NATIONAL WETLAND ATLAS:

JAMMU AND KASHMIR

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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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
The University of Kashmir, Srinagar

February 2010

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MESSAGE

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

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

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

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

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

(Jairam Ramesh)

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FOREWORD

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

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

January 25, 2010

(Ranganath R. Navalgund)

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

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

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(Sushma Panigrahy)

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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 Jammu and Kashmir, which is part of the National Wetland Atlas of India, is an attempt in this direction.

1.1 Wetlands

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

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

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

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

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

Despite these benefits, wetlands are the first target of human interference and are among the most threatened of all natural resources. Around 50% of the earth's 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, 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 (IRS) satellites. Since the launch of the first satellite IRS 1A in 1987, India has now a number of satellites providing data in multi-spectral bands with different spatial resolution. IRS P6/RESOURCESAT 1 is the current generation satellite that provides multi-spectral images in spatial resolution of 5.8 m (LISS IV), 23.5 m (LISS III) and 56m (AWiFS). Over the past few decades, Indian remote sensing data has been successfully used in various fields of natural resources (Navalgund et al. 2002).

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

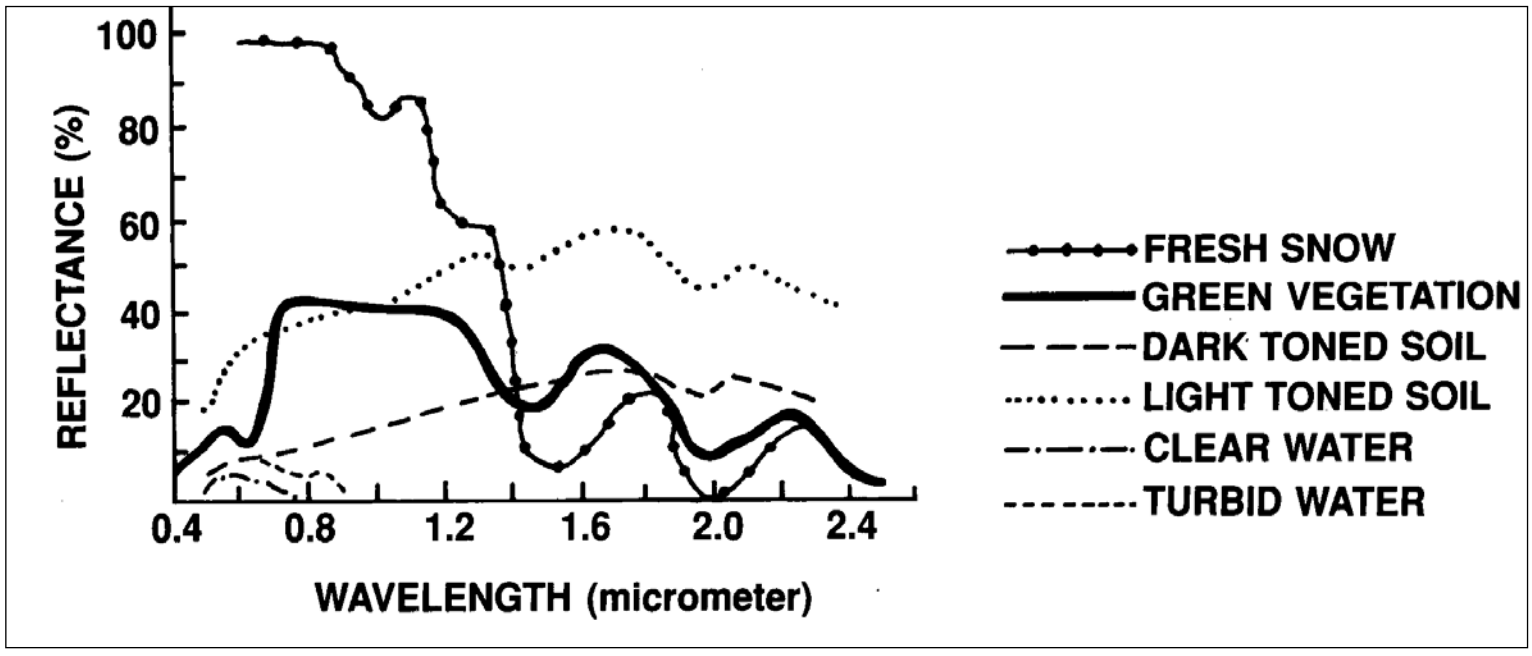
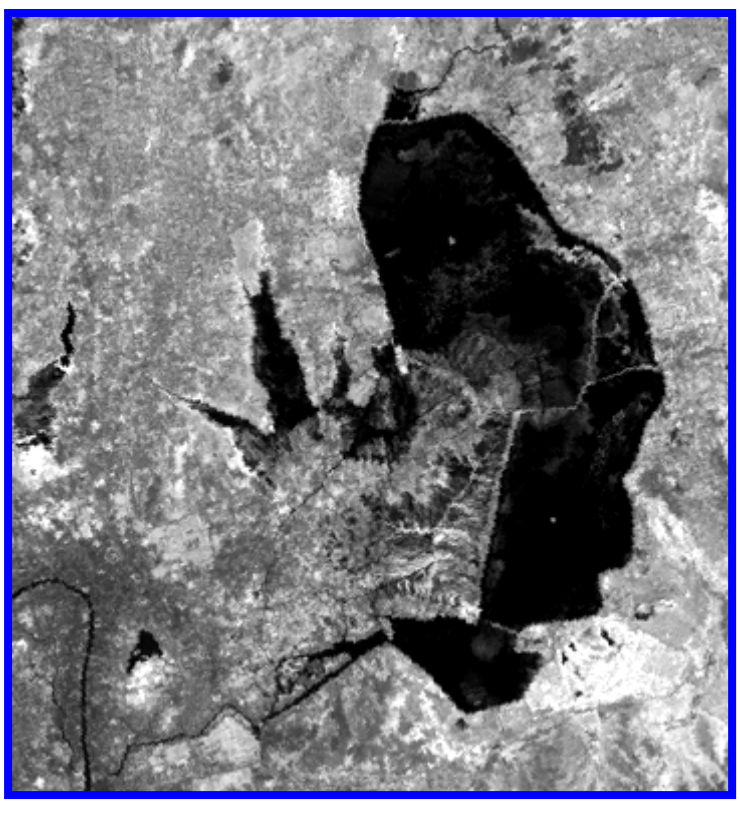


