



सत्यमेव जयते

# NATIONAL WETLAND ATLAS: KARNATAKA



Sponsored by  
Ministry of Environment and Forests  
Government of India



Space Applications centre  
Indian Space Research Organisation  
Ahmedabad – 380 015



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

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

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

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# **NATIONAL WETLAND ATLAS**

## ***KARNATAKA***

**Sponsored by**

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

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

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

**And**

**Karnataka State Remote Sensing Applications Centre, (KSRSAC), Bangalore**

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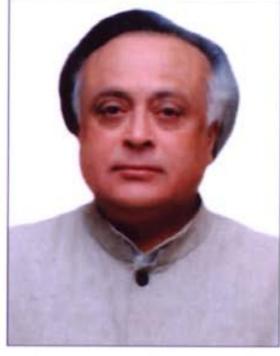
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जयराम रमेश  
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## MESSAGE

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

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

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

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

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

(Jairam Ramesh)





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## FOREWORD

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

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

January 25, 2010

(Ranganath R. Navalgund)



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## 1.0 INTRODUCTION

It is increasingly realized that the planet earth is facing grave environmental problems with fast depleting natural resources and threatening the very existence of most of the ecosystems. Serious concerns are voiced among scientists, planners, sociologists, politicians, and economists to conserve and preserve the natural resources of the world. One of the 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 wetland atlas of Karnataka, which is part of the National Wetland Atlas of India, is an attempt in this direction.

### 1.1 Wetlands

Wetlands are one of the crucial natural resources. Wetlands are areas of land that are either temporarily or permanently covered by water. This means that a wetland is neither truly aquatic nor terrestrial; it is possible that wetlands can be both at the same time depending on seasonal variability. Thus, wetlands exhibit enormous diversity according to their genesis, geographical location, water regime and chemistry, dominant plants and soil or sediment characteristics. Because of their transitional nature, the boundaries of wetlands are often difficult to define. Wetlands do, however, share a few attributes common to all forms. Of these, hydrological structure (the dynamics of water supply, throughput, storage and loss) is most fundamental to the nature of a wetland system. It is the presence of water for a significant period of time which is principally responsible for the development of a wetland. One of the first widely used classifications systems, devised by Cowardin *et al*, (1979), was associated to its hydrological, ecological and geological aspects, such as: marine (coastal wetlands including rock shores and coral reefs, estuarine (including deltas, tidal marshes, and mangrove swamps), lacustrine (lakes), riverine (along rivers and streams), palustrine ('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](http://www.MAweb.org)). The Millennium Assessment (MA) uses the following typology to categories 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 is 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 technique

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

now 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 includes visible light, near-, mid- and far-infrared (thermal), microwave, and long-wave radio energy. The capability of multiple sources of information is unique to remote sensing. Of specific advantage is the spectral, temporal, and spatial resolution. Spectral resolution refers to the width or range of each spectral band being recorded. Since each target affects different wavelengths of incident energy differently, they are absorbed, reflected or transmitted in different proportions. Currently, there are many land resource remote sensing satellites that have sensors operating in the green, red, near infrared and short wave Infra red regions of the electromagnetic spectrum giving a definite spectral signature of various targets due to difference in radiation absorption and reflectance of targets. These sensors are of common use for land cover studies, including wetlands. Figure 1 shows typical spectral signature of few targets from green to SWIR region. Converted to image, in a typical false colour composite (FCC) created using NIR, red and green bands assigned as red, green and blue colour, the features become very distinct as shown in Figure 2. In FCC, the vegetation thus appears invariably red (due to high reflection in NIR from green leaves).

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

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

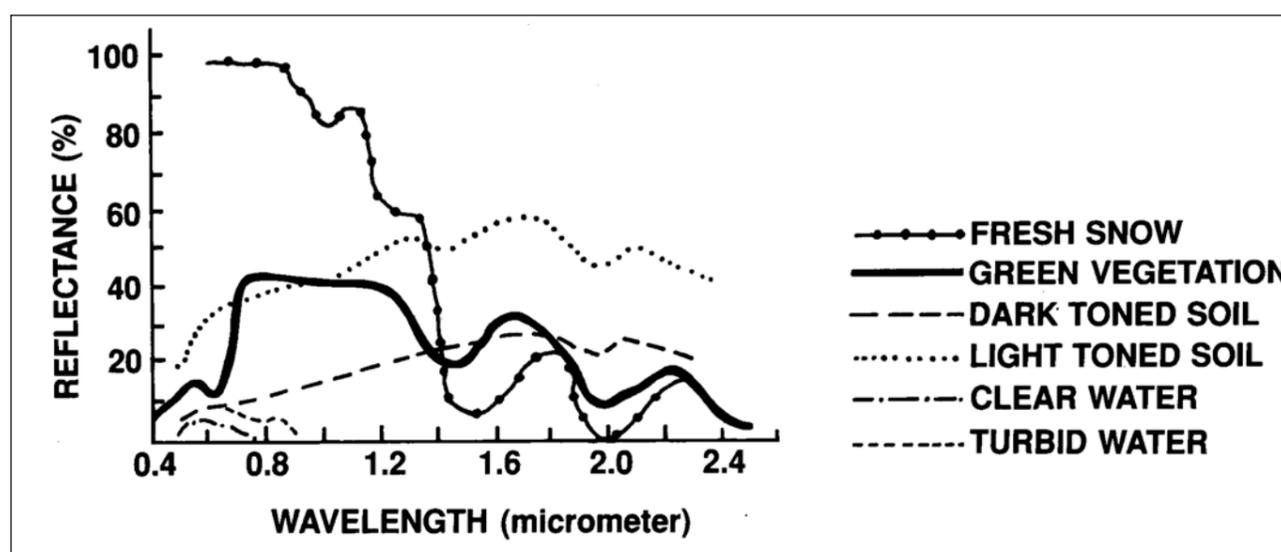


Figure 1: Spectral Signature of various targets

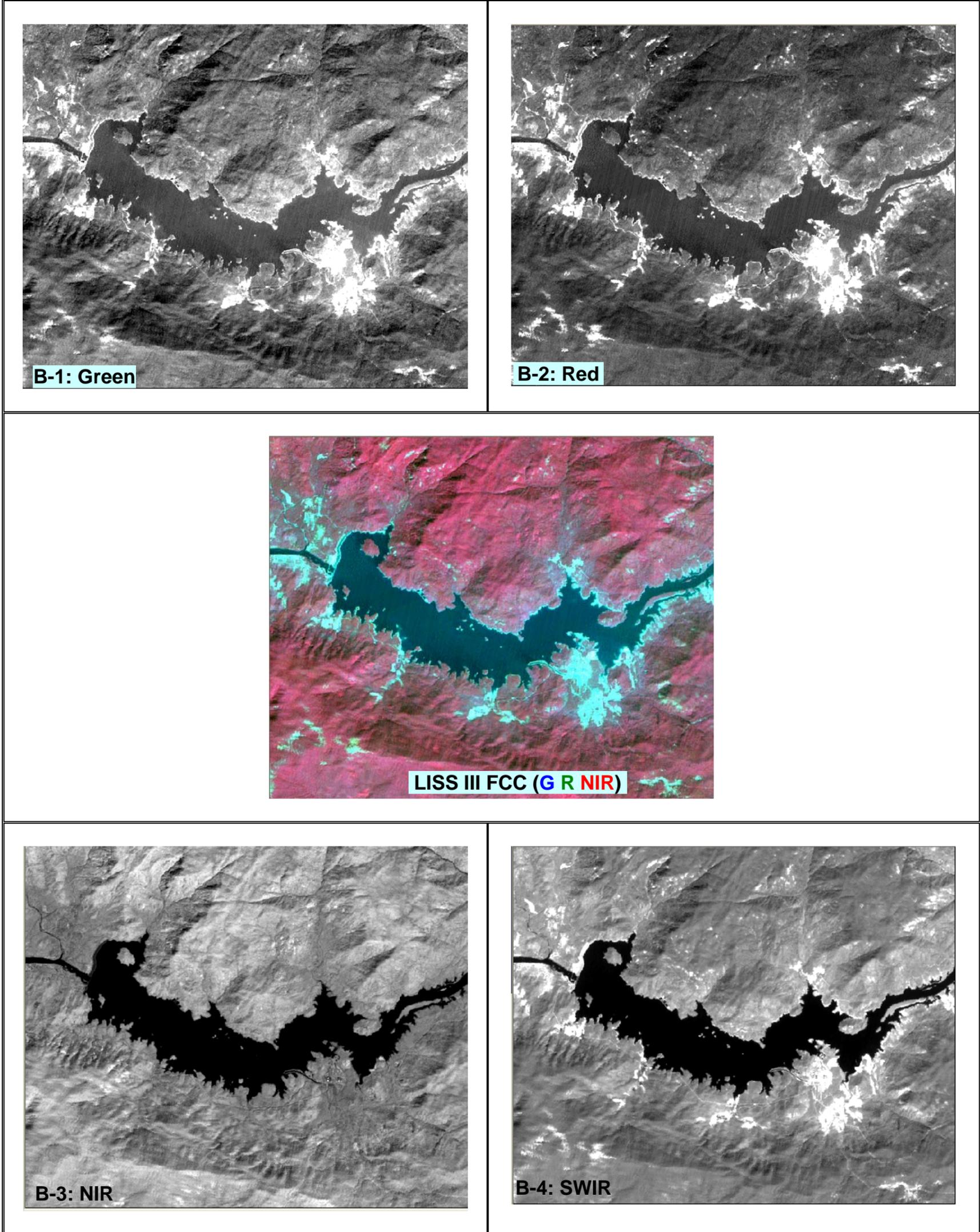


Figure 2: Various land features as they appear in four spectral bands and in a typical three band FCC

### 1.3 Wetland Inventory of India

India with its large geographical spread supports large and diverse wetland classes, some of which are unique. Wetlands, variously estimated to be occupying 1-5 per cent of geographical area of the country, support about a fifth of the known biodiversity. Like any other place in the world, there is a looming threat to the aquatic biodiversity of the Indian wetlands as they are often under a regime of unsustainable human pressures. Sustainable management of these assets therefore is highly relevant. Realising this, Govt. of India has initiated many appropriate steps in terms of policies, programmes and plans for the preservation and conservation of these ecosystems. India is a signatory to the Ramsar Convention for management of wetland, for conserving their biodiversity and wise use extending its scope to a wide variety of habitats, including rivers and lakes, coastal lagoons, mangroves, 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](http://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 India was carried out during 1992-93 by Space Applications Centre (ISRO), Ahmedabad, at the behest of the Ministry of Environment and Forests (MoEF), Govt. of India using remote sensing data from Indian Remote Sensing satellites (IRS-Series). The mapping was done at 1:250,000 scale using IRS 1A LISS-I/II data of 1992-93 timeframe under the Nation-wide Wetland Mapping Project. Since, no suitable wetland classification existed for comprehensive inventory of wetlands in the country at that time, the project used a classification system based on Ramsar Convention definition of wetlands. The classification considers all parts of a water mass including its ecotonal area as wetland. In addition, fish and shrimp ponds, saltpans, reservoirs, gravel pits were also included as wetlands. This inventory put the wetland extent (inland as well as coastal) at about 8.26 million ha. (Garg *et al*, 1998). These estimates (24 categories) do not include rice/paddy fields, rivers, canals and irrigation channels.

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

## **2.0 NATIONAL WETLAND INVENTORY AND ASSESSMENT (NWIA) PROJECT**

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

The main objectives of the project are:

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

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

### **2.1 Wetland Classification System**

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

### **2.2 Spatial Framework and GIS Database**

The National Spatial Framework) (NSF) has been used as the spatial framework to create the database (Anon. 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 nationwide administrative as well as natural hierarchy (State-district- within the feature class for each of the theme. All data elements are given a unique name, which are self explanatory with short forms.

Following wetland layers are generated for each inland wetland:

- Wetland extent: As wetlands encompass open water, aquatic vegetation (submerged, floating and emergent), the wetland boundary should ideally include all these. Satellite image gives a clear signature of the wetland extent from the imprint of water spread over the years.
- Water spread: There are two layers representing post-monsoon and pre-monsoon water spread during the year of data acquisition.

- Aquatic vegetation spread: The presence of vegetation in wetlands provides information about its tropic 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 ( low, medium and high) is followed for pre and post-monsoon turbidity of lakes, reservoirs, barrages and other large wetlands.
- Small wetlands (smaller than minimum mappable unit) are mapped as point features.
- Base layers like major road network, railway, settlements, and surface drainage are created (either from the current image or taken from other project data base).

Table 1: Wetland Classification System and coding

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

\* Wetland type code

### **3.0 STUDY AREA**

Karnataka is a land of unparalleled natural beauty and bounty. It is located in the southwestern part of India. Covering a spatial extent of 1, 91,791 Sq.km. (5.35% of country's total geographical area) with 27 districts and 176 talukas. Its length (north to south) is about 750 km and width (from east to west) about 400 km, with a coast line of about 320 km. It is situated on the western edge of the Deccan plateau with Andhra Pradesh on the north-eastern & eastern portion, Tamilnadu on the south eastern part, Kerala state on the south-western part, Maharashtra and Goa on the north-western part and western portion of the state is bounded by the Arabian Sea. The state lies between 11°31' to 18°45' N latitudes and 74°12' to 78°40' E longitudes (Figure 3) endowed with numerous rivers, lakes and streams.

#### **Physiography**

Physiographically Karnataka state can be divided into two major classes, namely coastal region, which is further sub-divided into the coastal plains and western ghats, and the Karnataka plateau, which is sub-divided into malnad and maidan. The maidan is further sub-divided into northern and southern maidan, latter being at much higher general elevation than the former. A narrow belt between the maidan and the malnad is often referred to as semi-malnad. The highest point is located in the south-western part of the state and the lowest in the valleys of the Tungabhadra and Hagari rivers.

#### **Coastal Region**

The coast line has a length of about 400 km and there is gradual transition between the Konkan coast in the north and Kerala coast in the south. The coastal region is further divided into two parts, the plains and the western ghats. The differential erosion, river piracy and faulting on a variety of lithological formations combine to dissect the plains to a large extent.

#### **Coastal Plains**

The plains are partly formed by marine denudation, but the level character of the land is severely restricted directly by the western ghats and transverse intrusion. Estuarine plains of Kali, Gangavali and the Tadri (Bedti) and the Sharavati rivers, separated by two east-west Sahyadri off shoots, borders the coastline.

#### **Western Ghats**

To the east of the coastal plains, the general elevation is higher and increase occurs abruptly resulting in western ghats sections. The western ghats run NNW to SSE for about 320 km.

#### **Karnataka Plateau**

The Karnataka plateau has two natural sub-divisions, the malnad and maidan. Which includes the northern upland or Deccan trap and southern upland.

#### **Climate and Rainfall**

As far as the climate in Karnataka is concerned, this state has a pleasant weather. The state is known to have a moderate summers and pleasant winters. The climate of the state is determined mainly by the geographical location with respect to the sea, monsoon winds and physiography. The state has very moist climate on the west-coast, semi-arid climate in the Malnad regions and warm (arid) climate in the northern districts. Summer (March to May), South-West monsoon (June to September), North-East monsoon (October to December) and winter (January – February) are the four seasons of the state. The spatial variation in the occurrence of rainfall in the state is highly variable from the western region (Malnad and coastal plain) to the Maidan region.

The seasonal rainfall distribution for the state as a whole indicate, that 71% of the annual normal rainfall is received during SW monsoon, 17% during NE monsoon and the remaining 12% during post-monsoon period. The average normal rainfall of the state is 1139 mm, received over 55 normal rainy days. The annual rainfall varies from as low as 562 mm in the central districts (Bagalkot) to as high as 4119 mm in the coastal district of Udupi. About 75% of the cultivable area is rain-fed. There is also negligible quantity of rainfall during summer and winter. Thus most of the agricultural production in the state is mainly dependent on spatial and temporal distribution of the rainfall.

#### **Agro climatic zones**

Based on the rain fall, climate, topography, soil, availability of water, cropping pattern and other agro-meteorological characteristics the entire country has been divided into 15 agro climatic zones and Karnataka state fall under the zones IX, X and XII the western plateau and hill region (IX), Southern plateau and hill region(X) and the west-coast plain and ghat region. The Karnataka state has been further divided into ten different agro-climatic zones such as, North-Eastern dry zone, Northern dry zone, Central dry zone,

South-Eastern dry zone, South dry zone, North-Eastern transition zone, Southern transition zone, Northern transition zone, Hilly zone and Coastal zone.

## Soil

The Karnataka state forms a part of Deccan plateau and the soils are mainly derived from granite, gneises and basalts. Besides these some part is having laterite and alluvial soils. The major soils founds are black soils, red soils, reddish brown soils, laterite soils, and coastal alluvial soils.

## Surface Drainage

Karnataka is blessed with numerous rivers and streams. By virtue of its varied terrain, climate and geographical position, it supports a rich diversity of inland and coastal wetlands, there are seven river basins, which drain the Karnataka state namely, Cauvery, Krishna, Godavari, West flowing rivers, North pennar, South pennar and Palar. Major area of the state lies in the Krishna basin. In the Western Ghats and Malnad regions, the drainage network is dense. Rivers Krishna and Godavari flow from Maharashtra state, whereas river Cauvery, Palar and Pennar originate in the state. The West-flowing rivers originate in the western ghats, finally find their way into the Arabian sea. The major rivers include Krishna, Bhima, Dudganga, Tungabhadra, Hirenyakeshi, Ghataprabha, Malaprabha, Cauvery, Godavari, Manjra, Karanja, Uttarpinakini, Dakshinpinakini, Palar, Kali, Aghanashini (Tadri), Netravati, Sharavati and Gangavali (Bedti), Mahadai, Chakranadi, Varahi, Barapole (Valapattanam), Arkavaty, Shimhsa, Lakshmanathirtha, Suvarnavathy, Kabini, Hemavathy. Apart from these rivers, Karnataka is bestowed with several reservoirs/barrages, lakes and backwater lagoons and beaches. The important wetland-types of Karnataka are Tanks/Ponds, Reservoir/Barrages and Rivers/Streams. The others are Tadri creek, Gurpur, Talakadu, Jaladhama, Honnemaradu, Holebaagilu, Brahmavara, Kabini river, Uppina Kudru and Harangi. The Karnataka state has finest beaches like Karwar, Gokarna (in Gokarna Om, Gokarna, Kudle, Half-moon and Paradise), Murdeshwar, Kurumgod, Maravanthe Malpe, Kaup, Suratkal, Panamboor and Ullal. Ecologically Important coastal areas in Karnataka are Honnavara–estuarine mangroves ecosystem and Coondapur–estuarine ecosystem. Reservoirs are the major wetlands that form the source of electricity. Major reservoirs include Tungabhadra, Kadra, Karanja, Alamatti, Hidkal, Narayanapura, Linganamakki, Chakra Supa.

As mentioned earlier, the Karnataka state has 27 districts and is covered by 317 Survey of India (SOI) topographical maps on 1:50,000 scale that form the spatial frame work for mapping (Figure 4) prepared using 15' x 15' grid. A detail of district information followed in the atlas is given in Annexure-II.

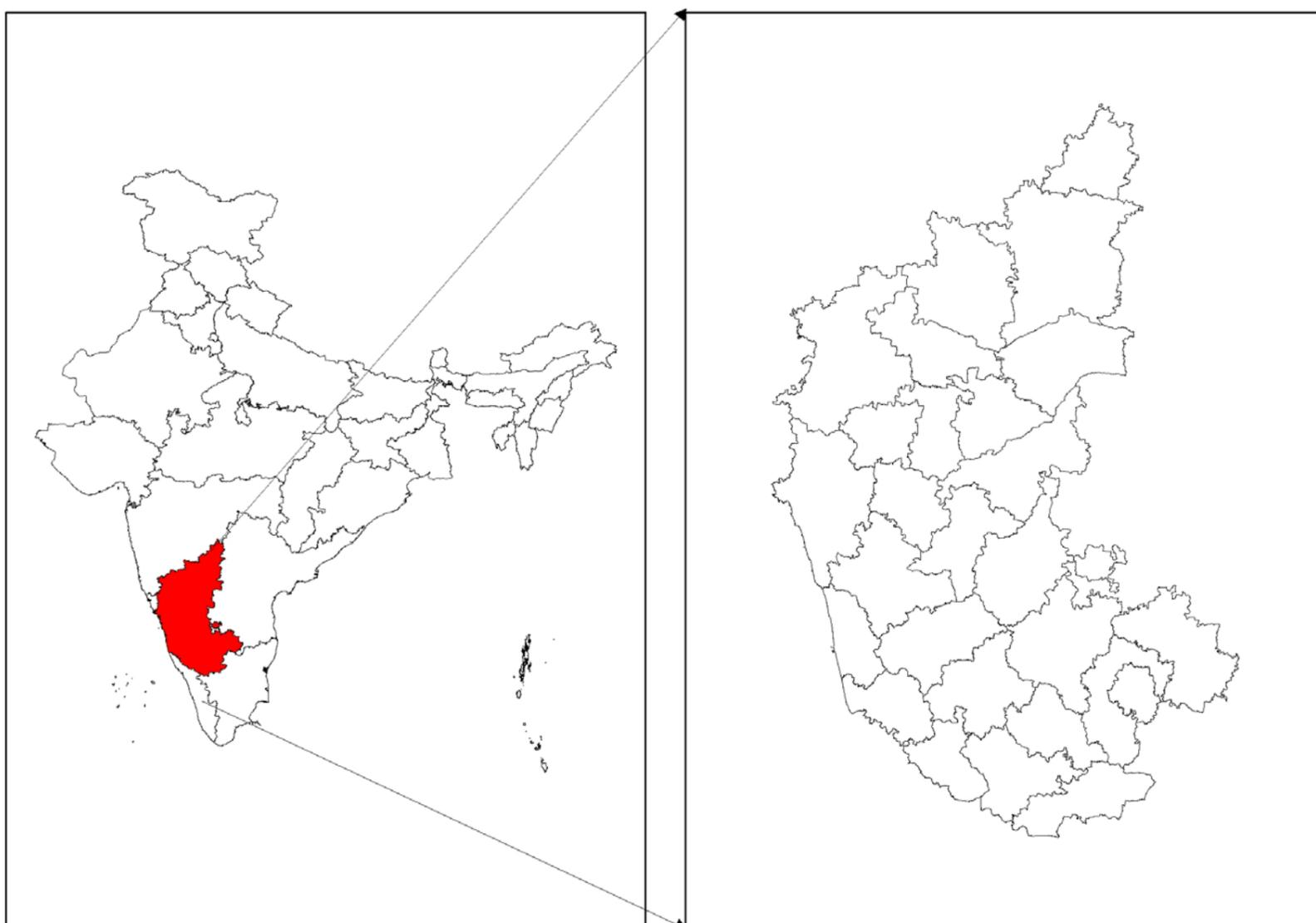


Figure 3: Location Map

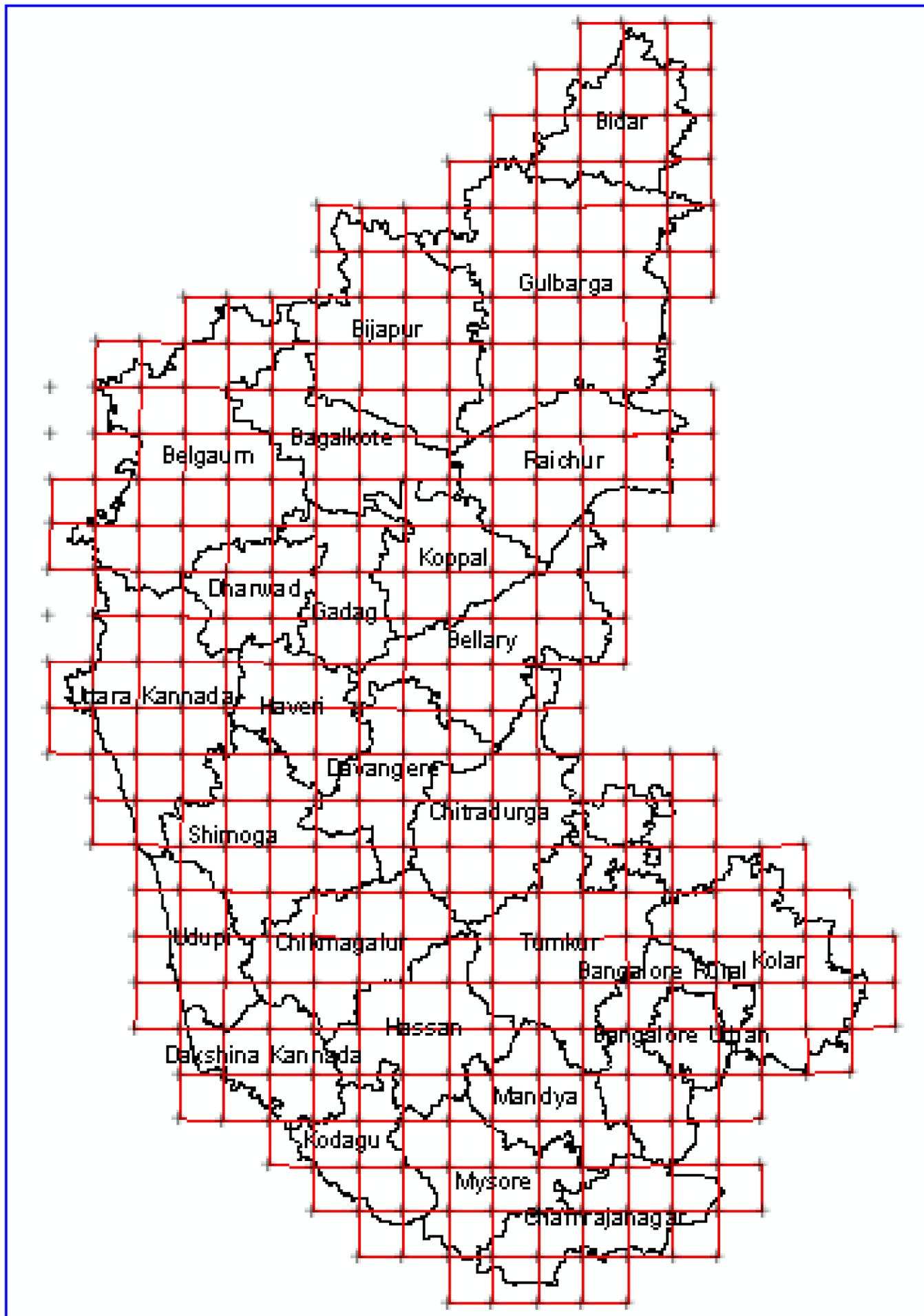


Figure 4 : Spatial Framework of Karnataka

#### 4.0 DATA USED

##### *Remote sensing data*

IRS P6 LISS III data was used to map the wetlands. IRS P6 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. The state of Karnataka is covered in 24 IRS LISS III scene (Figure 5). Two-date data, one acquired during October/November and another during April/May were used to capture the post-monsoon and pre-monsoon hydrological variability of the wetlands respectively (Table-2). Figure 6 shows the overview of the part of Karnataka as seen in the LISS III FCC of post- monsoon pre-monsoon data respectively.

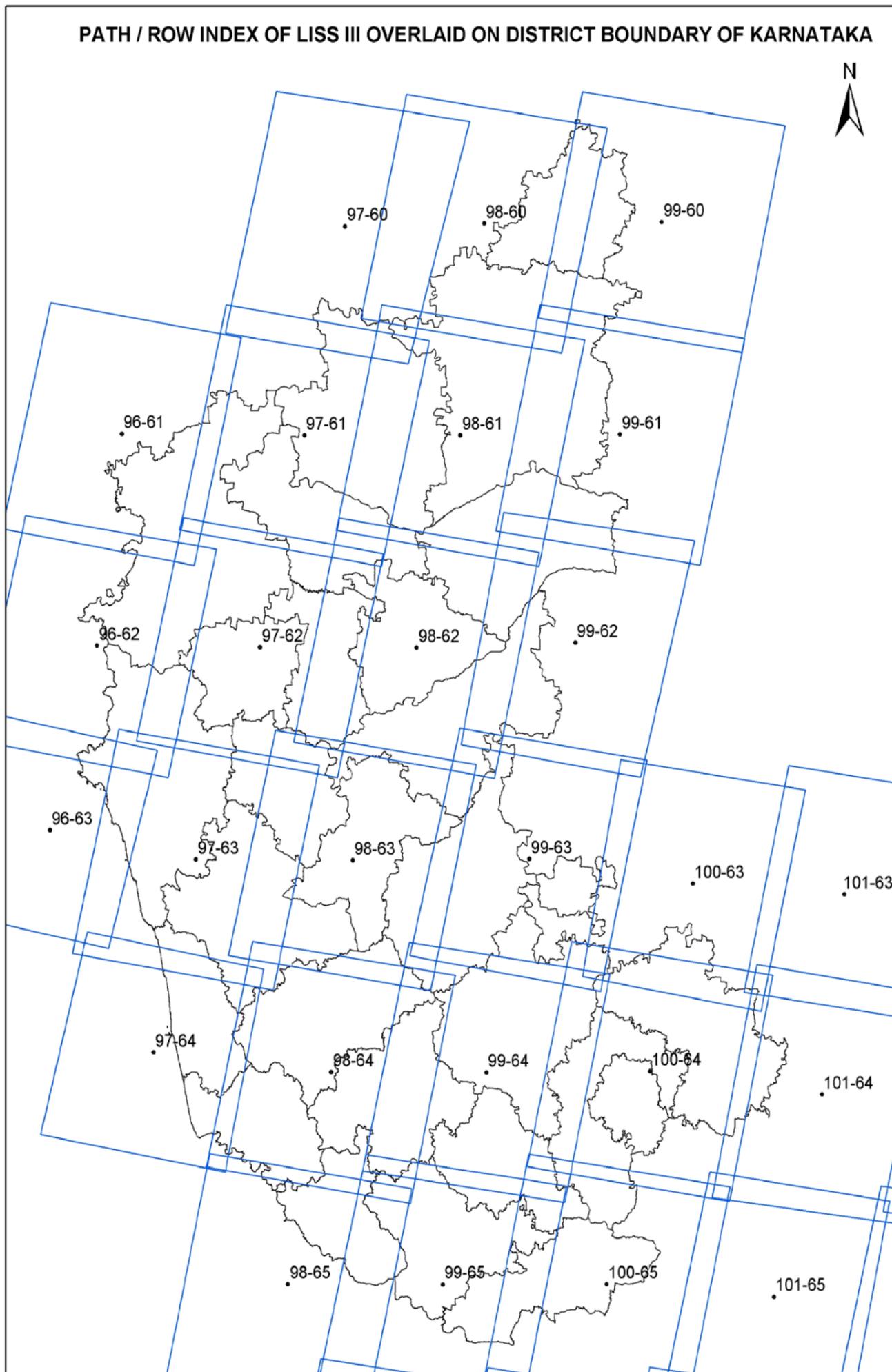


Figure 5: IRS P6 LISS-III coverage of Karnataka

**Ground truth data**

Remote sensing techniques require certain amount of field observation called “ground truth” in order to deduce 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 (qualitative), status of aquatic vegetation and water spread. All field data collection work has been done during October and November 2008.

## Other data

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

Table-2: Satellite data used

<b>Sr. No</b>	<b>Resourcesat LISS III Path Row</b>	<b>Post-monsoon</b>	<b>Pre-monsoon</b>
1	97-60	January 15,2007	March 03,2007
2	98-60	December 07,2006	May 24,2007
3	99-60	October 25,2006	May 05,2007
4	96-61	November 08, 2005	May 14, 2007
5	97-61	December 02,2006	April 25,2007
6	98-61	December 07,2006	April 30,2007
7	99-61	January 05,2007	April 11,2007
8	96-62	November 08, 2005	April 25, 2006
9	97-62	January 19,2007	April 25,2007
10	98-62	December 07, 2006	April 30,2007
11	99-62	January 05,2007	March 18,2007
12	96-63	January 14,2007	March 03,2007
13	97-63	January 25,2007	April 25,2007
14	98-63	December 07,2006	April 11,2007
15	99-63	January 05,2007	April 30,2007
16	100-63	February 27,2007	May 10,2007
17	97-64	January 19,2007	March 13,2007
18	98-64	December 07,2007	April 30,2007
19	99-64	December 07,2006	March 07,2007
20	100-64	March23,2007	May 10,2007
21	98-65	December 07,2006	January 24,2007
22	99-65	January 05,2007	May 23, 2007
23	100-65	November 28, 2005	May 23,2007
24	101-64	February 08,2007	May 15,2007

## 5.0 METHODOLOGY

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

- 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 on-screen interpretation
- Generation of base layers (rail, road network, settlements, drainage, administrative boundaries) from satellite image and ancillary data.
- Mosaicing/edge matching to create district and state level database.
- Coding of the wetlands following the standard classification system and codification as per NWIA manual.
- Preparation of map compositions and generation of statistics
- Outputs on A3 size prints and charts for atlas.

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

### 5.1 Creation of spatial framework

This is the most important task as the state forms a part of the national frame work and is covered in multiple map sheets. To create NWIA database, NNRMS/NRDB standards are followed and four corners of the 1:50,000 (15' x 15') grids are 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 Karnataka state is shown in Figure 4.

### 5.2 Geo-referencing of satellite data

In this step the raw satellite images were converted to specific map projection using geometric correction. This is done using 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.

### 5.3 Mapping of wetlands

The delineation of wetlands through image analysis forms the foundation for deriving all wetland classes and results. Consequently, a great deal of emphasis has been placed on the quality of the image Interpretation. In the present study, the mapping of wetlands was done following digital classification and 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) =  $(\text{Green} - \text{NIR}) / (\text{Green} + \text{NIR})$
- ii) Modified Normalised Difference Water Index (MNDWI) =  $(\text{Green} - \text{MIR}) / (\text{Green} + \text{MIR})$
- iii) Normalised Difference Vegetation Index (NDVI) =  $(\text{NIR} - \text{Red}) / (\text{NIR} + \text{Red})$
- iv) Normalised Difference Pond Index (NDPI) =  $(\text{MIR} - \text{Green}) / (\text{MIR} + \text{Green})$
- v) Normalised Difference Turbidity Index (NDTI) =  $(\text{Red} - \text{Green}) / (\text{Red} + \text{Green})$

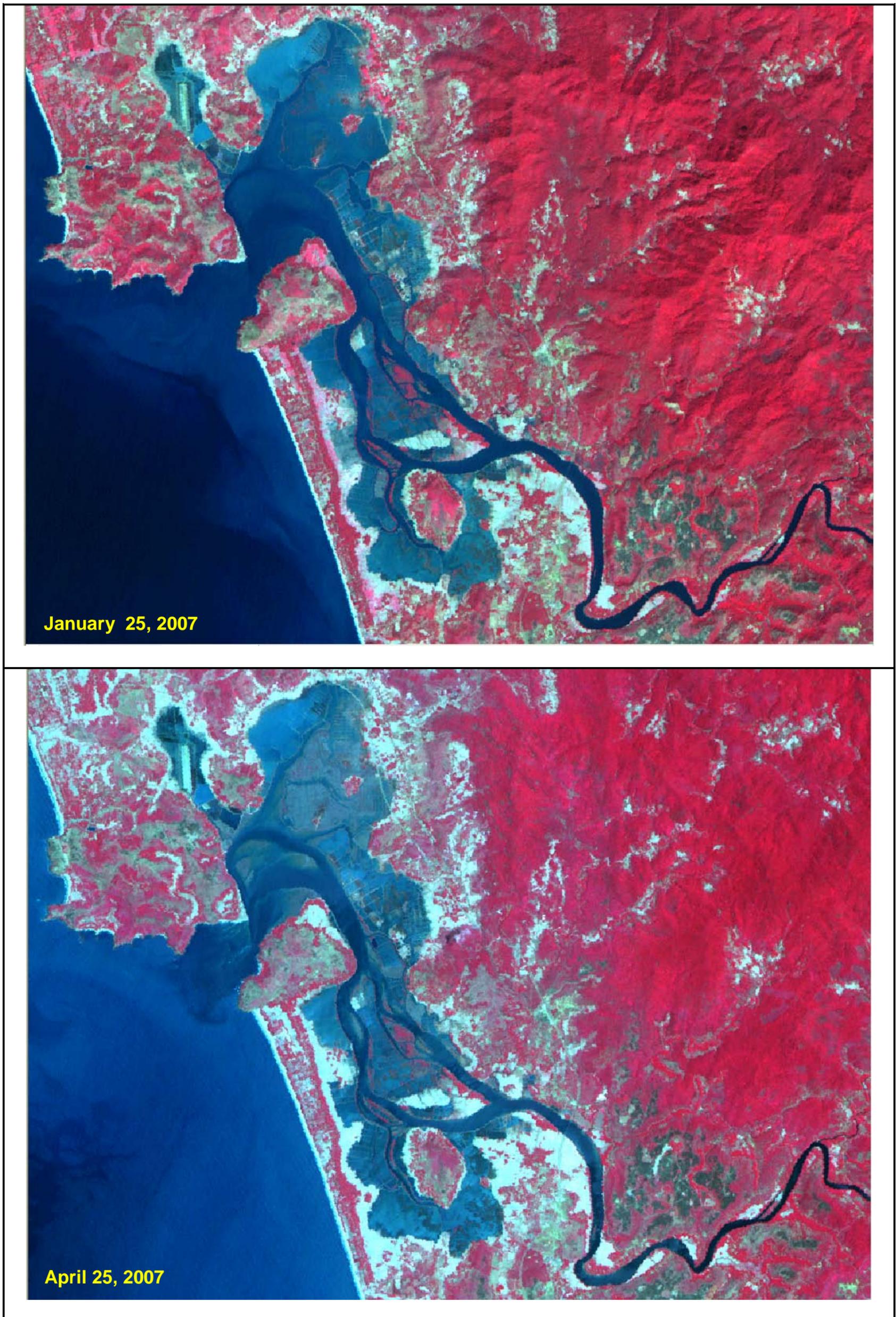


Figure 6: Part of Karnataka state as seen on IRS P6 LISS-III FCC

The indices were generated using standard image processing software, stacked as layers (Figure 7). Various combinations of the indices/spectral bands were used to identify the wetland features as shown in Figure 8. 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 delineate the 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. In the False Colour Composite (FCC) these generally appear in different hues (Table-3).

Table 3: Qualitative turbidity ratings

Sr. No.	Qualitative Turbidity	Conditional criteria	Hue on FCC
1.	Low	$> +1\sigma$	Dark blue/blackish
2.	Moderate	$> -1\sigma$ to $\leq +1\sigma$	Medium blue
3.	High/Bottom reflectance	$\leq \mu - 1\sigma$	Light blue/whitish blue

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

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

#### 5.5 Generation of reference layers

Base layers like major rail, road network, settlements, 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.

#### 5.6 Coding and attribute scheme

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

#### 5.7 Map composition and output

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

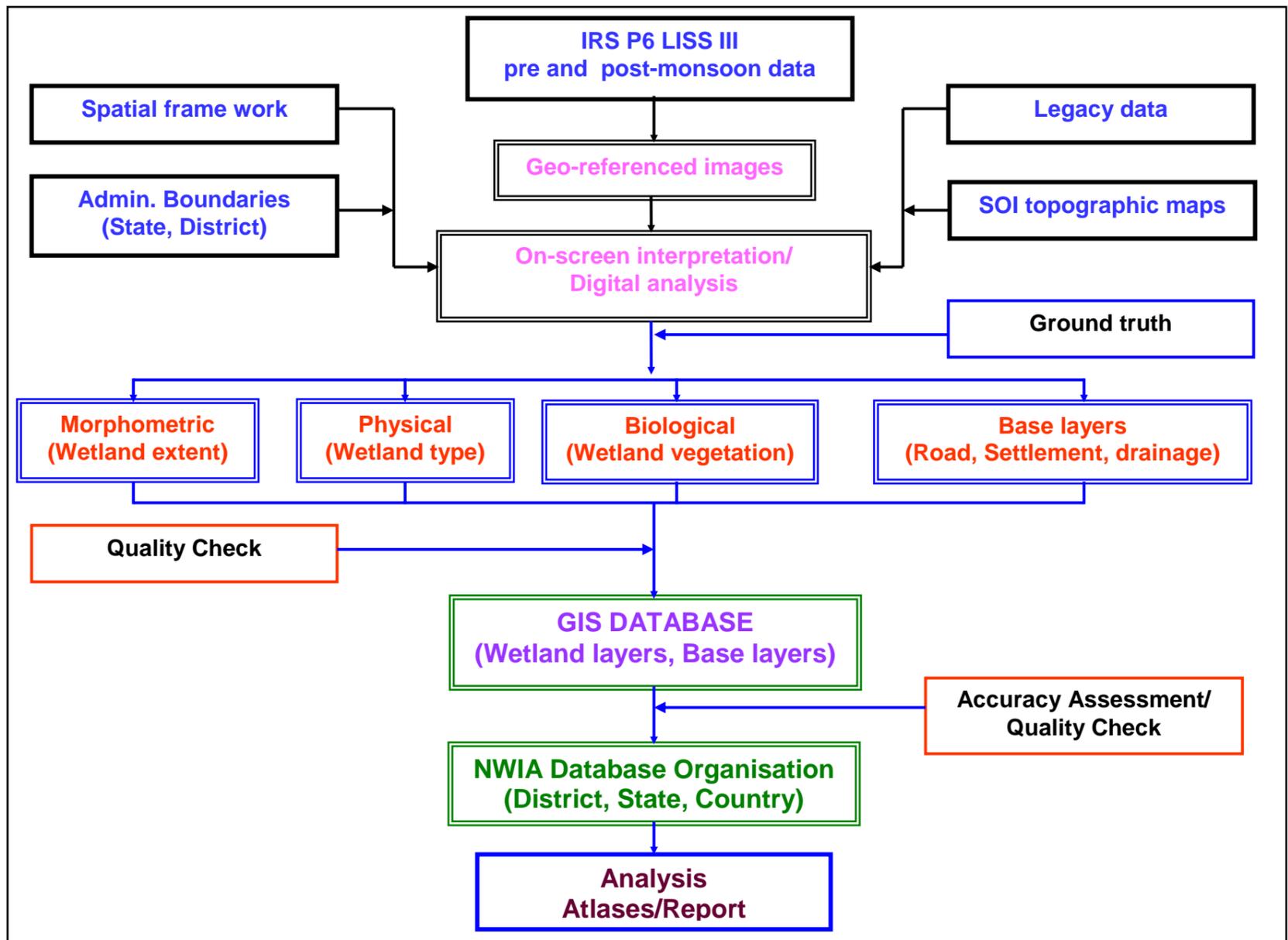


Figure 7: Flow chart of the methodology used

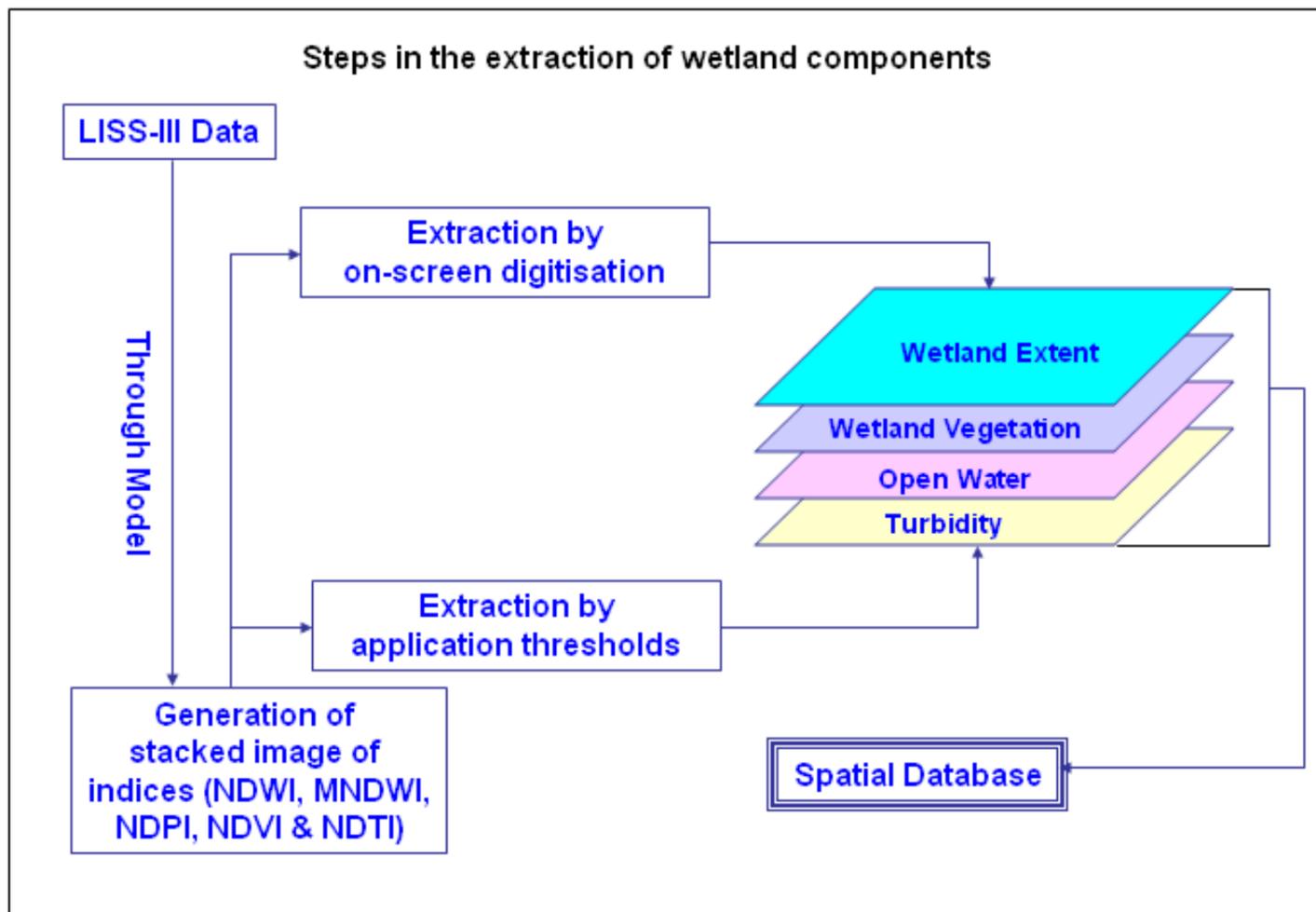


Figure 8: Steps in the extraction of wetland components

## **6.0 ACCURACY ASSESSMENT**

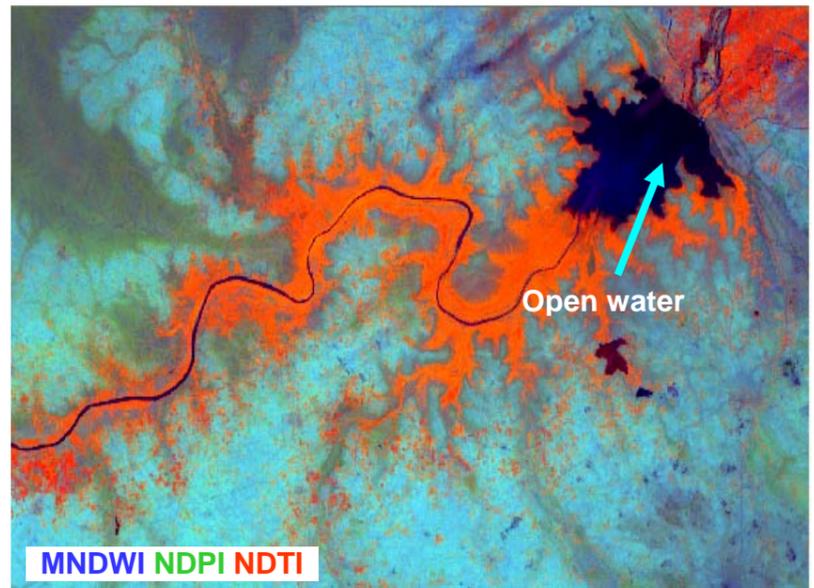
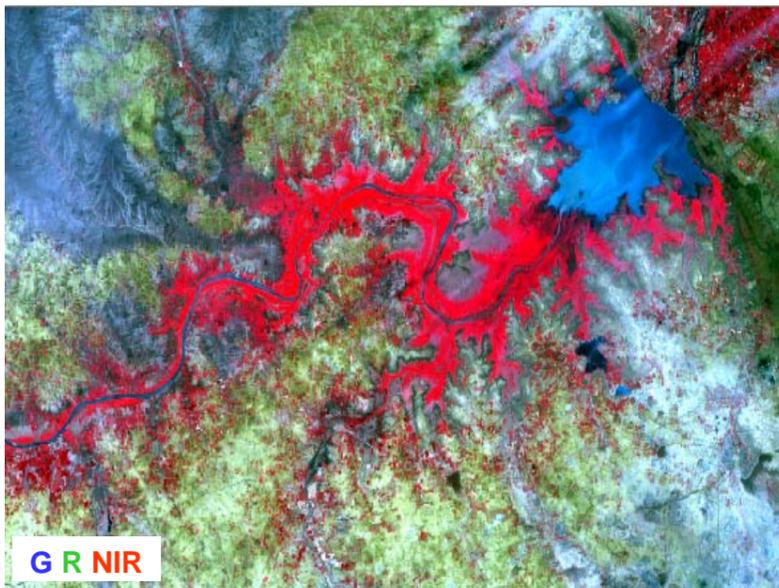
A comprehensive accuracy assessment protocol has been followed for determining the quality of information derived from remotely sensed data. Accuracy assessment involves determination of thematic (classification) as well as locational accuracy. In addition, GIS database(s) contents have been also evaluated 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 percent of the work. The various stages of quality check include:

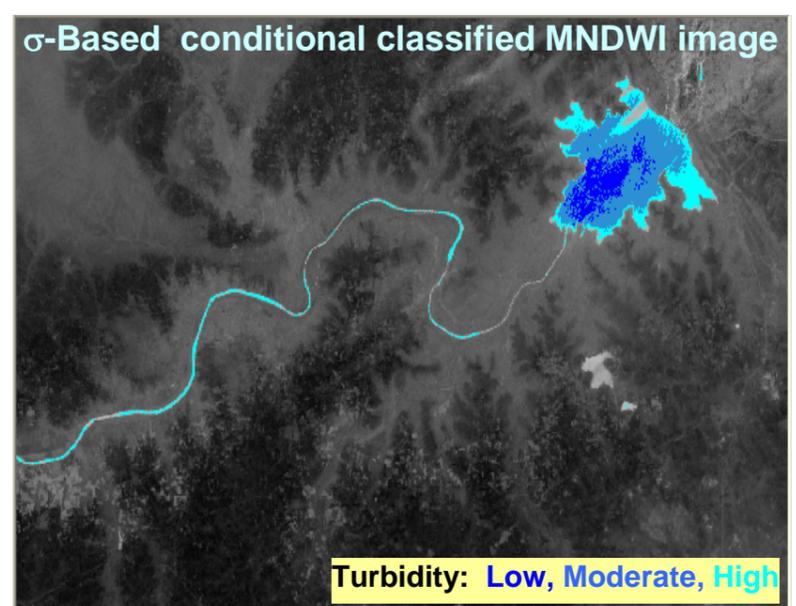
1. Image-to-Image Geo-referencing/Data generation
2. Reference layer preparation using NWIA post monsoon and pre-monsoon LISS-III data.
3. Wetland mapping using visual/digital interpretation techniques.
4. Geo-data base creation and organization
5. Output products.

### **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 (Arc/GIS) were used to correct digital artifacts including polygon topology. Additional customized data inspections were made to ensure that the changes indicated at the image interpretation stage were properly executed.



Useful for delineation of wetland vegetation and open water features



Useful for qualitative turbidity delineation

Tungabhadra reservoir as seen on IRS LISS III data, 30 April, 2007

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



# **MAPS AND STATISTICS**



## 7.0 WETLANDS OF KARNATAKA: MAPS AND STATISTICS

Area estimates of various wetland categories for Karnataka have been carried out using GIS layers of wetland boundary, water-spread, aquatic vegetation and turbidity. In the state of Karnataka 11412 wetlands have been delineated, in addition to 13864 wetlands smaller than 2.25 ha, which have been shown as point features. Total wetland area is estimated to be 643576 ha (Table 4). 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 besides the small wetlands (<2.25 ha) constituting about 2 per cent of the wetland area.

Table 4: Summary statistics of aerial estimates of wetlands in Karnataka

Sr. No.	Wettcode	Category	Number	Total Wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-Monsoon area
1	1100	Inland Wetlands - Natural	515	183465	28.51	150117	110756
2	1200	Inland Wetlands -Man-made	10509	437960	68.05	274525	147544
		Total - Inland	11024	621425	96.56	424642	258300
3	2100	Coastal Wetlands - Natural	313	4696	0.73	323	1328
4	2200	Coastal Wetlands - Man-made	75	3591	0.56	2956	3363
		Total - Coastal	388	8287	1.29	3279	4691
		<b>Sub-Total</b>	<b>11412</b>	<b>629712</b>	<b>97.85</b>	<b>427921</b>	<b>262991</b>
5		Wetlands (<2.25 ha)	13864	13864	2.15	0	0
		<b>Total</b>	<b>25276</b>	<b>643576</b>	<b>100</b>	<b>427921</b>	<b>262991</b>

The major wetland types are Tanks/Ponds (222030 ha) followed by Reservoirs/Barrages (213527 ha) and River/Streams (179731 ha). Tanks/Ponds were dominant in terms of number (10386) as well as extent and accounted for about 35 per cent of wetland extent in the state (Table 5). Reservoir/Barrage category fewer in number (70) compared to Tank/Pond but ranked next comprising about 33 per cent of wetland extent. The open water extent (427921 ha) is estimated to be about 66 per cent of wetland extent in post-monsoon has shown a significant decrease to 262991 ha, which turns about to be about 41 per cent. 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 %). Graphical distribution of wetland type is shown in Figure 10.

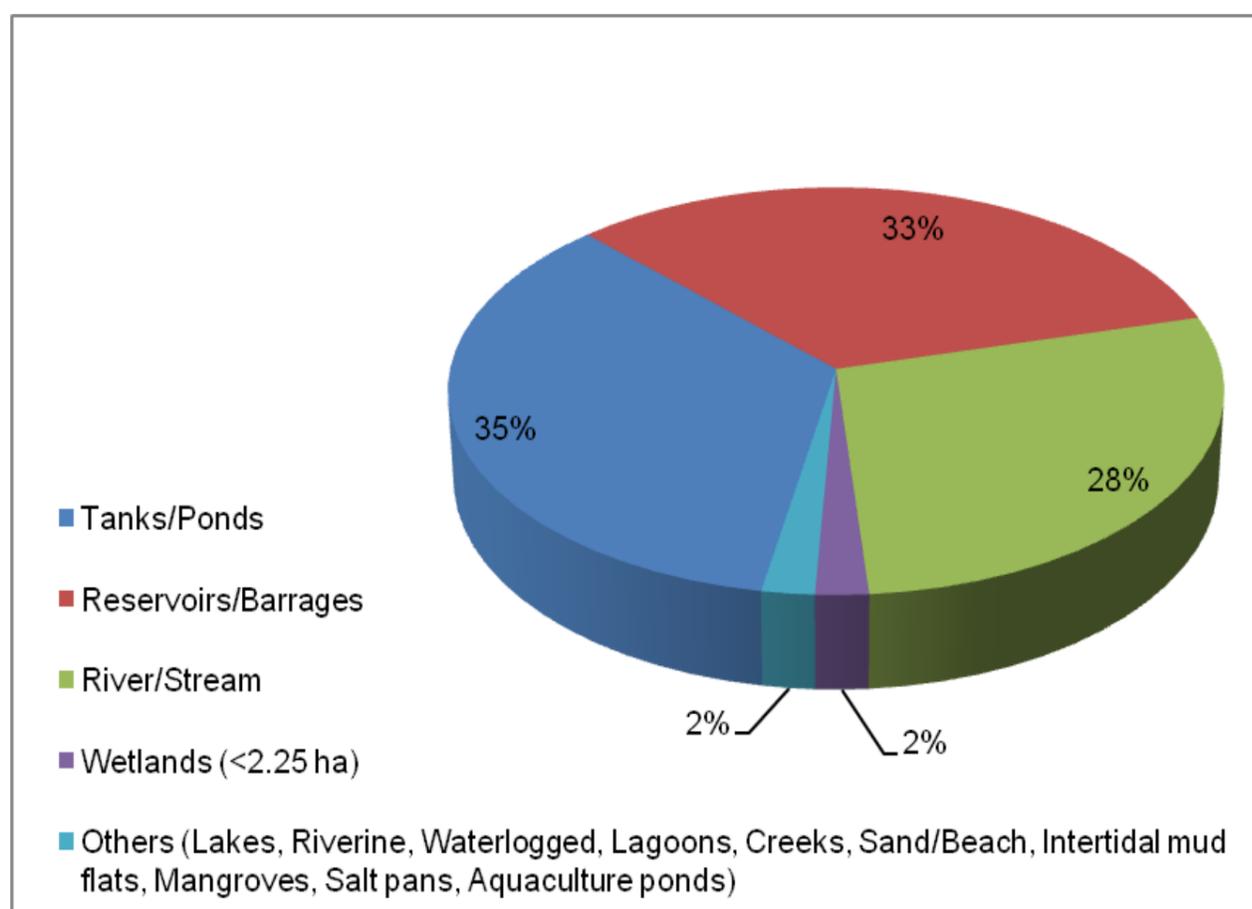


Figure 10: Type-wise wetland distribution in Karnataka

In terms of vegetation specific to wetlands, has shown an increase from 80818 ha in post-monsoon to 107259 ha in pre-monsoon. This accounts for about 13 and 17 % in post- and pre-monsoon seasons respectively out of the total wetland area of 629712 ha (Table 5). Qualitative turbidity estimated for open water shows that moderate turbidity is prevalent in wetlands of Karnataka 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%). In case of pre-monsoon there is change in the trend. Out of 262991 ha of open water in pre-monsoon, about 68 per cent is under moderate turbidity followed by low (23 %) and high (9). The increase in aerial extent under low turbidity may be attributed to the settling of sediments received by the wetlands during monsoon.

Table 5: Area estimates of wetlands in Karnataka

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total Wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	27	638	0.10	314	272
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	61	1051	0.16	558	319
5	1105	Waterlogged	93	2045	0.32	1132	925
6	1106	River/Stream	334	179731	27.93	148113	109240
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	70	213527	33.18	187002	92834
8	1202	Tanks/Ponds	10386	222030	34.50	86679	54147
9	1203	Waterlogged	53	2403	0.37	844	563
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>11024</b>	<b>621425</b>	<b>96.56</b>	<b>424642</b>	<b>258300</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	2	72	0.01	68	61
12	2102	Creeks	13	97	0.02	80	45
13	2103	Sand/Beach	61	1897	0.29	-	-
14	2104	Intertidal mud flats	97	1663	0.26	175	1222
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	140	967	0.15	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	4	812	0.13	812	812
19	2202	Aquaculture ponds	71	2779	0.43	2144	2551
		<b>Total - Coastal</b>	<b>388</b>	<b>8287</b>	<b>1.29</b>	<b>3279</b>	<b>4691</b>
		<b>Sub-Total</b>	<b>11412</b>	<b>629712</b>	<b>97.85</b>	<b>427921</b>	<b>262991</b>
		Wetlands (<2.25 ha), mainly Tanks	13864	13864	2.15	-	-
		<b>Total</b>	<b>25276</b>	<b>643576</b>	<b>100.00</b>	<b>427921</b>	<b>262991</b>

<b>Area under Aquatic Vegetation</b>	80818	107259
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<b>Area under turbidity levels</b>		
Low	65547	60149
Moderate	326173	178414
High	36201	24428

## 7.1 DISTRICT-WISE WETLAND MAPS AND STATISTICS

Over all the wetlands account for 3.4 per cent of geographical area of the state with all of them falling less than one per cent under wetlands to the geographical area of the districts. District-wise distribution of wetlands shown 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 6). 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 registered highest area (50608 ha). Overall there is a reduction of 39 per cent area in the open water from post-monsoon (427921 ha) to pre-monsoon (262991 ha). The seasonal change is least in Udupi (2 %) while highest in Koppal (80 %). Shiomga district ranked first in terms of open water spread (41254 ha) in post-monsoon while Uttara Kannada district registered highest (32070ha) in pre-monsoon season. Wetland statistics followed by wetland map and corresponding satellite data for each district is given to have a fairly good idea about the distribution pattern and density of wetlands in the district. District-wise distribution of wetlands is depicted graphically in figure 11.

