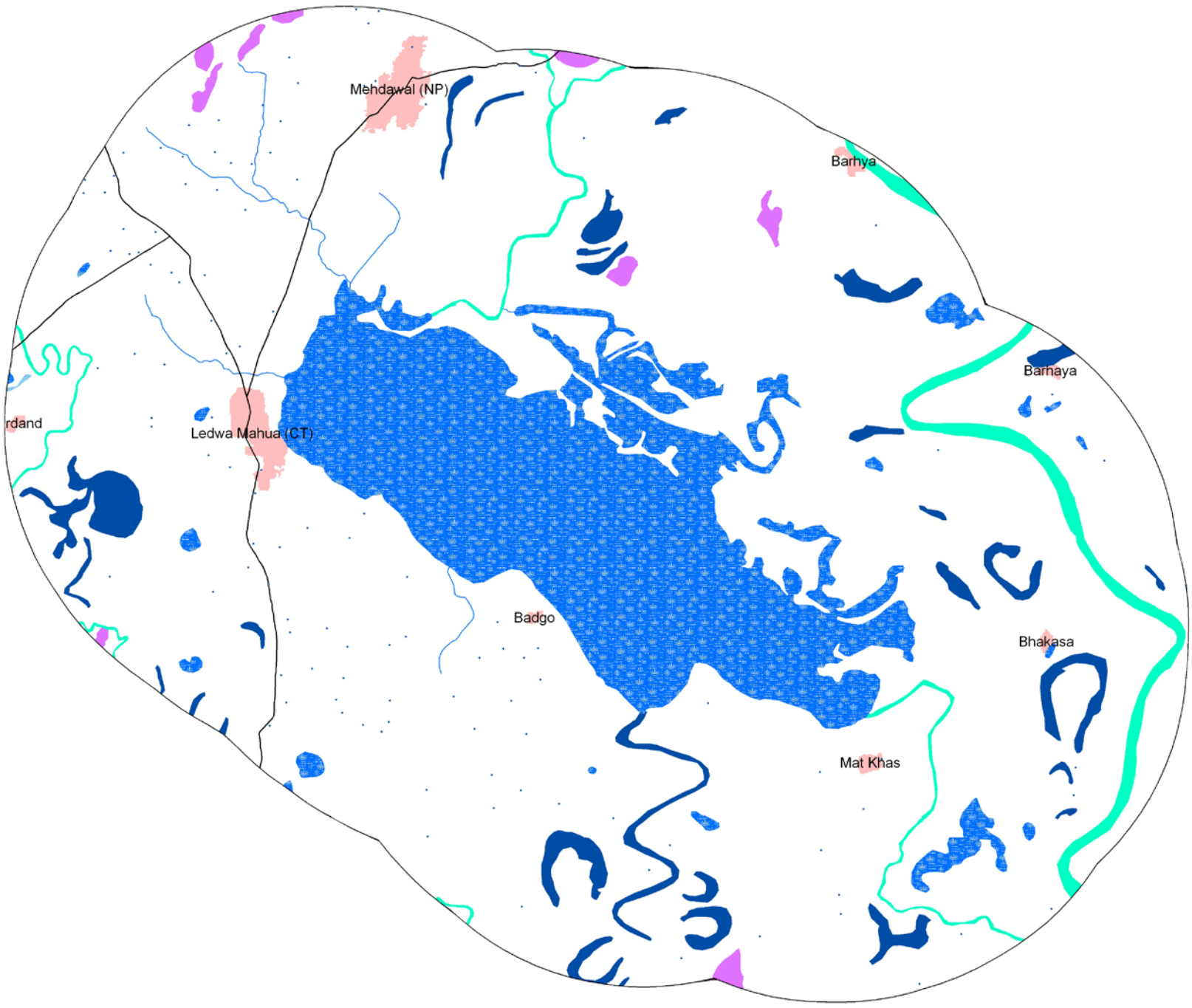
Pre-monsoon 2007

Plate 65: Bakhira Wildlife Sanctuary

State : Uttar Pradesh

WETLAND MAP

Bakhira Wildlife Sanctuary

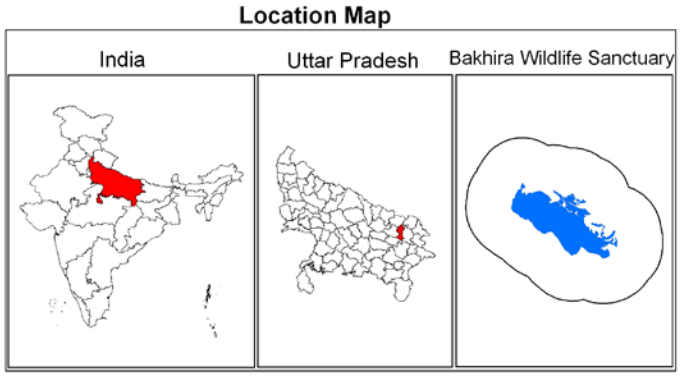


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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

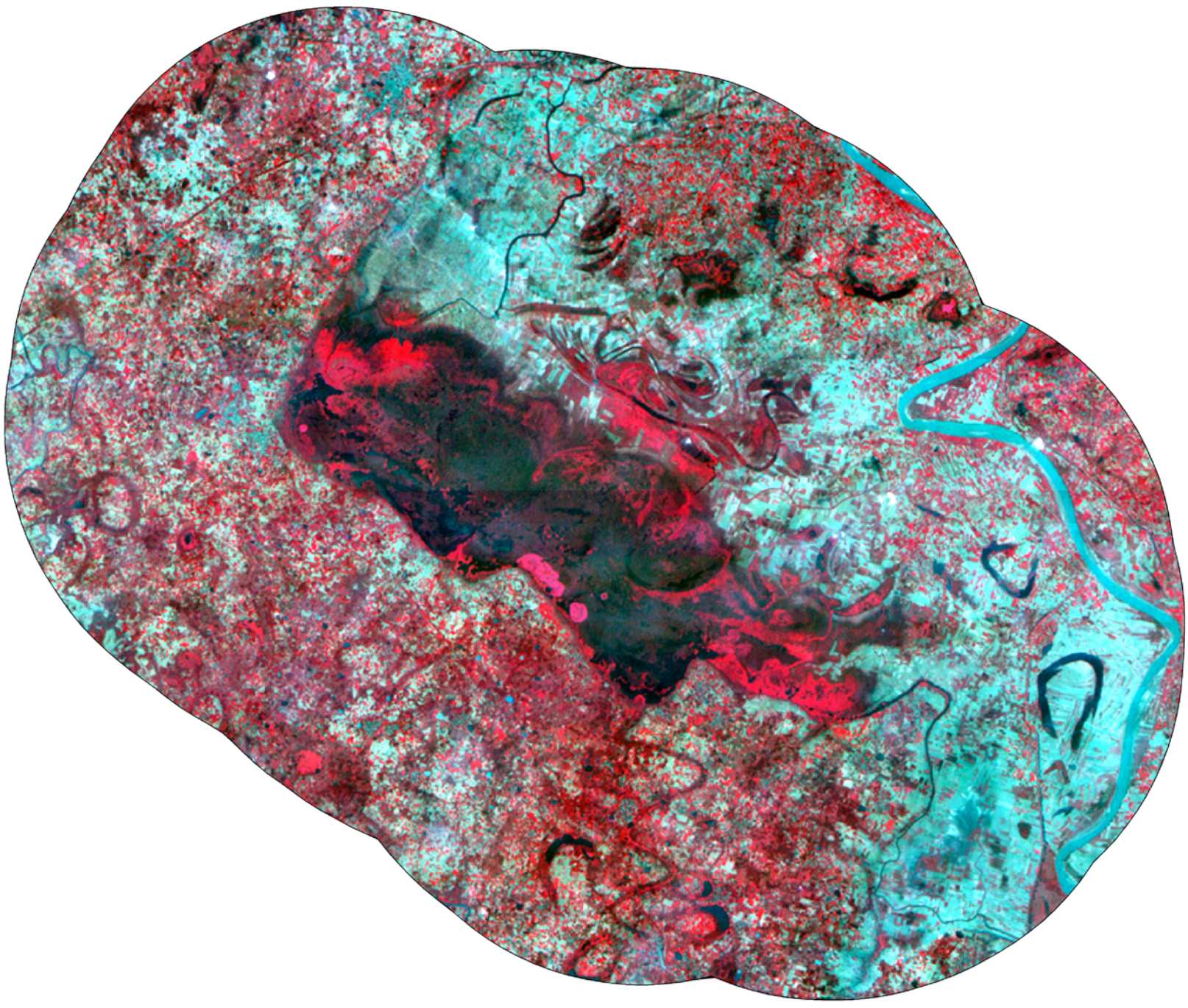
Ministry of Environment and Forests
Government of India

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

State : Uttar Pradesh

WETLAND MAP

Bakhira Wildlife Sanctuary

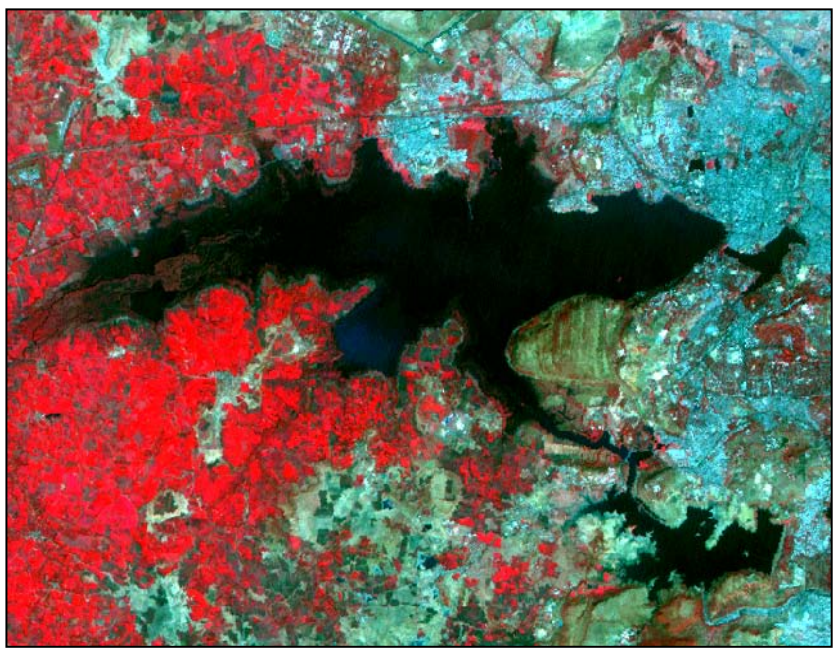


IRS P6 LISS-III post monsoon data (2006)

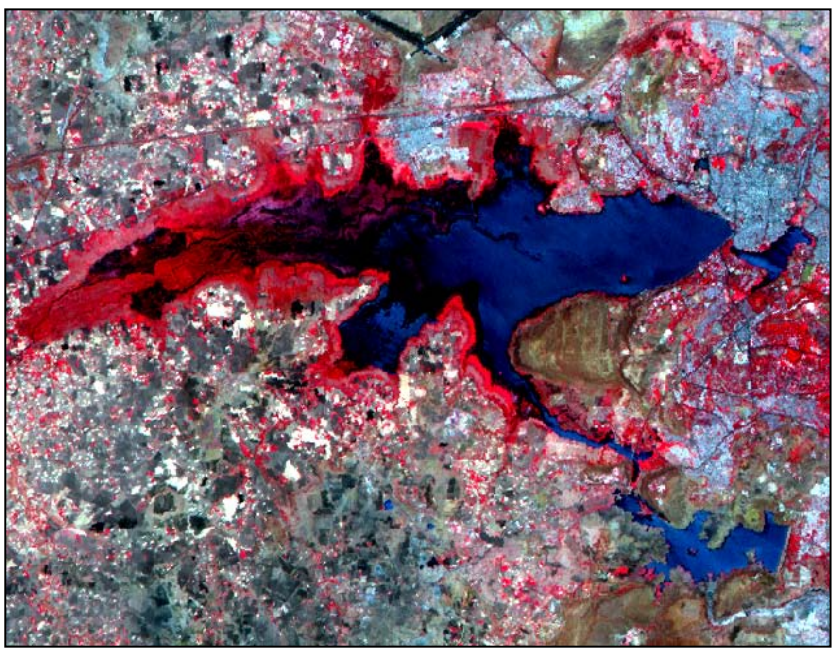
Plate 67: IRS LISS-III FCC – 5 km buffer area of Bakhira Wildlife Sanctuary

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

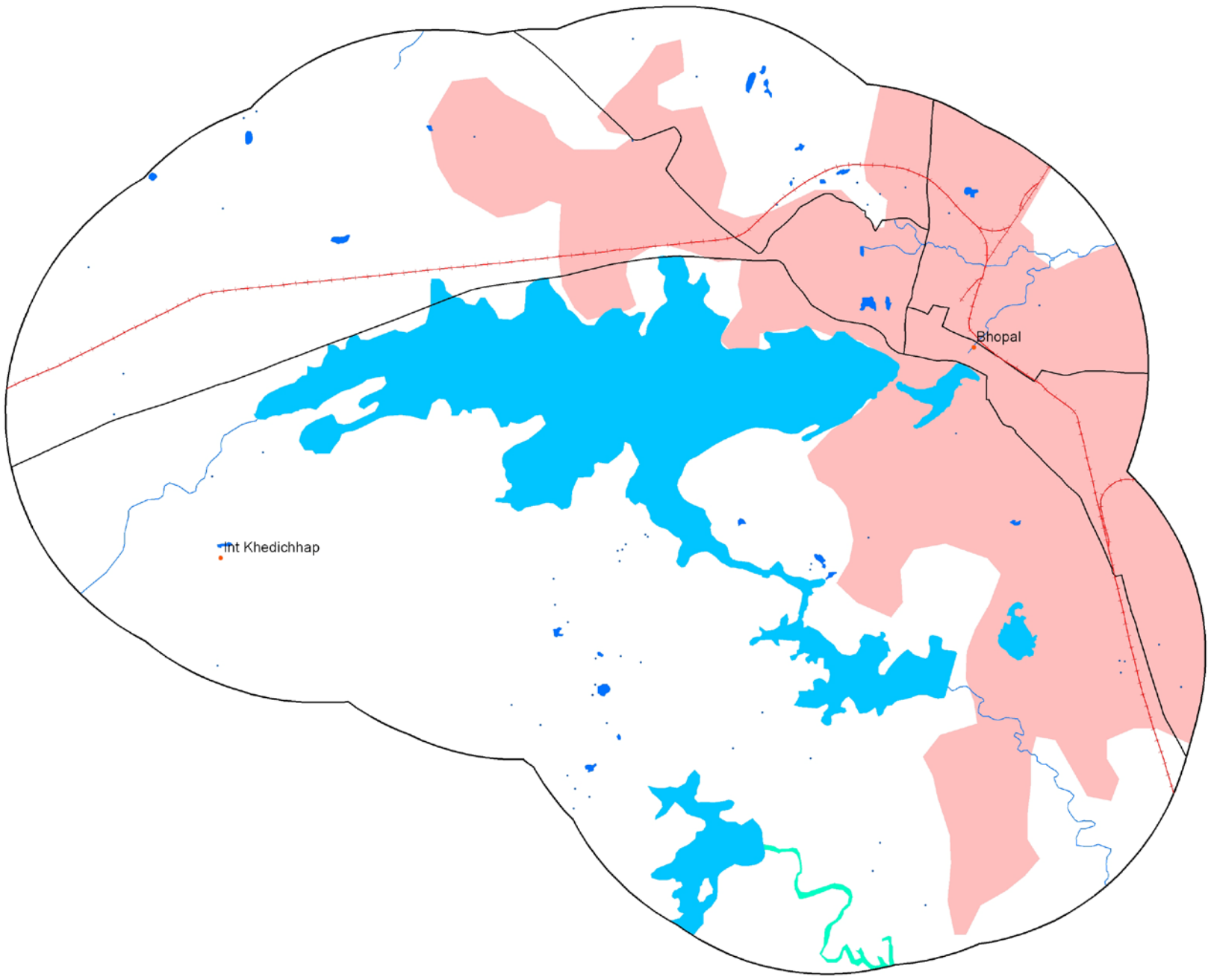


Plate 68: Bhoj Lake

State : Madhya Pradesh

WETLAND MAP

Bhoj Reservoir

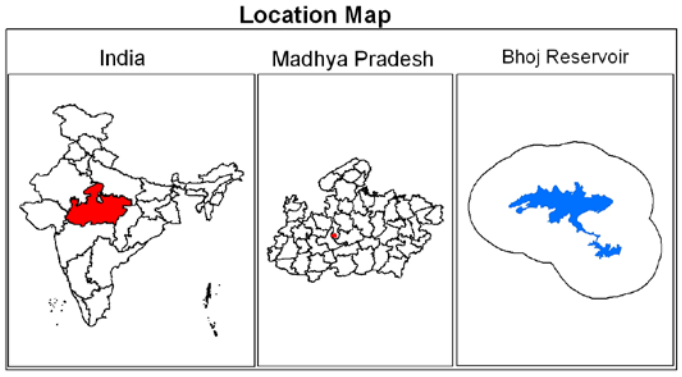


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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.

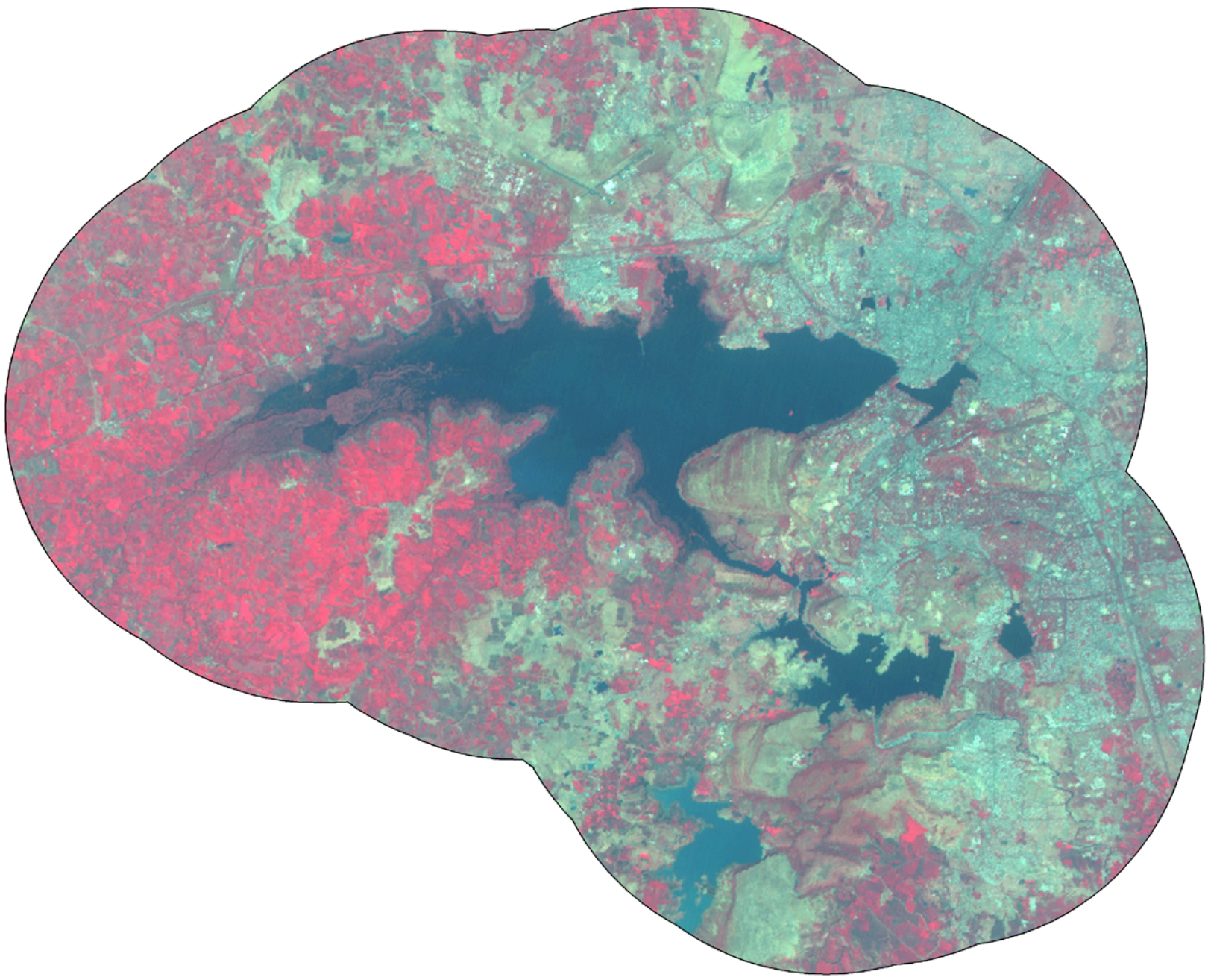
Sponsored By:

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.