Figure 1: Spectral Signature of various targets

Red

Green



NIR

SWIR

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

Further updating of wetland maps of India was carried out by SAC using IRS P6/Resourcesat LISS-III 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 Jammu and Kashmir.

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.

2.2.1 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 trophic condition. As is known, aquatic vegetation is of four types, viz. benthic, submerged, floating, and emergent. It is possible to delineate last two types of vegetation using optical remote sensing data. A qualitative layer pertaining to presence of vegetation is generated for each season (as manifested on pre-monsoon and post-monsoon imagery).
- Turbidity level of open water: A layer pertaining to a qualitative turbidity rating is generated. Three qualitative turbidity ratings (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).

In the case of coastal wetlands only wetland extent is given.

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

3.0 STUDY AREA

Jammu and Kashmir is located in the northern part of the Indian sub continent in the vicinity of the Karakoram and western mountain ranges. It falls in the great northwestern complex of the Himalayan Ranges with marked relief variation, snow-capped summits, antecedent drainage and complex geological structure. Wetlands both lotic and lentic are found here. The total area of the state of Jammu and Kashmir is about 2,22,236 sq. km. Kashmir comprises three natural divisions, namely, Jammu, Kashmir and Ladakh.

Broadly, the state of Jammu and Kashmir comprises three distinct climatic regions: cold arid desert areas of Ladakh, temperate Kashmir Valley, and the humid sub-tropical region of Jammu. Mean monthly temperature is lowest in January and highest in July except in Jammu where highest temperature is experienced in June. Mean monthly temperature in January varies from –17°C at Drass to 14°C at Jammu; Kargil and Leh being other stations of below freezing average.