Table-6: District-wise wetland area

Sr. No.	District	Area of district (km <sup>2</sup> )	Wetland area (ha)	% of total wetland area	% of district area	Open water extent (ha)		Seasonal change (%)
						Post-monsoon	Pre-monsoon	
1	Belgaum	13415	33412	5.2	0.2	22090	13639	-38
2	Bagalkot	6594	37470	5.8	0.2	34770	14577	-58
3	Bijapur	10475	33143	5.1	0.2	25935	12204	-53
4	Gulbarga	16224	34741	5.4	0.2	24484	20125	-18
5	Bidar	5448	10586	1.6	0.1	7697	5326	-31
6	Raichur	5559	27820	4.3	0.1	22041	13270	-40
7	Koppal	8458	25046	3.9	0.1	20453	4011	-80
8	Gadag	4657	4248	0.7	0.0	3579	2358	-34
9	Dharwad	4230	3965	0.6	0.0	2603	2075	-20
10	Uttar Kannada	10291	42190	6.6	0.2	35487	32070	-10
11	Haveri	4851	9353	1.5	0.0	5704	3728	-35
12	Bellary	8419	33372	5.2	0.2	28241	7640	-73
13	Chitradurga	8388	27486	4.3	0.1	14836	9137	-38
14	Davanagere	6018	16886	2.6	0.1	9171	6152	-33
15	Shimoga	8465	46131	7.2	0.2	41254	26184	-37
16	Udupi	3598	12226	1.9	0.1	9899	9739	-2
17	Chikmagalur	7201	23420	3.6	0.1	18795	12188	-35
18	Tumkur	10598	50608	7.9	0.3	16873	12024	-29
19	Kolar	8223	36538	5.7	0.2	5823	3320	-43
20	Bangalore -Urban	2190	8620	1.3	0.0	2518	2254	-10
21	Bangalore Rural	5815	19132	3.0	0.1	4205	3867	-8
22	Mandya	4961	23418	3.6	0.1	14009	9561	-32
23	Hassan	6814	32564	5.1	0.2	18590	11143	-40
24	Daksina Kannada	4843	10911	1.7	0.1	9558	8344	-13
25	Kodagu	4102	4018	0.6	0.0	3024	2029	-33
26	Mysore	6269	25243	3.9	0.1	21864	12410	-43
27	Chamrajnagar	5685	11029	1.7	0.1	4418	3616	-18
	<b>Total</b>	<b>191791</b>	<b>643576</b>	<b>100.0</b>	<b>3.4</b>	427921	262991	-39

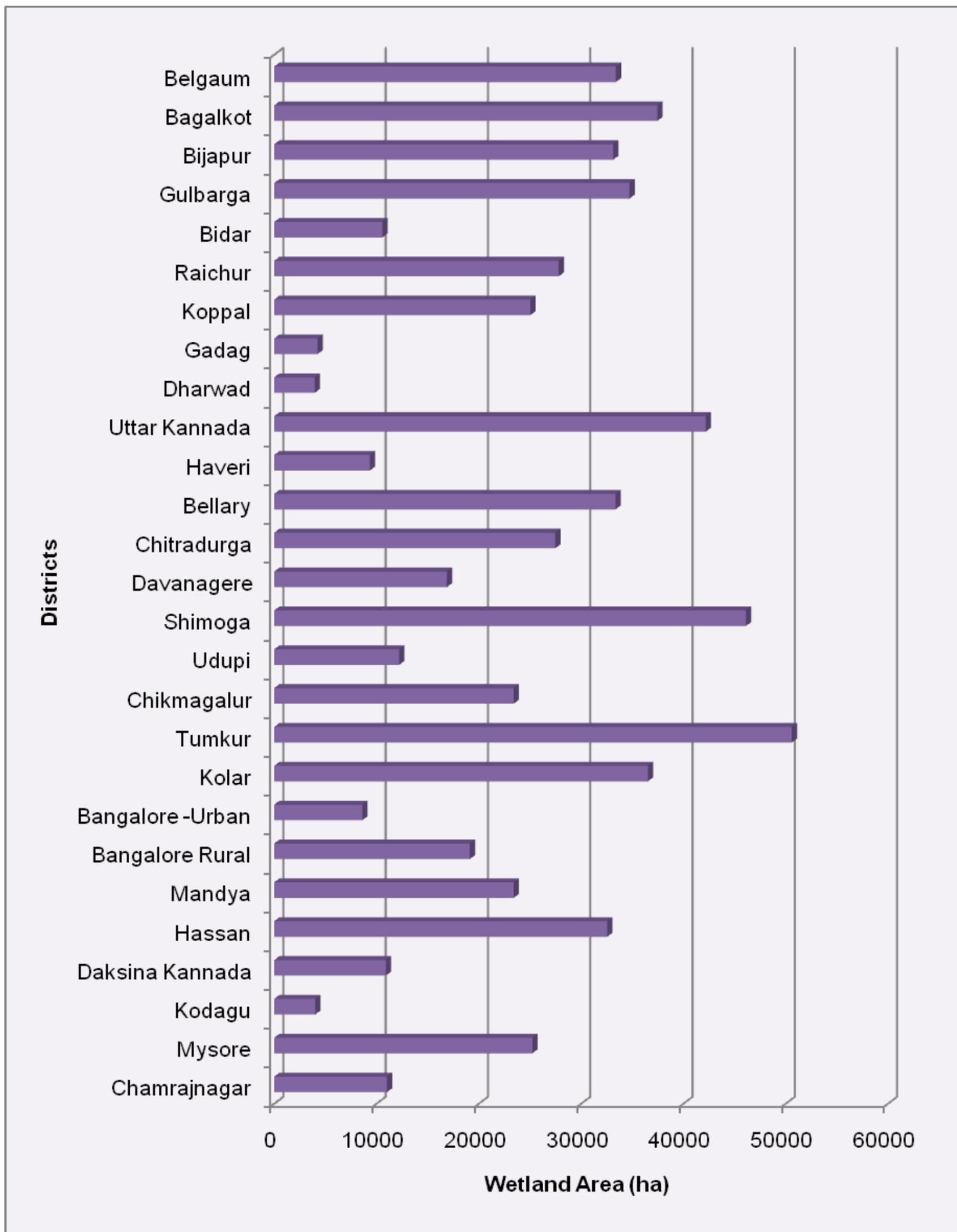
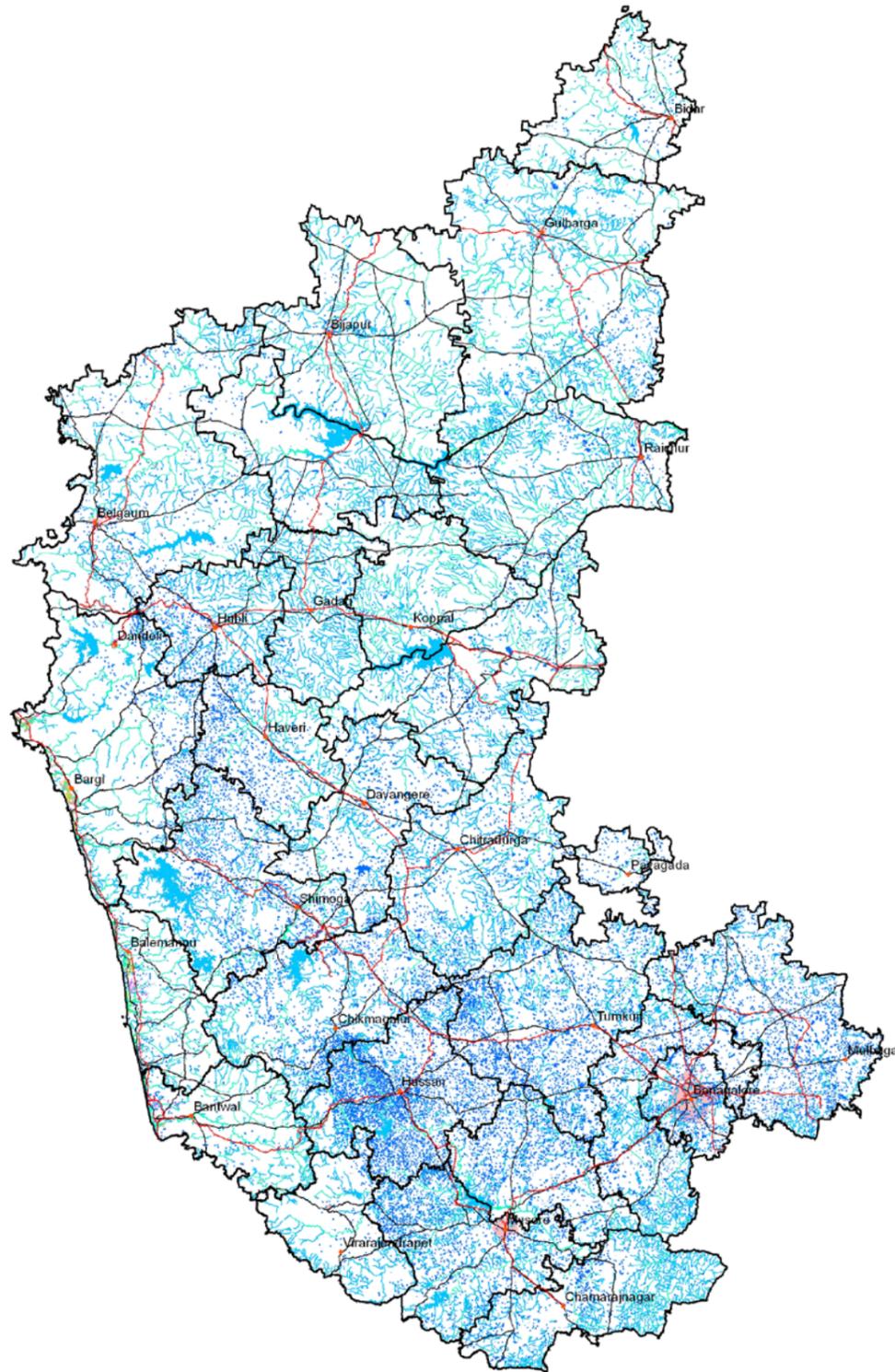


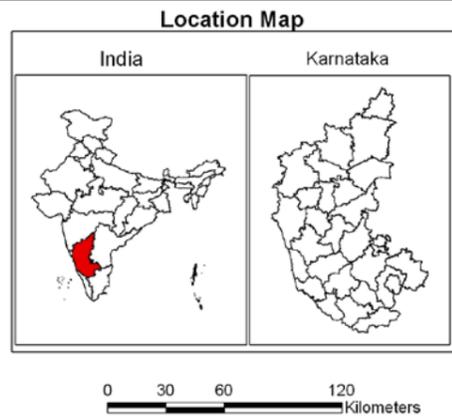
Figure 11: District-wise graphical distribution of wetlands

### WETLAND MAP



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



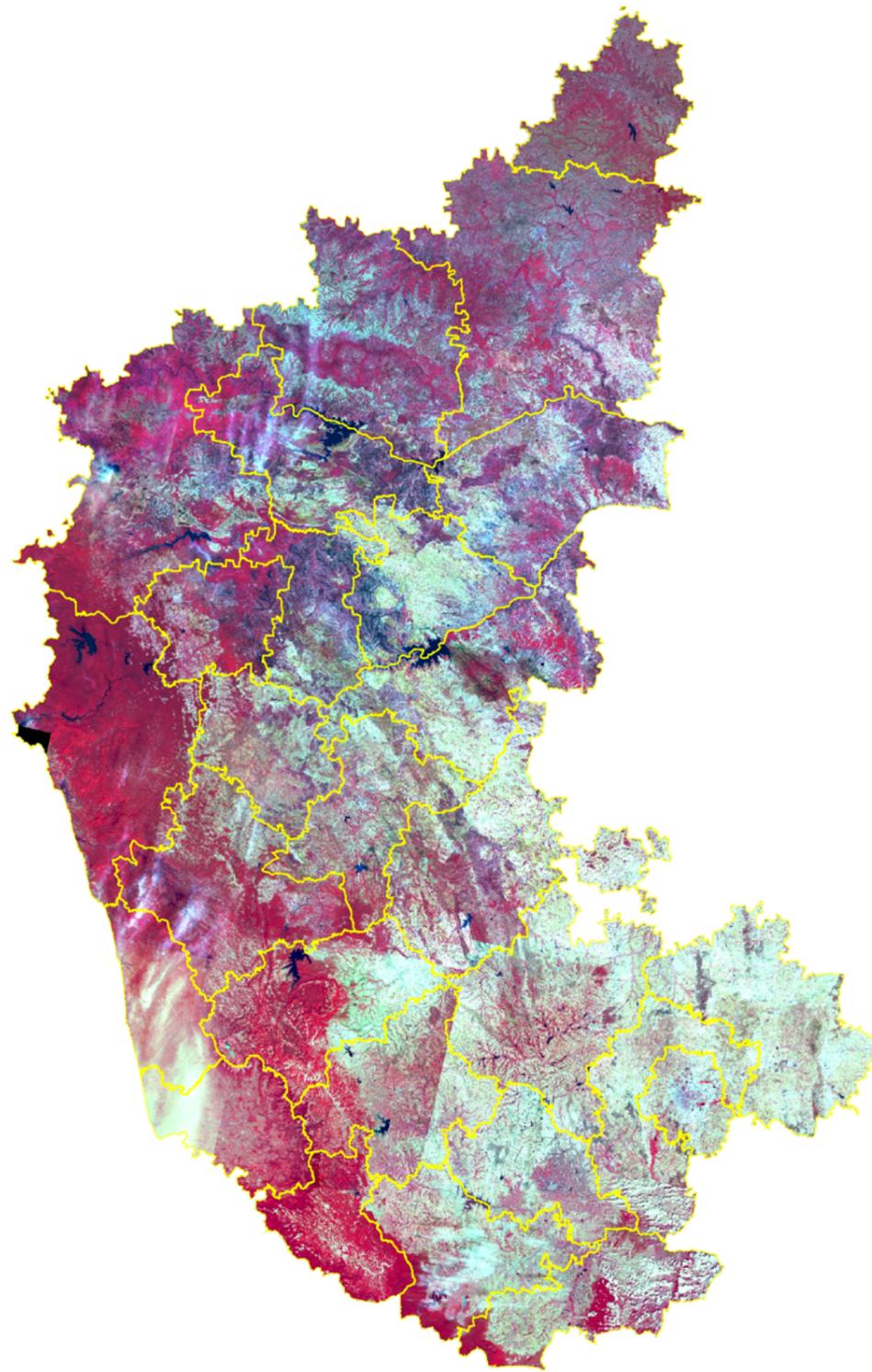
**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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

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



State : Karnataka



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

### 7.1.1 Belgaum

Belgaum district located in the north-western part of the State lies between 15°15'00" to 17°00'00" N latitudes and 73°59'00" to 75°30'00" longitudes E. The district has a total geographical area of 13,415 sq. km. East flowing rivers namely, Malaprabha, Markandeya, Dudganga, Krishna, Mahadai and Ghataprabha drain this district. Hidkal, Renuka Sagar reservoir/Barrages and Rakaskoppa tanks are the large wetlands of this district. Famous falls like Gokak, Vajrapoha, Godachina malki and Ghataprabha Bird century are located in this district, which enriches the wetlands.

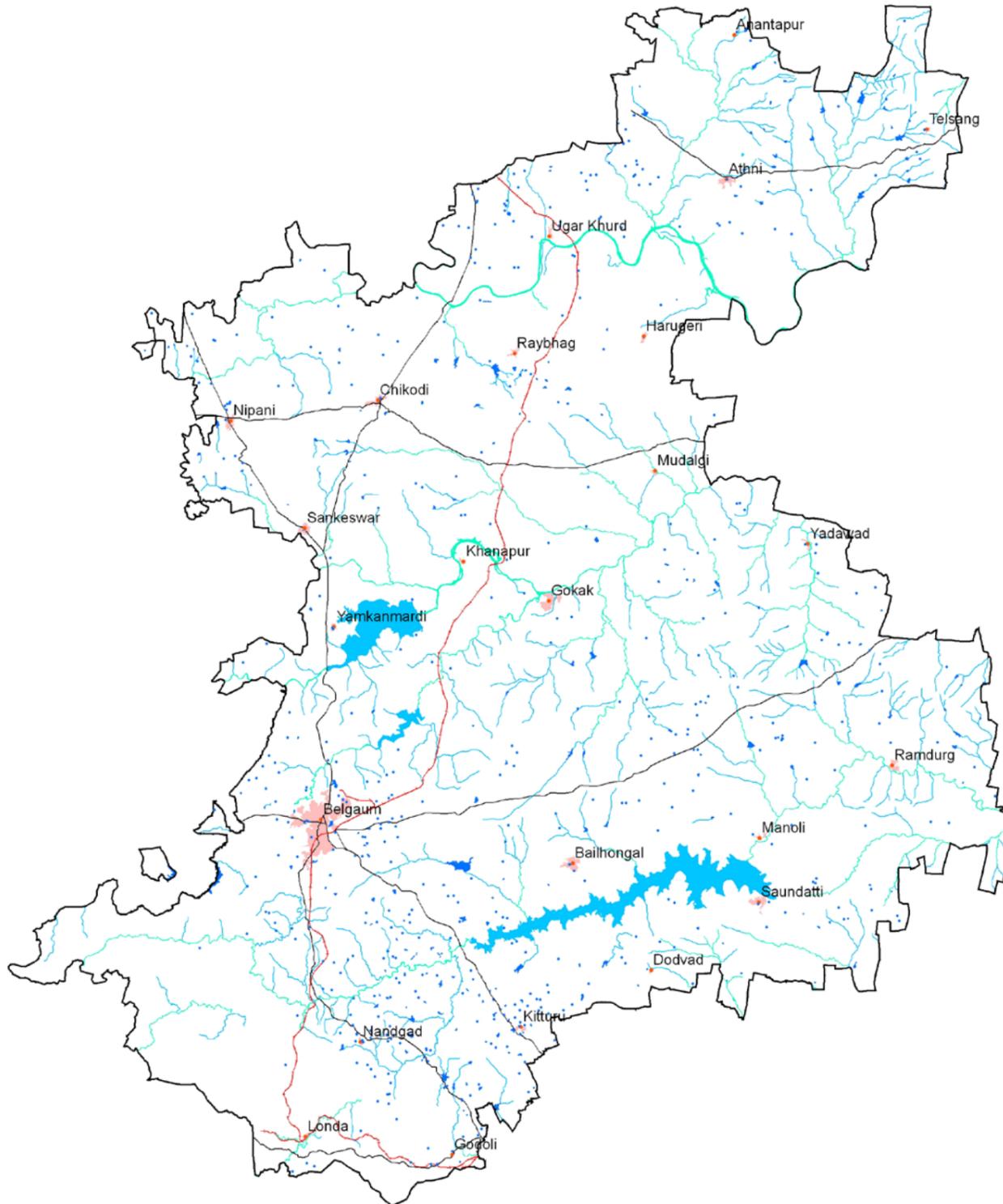
The district comprises of 288 wetlands, which were mapped besides 431 small wetlands (<2.25 ha). These wetlands account for 33412 ha. Three wetland types (Table 7) are Reservoir/Barrages, (19213 ha) followed by River/Stream (9936 ha) and Tanks/Ponds (3832 ha) exists in the district. Aquatic vegetation has an increase from 4190 ha in post-monsoon to 5402 ha in pre-monsoon. Analysis of wetland status in terms of open water the district has recorded 22090 ha and 13639 ha of during post-monsoon and pre-monsoon respectively out of 32981 ha (excluding wetlands <2.25 ha). Qualitative turbidity of the open water dominated by moderate (20625 ha) followed by high turbidity (1465 ha) while low turbidity has not been observed in post-monsoon. During pre-monsoon the turbidity was dominated by moderate (8491 ha) followed by low (4282 ha) and high (866 ha).

Table 7: Area estimates of wetlands in Belgaum

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total Wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	30	9936	29.74	8333	6619
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	3	19213	57.50	11190	5393
8	1202	Tanks/Ponds	255	3832	11.47	2567	1627
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>288</b>	<b>32981</b>	<b>98.71</b>	<b>22090</b>	<b>13639</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
16	2201	Salt pans	-	-	0.00	-	-
17	2202	Aquaculture ponds	-	-	0.00	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>0.00</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>288</b>	<b>32981</b>	<b>98.71</b>	<b>22090</b>	<b>13639</b>
		Wetlands (<2.25 ha), mainly Tanks	431	431	1.29	-	-
		<b>Total</b>	<b>719</b>	<b>33412</b>	<b>100.00</b>	<b>22090</b>	<b>13639</b>

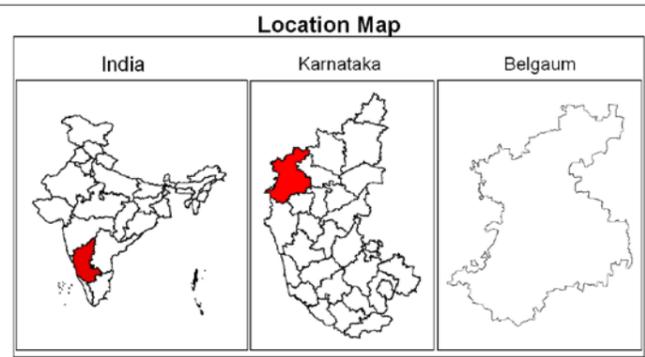
<b>Area under Aquatic Vegetation</b>	4190	5402
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<b>Area under turbidity levels</b>		
Low	-	4282
Moderate	20625	8491
High	1465	866



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

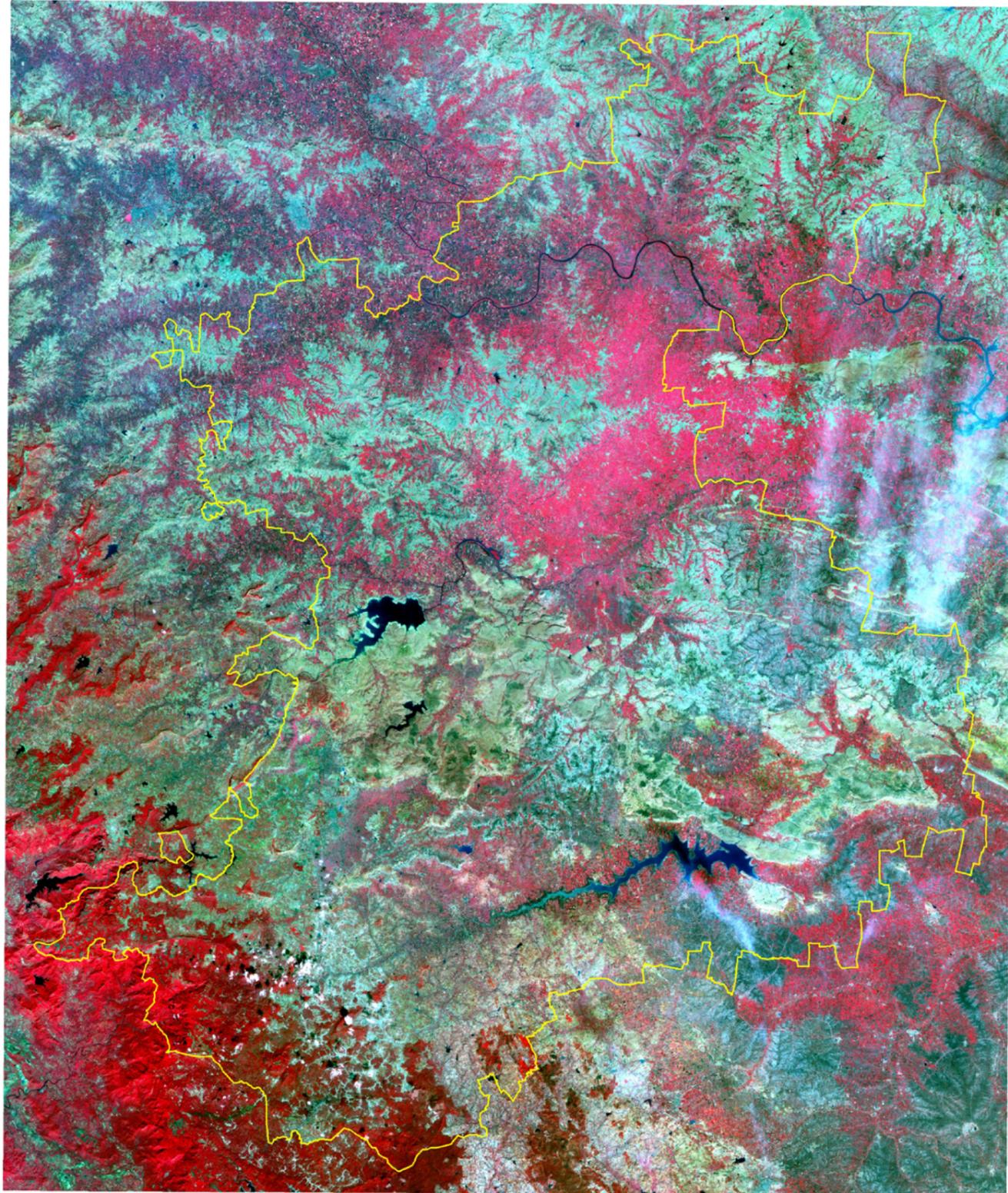


**Data Source :**  
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 Dept. of IT, BT & S&T, GOK, Bangalore, Karnataka

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





### 7.1.2 Bagalkot

Bagalkot district situated in the northern part of Karnataka State lies between the 15°50'00" to 16°10'30" N latitudes and 75°01'40" to 76°20'00" longitudes E. The district with the total geographical area of 6,594 sq km. The district is bounded by the districts of Bijapur on the North, Gadag on the South, Raichur on the East, Koppal on the South-East and Belgaum on the West. Major rivers Ghataprabha, Malaprabha and Krishna rivers that drain the district, Almatti reservoir across the Krishna River and Muchakhandi tank are the major wetlands.

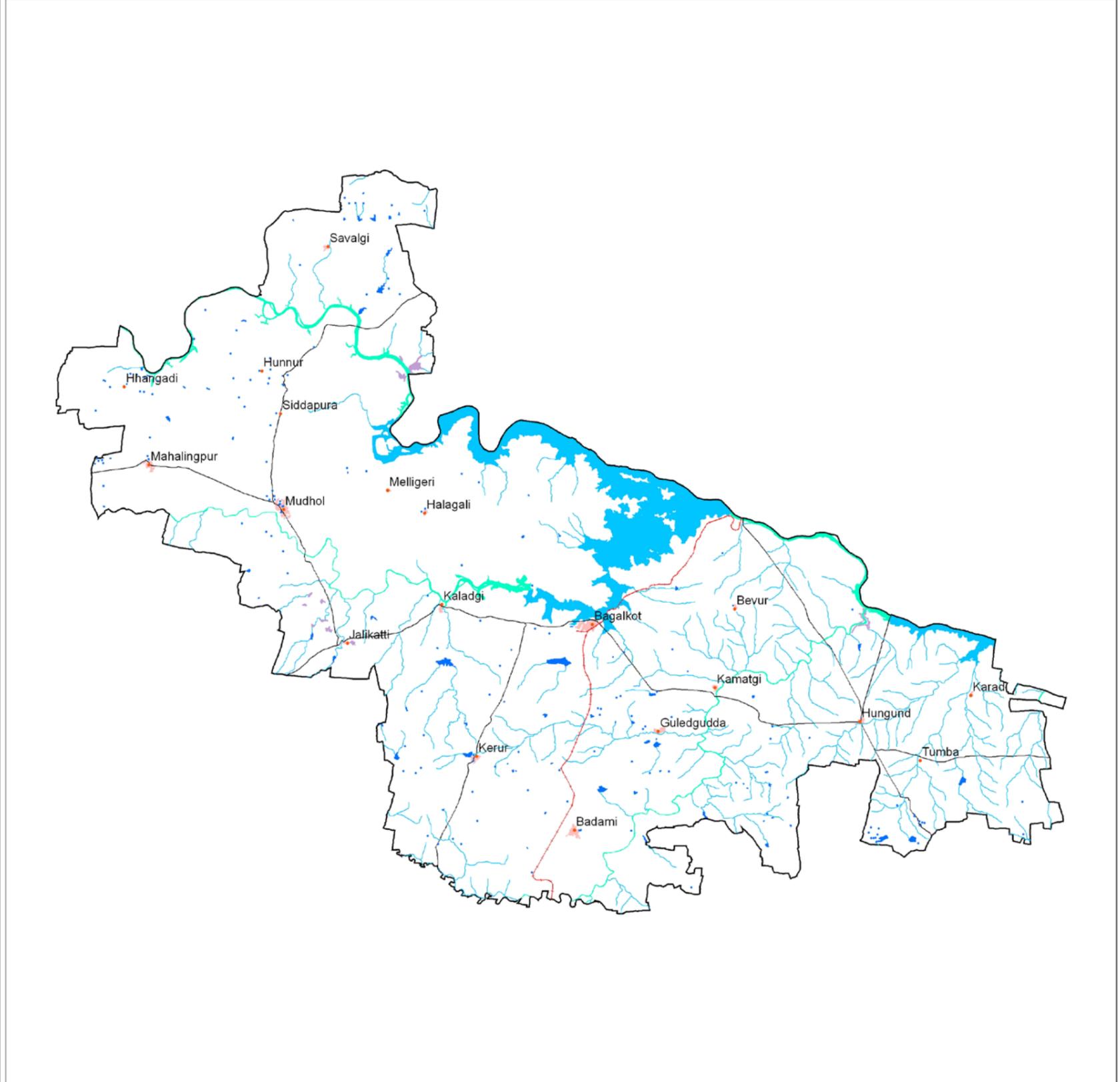
In the Bagalkot district 127 wetlands have been delineated, besides detection of 128 wetlands smaller than 2.25 ha. Total wetland area estimated to be 37470 ha (Table 8), which accounts for about 6 per cent of total wetland area of the state. The major wetland types are Reservoir/Barrages (28223 ha ) River/Stream (6817 ha), and Tanks/Ponds (1719 ha). Analysis of wetlands in terms of aquatic vegetation and open water has shown that 879 ha and 1946 ha of wetland area is under aquatic vegetation, and 34770 ha and 14577 ha under open water category during post-monsoon and pre-monsoon respectively. Turbidity is dominated by moderate followed by low and high in both the seasons (Table 8).

Table 8: Area estimates of wetlands in Bagalkot

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total Wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	15	6817	18.19	6484	5273
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	2	28223	75.32	26890	8543
8	1202	Tanks/Ponds	94	1719	4.59	861	592
9	1203	Waterlogged	16	583	1.56	535	169
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>127</b>	<b>37342</b>	<b>99.66</b>	<b>34770</b>	<b>14577</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>127</b>	<b>37342</b>	<b>99.66</b>	<b>34770</b>	<b>14577</b>
		Wetlands (<2.25 ha), mainly Tanks	128	128	0.34	-	-
		<b>Total</b>	<b>255</b>	<b>37470</b>	<b>100.00</b>	<b>34770</b>	<b>14577</b>

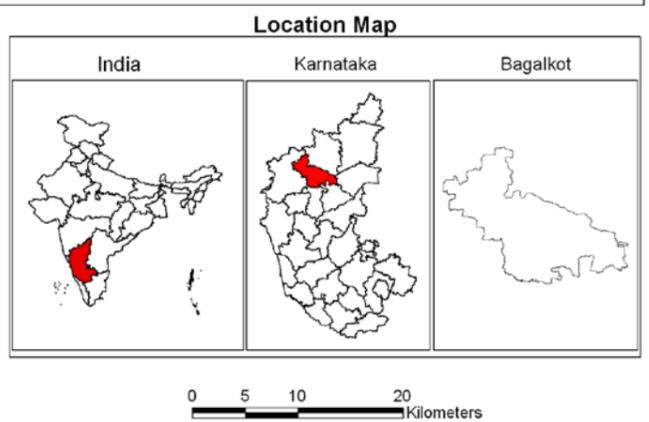
<b>Area under Aquatic Vegetation</b>	879	1946
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<b>Area under turbidity levels</b>		
Low	11950	2133
Moderate	22590	12339
High	230	105



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

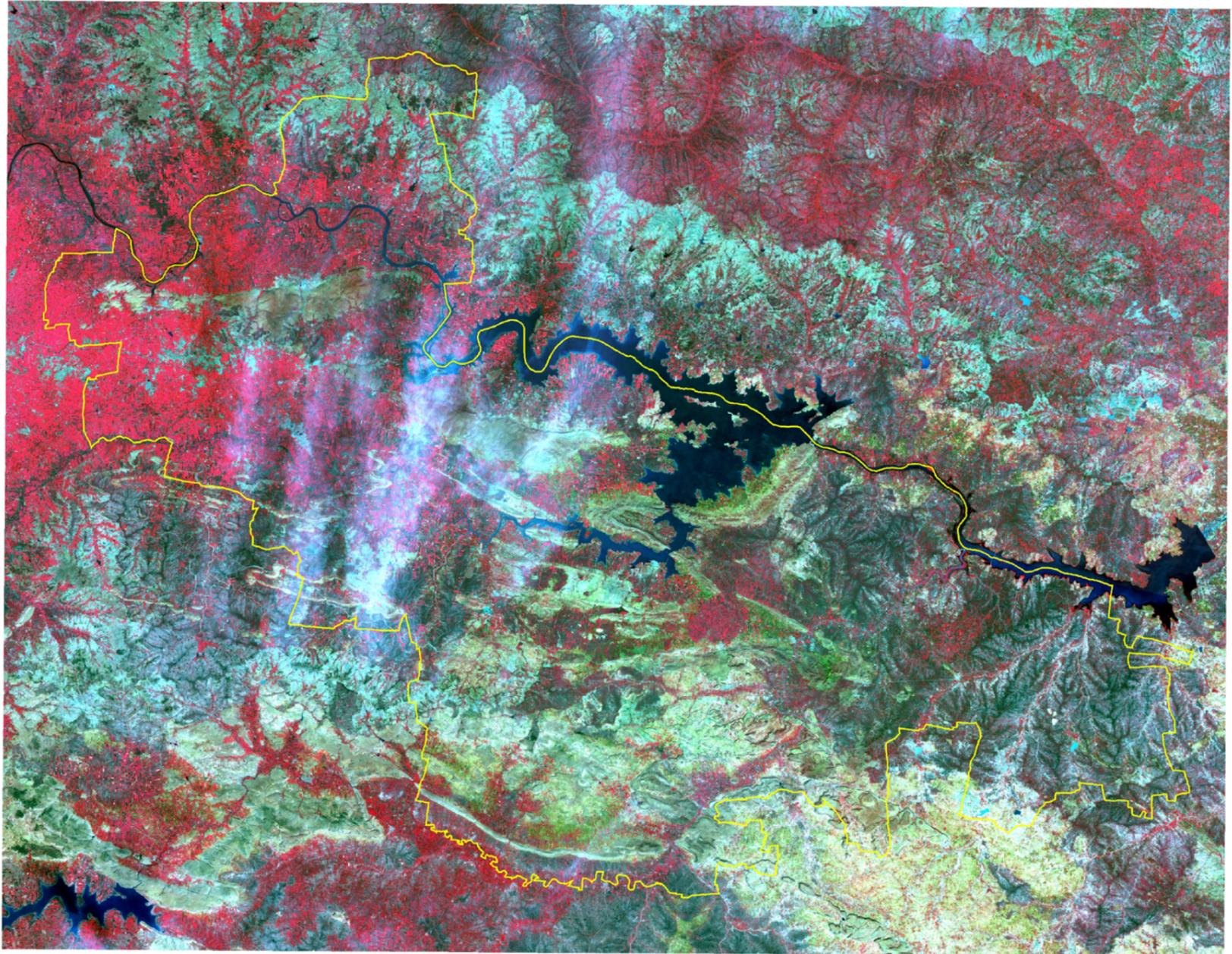


**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

**Prepared By :**  
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**Sponsored By :**  
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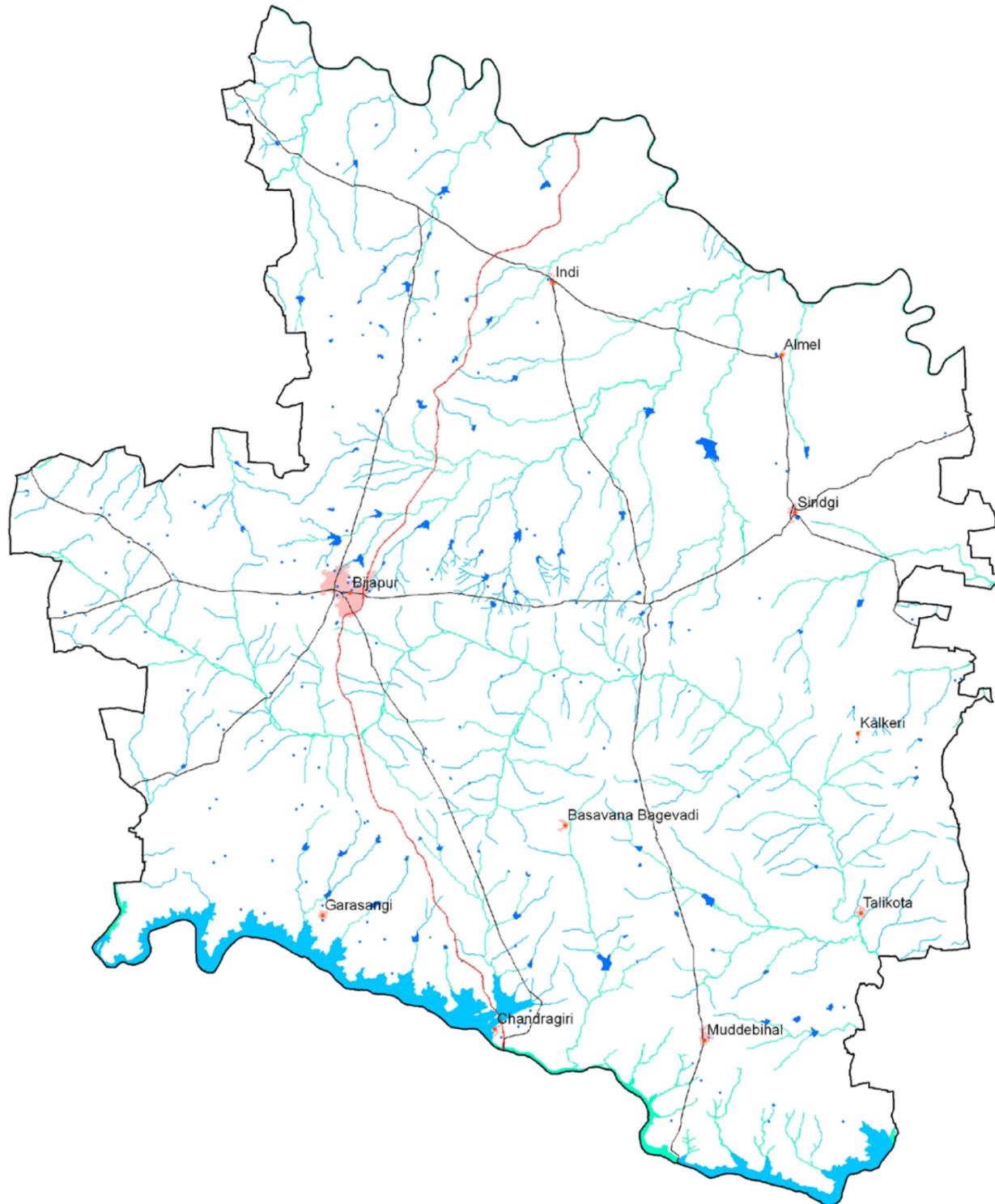
### 7.1.3 Bijapur

Bijapur district is situated in the northern part of Karnataka State and lies between the latitudes 16°09'20" to 17°28'96" N and longitudes 75°19.53'30" to 76°28.11'77" E. The district with a total geographical area of 10475 sq km is bounded on the North and North-West by Maharashtra State and East by Gulbarga, Raichur and Bagalkot districts on the South and Belgaum on the West. Bijapur district is drained by 3 rivers namely Krishna, Bhima and Doni. Almatti dam is located between Bijapur and Bagalkot districts, Narayanapura reservoir is located near southeastern border of district between Bijapur and Gulbarga districts, which are the major sources of water storage for various purposes.

Bagalkot district is comprises 273 wetlands, out which 102 are smaller than 2.25 ha and 171 are >2.25 ha. The area under wetland is estimated to be 33143 ha (Table 9). The only wetland types observed are Reservoir/Barrages (17796 ha ) accounting for about 54 per cent followed by River/Stream (11626 ha), and Tanks/Ponds (3619 ha). Analysis of wetland status in terms of aquatic vegetation and open water has shown that 470 ha and 2962 ha of wetland area is under aquatic vegetation while open water comprised of 25935 ha and 12204 ha during post-monsoon and pre-monsoon respectively. Qualitative turbidity of the open water is observed to dominated by moderate (23196 ha and 7379 ha) followed by low (2064 ha and 4819 ha) and high turbidity (675 ha and 6 ha).

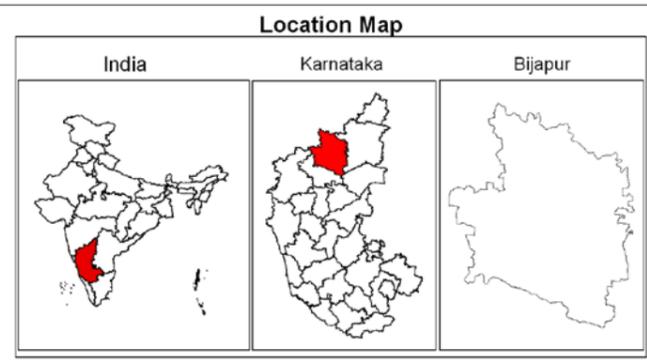
Table 9: Area estimates of wetlands in Bijapur

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total Wetland area	% of wetland area	Open Water		
						Post-monsoon area	Pre-monsoon area	
	<b>1100</b>	<b>Inland Wetlands - Natural</b>						
1	1101	Lakes/Ponds	-	-	-	-	-	
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-	
3	1103	High altitude wetlands	-	-	-	-	-	
4	1104	Riverine wetlands	-	-	-	-	-	
5	1105	Waterlogged	-	-	-	-	-	
6	1106	River/Stream	53	11626	35.08	6982	4090	
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>						
7	1201	Reservoirs/Barrages	2	17796	53.69	16265	7077	
8	1202	Tanks/Ponds	116	3619	10.92	2688	1037	
9	1203	Waterlogged	-	-	-	-	-	
10	1204	Salt pans	-	-	-	-	-	
		<b>Total - Inland</b>	<b>171</b>	<b>33041</b>	<b>99.69</b>	<b>25935</b>	<b>12204</b>	
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>						
11	2101	Lagoons	-	-	-	-	-	
12	2102	Creeks	-	-	-	-	-	
13	2103	Sand/Beach	-	-	-	-	-	
14	2104	Intertidal mud flats	-	-	-	-	-	
15	2105	Salt Marshes	-	-	-	-	-	
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>						
16	2201	Salt pans	-	-	-	-	-	
17	2202	Aquaculture ponds	-	-	-	-	-	
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	
		<b>Sub-Total</b>	<b>171</b>	<b>33041</b>	<b>99.69</b>	<b>25935</b>	<b>12204</b>	
		Wetlands (<2.25 ha), mainly Tanks	102	102	0.31	-	-	
		<b>Total</b>	<b>273</b>	<b>33143</b>	<b>100.00</b>	<b>25935</b>	<b>12204</b>	
		<b>Area under Aquatic Vegetation</b>					470	2962
		<b>Area under turbidity levels</b>						
		Low					2064	4819
		Moderate					23196	7379
		High					675	6



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



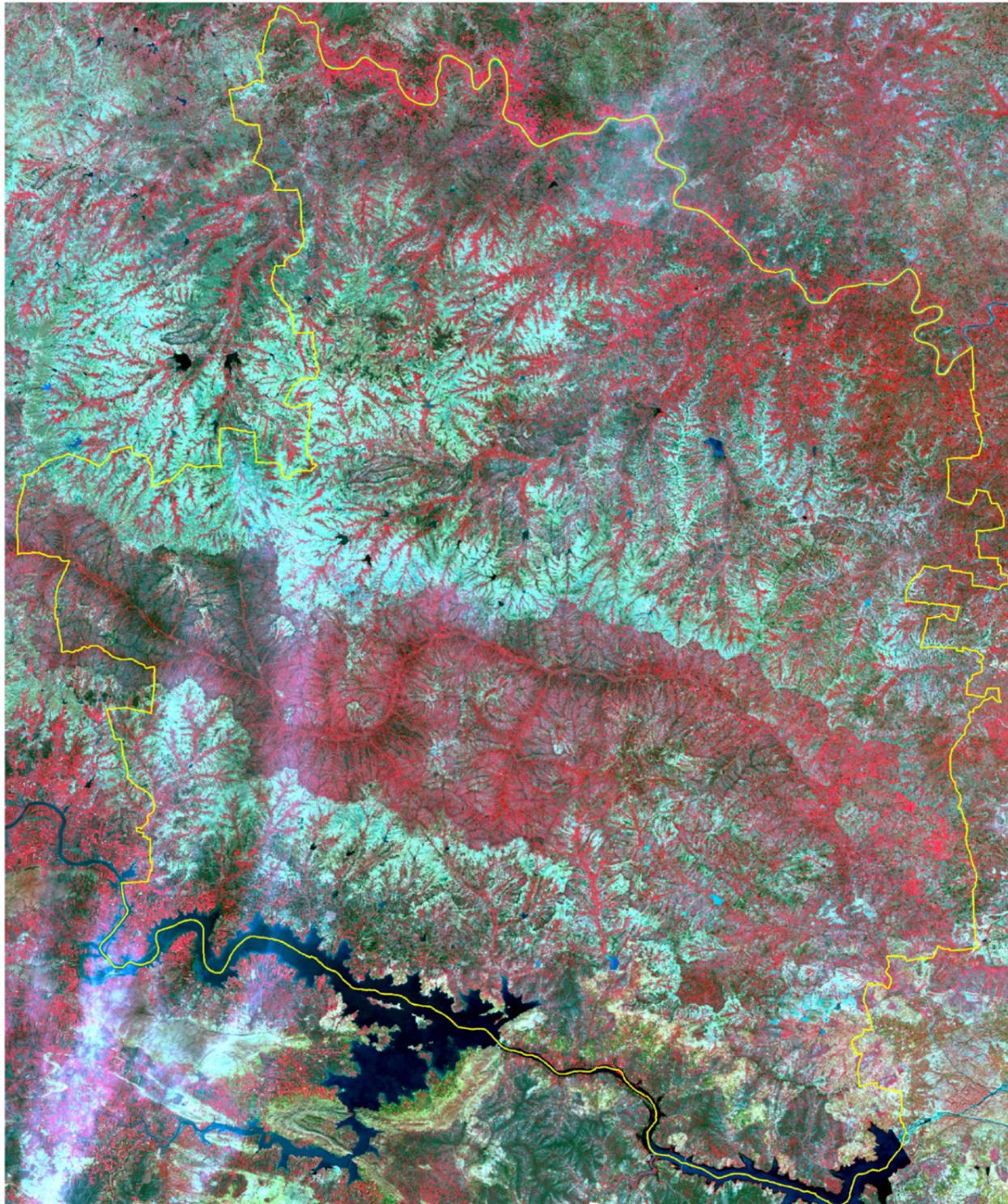
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**Data Source :**  
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

**Prepared By :**  
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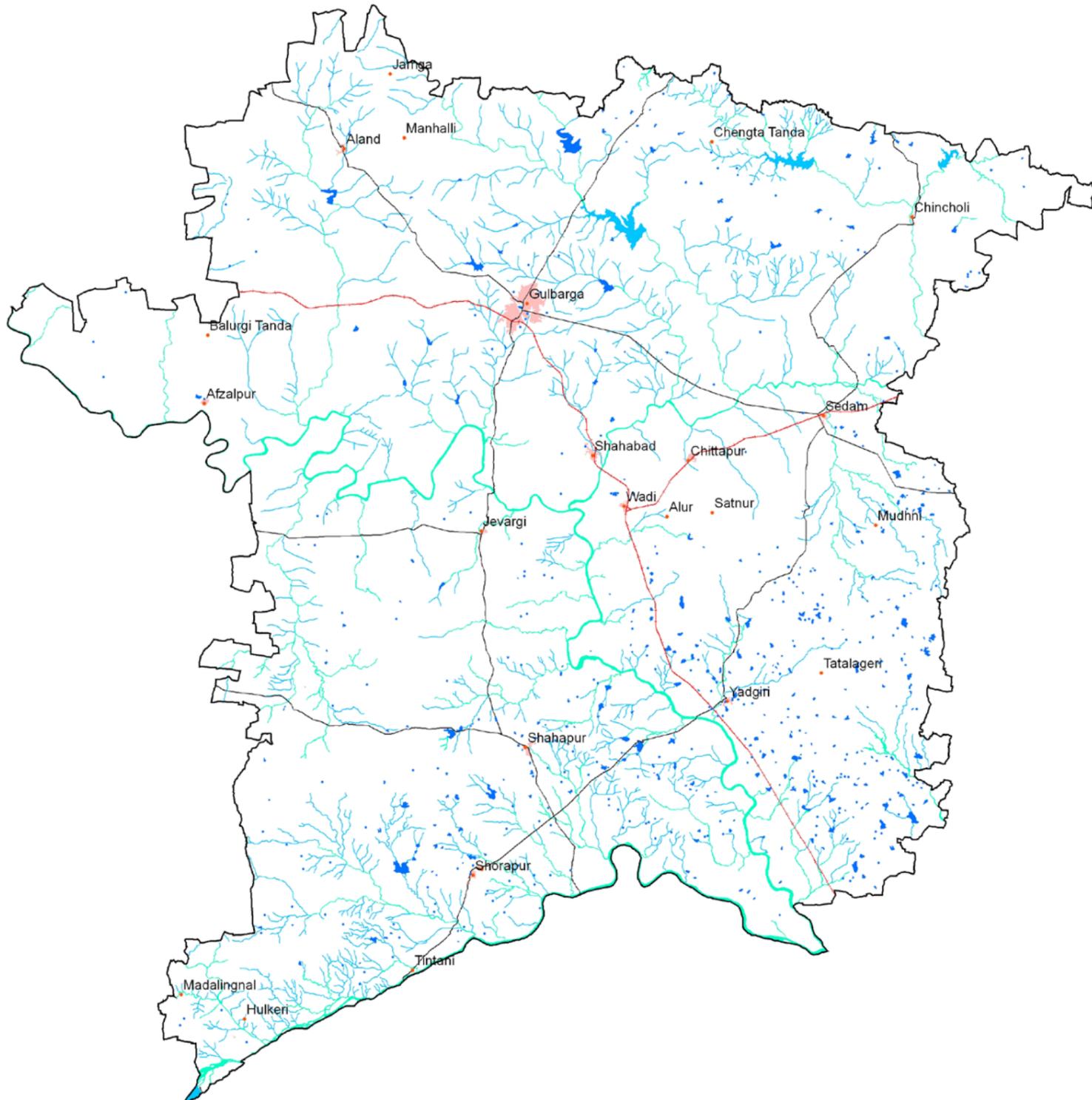
### 7.1.4 Gulbarga

Gulbarga district situated in the northern part of Karnataka State lies between 16°11'00" to 17°46'00" N latitudes and 76°02'00" to 77°42'00" E longitudes. It is having a total geographical area of 16,224.4 sq km. The district is bounded on the North by Bidar, on the South by Raichur, on the East by Andhra Pradesh and West by Bijapur. This district is drained by Krishna and Bhima river system.

Area estimates of various wetland categories for Gulbarga shows that there are 646 wetlands, which include 232 wetlands smaller than 2.25 ha. Total wetland area estimated to be 34741 ha (Table 10). The only types of wetlands observed in the district area River/Stream (22653 ha), Tanks/Ponds (8471 ha) and Reservoirs/Barrages (3385 ha). River/Barrage (65 %) singularly dominated the extent under wetlands. Analysis of wetland status in terms of aquatic vegetation, it is estimated to be 2791 ha and 1890 ha of wetland area is under vegetation in post-monsoon and pre-monsoon respectively. The open water extent (24484 ha) accounted for 71 per cent of wetland in post-monsoon, which had decreased to 20125 ha in pre-monsoon season. Moderate turbidity dominated the open water in post-monsoon (24373 ha) as well as pre-monsoon (15766 ha).

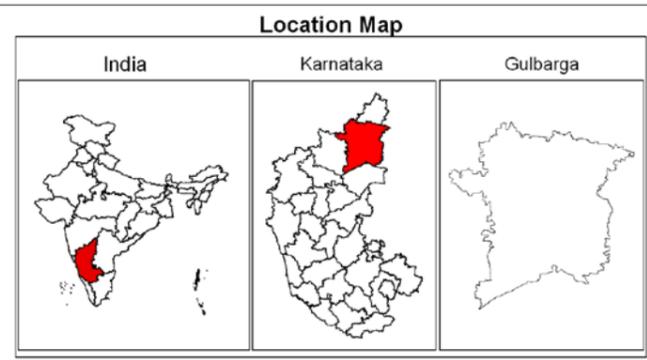
Table 10: Area estimates of wetlands in Gulbarga

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total Wetland area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	26	22653	65.21	16826	13180
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	4	3385	9.74	3180	3343
8	1202	Tanks/Ponds	384	8471	24.38	4478	3602
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>414</b>	<b>34509</b>	<b>99.33</b>	<b>24484</b>	<b>20125</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
16	2201	Salt pans	-	-	-	-	-
17	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>414</b>	<b>34509</b>	<b>99.33</b>	<b>24484</b>	<b>20125</b>
		Wetlands (<2.25 ha), mainly Tanks	232	232	0.67	-	-
		<b>Total</b>	<b>646</b>	<b>34741</b>	<b>100.00</b>	<b>24484</b>	<b>20125</b>
		<b>Area under Aquatic Vegetation</b>				2791	1890
		<b>Area under turbidity levels</b>					
		Low				43	4359
		Moderate				23473	15766
		High				968	3



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

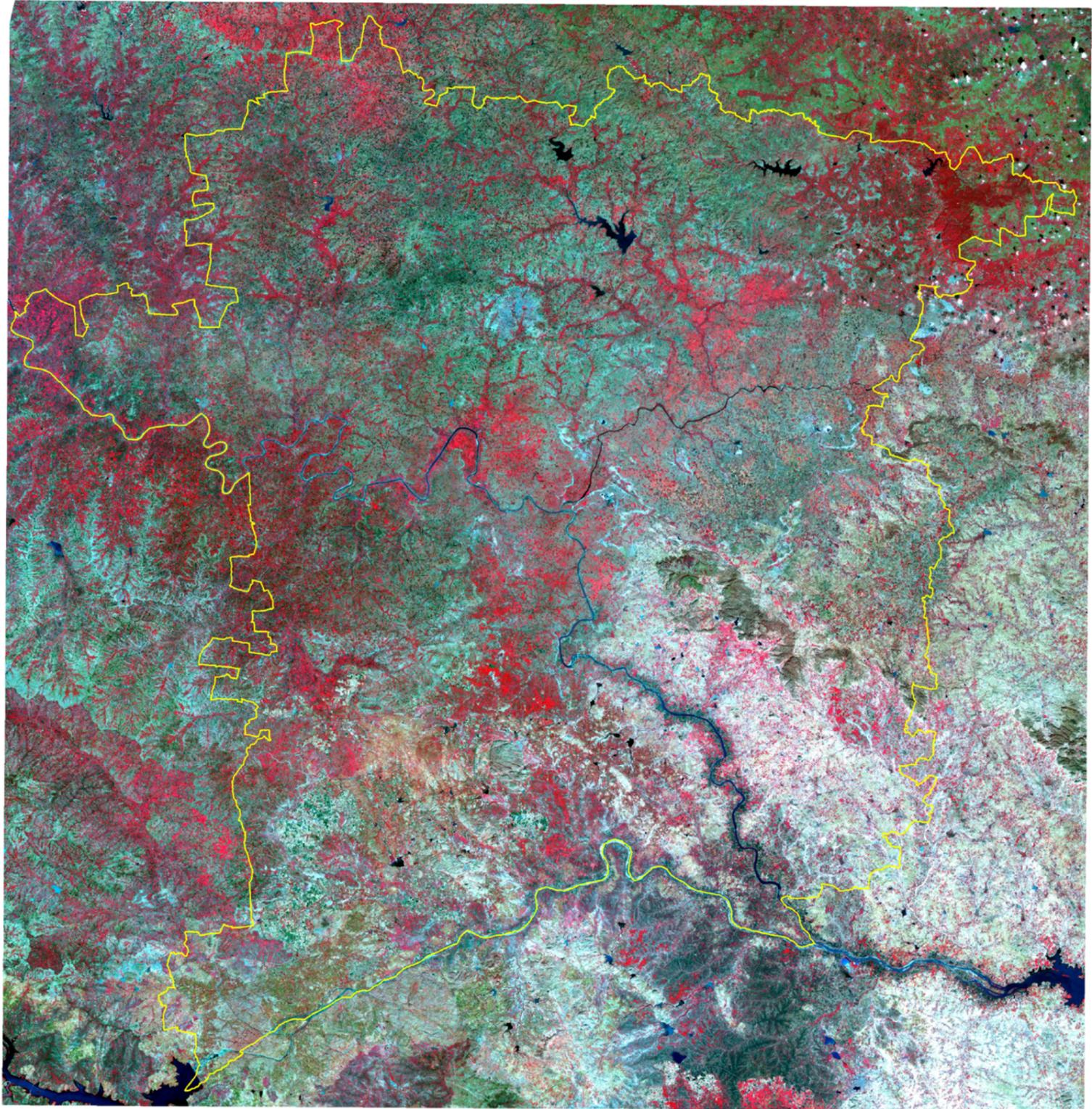


**Data Source :**  
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### 7.1.5 Bidar

The district lies in the northern part of Karnataka State and is geographically located between latitude 17°35'00" to 18°25'00" N and longitudes 76°42'00" to 77°39'00" E. The district has an area extent of 5448 sq km. Manjara, Karanja and Mullamari and Madhura are the major rivers that drain the district with Karanja reservoir being the major water source.

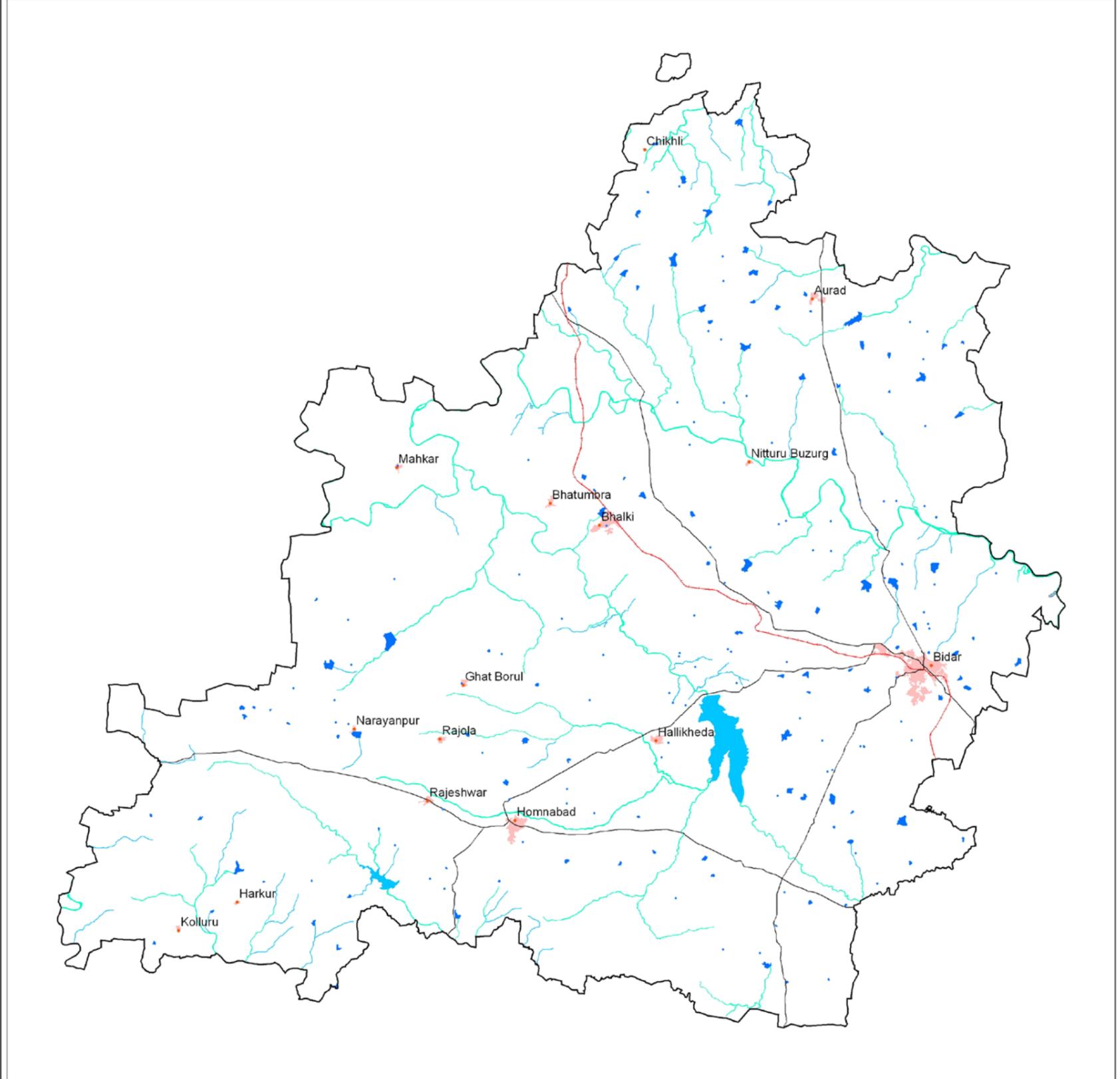
Area estimates of various wetland categories for Bidar shows that there are 233 wetlands, which include 87 wetlands smaller than 2.25 ha. Extent under wetland is estimated to be 10586 ha (Table 11). Four wetland types are observed in the district namely River/Stream (5259 ha) Reservoirs/Barrages (2780 ha), Tanks/Ponds (2441 ha) and Riverine wetlands (19 ha). The extent under open water of wetlands accounted for about 73 per cent in post-monsoon (7697 ha) and has shown a reduction to 51 per cent in pre-monsoon season (5326 ha) out the total wetland area of 10499 ha. Aquatic vegetation shown an increase from 832 ha in post-monsoon followed by low (377 ha) and high (6 ha). On the other hand the open water in pre-monsoon has been observed to be moderate (2922 ha) or low (2404 ha) without high turbidity.

Table 11: Area estimates of wetlands in Bidar

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Area in ha	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	1	19	0.18	7	6
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	24	5259	49.68	3667	1801
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	2	2780	26.26	2508	1895
8	1202	Tanks/Ponds	119	2441	23.06	1515	1624
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>146</b>	<b>10499</b>	<b>99.18</b>	<b>7697</b>	<b>5326</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>146</b>	<b>10499</b>	<b>99.18</b>	<b>7697</b>	<b>5326</b>
		Wetlands (<2.25 ha), mainly Tanks	87	87	0.82	-	-
		<b>Total</b>	<b>233</b>	<b>10586</b>	<b>100.00</b>	<b>7697</b>	<b>5326</b>

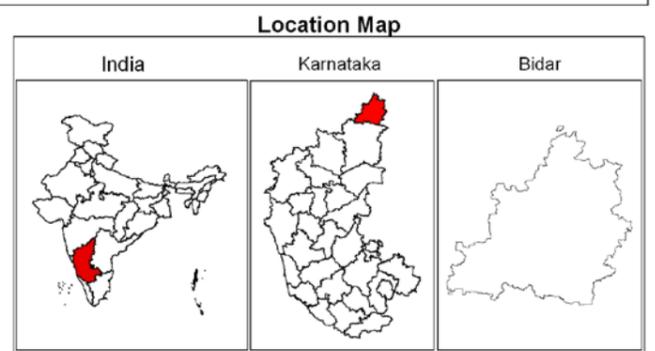
<b>Area under Aquatic Vegetation</b>	832	1115
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<b>Area under turbidity levels</b>		
Low	377	2404
Moderate	7314	2922
High	6	-



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

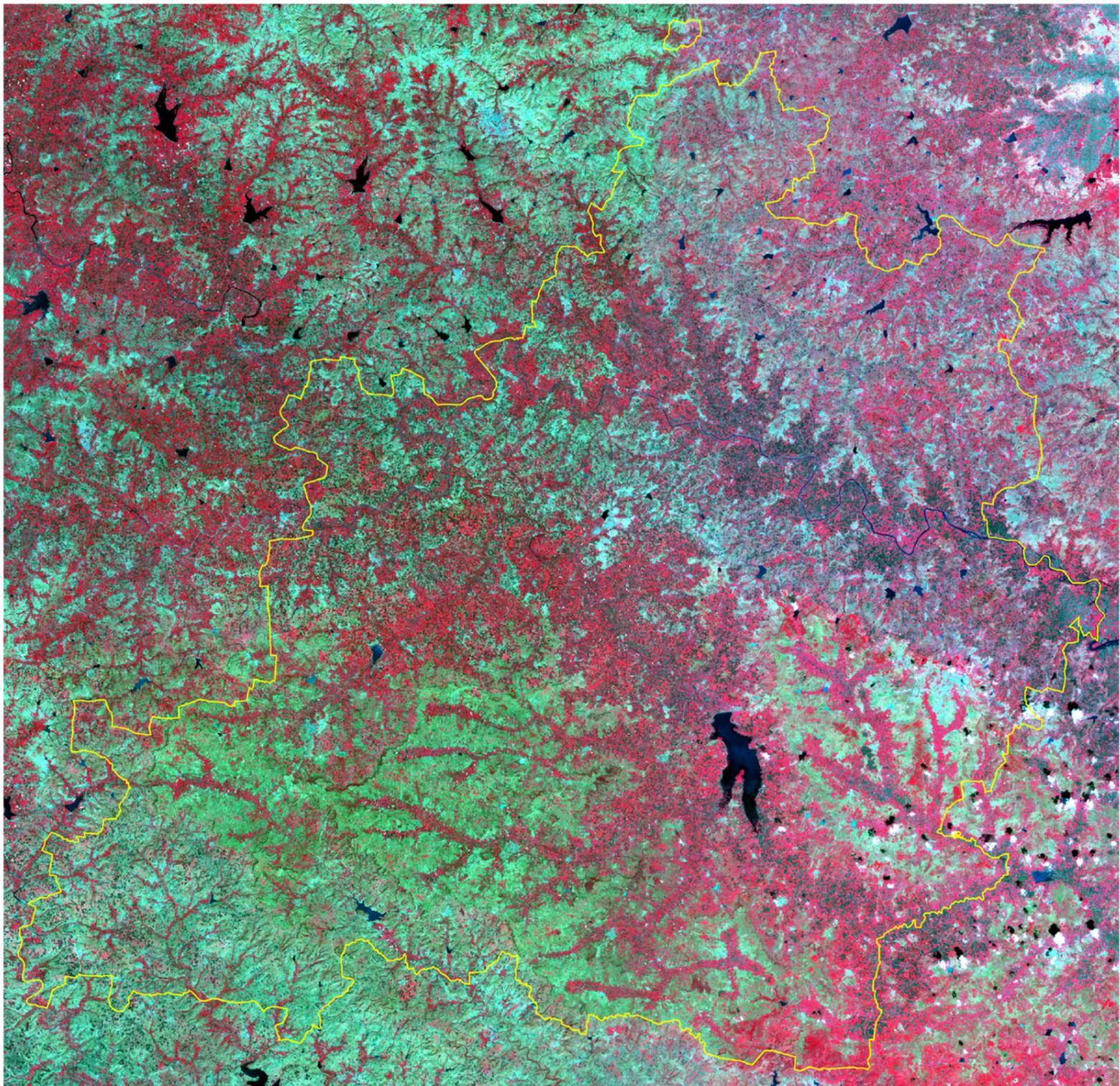


**Data Source :**  
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### 7.1.6 Raichur

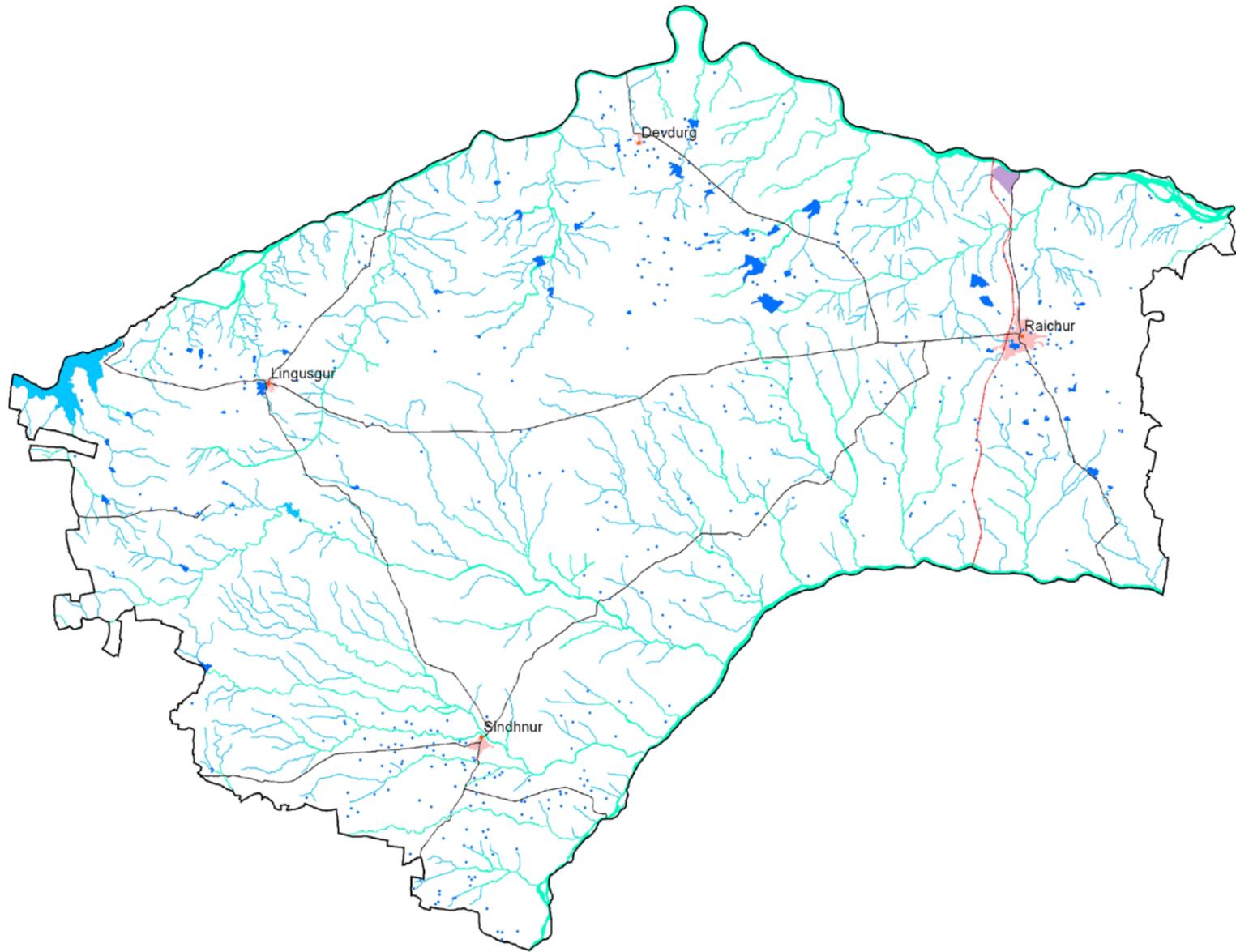
The district lies in the North-eastern part of Karnataka State and is geographically located between latitudes 12°13'14" to 13°33'30" N and longitudes 75°32'26" to 76°39'32". Rivers Krishna and Tungabhadra forms the northern and southern boundaries of the district. The district has an aerial extent of 5559 sq km. The district is bounded on the North by Gulbarga, on the South by Bellary and Koppal, on the East by Andhra Pradesh and West by Bagalkot and part of Koppal. Krishna and Tungabhadra rivers that drain this district.

Area estimates of various wetland categories for Raichur shows that there are 453 wetlands including 326 wetlands smaller than 2.25 ha. Total wetland area is estimated to be 27820 ha (Table 12). The River/Stream (19919 ha) ranked first, accounting for about 72 per cent of extent under wetlands followed by Reservoirs/Barages (3335 ha) and Tanks/Ponds (3706 ha). Analysis of wetland status in terms of open water indicates a reduction of about 40 per cent from post-monsoon (22041 ha) to pre-monsoon (13270 ha). On the other hand aquatic vegetation has shown a significant increase from 1102 (post-monsoon) ha to 2810 ha (pre-monsoon). Turbidity of the open water remained dominantly moderate in post-monsoon (21063 ha) as well as in pre-monsoon (11909 ha).