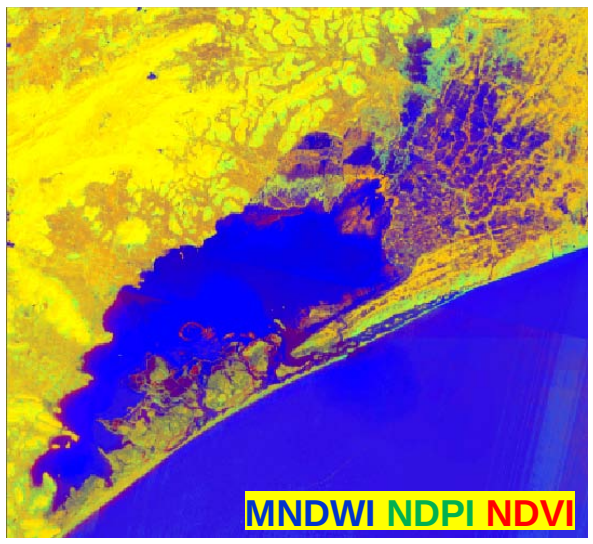
Flora: 22 species algae,150 species of vascular plants are recorded in the lagoon. The dominant emergent plants are *Pragmites karka*, *Typha angustata*, *Cyperus sp*. and *Kailinga triceps*. Submerged vegetation is dominated by *Enteromorpha sp*., *Gracillaria sp*., *Cladophora sp*., *Polysiphonia sp*.,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





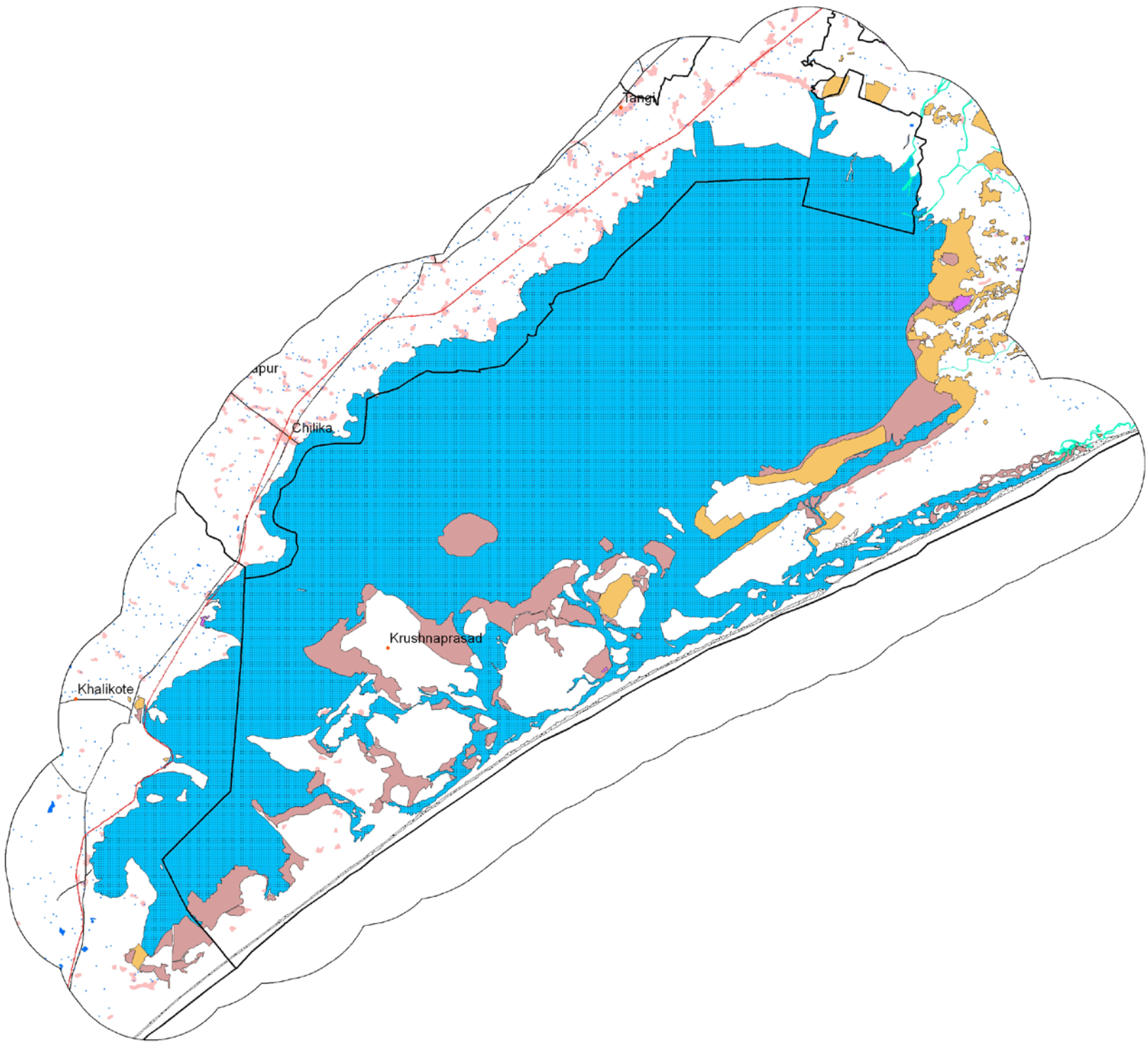


Plate – 71: Chilika Lagoon

State : Orissa

WETLAND MAP

Chilika Lagoon

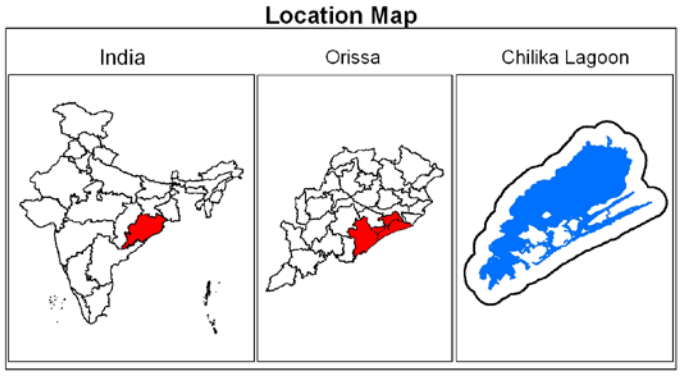


Symbol Typecode	Level I	Level II	Level III
	Inland Wetlands		
		Natural	
1101			Lakes/Ponds
1102			Ox-bow lakes/ Cut-off meanders
1103			High altitude wetlands
1104			Riverine wetlands
1105			Waterlogged
1106			River/Stream
		Man-made	
1201			Reservoirs/Barrages
1202			Tanks/Ponds
1203			Waterlogged
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)

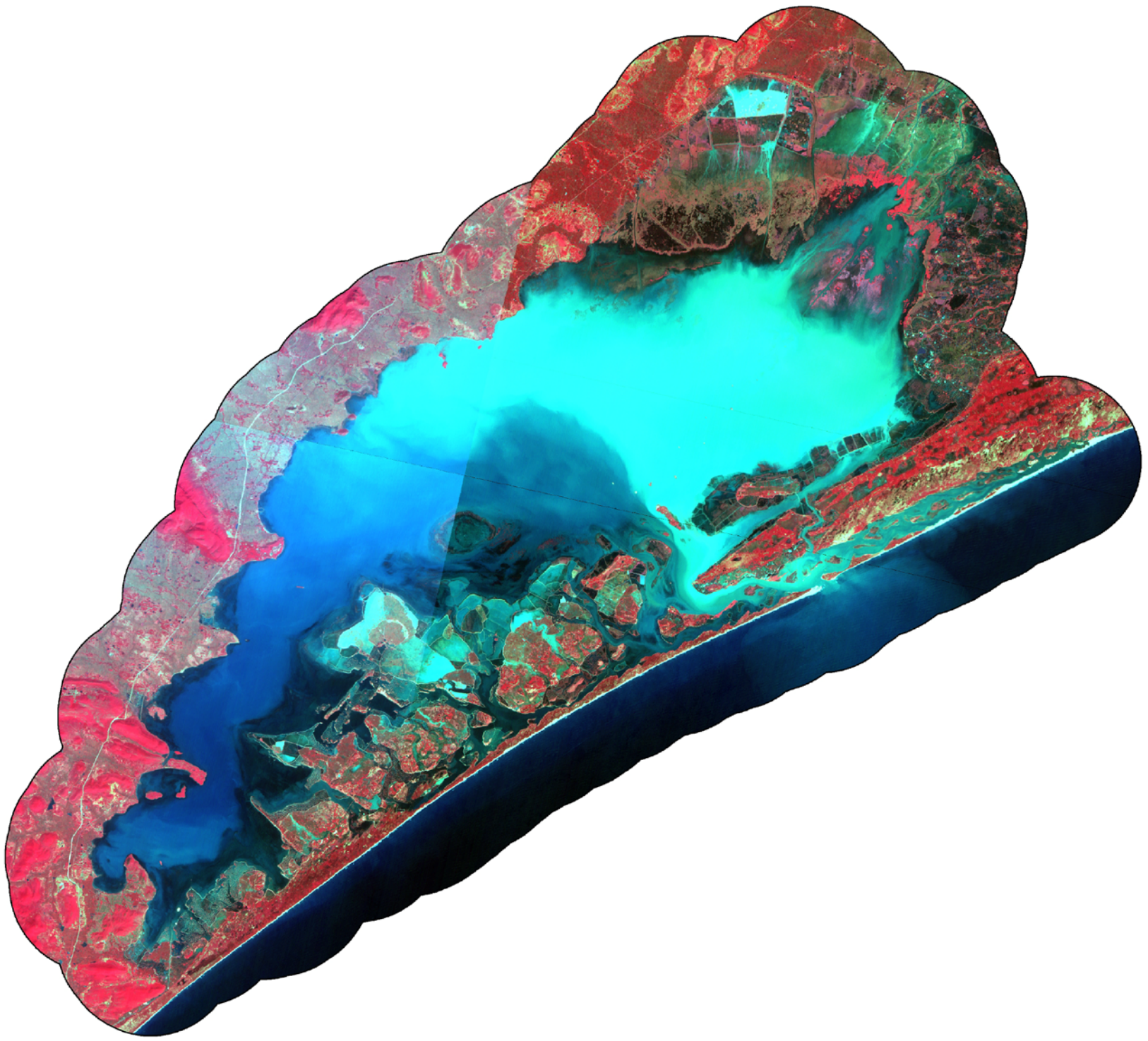
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Orissa Space Applications Centre, Bhubaneswar

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

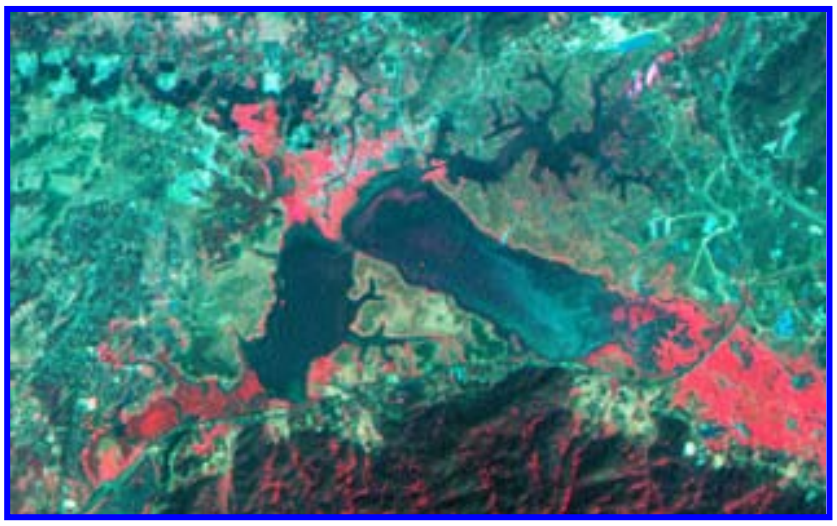


IRS P6 LISS III post-monsoon data (2006)

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 District: Kamrup Ownership: State, Fishery Department
Area	589 ha
Wetland Type	Freshwater Swamp, Lake
Climate	Rainfall : >2000 mm 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.* 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)



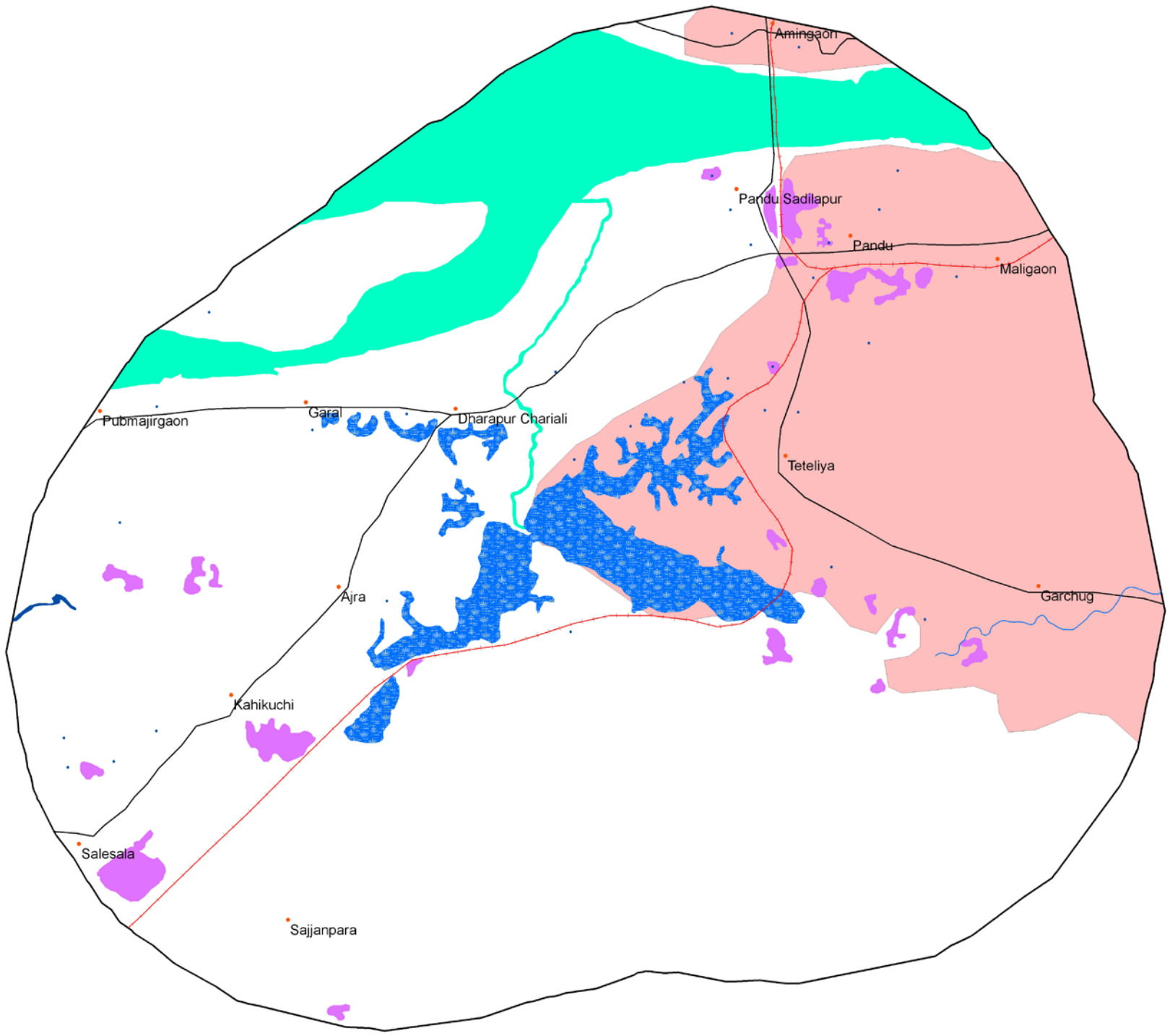


Plate 74: Deepor Beel

State : Assam

WETLAND MAP

Deepor Beel

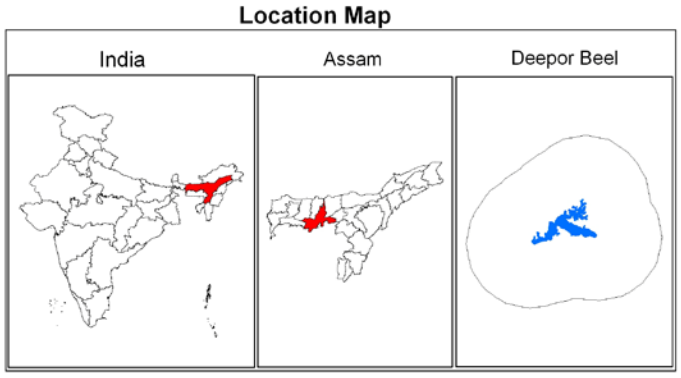


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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

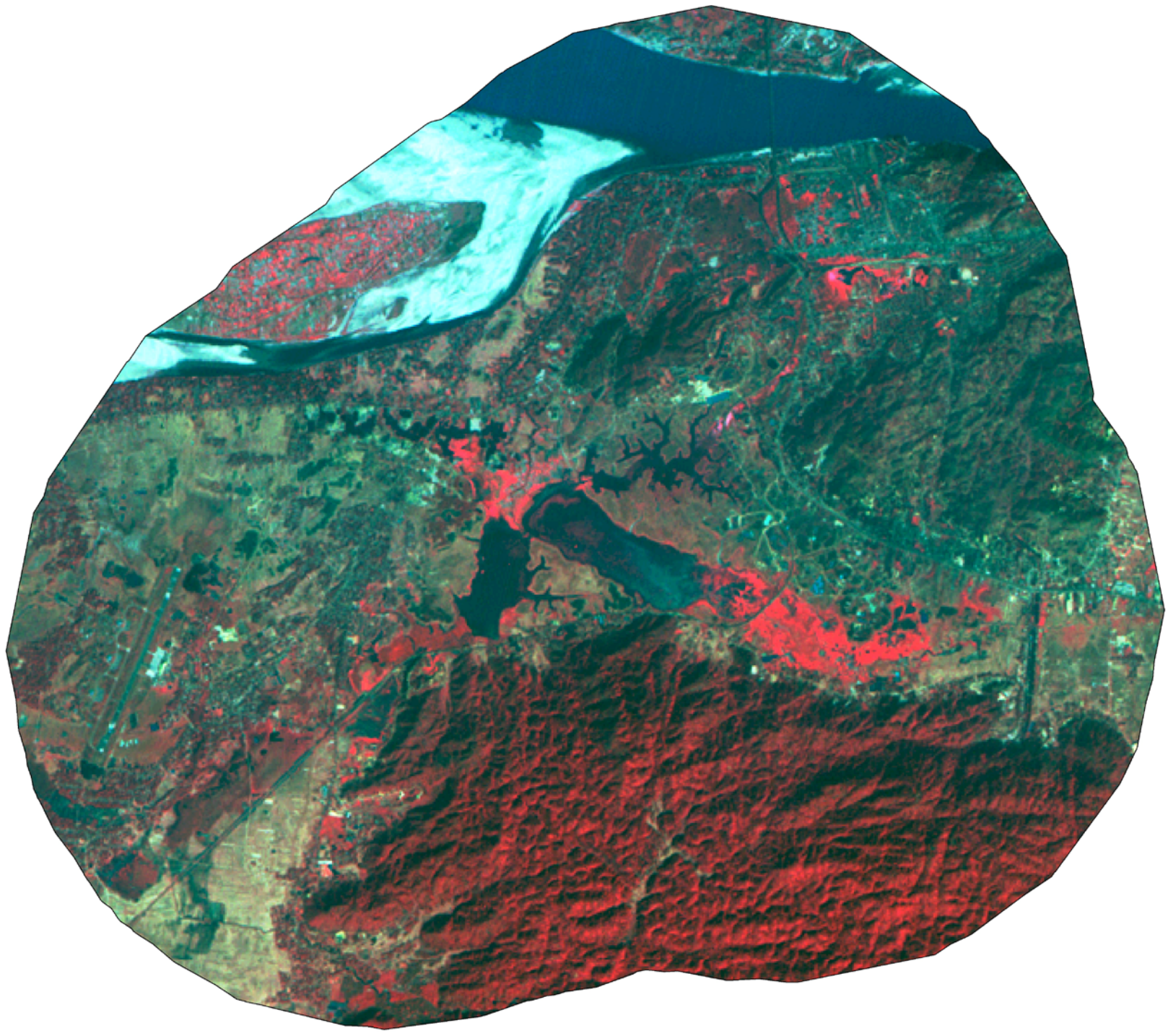
Sponsored By:

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



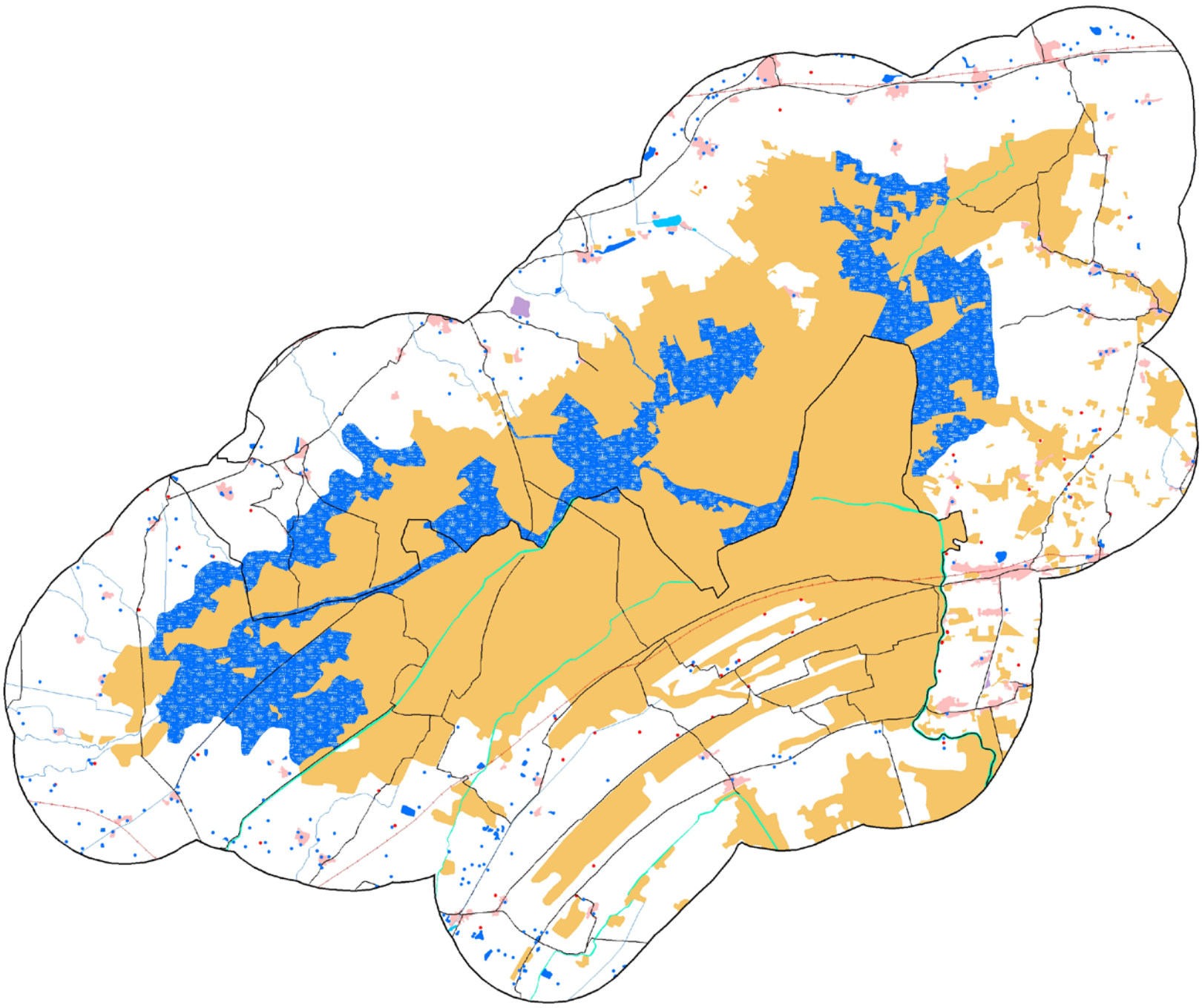
IRS P6 LISS-III image: Part of Kolleru lake