The *Jhelum* is the main waterway of the valley of Kashmir. It rises from a spring called Verinag from where a number of tributaries join the Jhelum and make it navigable from Khannabal to Wular Lake. Its total length in the valley is 177 km. The *Ravi* is the smallest river leaves the Himalayas at Basoli and passes close to Kathua near Madhopur where it enters the plain of the Punjab. The *Tawi* River, draining the outer hill region, flows around the city of Jammu. The *Chenab* river rises in the Himalayan contour of Lahul and Spiti. Two streams, more or less parallel, the Chandra and the Bhaga, form the Chandrabhaga, or the Chenab. It drains the eastern section of the southern slope of Pir Panjal. The *Indus* is another important river, which originates in Tibet near Kashmir border. A considerable portion of this river flows through our neighboring nations.

Kashmir valley is known as the land of wetlands. Noted among the lakes of Kashmir valley are Sheeshnag, Manasbal, Wular lake , Dal lake, Hokersar, Nilnag, Gangbal, Vaishan sar, Kishan sar, Kausarnag, Khanpur and Waskur. In Ladakh region, Large number of lakes are found in the Ladakh region. Most of them are of glacial origin. Tsokar, Tso Moriri and Pangong Tso are main wetland of Ladakh region.

The territory of the state is divided into seven physiographic zones closely associated with the structural components of the western Himalayas. (Source: http://www.indianembassy.org/policy/kashmir/kashmir-MEA, and http://www.jammu-kashmir.com /basicfacts)

The spatial framework was prepared using 15’ x 15’ grid. The state is covered by 420 Survey of India topographic maps on 1:50,000 scale that form the spatial frame work for mapping (Figure 4). Total number of districts is twenty. The detailed information regarding the district name, district boundary, and the district code used in data base is given in Annexure - II. The district code followed in this is as per the census data base code.