Table 12: Area estimates of wetlands in Raichur

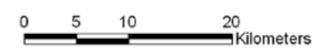
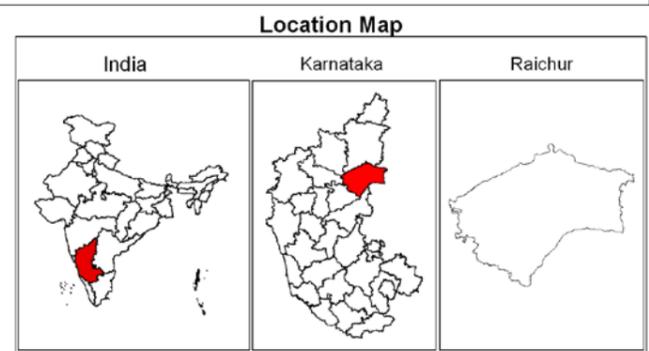
Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	13	19919	71.60	16055	9247
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	2	3335	11.99	3259	1954
8	1202	Tanks/Ponds	111	3706	13.32	2510	1872
9	1203	Waterlogged	1	534	1.92	217	197
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>127</b>	<b>27494</b>	<b>98.83</b>	<b>22041</b>	<b>13270</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>127</b>	<b>27494</b>	<b>98.83</b>	<b>22041</b>	<b>13270</b>
		Wetlands (<2.25 ha), mainly Tanks	326	326	1.17	-	-
		<b>Total</b>	<b>453</b>	<b>27820</b>	<b>100.00</b>	<b>22041</b>	<b>13270</b>

<b>Area under Aquatic Vegetation</b>	1102	2810
<b>Area under turbidity levels</b>		
Low	467	109
Moderate	21063	11909
High	511	1252



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

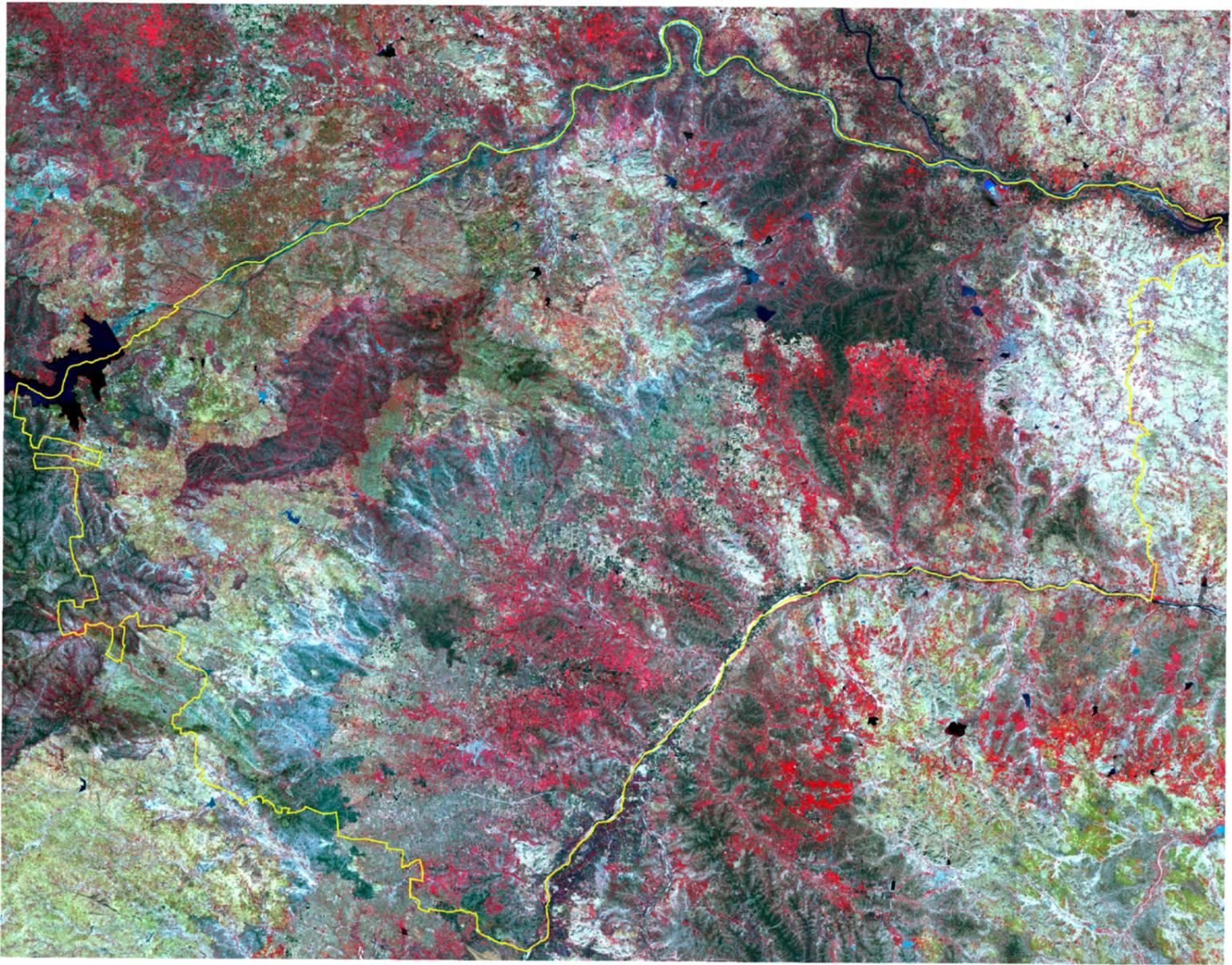


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### 7.1.7 Koppal

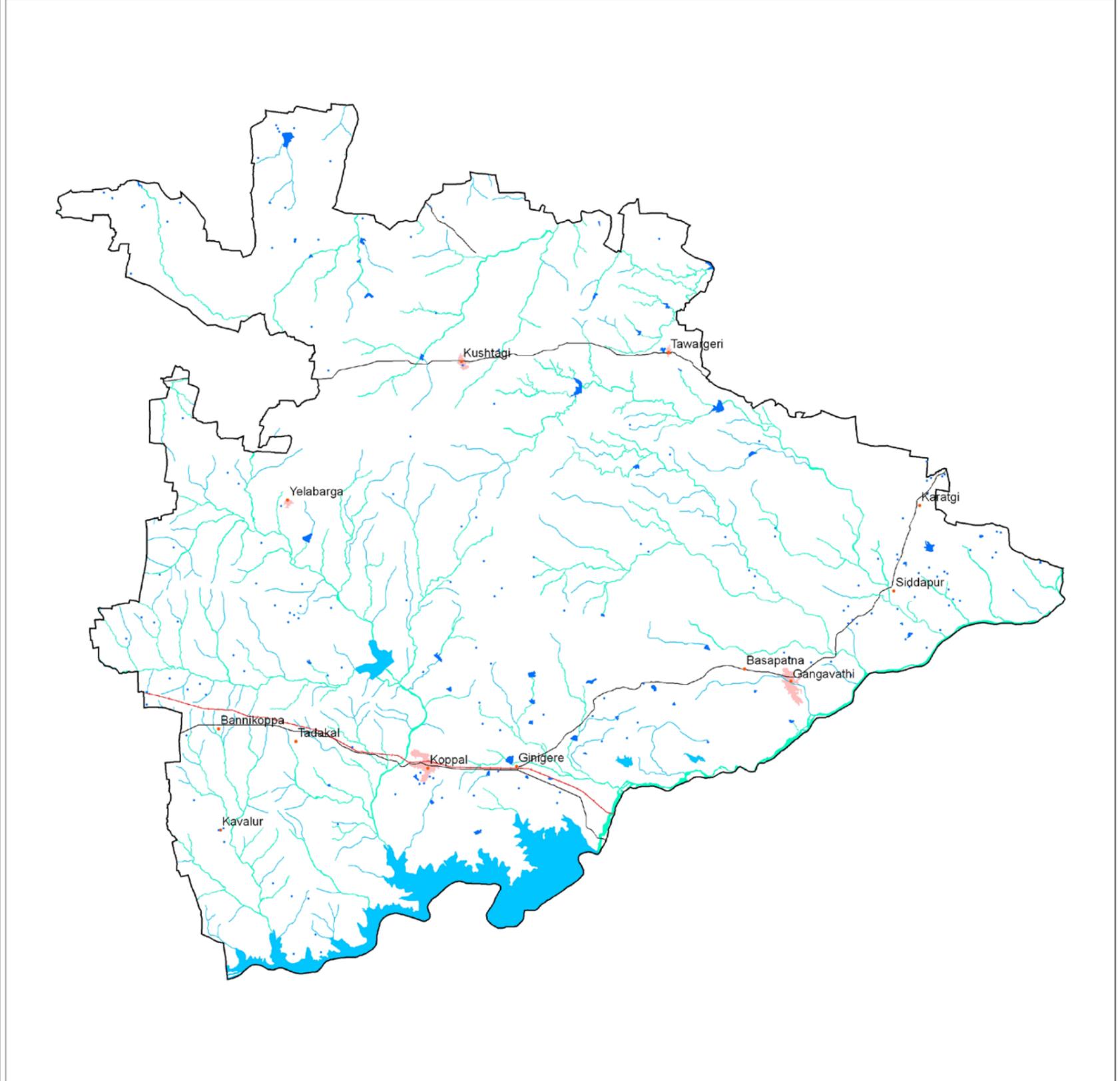
The district lies in the north-eastern part of Karnataka State and is located between the latitudes 16°00'32" to 15°08'17" N and longitudes 75°46'38" to 76°48'45" E. It has a total geographical area of 8458 sq km. The district is bounded on the North by Bagalkot and Raichur districts, on the South-East by Bellary district, and West by Gadag district. The district is drained by Tungabhadra and Krishna rivers.

Area estimates of various wetland categories for Koppal indicates the presence of 252 wetlands including 161 wetlands smaller than 2.25 ha. Total wetland area is estimated to be 25046 ha (Table 13). The Reservoirs/Barages (15276 ha ) category is is the largest in terms of areal extent (about 61 per cent) followed by River/Stream (8376 ha)and Tanks/Ponds (1233 ha). Extent of open water has shown a drastic reduction of more than 5 times from 20453 ha in post-monsoon to 4011 ha in pre-monsoon. On the other hand aquatic vegetation has shown about four-fold increase 1744 ha and 6386 ha during post-monsoon to pre-monsoon. Turbidity of the open water is observed to be moderate in dominance in post-monsoon (16434 ha out of 20453 ha) as well as in pre-monsoon season (2694 ha) out of 4011 ha.

Table 13: Area estimates of wetlands in Koppal

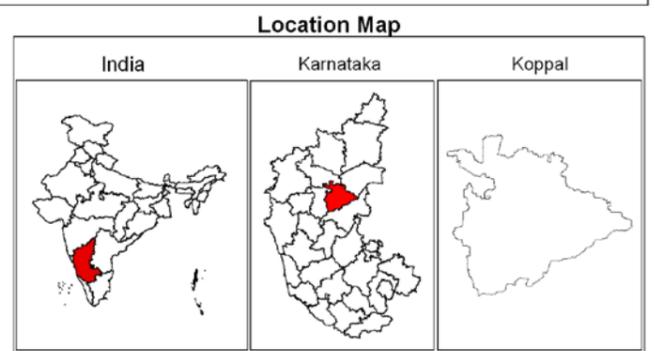
Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	33	8376	33.44	6227	1516
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	4	15276	60.99	13643	2248
8	1202	Tanks/Ponds	54	1233	4.92	583	247
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>91</b>	<b>24885</b>	<b>99.36</b>	<b>20453</b>	<b>4011</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>91</b>	<b>24885</b>	<b>99.36</b>	<b>20453</b>	<b>4011</b>
		Wetlands (<2.25 ha), mainly Tanks	161	161	0.64	-	-
		<b>Total</b>	<b>252</b>	<b>25046</b>	<b>100.00</b>	<b>20453</b>	<b>4011</b>

<b>Area under Aquatic Vegetation</b>	1744	6386
<b>Area under turbidity levels</b>		
Low	3809	1256
Moderate	16434	2694
High	210	61



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

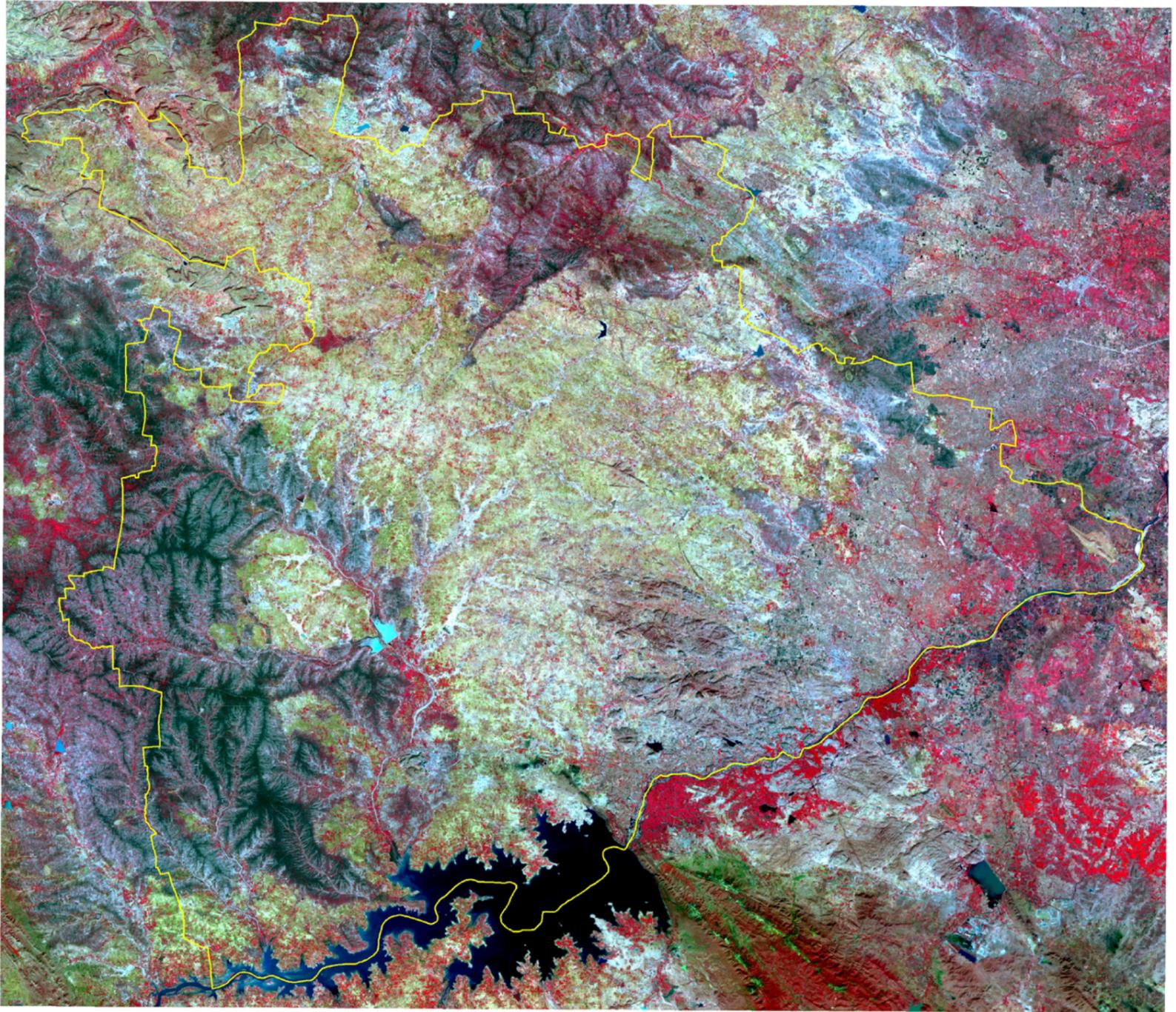


**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

**Prepared By :**  
 Space Applications Centre (ISRO), Ahmedabad  
 and  
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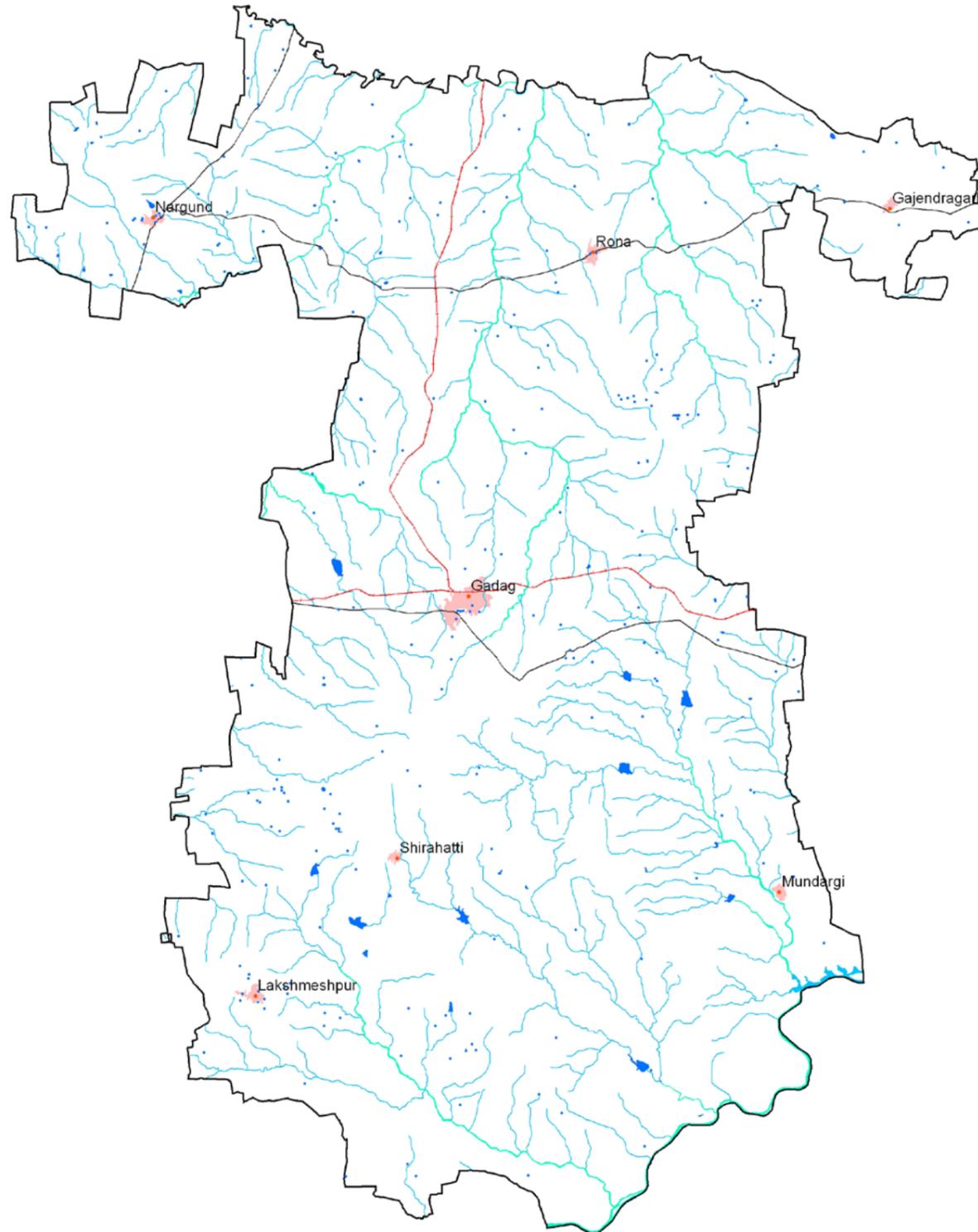
### 7.1.8 Gadag

Gadag district situated in the north-central part of Karnataka State lies between the latitudes 14°52'22" to 15°53'02" N and longitudes 75°16'28" to 76°02'50" E. The total geographical area of the district is 4657 sq km. Gadag district is bounded by Koppal district on the East, Dharwad district on the West, Bagalkot district on the North and Haveri and Bellary districts towards the South. Malaprabha river borders Gadag district in the northern part and Tungabhadra River borders the south-east. The seasonal drains like Hirehalla, Bennihalla, Sasavehalla etc, drains the district.

Area under wetlands in this district stands out to be 4248 ha comprising 291 wetlands including 217 wetlands smaller than 2.25 ha (Table 14). River/Stream occupies largest per cent (66) of wetland extent followed by Tank/Pond (21 %) and a lonely Reservoir/Barrage (7.5 %). The small wetlands (<2.25 ha) account for about 5 per cent of the wetland area. Analysis of wetland status in terms of open water and aquatic vegetation show that the seasonal reduction of open water post-monsoon to pre-monsoon is from 3579 ha to 2358 ha. Extent of aquatic vegetation stands out to be 182 ha in post-monsoon, which has increased to 251 ha pre-monsoon. Analysis of open water turbidity shows that moderate turbidity dominated both the seasons i.e. 64 and 73 per cent in post-monsoon and pre-monsoon respectively followed by high and low.

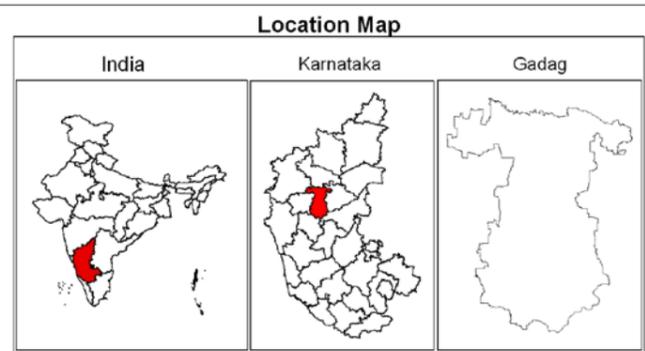
Table 14: Area estimates of wetlands in Gadag

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Area in ha	
						Open Water Post-monsoon area	Open Water Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	13	2810	66.15	2708	1875
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	1	318	7.49	167	41
8	1202	Tanks/Ponds	60	903	21.26	704	442
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>74</b>	<b>4031</b>	<b>94.89</b>	<b>3579</b>	<b>2358</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
16	2201	Salt pans	-	-	-	-	-
17	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>74</b>	<b>4031</b>	<b>94.89</b>	<b>3579</b>	<b>2358</b>
		Wetlands (<2.25 ha), mainly Tanks	217	217	5.11	-	-
		<b>Total</b>	<b>291</b>	<b>4248</b>	<b>100.00</b>	<b>3579</b>	<b>2358</b>
<b>Area under Aquatic Vegetation</b>						182	251
<b>Area under turbidity levels</b>							
Low						353	118
Moderate						2288	1726
High						938	514



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

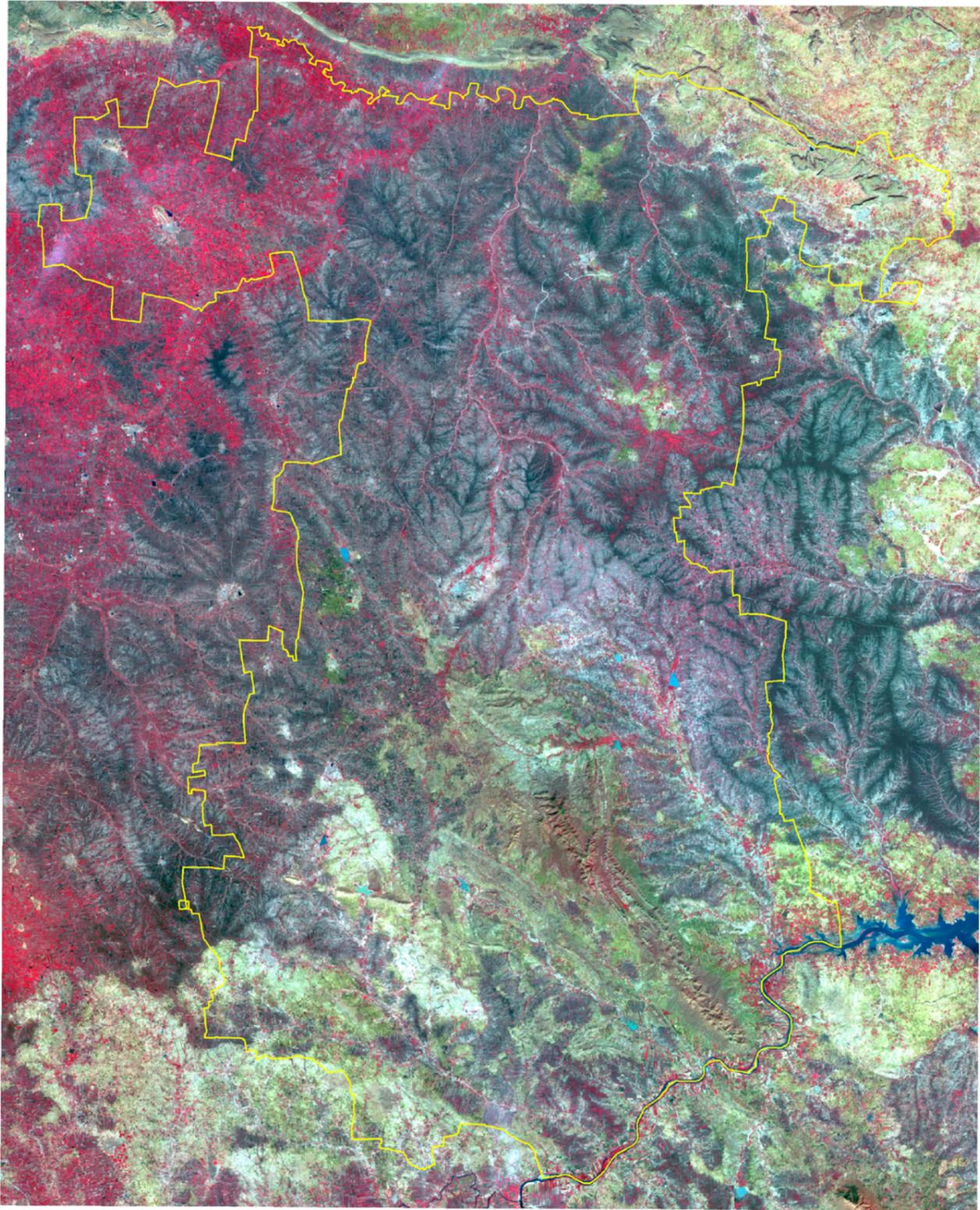


**Data Source :**  
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### 7.1.9 Dharwad

The district lies in the north-western part of Karnataka State and is geographically located between latitudes 15°02'04" and 15°42'08" N and 74°43'17" and 75°34'00" E longitudes. The district has an aerial extent of 4,230 sq km. Tuprihalla, Bennihalla, Hirehalla, Bedtihalla and Handigar halla form important surface drainage of the district while Neerasagar and Unkal kere are the important tanks.

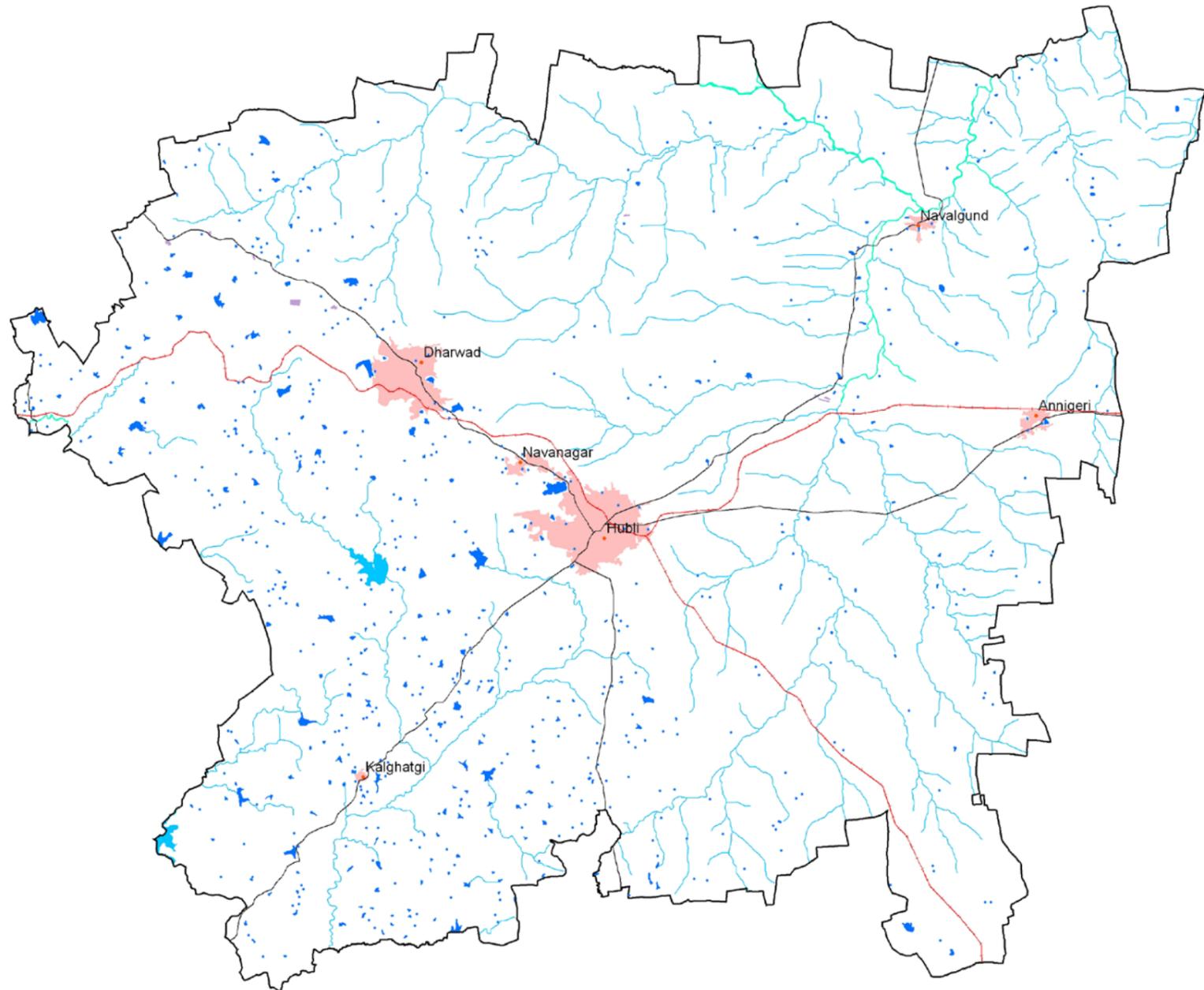
Dharwad district shows the presence of 691 wetlands including 416 smaller than 2.25 ha (Table 15). Total wetland area estimated is 3965 ha. The small wetlands contribute about 10 per cent to the extent of wetlands, which is significant. In terms of extent, Tanks/Ponds (2250 ha) rank first accounting for about 57 per cent of wetland area followed by River/Stream (660 ha) and Reservoirs/Barages (568 ha). Seasonal change in open water extent shows a reduction of about 15 per cent from post-monsoon (2603 ha) to 2075 ha in pre-monsoon. Aquatic vegetation has shown an increase of 2.3 times from post-monsoon (352 ha) to pre-monsoon (802 ha). Out of 2603 ha of open water, turbidity remained moderate comprising 1723 ha and 1398 ha in post- and pre-monsoon seasons respectively while highly turbid areas of open water were 880 ha and 677 ha. Notably, low turbidity has not been observed in both the seasons.

Table 15: Area estimates of wetlands in Dharwad

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	7	660	16.65	660	578
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	3	568	14.33	458	360
8	1202	Tanks/Ponds	256	2250	56.75	1455	1108
9	1203	Waterlogged	9	71	1.79	30	29
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>275</b>	<b>3549</b>	<b>89.51</b>	<b>2603</b>	<b>2075</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
16	2201	Salt pans	-	-	-	-	-
17	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>275</b>	<b>3549</b>	<b>89.51</b>	<b>2603</b>	<b>2075</b>
		Wetlands (<2.25 ha), mainly Tanks	416	416	10.49	-	-
		<b>Total</b>	<b>691</b>	<b>3965</b>	<b>100.00</b>	<b>2603</b>	<b>2075</b>

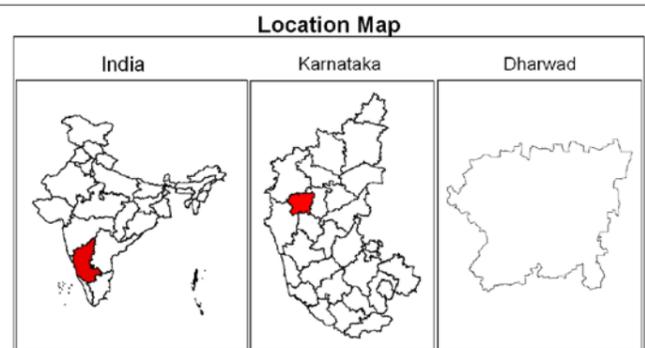
<b>Area under Aquatic Vegetation</b>	352	802
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<b>Area under turbidity levels</b>		
Low	-	-
Moderate	1723	1398
High	880	677



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

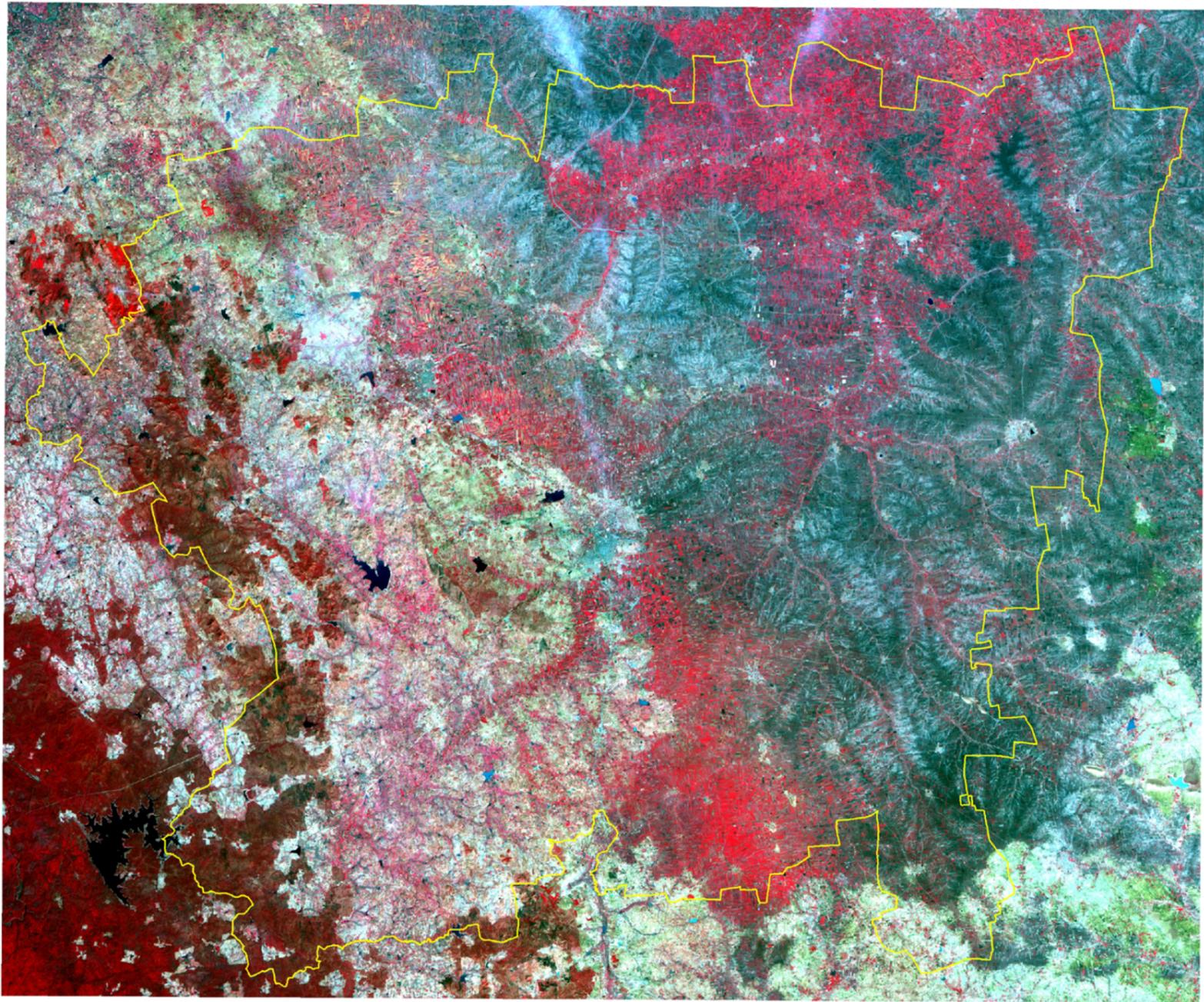


**Data Source :**  
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### 7.1.10 Uttar Kannada

This district located in the mid-western part of Karnataka State lies between the latitudes 13°55'00" to 15°31'00" N and longitudes 74°09'00" to 75°07'00" E. The total geographical area of the district is 10291 sq km. The major rivers are Kalinadi, Bedti, Gangavali, Aghanashini, Tadri, Sharavati and Shalmala form the surface drainage of the district. Major reservoirs like Kadra dam, Supa dam, Dharma, Bommanalli and Tattihalla reservoir are located in the district. This district is blessed by numerous waterfalls and Anashi National Park and Dandeli wildlife sanctuary. Ecologically important coastal areas in Karnataka are Honnavara – Estuarine and mangroves ecosystem including the world renowned beach 'Om' located in Gokarn.

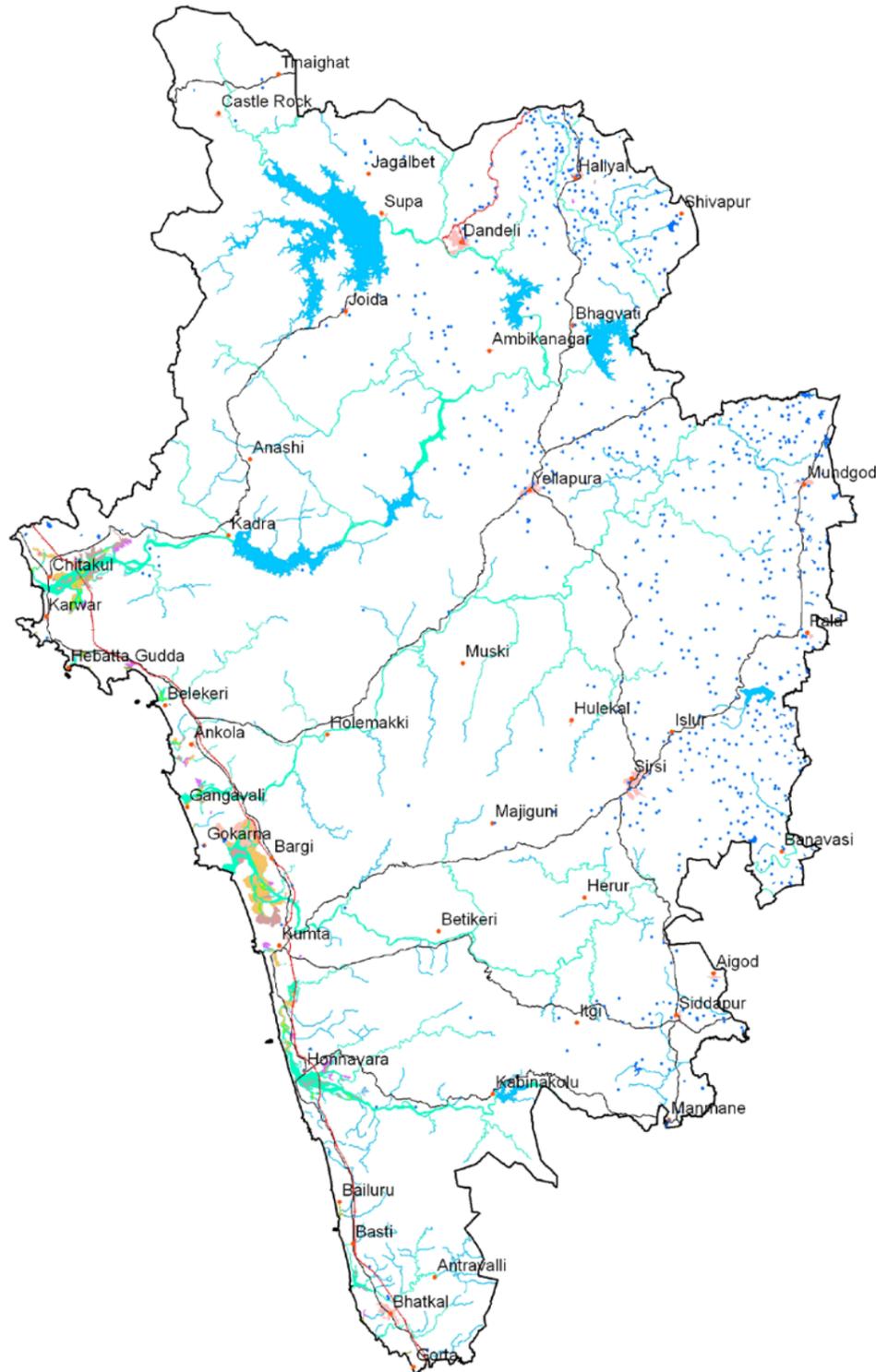
Area estimates of various wetland categories for Uttar Kannada have indicates the presence of 1016 wetlands including 570 wetlands smaller than 2.25 ha. Total wetland area is estimated to be 42190 ha (Table 16). Even though there is diversity of wetland types observed in the district, Reservoirs/Barages (18911 ha) accounted for about 45 per cent followed by River/Stream (14458 ha) , Tanks/Ponds (1294 ha), Intertidal mudflats (1471 ha), Mangroves (384 ha) and Creeks (60 ha). Aquatic vegetation has shown a decrease from 3739 ha and 2885 ha in post- and pre-monsoon seasons respectively. Wetland area under open water category during post-monsoon (35487 ha) has decreased to 32070 ha pre-monsoon. Turbidity remained dominated by moderate turbidity in both seasons.

Table 16: Area estimates of wetlands in Uttar Kannada

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	15	270	0.64	176	178
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	8	122	0.29	68	62
5	1105	Waterlogged	24	581	1.38	349	326
6	1106	River/Stream	23	14458	34.27	14190	13699
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	7	18911	44.82	17209	13184
8	1202	Tanks/Ponds	148	1294	3.07	554	457
9	1203	Waterlogged	2	19	0.05	14	19
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>227</b>	<b>35655</b>	<b>84.51</b>	<b>32560</b>	<b>27925</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	1	22	0.05	22	17
12	2102	Creeks	7	60	0.14	53	38
13	2103	Sand/Beach	37	989	2.34	-	-
14	2104	Intertidal mud flats	65	1471	3.49	108	1102
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	52	384	0.91	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	4	812	1.92	812	812
19	2202	Aquaculture ponds	53	2227	5.28	1932	2176
		<b>Total - Coastal</b>	<b>219</b>	<b>5965</b>	<b>14.14</b>	<b>2927</b>	<b>4145</b>
		<b>Sub-Total</b>	<b>446</b>	<b>41620</b>	<b>98.65</b>	<b>35487</b>	<b>32070</b>
		Wetlands (<2.25 ha), mainly Tanks	570	570	1.35	-	-
		<b>Total</b>	<b>1016</b>	<b>42190</b>	<b>100.00</b>	<b>35487</b>	<b>32070</b>

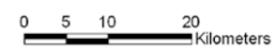
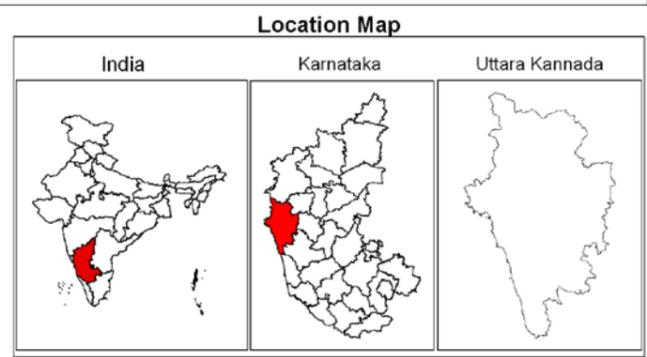
<b>Area under Aquatic Vegetation</b>	3739	2885
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<b>Area under turbidity levels</b>		
Low	1433	11827
Moderate	27446	18114
High	6608	2129



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

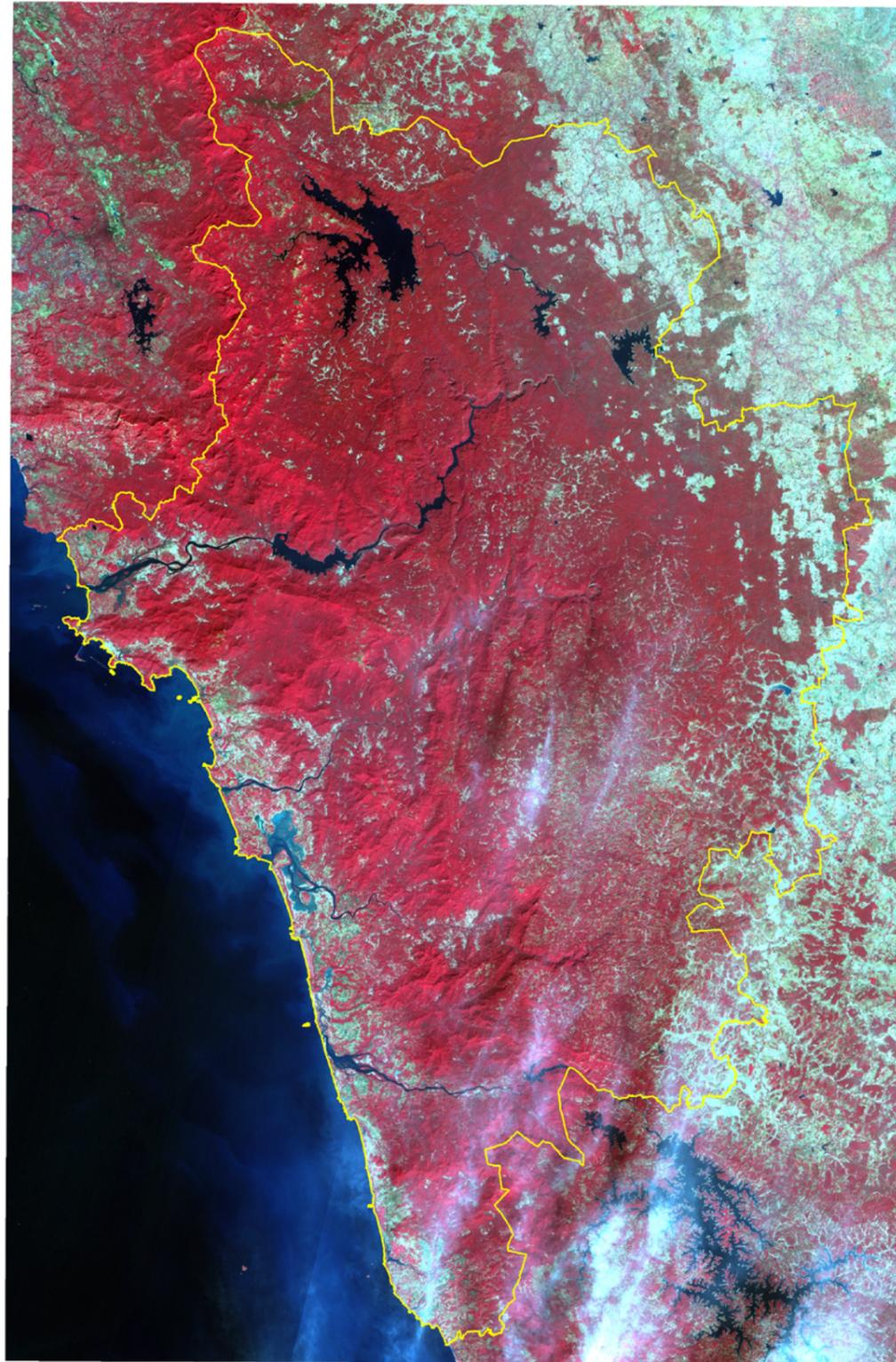


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### 7.1.11 Haveri

Haveri district lies in the central part of Karnataka State and is geographically located between latitudes 14°16'18" to 15°00'36" N and longitudes 75°00'36" to 75°49'30" E. The total geographical area of the district is 4851 sq km. Tungabhadra, Daharma, Kumadvathi and Varadha rivers drain the district.

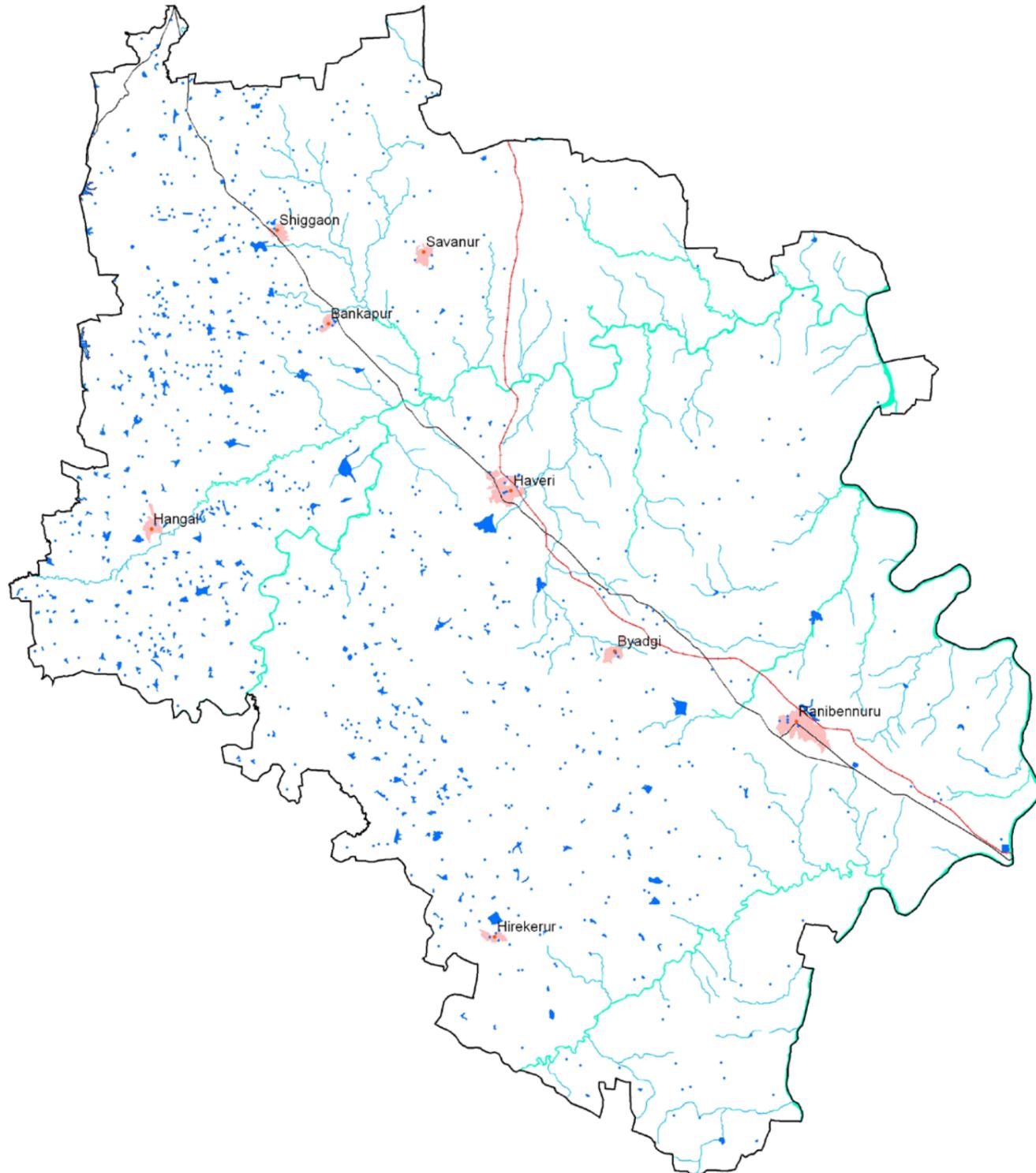
The district comprises of 913 wetlands including 595 wetlands smaller than 2.25 ha which have been shown as point features. Total wetland area is estimated to be 9353 ha (Table 17). The major wetland types are River/Stream (4960 ha) and Tanks/Ponds (3660 ha) . Aquatic vegetation shown an extent of 426 ha and 452 ha out of wetland area during post-monsoon and Pre-monsoon respectively. Open water has shown a decrease of about 15 per cent from post-monsoon (5704 ha) to Pre-monsoon (3728 ha). Qualitative turbidity is dominantly moderate in both the seasons followed by high and low.

Table 17: Area estimates of wetlands in Haveri

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	2	138	1.48	77	45
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	4	4960	53.03	3669	3040
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	312	3660	39.13	1958	643
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>318</b>	<b>8758</b>	<b>93.64</b>	<b>5704</b>	<b>3728</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>318</b>	<b>8758</b>	<b>93.64</b>	<b>5704</b>	<b>3728</b>
		Wetlands (<2.25 ha)	595	595	6.36	-	-
		<b>Total</b>	<b>913</b>	<b>9353</b>	<b>100.00</b>	<b>5704</b>	<b>3728</b>

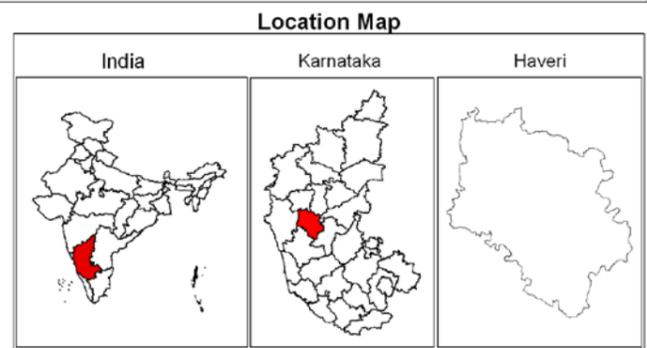
<b>Area under Aquatic Vegetation</b>	426	452
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<b>Area under turbidity levels</b>		
Low	80	9
Moderate	5112	3624
High	512	95



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

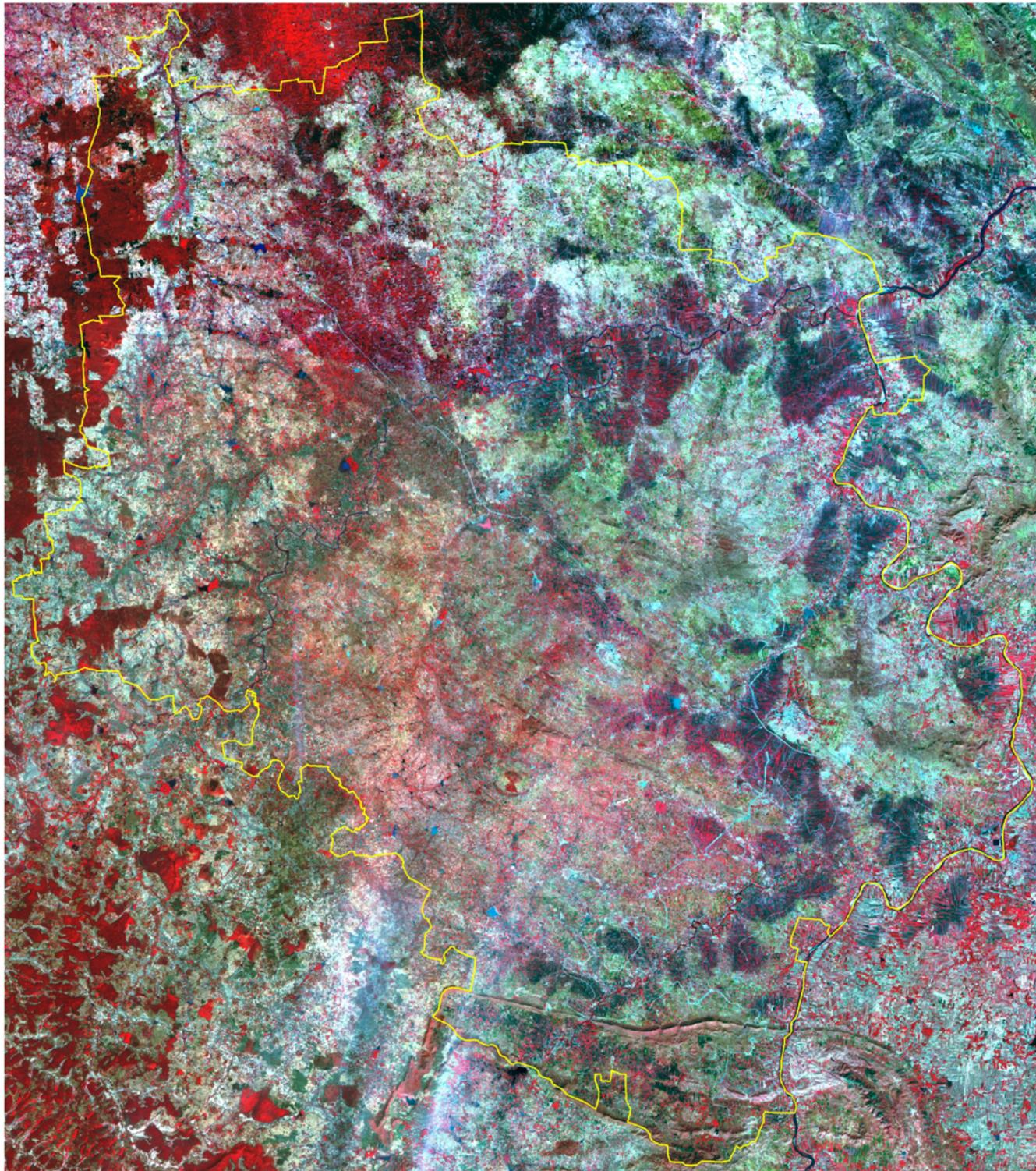


**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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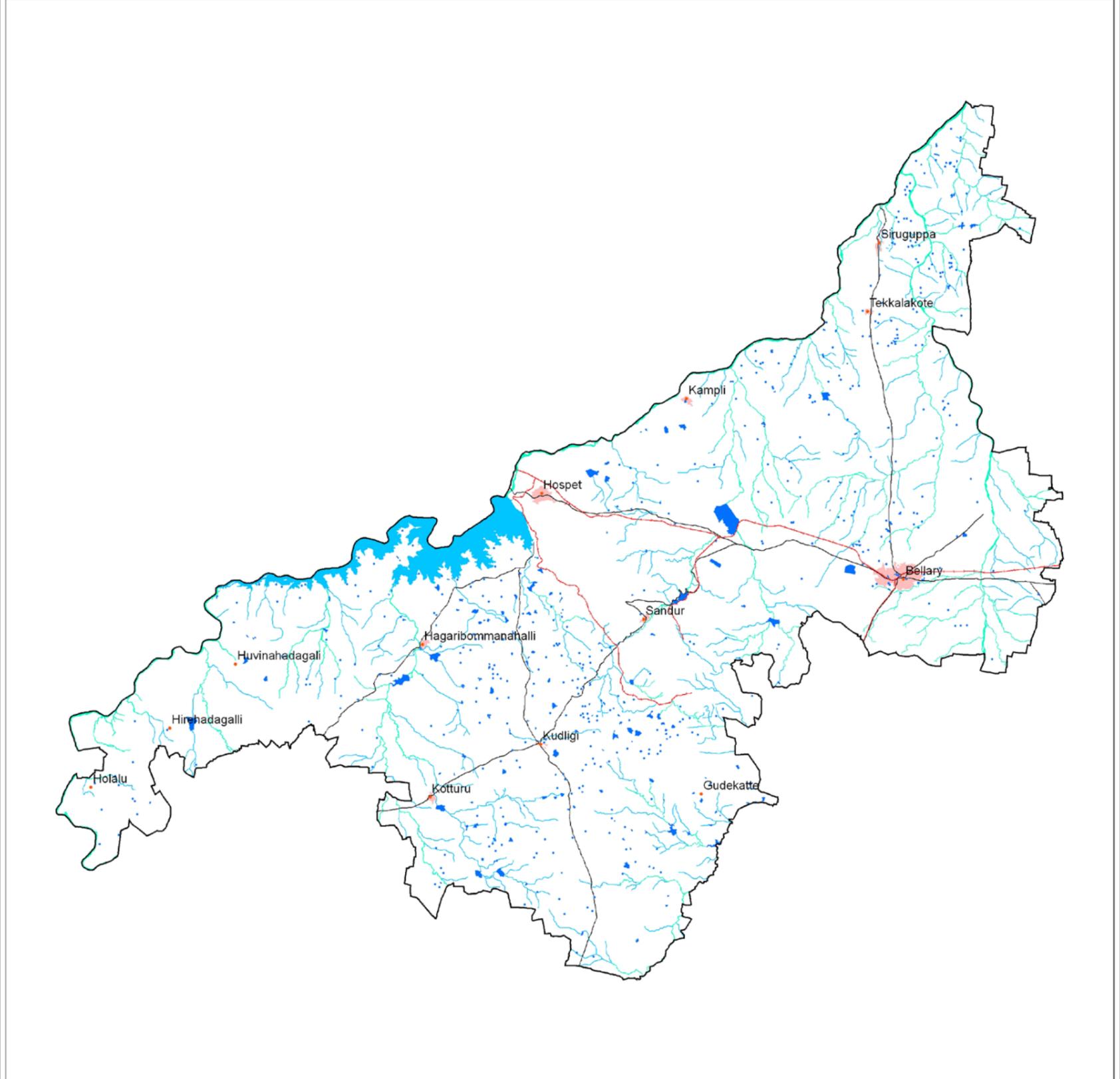
### 7.1.12 Bellary

Bellary district situated in eastern Karnataka spread from south-west to north-east of the state. The district is geographically located between latitudes 14°33'33" to 15°50'1" N and longitudes 75°39'52" to 77°10'5"E with an areal extent of 8419 sq km. Hagari and Tungabhadra rivers drain Bellary district. One of the major reservoirs, the Tungabhadra reservoir is located along the district border.

Area estimates of various wetland show the presence of 674 wetlands that include 397 wetlands smaller than 2.25 ha. Total wetland area is estimated to be 33372 ha (Table 19). The major wetland types are Reservoir/Barrages (16801 ha) followed by River/Stream (10439 ha) and Tanks/Ponds (5735 ha). Aquatic vegetation has shown a 7 times increase in extent from post-monsoon (1032 ha) to Pre-monsoon (7402 ha). Area under open water (28241 ha) in post-monsoon season accounted for about 86 per cent of wetland extent, which has drastically reduced to 7640 ha in Pre-monsoon that turns out to be about 23 per cent. Moderate turbidity dominated the open water in post- as well as Pre-monsoon (23176 ha and 6195 ha) followed by low and high (4469 ha and 596 ha) in post-monsoon; high (928 ha) and low (517 ha) in Pre-monsoon season.