Plate 77: Kolleru Lake

State : Andhra Pradesh

WETLAND MAP

Kolleru Lake

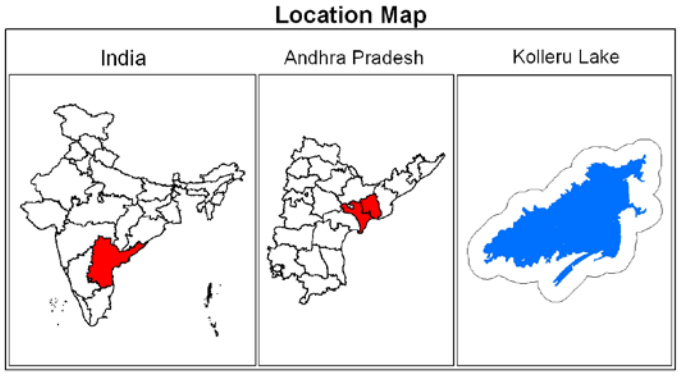


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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

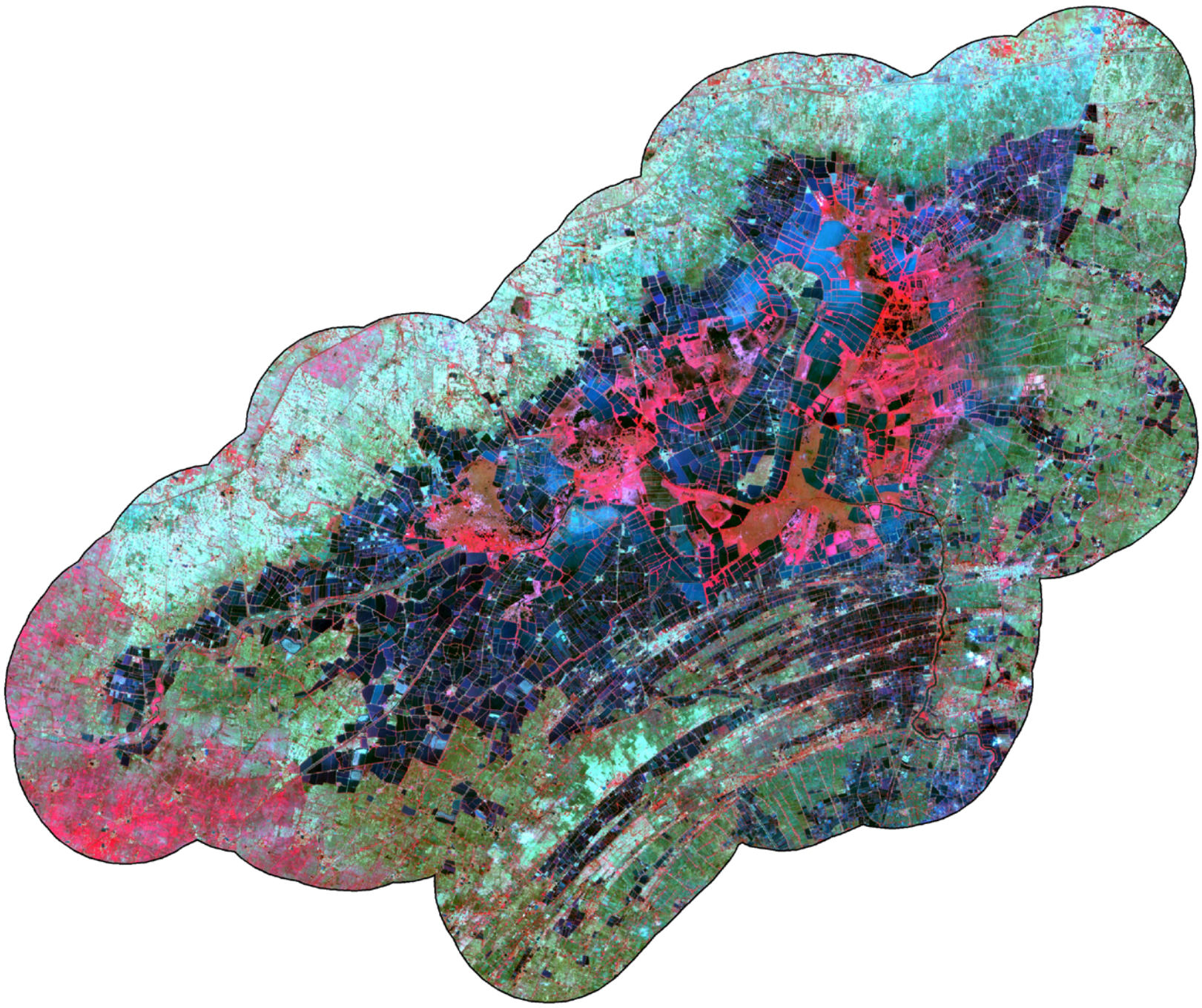
Sponsored By:

Ministry of Environment and Forests
Government of India

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

State : Andhra Pradesh

Kolleru Lake

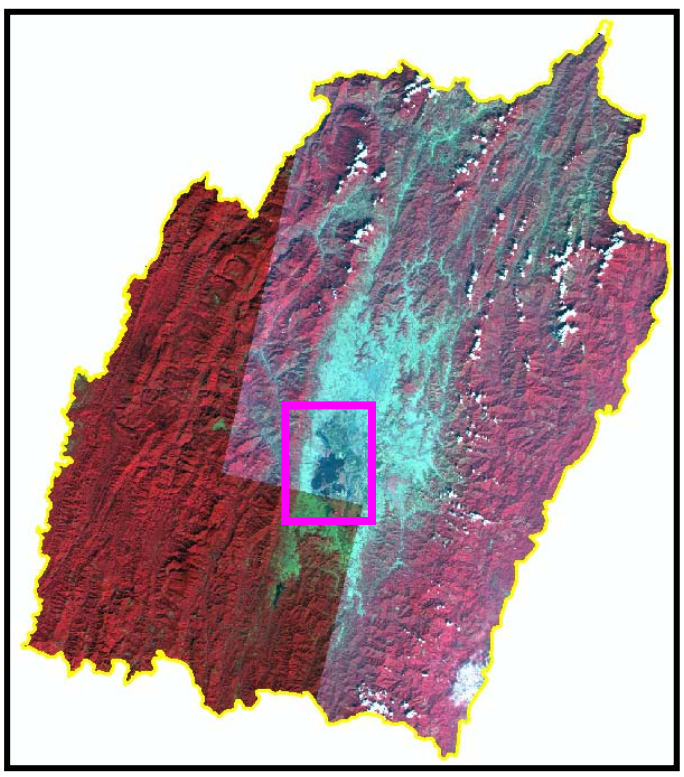


IRS P6 LISS-III Post-monsoon data (2006)

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 Temperature: 0^o to 35^o C.
Morphometric features	Maximum length: 26 km Maximum breadth: 13 km Maximum depth: 4.58 m 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.



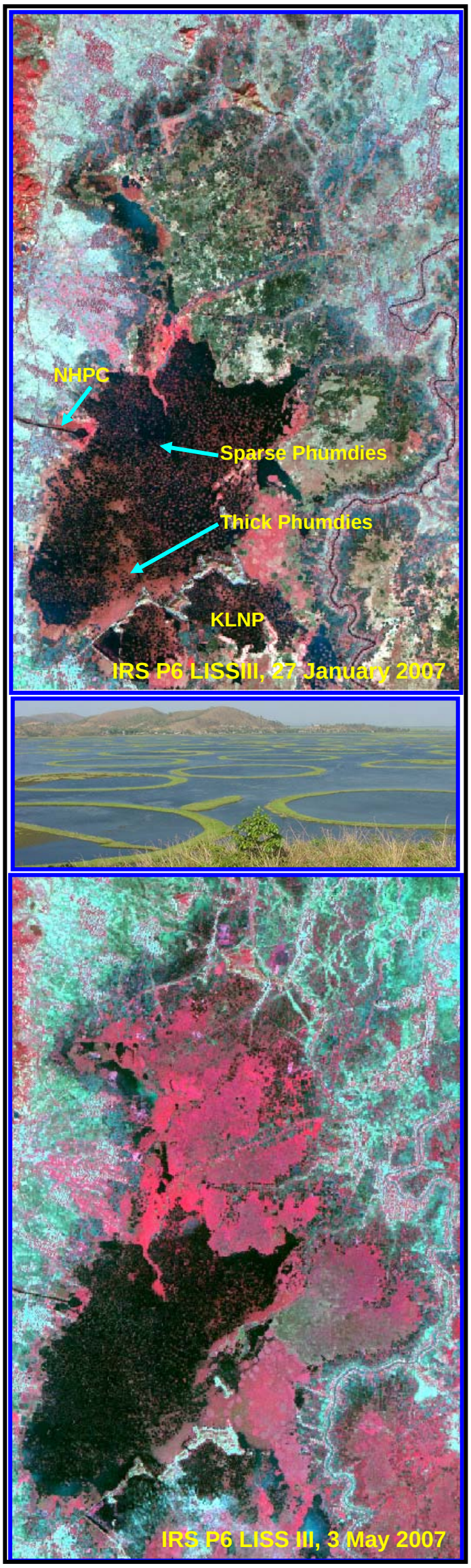
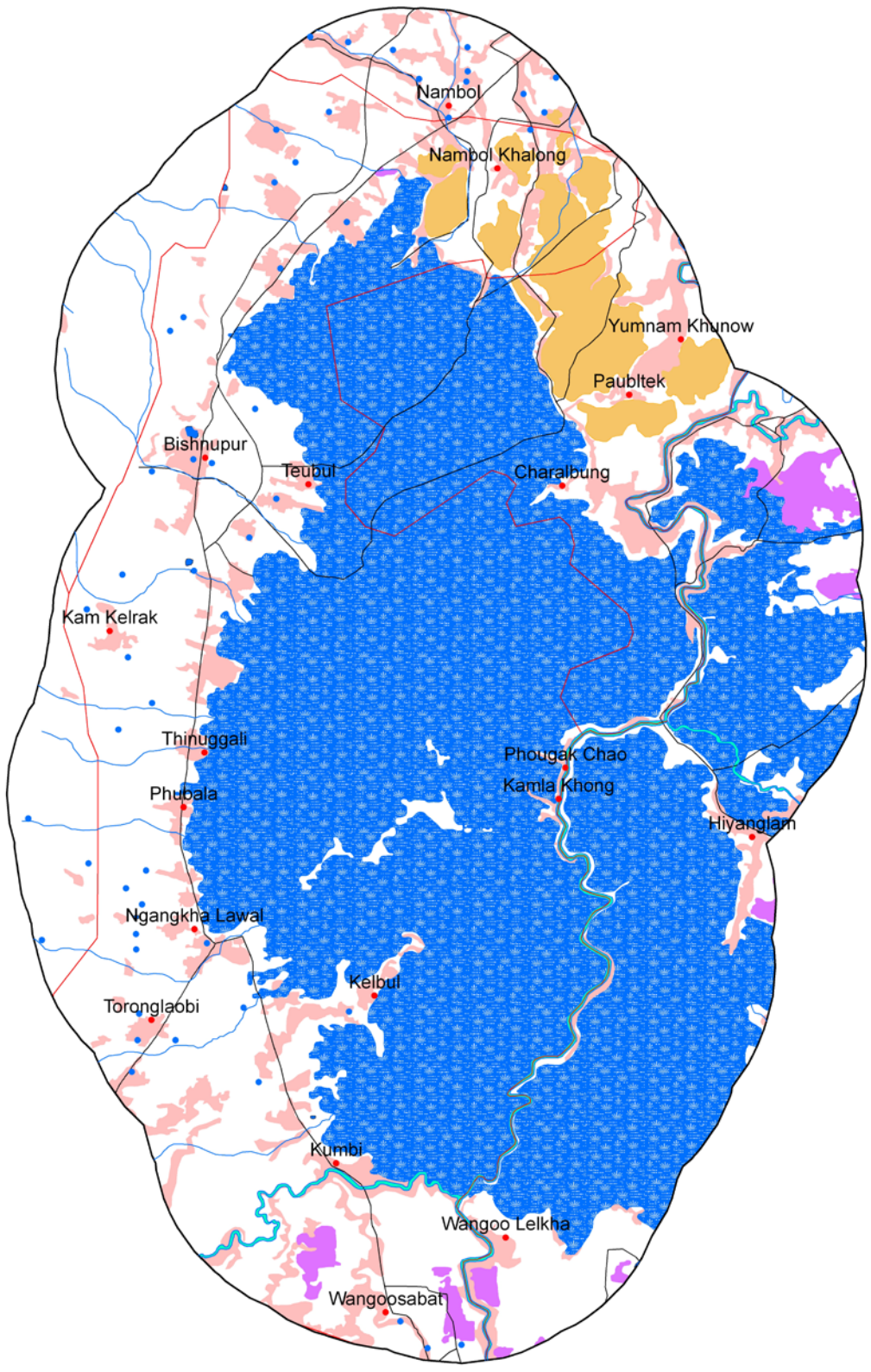


Plate 80: Loktak lake

State : Manipur

WETLAND MAP

Loktak Lake

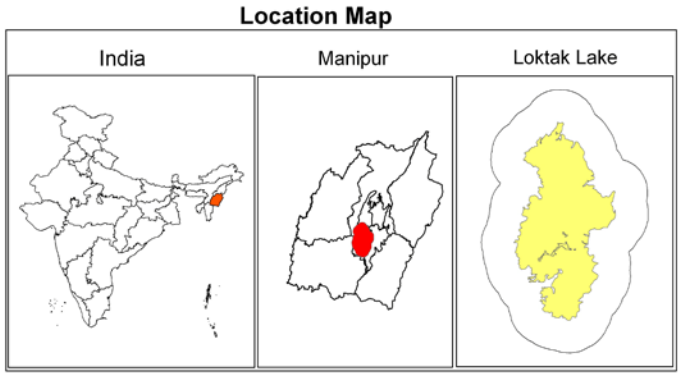


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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)

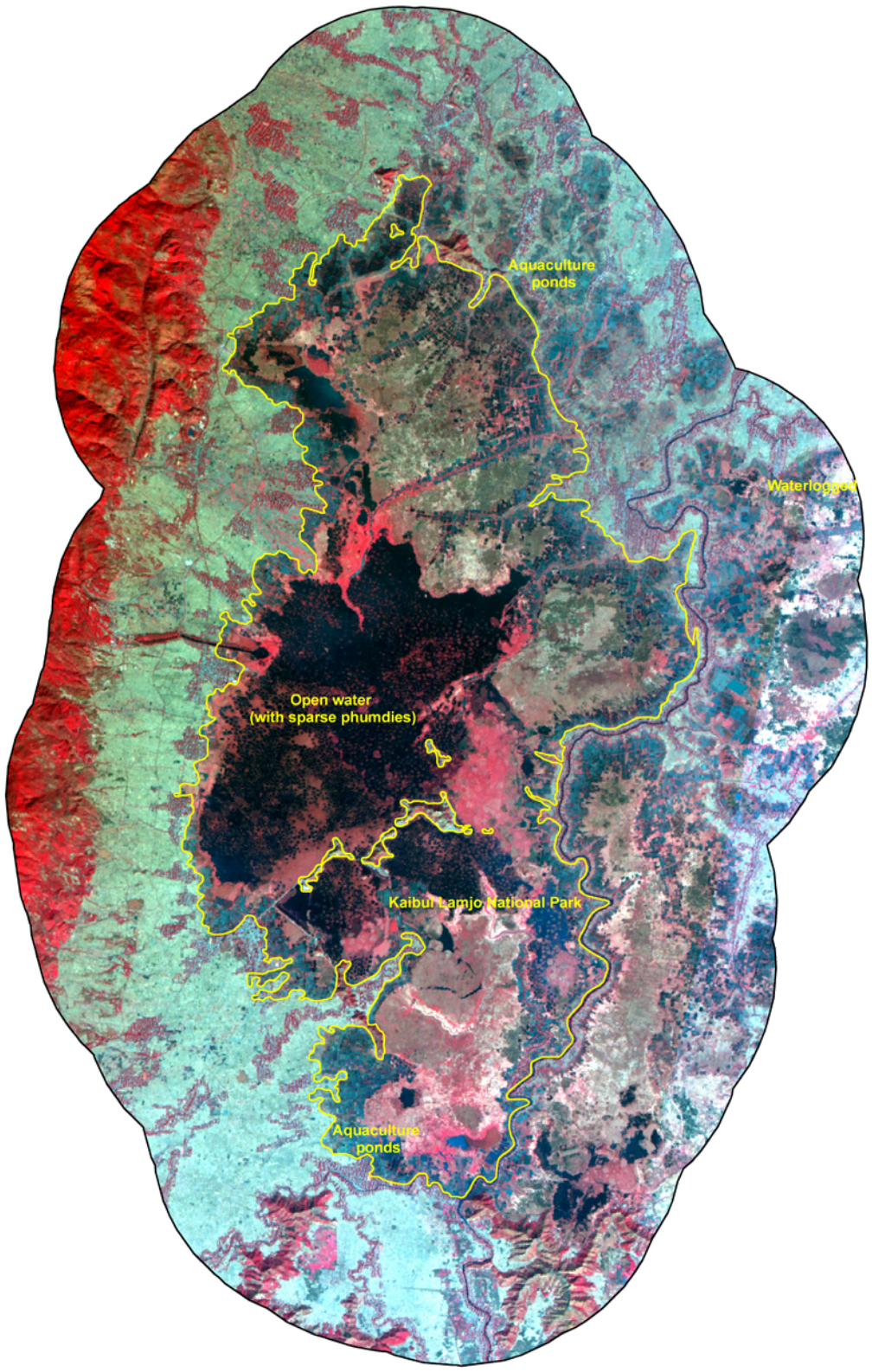
Prepared By :
Space Applications Centre (ISRO), Ahmedabad

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 Nal Sarovar

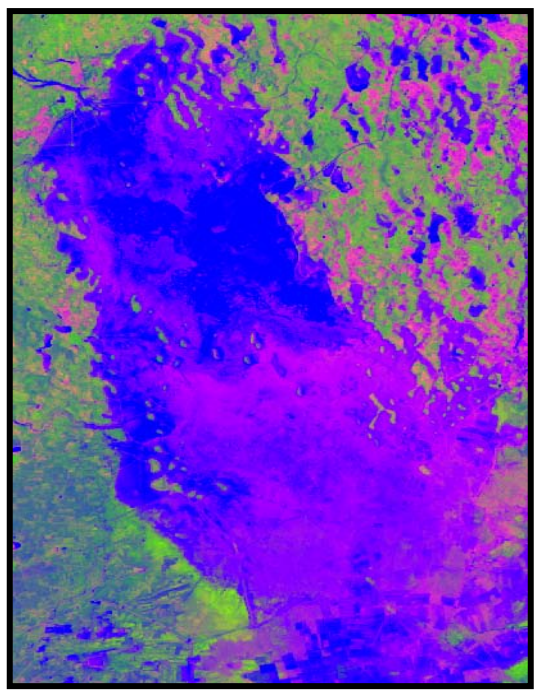
Name	Nal Sarovar
Location	22^{o} 40' 21" to 22^{o} 52' 00" N Latitude and 71^{o} 58' 55" to 72^{o} 06' 43" E Longitude
Area	14673 ha
Wetland Type	Lake/Pond
Climate	Dry, tropical monsoon climate, with rainfall from the southwest monsoon concentrated in July, August and September. Average annual rainfall is about 400 mm
Description	Nal Sarovar 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)