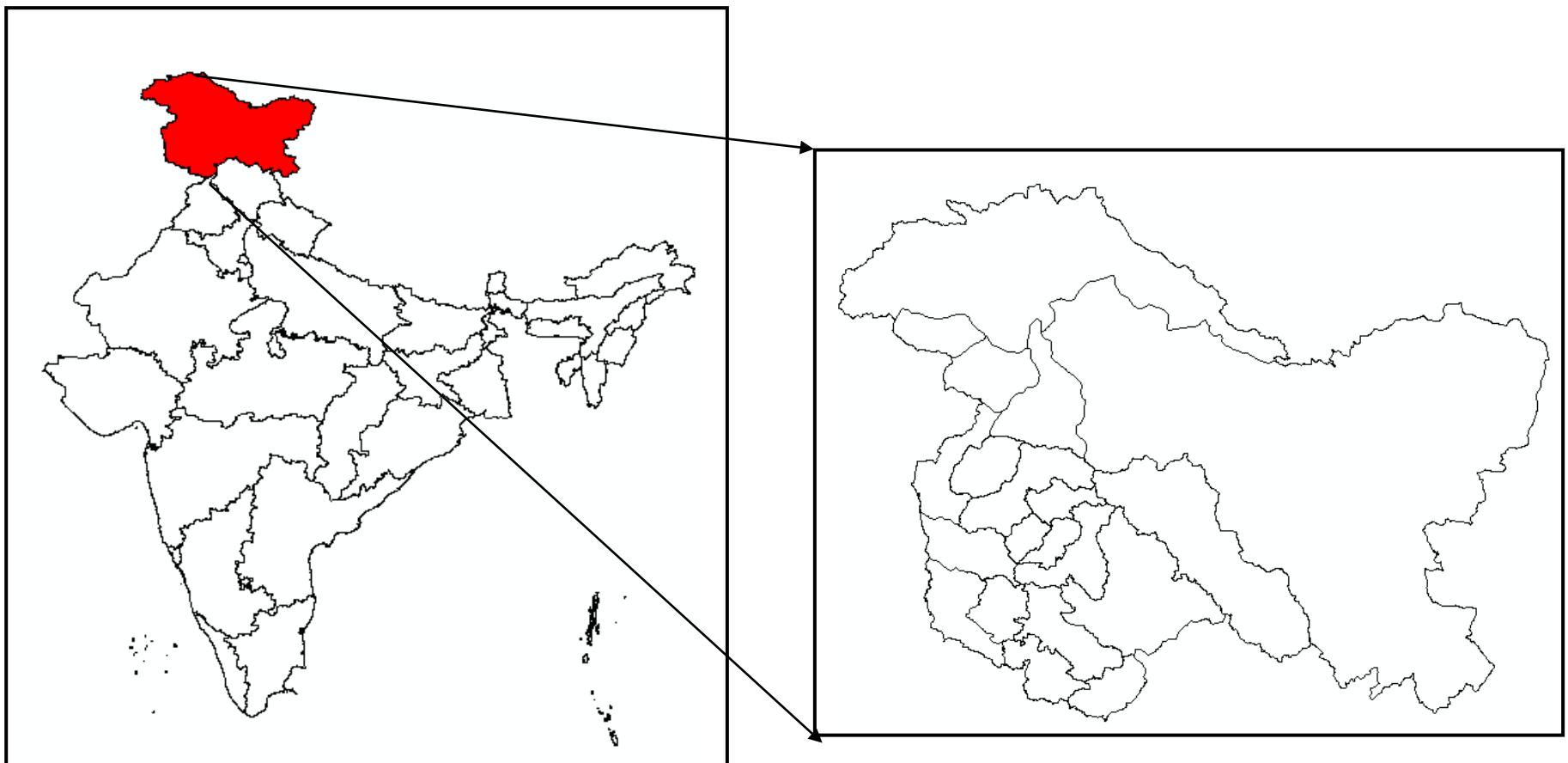


Figure 3: Location Map

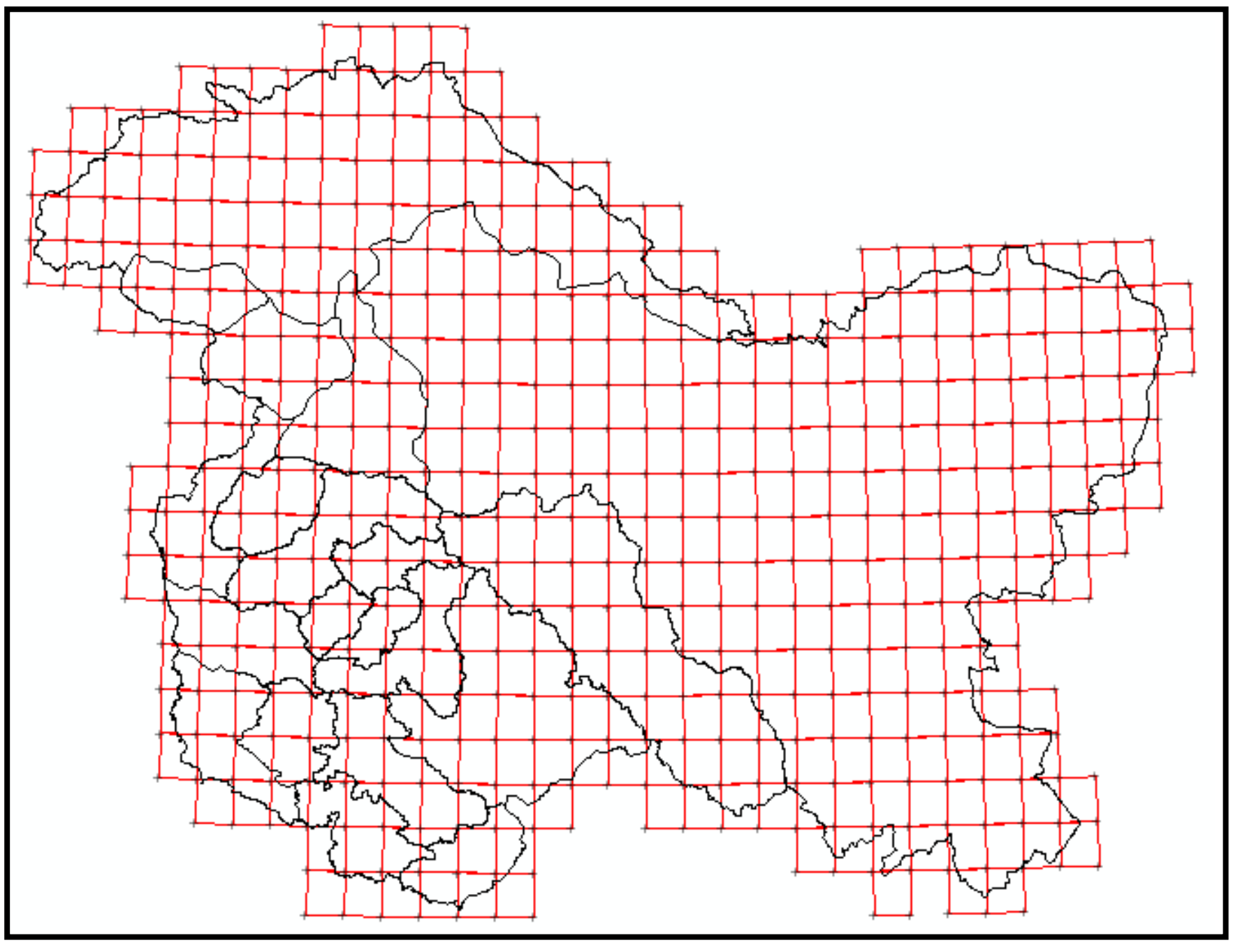


Figure 4: Spatial Framework of Jammu and Kashmir

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 Jammu and Kashmir is covered in 28 (Twenty eight) IRS LISS III scenes (Figure 5). Two date-data, one acquired during pre-monsoon (March–July) and post-monsoon (September-January) were used to capture hydrological variability of the wetlands (Table-2). Figure 5 shows the overview of the part of Jammu and Kashmir valley as seen in the LISS III FCC of post- monsoon pre-monsoon data respectively.

Ground truth data

Remote sensing techniques require certain amount of field observations called “ground truth” in order to develop interpretation key and to enhance thematic accuracy. 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 Performa as per the NWIA manual was used to record the field data. Field photographs are also taken to record the water quality (subjective), status of aquatic vegetation and water spread. All field verification work has been done during 2008-2009.