Table 19: Area estimates of wetlands in Bellary

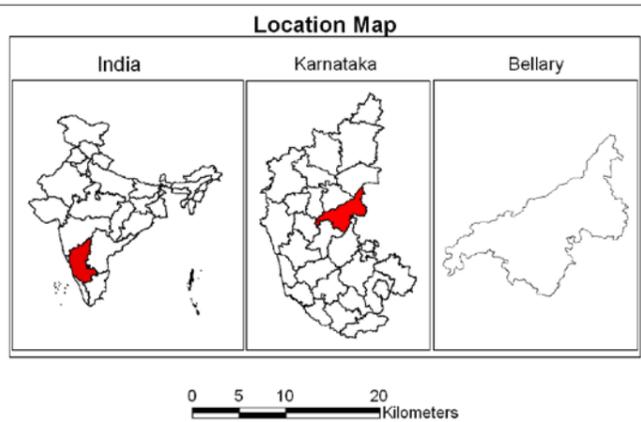
Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Area in ha	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	25	10439	31.28	8050	4021
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	1	16801	50.34	15878	1567
8	1202	Tanks/Ponds	251	5735	17.19	4313	2052
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>277</b>	<b>32975</b>	<b>98.81</b>	<b>28241</b>	<b>7640</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
16	2201	Salt pans	-	-	-	-	-
17	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>277</b>	<b>32975</b>	<b>98.81</b>	<b>28241</b>	<b>7640</b>
		Wetlands (<2.25 ha)	397	397	1.19	-	-
		<b>Total</b>	<b>674</b>	<b>33372</b>	<b>100.00</b>	<b>28241</b>	<b>7640</b>
<b>Area under Aquatic Vegetation</b>						1032	7402
<b>Area under turbidity levels</b>							
Low						4469	517
Moderate						23176	6195
High						596	928



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

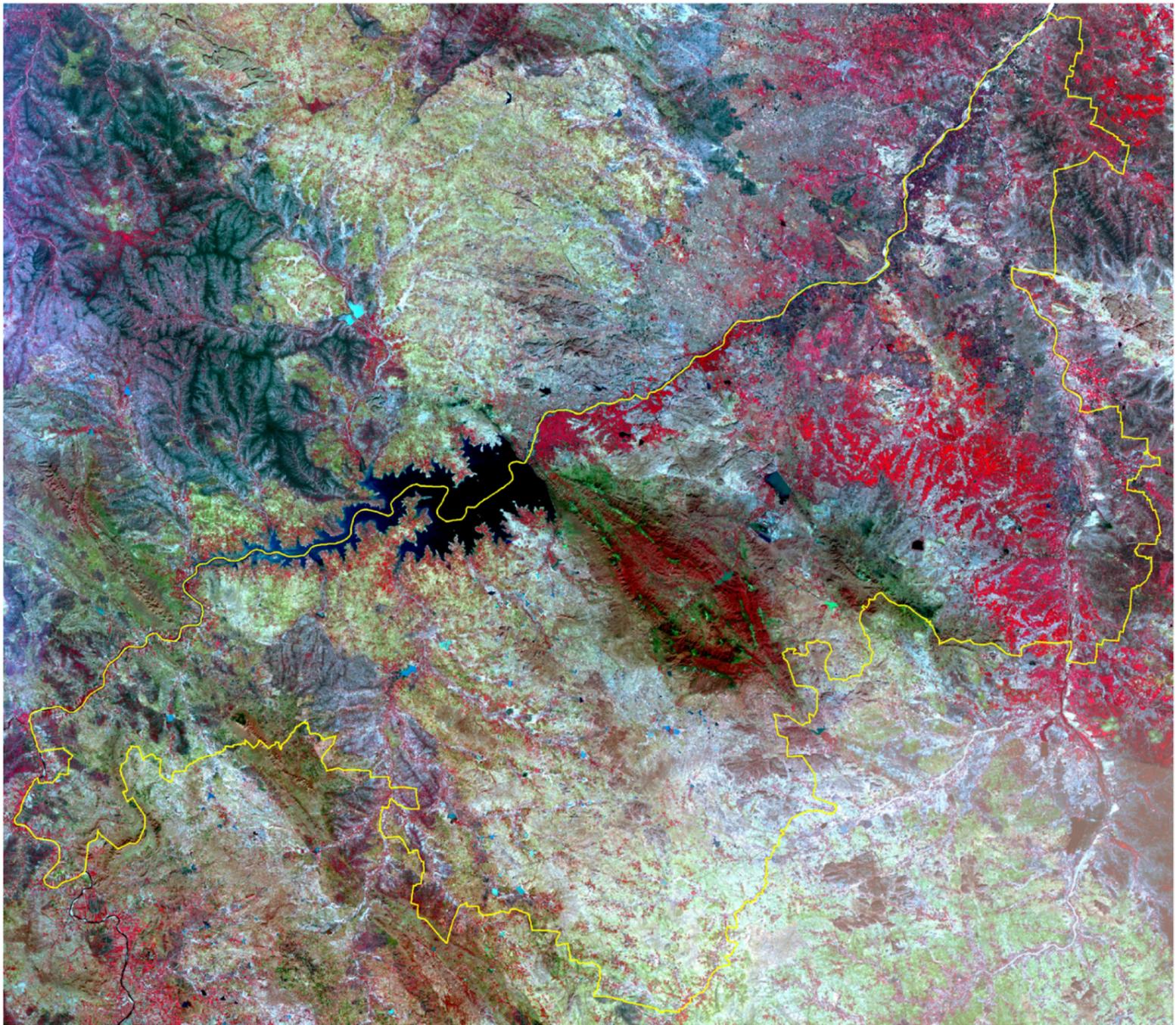


**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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### 7.1.13 Chitradurga

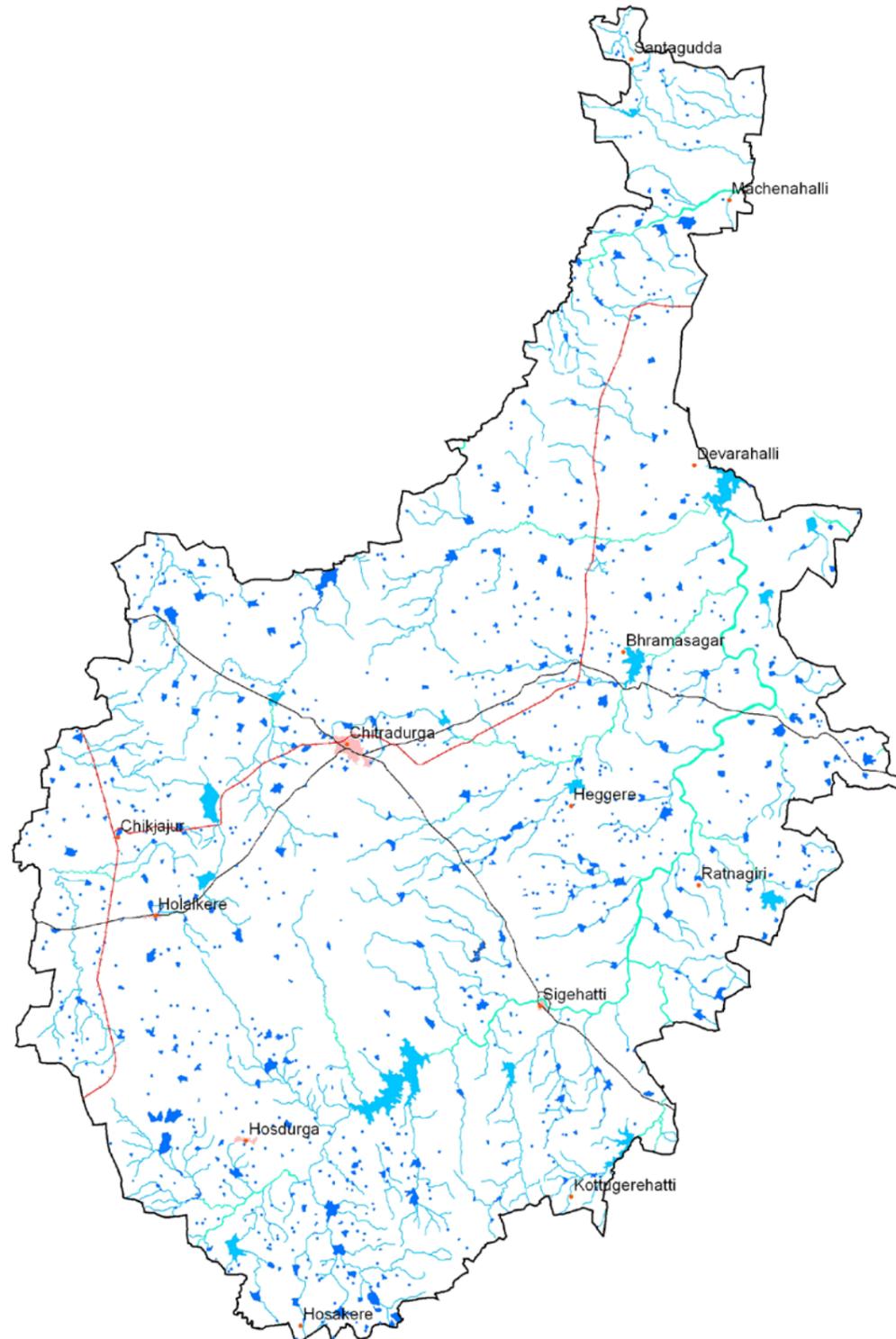
The district is situated in the eastern part of Karnataka with an aerial extent of 8388 sq km and located between latitudes 13°34'00" to 15°02'00" N and longitudes 76°0'00" to 77°01'00" E. Vedavathi, Hagari and Swarnamukhi rivers for main surface drainage of the district. The Vanivilas Sagar Dam was located across the Vedavati River. Other important reservoirs are Gayathri, Rangayana durga and Narayanapur anicut. Chitradurga district has the presence of 974 including 377 smaller wetlands of < 2.25 ha.

The area under wetlands recorded as 27486 ha (Table 19). The major wetland types are Tanks/Ponds (15070 ha), followed by Reservoir/Barrages (7539 ha ) and River/Stream (4360 ha). Open water extent in post-monsoon (14836 ha) is about 55 per cent of wetland extent has got reduced to about 35 per cent in Pre-monsoon (9137 ha). Unlike other preceding districts, there is a decrease in aquatic vegetation from post-monsoon (8132 ha) to pre-monsoon (6588 ha). Moderate turbidity accounted for largest area (7112 ha) in post-monsoon followed by high (5840 ha) and low (1884 ha). In case of Pre-monsoon the high turbidity (5183 ha) dominated the open water followed by moderate (3168 ha) and low (789 ha).

Table 19: Area estimates of wetlands in Chitradurga

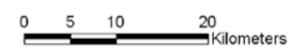
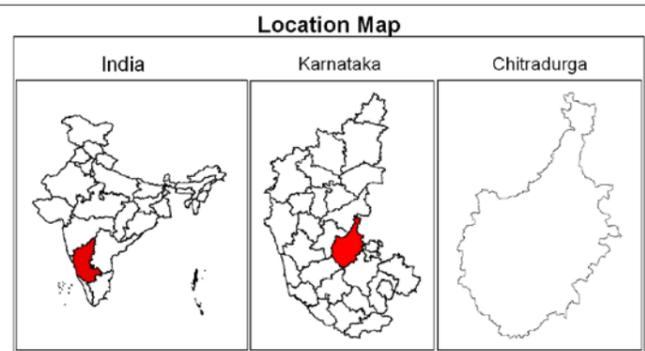
Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	1	140	0.51	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	20	4360	15.86	4077	240
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	16	7539	27.43	4025	3970
8	1202	Tanks/Ponds	560	15070	54.83	6734	4927
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>597</b>	<b>27109</b>	<b>98.63</b>	<b>14836</b>	<b>9137</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>597</b>	<b>27109</b>	<b>98.63</b>	<b>14836</b>	<b>9137</b>
		Wetlands (<2.25 ha)	377	377	1.37	-	-
		<b>Total</b>	<b>974</b>	<b>27486</b>	<b>100.00</b>	<b>14836</b>	<b>9137</b>

<b>Area under Aquatic Vegetation</b>	8132	6588
<b>Area under turbidity levels</b>		
Low	1884	786
Moderate	7112	3168
High	5840	5183



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



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

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### 7.1.14 Davanagere

Davanagere district is situated in the central part of Karnataka state between latitudes 13°42'17" to 14°55'51" N and longitudes 75°23'59" to 76°32'05" E. The geographical area of the district is 6018 sq km. Tungabhadra and Chinna Hagari or Jagana Halla rivers form the major surface drainage, a major tank is Sulekere and a major reservoir is Shanthi Sagar located in this district.

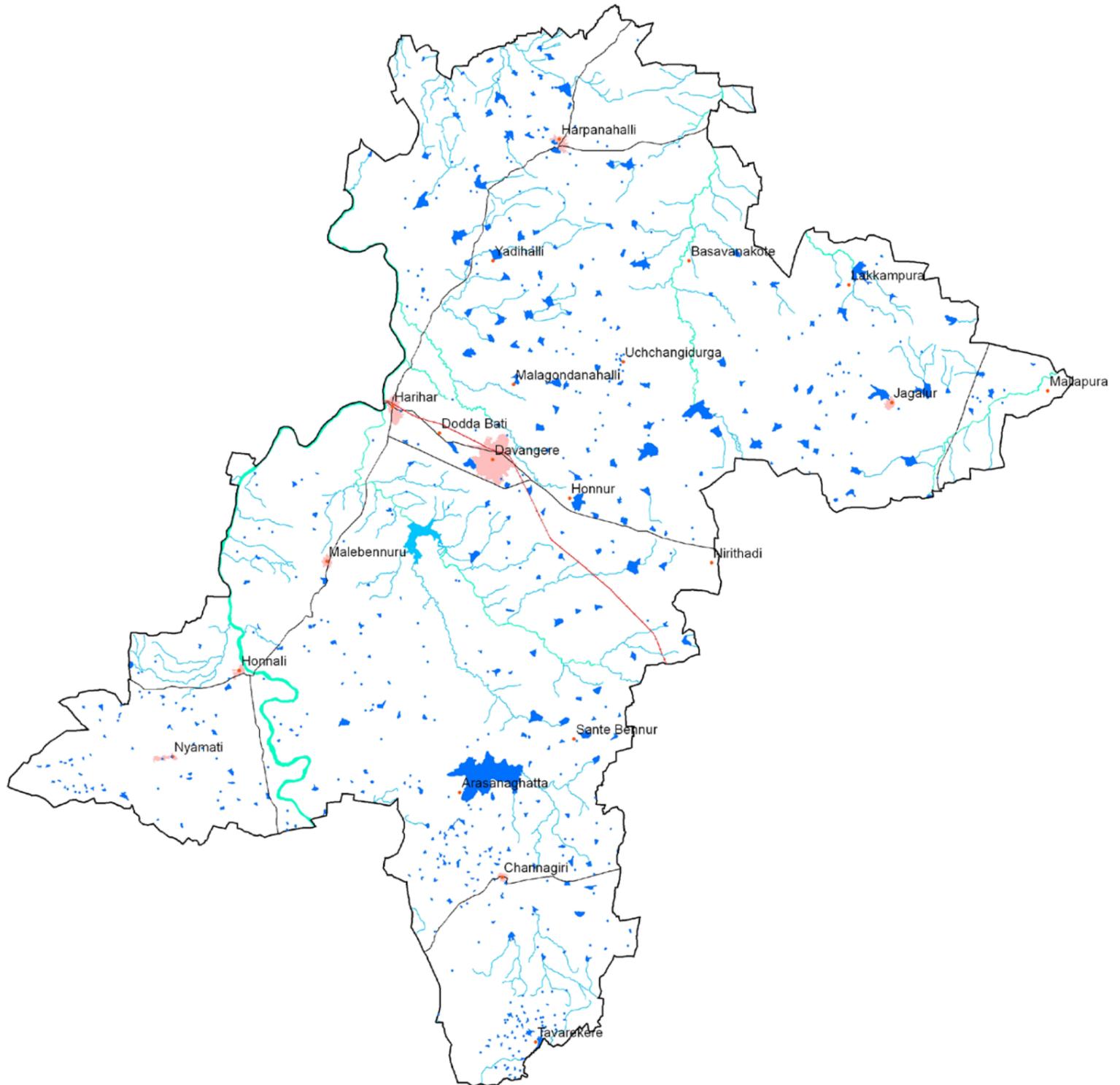
Davanagere has 633 wetlands (Table 20) including 278 wetlands smaller than 2.25 ha. Wetland area is estimated to be 16886 ha. The major wetland types are Tanks/Ponds (12009 ha) followed by River/Stream (3851 ha) and Reservoir/Barrages (748 ha). Open water extent has a decrease from 9171 ha in post-monsoon to 6152 ha in pre-monsoon. Aquatic vegetation has also shown a decrease from 3262 ha to 2189 ha. Turbidity of open water was dominated by low (5255 ha) followed by moderate (3855 ha) and high (61 ha) in post-monsoon. In case of Pre-monsoon the turbidity was dominated by moderate (5907 ha) followed by high (240ha) and low (5 ha).

Table 20: Area estimates of wetlands in Davanagere

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	6	3851	22.81	3322	2553
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	1	748	4.43	625	634
8	1202	Tanks/Ponds	348	12009	71.12	5224	2965
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>355</b>	<b>16608</b>	<b>98.35</b>	<b>9171</b>	<b>6152</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>355</b>	<b>16608</b>	<b>98.35</b>	<b>9171</b>	<b>6152</b>
		Wetlands (<2.25 ha)	278	278	1.65	-	-
		<b>Total</b>	<b>633</b>	<b>16886</b>	<b>100.00</b>	<b>9171</b>	<b>6152</b>

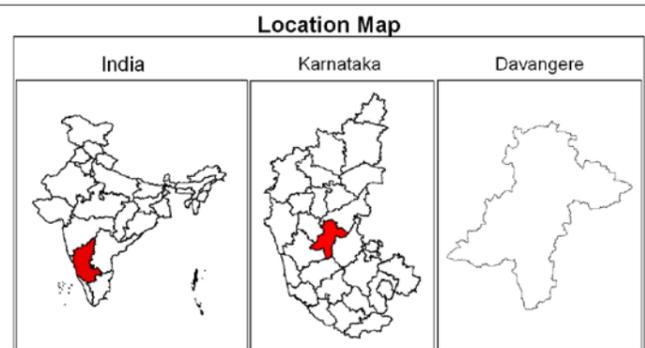
<b>Area under Aquatic Vegetation</b>	3262	2189
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<b>Area under turbidity levels</b>		
Low	5255	5
Moderate	3855	5907
High	61	240



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

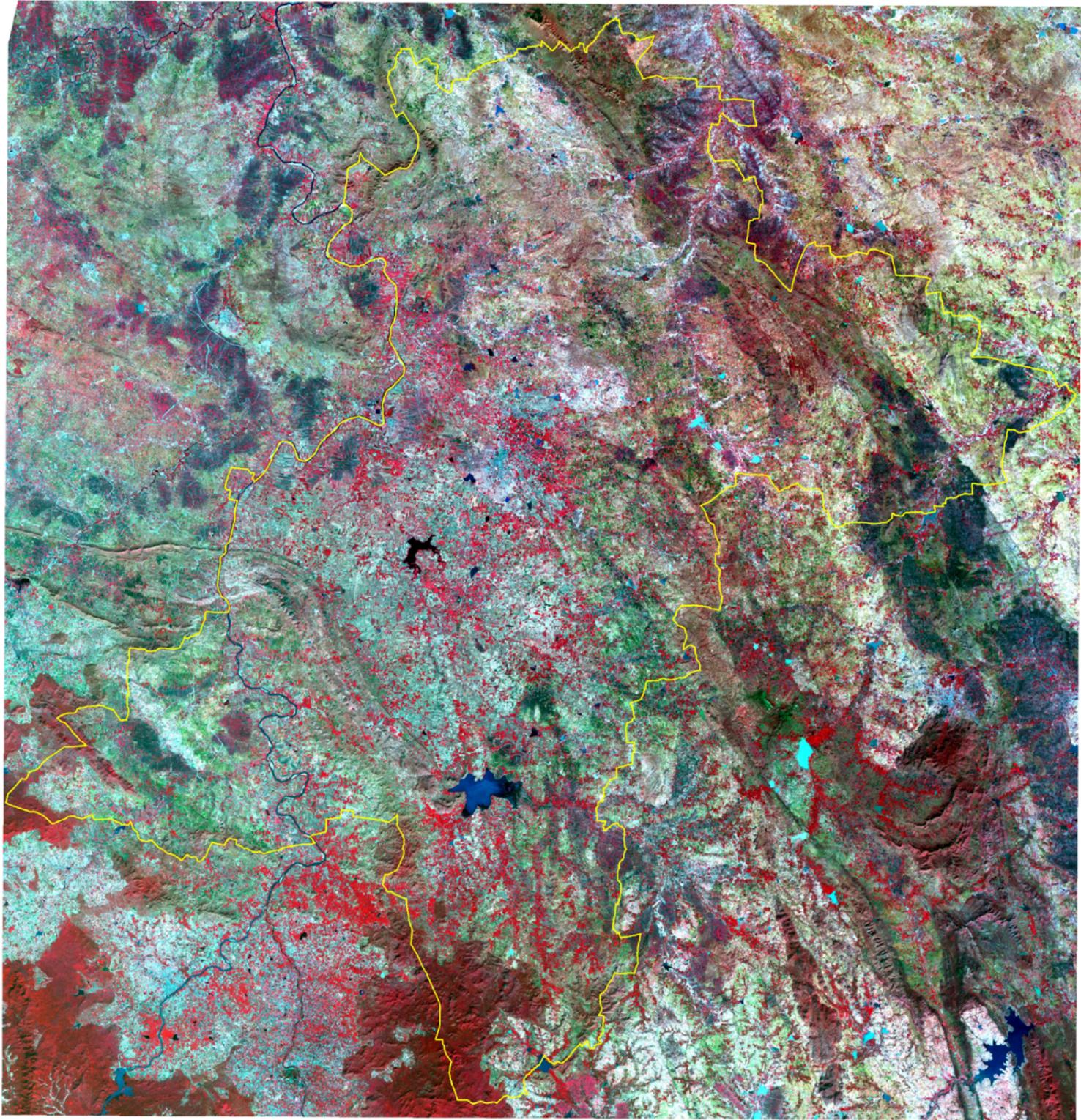


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## 7.1.15 Shimoga

Shimoga district is situated in the western part of Karnataka State and lies between latitudes 13°27'00" to 14°39'00" N and longitudes 74°38'00" to 76°04'00" E with a geographical area of 8465 sq km. The district is blessed with surface drainage system formed by Tunga, Bhadra, Tungabhadra, Varda, Dandavathy, Kumudavathy, Varahi and Sharavati rivers. The district has Linganamakki reservoir, Gajnur dam, Chakra reservoir and the renowned Jogfalls. Agumbe is the place that is known to receive the highest rain fall in the state is also located in this district. Mandagadde and Gudavi bird sanctuaries are located in this district.

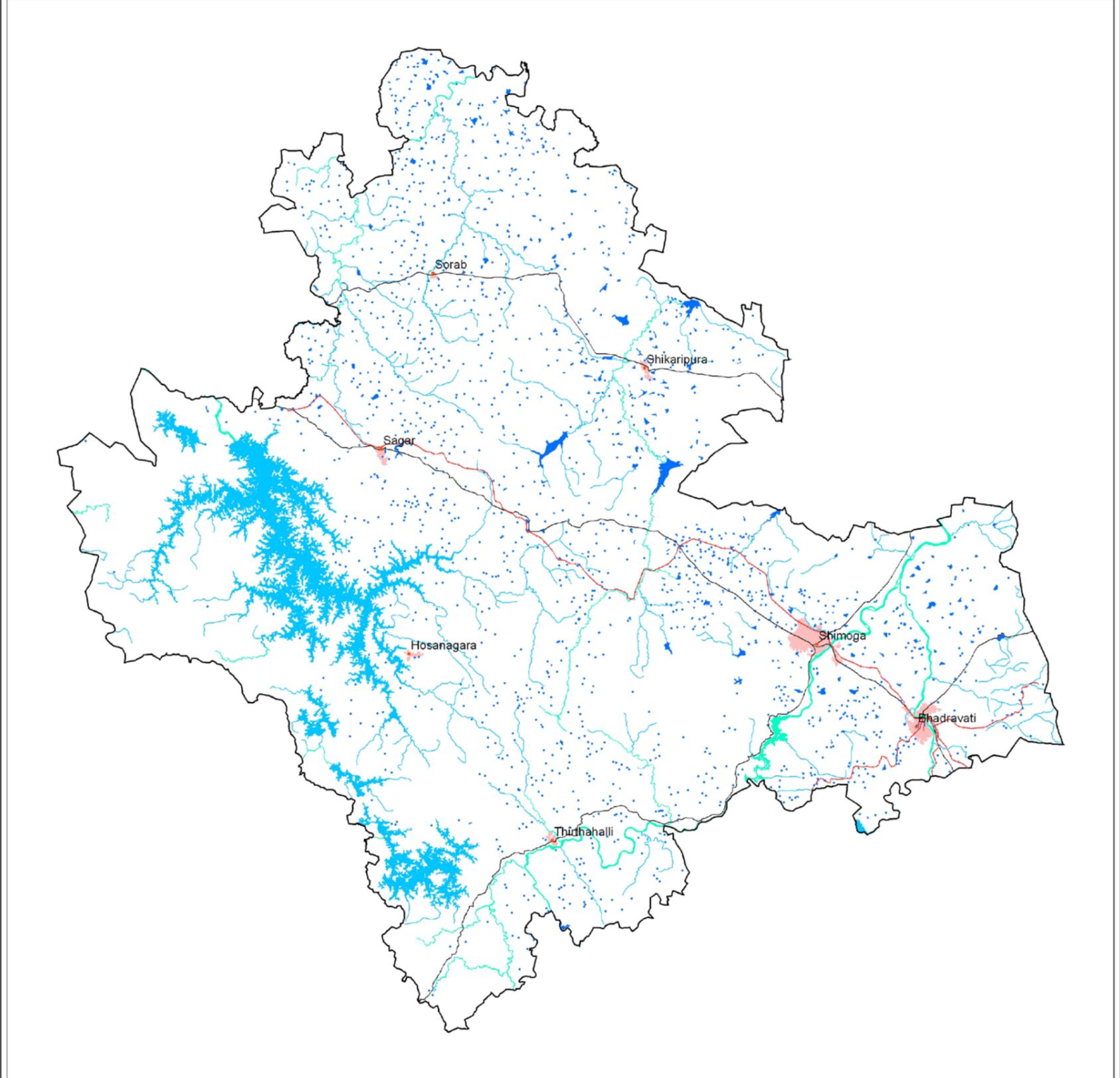
Shimoga district comprises of 1714 wetlands including 1204 wetlands smaller than 2.25 ha. Total wetland area estimated is 46131 ha (Table 21). The major wetland types are Reservoir/Barrages (33840 ha) followed by River/Stream (5578 ha) and Tanks/Ponds (5509 ha) . Aquatic vegetation has shown an increase of 965 ha from 1950 ha to 2915 ha during post-monsoon to Pre-monsoon respectively. Open water extent has shown a decrease of 15070 ha from 41254 ha in post-monsoon to 26184 ha in Pre-monsoon accounting for about 34 per cent in seasonal change. Moderate turbidity of open water ranked first in both the seasons followed by low and high.

Table 21: Area estimates of wetlands in Shimoga

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	14	5578	12.09	5019	4752
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	6	33840	73.36	32991	19689
8	1202	Tanks/Ponds	490	5509	11.94	3244	1743
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>510</b>	<b>44927</b>	<b>97.39</b>	<b>41254</b>	<b>26184</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>510</b>	<b>44927</b>	<b>97.39</b>	<b>41254</b>	<b>26184</b>
		Wetlands (<2.25 ha)	1204	1204	2.61	-	-
		<b>Total</b>	<b>1714</b>	<b>46131</b>	<b>100.00</b>	<b>41254</b>	<b>26184</b>

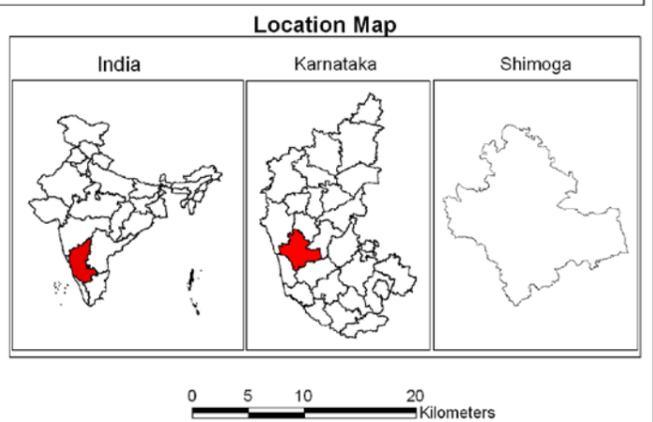
<b>Area under Aquatic Vegetation</b>	1950	2915
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<b>Area under turbidity levels</b>		
Low	3017	5523
Moderate	37625	19446
High	612	1215



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

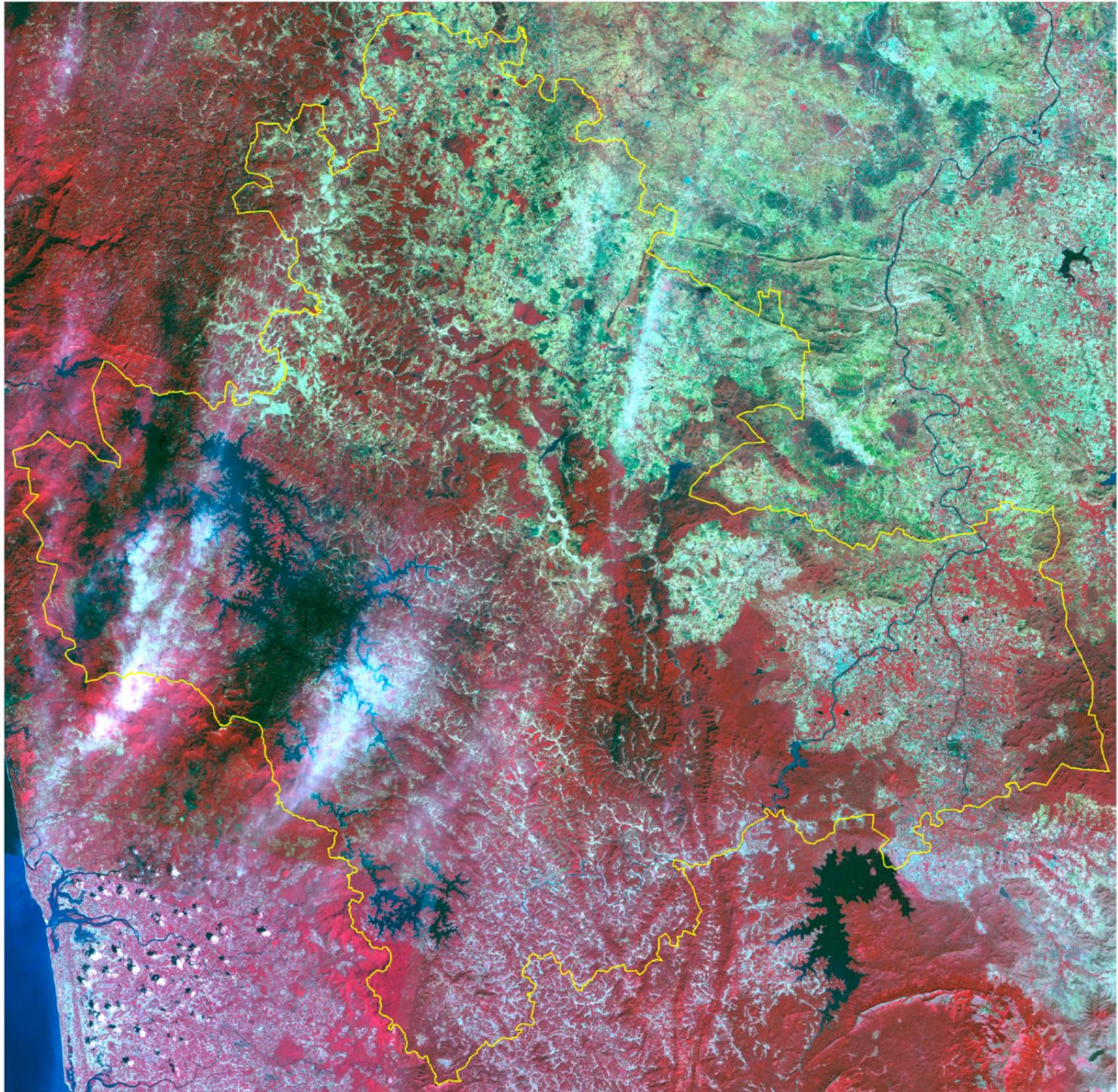


**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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

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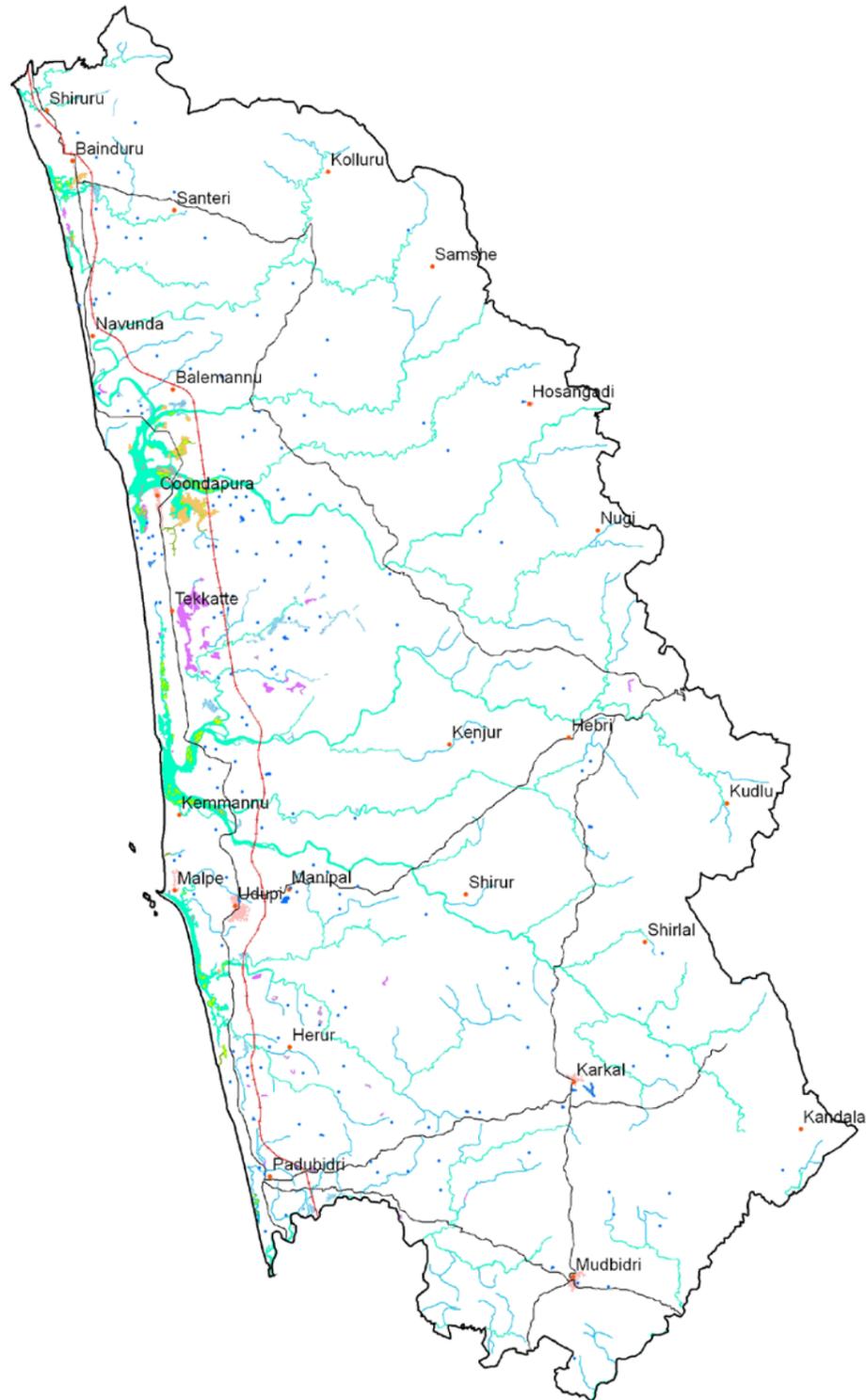
## 7.1.16 Udupi

Udupi district is situated in the western part of Karnataka state and lies between latitudes 12°58'00" to 13°58'00" N and longitudes 74°35'00" to 75°2'00" E with a geographical area of 3598 sq km. The district is drained by Swarna, Haladi, Mulki, Kollur, Sita and Chakra rivers. Popular St. Maris Island is located in this district besides beaches like Malpe, Maravanthe. Ecologically important coastal areas comprise mangroves ecosystem and Coondapur – Estuarine ecosystem.

Area estimates of various wetland categories for Udupi indicates that 409 wetlands have been delineated including 157 wetlands smaller than 2.25 ha. Area under wetland is estimated to be 12226 ha (Table 22). The major wetland types are River/Stream (8727 ha), natural waterlogged areas (702 ha), Riverine wetlands (605 ha), Sand/Beach (543) and Mangroves (501 ha). The extent under open water has shown marginal reduction from 9899 ha (post-monsoon) to 9739 ha (pre-monsoon). Moderate turbidity accounted for largest area of open water in both the seasons followed by low and high in post-monsoon, with *vice-a-verse* in Pre-monsoon season.

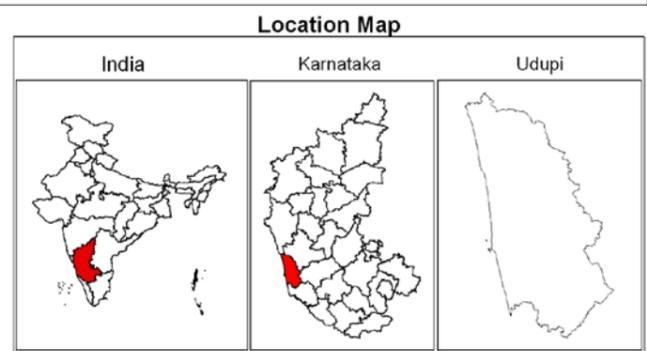
Table 22: Area estimates of wetlands in Udupi

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	4	50	0.41	33	33
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	40	605	4.95	388	198
5	1105	Waterlogged	27	702	5.74	525	468
6	1106	River/Stream	15	8727	71.38	8535	8468
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	20	121	0.99	68	41
9	1203	Waterlogged	10	86	0.70	38	33
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>116</b>	<b>10291</b>	<b>84.17</b>	<b>9587</b>	<b>9241</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	1	50	0.41	46	44
12	2102	Creeks	6	37	0.30	27	7
13	2103	Sand/Beach	12	543	4.44	-	-
14	2104	Intertidal mud flats	23	130	1.06	38	85
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	78	501	4.10	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	16	517	4.23	201	362
		<b>Total - Coastal</b>	<b>136</b>	<b>1778</b>	<b>14.54</b>	<b>312</b>	<b>498</b>
		<b>Sub-Total</b>	<b>252</b>	<b>12069</b>	<b>98.72</b>	<b>9899</b>	<b>9739</b>
		Wetlands (<2.25 ha)	157	157	1.28	-	-
		<b>Total</b>	<b>409</b>	<b>12226</b>	<b>100.00</b>	<b>9899</b>	<b>9739</b>
<b>Area under Aquatic Vegetation</b>						1426	1264
<b>Area under turbidity levels</b>							
Low						897	2605
Moderate						8444	4285
High						558	2849



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



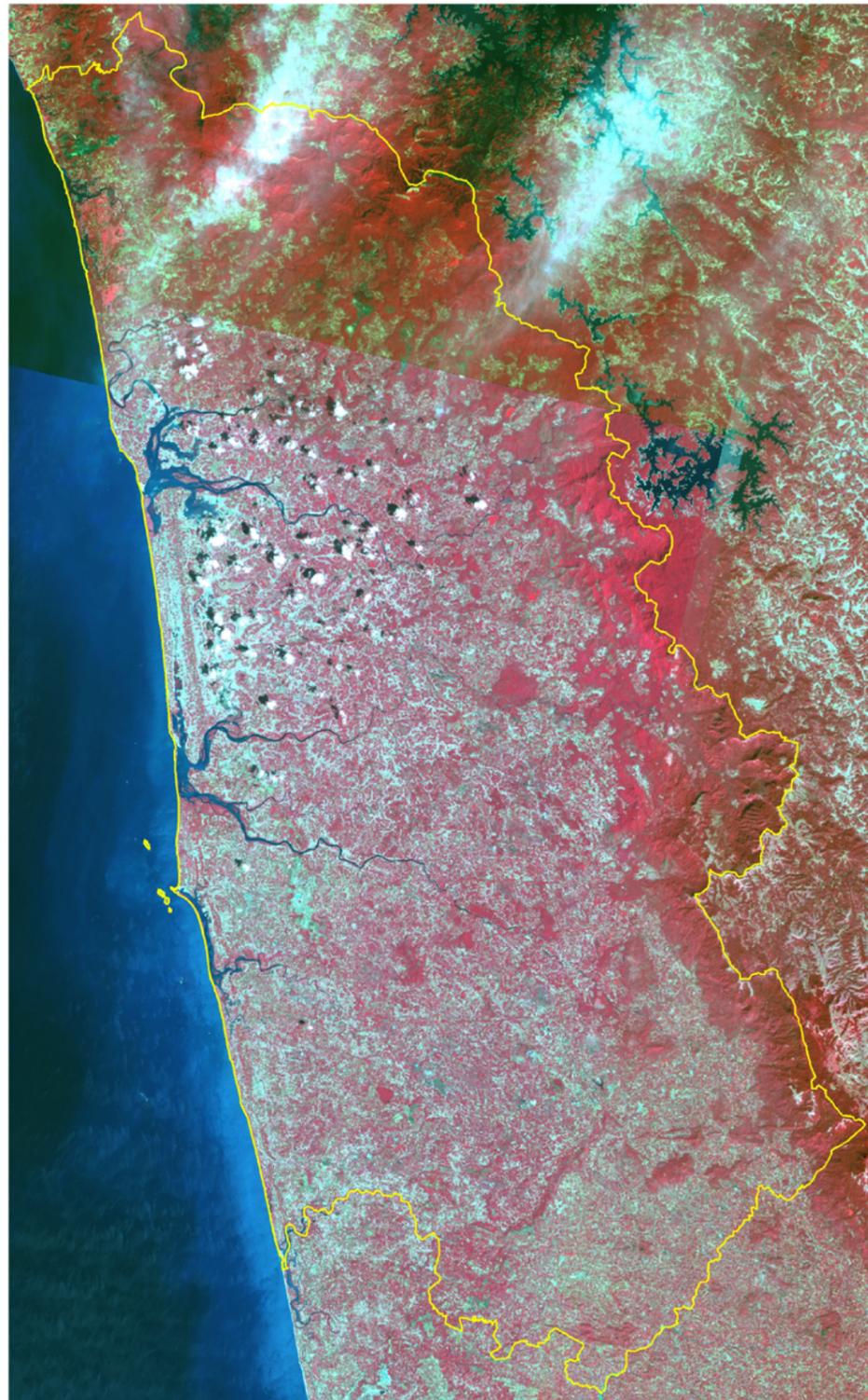
0 4.5 9 18 Kilometers

**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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### 7.1.17 Chikmagalur

Chikmagalur district located in the south-western part of Karnataka with a geographical area of 7201 sq km bound between latitudes 12°54'42" to 13°53'53" N and longitudes 75°04'46" to 76°21'15" E. Chikmagalur district is drained by Bhadra, Vedavati and Tunga rivers and has a major reservoir built across Bhadra river near Narasimharajapura, and the other one is Jammada Halla Reservoir is built at near uggalapura. Besides Kuduremukh National park, Bhadra wild life sanctuary, Hebbe falls, Manikyadhara falls, Kallatti falls, which are located in this districts.

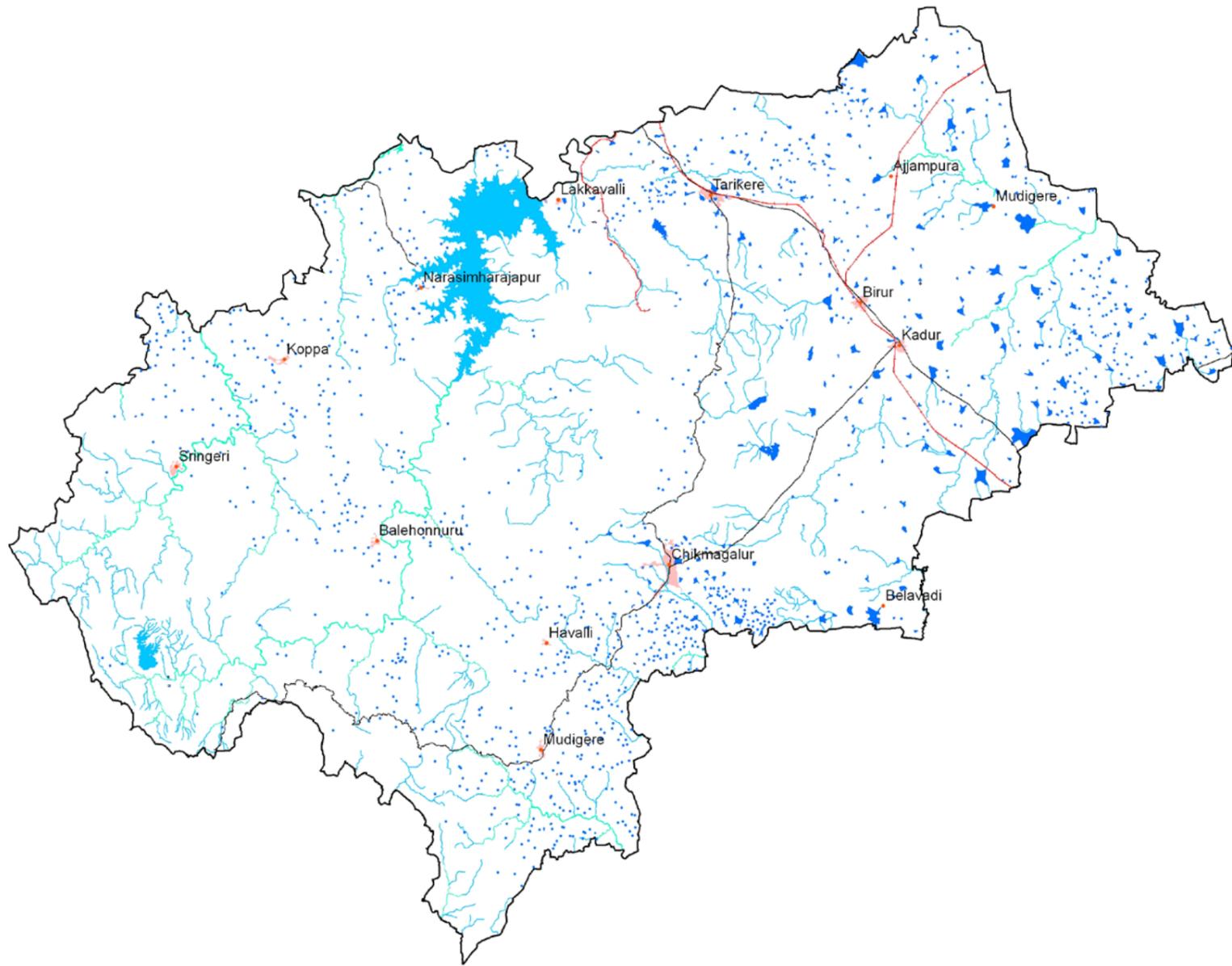
Area estimates of various wetland categories for Chikmagalur shows the presence of 1379 wetlands including 963 wetlands smaller than 2.25 ha. Total wetland area is estimated to be 23420 ha (Table 23). The major wetland types are Reservoir/Barrages (12389 ha) followed by Tanks/Ponds (6881 ha) and River/Stream (3146 ha). Aquatic vegetation has increased more than double that of post-monsoon estimate (3120 ha) to 6560 ha in pre-monsoon. Wetland area under open water has shown about 30 per cent decrease from post-monsoon (18795 ha) to Pre-monsoon (15188 ha). Turbidity of the open water remained dominantly low in both seasons followed by moderate and high.

Table 23: Area estimates of wetlands in Chikmagalur

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total Wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	5	20	0.09	16	12
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	3	10	0.04	19	10
6	1106	River/Stream	12	3146	13.43	2960	3005
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	2	12389	52.90	12284	7373
8	1202	Tanks/Ponds	393	6881	29.38	3506	1777
9	1203	Waterlogged	1	11	0.05	10	11
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>416</b>	<b>22457</b>	<b>95.89</b>	<b>18795</b>	<b>12188</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>416</b>	<b>22457</b>	<b>95.89</b>	<b>18795</b>	<b>12188</b>
		Wetlands (<2.25 ha)	963	963	4.11	-	-
		<b>Total</b>	<b>1379</b>	<b>23420</b>	<b>100.00</b>	<b>18795</b>	<b>12188</b>

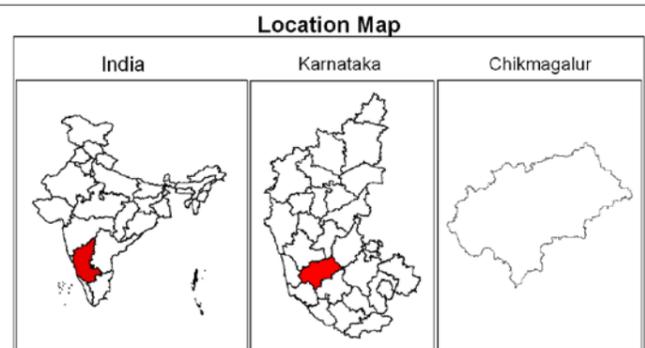
<b>Area under Aquatic Vegetation</b>	3120	6560
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<b>Area under turbidity levels</b>		
Low	12581	6973
Moderate	5384	3643
High	830	1572



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

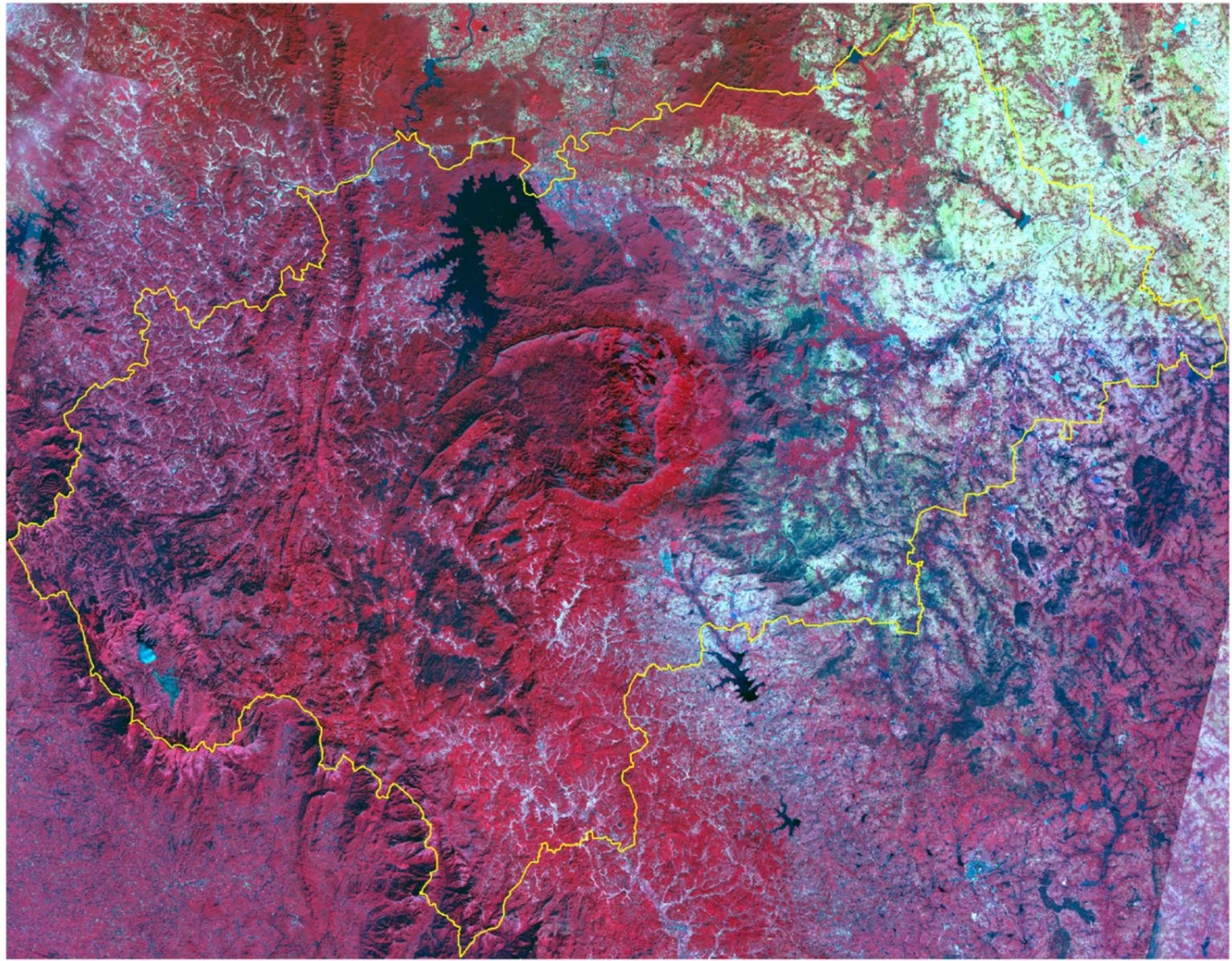


**Data Source :**  
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### 7.1.18 Tumkur

The district lies in the eastern part of Karnataka state and is located in between latitudes 12°45'00" to 14°20'00" N and longitudes 76°20'00" to 77°31'00" E. The district is having a geographical area of 10598 sq km. Shimsha, Jayamangali and Swarnamukhi and Kumudavathy rivers form the surface drainage of the district.

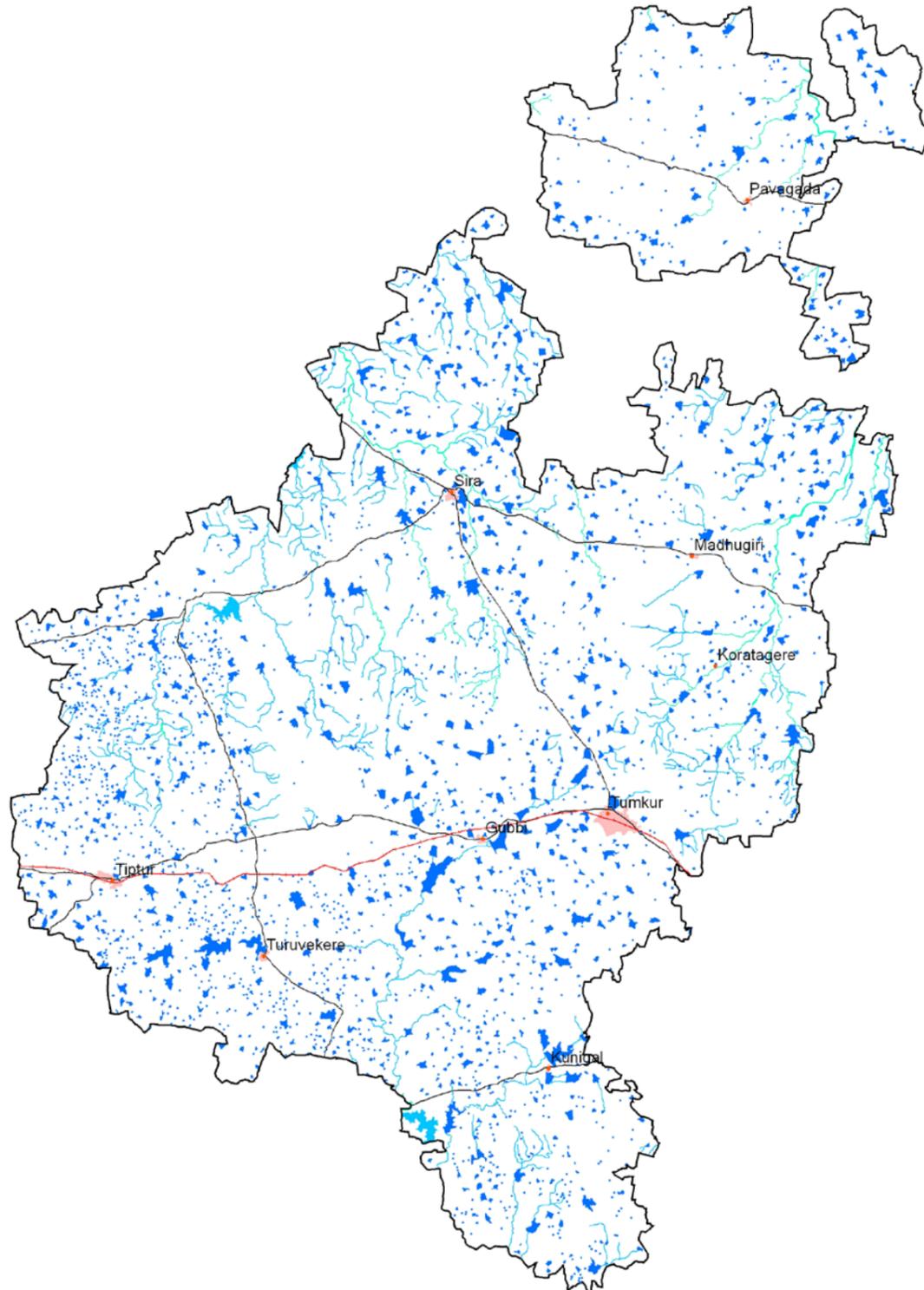
Tumkur district registered 2532 wetlands including 1149 wetlands smaller than 2.25 ha, which accounted for 50608 ha (Table 24). The major wetland types are Tanks/Ponds (45130 ha) comprising about 89 per cent of extent under wetlands followed by River/Stream (2629 ha) and Reservoir/Barrages (1700 ha). Aquatic vegetation has shown a marginal decrease from 13787 ha in post-monsoon to 11267 ha in Pre-monsoon season. Wetland area under open water was not significant compared to the total area under wetlands. It was observed to about 34 per cent in post-monsoon and further got reduced to 24 per cent in pre-monsoon. Moderate turbidity dominated the open water followed by high and low turbidity in both the seasons.

Table 24: Area estimates of wetlands in Tumkur

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	33	2629	5.19	1854	533
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	3	1700	3.36	1207	1059
8	1202	Tanks/Ponds	1347	45130	89.18	13812	10432
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>1383</b>	<b>49459</b>	<b>97.73</b>	<b>16873</b>	<b>12024</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>1383</b>	<b>49459</b>	<b>97.73</b>	<b>16873</b>	<b>12024</b>
		Wetlands (<2.25 ha)	1149	1149	2.27	-	-
		<b>Total</b>	<b>2532</b>	<b>50608</b>	<b>100.00</b>	<b>16873</b>	<b>12024</b>

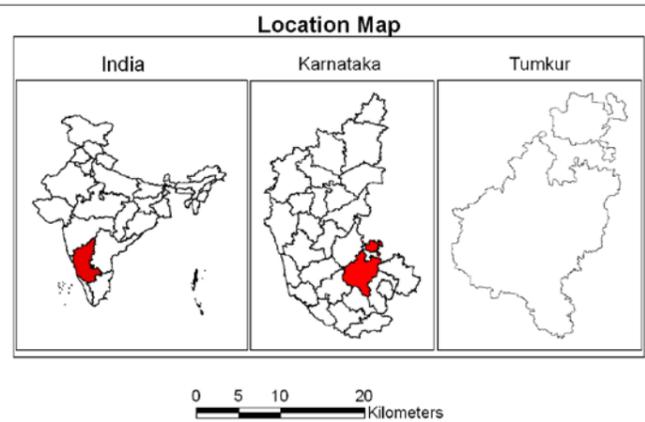
<b>Area under Aquatic Vegetation</b>	13787	11267
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<b>Area under turbidity levels</b>		
Low	80	1102
Moderate	12475	8838
High	4318	2084



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

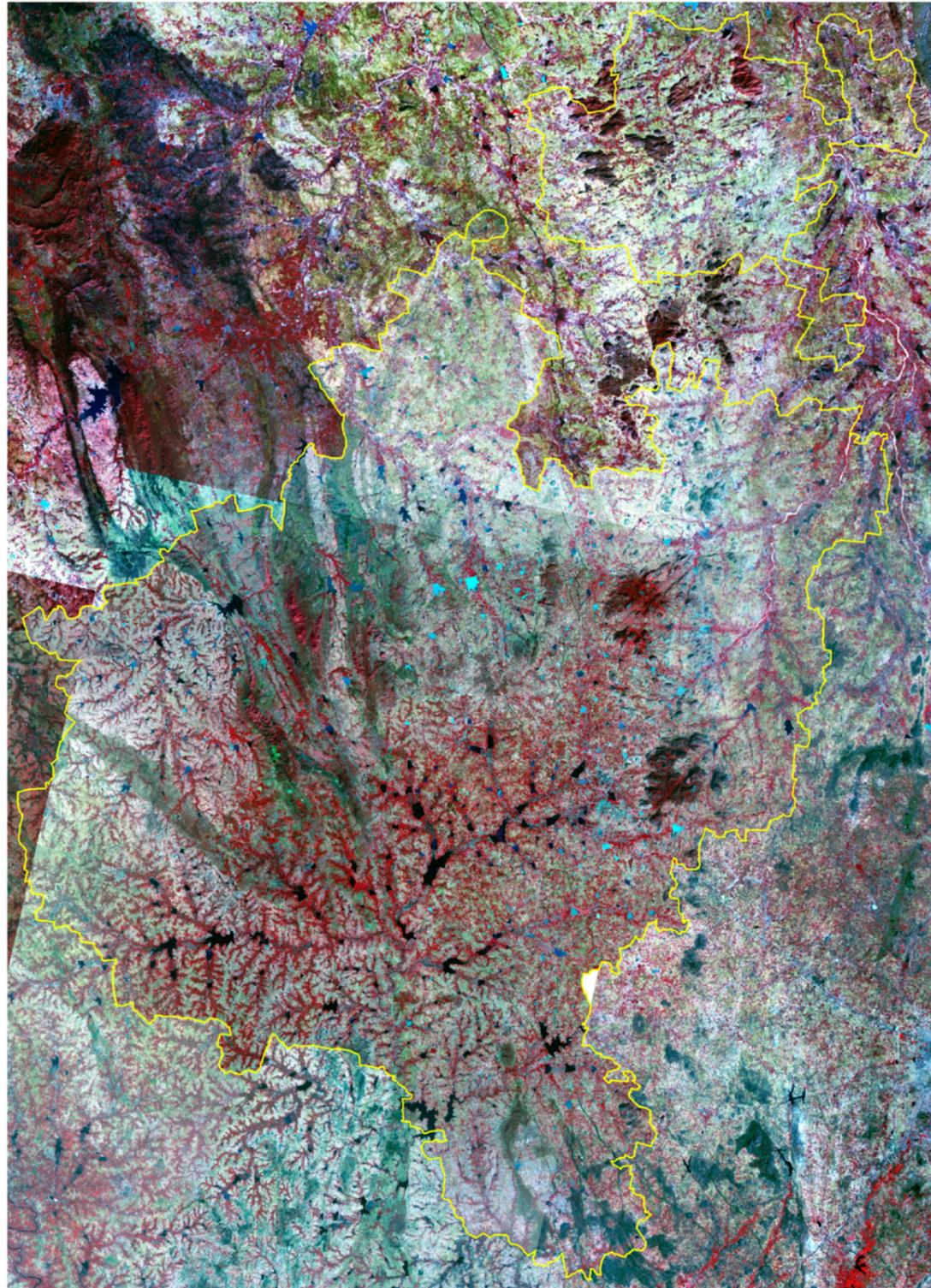


**Data Source :**  
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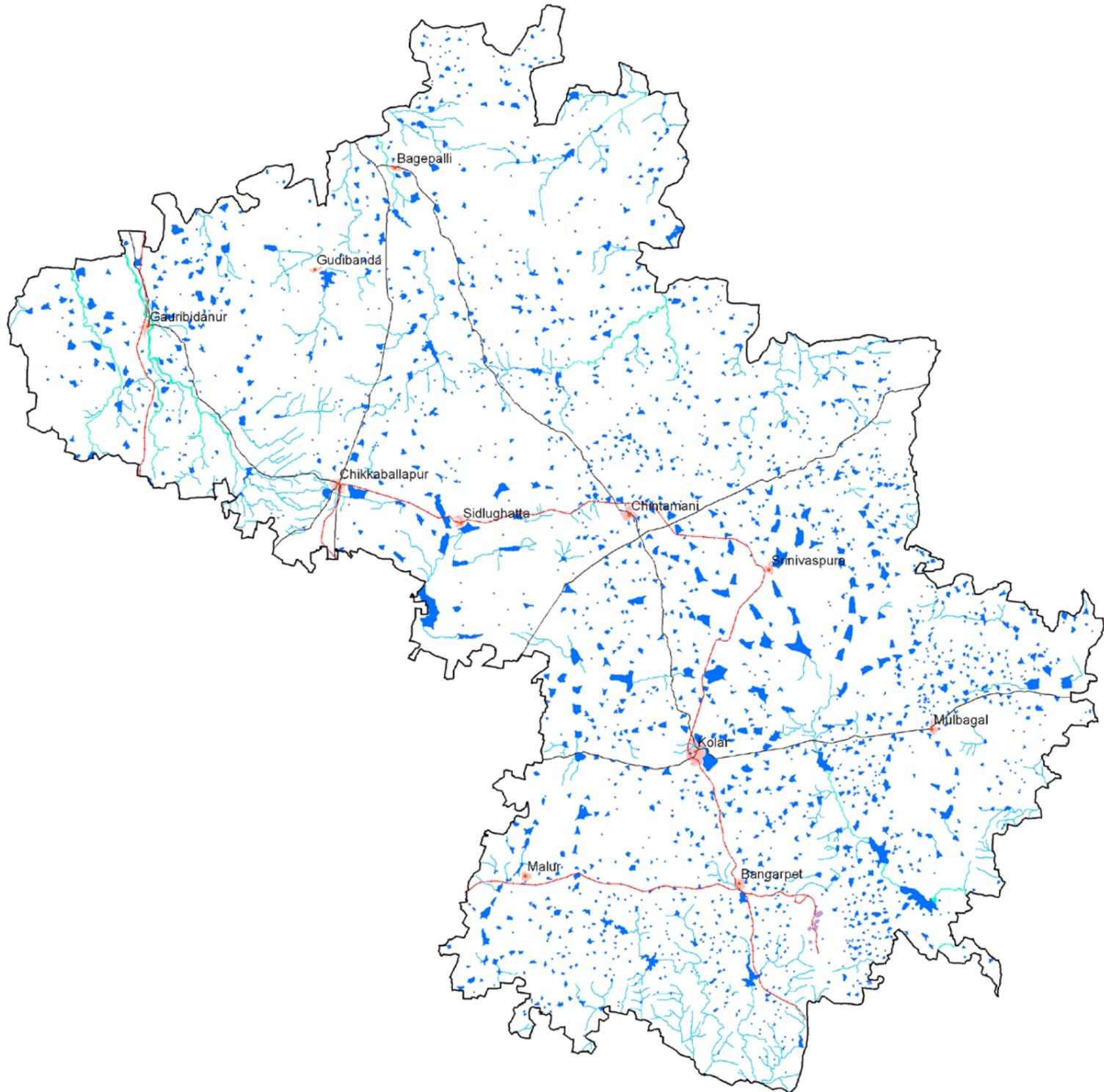
## 7.1.19 Kolar

Kolar district is situated in the eastern part of Karnataka state bound between latitudes 12°46'00" to 13°58'00" N and longitudes 72°21'00" to 78°35'00" E with a geographical area of 8223 sq km. Palar, Papagni, South Pennar and North Pennar rivers that form the surface drainage of the district.

Kolar district comprised 36538 ha under various types of wetlands distributed among 2135 wetlands including 597 that are smaller than 2.25 ha (Table 25). The major wetland types are Tanks/Ponds (34221 ha) followed by River/Stream (1567 ha). The extent of open water of wetlands is small in terms of per centage. It accounted for only 16 per cent in post-monsoon and further got reduced to 9 per cent in pre-monsoon. It is reflected in the analysis of wetland status in terms of aquatic vegetation that accounted for around 6498 ha and 8032 ha of wetland area during post-monsoon and Pre-monsoon respectively. Moderate turbidity dominated the open water in terms of extent followed by high and low turbidity in both the seasons. One significant observation made out is the wetland boundaries delineated based on the foot prints of wetlands leading to the total extent of wetlands is about 6 per cent (Table 5) of the total area of wetlands in the state, but together, open water and aquatic vegetation and indicates a very low extent i.e. 34 and 32 in post-monsoon and Pre-monsoon respectively. This may be due to sub-normal rainfall in the area during the acquisition of the satellite data used in the study.