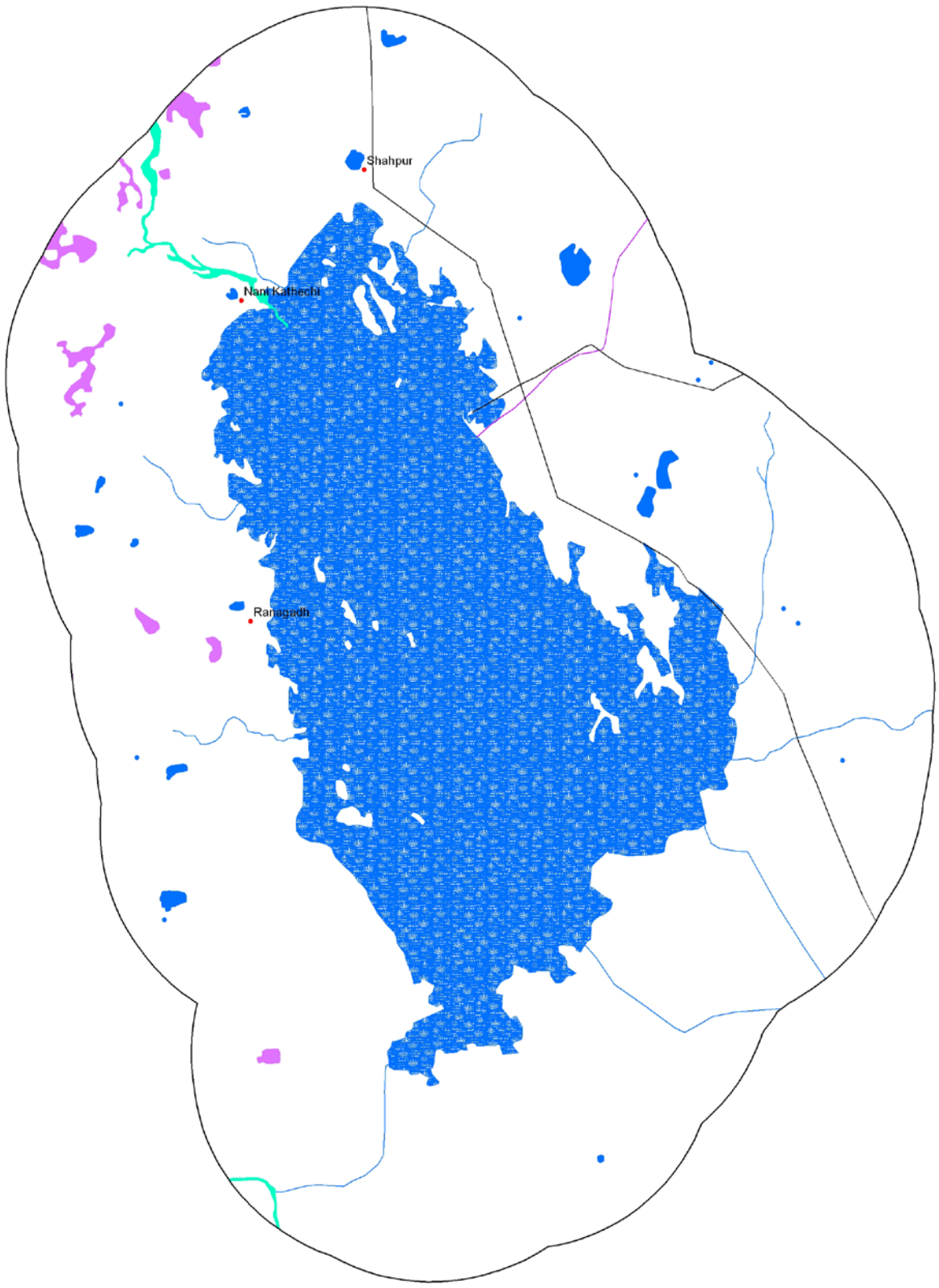
Indices (MNDWI NDPI NDVI)
Post-monsoon data (2006)

Plate 83: Nal Sarovar

State : Gujarat

WETLAND MAP

Nal Sarover



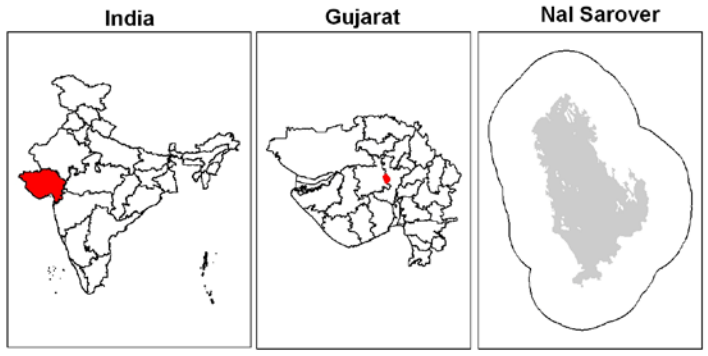
Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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

India | Gujarat | Nal Sarover



1 0.5 0 1 2 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 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 Nal Sarovar

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

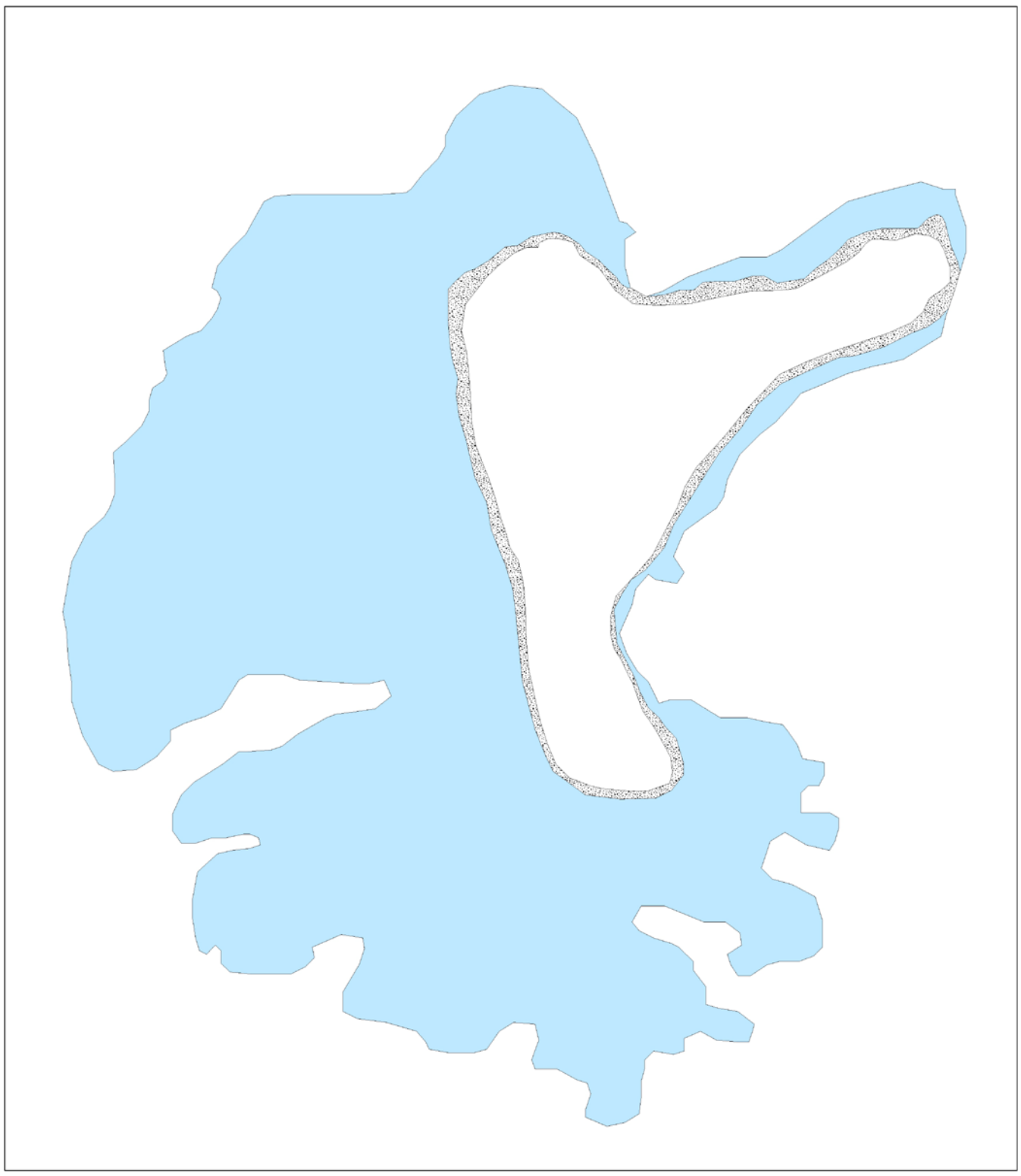
Area in ha

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

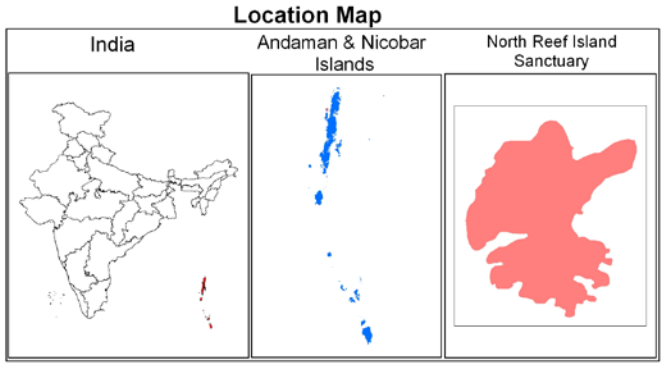


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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



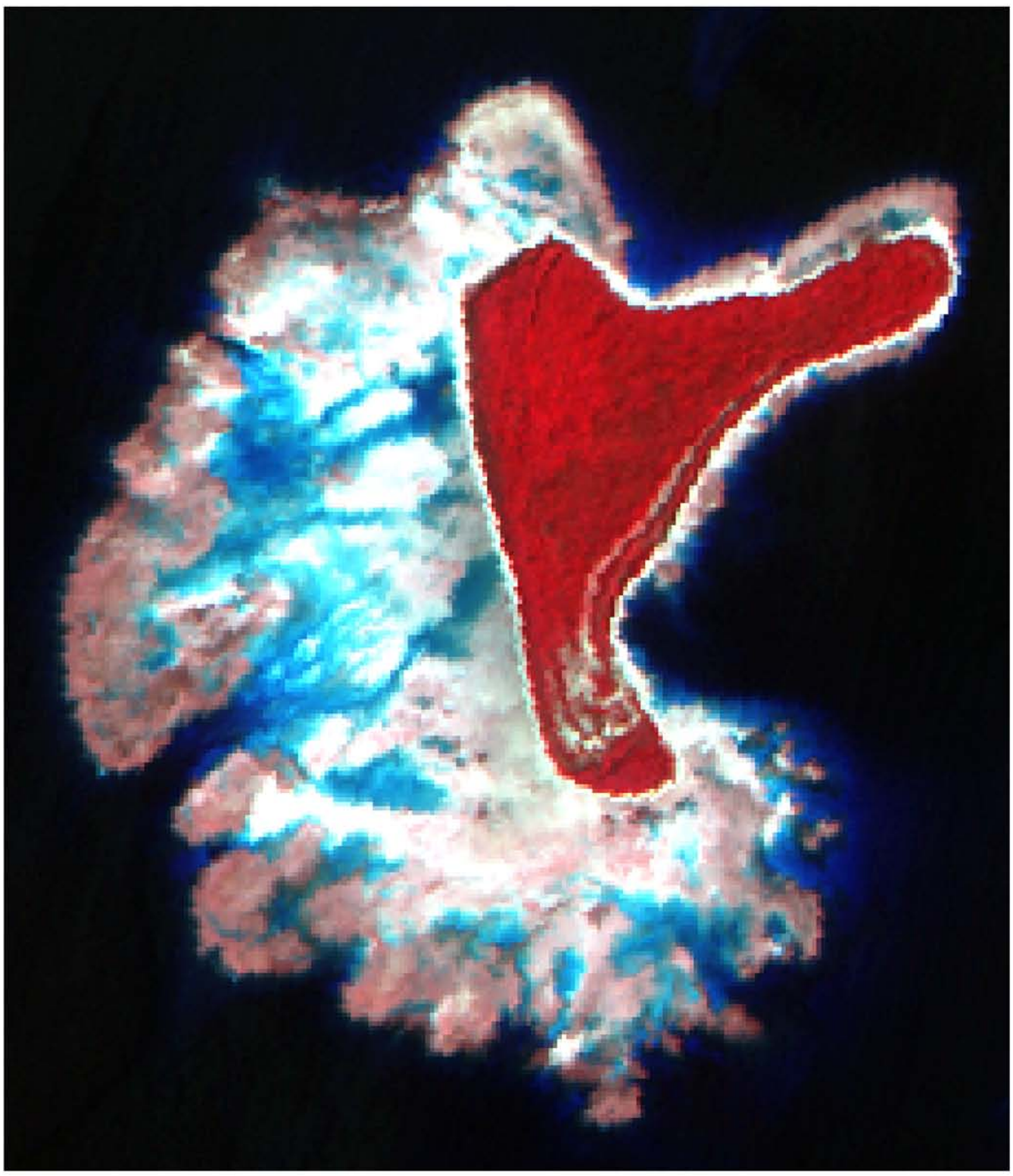
0 0.25 0.5 1 Kilometers

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 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. 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. *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. 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.

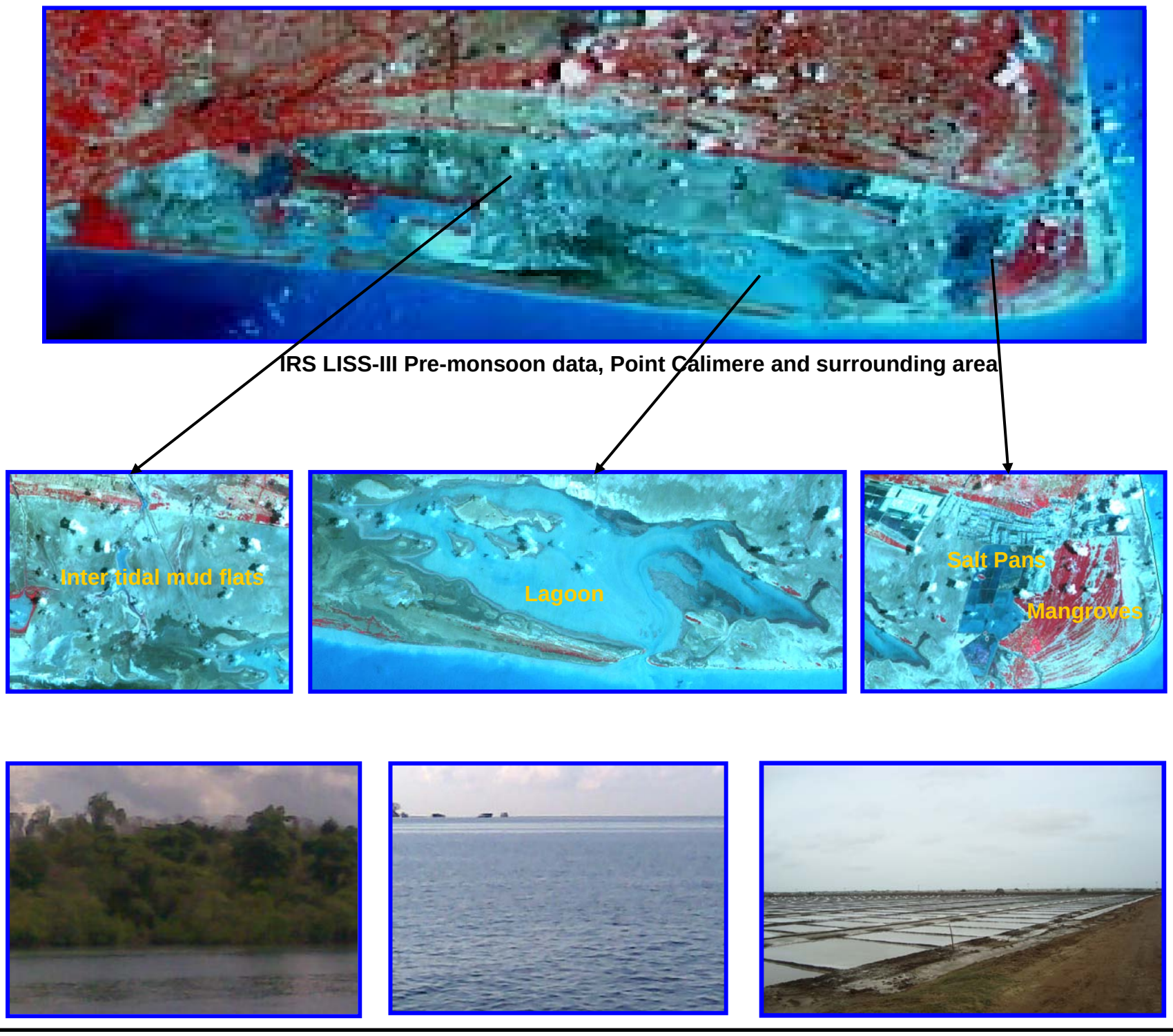
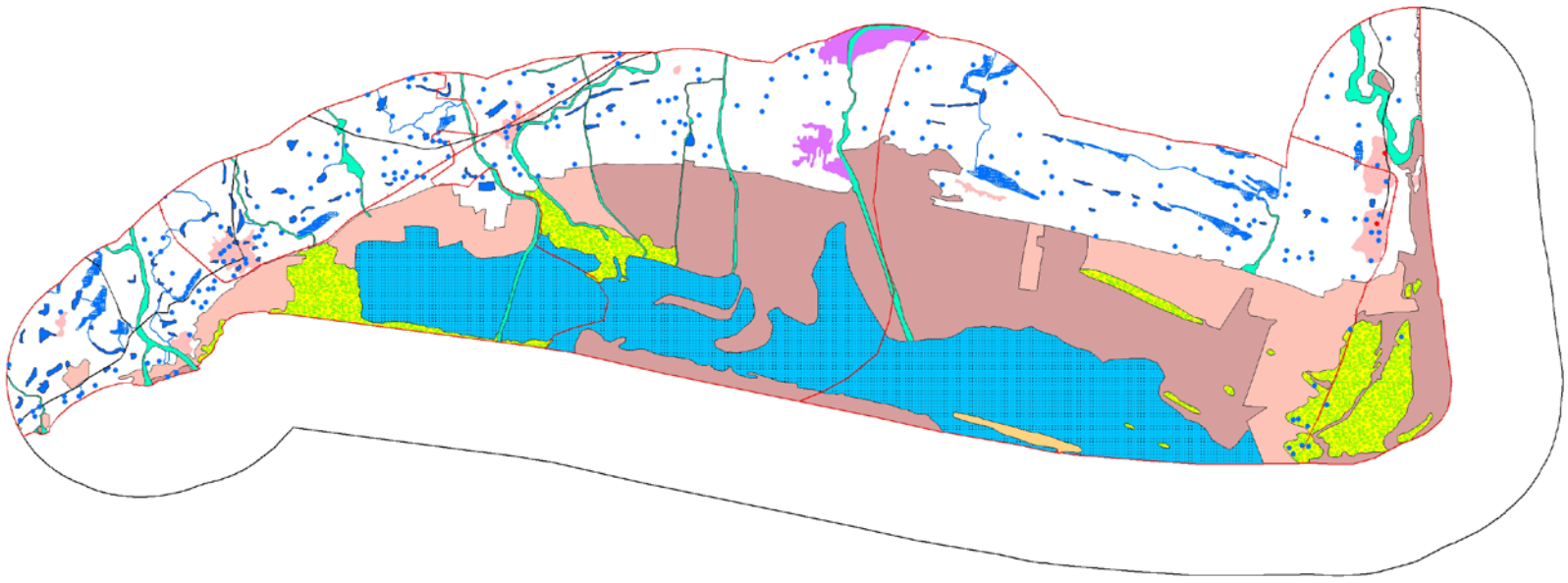


Plate 88: Point Calimere Wildlife and Bird Sanctuary

State : Tamil Nadu

WETLAND MAP

Point Calimere Wildlife and Bird Sanctuary

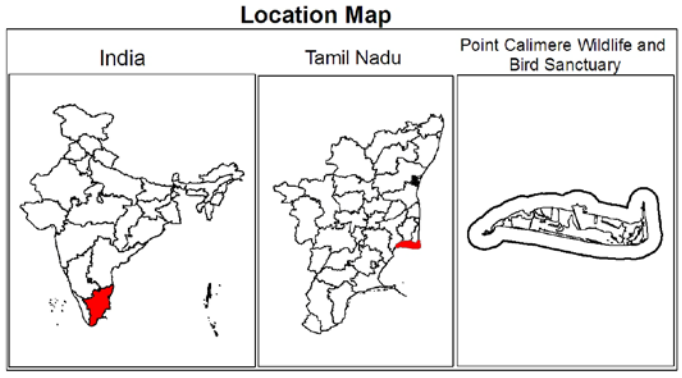


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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:

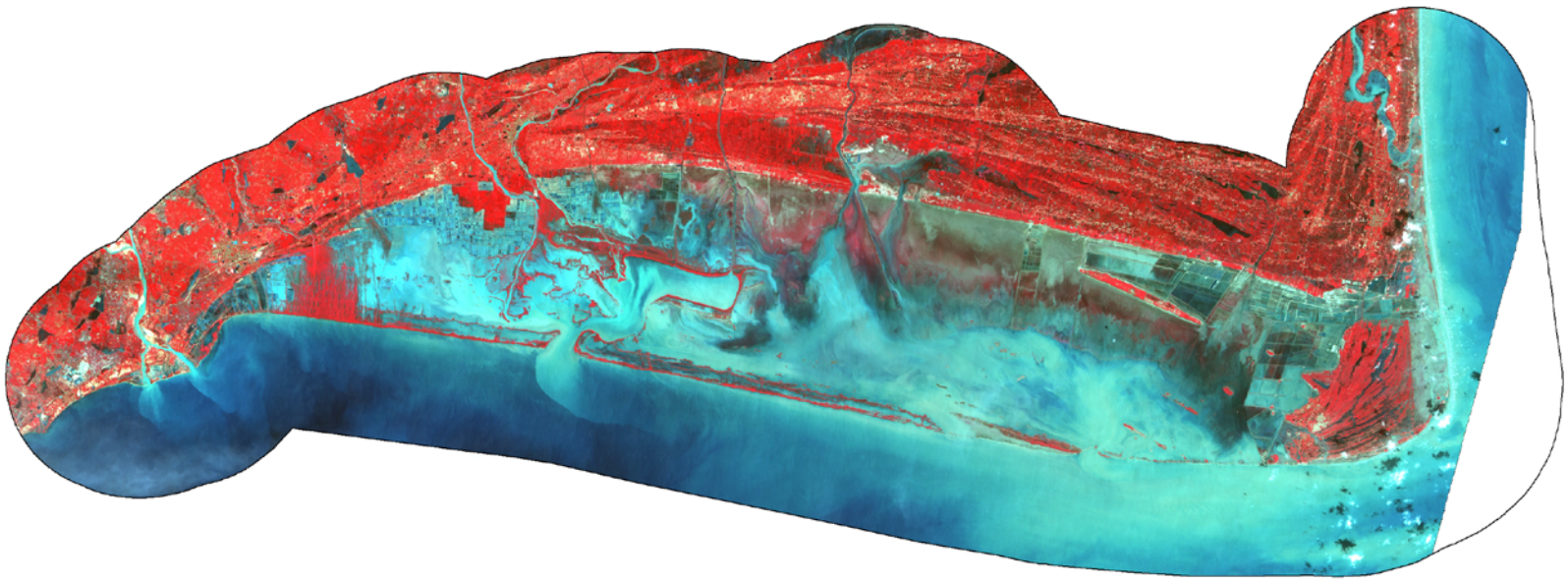
Ministry of Environment and Forests
Government of India