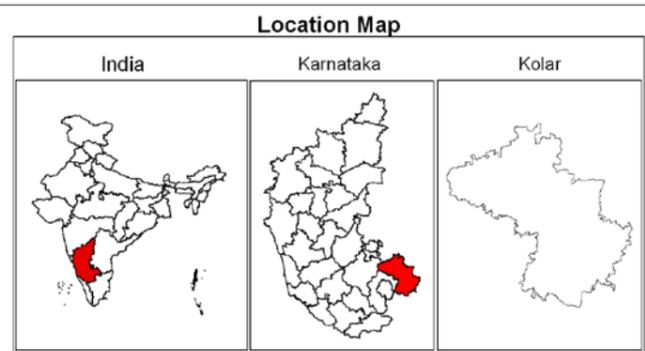
Table 25: Area estimates of wetlands in Kolar

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water Post-monsoon Area	Open Water Pre-monsoon Area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
3	1104	Reverine wetlands	-	-	-	-	-
4	1105	Waterlogged	-	-	-	-	-
5	1106	River/Stream	10	1567	4.29	982	81
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
6	1201	Reservoirs/Barrages	-	-	-	-	-
7	1202	Tanks/Ponds	1525	34221	93.66	4841	3239
8	1203	Waterlogged	3	153	0.42	-	-
9	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>1538</b>	<b>35941</b>	<b>98.37</b>	<b>5823</b>	<b>3320</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
10	2101	Lagoons	-	-	-	-	-
11	2102	Creeks	-	-	-	-	-
12	2103	Sand/Beach	-	-	-	-	-
13	2104	Intertidal mud flats	-	-	-	-	-
14	2105	Salt Marshes	-	-	-	-	-
15	2106	Mangroves	-	-	-	-	-
16	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
17	2201	Salt pans	-	-	-	-	-
18	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>1538</b>	<b>35941</b>	<b>98.37</b>	<b>5823</b>	<b>3320</b>
		Wetlands (<2.25 ha)	597	597	1.63	-	-
		<b>Total</b>	<b>2135</b>	<b>36538</b>	<b>100.00</b>	<b>5823</b>	<b>3320</b>
<b>Area under Aquatic Vegetation</b>						6498	8032
<b>Area under turbidity levels</b>							
Low						200	274
Moderate						4611	2394
High						1012	652



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

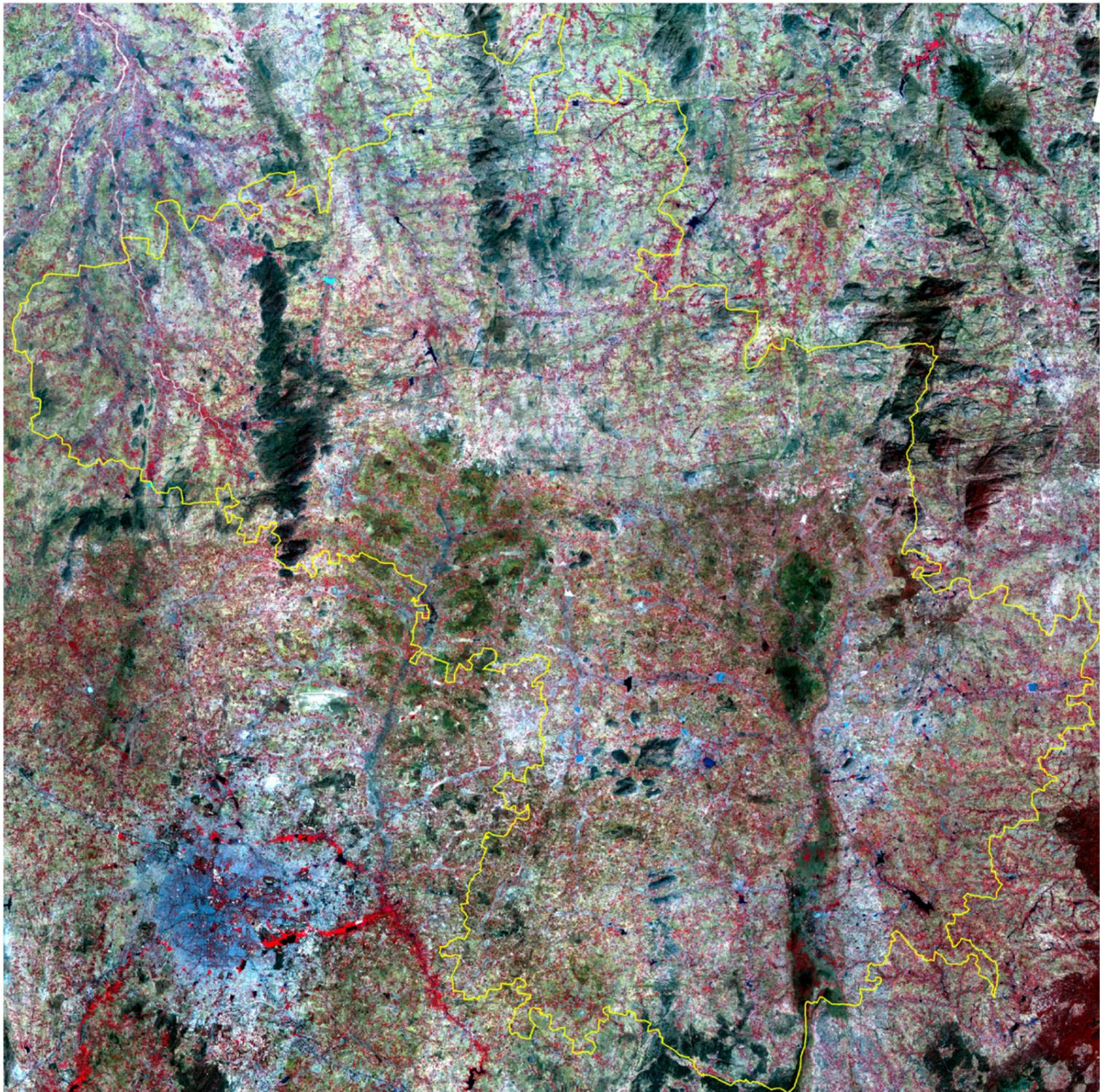


**Data Source :**  
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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

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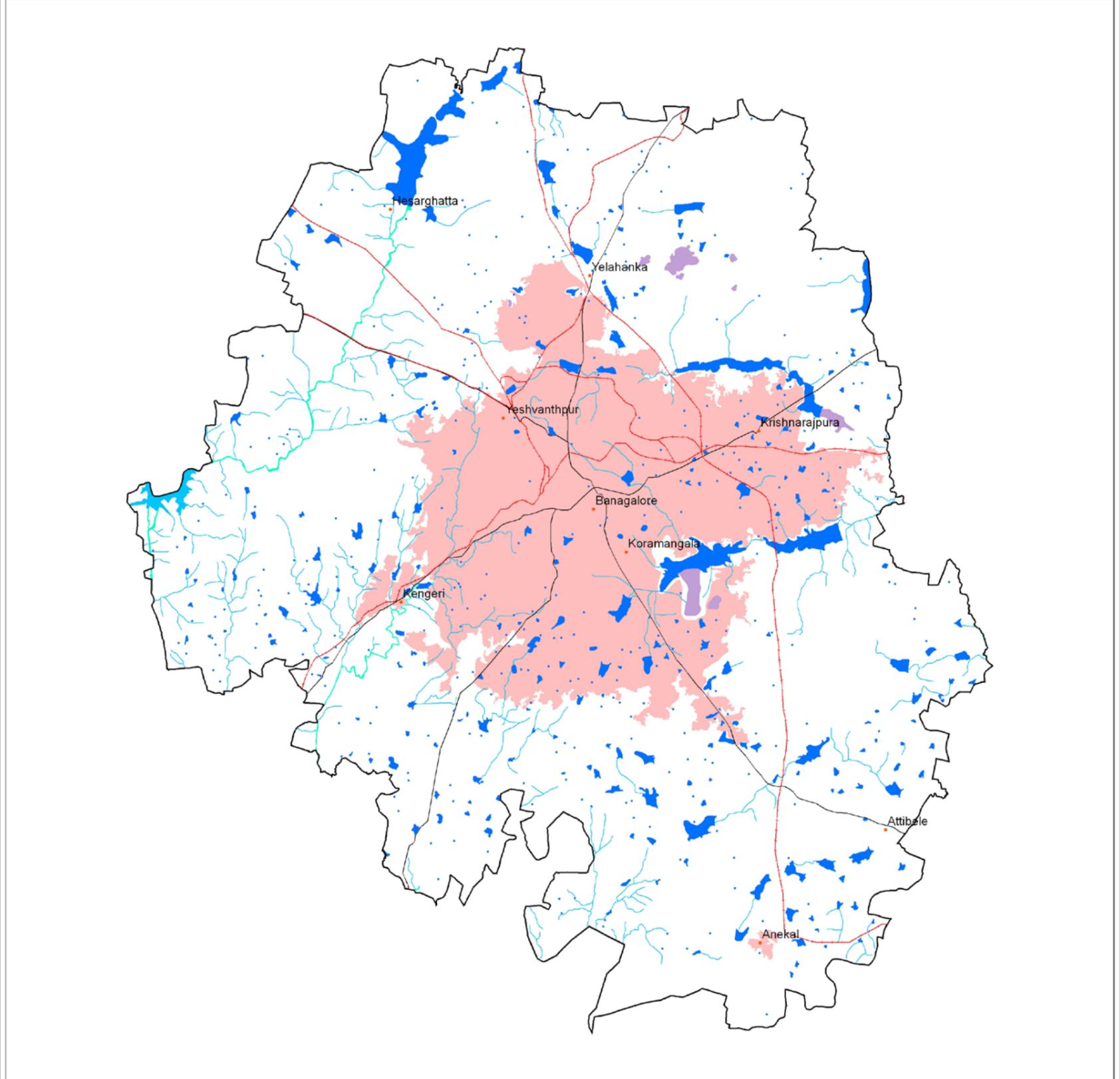
### 7.1.20 Bangalore - Urban

Bangalore district situated in the south-eastern part of Karnataka State has an aerial extent of 2190 sq km bound between the latitudes 12°39'00" to 13°13'00" N and longitudes 77°22'00" to 77°52'00" E. The major rivers are Arkavathi and Vrishabhavathy. It has a major reservoir at Tippagondanahalli (TGR). Major Tanks like Kodigehalli kere, Hebbal Kere, Nagavara kere, Hennur kere, Matti kere, Sankey Tank, Hesaraghatta tank and Ulsoor lake; and popular Bannerghatta National Park are located in this district.

This district comprises of 580 wetlands that includes 325 wetlands smaller than 2.25 ha (Table 26). Total wetland area is estimated to be 8620 ha. The major wetland types are Tanks/Ponds (6825 ha) followed by natural waterlogged areas (766 ha), River/Stream (367 ha) and Reservoir/Barrages (337 ha). Analysis of wetland status in terms of open water indicates that the extent accounts for about 30 and 20 in terms of per cent of the wetland area. Aquatic vegetation comprised 2510 ha in post-monsoon while the extent is 1674 ha in pre-monsoon. Turbidity of the open water moderate followed by high without low turbidity in post monsoon. However, in Pre-monsoon the domination of moderate turbidity remained dominant followed by high and low.

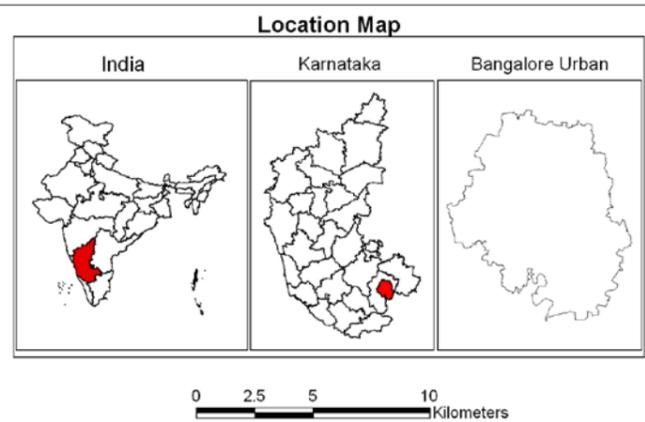
Table 26: Area estimates of wetlands in Bangalore

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Area in ha	
						Open Water Post-monsoon area	Open Water Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	6	367	4.26	342	127
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	1	337	3.91	115	138
8	1202	Tanks/Ponds	239	6825	79.18	2061	1982
9	1203	Waterlogged	9	766	8.89	-	7
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>255</b>	<b>8295</b>	<b>96.23</b>	<b>2518</b>	<b>2254</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>255</b>	<b>8295</b>	<b>96.23</b>	<b>2518</b>	<b>2254</b>
		Wetlands (<2.25 ha)	325	325	3.77	-	-
		<b>Total</b>	<b>580</b>	<b>8620</b>	<b>100.00</b>	<b>2518</b>	<b>2254</b>
<b>Area under Aquatic Vegetation</b>						2510	1674
<b>Area under turbidity levels</b>							
Low						-	101
Moderate						2048	1749
High						470	404



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

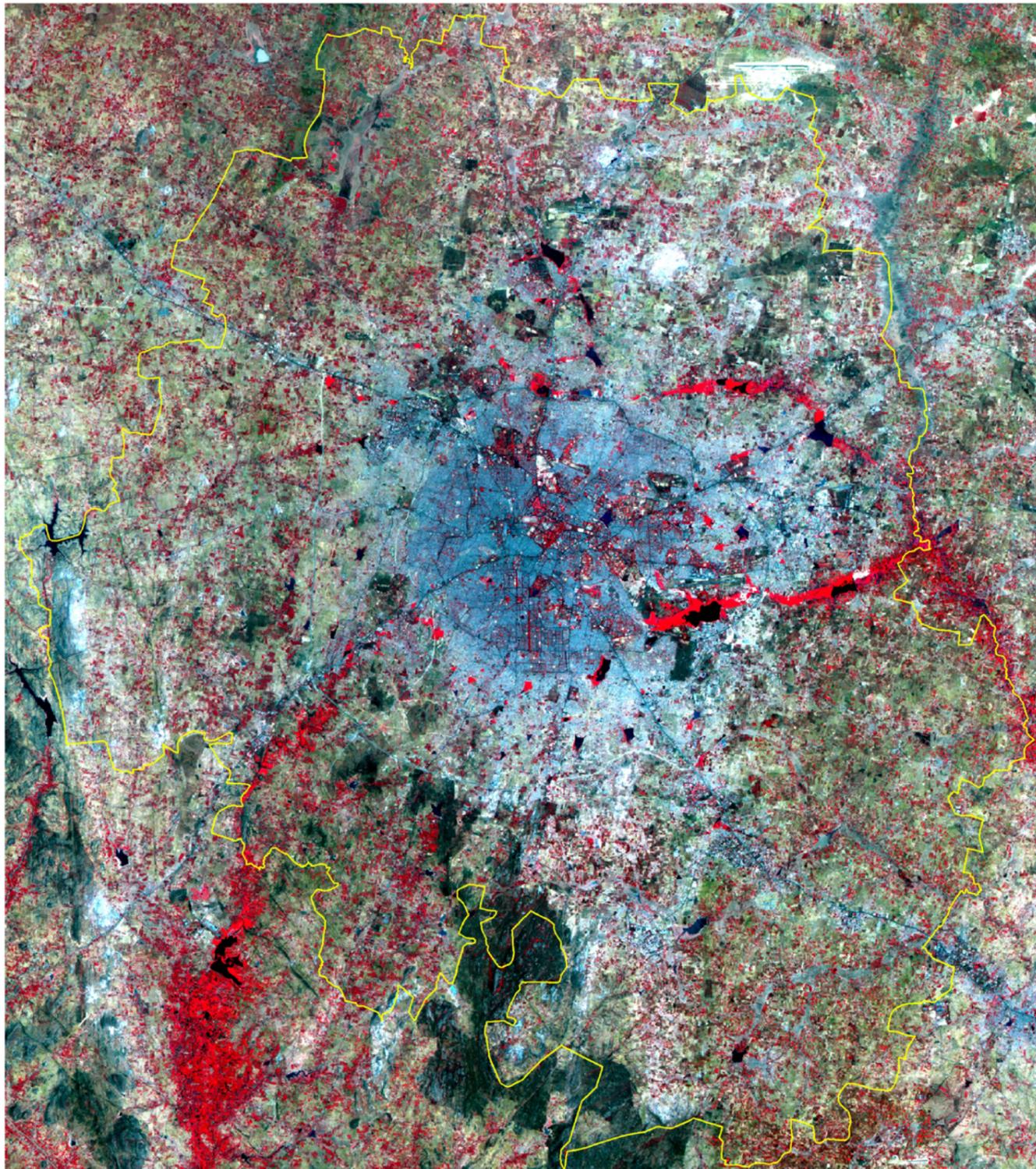


**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

**Prepared By :**  
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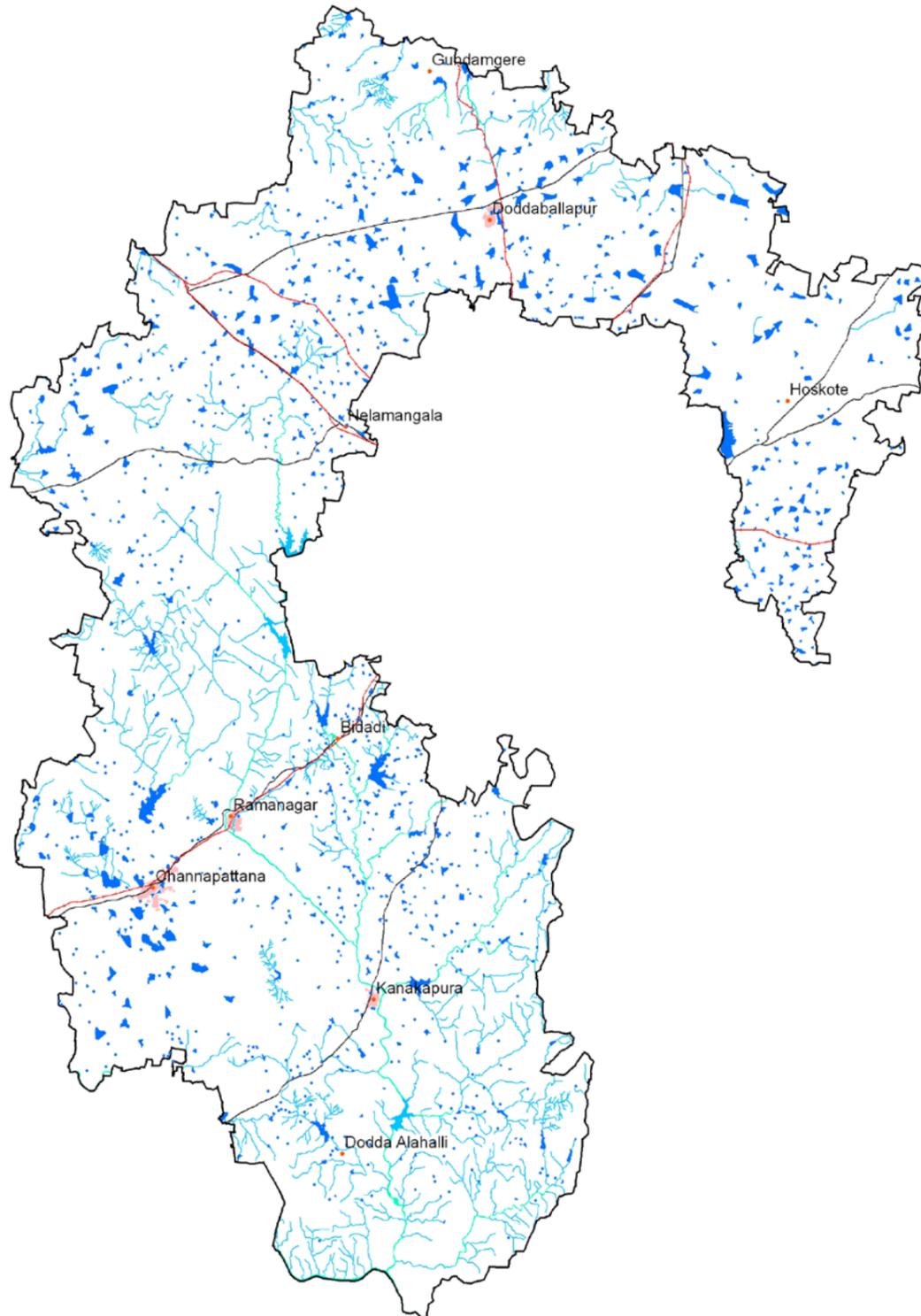
### 7.1.21 Bangalore Rural

Bangalore Rural district is situated in the south-eastern part of Karnataka. The district lies between the latitudes 12°14'00" to 13°30'00" N and longitudes 77°05'00" to 78°00'00" E with a total geographical area of 5,815 sq km. The district is drained by Dakshina Pinakini, Arkavathi, Vrushabhavati, Cauvery, Kumudavati, Shimsha and Kanva rivers and also comprises reservoirs viz. Kanva and part of Chamrajnagar.

Area estimates of various wetland categories for Bangalore Rural show that the district has 1163 wetlands including 375 wetlands smaller than 2.25 ha. Total wetland area is estimated to be 19132 ha (Table 27). The major wetland types are Tanks/Ponds (15757 ha) followed by River/Stream (2116 ha) and Reservoir/Barrages (884 ha). Extent of open water component accounts for 22 and 21 per cent in post-monsoon (4205 ha) and 3867 ha in pre-monsoon. Analysis of wetland status in terms of aquatic vegetation showed that 2603 ha and 3919 ha of wetland area is infested with aquatic vegetation during post-monsoon and pre-monsoon respectively. Open water prevalently moderate in turbidity followed by high and low in both the seasons.

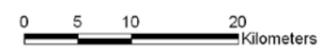
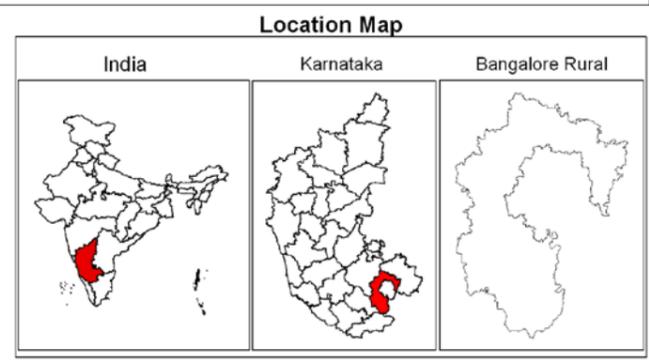
Table 27: Area estimates of wetlands in Bangalore Rural

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-Monsoon Area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	18	2116	11.06	2017	1284
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	4	884	4.62	305	498
8	1202	Tanks/Ponds	766	15757	82.36	1883	2085
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>788</b>	<b>18757</b>	<b>98.04</b>	<b>4205</b>	<b>3867</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>788</b>	<b>18757</b>	<b>98.04</b>	<b>4205</b>	<b>3867</b>
		Wetlands (<2.25 ha), mainly Tanks	375	375	1.96	-	-
		<b>Total</b>	<b>1163</b>	<b>19132</b>	<b>100.00</b>	<b>4205</b>	<b>3867</b>
<b>Area under Aquatic Vegetation</b>						2603	3919
<b>Area under turbidity levels</b>							
Low						57	124
Moderate						2679	3080
High						1469	663



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

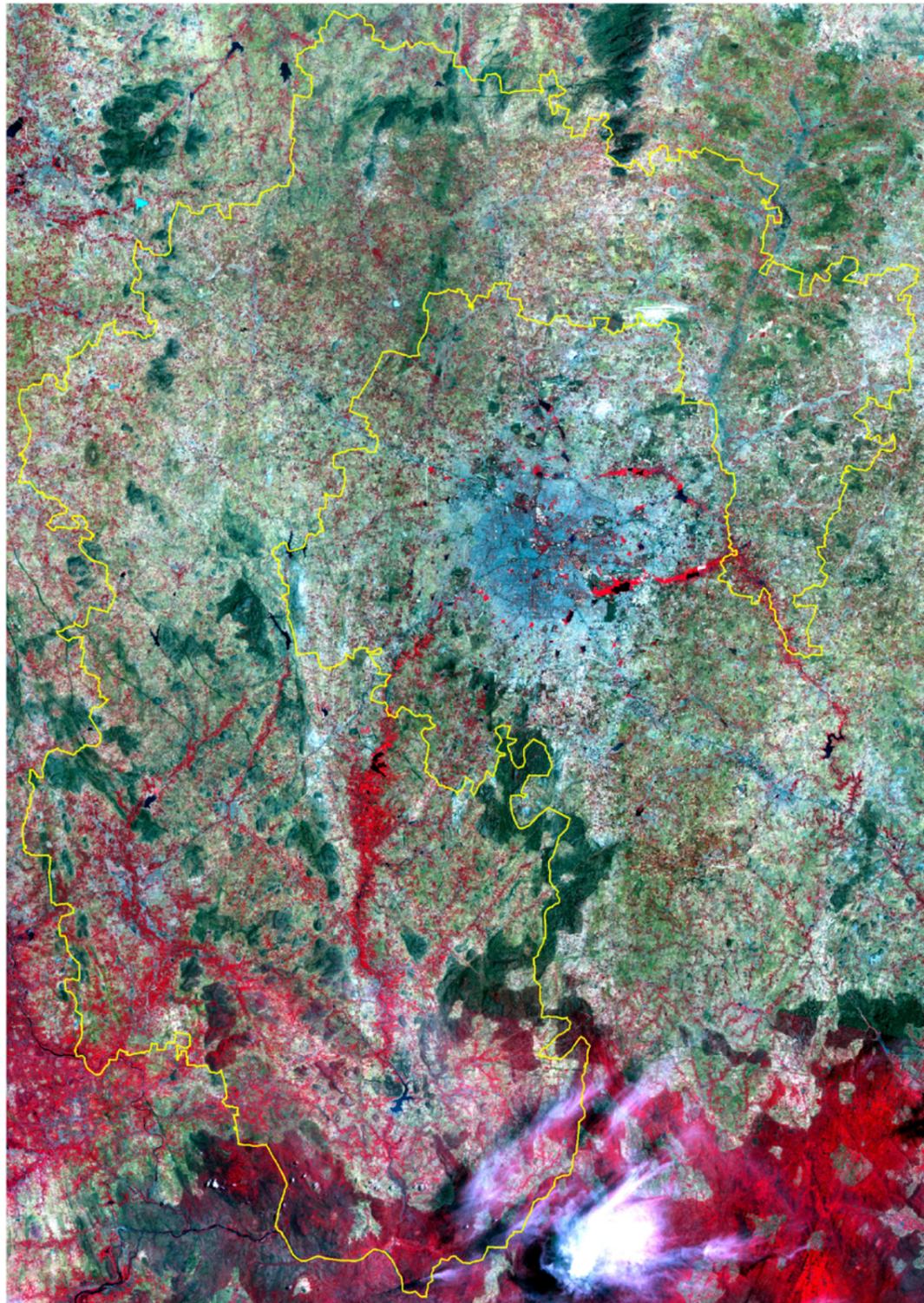


**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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## 7.1.22 Mandya

Mandya district is situated in the southern part of Karnataka State and lies between latitudes 12°13'00" to 13°04'00" N and longitudes 76°19'00" to 77°20'00" E. The district has a geographical area of 4961 sq km. The district is drained by Shimsa, Cauvery, Hemavathy and Lokapavani rivers. Krishna raja Sagar dam is built across the river Cauvery. Two popular bird sanctuaries namely; Kokkare Belluru and Ranganathitoo and Maddur Lake is located in this district. Wetland based tourist places like Shimsha falls, Shivana samudra and Krisnaraja sagar Brindavana Garden are also located in this district.

Mandya has the presence of 1207 wetlands that include 682 wetlands smaller than 2.25 ha. Total wetland area is estimated to be 23418 ha (Table 28). The major wetland types are Tanks/Ponds (12518 ha) followed by River/Stream (5262 ha) and Reservoir/Barrages (4797 ha). Open water extent accounted for 14009 ha in post-monsoon, which has a decrease to 9561 ha in pre-monsoon. Analysis of wetland status in terms of aquatic vegetation shown the extent to be 6075 ha in post-monsoon, which has shown an increase to 8390 ha in pre-monsoon. Turbidity analysis of the open water shown that in post-monsoon the moderate turbidity accounted most in terms of aerial extent (9446 ha) followed by high (2490 ha) and low (2073 ha). In case of pre-monsoon the moderate level dominated the turbidity of open water with an extent of 7937 ha followed by low (1347 ha) and high (277 ha).

Table 28: Area estimates of wetlands in Mandya

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Area in ha	
						Open Water Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	11	5262	22.47	3929	4146
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	5	4797	20.48	3524	1432
8	1202	Tanks/Ponds	508	12518	53.45	6556	3885
9	1203	Waterlogged	1	159	0.68	-	98
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>525</b>	<b>22736</b>	<b>97.09</b>	<b>14009</b>	<b>9561</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>525</b>	<b>22736</b>	<b>97.09</b>	<b>14009</b>	<b>9561</b>
		Wetlands (<2.25 ha), mainly Tanks	682	682	2.91	-	-
		<b>Total</b>	<b>1207</b>	<b>23418</b>	<b>100.00</b>	<b>14009</b>	<b>9561</b>

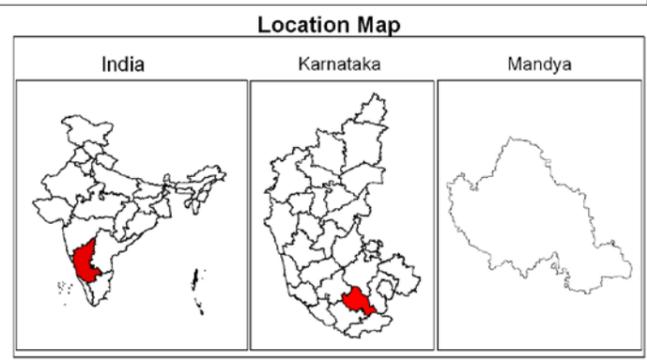
<b>Area under Aquatic Vegetation</b>	6075	8390
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<b>Area under turbidity levels</b>		
Low	2073	1347
Moderate	9446	7937
High	2490	277



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



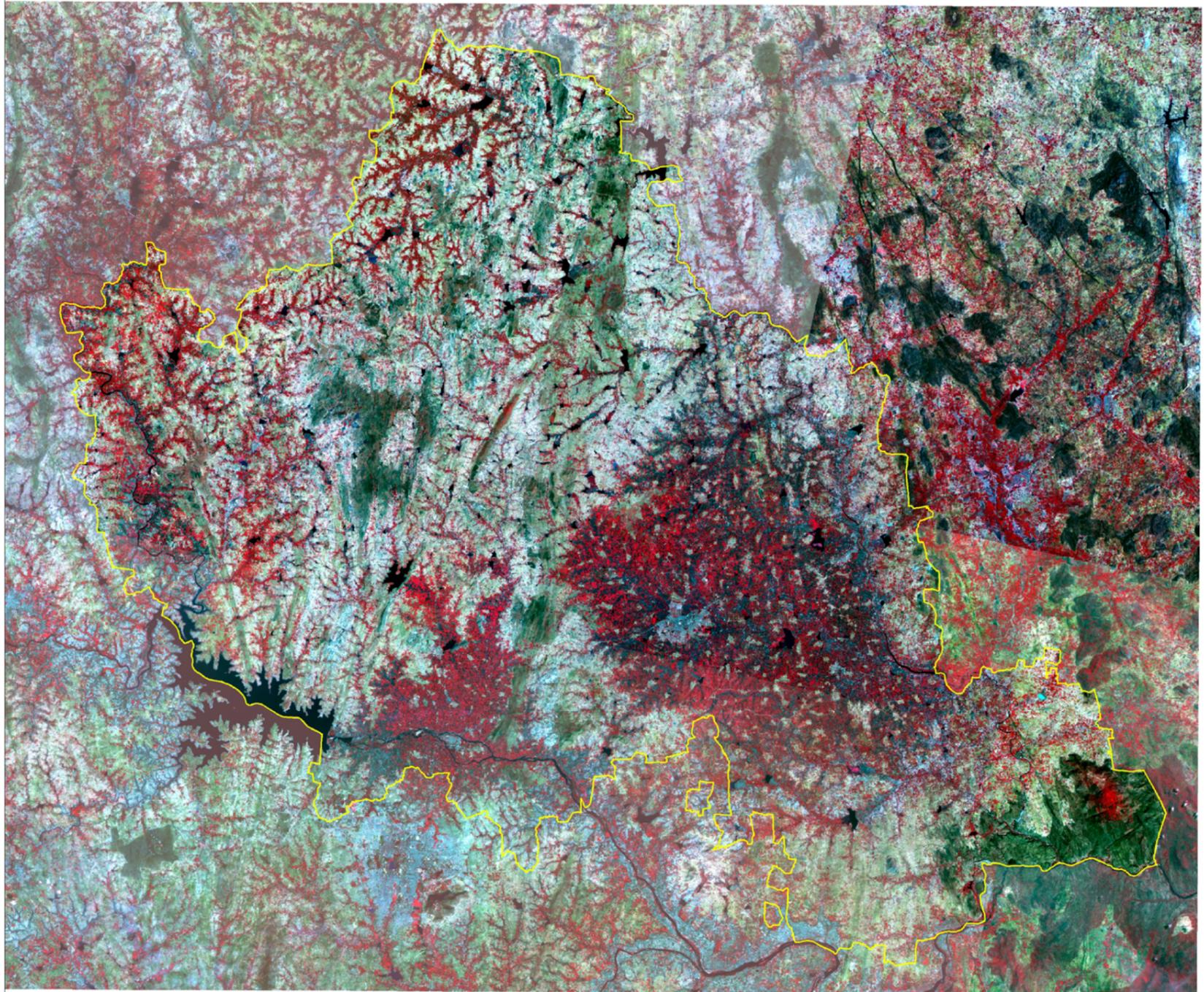
0 4.5 9 18 Kilometers

**Data Source :**  
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Dept. of IT, BT & S&T, GOK, Bangalore, Karnataka

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### 7.1.23 Hassan

Hassan district situated in the south-western part of the state with a total geographical area of 6,814 sq km bound between the latitudes 12°30'39" to 13°13'36" N and longitudes 75°32'49" to 72°38'00" E. Hemavathi, Yagachi, Cauvery and Vatehole rivers that drain the district and Harangi, Yagachi and Vatehole are the major reservoirs of the district.

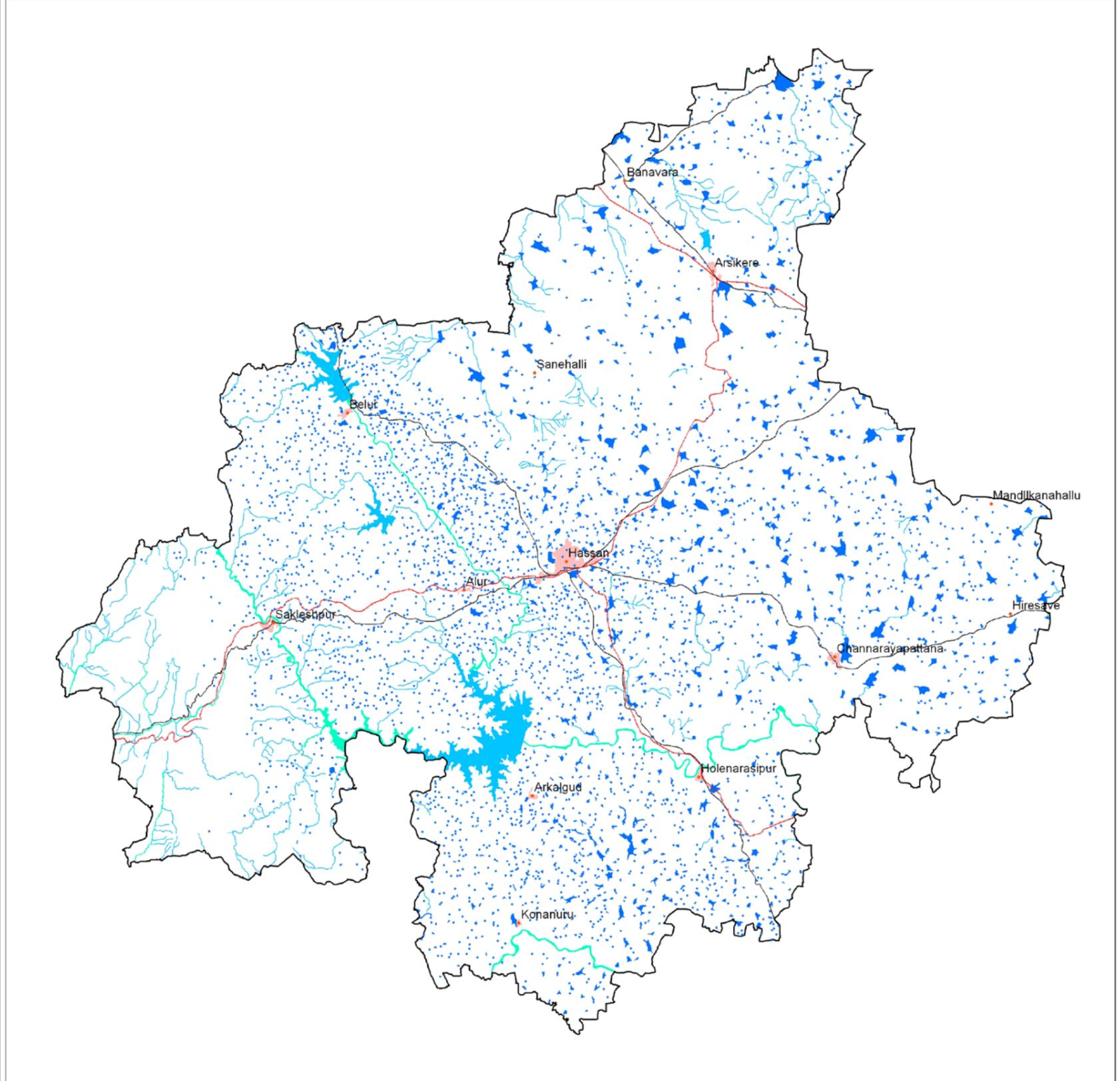
The Hassan district recorded 3718 wetlands including 2351 wetlands smaller than 2.25 ha. Total wetland area is estimated to be 32564 ha (Table 29). The major wetland types are Tanks/Ponds (18071 ha) followed by Reservoir/Barrages (7945 ha) and River/Stream (4197 ha). Analysis of wetland status in terms of open water indicates that there is a decrease of about 25 per cent in the extent from post-monsoon (18590 ha) to pre-monsoon (11143 ha). In case of aquatic vegetation an increase of about 15 per cent is observed from post-monsoon (7253 ha) to 11661 ha in pre-monsoon. Open water remained significantly moderate in turbidity with 10686 ha in post-monsoon and 9739 ha in pre-monsoon. Extent under low turbidity was considerably high in post-monsoon (5265 ha) compared to pre-monsoon, which is observed to be 556 ha. Similarly the extents under highly turbid zones of open water were also much higher in post-monsoon (2639 ha) compared to pre-monsoon (848 ha).

Table 29: Area estimates of wetlands in Hassan

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-Monsoon Area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1104	Riverine wetlands	-	-	-	-	-
3	1105	Waterlogged	-	-	-	-	-
4	1106	River/Stream	9	4197	12.89	3431	2973
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
5	1201	Reservoirs/Barrages	4	7945	24.40	6385	4647
6	1202	Tanks/Ponds	1354	18071	55.49	8774	3523
7	1203	Waterlogged	-	-	-	-	-
8	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>1367</b>	<b>30213</b>	<b>92.78</b>	<b>18590</b>	<b>11143</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
9	2101	Lagoons	-	-	-	-	-
10	2102	Creeks	-	-	-	-	-
11	2103	Sand/Beach	-	-	-	-	-
12	2104	Intertidal mud flats	-	-	-	-	-
13	2105	Salt Marshes	-	-	-	-	-
14	2106	Mangroves	-	-	-	-	-
15	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
16	2201	Salt pans	-	-	-	-	-
17	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>1367</b>	<b>30213</b>	<b>92.78</b>	<b>18590</b>	<b>11143</b>
		Wetlands (<2.25 ha), mainly Tanks	2351	2351	7.22	-	-
		<b>Total</b>	<b>3718</b>	<b>32564</b>	<b>100.00</b>	<b>18590</b>	<b>11143</b>

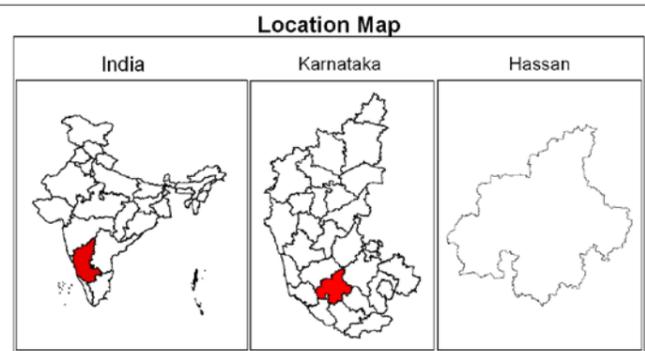
<b>Area under Aquatic Vegetation</b>	7253	11661
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<b>Area under turbidity levels</b>		
Low	5265	556
Moderate	10686	9739
High	2639	848



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

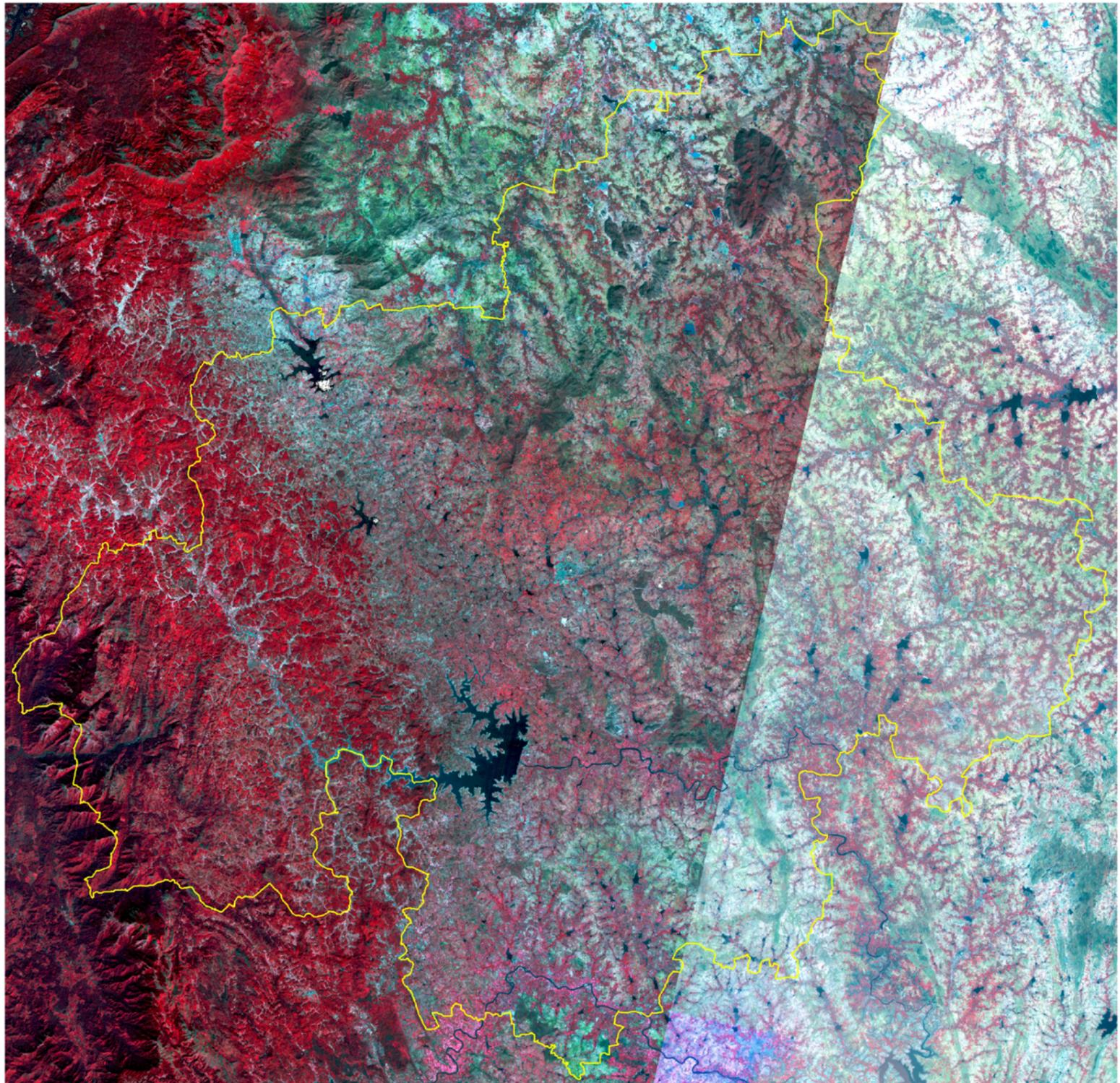


**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

**Prepared By :**  
 Space Applications Centre (ISRO), Ahmedabad  
 and  
 Karnataka State Remote Sensing Applications Centre (KRSRAC)  
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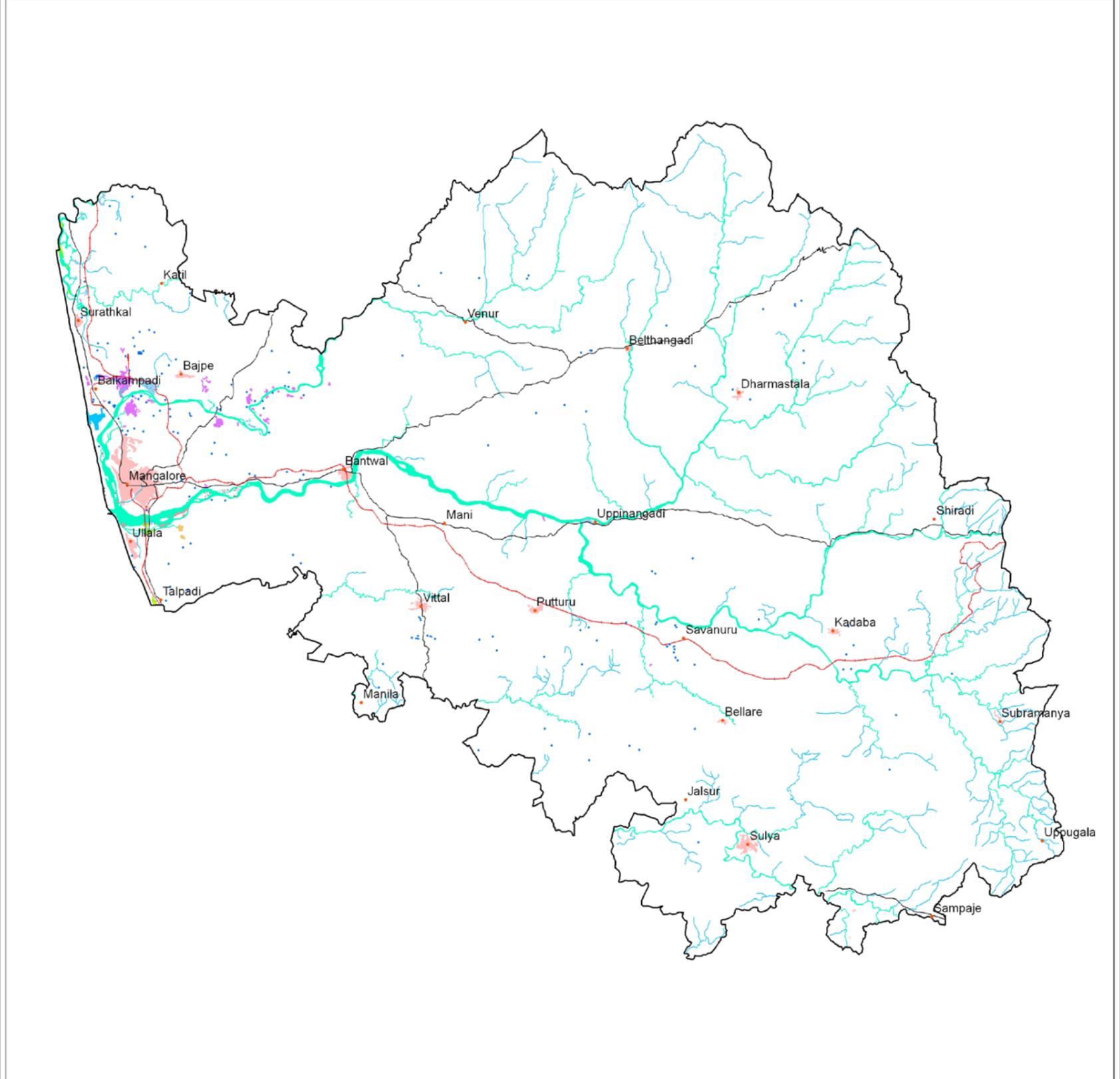
### 7.1.24 Dakshina Kannada

Dakshina Kannada district situated in the south-western part of Karnataka state lies between latitudes 12°52'00" to 13°15'00" N and longitudes 74°00'00" to 75°15'00" E. The total geographical area of the district is 4843 sq km. Netravati, Swarna, Gulpura, Kumaradhara, Pavange and Payaswini are the major rivers in the district and are west flowing rivers draining into Arabian Sea. Area estimates of various wetland categories for

Dakshina Kannada show the presence of 261 wetlands including 149 wetlands smaller than 2.25 ha. The wetland area is estimated to be 10911 ha (Table 30). The major wetland types are River/Stream (9073 ha) constituting about 83 per cent of wetland area followed by natural waterlogged (611 ha), Sand/Beach (365 ha) and Reservoir/Barrages (159 ha). Analysis of wetland status in terms of open water shows that there is a decrease of about 11 per cent from post-monsoon to pre-monsoon season. Aquatic vegetation accounted for 7 and 3 per cent of wetland area. It has shown a decrease from 803 ha and 431 ha during post-monsoon and pre-monsoon respectively. Qualitative turbidity analysis of the open water showed that moderate turbidity dominated both the seasons. High turbidity did not prevail in post-monsoon.

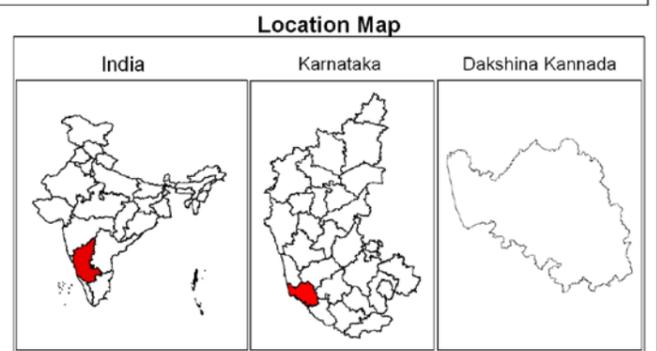
Table 30: Area estimates of wetlands in Dakshina Kannada

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	2	20	0.18	12	4
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	12	305	2.80	95	53
5	1105	Waterlogged	37	611	5.60	234	121
6	1106	River/Stream	13	9073	83.15	8973	7926
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	2	159	1.46	156	159
8	1202	Tanks/Ponds	11	50	0.46	48	33
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>77</b>	<b>10218</b>	<b>93.65</b>	<b>9518</b>	<b>8296</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	14	365	3.35	-	-
14	2104	Intertidal mud flats	9	62	0.57	29	35
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	10	82	0.75	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	2	35	0.32	11	13
		<b>Total - Coastal</b>	<b>35</b>	<b>544</b>	<b>4.99</b>	<b>40</b>	<b>48</b>
		<b>Sub-Total</b>	<b>112</b>	<b>10762</b>	<b>98.63</b>	<b>9558</b>	<b>8344</b>
		Wetlands (<2.25 ha), mainly Tanks	149	149	1.37	-	-
		<b>Total</b>	<b>261</b>	<b>10911</b>	<b>100.00</b>	<b>9558</b>	<b>8344</b>
<b>Area under Aquatic Vegetation</b>						803	431
<b>Area under turbidity levels</b>							
Low						10	1766
Moderate						9548	5721
High						-	857



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

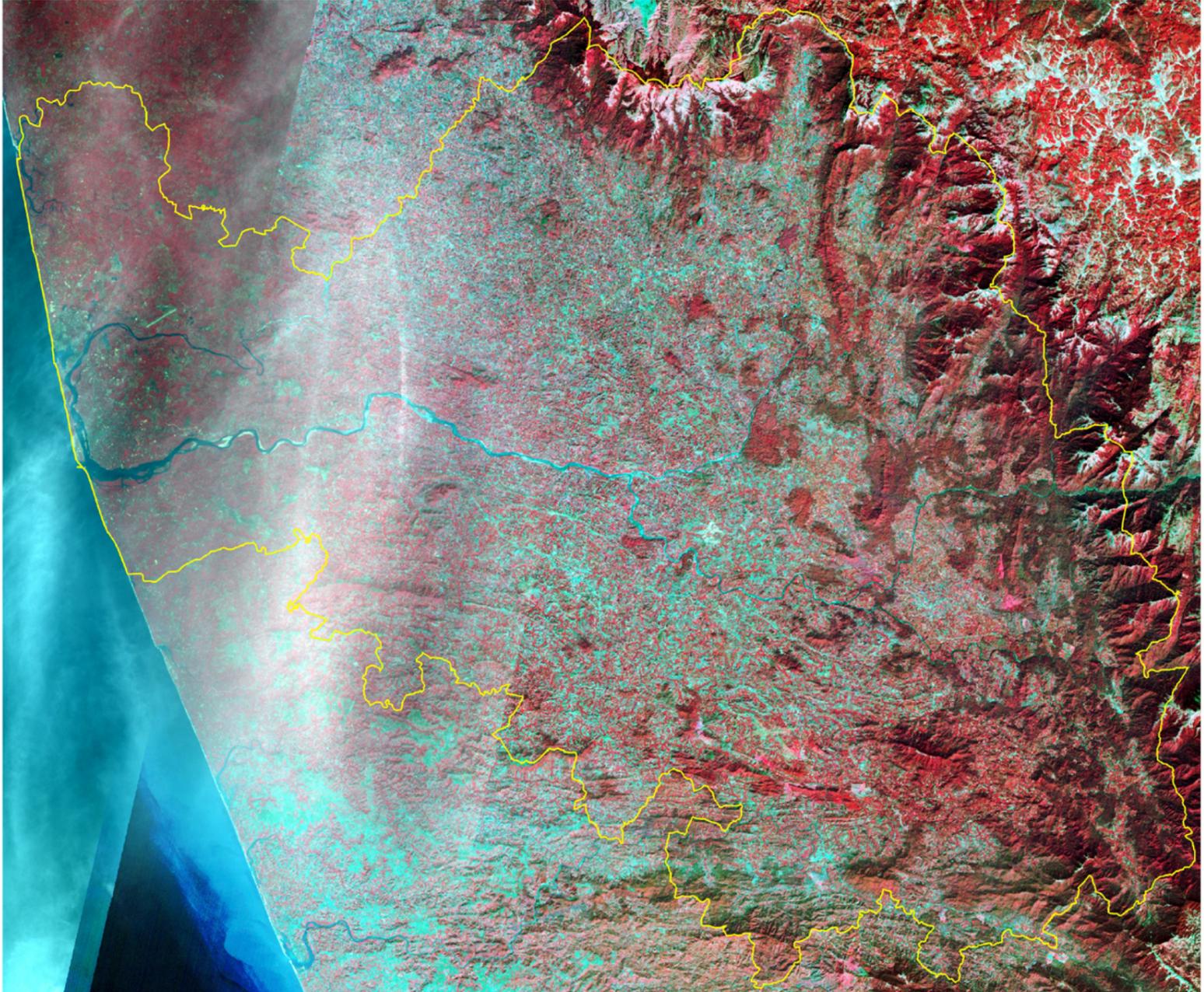


**Data Source :**  
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

**Prepared By :**  
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### 7.1.25 Kodagu

Kodagu district situated in the South-West of Karnataka state lies between the latitudes 11°56'00" to 12°50'00" N and longitudes 75°22'00" to 76°11'00" E with a geographical area of the district is 4102 sq km. After Agumbe, the other region of the state, which receives very heavy rainfall, is the western half of Kodagu (Bhagamandala-Pullingotath-Mukut-Karika areas). The highest rain fall in the area is 6032 mm recorded at Bhagamandala, very near to the origin of the river Cauvery. The district is drained by Cauvery, Laksmanathirtha, Harangi and Barapole. Abby falls, Irfu falls and Nagara hole national wildlife sanctuary, Brhammagiri wildlife sanctuary, Pushpagiri wildlife sanctuary and TalaKaveri wildlife sanctuary are located in this district.

Area estimates of various wetland categories for Kodagu show the presence of 222 wetlands including 182 wetlands smaller than 2.25 ha. Total wetland area is estimated to be is 4018 ha (Table 31). The major wetland types are Reservoir/Barrages (1972 ha) followed by River/Stream (1667 ha) and Tanks/Ponds (197 ha). Analysis of wetland status in terms of open water shows that there is about 25 per cent decrease in the water spread from post-monsoon (3024 ha) to pre-monsoon (2029 ha). Conversely, the aquatic vegetation has shown an increase from 322 ha to 684 ha. Qualitative turbidity of the open water is dominantly moderate (1846 ha) followed by low (884 ha) and high (294 ha) in post-monsoon. While in case of pre-monsoon, again moderate turbidity dominated the aerial extent (1406 ha) followed by high and low levels of turbidity.

Table 31: Area estimates of wetlands in Kodagu

Sr. No.	Wet code	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	7	1667	41.49	1582	1349
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	2	1972	49.08	1301	579
8	1202	Tanks/Ponds	31	197	4.90	141	101
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>40</b>	<b>3836</b>	<b>95.47</b>	<b>3024</b>	<b>2029</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>40</b>	<b>3836</b>	<b>95.47</b>	<b>3024</b>	<b>2029</b>
		Wetlands (<2.25 ha), mainly Tanks	182	182	4.53	-	-
		<b>Total</b>	<b>222</b>	<b>4018</b>	<b>100.00</b>	<b>3024</b>	<b>2029</b>

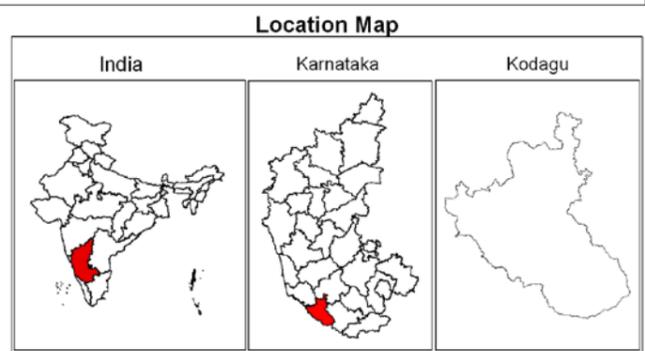
<b>Area under Aquatic Vegetation</b>	322	684
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<b>Area under turbidity levels</b>		
Low	884	224
Moderate	1846	1406
High	294	399



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

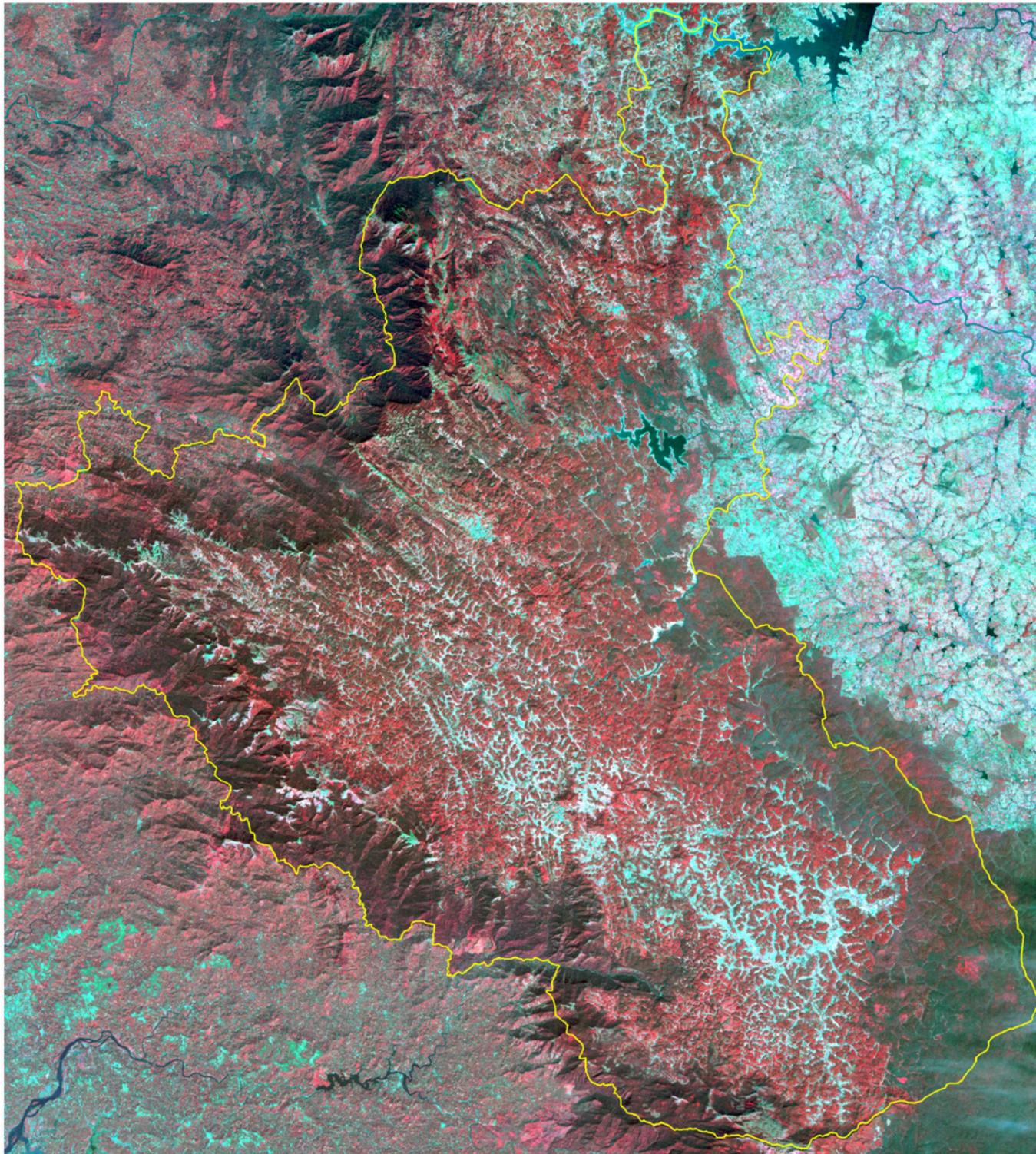


**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

**Prepared By :**  
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## 7.1.26 Mysore

Mysore district situated in the southern part of Karnataka state lies between the latitudes 11°44'10" to 12°39'15" N and longitudes 75°54'37" to 77°08'11" E with a geographical area of 6269 sq km. The district is drained by Cauvery, Kabini, Lakshmanthra, Palar, Nugu rivers. The major reservoirs are Kabini, Nugu, Taraka and Hebbala. The important tanks namely, Karangei Kere, Devanur Kere and Kukkarahalli Kere are located in the district. Apart from this Arabhittu wildlife sanctuary, Nugu wildlife sanctuary and Chunchana kotte reservoir are also located in this district.

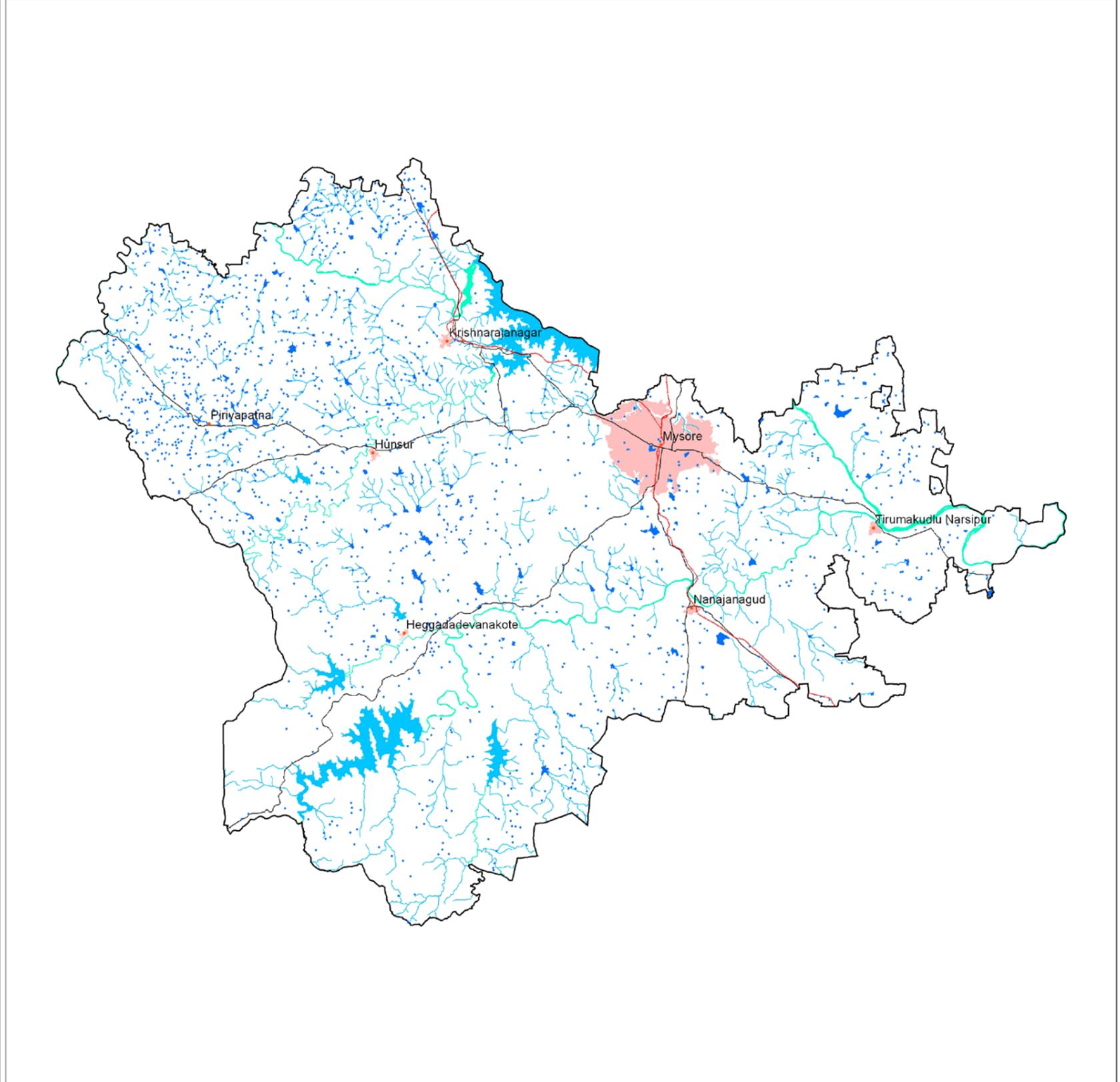
Area estimates of various wetland categories for Mysore recorded 1595 wetlands including 1068 wetlands smaller than 2.25 ha. Total wetland area is estimated to be 25243 ha (Table 32). The major wetland types are Reservoir/Barrages (13699 ha) followed by Tanks/Ponds (5239 ha) and River/Stream (5237 ha). Aquatic vegetation showed an increase from 2 per cent of wetland extent in post-monsoon (576 ha) to 26 per cent in pre-monsoon (6204 ha). Wetland area under open water category has considerably decreased by about 40 per cent from post-monsoon to pre-monsoon. during post-monsoon and pre-monsoon respectively. Qualitative turbidity analysis of the open water showed that low and moderate and high turbidity prevail. Open water extent was dominated by moderate turbidity followed by low and high levels of turbidity in both the seasons.

Table 32: Area estimates of wetlands in Mysore

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	8	5237	20.75	4534	4457
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	6	13699	54.27	12883	6540
8	1202	Tanks/Ponds	513	5239	20.75	4447	1413
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>527</b>	<b>24175</b>	<b>95.77</b>	<b>21864</b>	<b>12410</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>527</b>	<b>24175</b>	<b>95.77</b>	<b>21864</b>	<b>12410</b>
		Wetlands (<2.25 ha), mainly Tanks	1068	1068	4.23	-	-
		<b>Total</b>	<b>1595</b>	<b>25243</b>	<b>100.00</b>	<b>21864</b>	<b>12410</b>

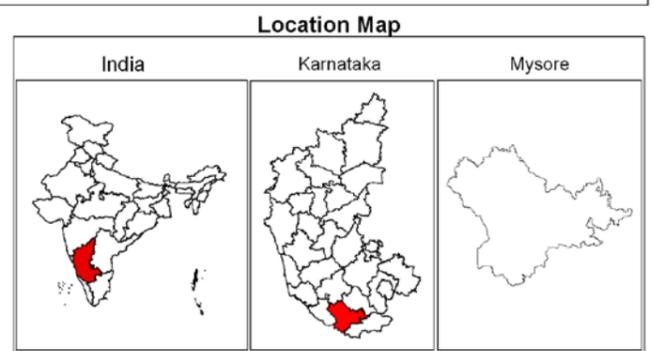
<b>Area under Aquatic Vegetation</b>	576	6204
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<b>Area under turbidity levels</b>		
Low	8284	6739
Moderate	11986	5442
High	1594	229



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

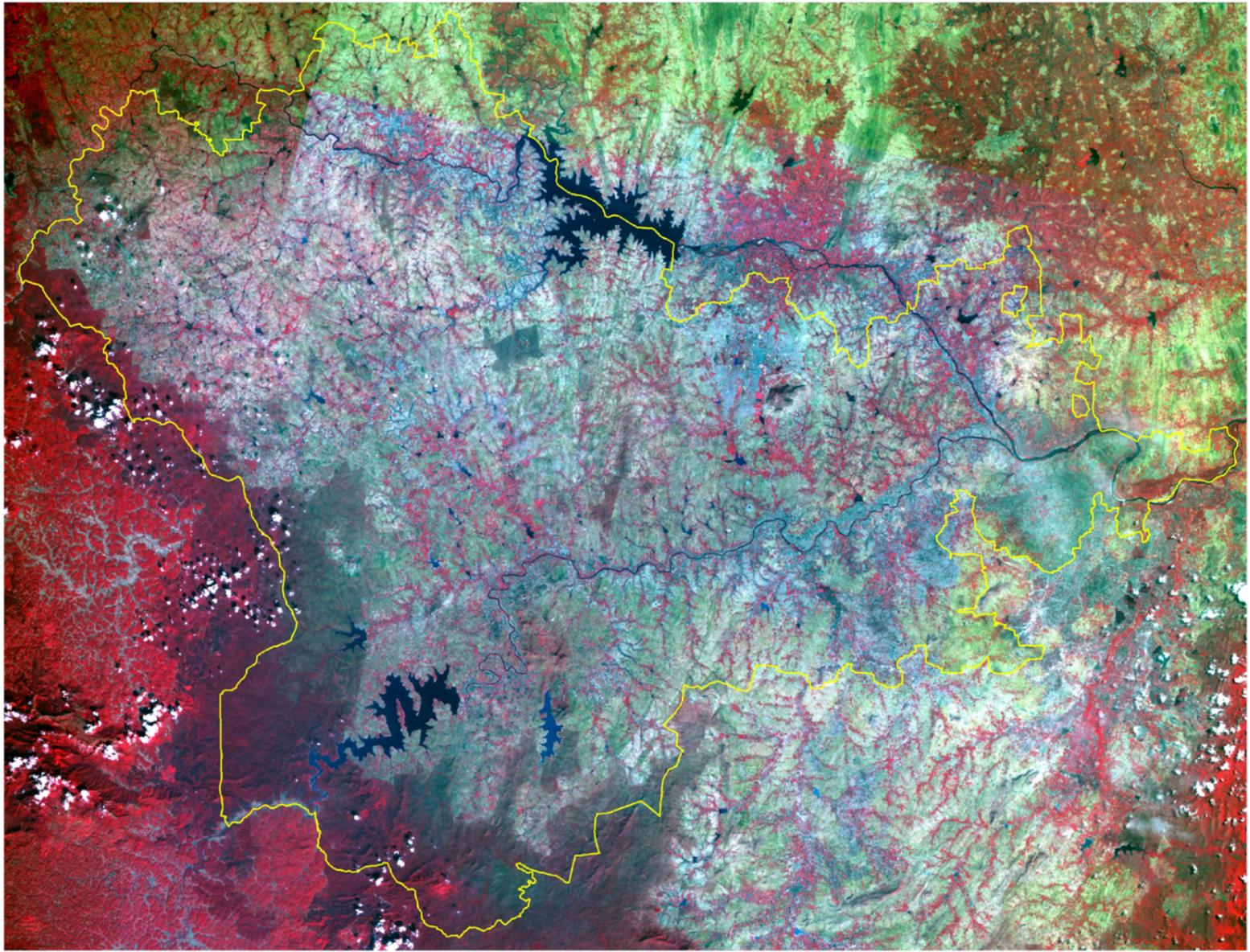


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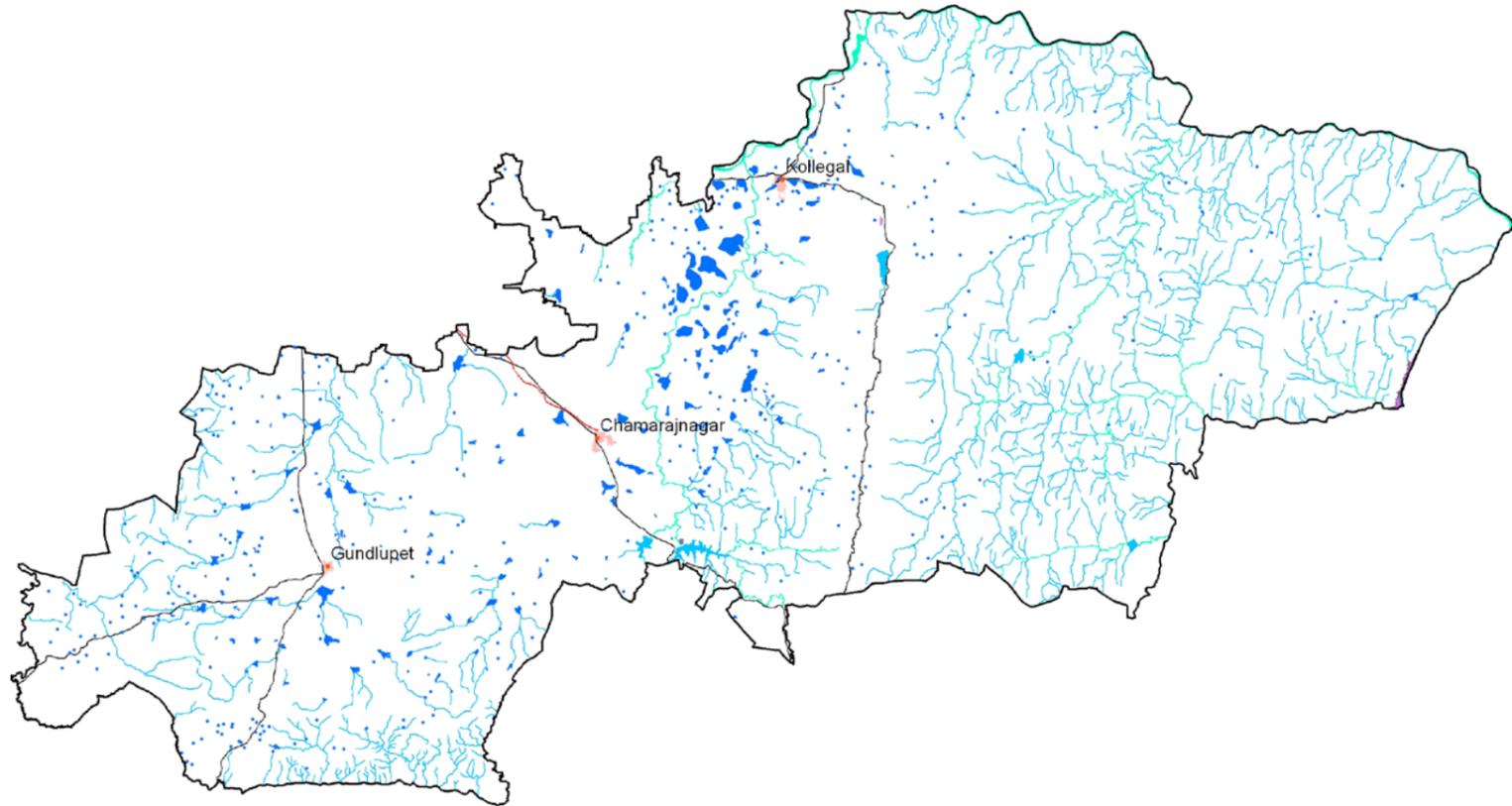
### 7.1.27 Chamrajnagar

Chamarajanagar district lies in the southern part of Karnataka state and is located between latitudes 11°35'21" to 12°8'59" N and longitudes 76°23'57" to 77°46'40"E. The district has a total geographical area of 5685 sq km. Important rivers that drain the district are Cauvery, Kabini, Gundal, Suvarnavathy, Uduthorehalla and Chikkahole. The major reservoirs are Chikkahole, Gundal, Nallur, Amani Kere are located in the district besides Bandipur wildlife sanctuary.

Area estimates of various wetland categories for Chamrajnagar enumerates the presence of 563 wetlands have been delineated; it includes 345 wetlands smaller than 2.25 ha have also been discerned. Total wetland area estimated is 11029 ha (Table 33). The major wetland types are Tanks/Ponds (5569 ha) followed by River/Stream (4041 ha) and Reservoir/Barrages (912 ha). Analysis of wetland status in terms of open water show that here is decrease from post-monsoon (4418 ha) to pre-monsoon (3616 ha). Aquatic vegetation has shown a four times decrease from 4762 ha in post-monsoon to 1178 ha in pre-monsoon. Qualitative turbidity analysis of the open water dominated by moderate turbidity followed by high and low turbidity.

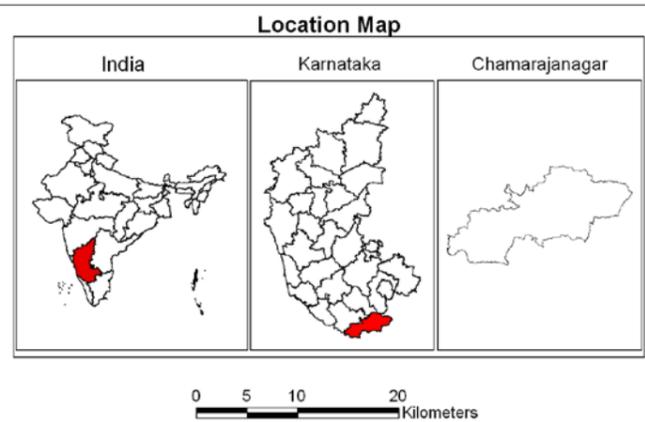
Table 33: Area estimates of wetlands in Chamrajnagar

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-Monsoon Area
	<b>1100</b>	<b>Inland Wetlands - Natural</b>					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	2	141	1.28	5	-
6	1106	River/Stream	19	4041	36.64	2705	2407
	<b>1200</b>	<b>Inland Wetlands -Man-made</b>					
7	1201	Reservoirs/Barrages	5	912	8.27	554	511
8	1202	Tanks/Ponds	191	5569	50.49	1154	698
9	1203	Waterlogged	1	21	0.19	-	-
10	1204	Salt pans	-	-	-	-	-
		<b>Total - Inland</b>	<b>218</b>	<b>10684</b>	<b>96.87</b>	<b>4418</b>	<b>3616</b>
	<b>2100</b>	<b>Coastal Wetlands - Natural</b>					
11	2101	Lagoons	-	-	-	-	-
12	2102	Creeks	-	-	-	-	-
13	2103	Sand/Beach	-	-	-	-	-
14	2104	Intertidal mud flats	-	-	-	-	-
15	2105	Salt Marshes	-	-	-	-	-
16	2106	Mangroves	-	-	-	-	-
17	2107	Coral Reefs	-	-	-	-	-
	<b>2200</b>	<b>Coastal Wetlands - Man-made</b>					
18	2201	Salt pans	-	-	-	-	-
19	2202	Aquaculture ponds	-	-	-	-	-
		<b>Total - Coastal</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
		<b>Sub-Total</b>	<b>218</b>	<b>10684</b>	<b>96.87</b>	<b>4418</b>	<b>3616</b>
		Wetlands (<2.25 ha), mainly Tanks	345	345	3.13	-	-
		<b>Total</b>	<b>563</b>	<b>11029</b>	<b>100.00</b>	<b>4418</b>	<b>3616</b>
<b>Area under Aquatic Vegetation</b>						4762	1178
<b>Area under turbidity levels</b>							
Low						15	191
Moderate						3988	3105
High						415	320



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
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  - District Boundary
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## **MAJOR WETLAND TYPES**



### 8.0 MAJOR WETLAND TYPES OF KARNATAKA

Major wetland types observed in the state are Rivers, Reservoirs, Tanks, Creeks, Mangroves, Aquaculture Ponds and Saltpans. Details are given in Plate-1a and 1b. Ground truth data was collected for selected wetland sites. The standard Performa 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. The location of the features was recorded using GPS. Field photographs of different wetland types are shown in Plates 2a-2e.

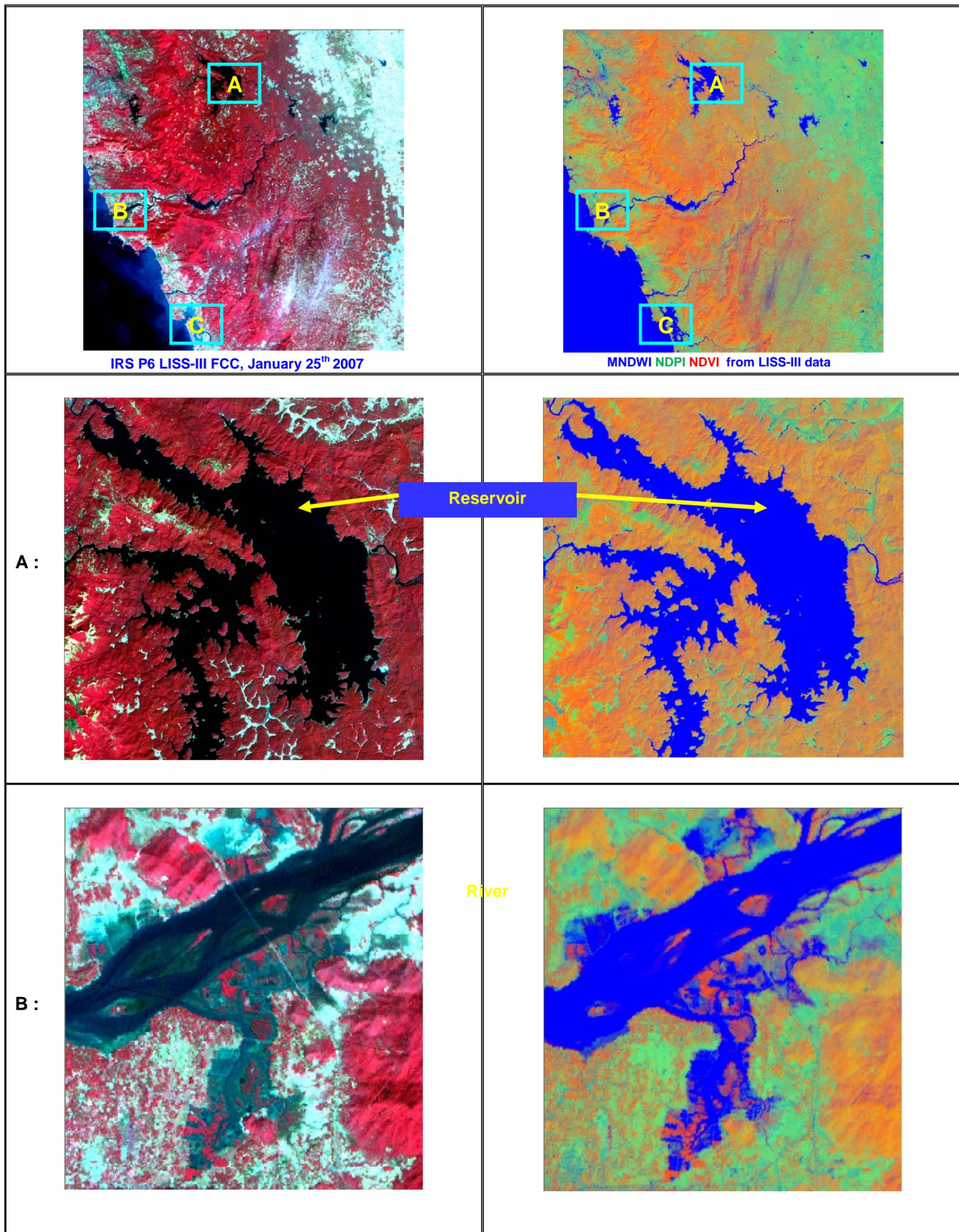


Plate – 1a: Major wetland types of Karnataka

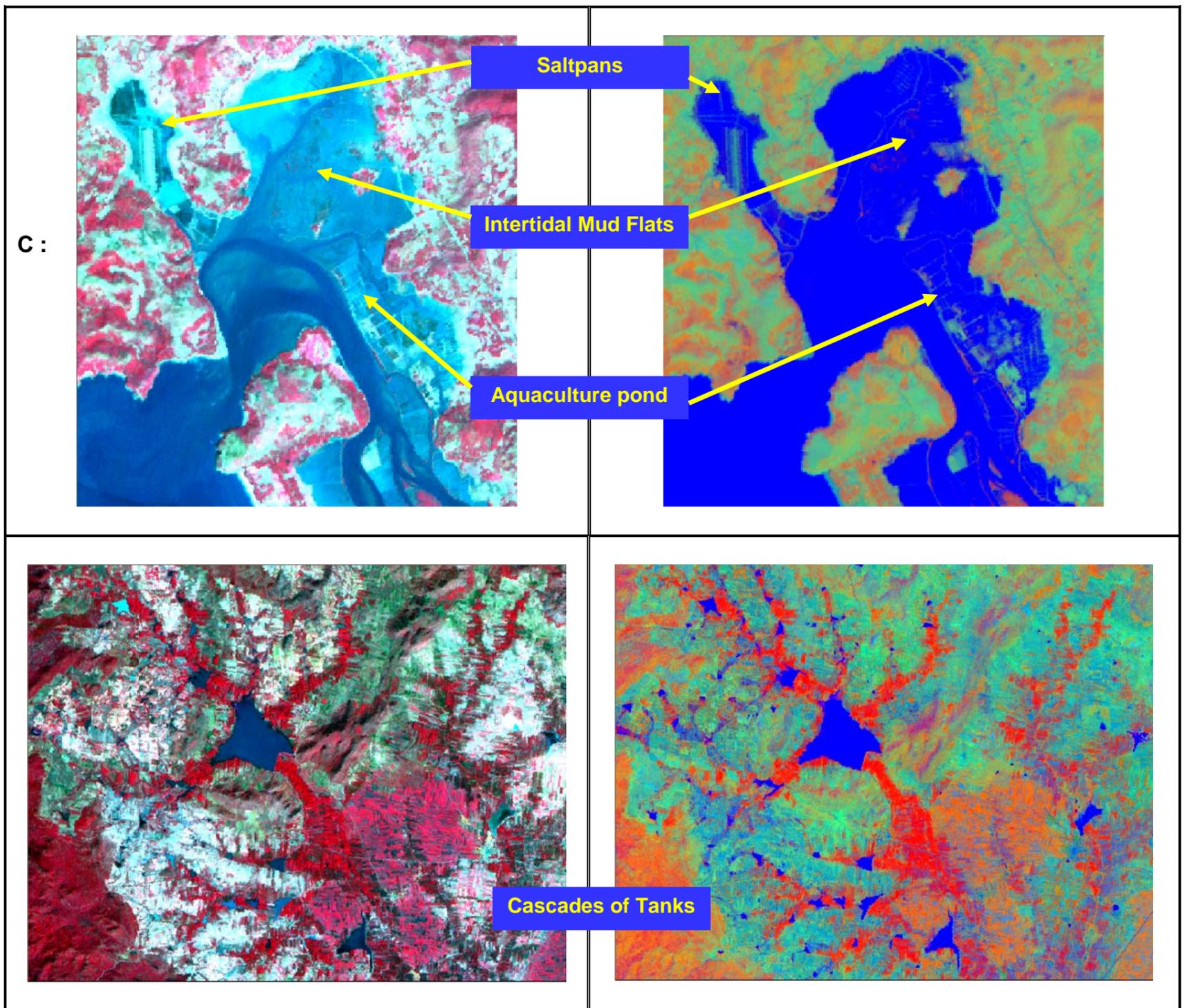


Plate – 1b: Major wetland types of Karnataka

Sl. No.	Description	Field photograph
1.	Wetland Type : Tank/Pond Floating Vegetation  Location : Longitude: 75° 04' 16.26" E Latitude : 13° 10' 0.57" N	
2.	Wetland Type : Tank/Pond  Location : Longitude: 74° 59' 54.56" E Latitude : 13° 12' 20.87" N	
3.	Wetland Type : Tank/Pond  Location : Longitude: 74° 59' 51.6" E Latitude : 13° 12' 13.01" N	
4.	Wetland Type : Lake/Pond  Location : Longitude: 75° 0' 45.1" E Latitude : 13° 12' 31.12" N	

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

Sl. No.	Description	Field photograph
5.	<p>Wetland Type : Lake/Pond</p> <p>Floating and Emergent vegetation</p> <p>Location :  Longitude: 74° 37' 55.71" E  Latitude : 13° 51' 31.81" N</p>	
6.	<p>Wetland Type : River/Stream</p> <p>Location :  Longitude: 74° 37' 45.05" E  Latitude : 13° 52' 0.29" N</p>	
7.	<p>Wetland Type : Intertidal Mudflat and Mangrove</p> <p>Location :  Longitude: 74° 44' 32.74" E  Latitude : 13° 37' 46.02" N</p>	
8.	<p>Wetland Type : Creek and Mangrove</p> <p>Location :  Longitude: 74° 44' 32.74" E  Latitude : 13° 37' 46.02" N</p>	

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

Sr. No.	Description	Field photograph
9.	Wetland Type: Tank/Pond Name: Datharmakki Kere Floating vegetation Location: longitude: 75° 46' 45.8" E latitude : N 13° 19 '40.1 "N	
10.	Wetland Type: Tank/Pond Floating vegetation Location: Longitude: 75°39' 34.7" E Latitude: 13° 42' 12.4" N	
11.	Wetland Type: Tank/Pond Floating vegetation Location : longitude: 75° 41' 25.9" E latitude : 13° 42' 17.2" N	
12.	Wetland Type: Tank/Pond Floating vegetation Location : longitude: 75° 41' 25.9" E latitude : 13° 42 17.2" N	

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

Sr. No.	Description	Field photograph
13.	Wetland Type: Waterlogged Area Location: longitude: 77° 37' 56.61" E latitude : 12° 52' 42.26" N	
14.	Wetland Type: Reservoir/Barrage Location : Longitude: 75° 53' 5.3" E Latitude: 13° 26' 17.5" N	
15.	Wetland Type: Reservoir/Barrage Name: Jammada Halla Reservoir Location: Longitude: 75° 45' 24.3" E Latitude: 13° 40' 57.6" N	
16.	Wetland Type: Reservoir/Barrage Location: Longitude: 75° 45' 24.3" E latitude: 13° 40' 56.6" N	

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

Sl. No.	Description	Field photograph
17.	Wetland Type : Reservoir Gorur Dam upstream Location : longitude: 76° 1' 30.5" E latitude : 12° 46' 22.6" N	
18.	Wetland Type : Tank/Pond Name: Shantigrama Tank Location : longitude: 76° 12' 53.2" E latitude : 12° 59' 29.5" N	
19.	Wetland Type : Tank/Pond Submerged Aquatic species Location : longitude: 76° 12' 58.6" E latitude : 13° 4' 12.4" N	
20.	Wetland Type : Tank/Pond Name: Nagathihalli kere Location : longitude: 76° 15' 1.2" E latitude : 13° 21' 32.6" N	

Plate 2e: Field photographs and ground truth data of different wetland types in Karnataka



# **IMPORTANT WETLANDS OF KARNATAKA**



### 9.0 IMPORTANT WETLANDS OF KARNATAKA

Byramangala, Markonahalli, Linaganamakki reservoirs, Maddur lake, Ranganthitoo Wildlife Sanctuary are five important wetland sites in Karnataka, Other than these wetlands, Almatti, Krishna Raja Sagar, Kabini, Tunghabhadra, Supa Dams, Shivanasamudra and Jog falls, Kali-Aghanashini-Varahi-Netravathi estuaries are some of the important wetland sites. Extensive field work was carried out for these wetland areas. Wetland maps have been prepared for 5 km buffer area of each wetland sites. Location map of important wetland sites is shown in Plate 3. Details of each wetland and wetland map of 5 km buffer area are shown in plates 4 to 18.

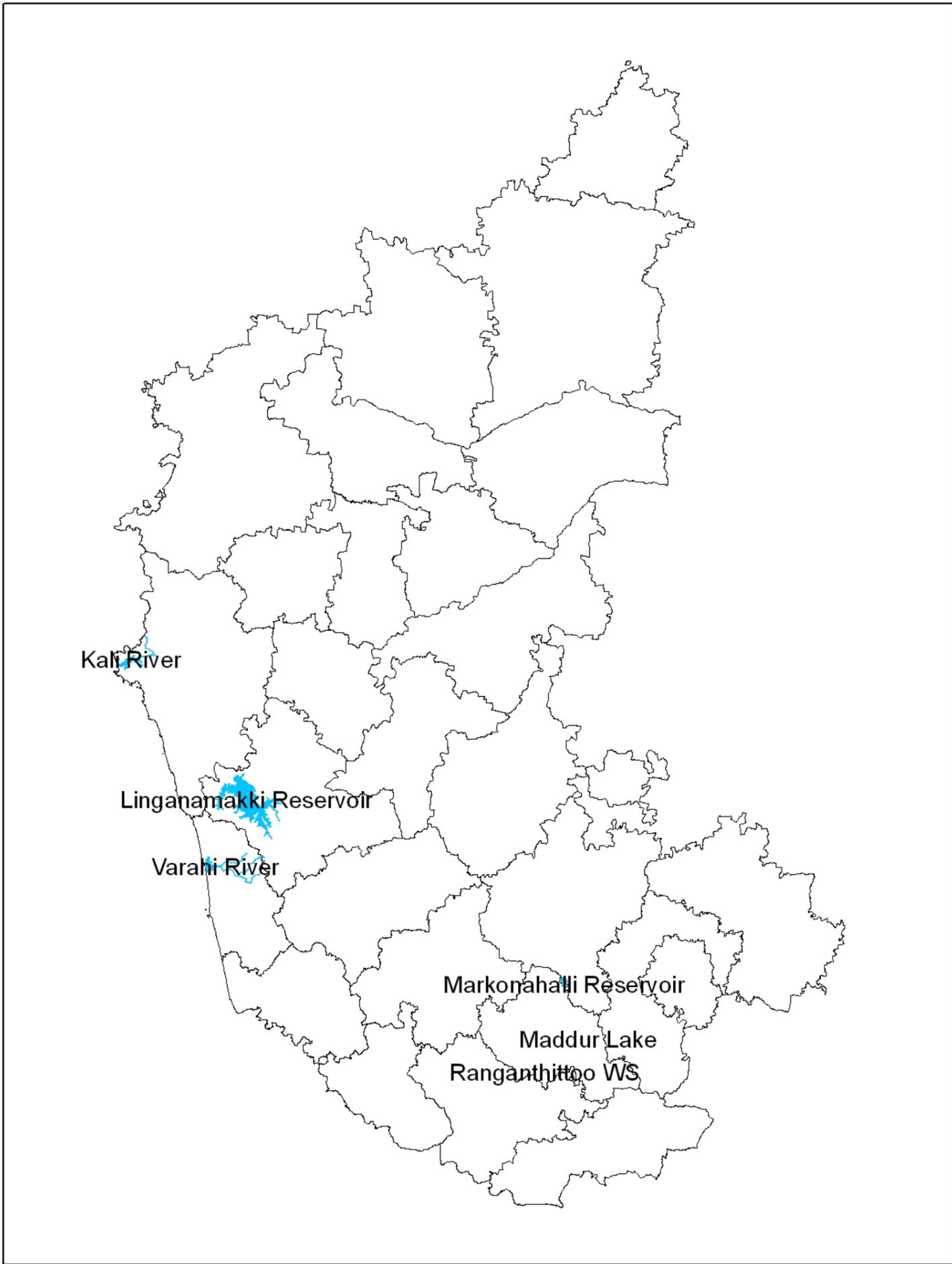


Plate – 3: Important Wetland sites of Karnataka

## 9.1 Byramangala Reservoir

**Name:** Byramangala Reservoir

**Location:**

Latitude : 12° 52' 32" N  
Longitude: 77° 20' 12" E

Located at the border of Bangalore Urban district.

**Area:** 412 ha

**Wetland type:** Reservoir

**Average Annual Rainfall:**

2400 mm, mostly occurring during June to September

**Description:**

Byramangala reservoir is located at 38 km away to the north-west of Bangalore city, Karnataka. The sewage-fed Byramangala reservoir built across the seasonal river Vrishabhavathy; In addition to the rains, the main source of water to this reservoir is the part of domestic sewage from Bangalore city which joins the river through a channel.

**A biotic factor:**

Tropical monsoon climate.  
The mean pH is 6.9  
Dissolved oxygen is 0.12 (mg/l)  
COD is 292.2 (mg/l).

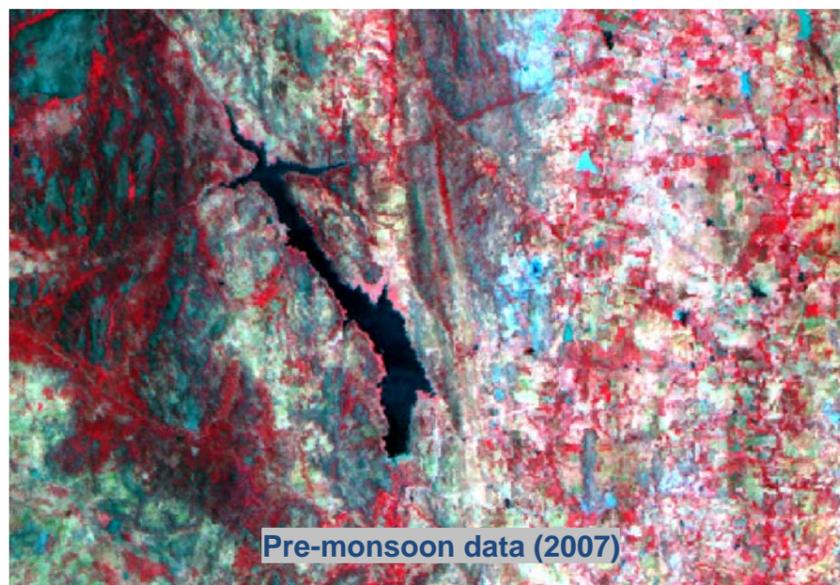
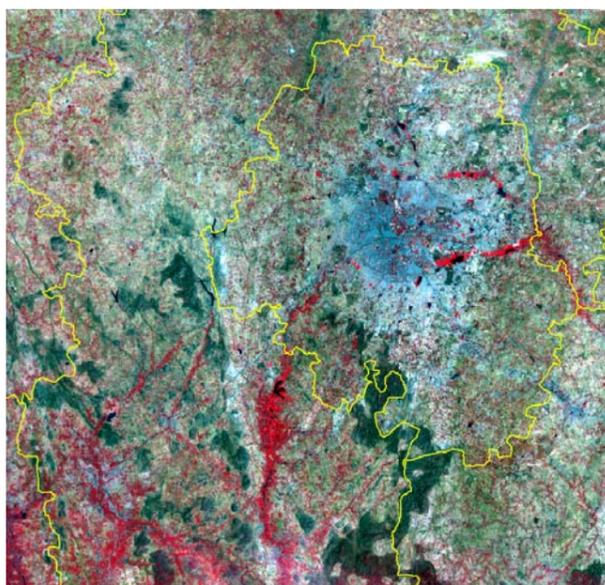
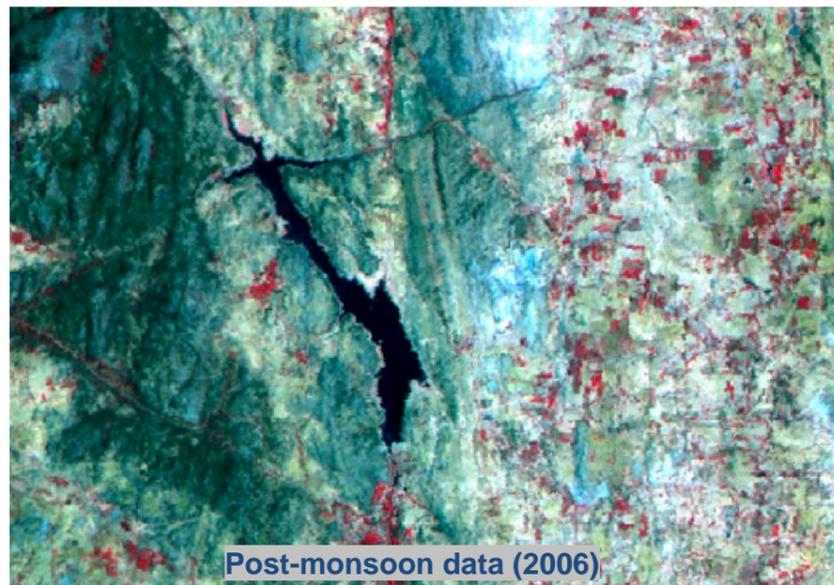
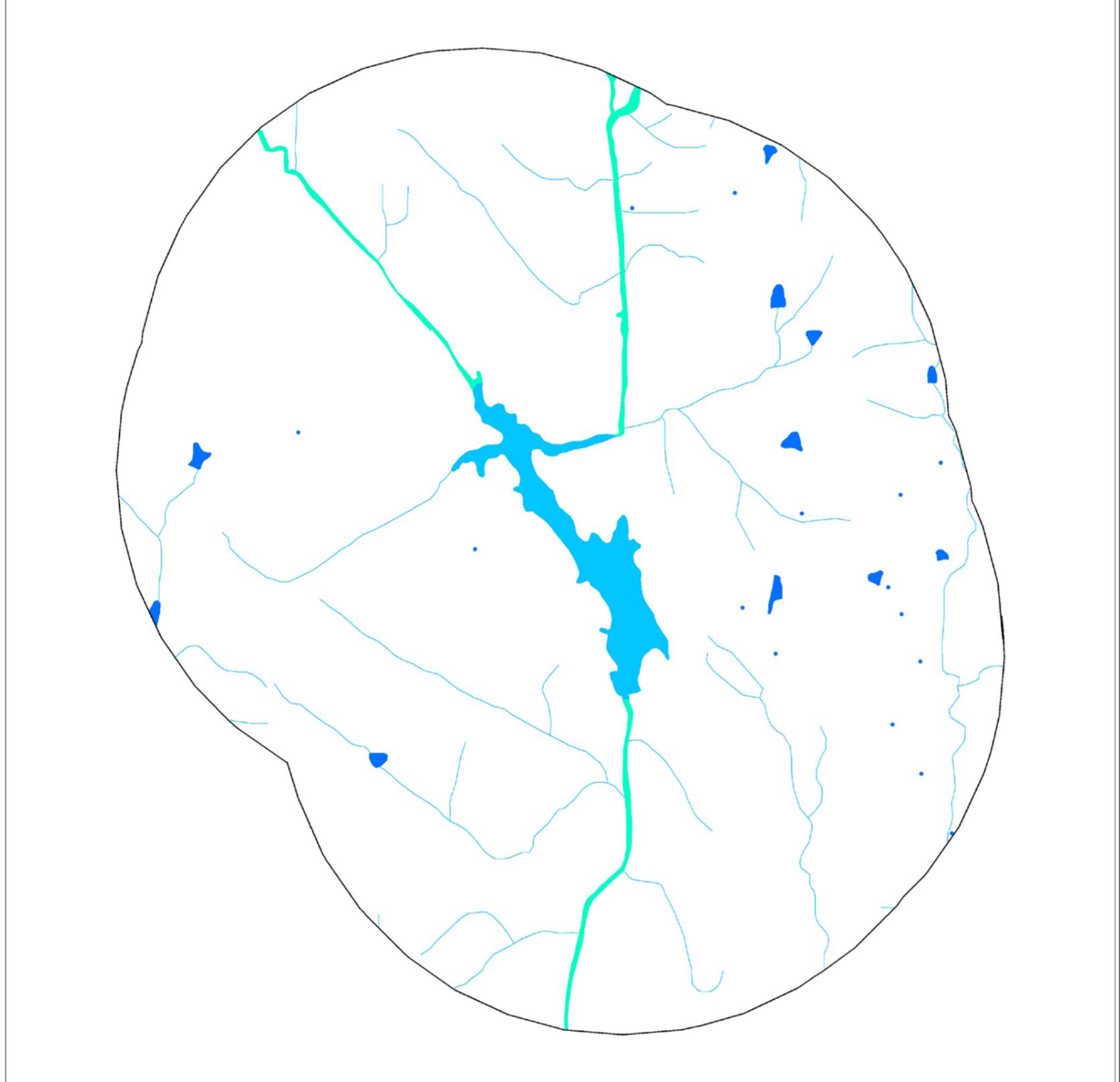
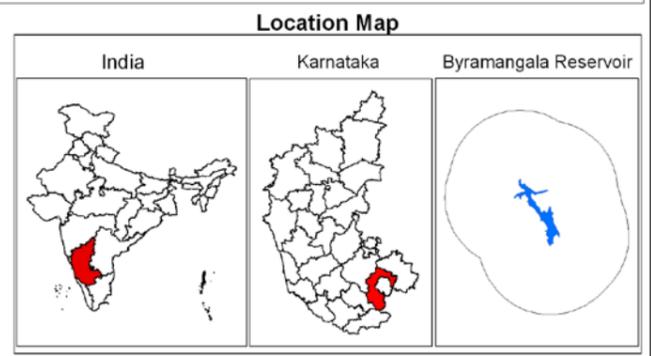


Plate 4: Byramangala Reservoir



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



0 1 2 4 Kilometers

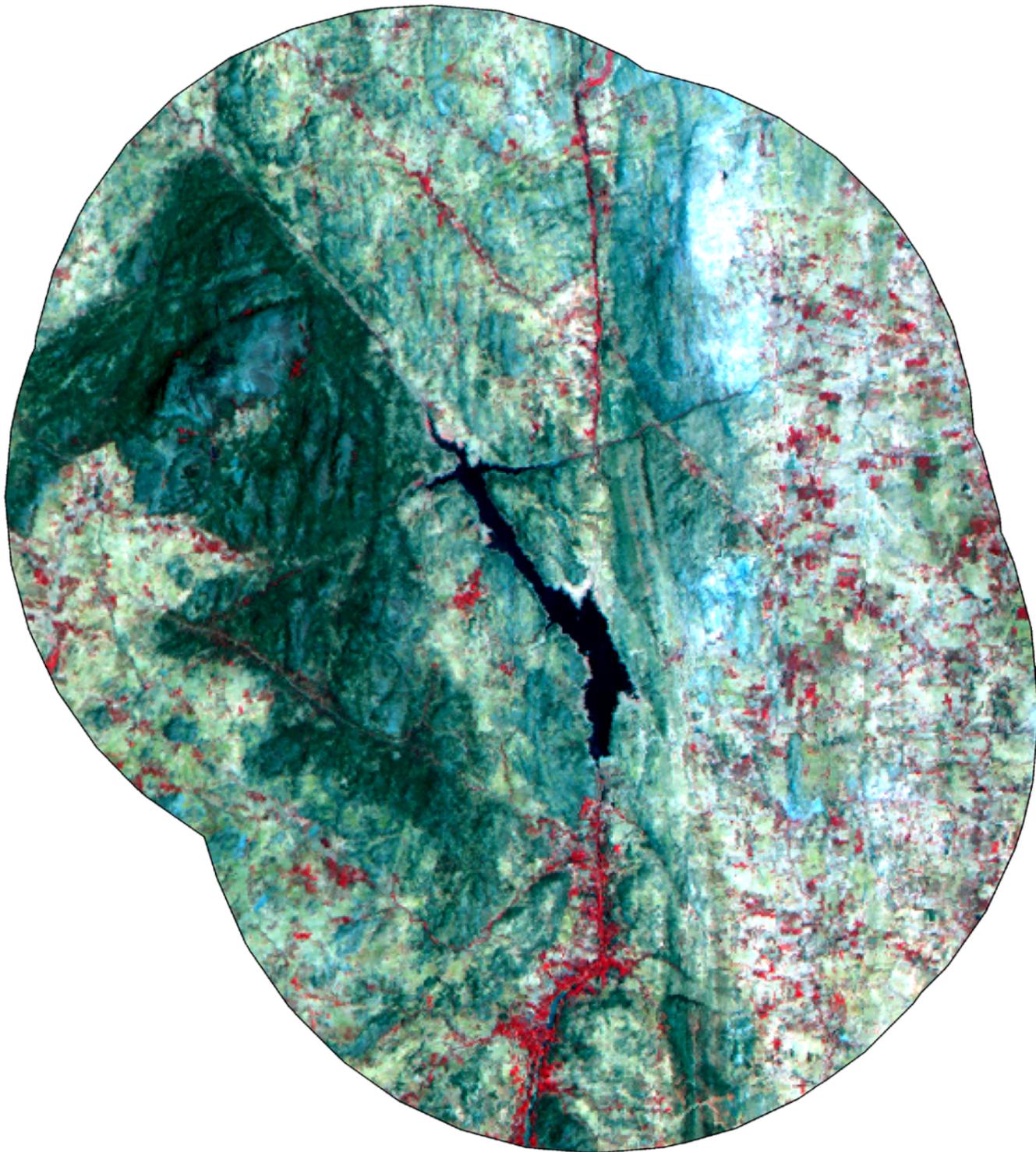
**Data Source :**  
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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

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Plate 5: Wetland map - 5 km buffer area of Byramangala Reservoir





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

Plate 6: IRS LISS-III FCC - 5 km buffer area of Byramangala Reservoir

## 9.2 Linganamakki Reservoir

**Name:** Linganamakki Reservoir

**Location:**

Latitude : 14° 10' 29" N  
Longitude: 74° 51' 00" E

Located at the border of Uttara Kannada, Haveri, Chikmagalur, Dakshina Kannada and Udupi districts.

**Area:** 32600 ha.

**Wetland type:** Reservoir

**Average Annual Rainfall:**

2400 mm, mostly occurring during June to September

**Description:**

Linganamakki reservoir lies in Shimoga district of Karnataka state. The reservoir was constructed across the river Sharavati, Western Ghats in 1964 for the purpose of power generation. The river Sharavati is one of the west flowing river of Karnataka that reserves through the Western Ghats. The river receives many tributaries with Haridravathi near Pattaguppe and Yenne Hole' near Bharangi being the major ones. Along with them, the minor tributaries like Nagodi Hole', Nandi Hole', Mavina Hole', Huruli Hole', and Birer Hole' also join this river. The water from Chakra and Savehaklu reservoirs of Chakra River has been diverted to this reservoir.

**Abiotic factor:**

Tropical monsoon climate.  
Maximum temperature of 34°C  
Minimum of 23.3°C  
pH values ranged from 6.52 to 8.41.

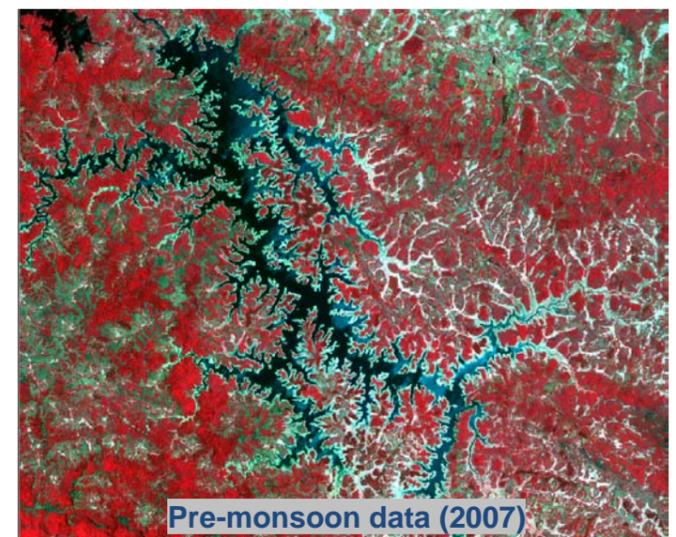
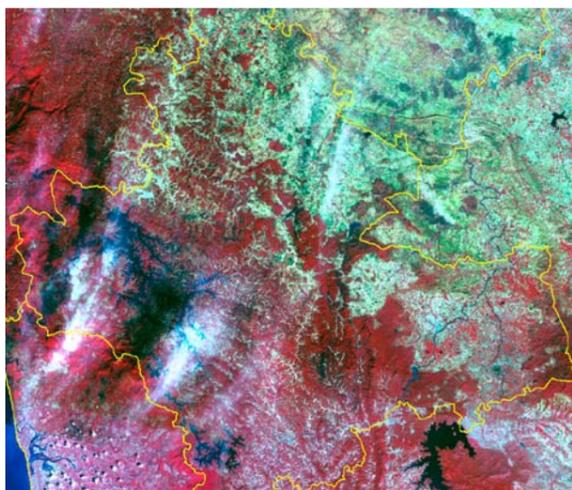
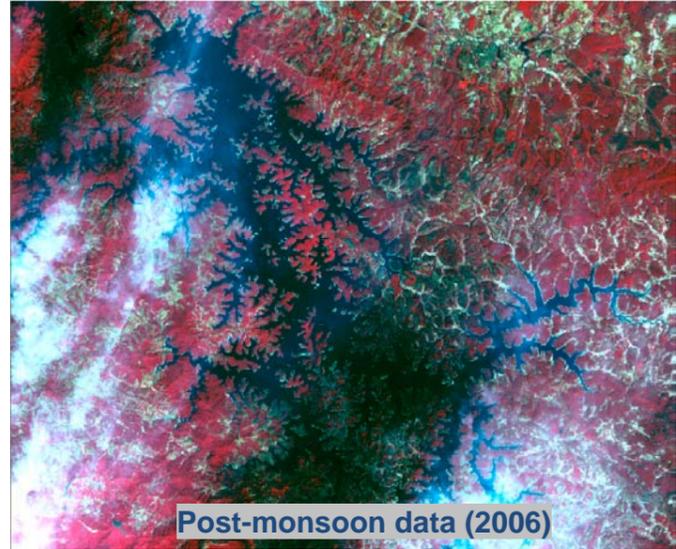
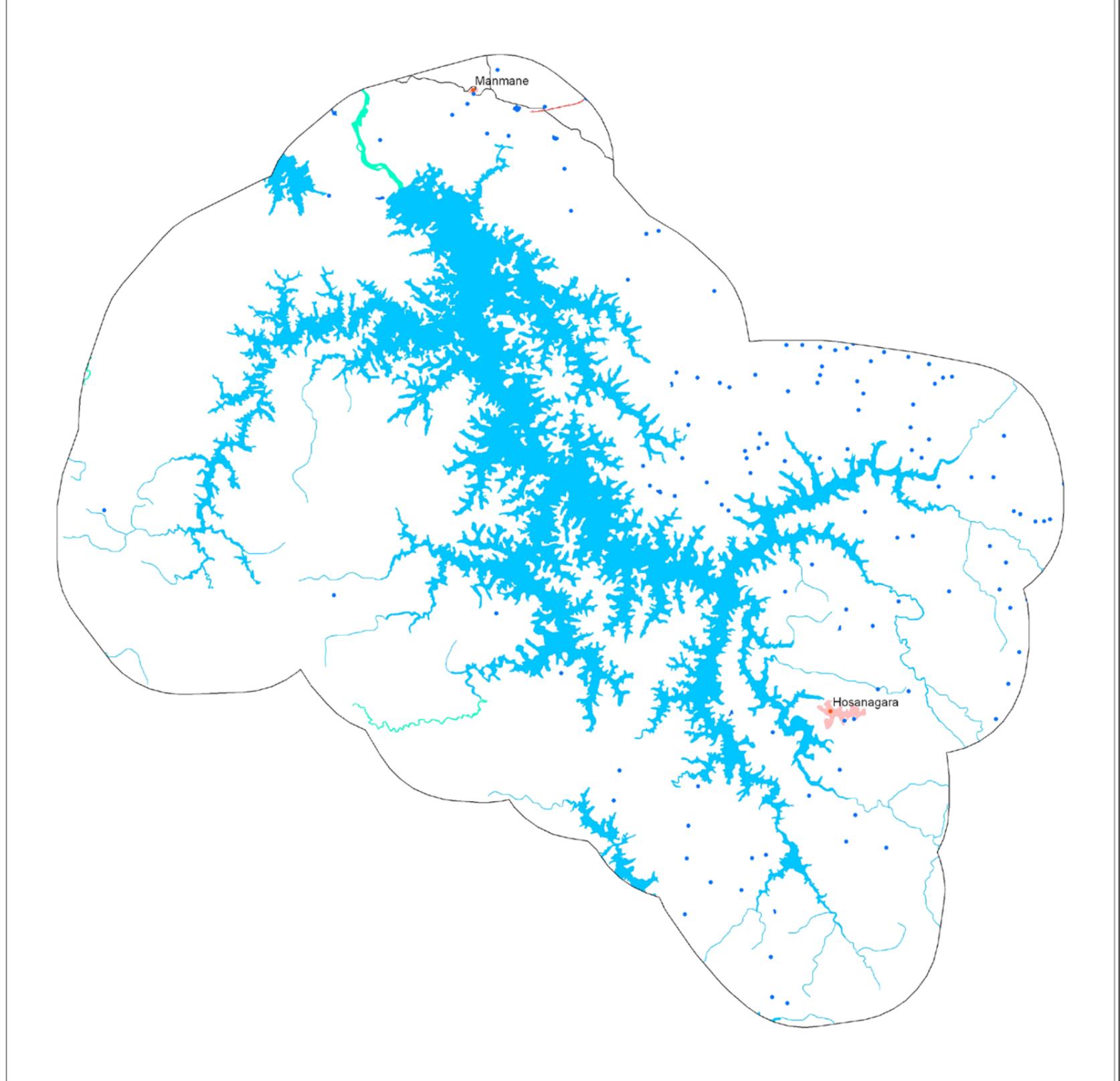
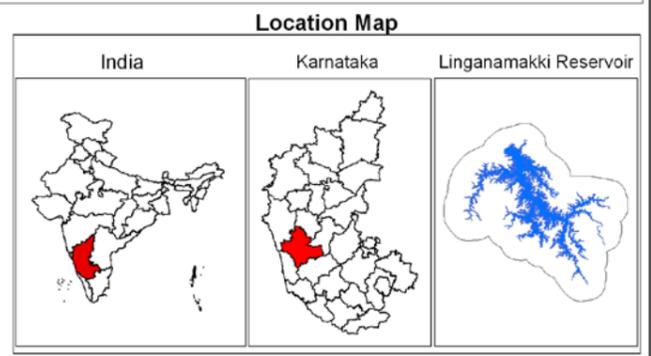


Plate 7: Linganamakki Reservoir



Symbol	Typecode	Level I	Level II	Level III
		<b>Inland Wetlands</b>		
			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
		<b>Coastal Wetlands</b>		
			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



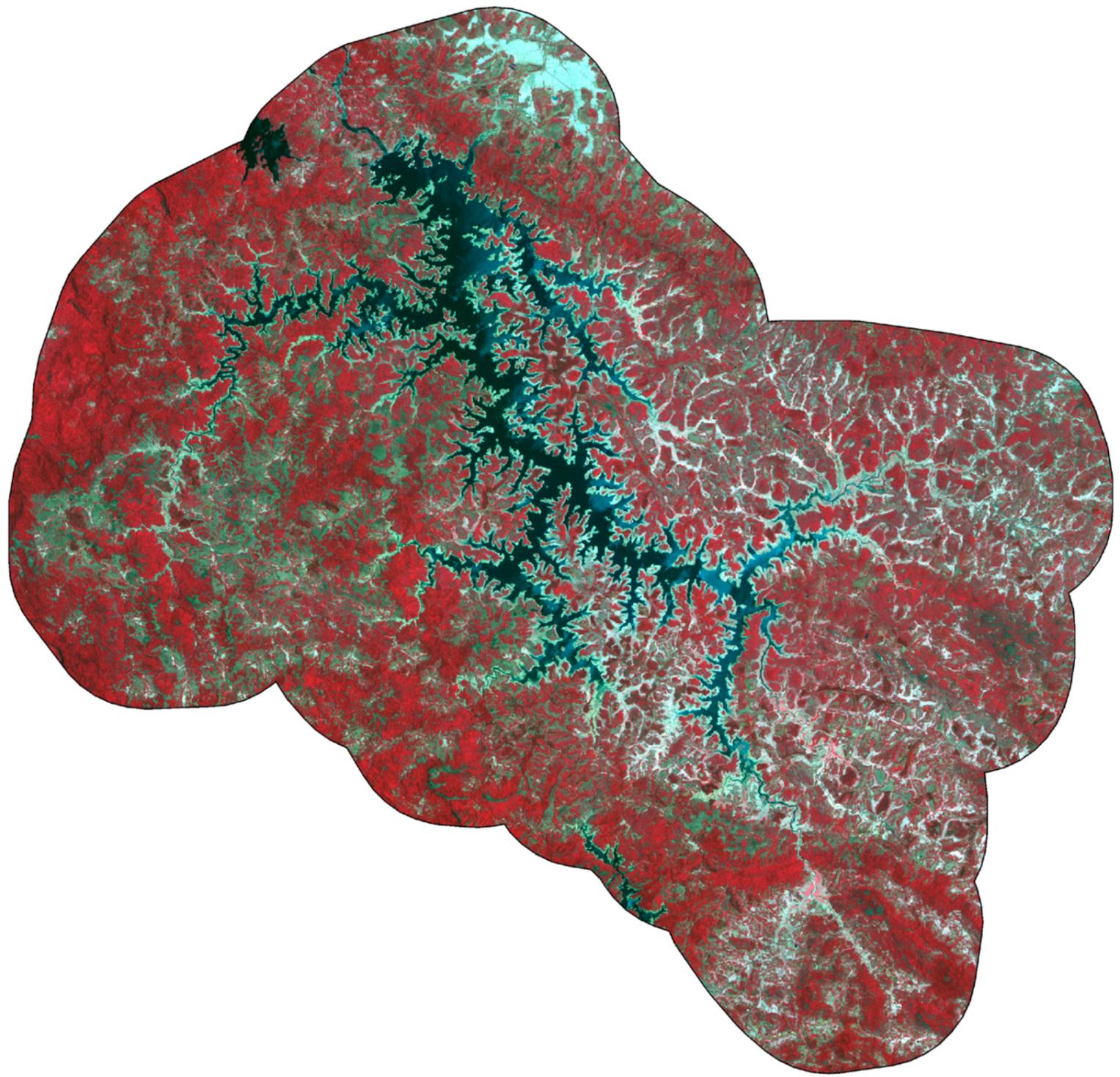
**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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

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

Plate 8: Wetland map - 5 km buffer area of Linganamakki Reservoir





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

Plate 9: IRS LISS-III FCC - 5 km buffer area of Linganamakki Reservoir

### 9.3 Maddur Lake

**Name:** Maddur Lake

**Location:**

Latitude : 12° 35' 46" N  
Longitude: 77° 01' 24" E

Located at the border of Mysore, Chamarajanagar and Bangalore Rural districts.

**Area:** 4220 ha

**Wetland type:** Lake

**Average Annual Rainfall:**

2400 mm, mostly occurring during June to September

**Description:**

Maddur lake is lies adjoining to Maddur town in Mandya district, karnataka. The maximum depth of the lake is 7.0 m with mean depth of 4.9 m. Canal water from Krishna Raja Sagar and run-off from surrounding agricultural areas is the constant source of water. The area comes under Kaveri (Cauvery) basin, subjected to intensive agriculture.

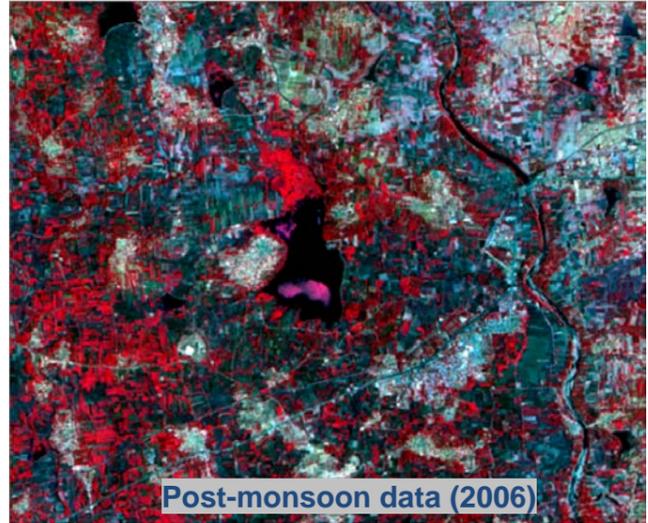
**Abiotic factors:**

Tropical monsoon climate.

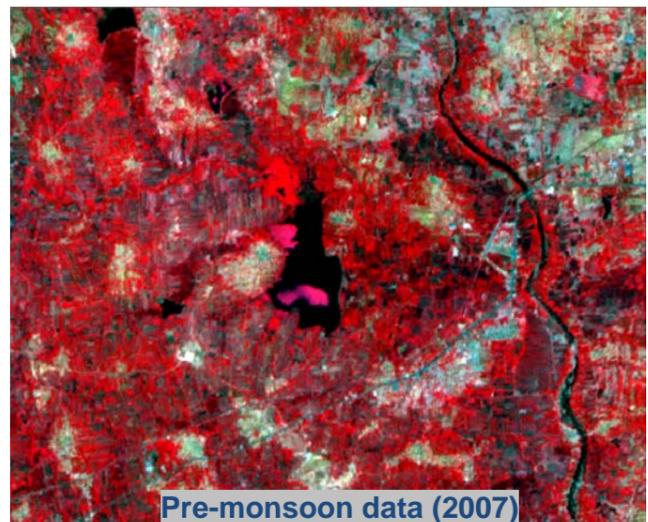
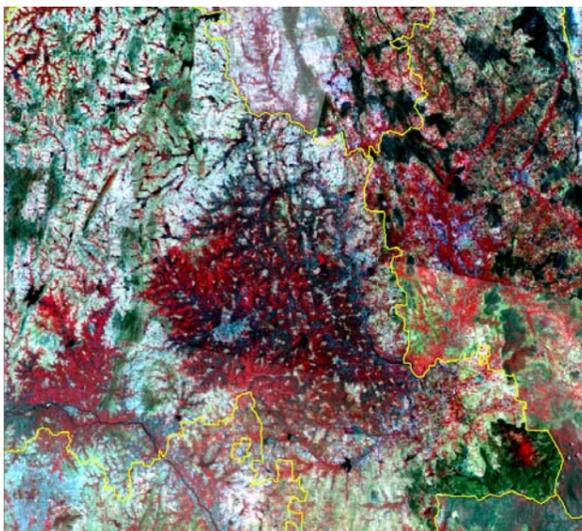
Maximum temperature of 32°C

Minimum of 21.2°C

pH values ranged from 7.6 to 8.3.

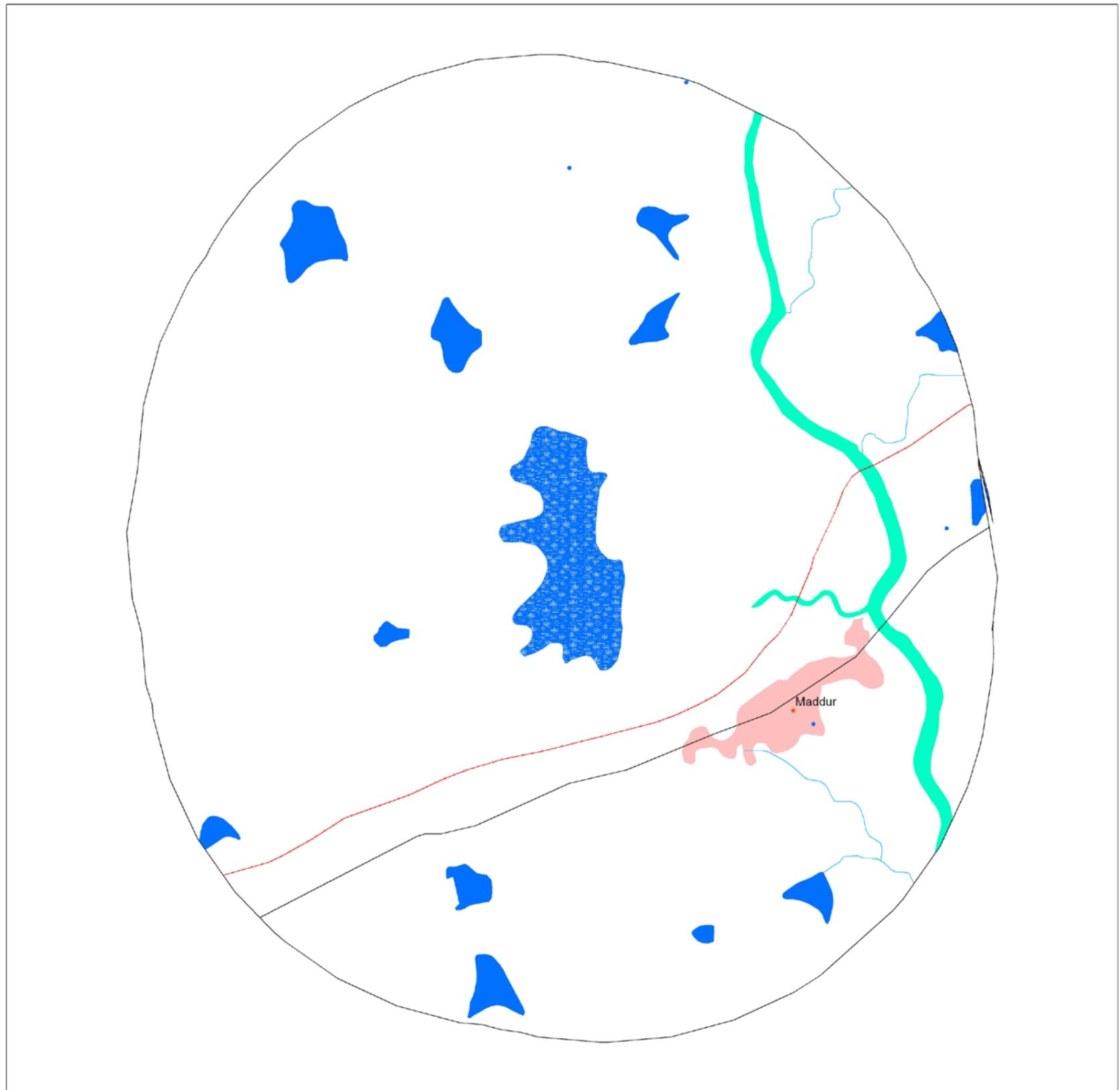


Post-monsoon data (2006)



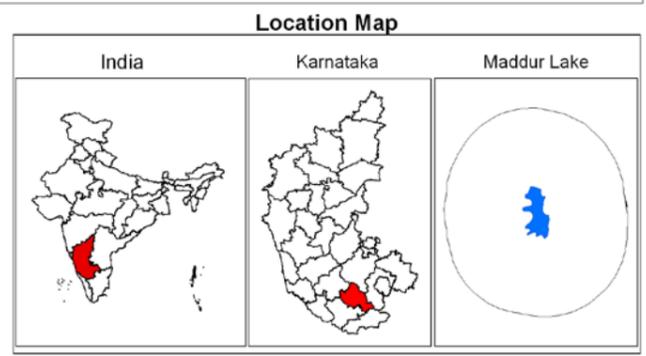
Pre-monsoon data (2007)

Plate 10: Maddur Lake



Symbol	Typecode	Level I	Level II	Level III
		<b>Inland Wetlands</b>		
			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
		<b>Coastal Wetlands</b>		
			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



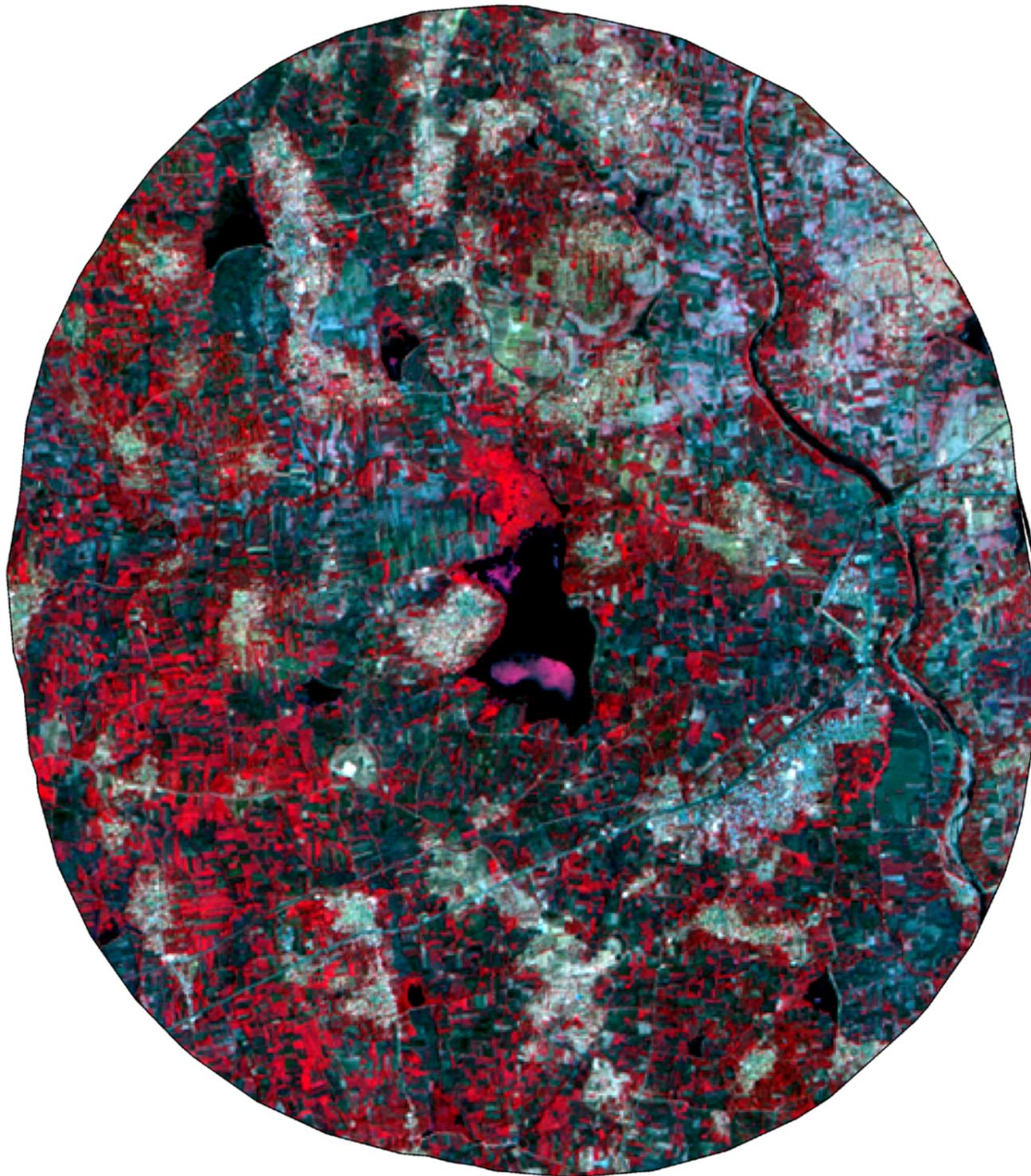
**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

**Prepared By :**  
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 Dept. of IT, BT & S&T, GOK, Bangalore, Karnataka

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 Government of India

Plate 11: Wetland map - 5 km buffer area of Maddur Lake





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

Plate 12: IRS LISS-III FCC - 5 km buffer area of Maddur Lake

### 9.4 Ranganthittoo Wildlife Sanctuary

**Name:** Ranganthittoo Wildlife Sanctuary

**Location:**

Latitude : 12° 26' 57" N  
 Longitude: 76° 44' 23" E

Located at the border of Mysore, Chamrajanagar, and Bangalore Rural districts.