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

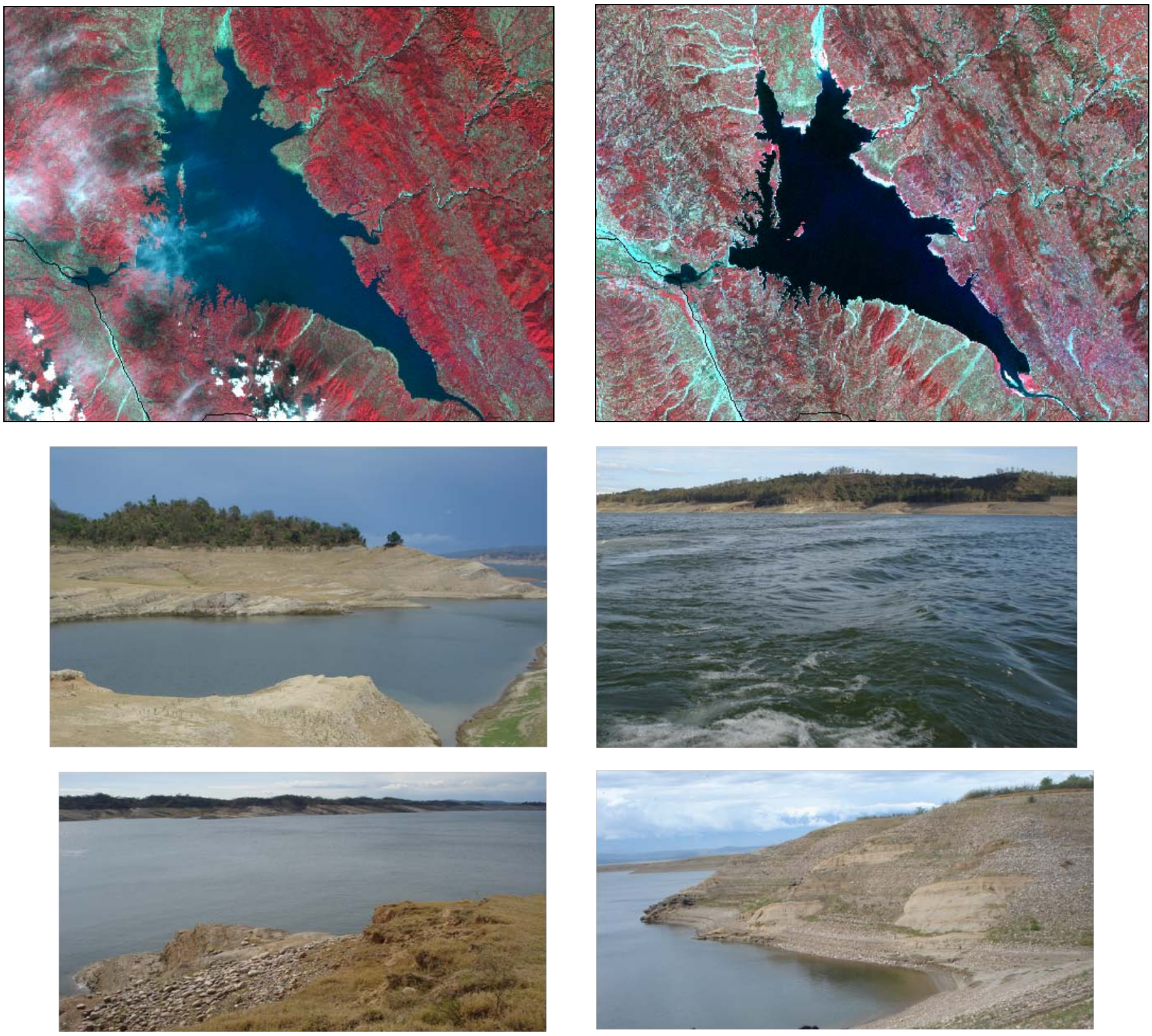
9.11 Pong Dam

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.



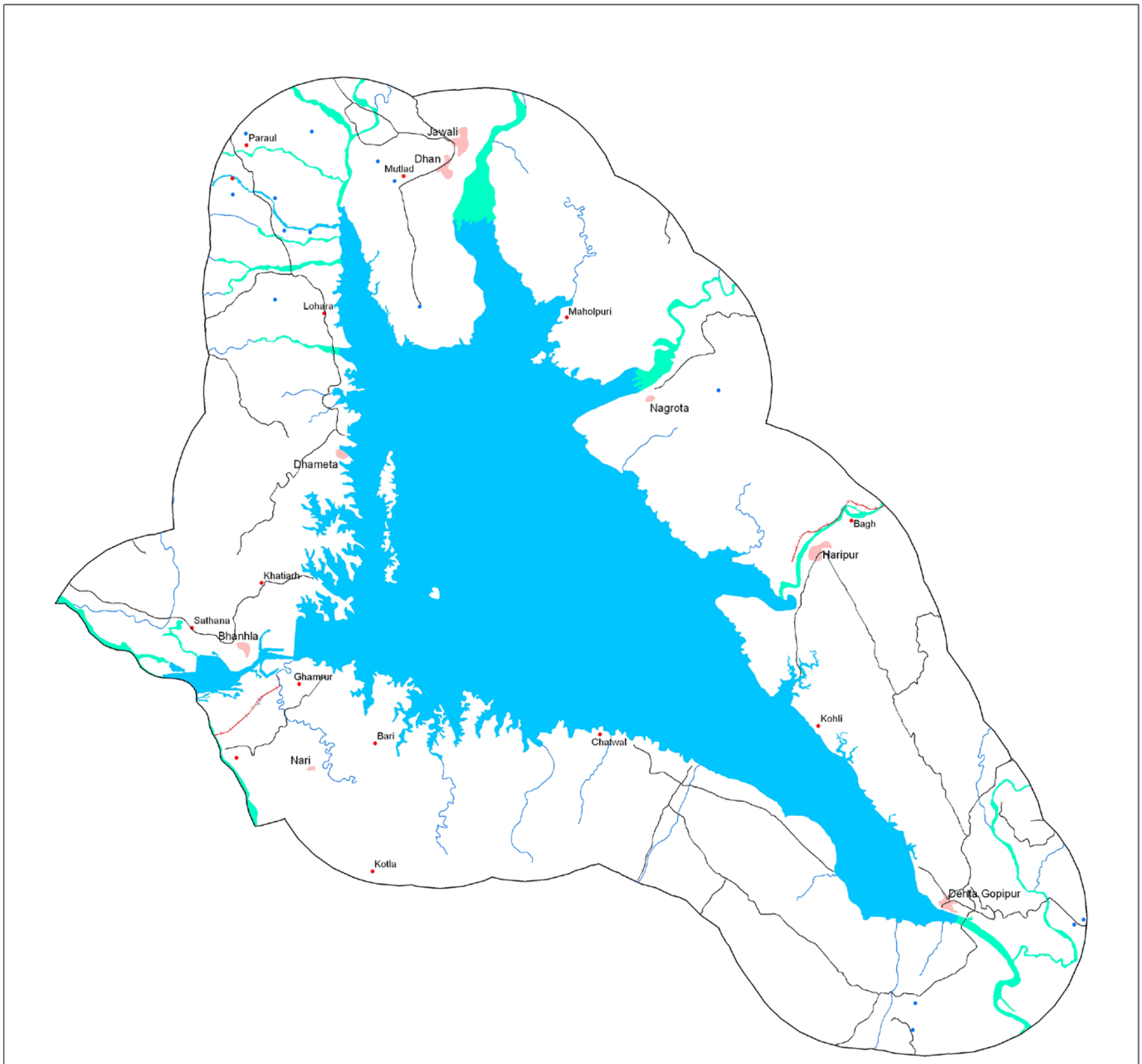
Views of the Pong Reservoir

Plate 91: 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

India | Himachal Pradesh | Pong Dam Lake

0 2.5 5 10 Kilometers

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

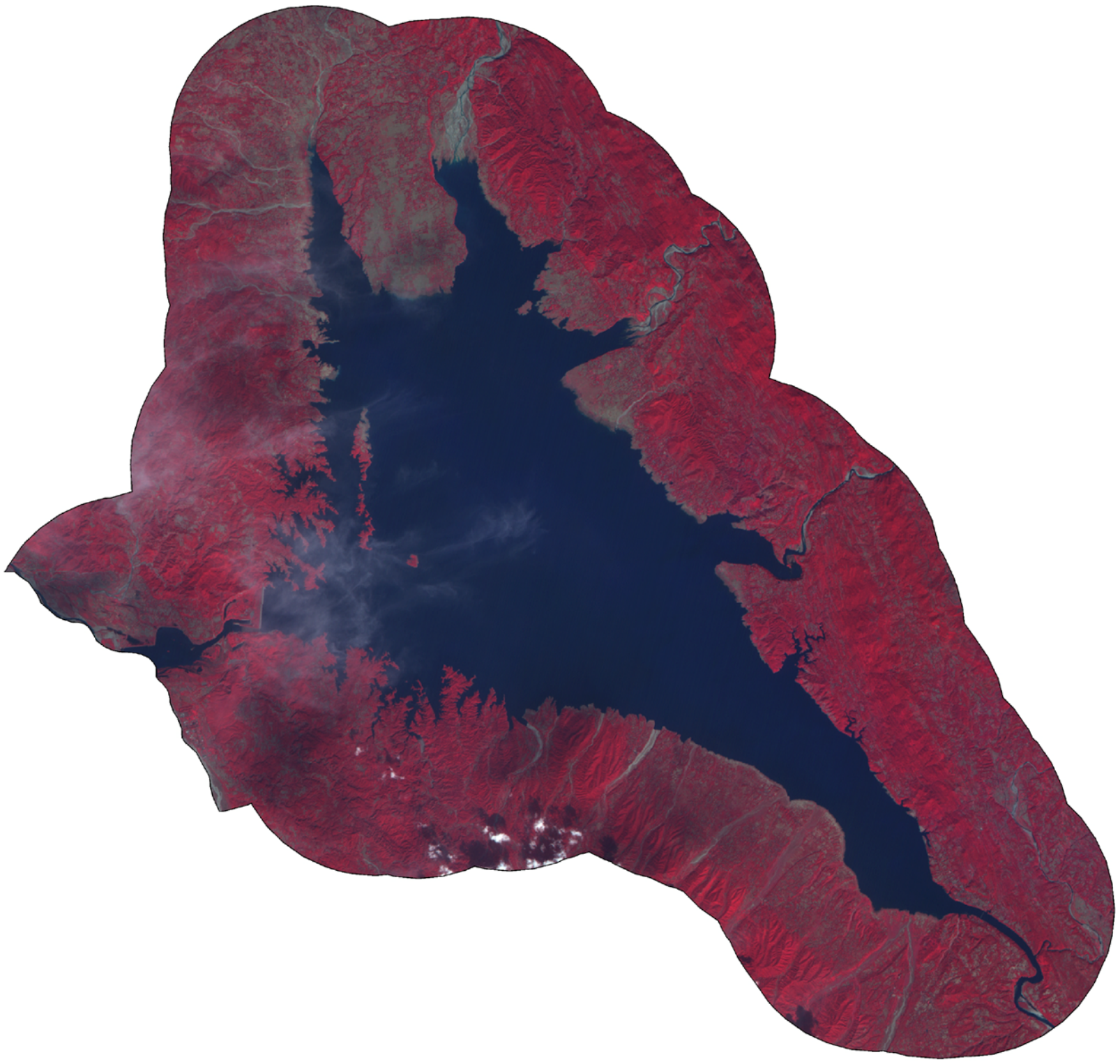
Prepared by:
Space Applications Centre (ISRO), Ahmedabad
and
HP Remote Sensing Cell
State Council for Science, Technology & Environment, Shimla

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

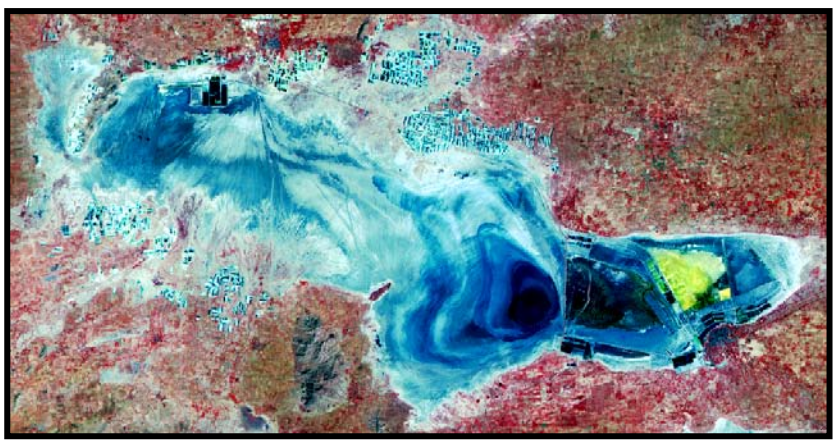


IRS-P6 LISS-III Post-monsoon data(2006-2007)

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 74°53'47" to 75°13'41" E Longitude
Area	24294 ha (Wetland Area)
Wetland Type	Lake
Climate	Average annual rainfall : 500 mm 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)



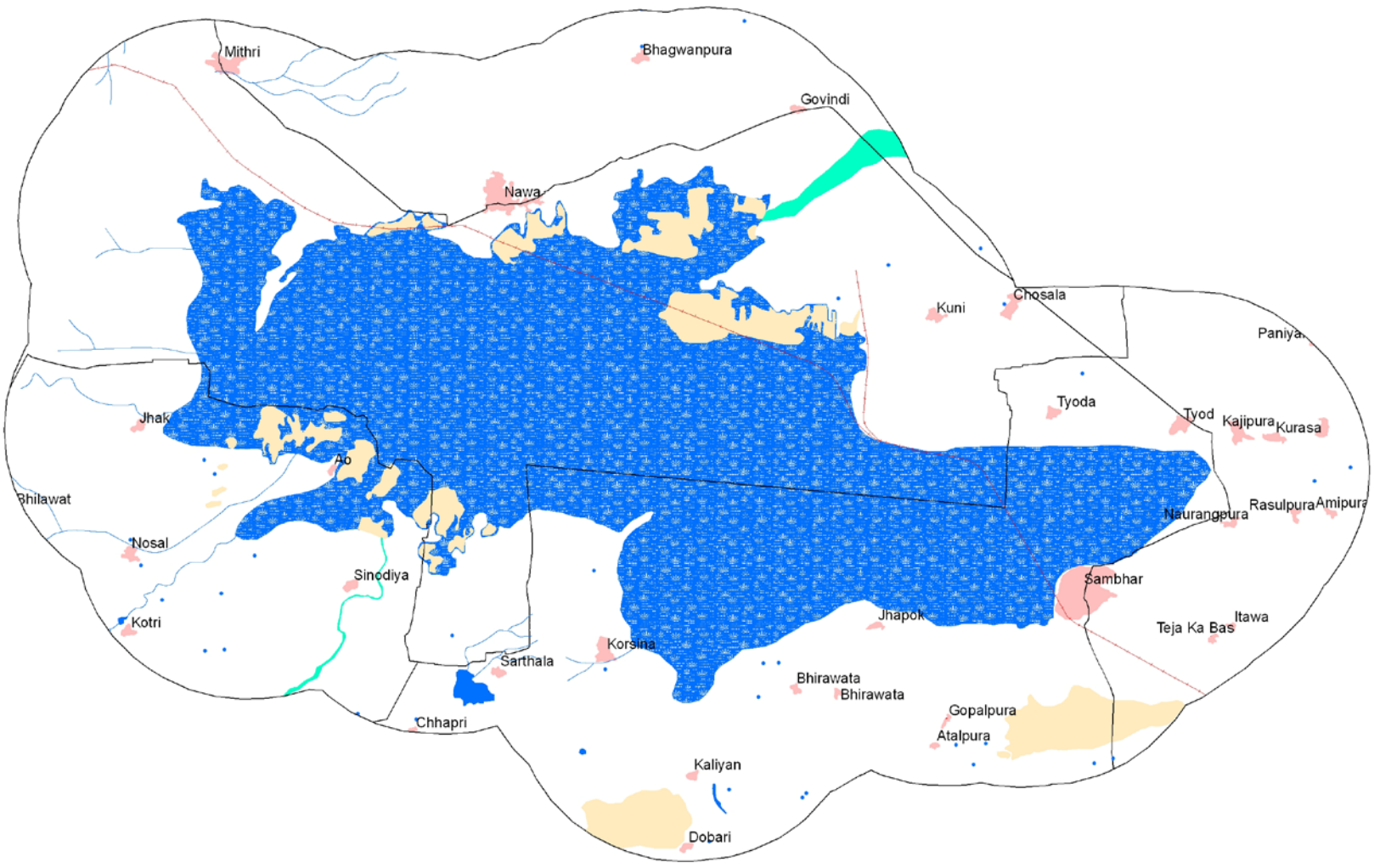


Plate 94: Sambhar Lake

State : Rajasthan

WETLAND MAP

Sambhar Lake

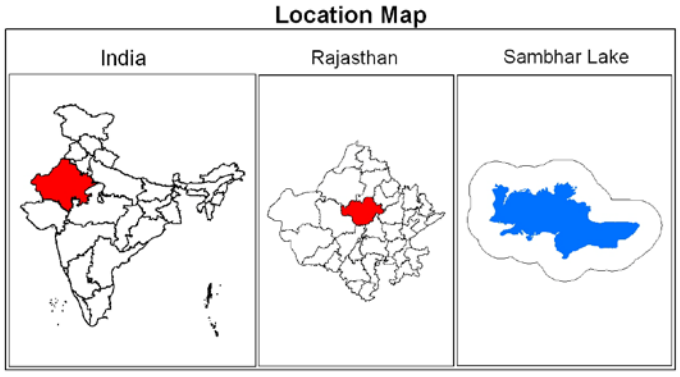


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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

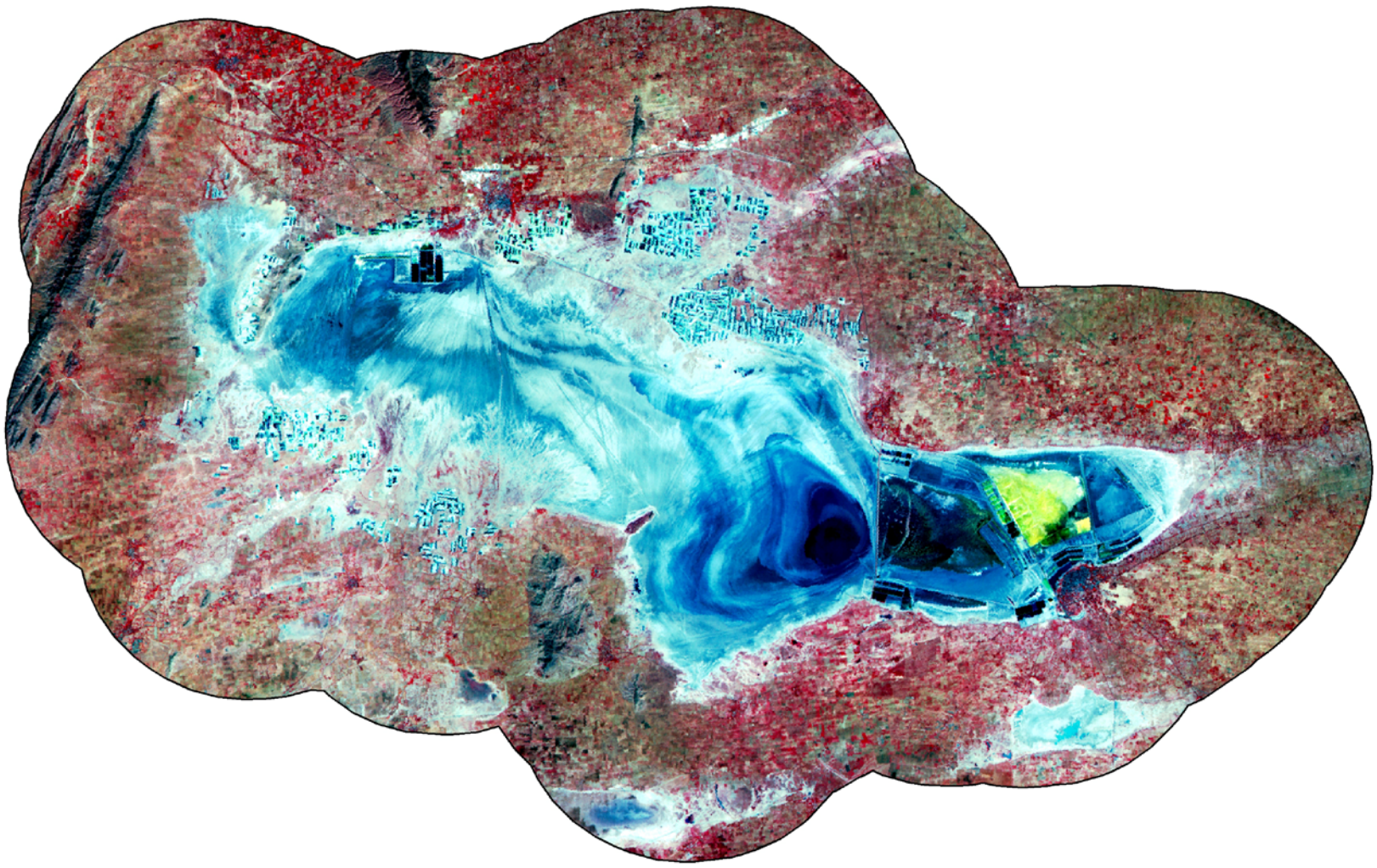
Sponsored By:

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. 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*).