**Area:** 67 ha

**Wetland type:** Bird Sanctuary (River)

**Average Annual Rainfall:**

2400 mm, mostly occurring during June to September

**Description:**

Ranganthittoo Wildlife Sanctuary is a stretch of the river Kaveri (Cauvery) flowing Ranganthittoo Sanctuary. The sanctuary is situated in the 15 km northeast of Mysore, Mandya district of Karnataka. The river flows relatively swiftly through an area of rocky terrain; there are many rocks as well as sandy islands, more or less neglected by the local human population. The larger islands are wooded and these, together with the wooded river banks, support a large breeding colony of waterbirds.

**Abiotic factors:** Tropical monsoon climate. The sanctuary receives benefit from both the southwest and northeast monsoon.

**Macrophytes:**

The smaller islands have a fringe of *Pandanus* sps. The larger islands and the river banks support a variety of shrubs and trees. The islands harbouring the heronries are covered by *Samania saman*, *Terminalia arjuna*, *Ponamia glabra*, *Salix tetrasperma*, *Combretum oblifolium*, *Polygonum bardatum*, and *Pandanus* sps.

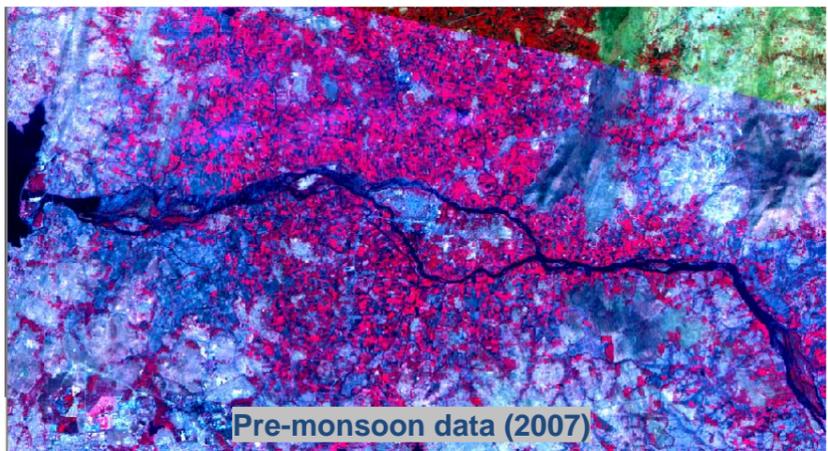
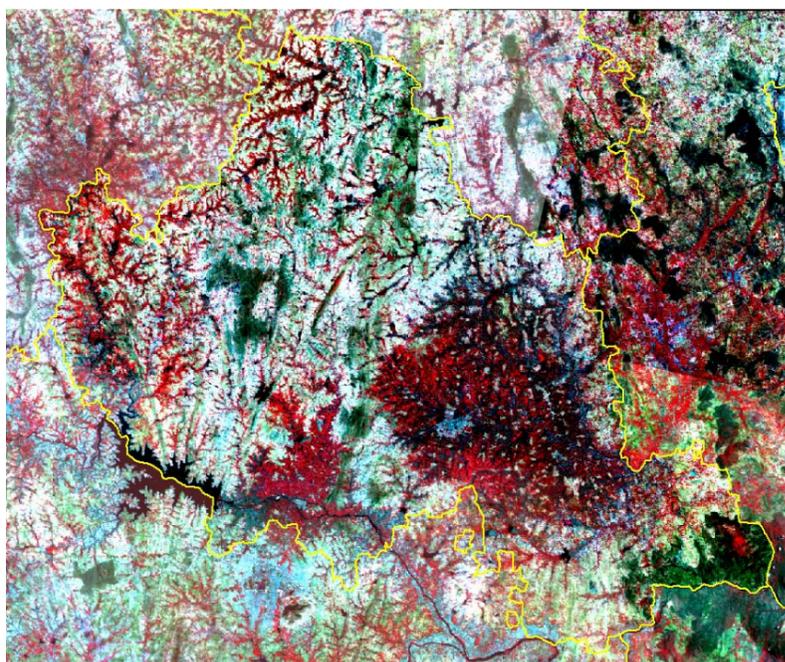
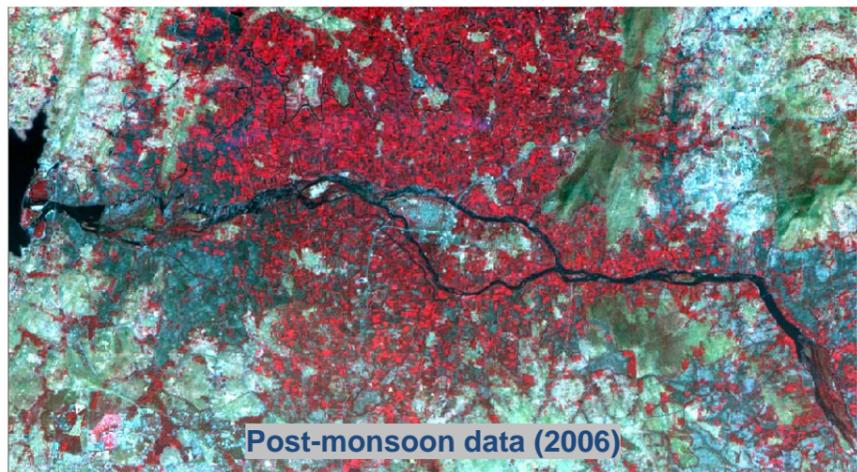
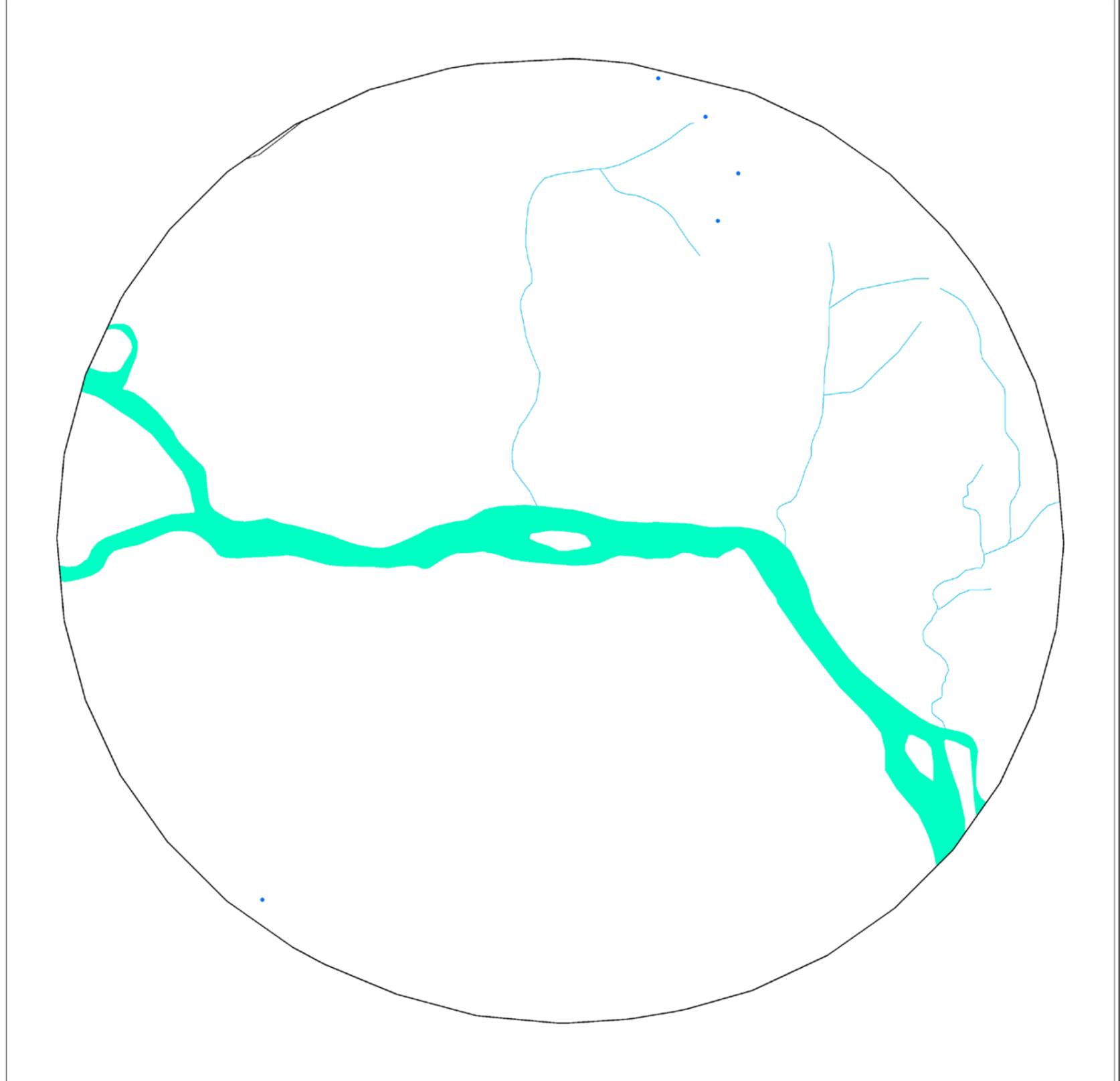
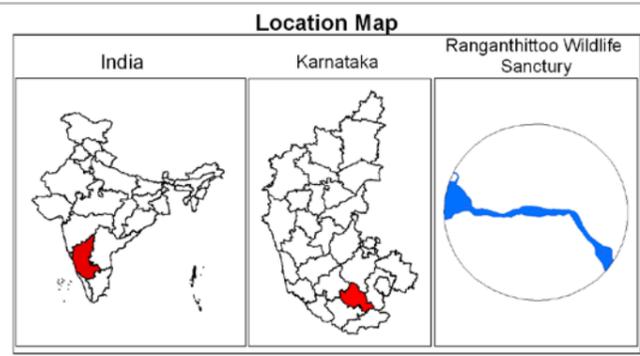


Plate 13: Ranganthittoo Wildlife Sanctuary



Symbol	Typecode	Level I	Level II	Level III
		<b>Inland Wetlands</b>		
			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
		<b>Coastal Wetlands</b>		
			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



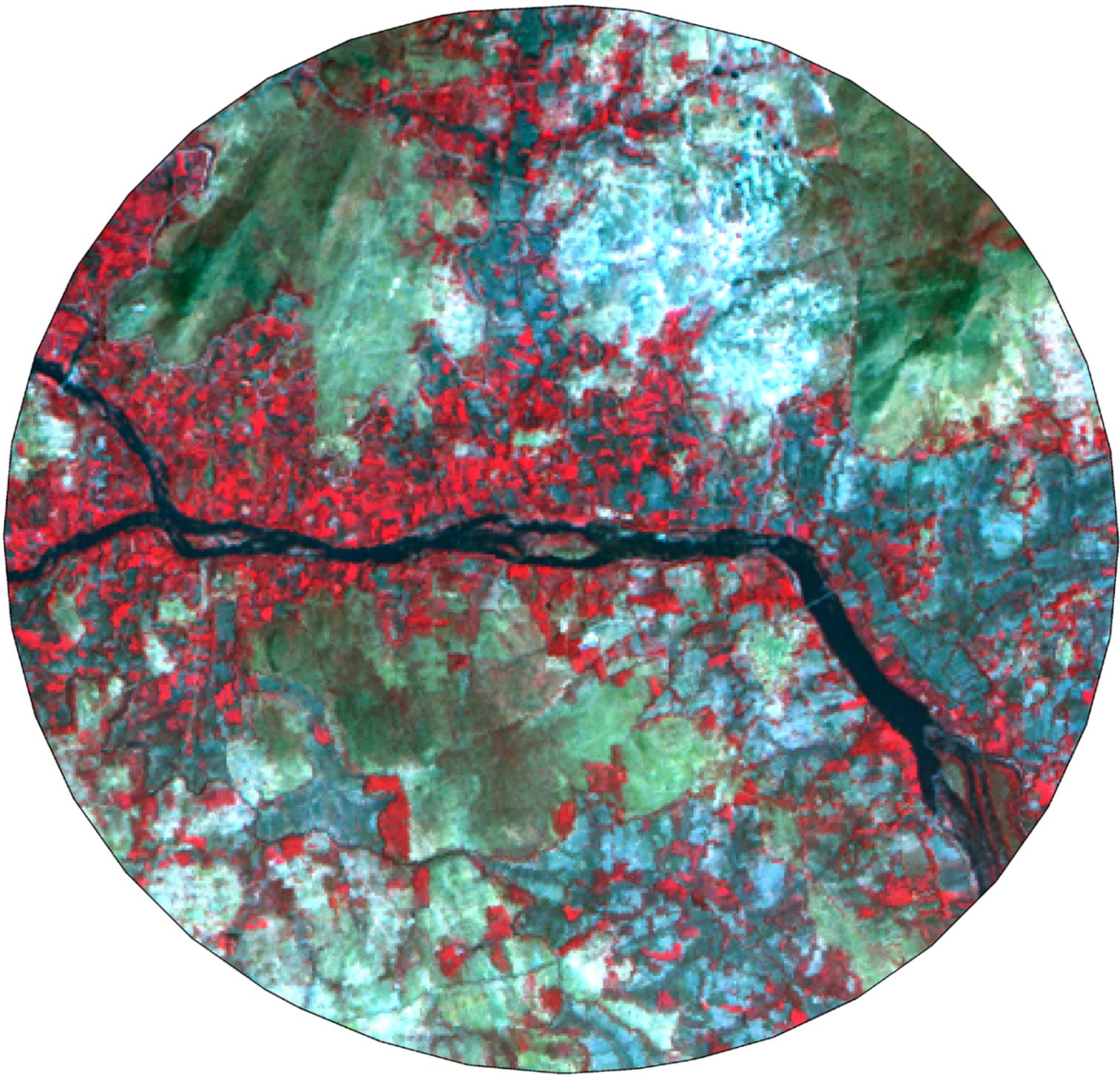
**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

**Prepared By :**  
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 Dept. of IT, BT & S&T, GOK, Bangalore, Karnataka

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

Plate 14: Wetland map - 5 km buffer area of Ranganthittoo Wildlife Sanctuary





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

Plate 15: IRS LISS-III FCC - 5 km buffer area of Ranganthittoo Wildlife Sanctuary

## 9.5 Markonahalli Reservoir

**Name:** Markonahalli Reservoir

**Location:**

Latitude : 12° 56' 24" N  
Longitude: 76° 52' 39" E

Located at the border of Bangalore Rural, Mandya, Hassan and Chitradurga districts.

**Area:** 1,336 ha

**Wetland type:** Reservoir

**Average Annual Rainfall:**

2400 mm, mostly occurring during June to September

**Description:**

Markonahalli reservoir lies in Tumkur district, Karnataka. It was constructed across the river Shimsha. The reservoir has a mean depth of 20.27 m and catchment area of 4103 km<sup>2</sup>.

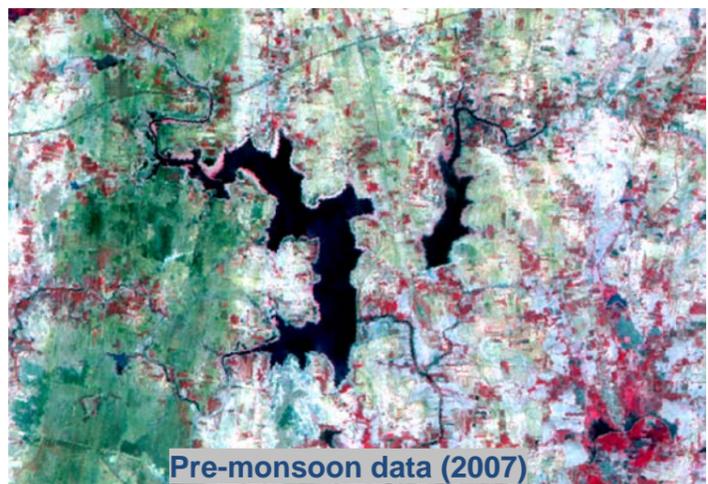
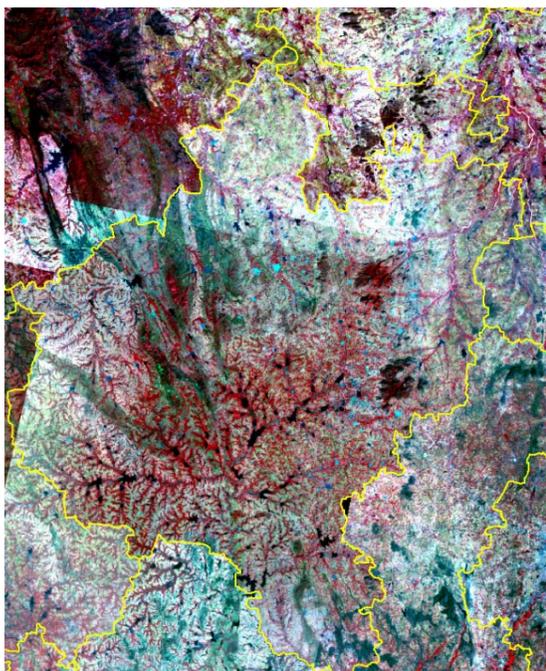
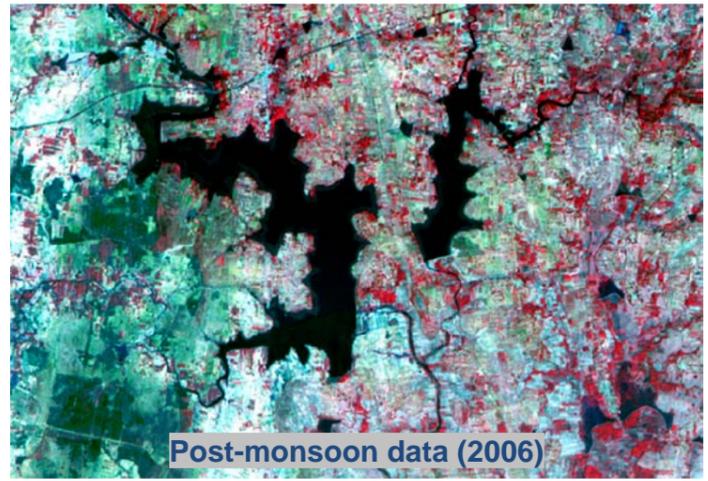
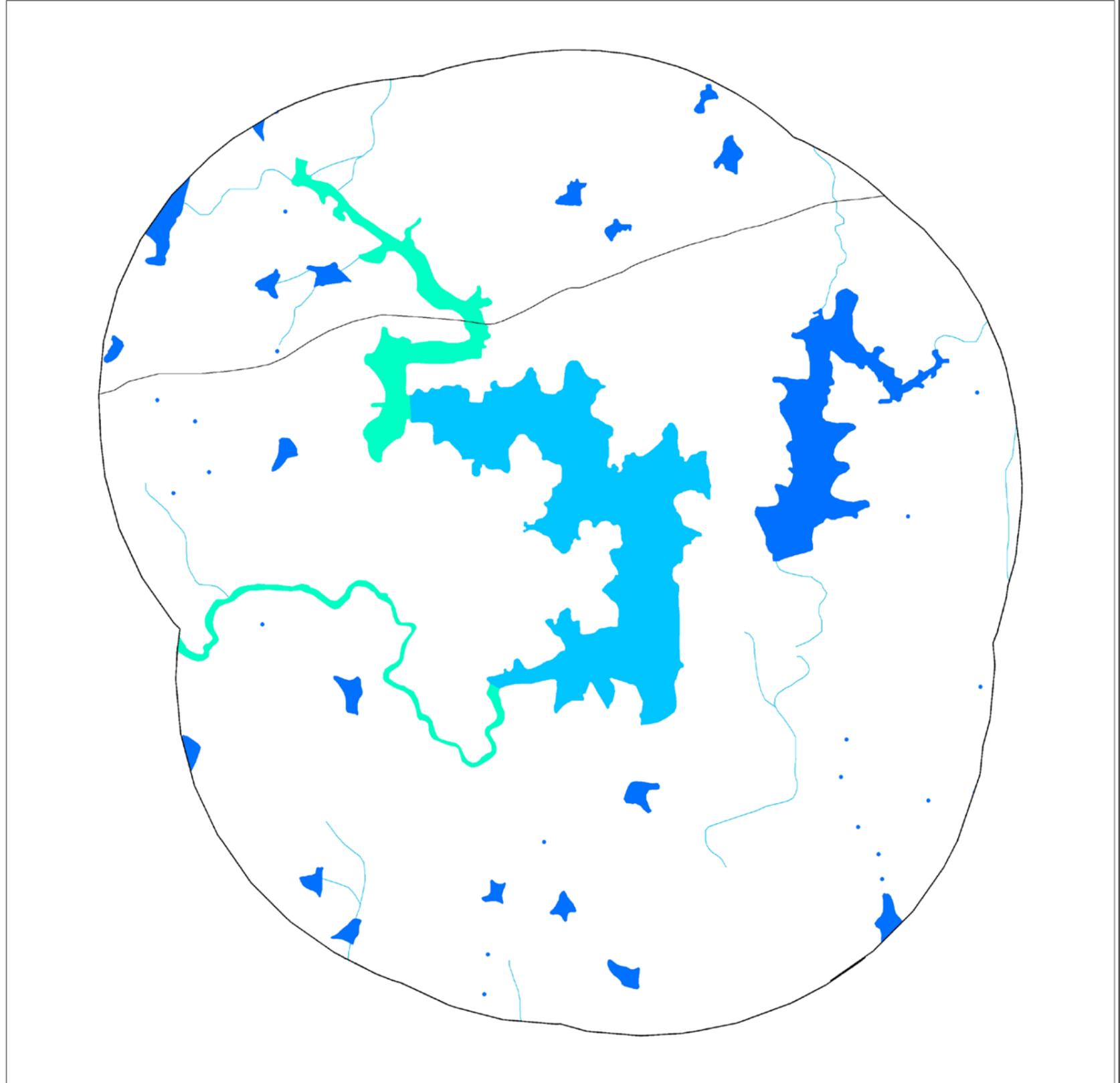
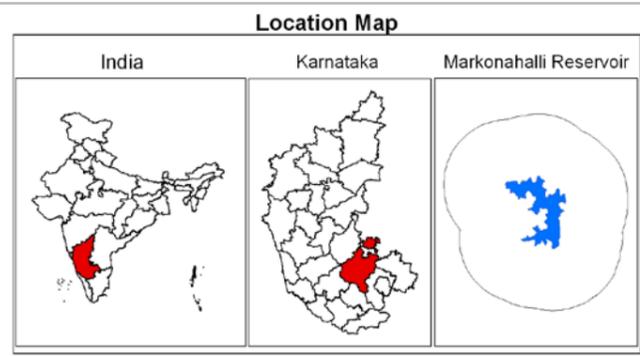


Plate 16: Markonahalli Reservoir



Symbol	Typecode	Level I	Level II	Level III
		<b>Inland Wetlands</b>		
			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	
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		<b>Coastal Wetlands</b>		
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	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



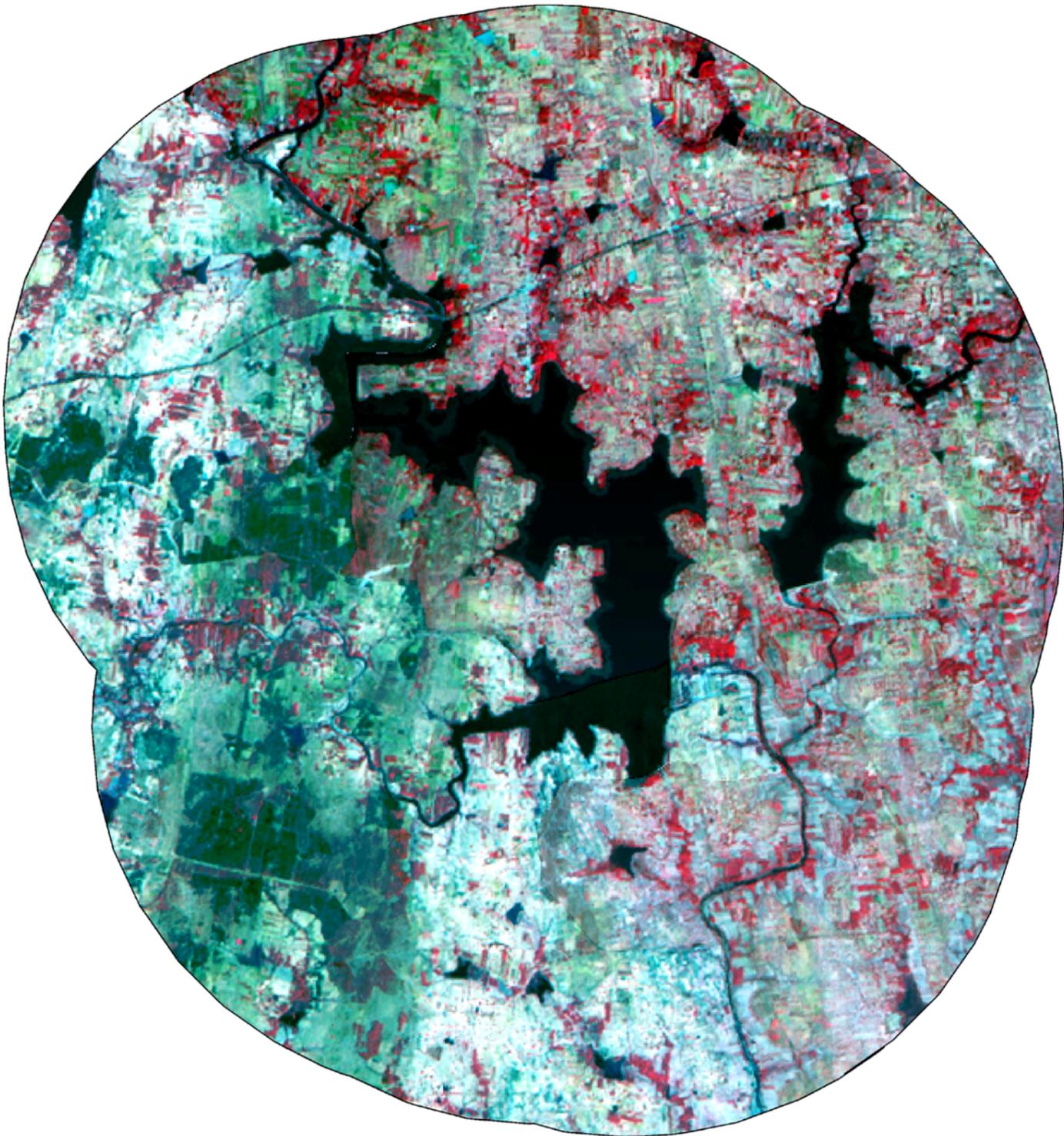
**Data Source :**  
 IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

**Prepared By :**  
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Plate 17: Wetland map - 5 km buffer area of Markonahalli Reservoir





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

Plate 18: IRS LISS-III FCC - 5 km buffer area of Markonahalli Reservoir

## 9.6 Kali River Estuary

### Estuaries of the Karnataka Coast:

A series of estuarine systems along 320 km of the Karnataka coast, from Karwar Bay in the north to Talapadi (Dakshina Kannada district) in the south. The Karnataka coast includes three districts of Uttara Kannada, Udupi and Dakshina Kannada. Fast-flowing rivers descending from the Western Ghats to the Arabian Sea slow down as they reach the coast and spread out into wide estuaries, lagoons, creeks, aquaculture ponds, saltpans and backwaters with extensive mudflats and many patches of mangroves forest. The mouths of most of these estuaries and creeks are narrow and permanently open to the sea. In some cases, the width of the mouth has been reduced by sand accretion. Many fish and prawn farms are located in the vicinity of the mangroves areas. Few important estuarine systems are, Estuary of the Kali River in Karwar Bay, Estuary of the Aghanashini River in Gokarna Bay, Estuary of the Varahi River in Kundapur Bay and Estuary of the Netravathi River in Mangalore Bay.

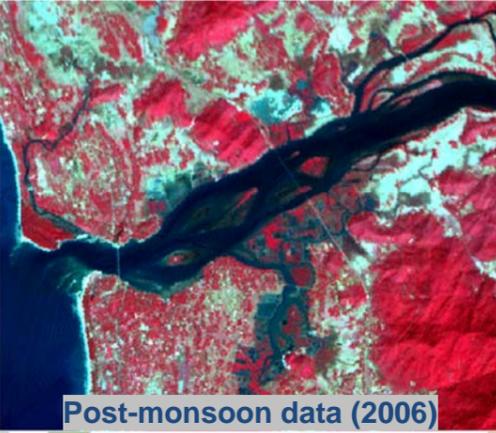
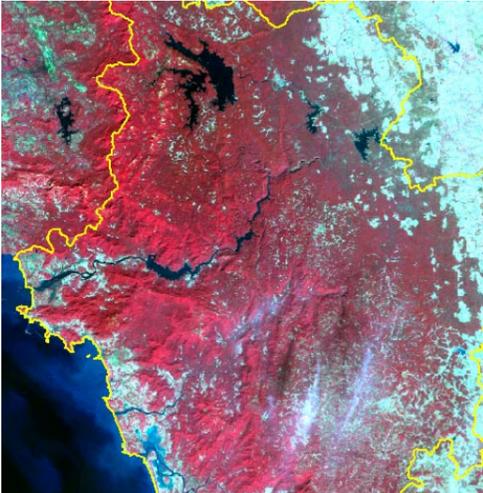
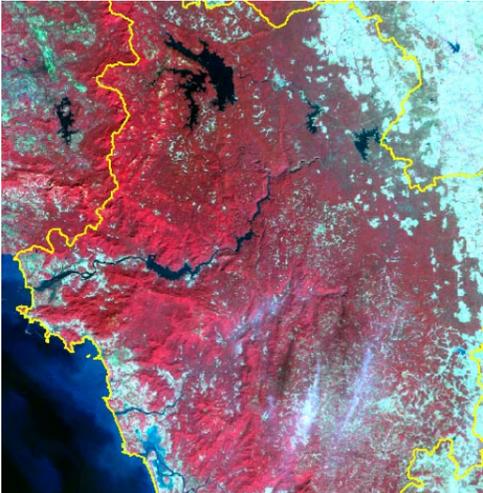
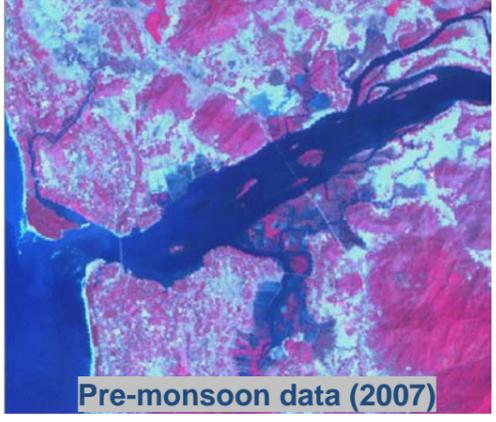
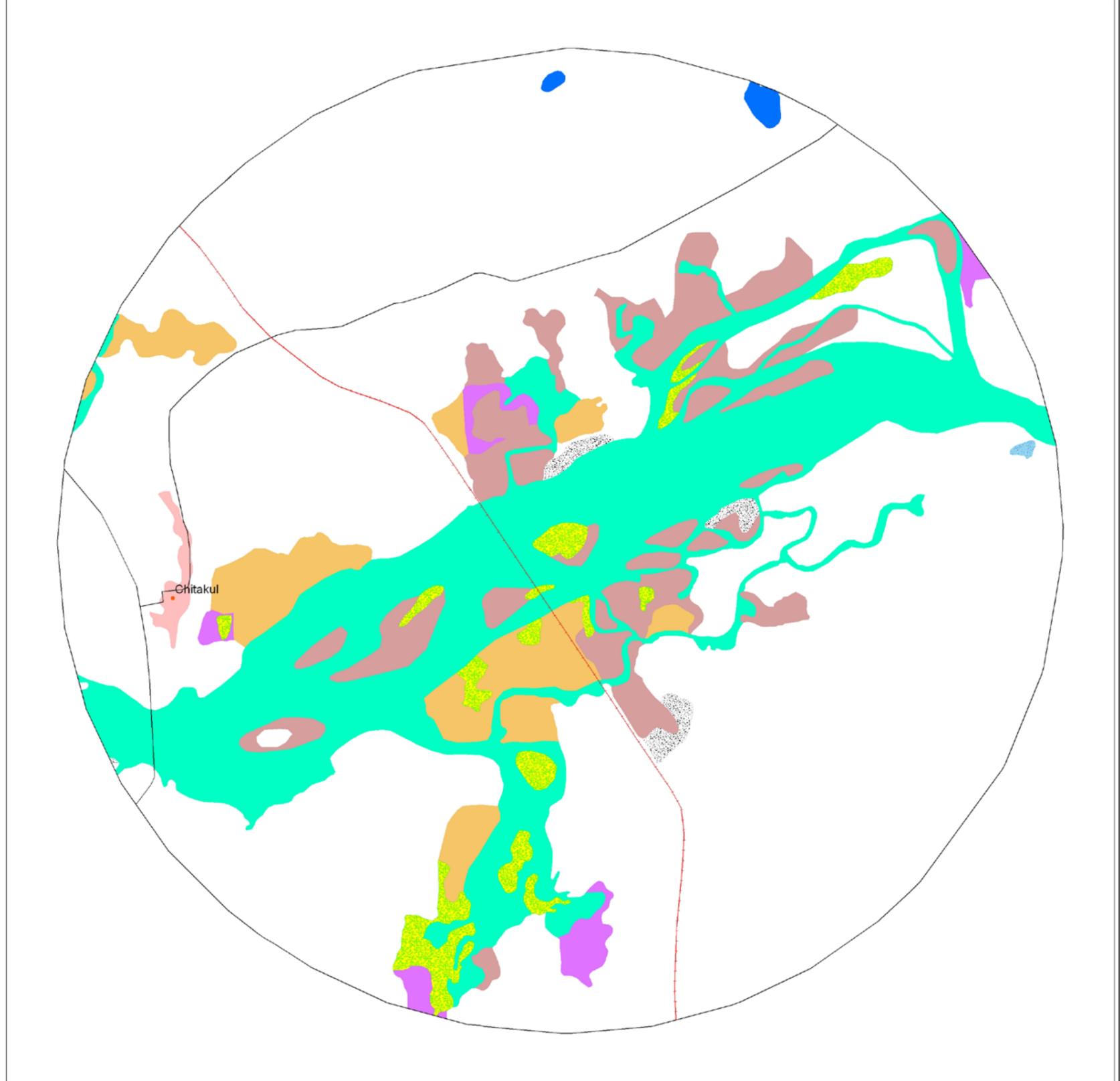
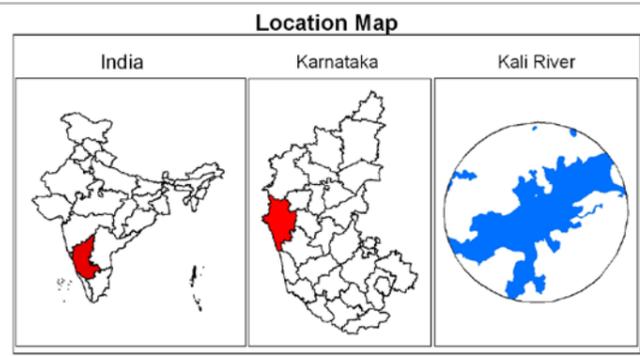
<p><b>Name:</b> Kali River</p> <p><b>Location:</b>  Latitude : 14° 51' 08" N  Longitude: 74° 09' 21" E</p> <p>Located at the border of Udupi, Belgaum and Haveri districts.</p> <p><b>Area:</b> 20,000 ha</p> <p><b>Wetland type:</b> River (Estuary)</p> <p><b>Average Annual Rainfall:</b></p>	 <p>Post-monsoon data (2006)</p>
<p>2500 mm, mostly occurring during June to September</p> <p><b>Description:</b></p> <p>Mangroves forest is particularly well developed in the Kali, Gangavalli, Aghanashini Rivers. Much of the intervening coastline is sandy beach backed by coastal dunes, but there are some short stretches of rocky shore. The total areas of the estuaries are about 20,000 ha.</p>	
	
	 <p>Pre-monsoon data (2007)</p>

Plate 19: Kali River Estuary



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



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

**Prepared By :**  
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and  
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Plate 20: Wetland map - 5 km buffer area of Kali River Estuary





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

Plate 21: IRS LISS-III FCC - 5 km buffer area of Kali River Estuary

## 9.7 Varahii River

**Name:** Varahi River

**Location:**

Latitude : 13° 38' 27" N  
Longitude: 74° 42' 11" E

Located at the border of Uttara Kannada, Dakshina Kannada and Shimoga districts.

**Area:** 20,000 ha

**Wetland type:** River (Estuary)

**Average Annual Rainfall:**

2500 mm, mostly occurring during June to September

**Description:**

Mangroves forest is particularly well developed in the Varahi, Talluru, Seeta, Swarna, Netravathi, Gurupura, Mulki and at the confluence of the Chakra Nadi, Kollur and Haladi Rivers near Gangolli Rivers (Kundapur). Much of the intervening coastline is sandy beach backed by coastal dunes, but there are some short stretches of rocky shore. The total areas of the estuaries are about 20,000 ha.

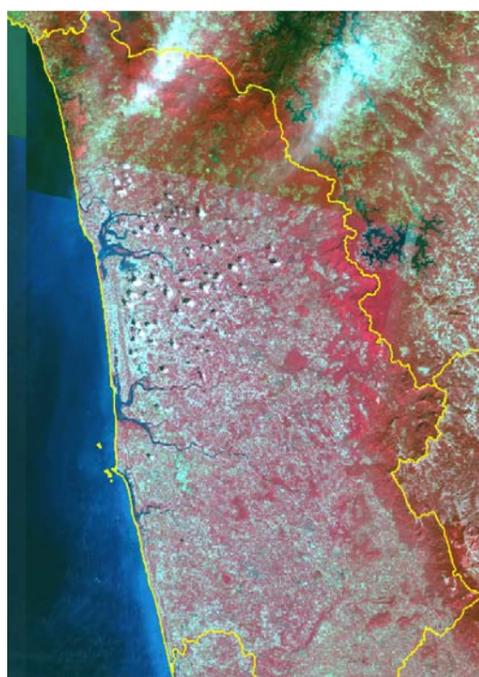
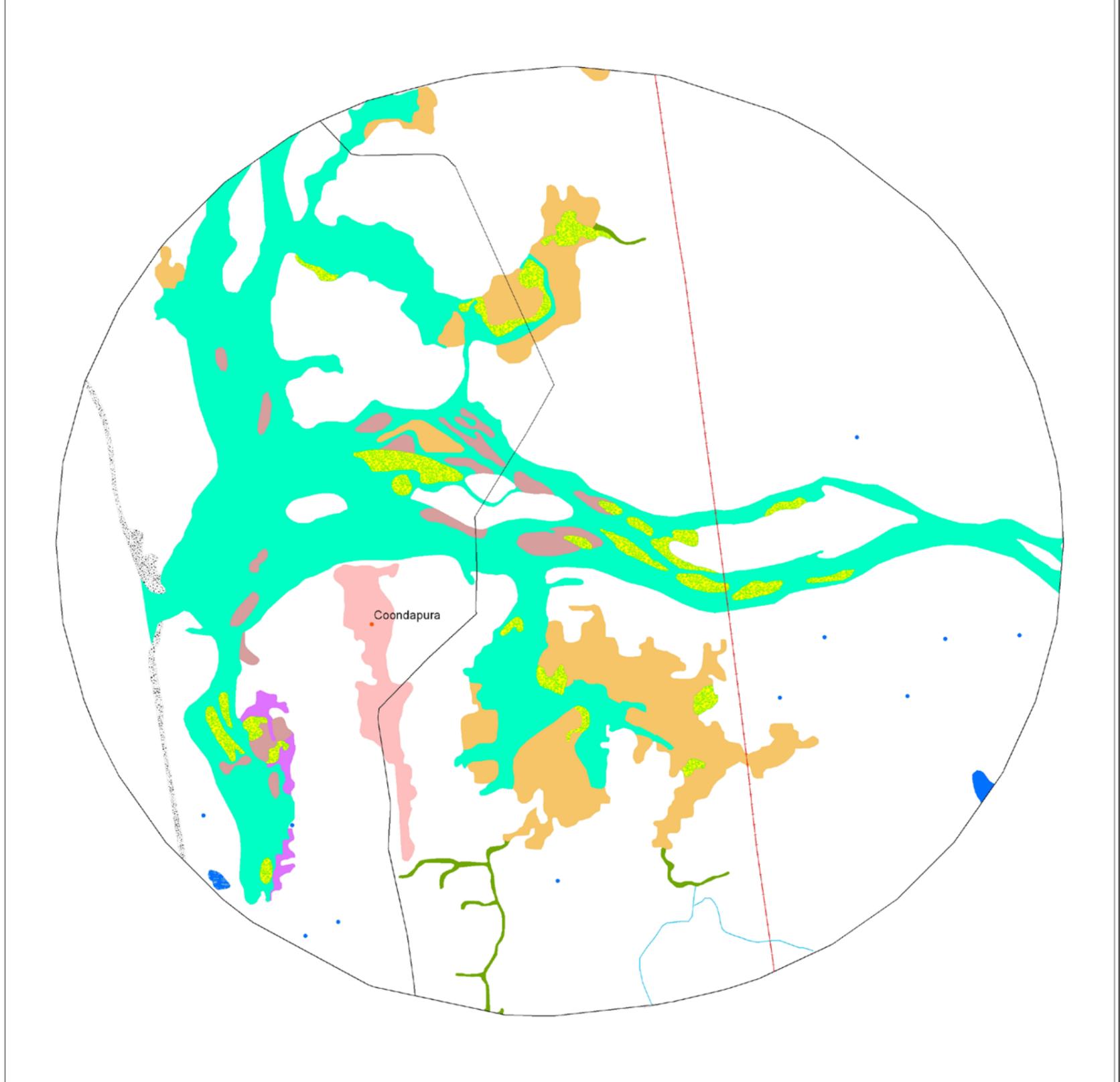
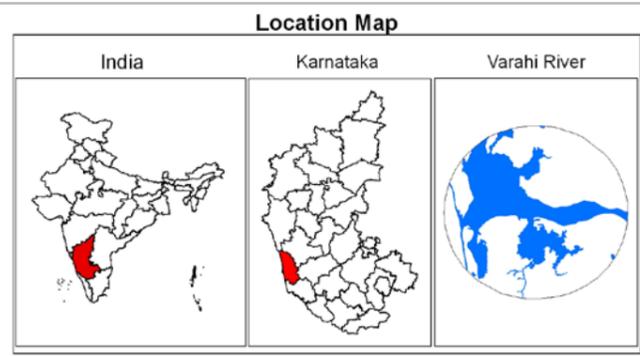


Plate 22: Varahii River



Symbol	Typecode	Level I	Level II	Level III
		<b>Inland Wetlands</b>		
			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
		<b>Coastal Wetlands</b>		
			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



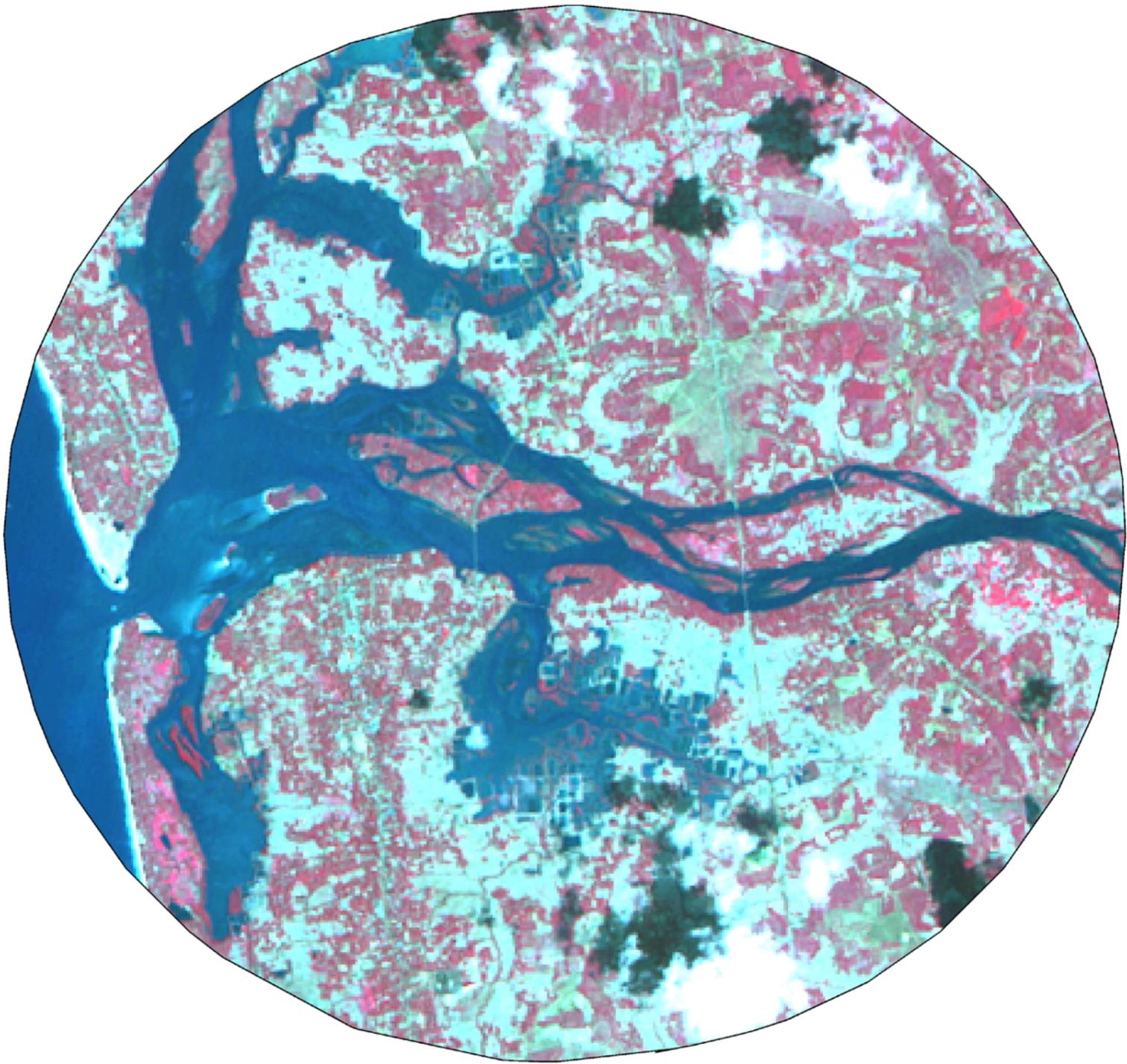
**Data Source :**  
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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Plate 23: Wetland map - 5 km buffer area of Varahi River





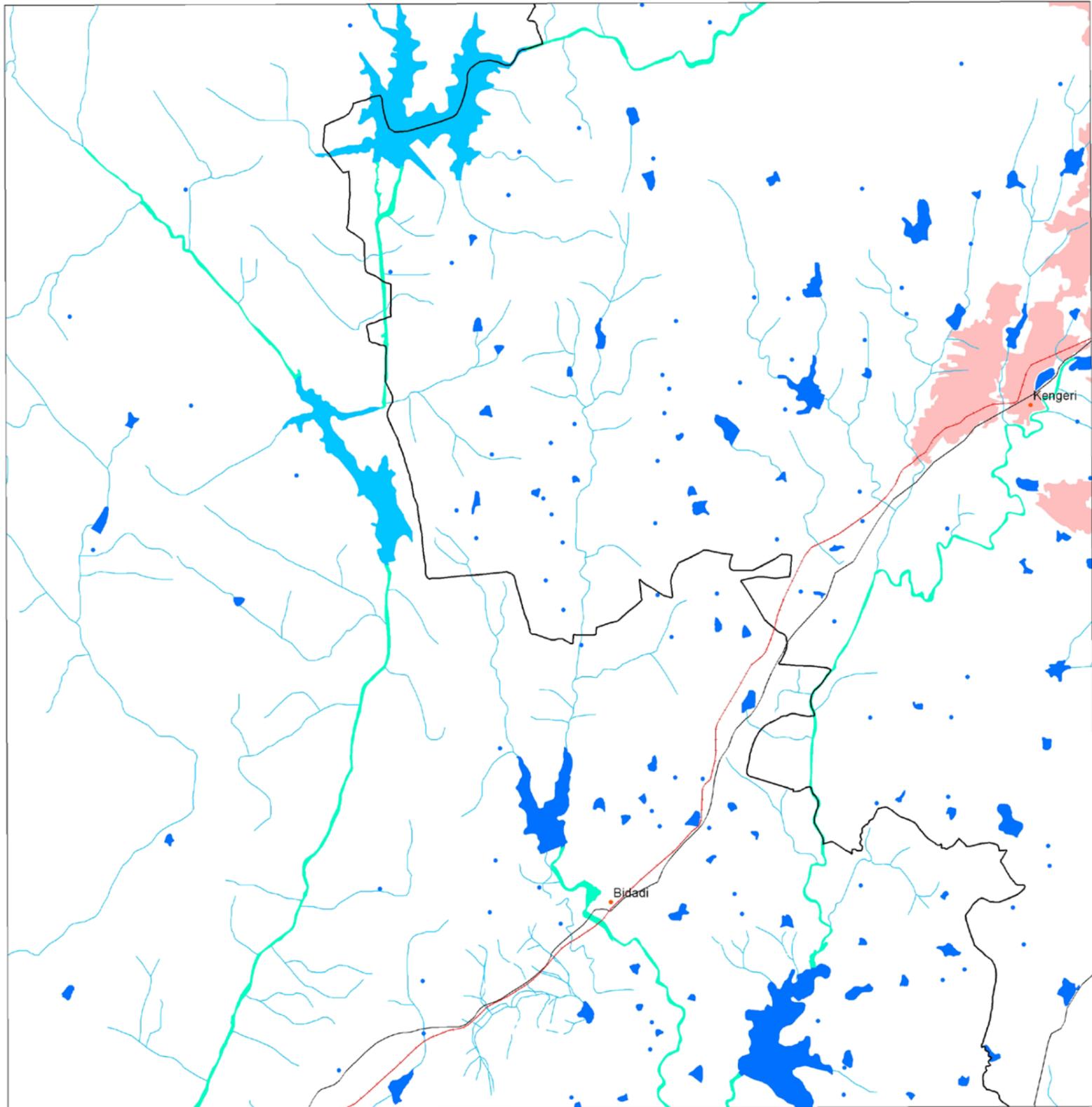
IRS P6 LISS-III Post-monsoon data (2006)

Plate 24: IRS LISS-III FCC - 5 km buffer area of Varahi River



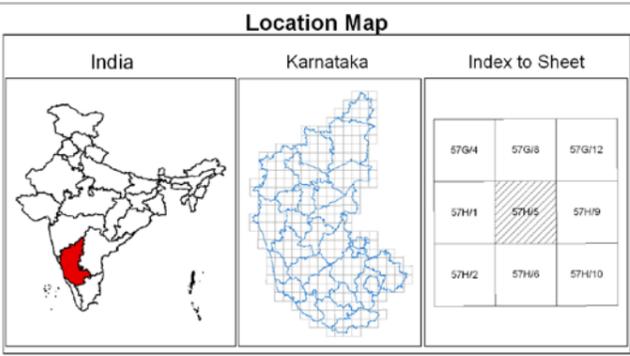
**SOI MAP-SHEET-WISE WETLAND MAPS**  
**(Selected)**





Symbol	Typecode	Level I	Level II	Level III
		<b>Inland Wetlands</b>		
			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
		<b>Coastal Wetlands</b>		
			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