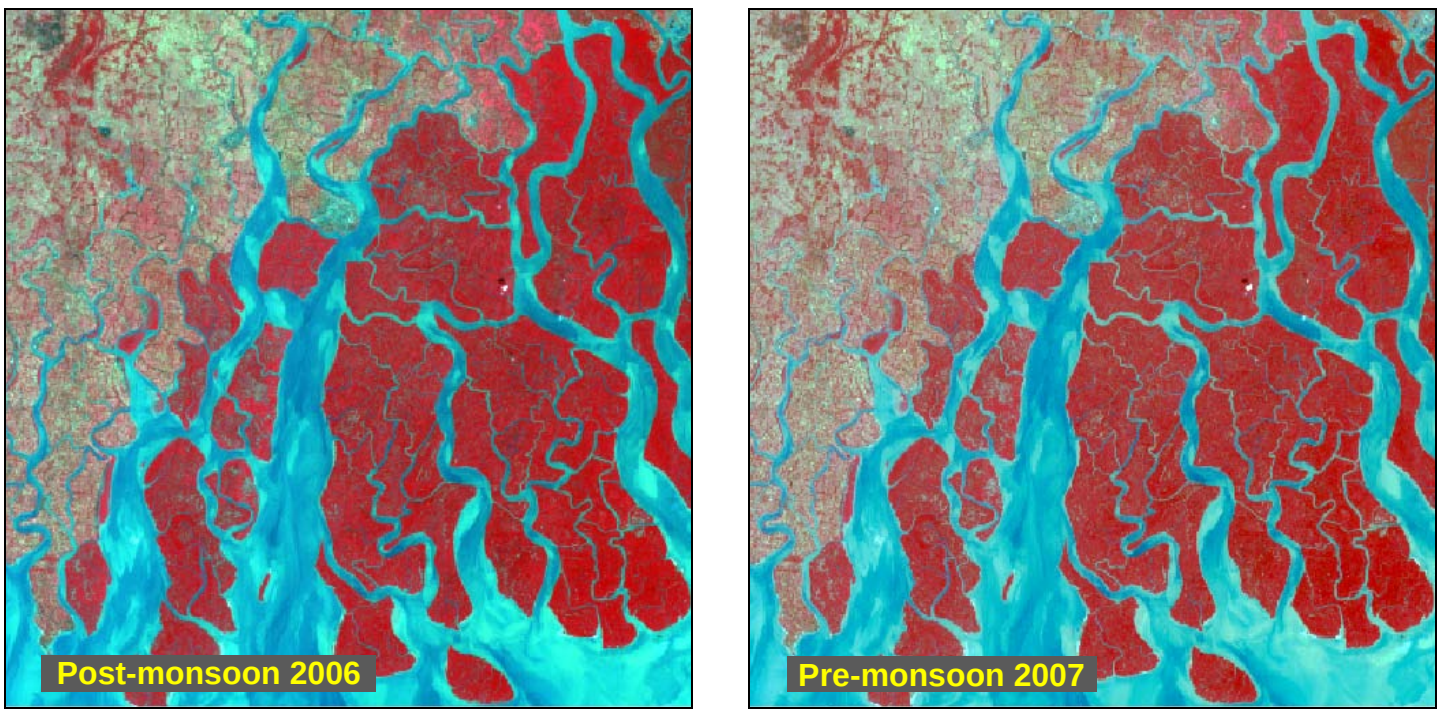
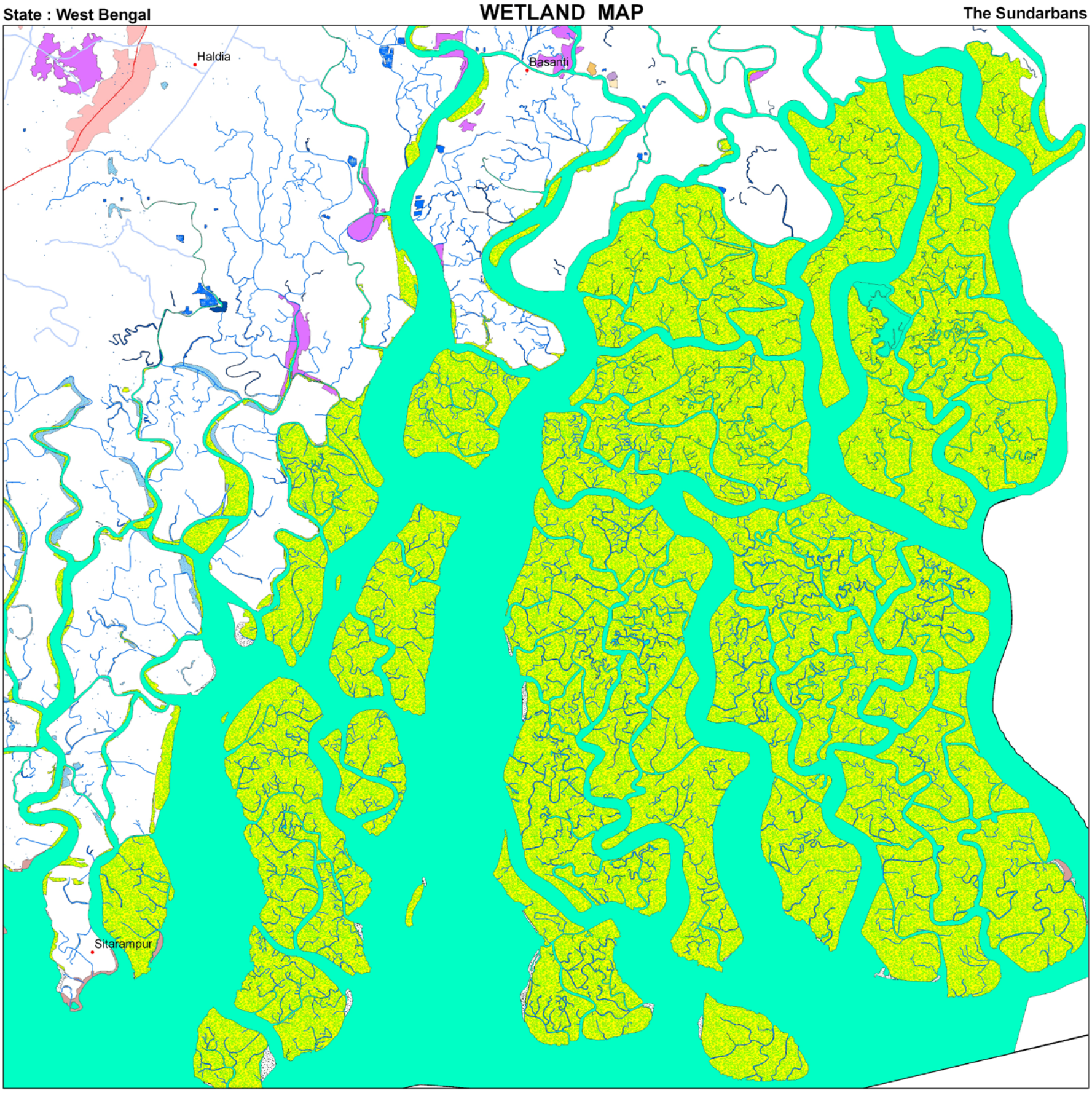


Plate 97: The Sundarbans

State : West Bengal

WETLAND MAP

The Sundarbans

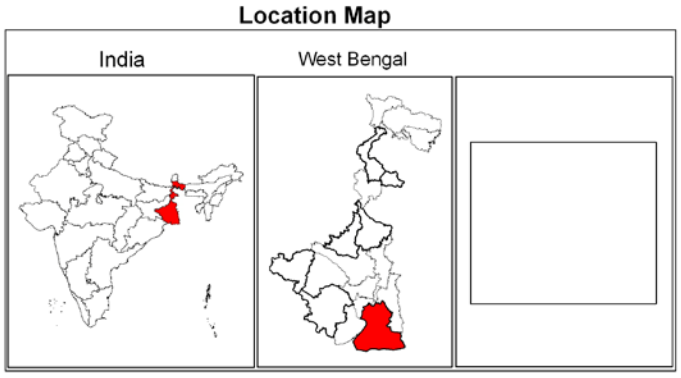


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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

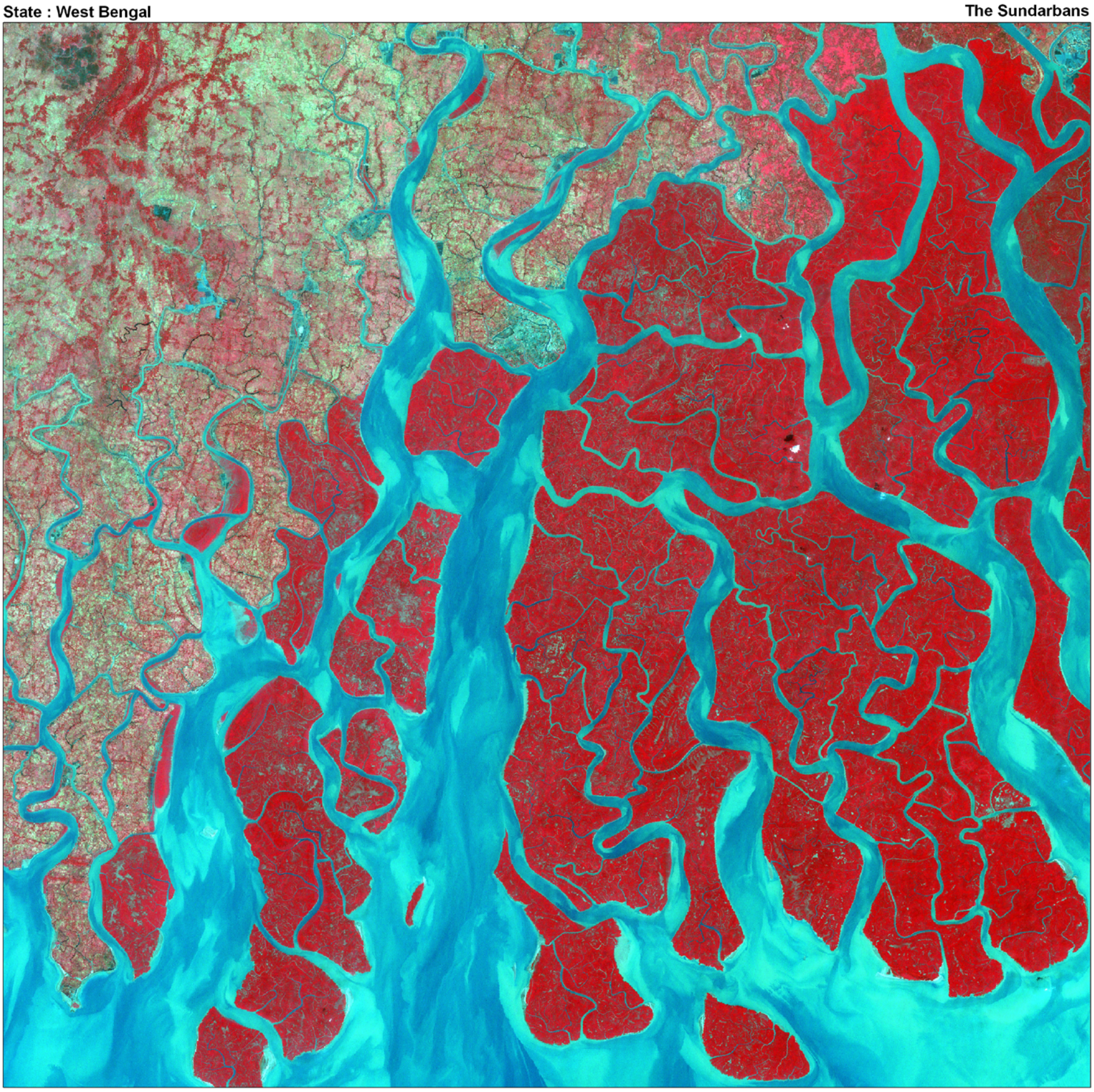
Sponsored By:

Ministry of Environment and Forests
Government of India

Plate 98: Wetland map - The Sundarbans

State : West Bengal

The Sundarbans

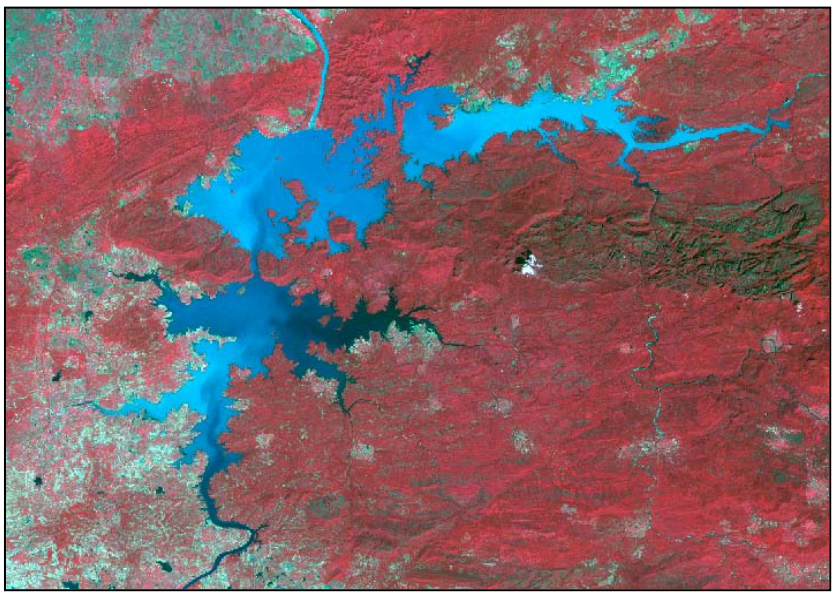


IRS P6 LISS-III post-monsoon data (2006)

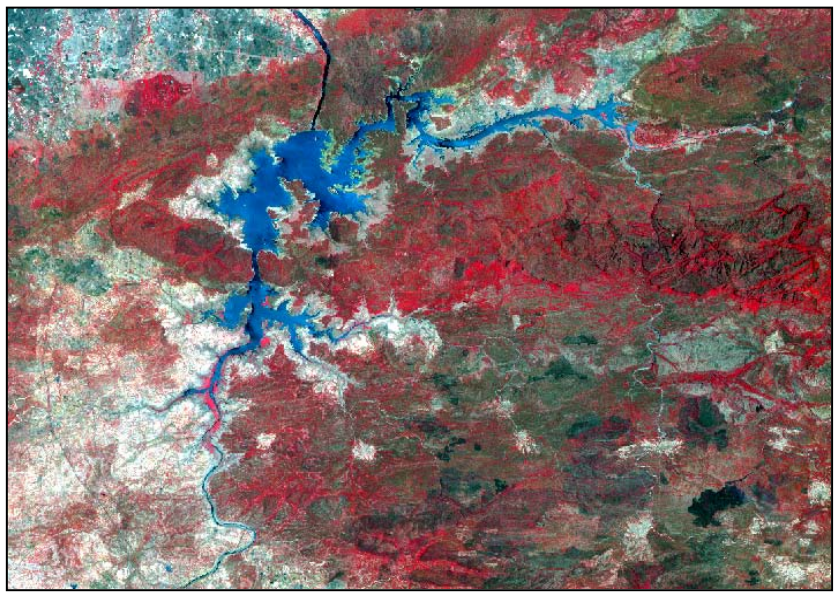
Plate 99: IRS LISS-III FCC of the Sunderbans

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

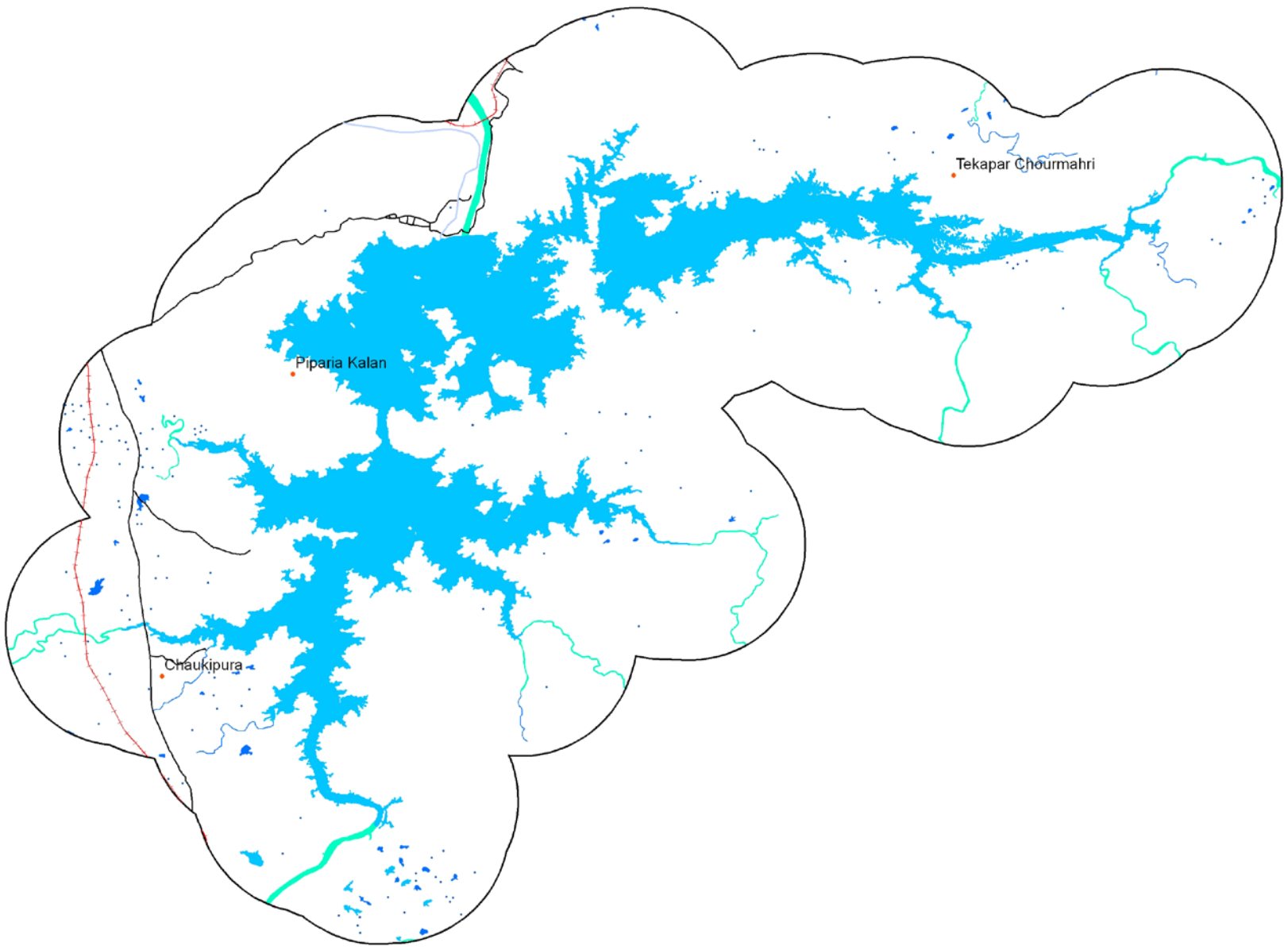


Plate 100: Tawa Reservoir

State : Madhya Pradesh

WETLAND MAP

Tawa Reservoir

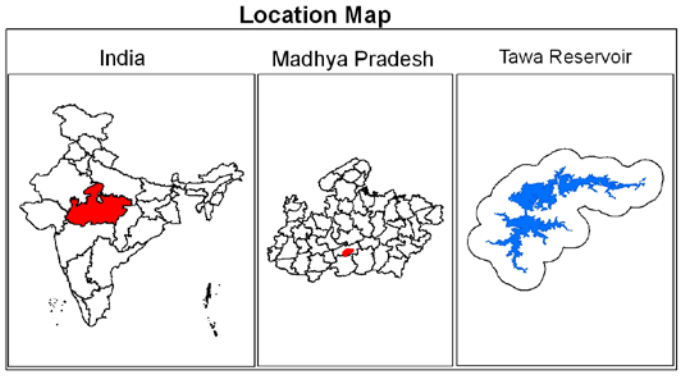


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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



2 1 0 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
and
Remote Sensing Applications Centre, (MPCST), Bhopal, M.P.

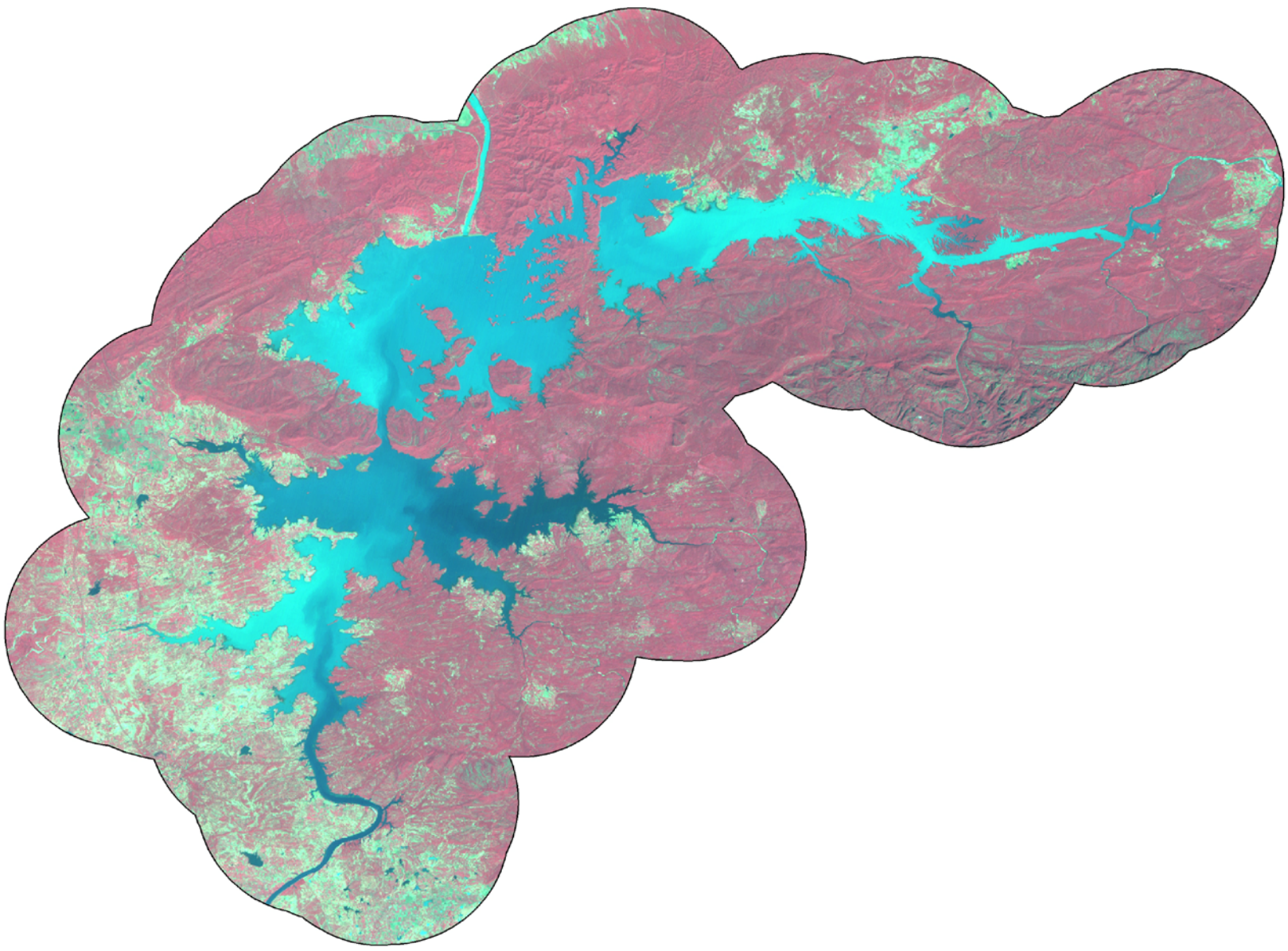
Sponsored By:

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 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



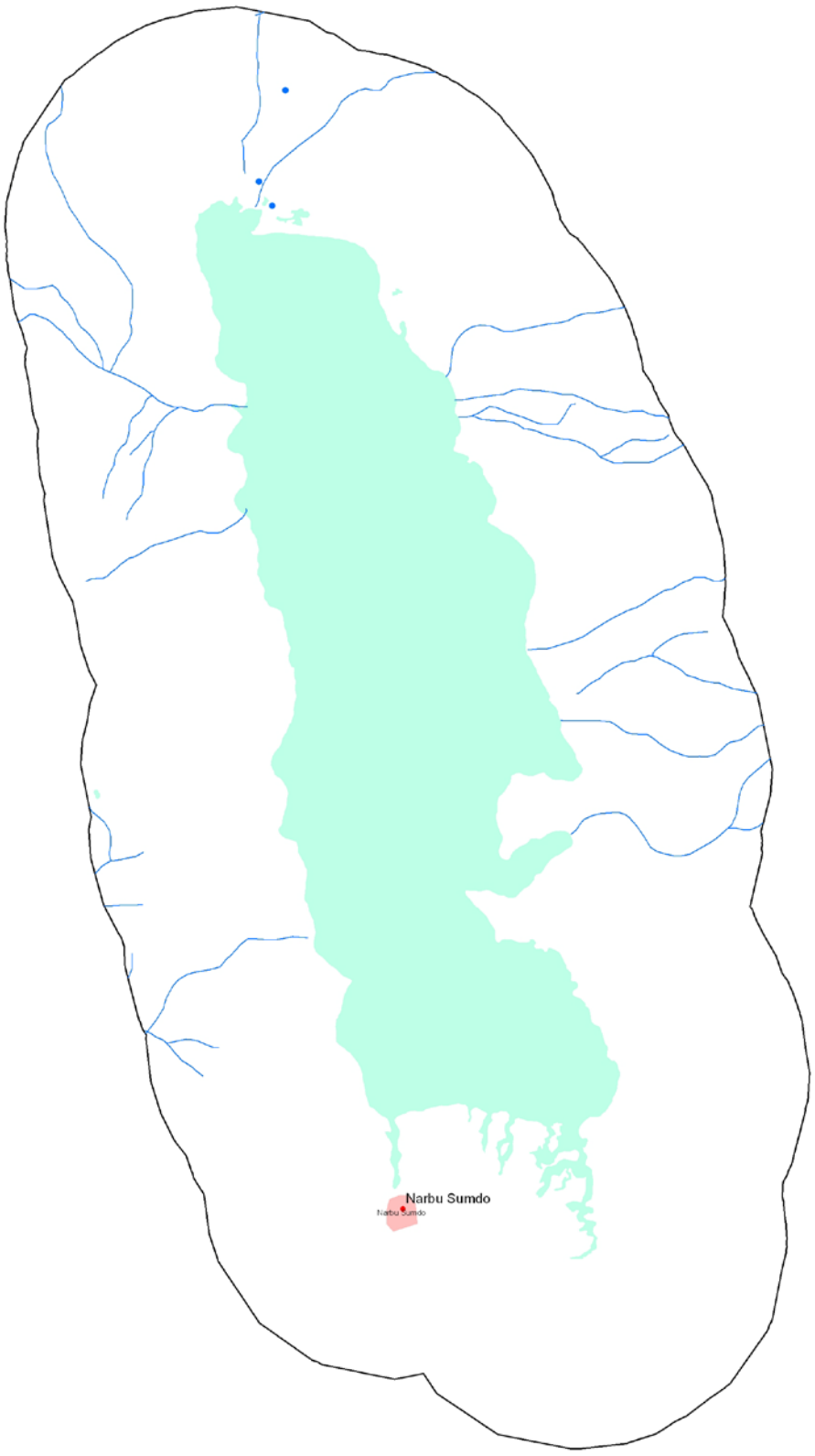
Pre-monsoon 2007

Plate 103: Tso Moriri

State : Jammu and Kashmir

WETLAND MAP

Tso_Morari

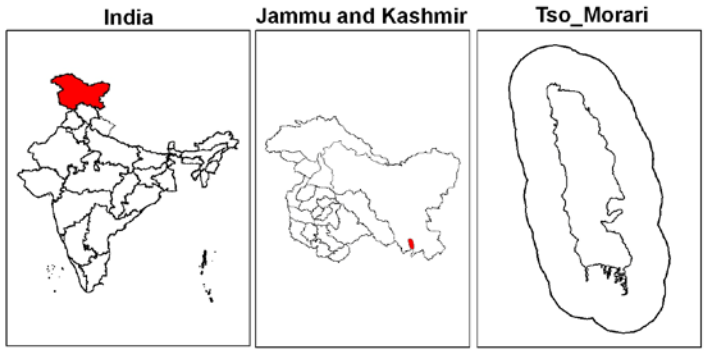


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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



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

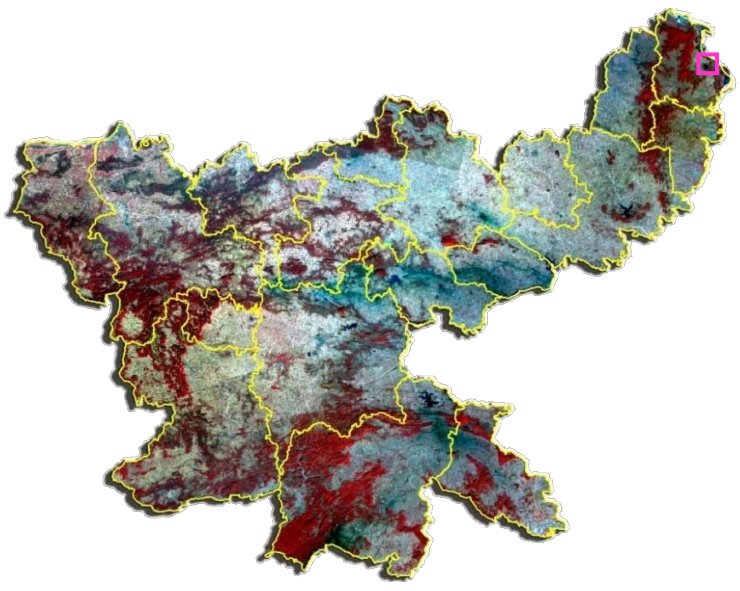


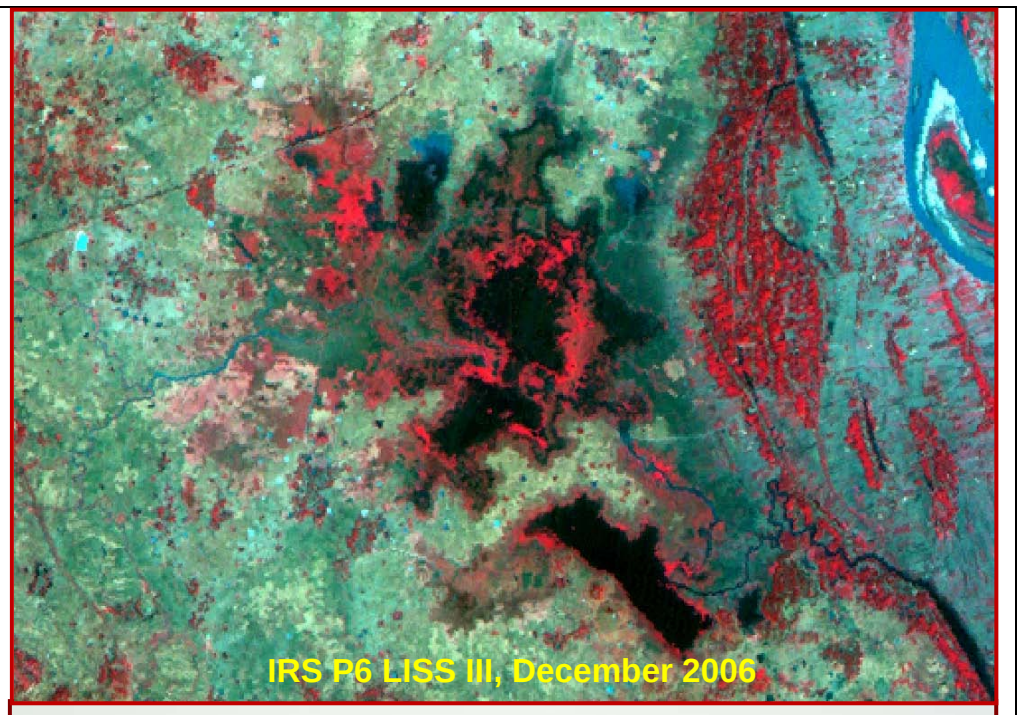
IRS P6 LISS-III pre-monsoon 2007 data

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 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.









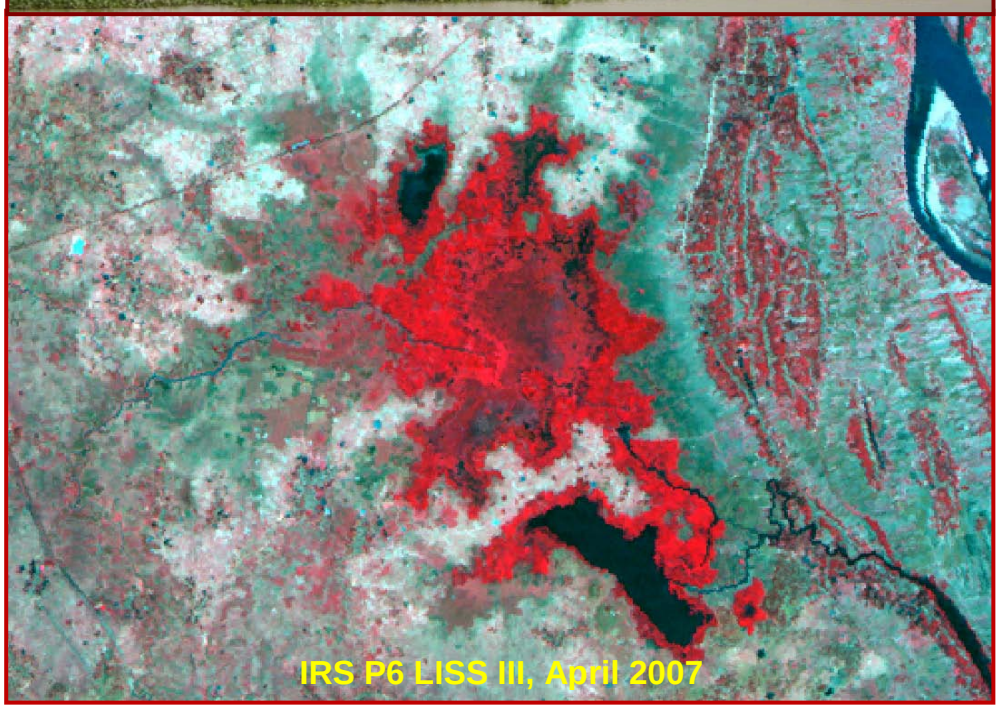
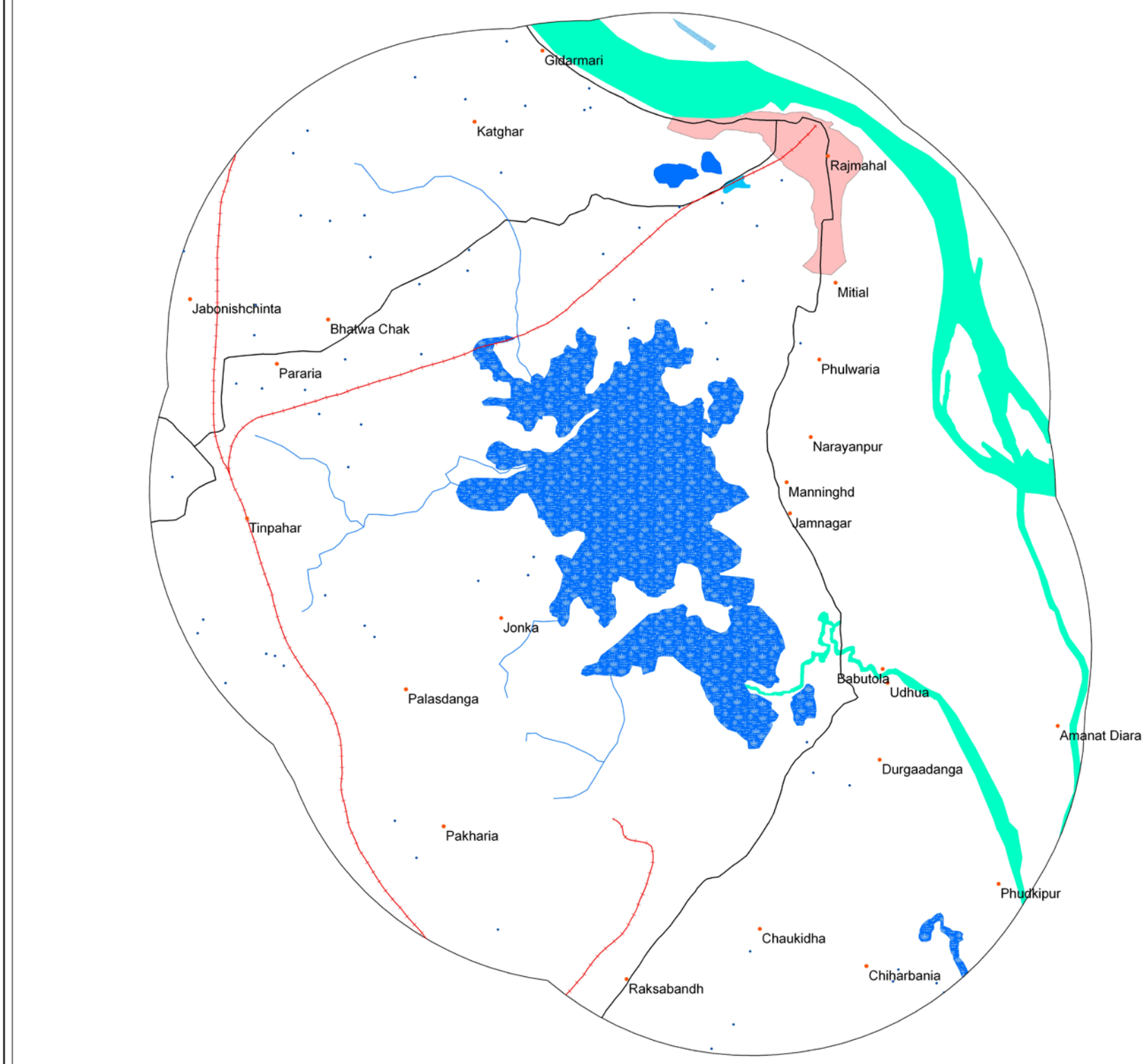


Plate 106: Udhwa Lake (Bird Sanctuary)

State : Jharkhand

WETLAND MAP

Udhwa Lake

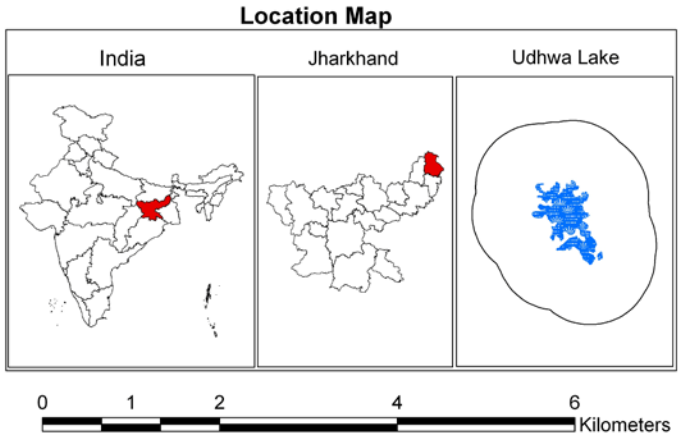


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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)

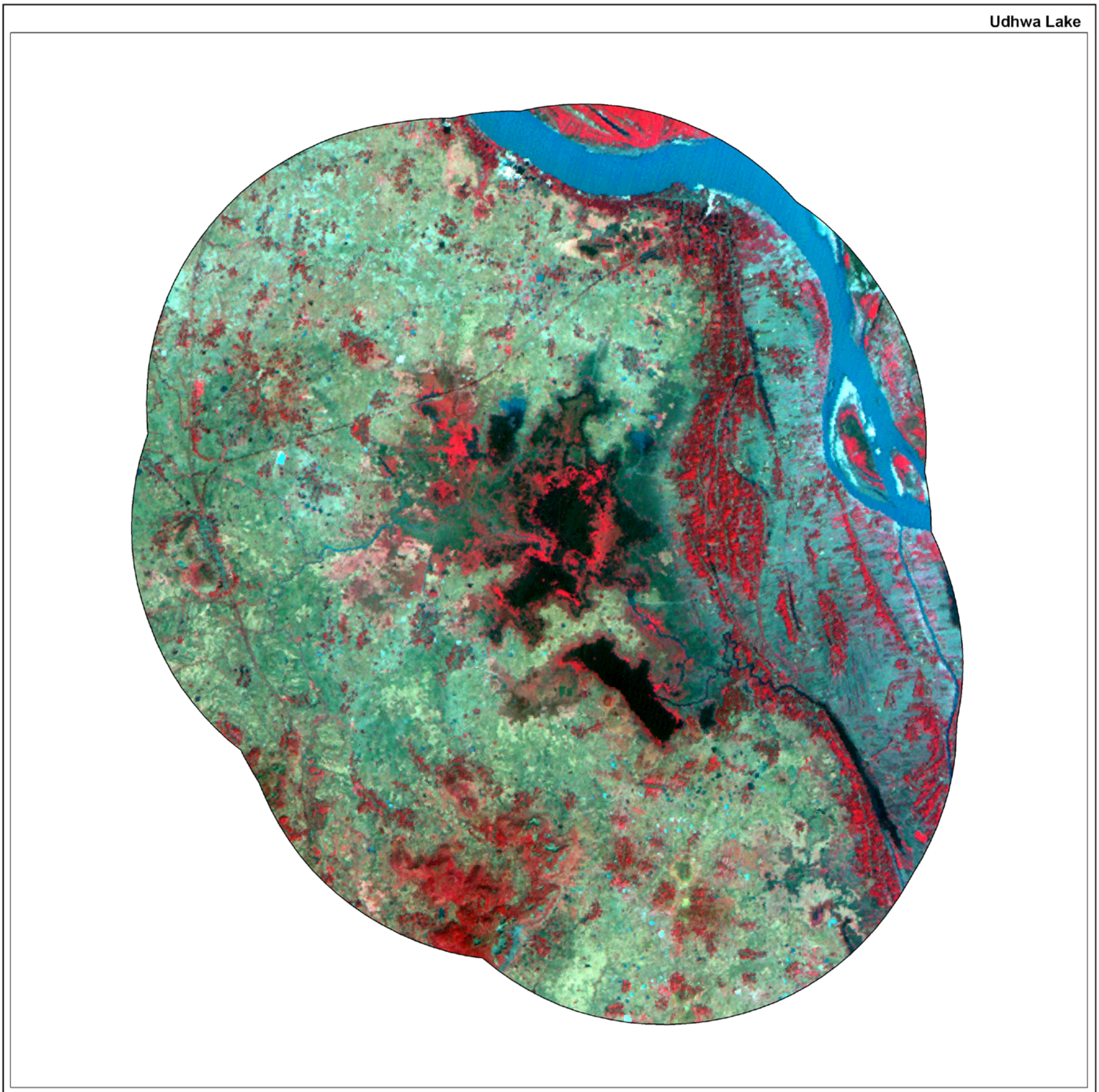
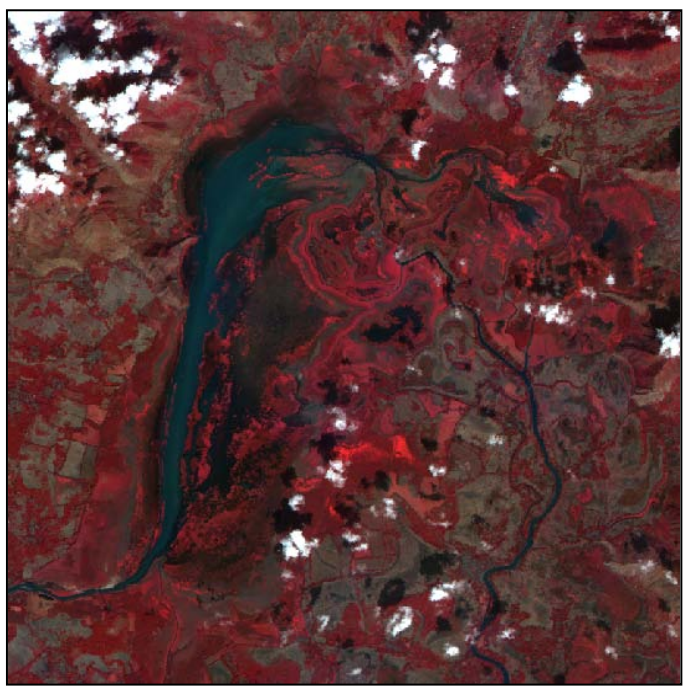