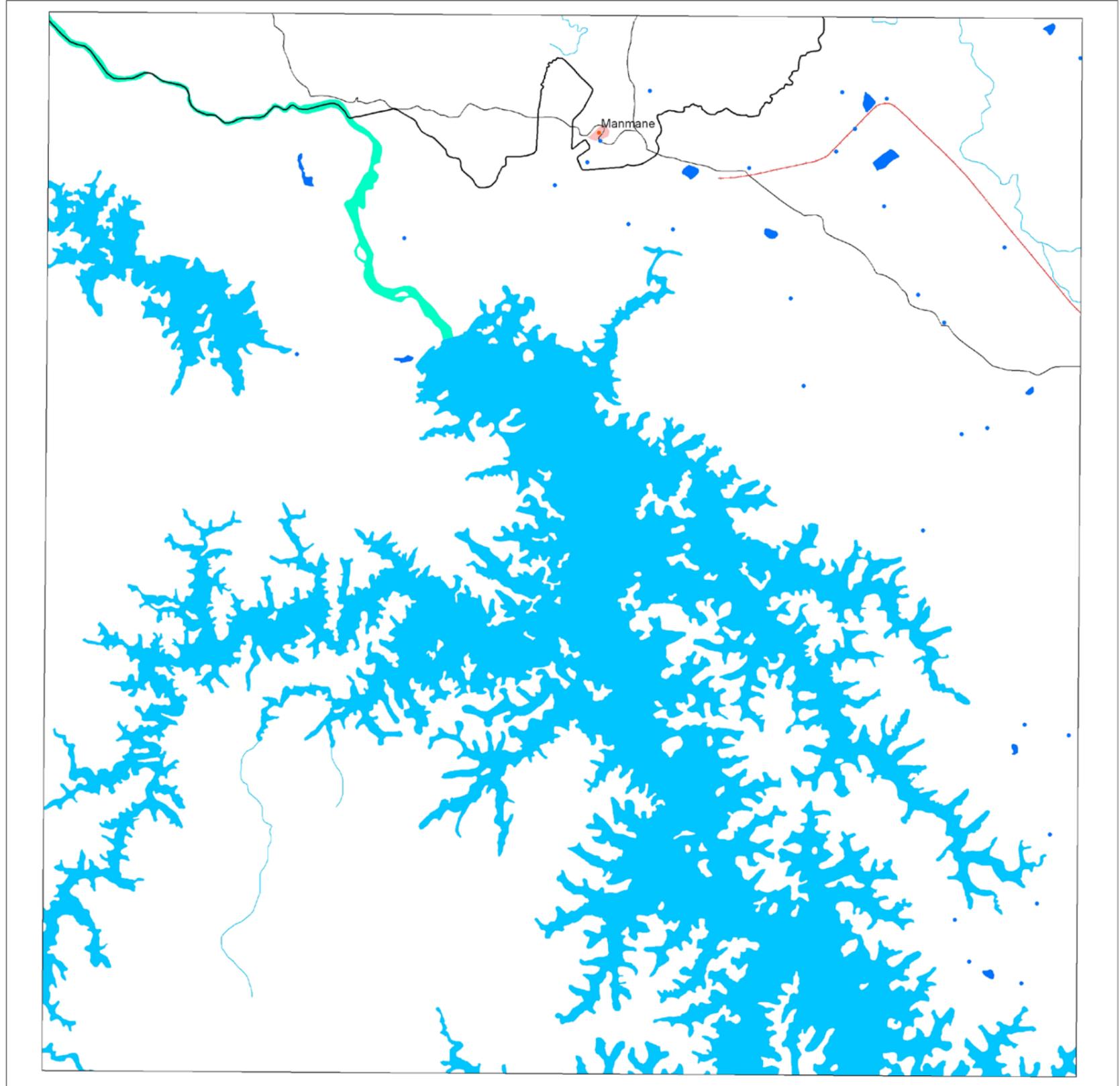
- Legend**
- Wetlands (<2.25 ha)
  - Settlements
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  - Railway
  - Drainage (line)
  - Roads
  - Town/Settlements
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**Data Source :**  
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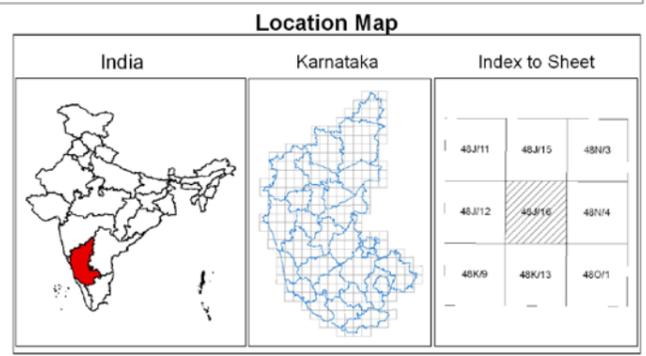
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Symbol	Typecode	Level I	Level II	Level III
		<b>Inland Wetlands</b>		
			Natural	
	1101			Lakes/Ponds
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	2107			Coral reefs
			Man-made	
	2201			Salt pans
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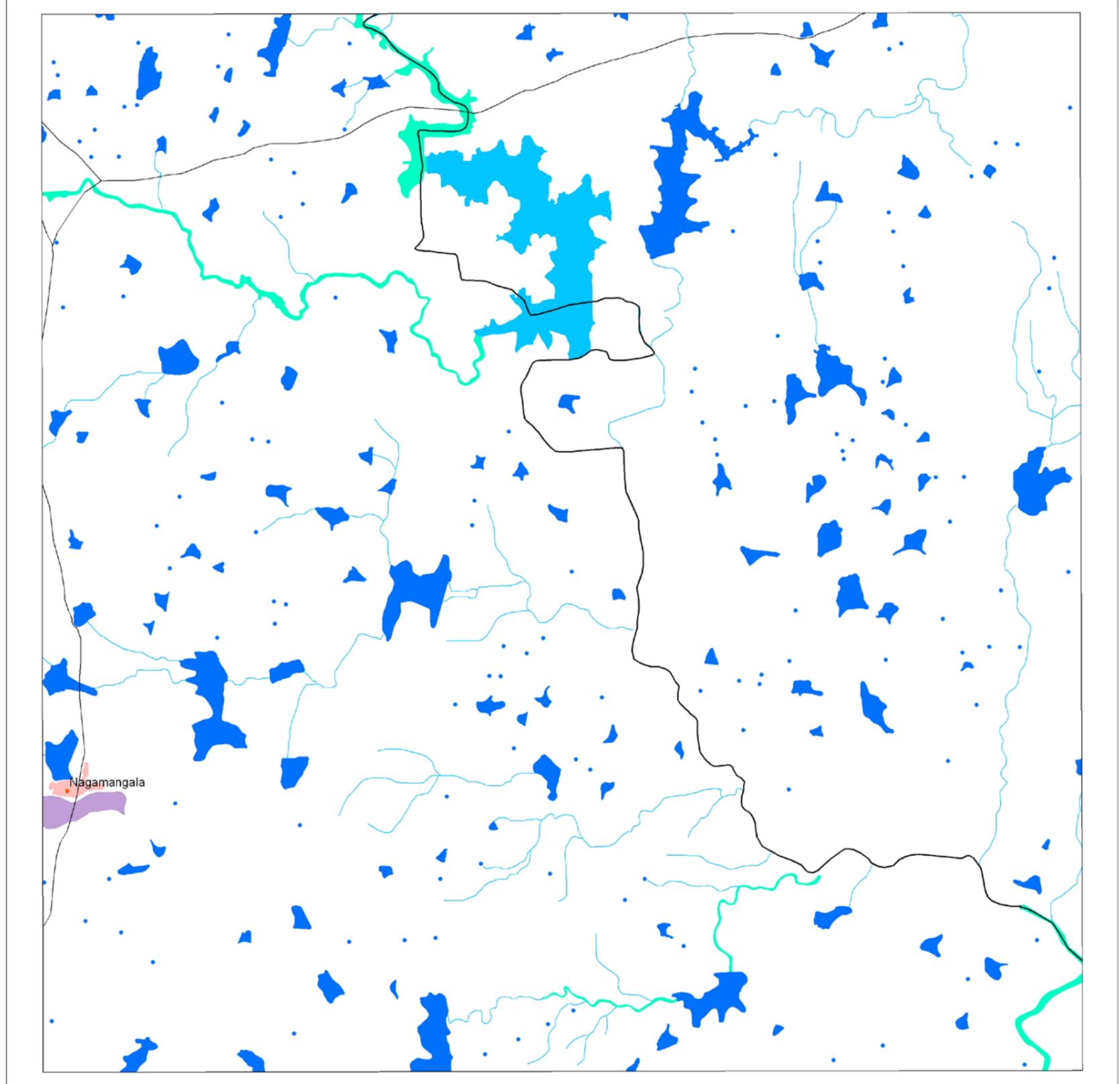
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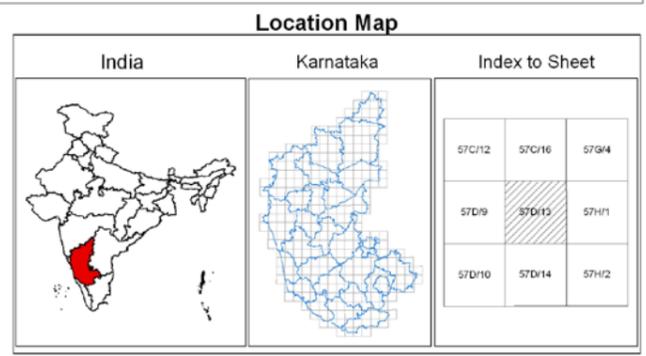
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			Man-made	
	2201			Salt pans
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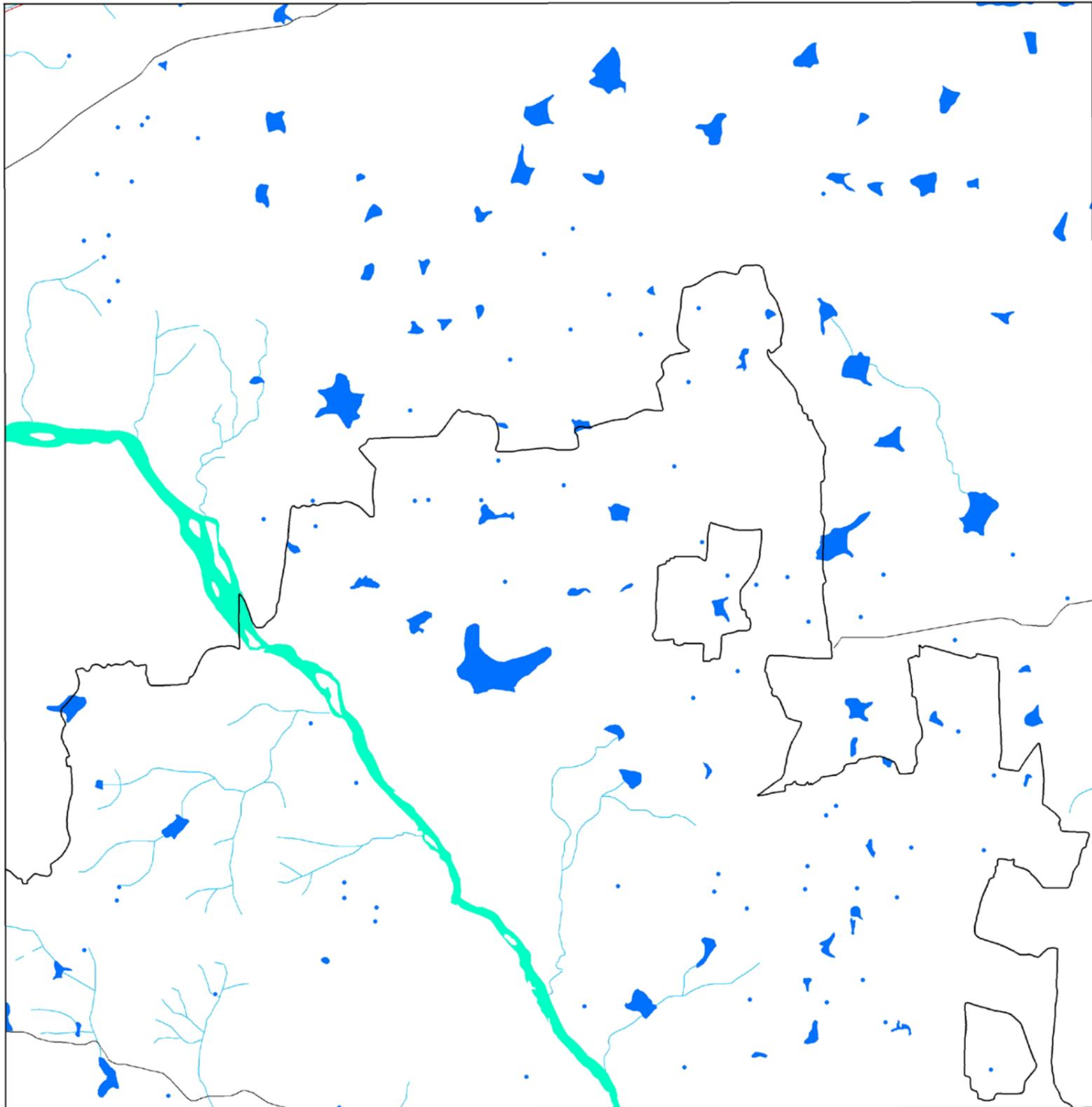
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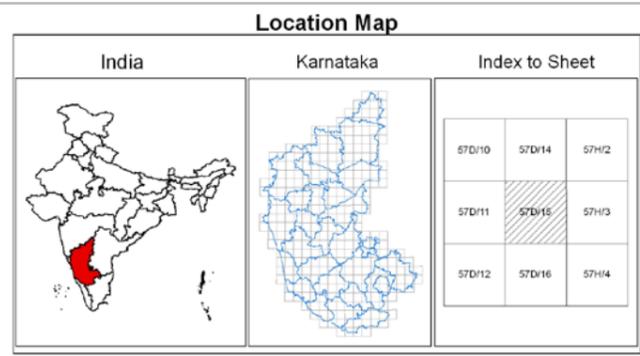
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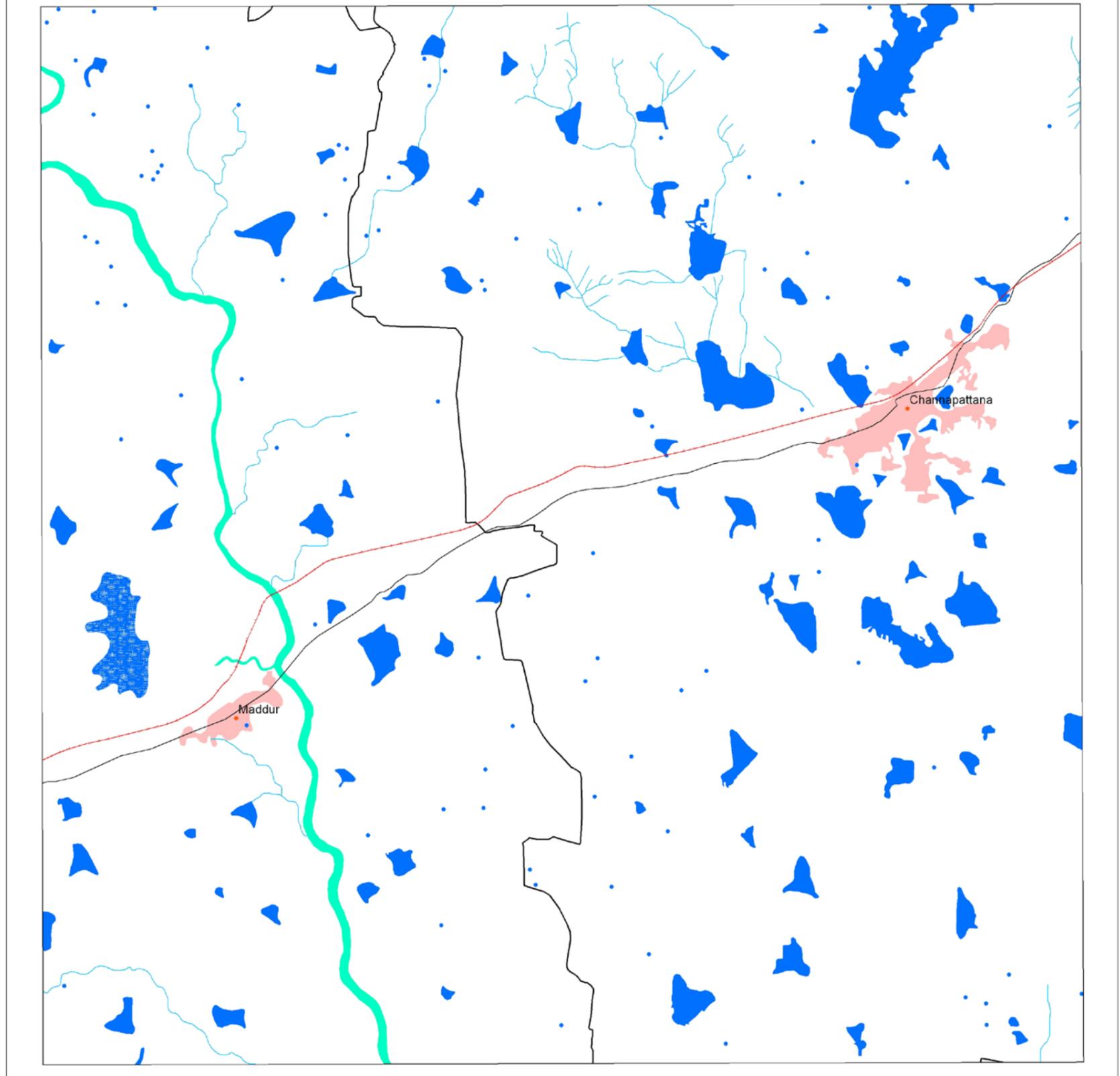
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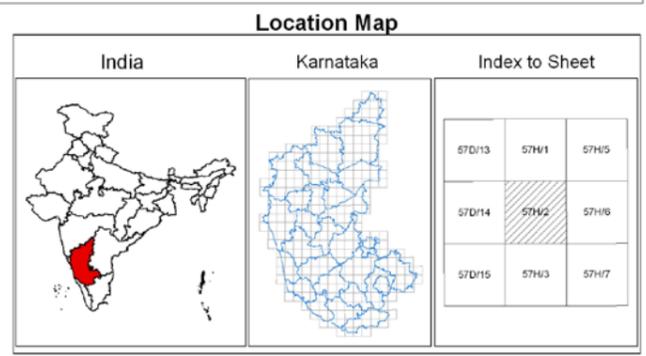
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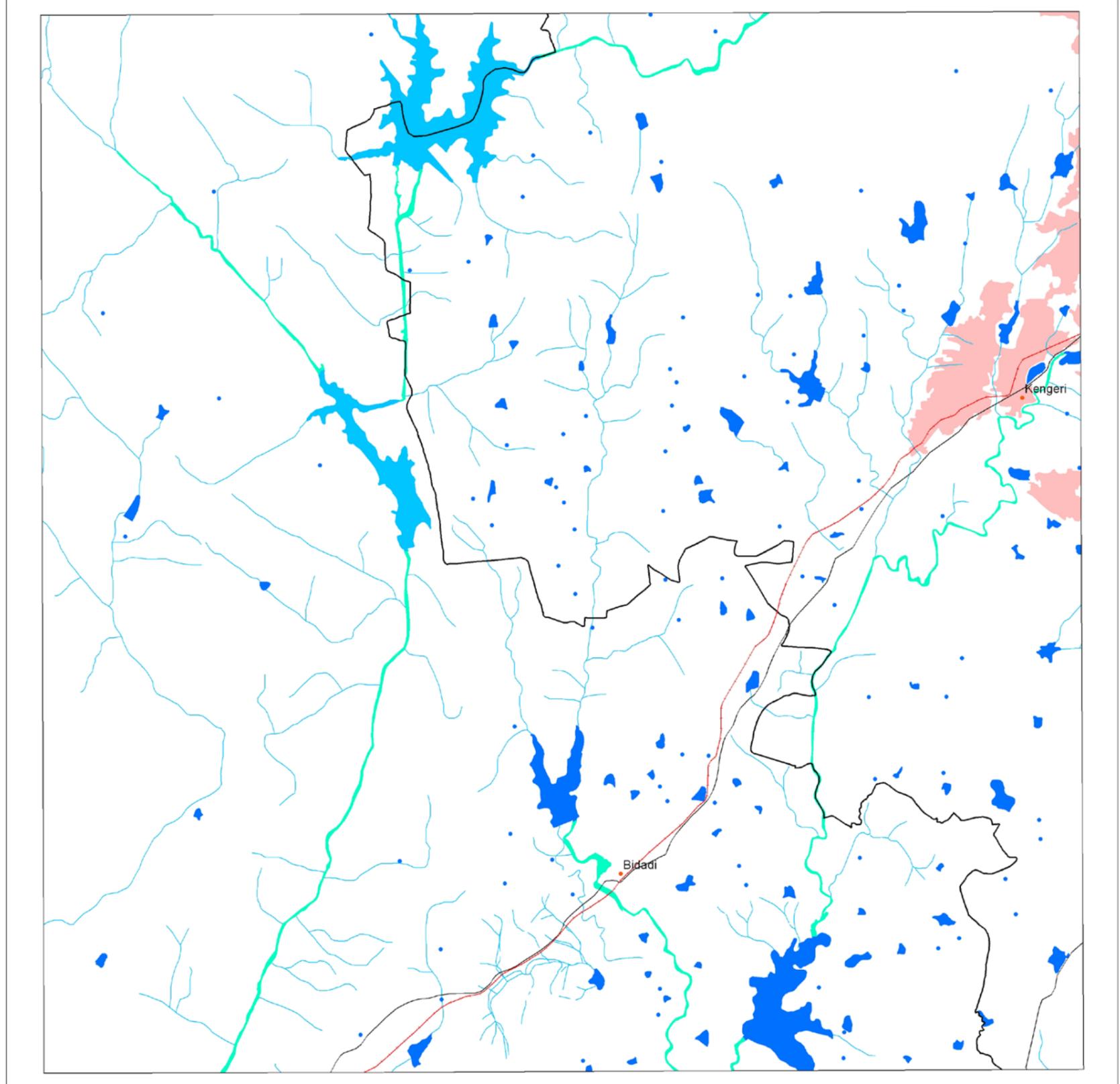
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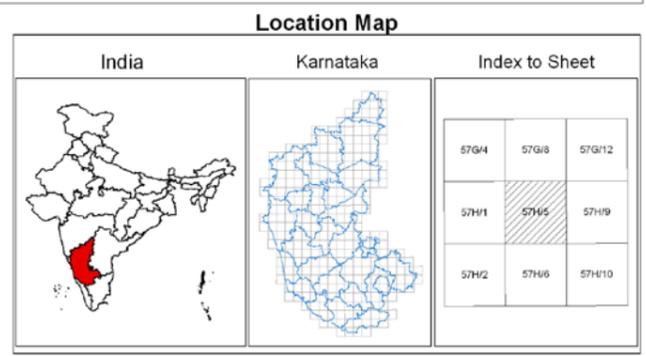
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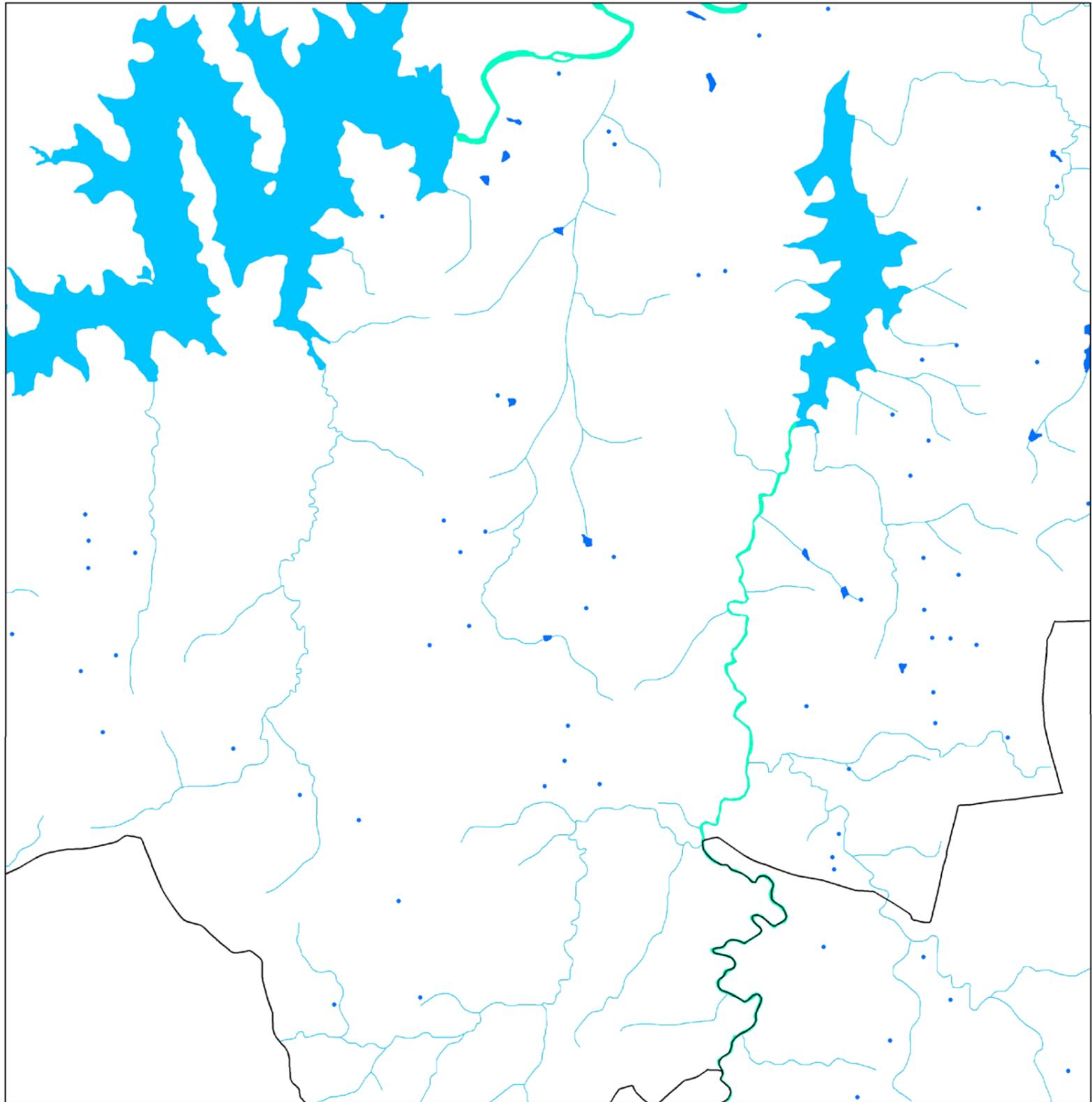
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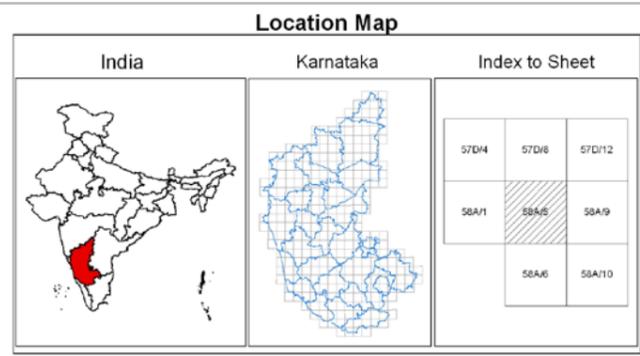
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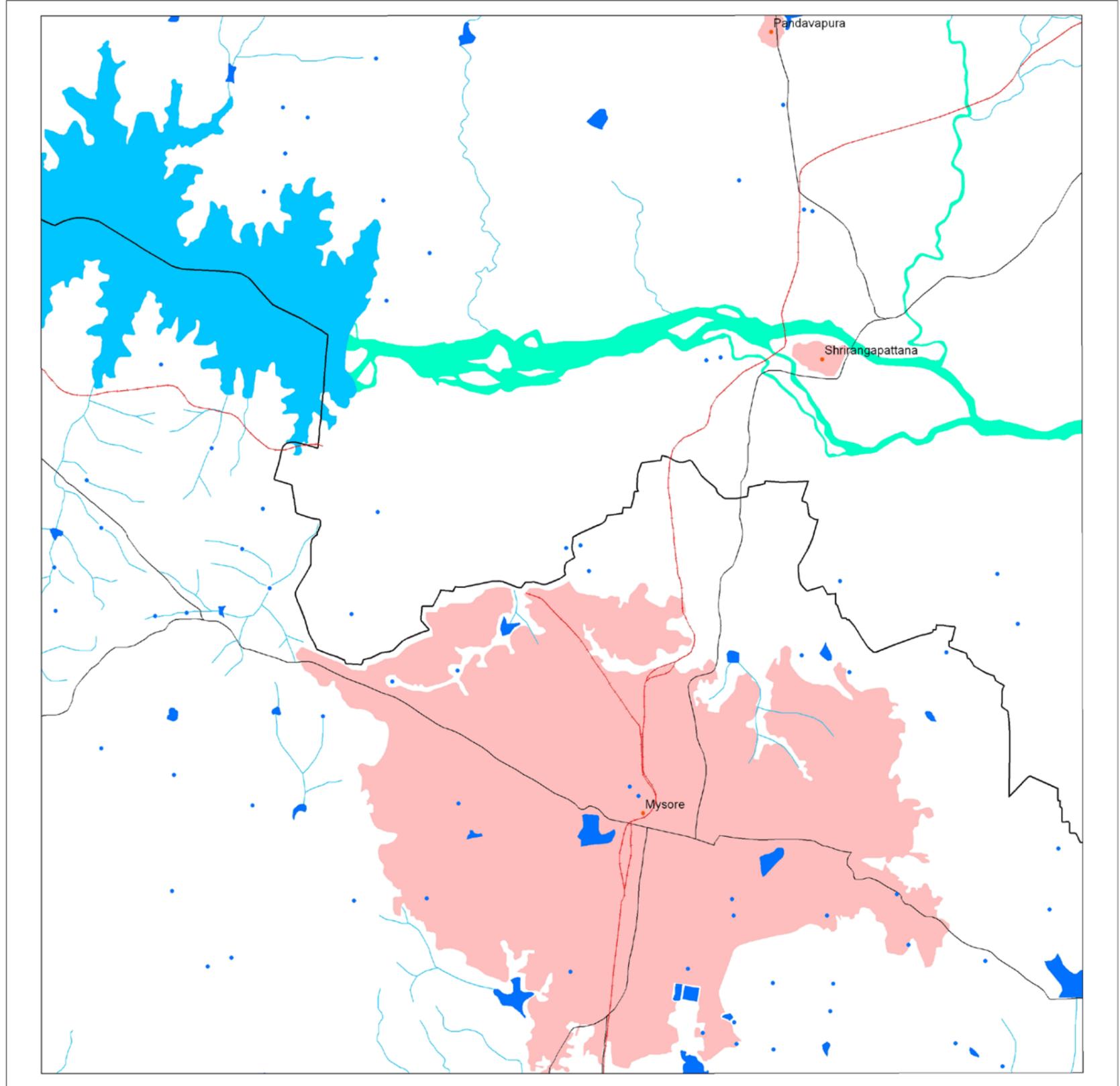
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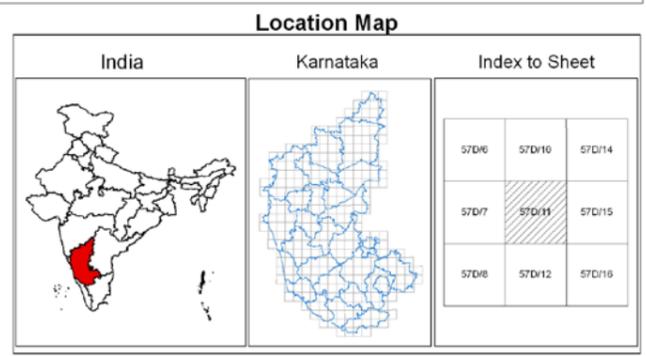
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		<b>Inland Wetlands</b>		
			Natural	
	1101			Lakes/Ponds
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	2202			Aquaculture ponds

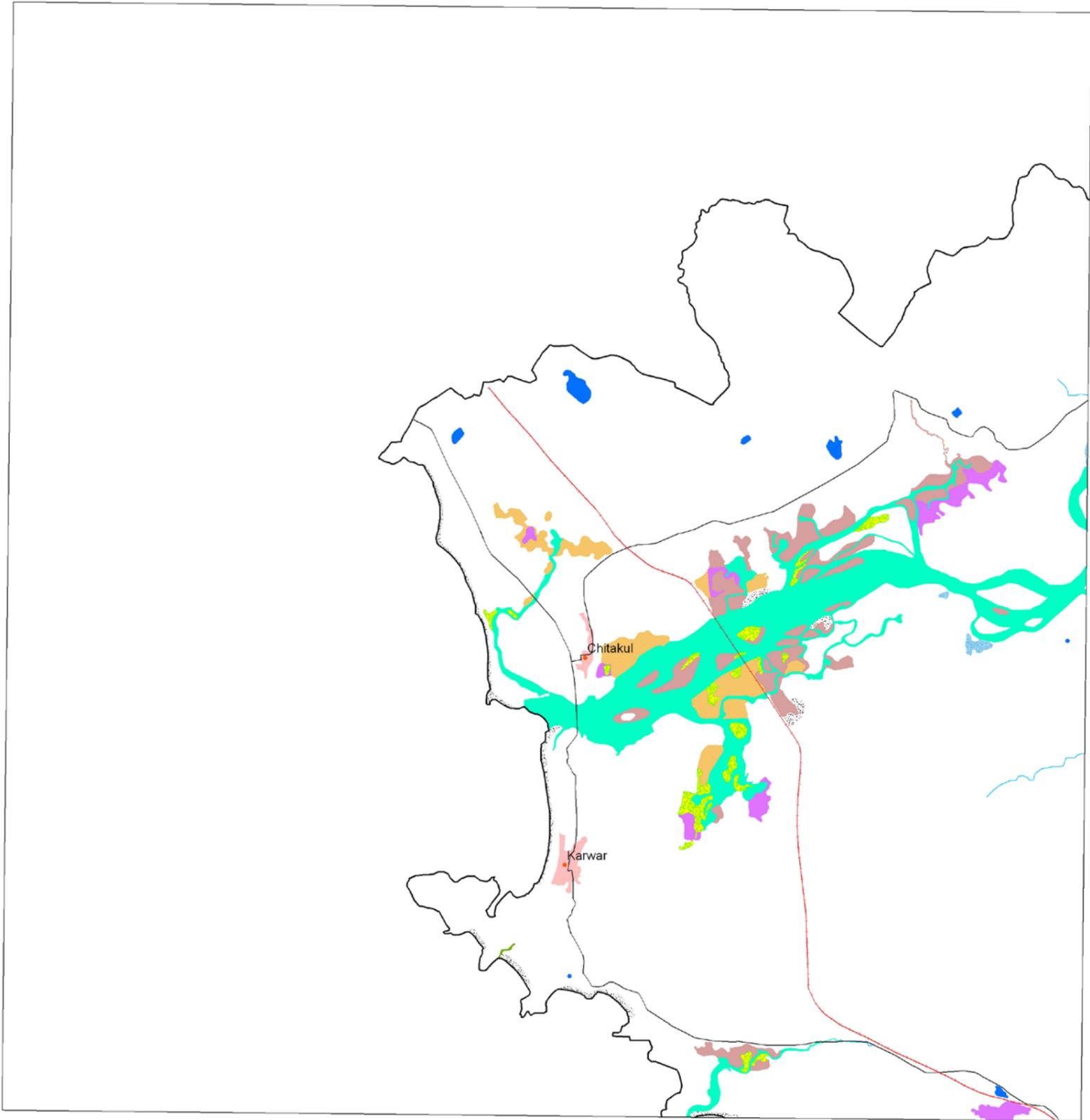
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**Data Source :**  
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

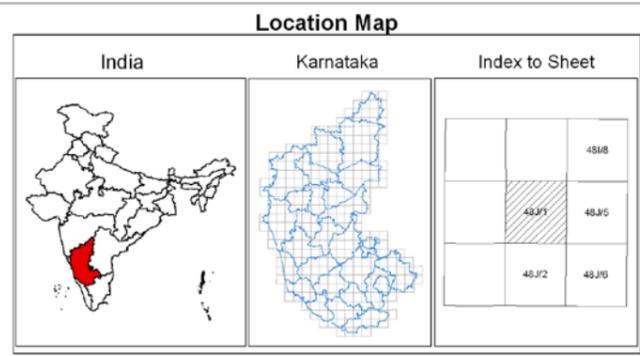
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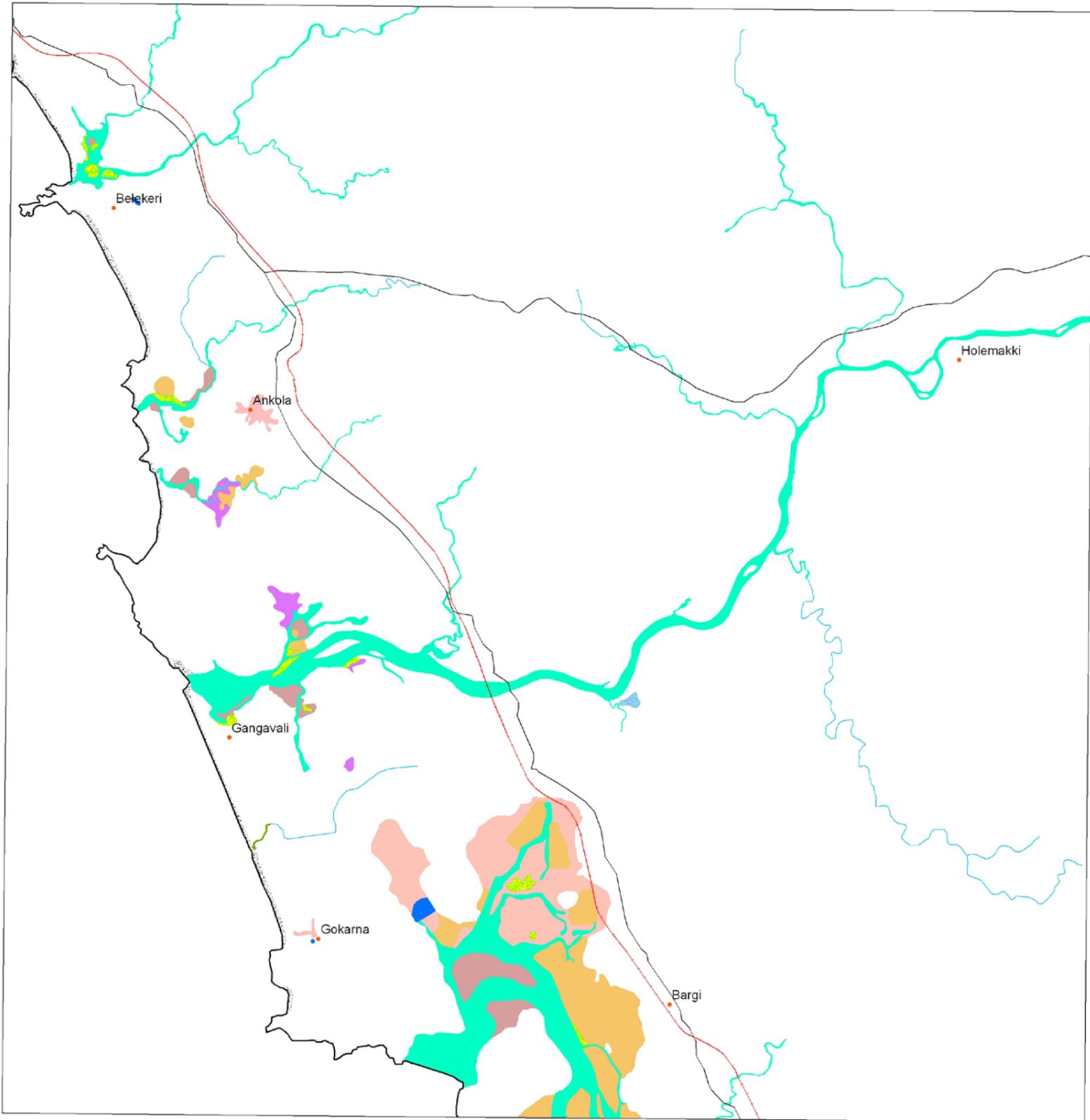
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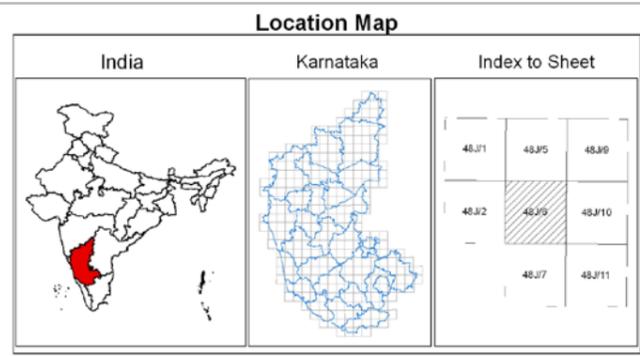
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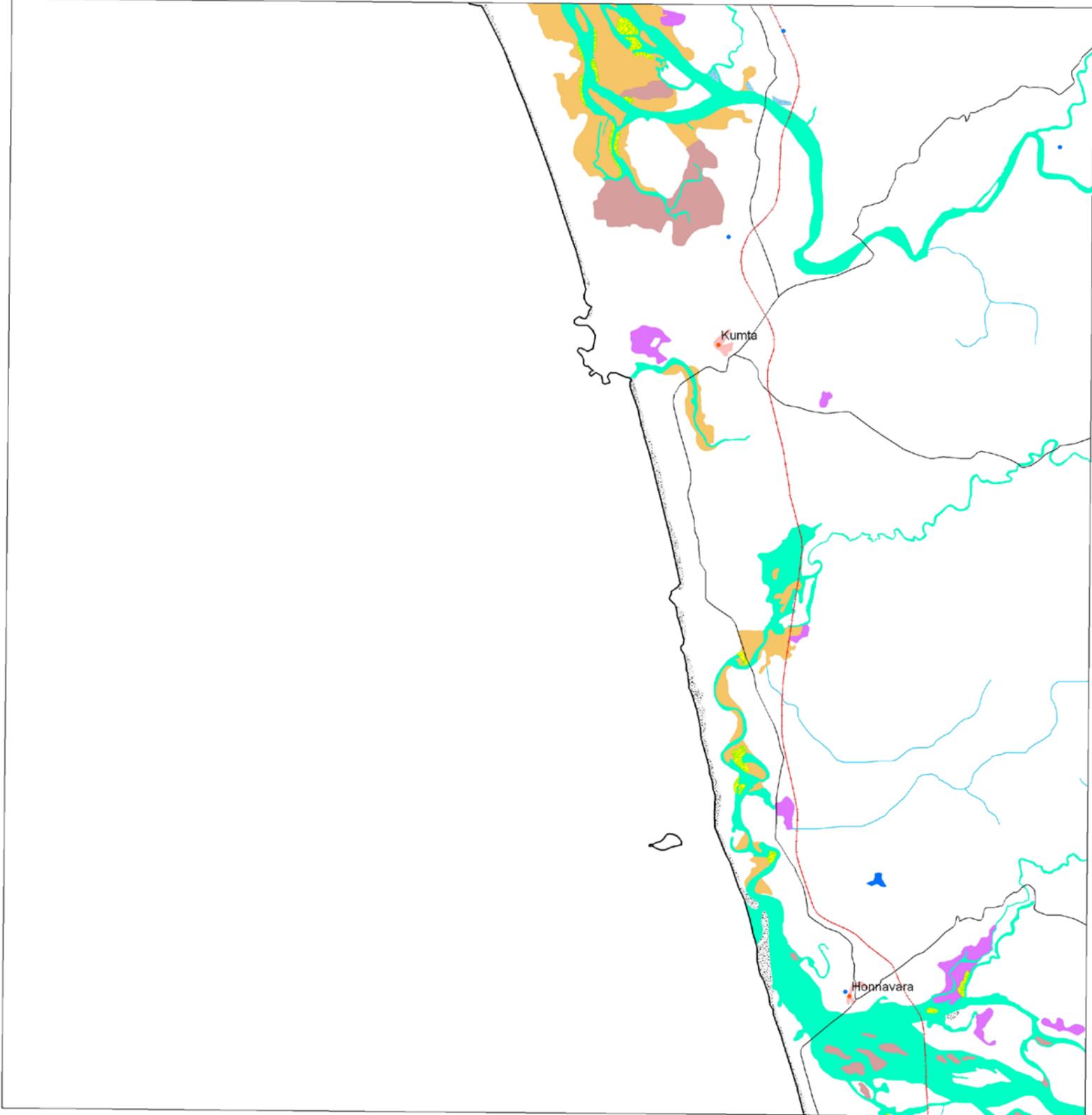
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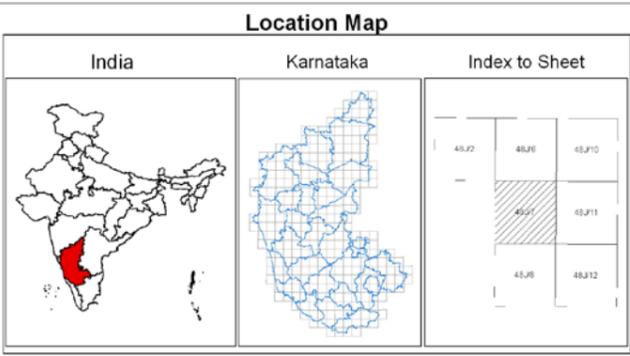
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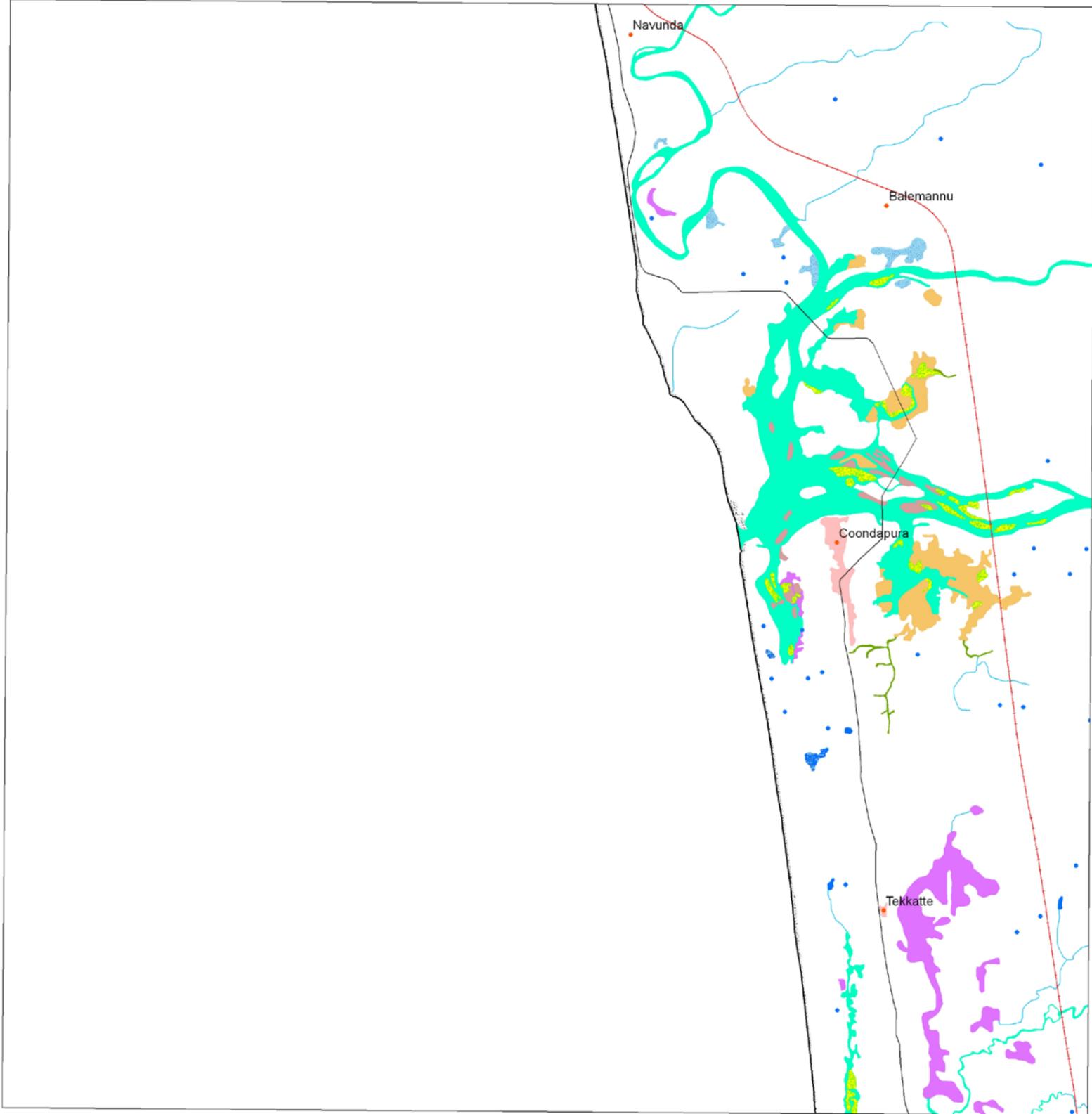
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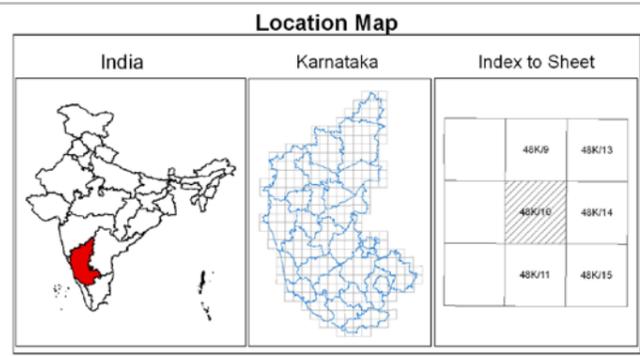
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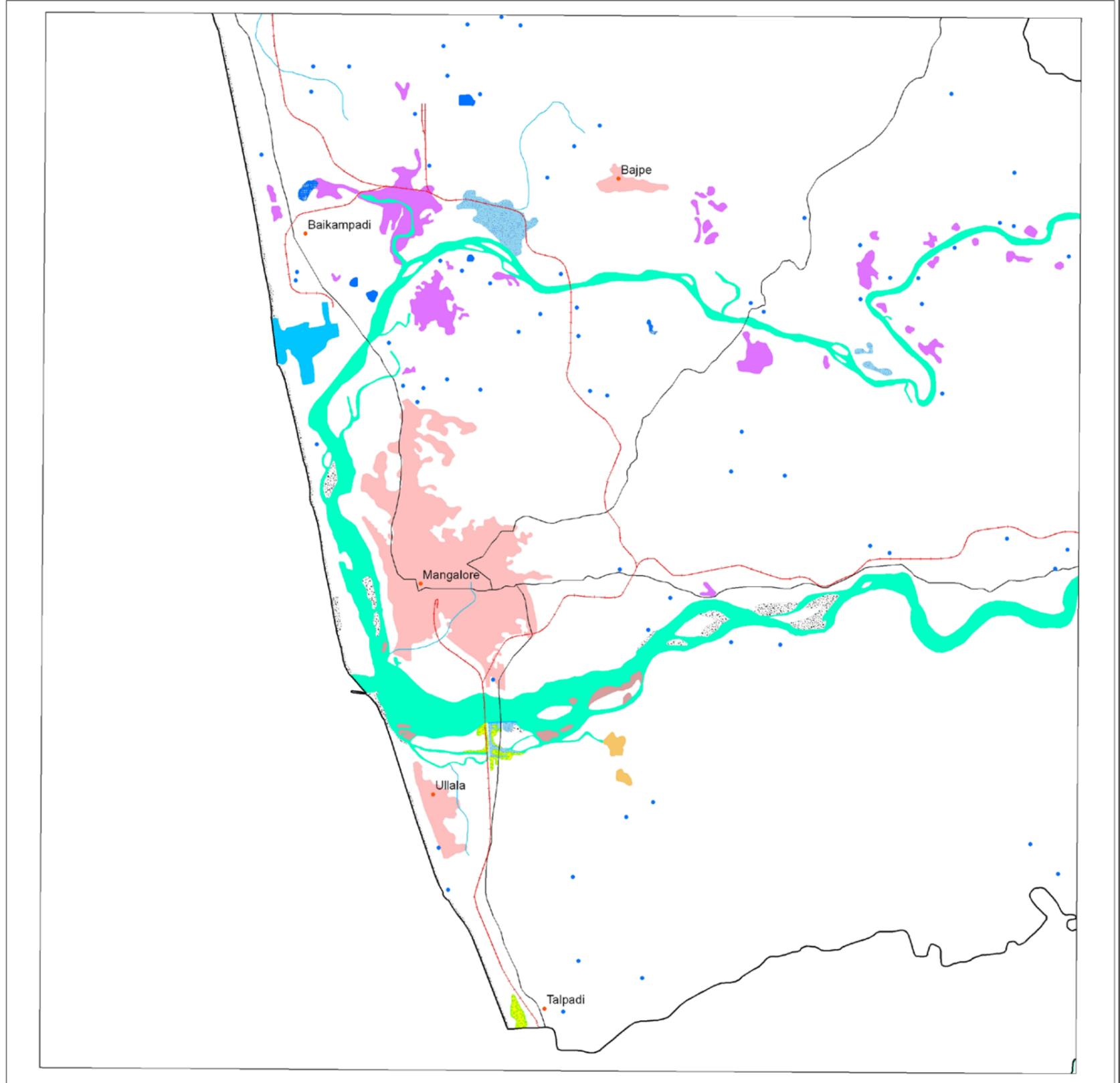
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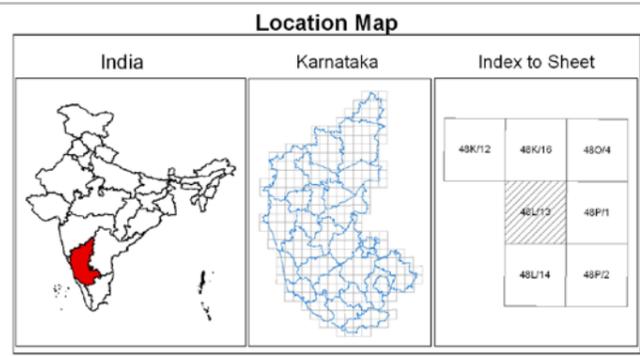
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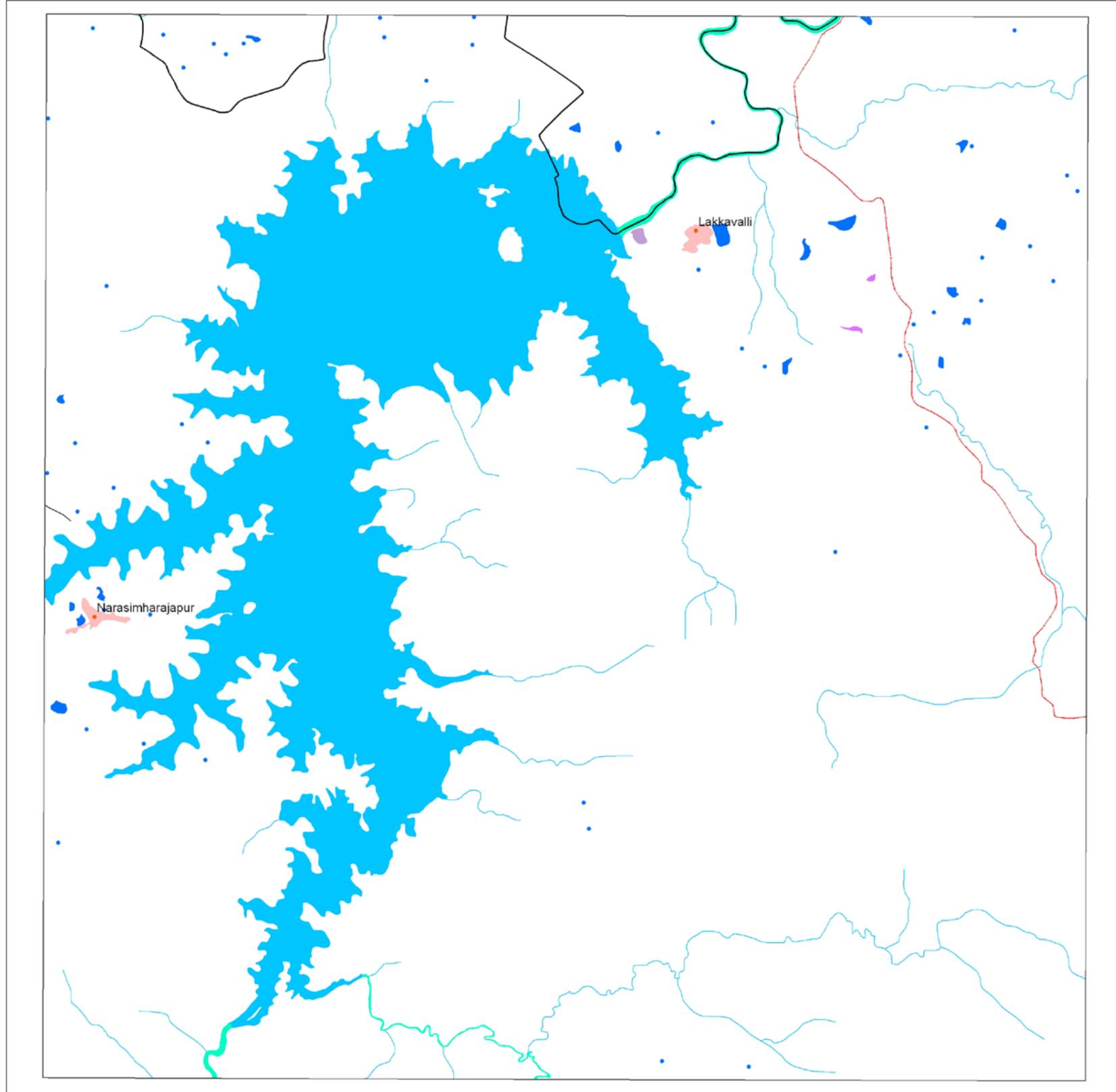


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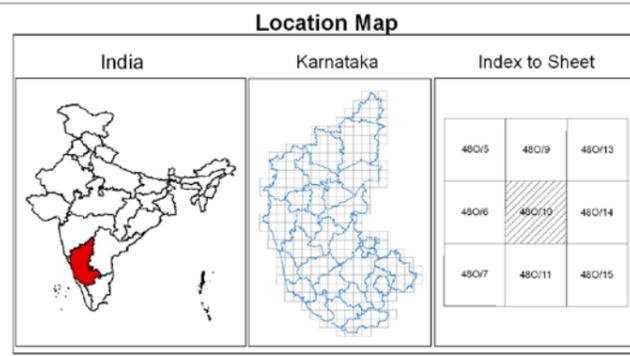
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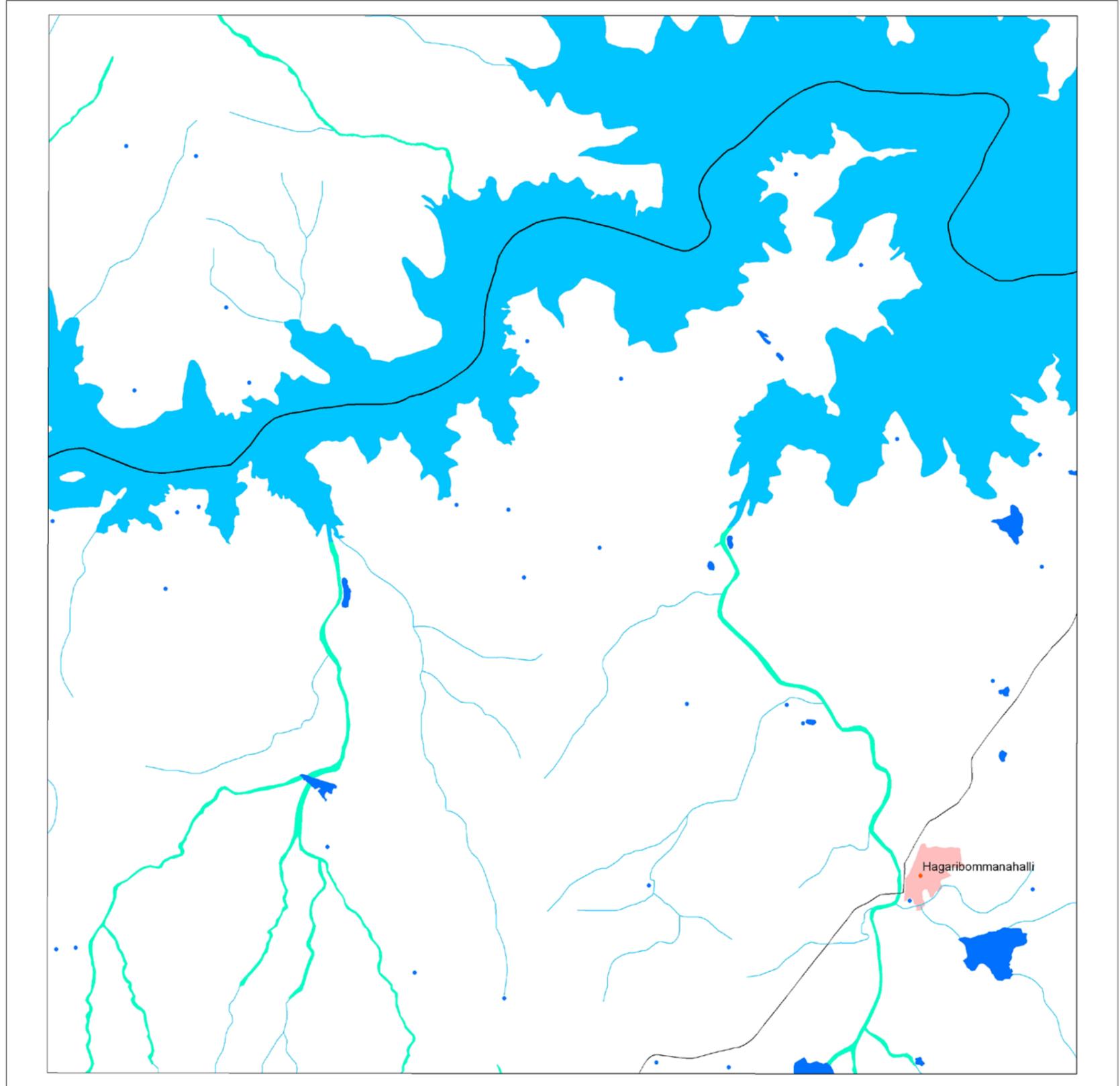
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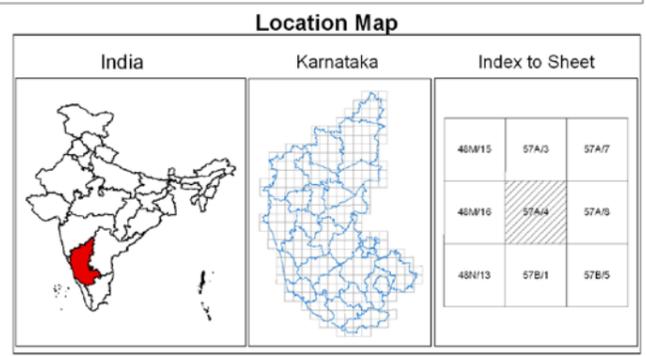
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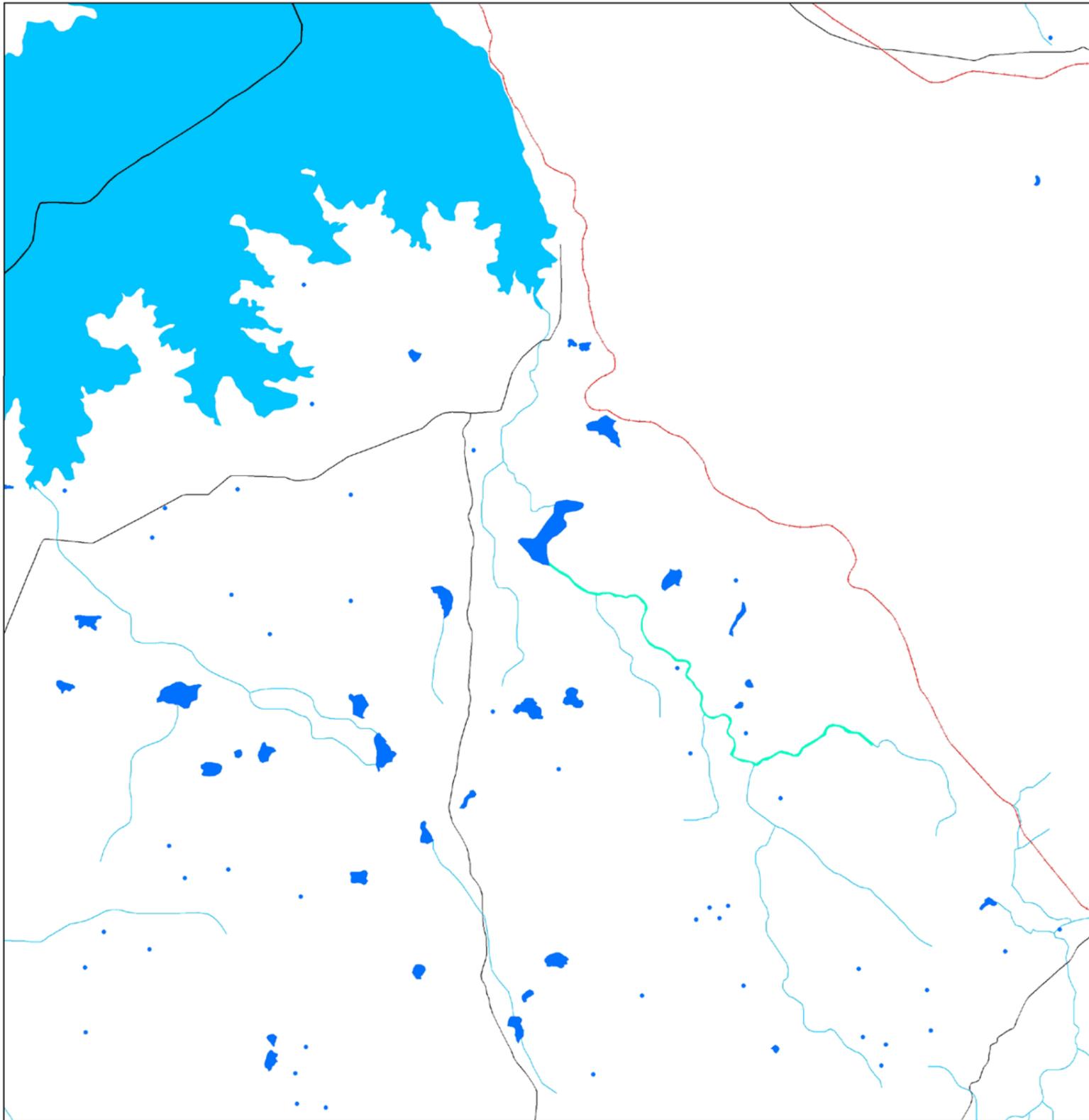


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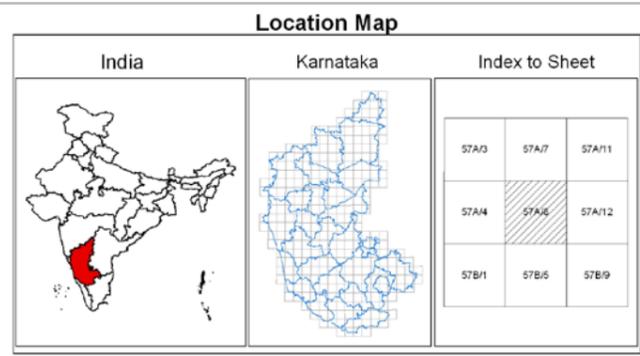
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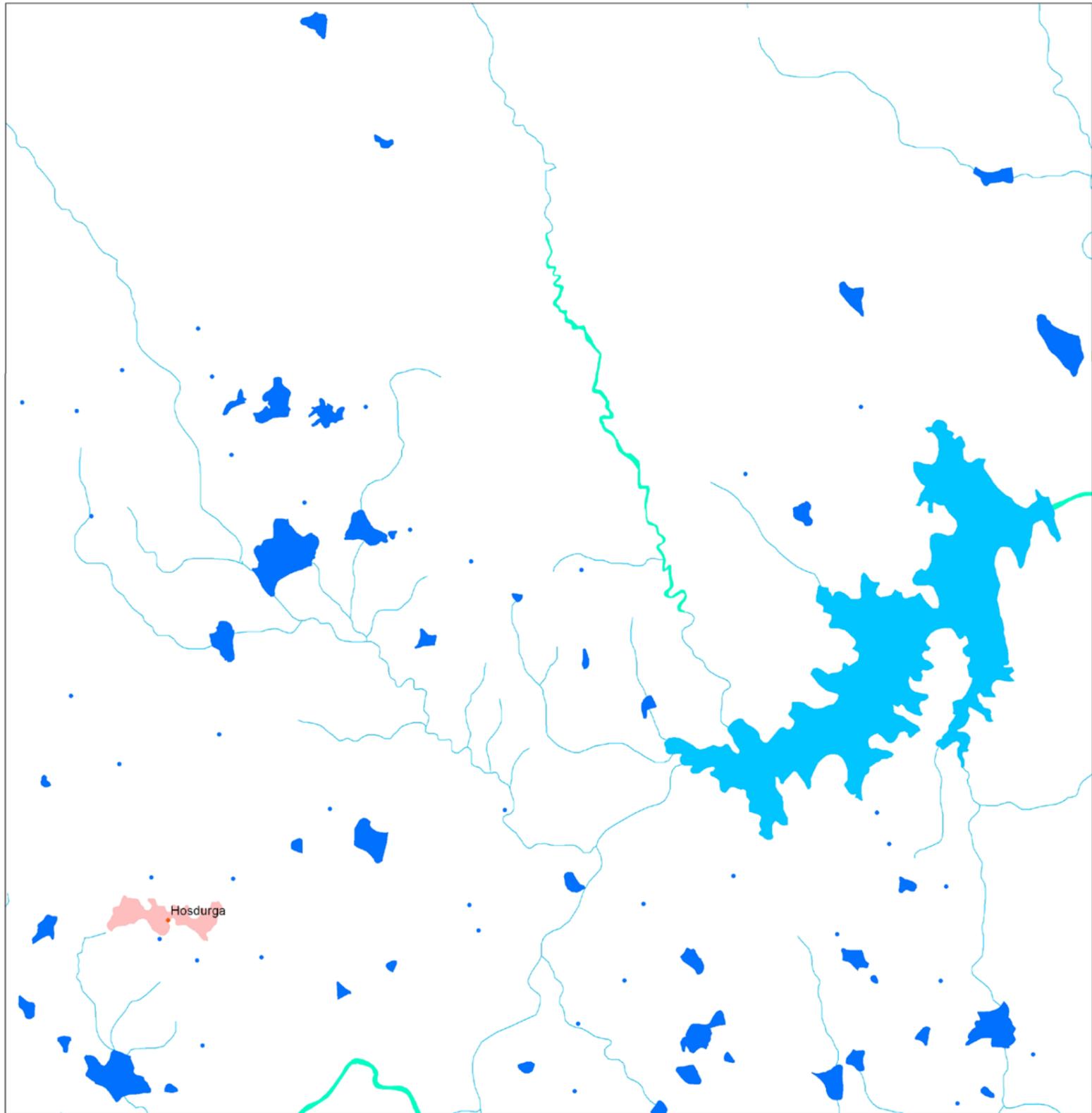
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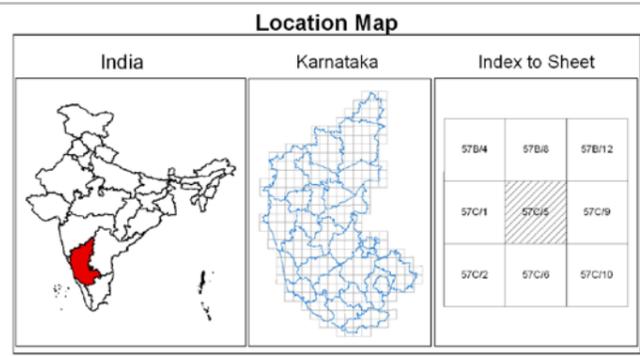
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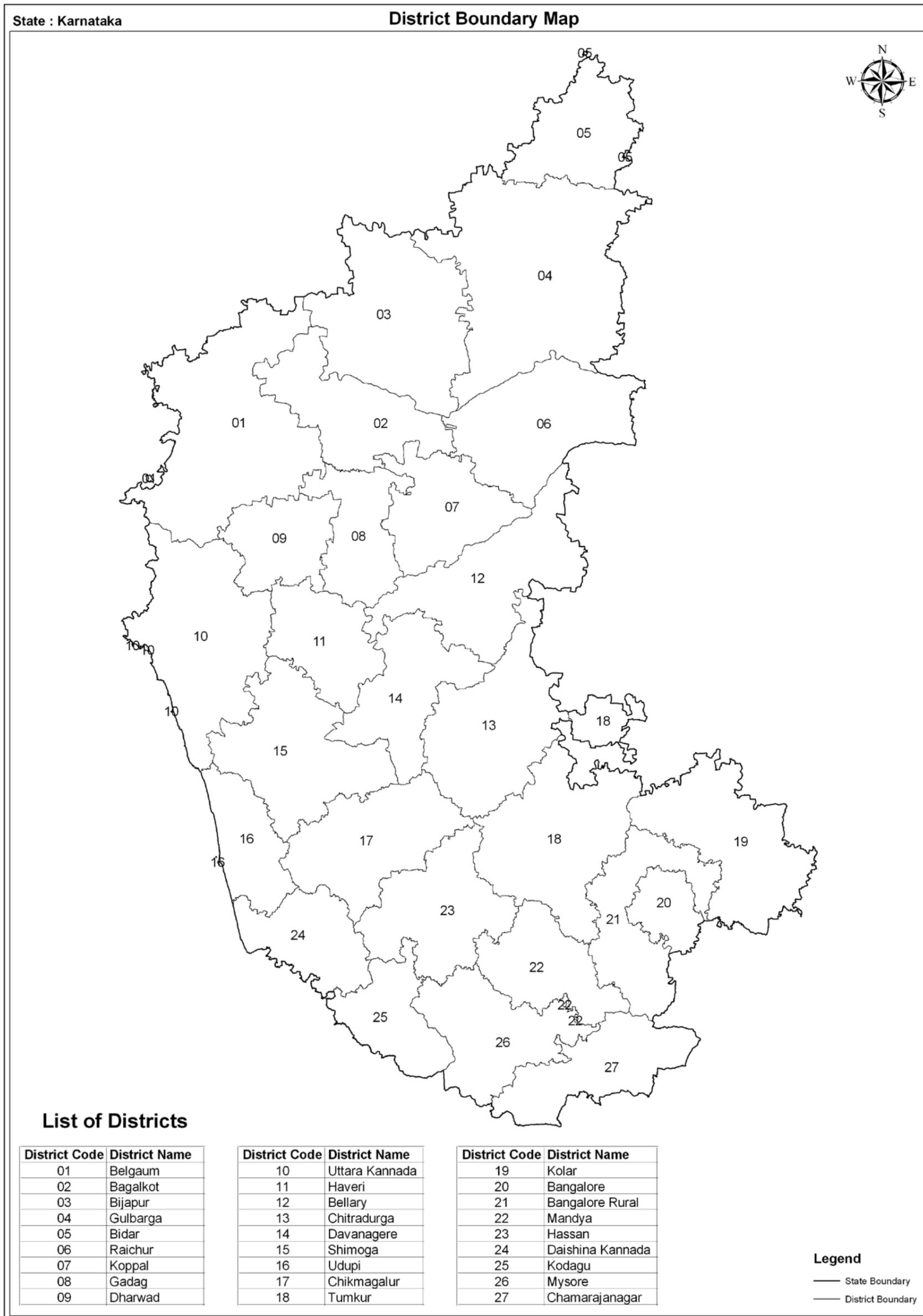
**Annexure I**  
**Definitions of wetland categories used in the project**

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	<b>Inland Wetlands</b>
1100	<b>Natural</b>
1101	<b>Lakes:</b> Larger bodies of standing water occupying distinct basins (Reid <i>et al</i> , 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	<b>Ox-bow lakes/ Cut off meanders:</b> 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 <i>et al</i> , 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	<b>High Altitude lakes:</b> 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	<b>Riverine Wetlands:</b> Along the major rivers, especially in plains water accumulates leading to formation of marshes and swamp. <b>Swamps</b> 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 <i>Sphagnum</i> ) could be called a swamp. In some areas reed grass - dominated wetlands are also called swamps). (Mitsch and Gosselink, 1986).  <b>Marsh:</b> 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.  <b>Comment:</b> Using satellite data it is difficult to differentiate between swamp and marsh. Hence, both have been clubbed together.
1105	<b>Waterlogged:</b> 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 <i>et al</i> , 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	<b>River/stream:</b> 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	<b>Man-made</b>
1201	<b>Reservoir:</b> A pond or lake built for the storage of water, usually by the construction of a dam across a river (Margarate <i>et al</i> , 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.  <b>Barrage:</b> 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	<p><b>Tanks/Ponds:</b> 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 <i>et al</i>, 1974). <b>Ponds</b> 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 <i>et al</i>, 1976). Tanks appear in light blue colour showing bottom reflectance.</p> <p>In this category <b>Industrial ponds/mining pools mainly comprising Abandoned Quarries are also included</b> (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), <b>Ash pond/Cooling pond</b> (The water body created for discharging effluents in industry, especially in thermal power plants (Encyclopaedic Directory of Environment, 1988) and <b>Cooling pond:</b> 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).</p>
1203	<p><b>Waterlogged :</b> 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.</p>
1204	<p><b>Salt pans:</b> 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.</p>
2000	<b>Coastal Wetlands</b>
2100	<b>Natural</b>
2101	<p><b>Lagoons/Backwaters:</b> 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 <i>et al</i>, 1976). <b>Backwater:</b> 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 <i>et al</i>, 1974).</p>
2102	<p><b>Creek:</b> 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.</p>
2103	<p><b>Sand/Beach:</b> 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.</p>
2104	<p><b>Intertidal mudflats:</b> 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).</p>
2105	<p><b>Salt Marsh:</b> 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.</p>
2106	<p><b>Mangroves:</b> 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.</p>
2107	<p><b>Coral reefs:</b> 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.</p>
2200	<b>Man-made</b>
2201	<p><b>Salt pans:</b> An undrained usually small and shallow rectangular, man-made depression or hollow in which saline water accumulates and evaporates leaving a salt deposit (Margarate <i>et al</i>, 1974). Salt pans are square or rectangular in shape. When water is there appearance is blue while salt is formed tone is white.</p>
2202	<p><b>Aquaculture ponds:</b> 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.</p>

**Annexure – II**  
**Details of District information followed in the atlas**



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



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