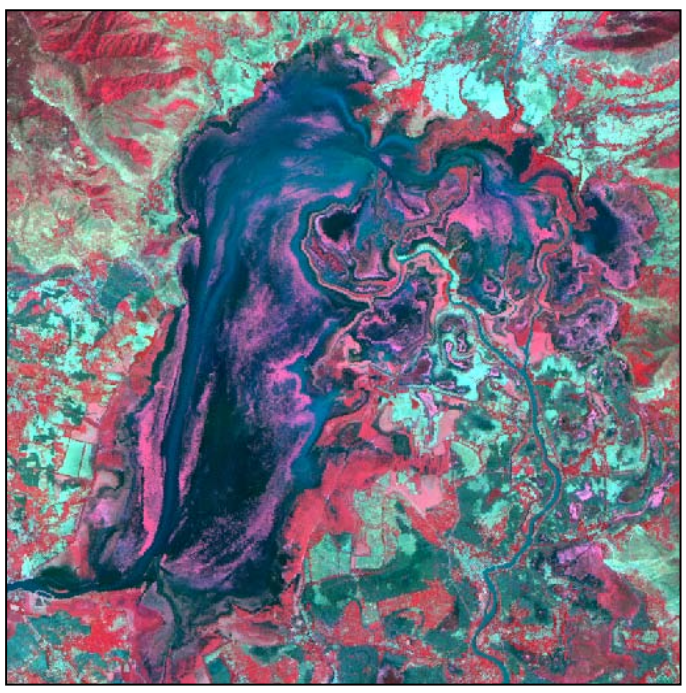
Plate 108: IRS LISS-III FCC – 5 km buffer area of Udhwa Lake (Bird Sanctuary)

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



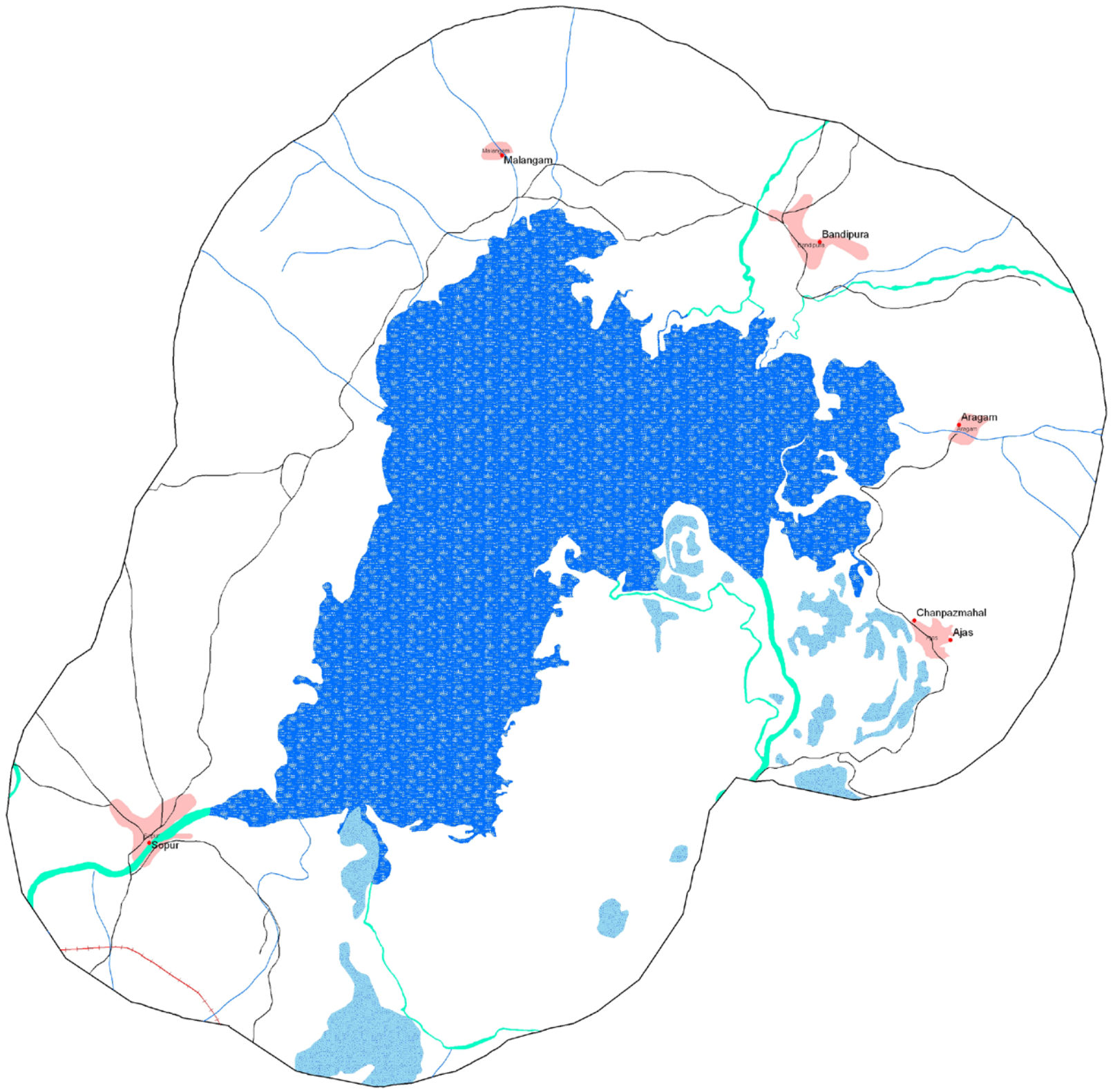
Pre-monsoon 2007

Plate 109: Wular Lake

State : Jammu and Kashmir

WETLAND MAP

Wular_Lake



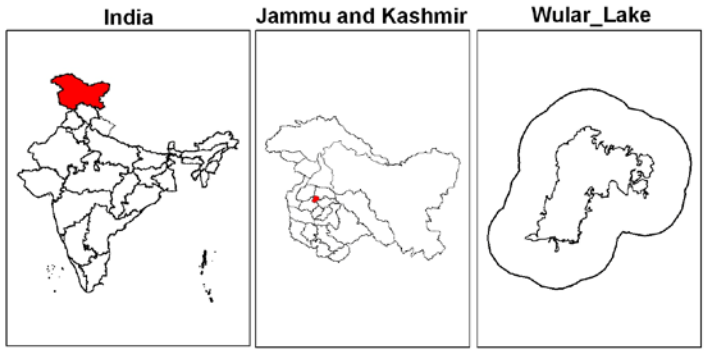
Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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

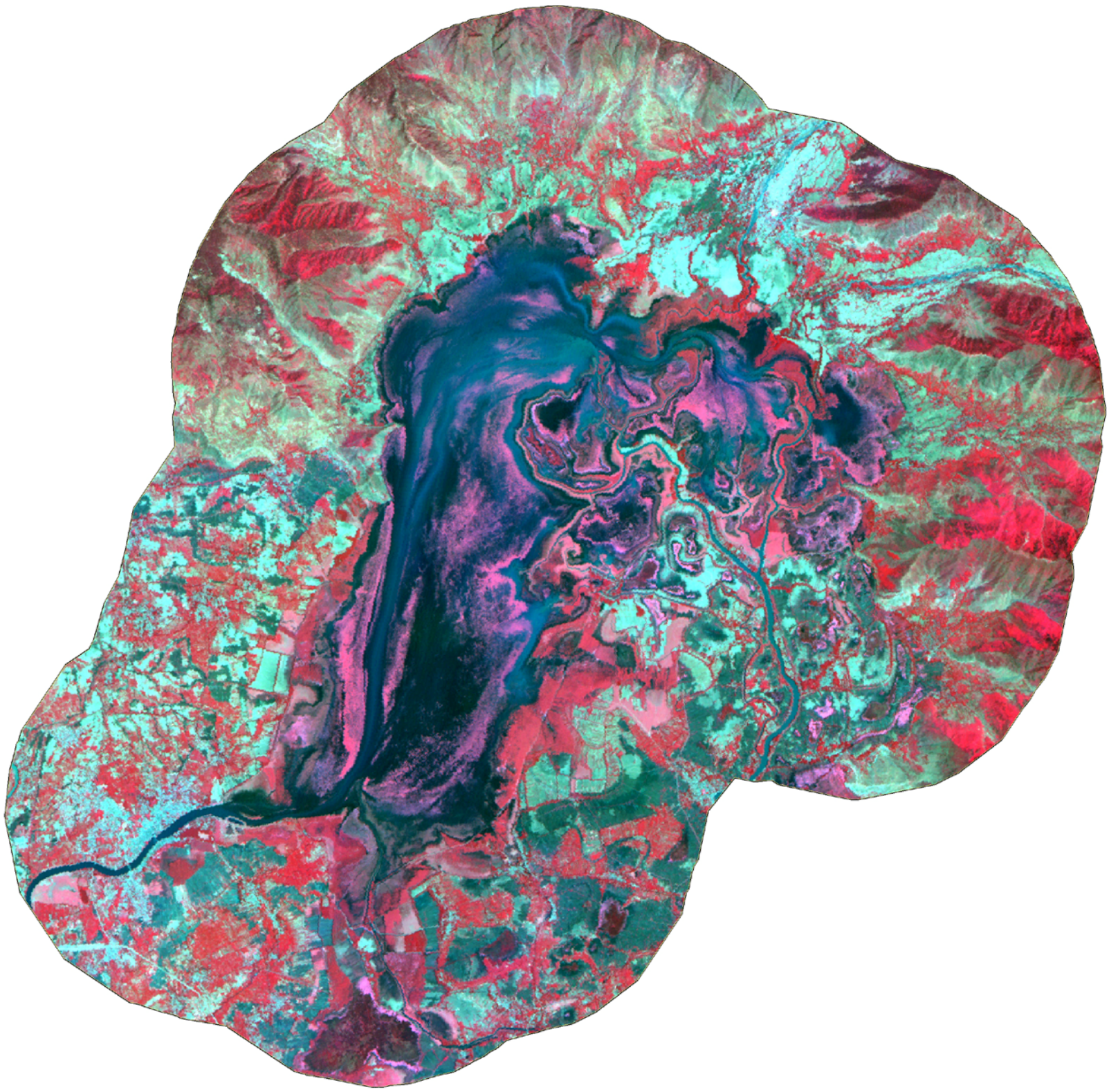
Sponsored By:

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

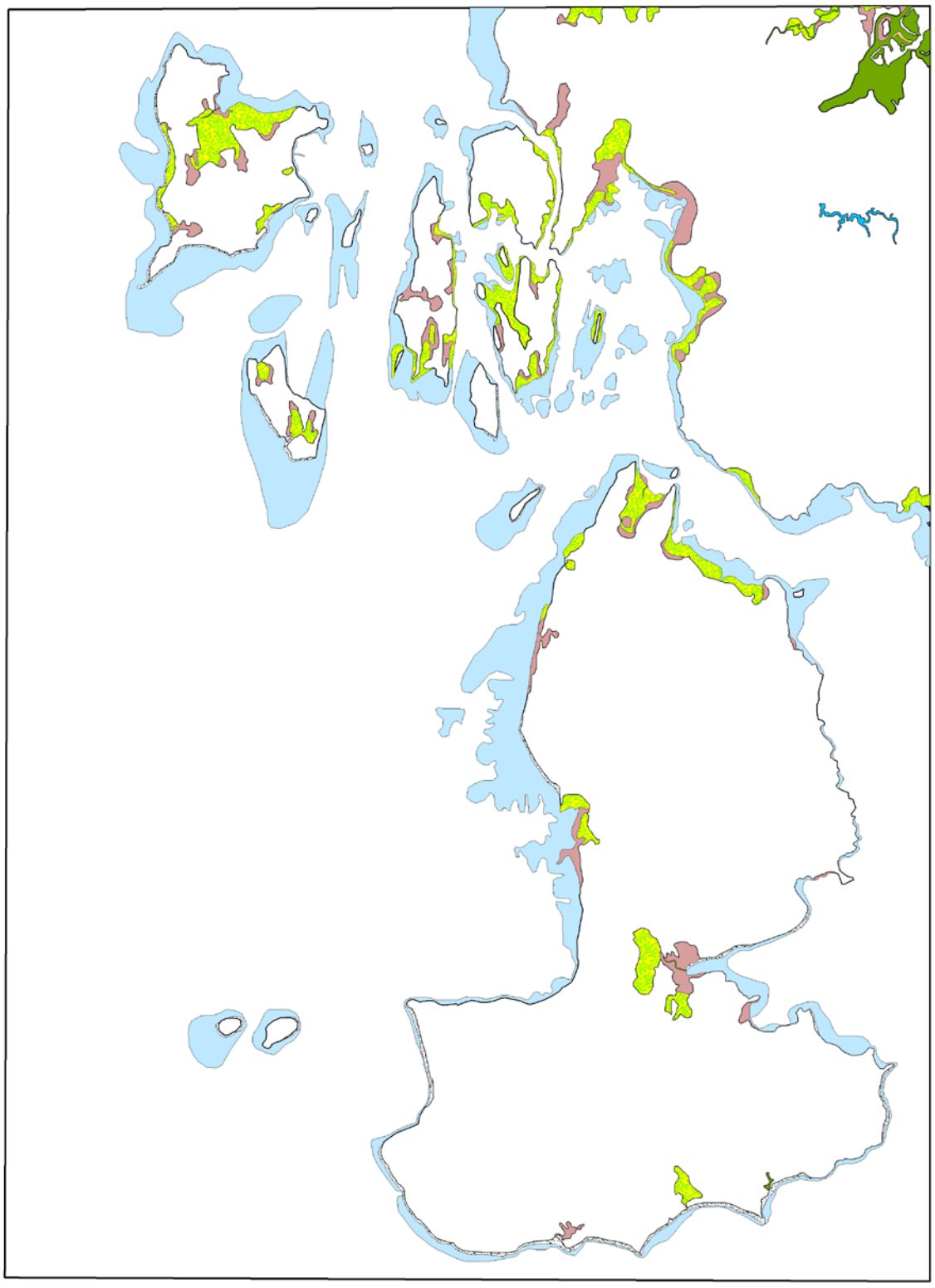
Area in ha

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

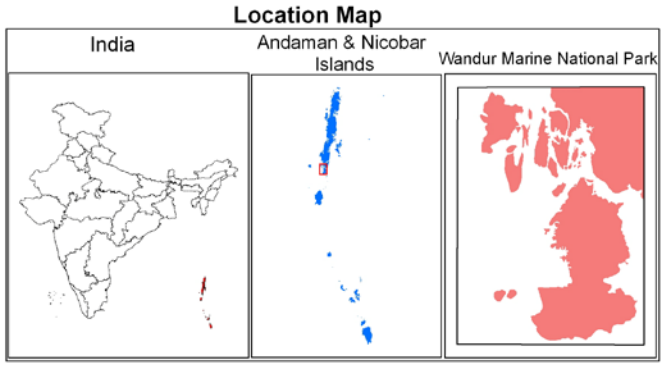


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			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

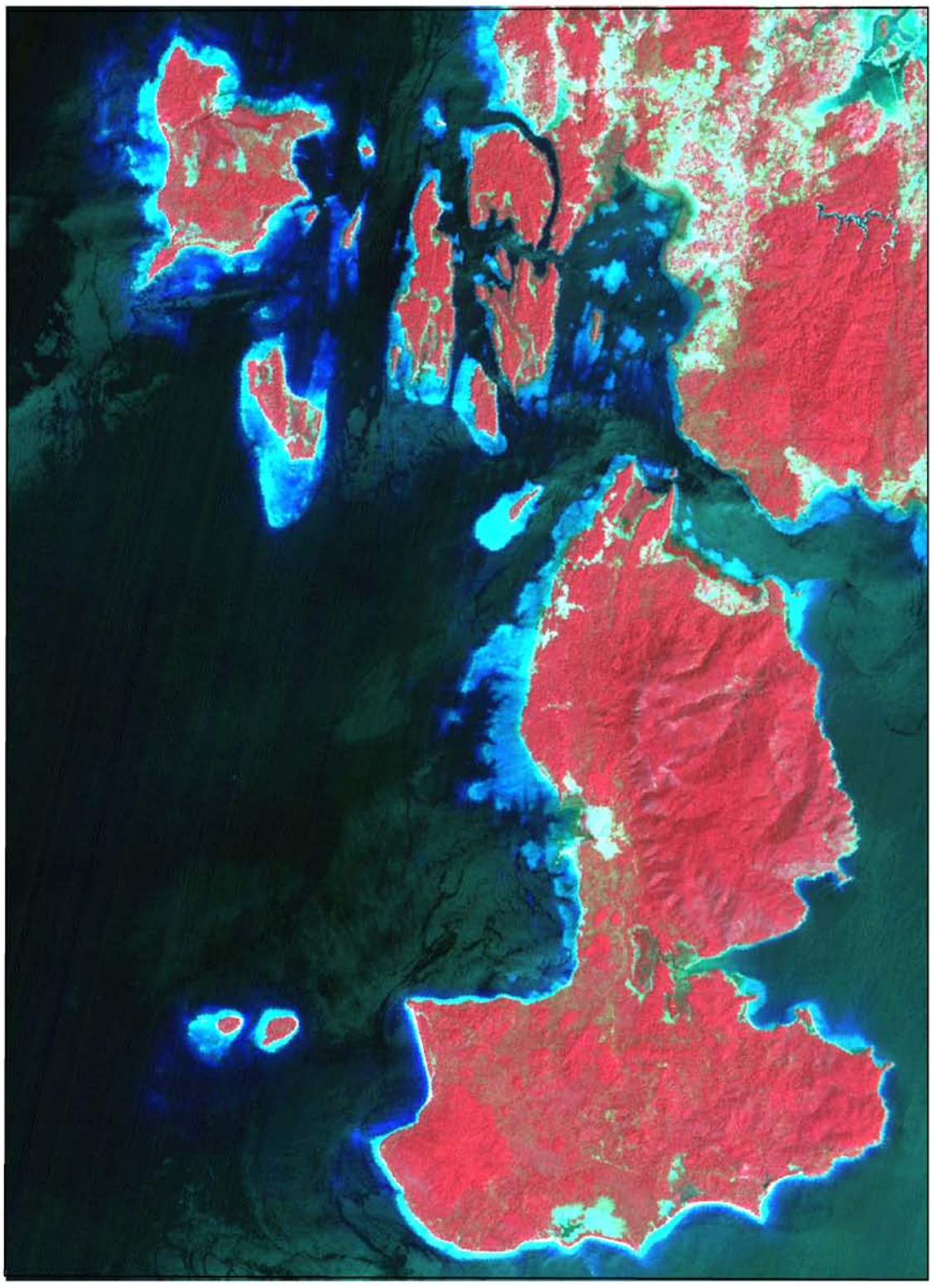


Plate 113: IRS LISS III FCC - 5 km buffer area of Wandur Marine National Park

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Annexure I
Definitions of wetland categories used in the project

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

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

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

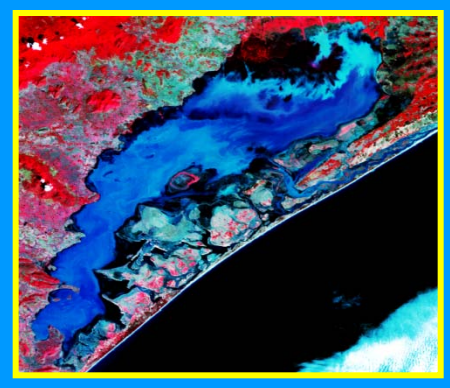
Source : Survey of India (Surveyed in 2004 and published in 2005)

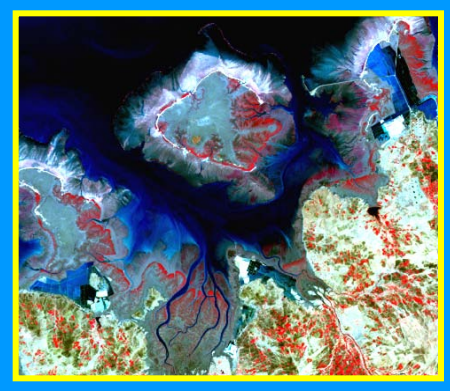
Space Applications Centre (SAC) is one of the major centres of the Indian Space Research Organisation (ISRO). It is a unique centre dealing with a wide variety of disciplines comprising design and development of payloads, societal applications, capacity building and space sciences, thereby creating a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

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

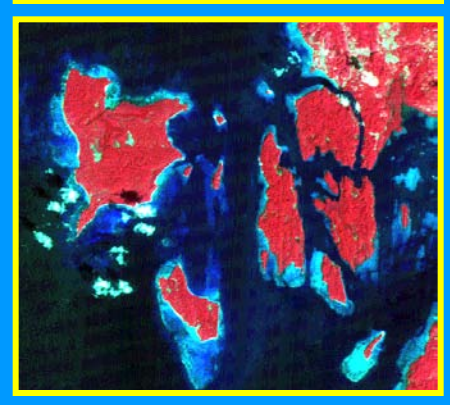
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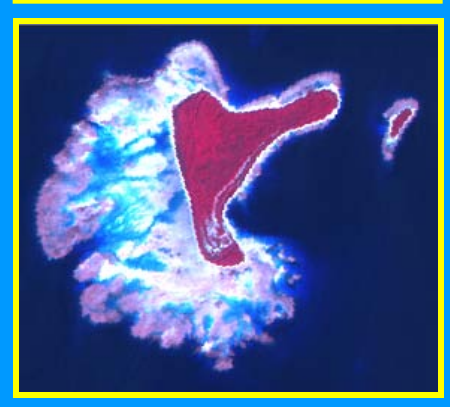












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