Other data

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

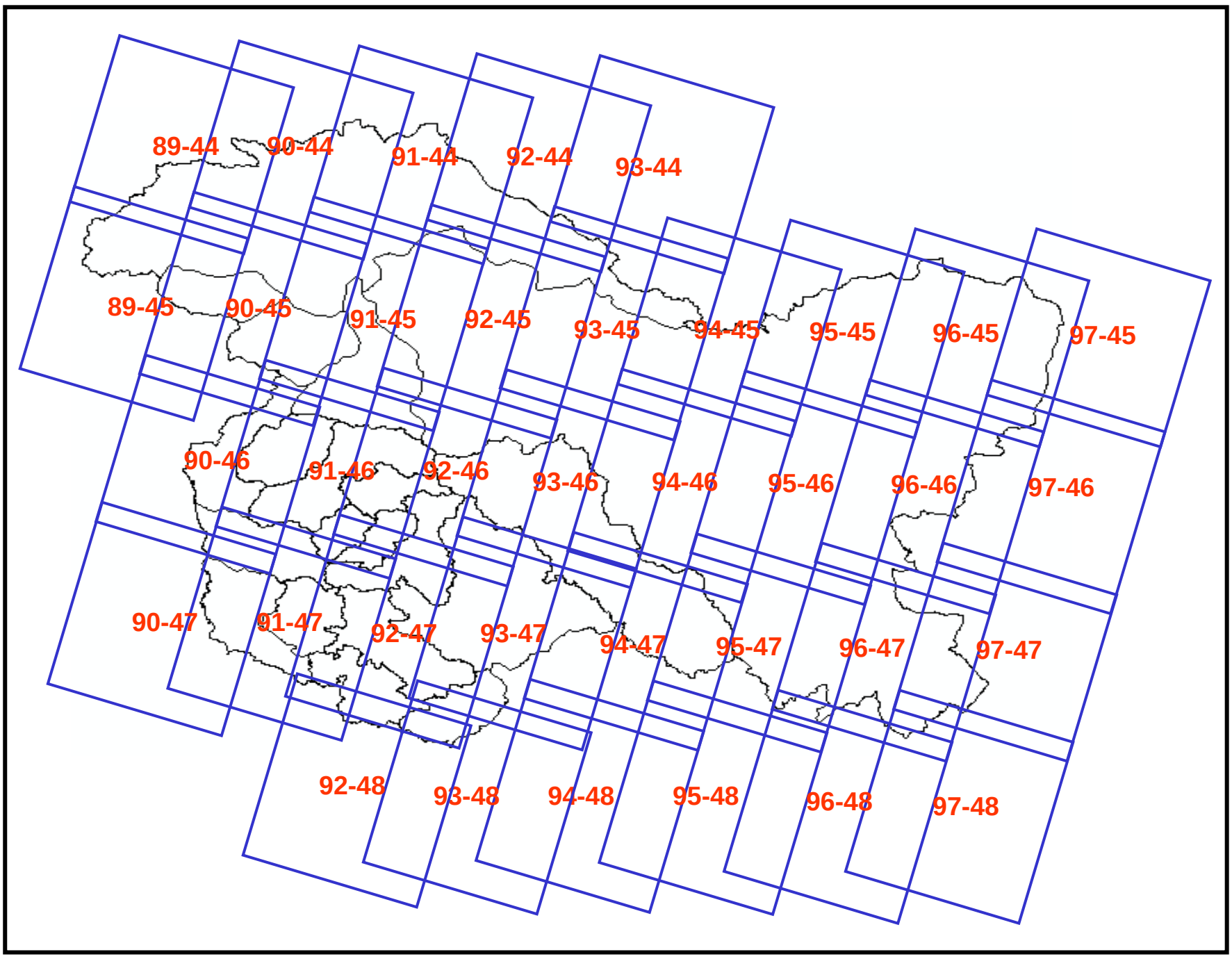


Figure 5: IRS P6 LISS-III coverage (path-row) of Jammu and Kashmir

5.0 METHODOLOGY

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

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

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

Table-2: Satellite data (LISS III) used*

S. No.	Path-Raw	Date of Acquisition	
		Post monsoon	Pre Monsoon
1.	90-44	October 28, 2006	April 14, 2007
2.	90-45	October 04, 2006	August 12, 2007
3.	91-44	October 09, 2006	May 13, 2007
4.	91-45	October 09, 2006	May 13, 2007
5.	91-46	October 09, 2006	May 13, 2007
6.	91-47	October 09, 2006	May 13, 2007
7.	92-44	November 07, 2006	July 29, 2007
8.	92-45	November 07, 2006	July 29, 2007
9.	92-46	October 14, 2006	May 18, 2007
10.	92-47	October 14, 2006	May 18, 2007
11.	93-45	January 23, 2007	July 10, 2007
12.	93-46	September 25, 2006	April 29, 2007
13.	93-47	December 30, 2006	April 29, 2007
14.	93-48	October 19, 2007	May 23, 2007
15.	94-45	October 24, 2006	April 10, 2007
16.	94-46	October 24, 2006	April 10, 2007
17.	94-47	October 24, 2006	April 10, 2007
18.	95-45	December 16, 2006	April 15, 2007
19.	95-46	October 05, 2006	April 15, 2007
20.	95-47	October 05, 2006	April 15, 2007
21.	96-45	November 03, 2006	March 27, 2007
22.	96-46	October 10, 2006	May 14, 2007
23.	96-47	October 10, 2006	May 14, 2007
24.	96-48	October 10, 2006	May 14, 2007
25.	97-45	October 15, 2006	April 01, 2007
26.	97-46	October 15, 2006	April 01, 2007
27.	97-47	September 21, 2006	June 12, 2007
28.	97-48	October 15, 2006	July 06, 2007

** Wherever, cloud cover is encountered in any particular scene, LISS III and LANDSAT ETM data of 2005-6 are also used.*

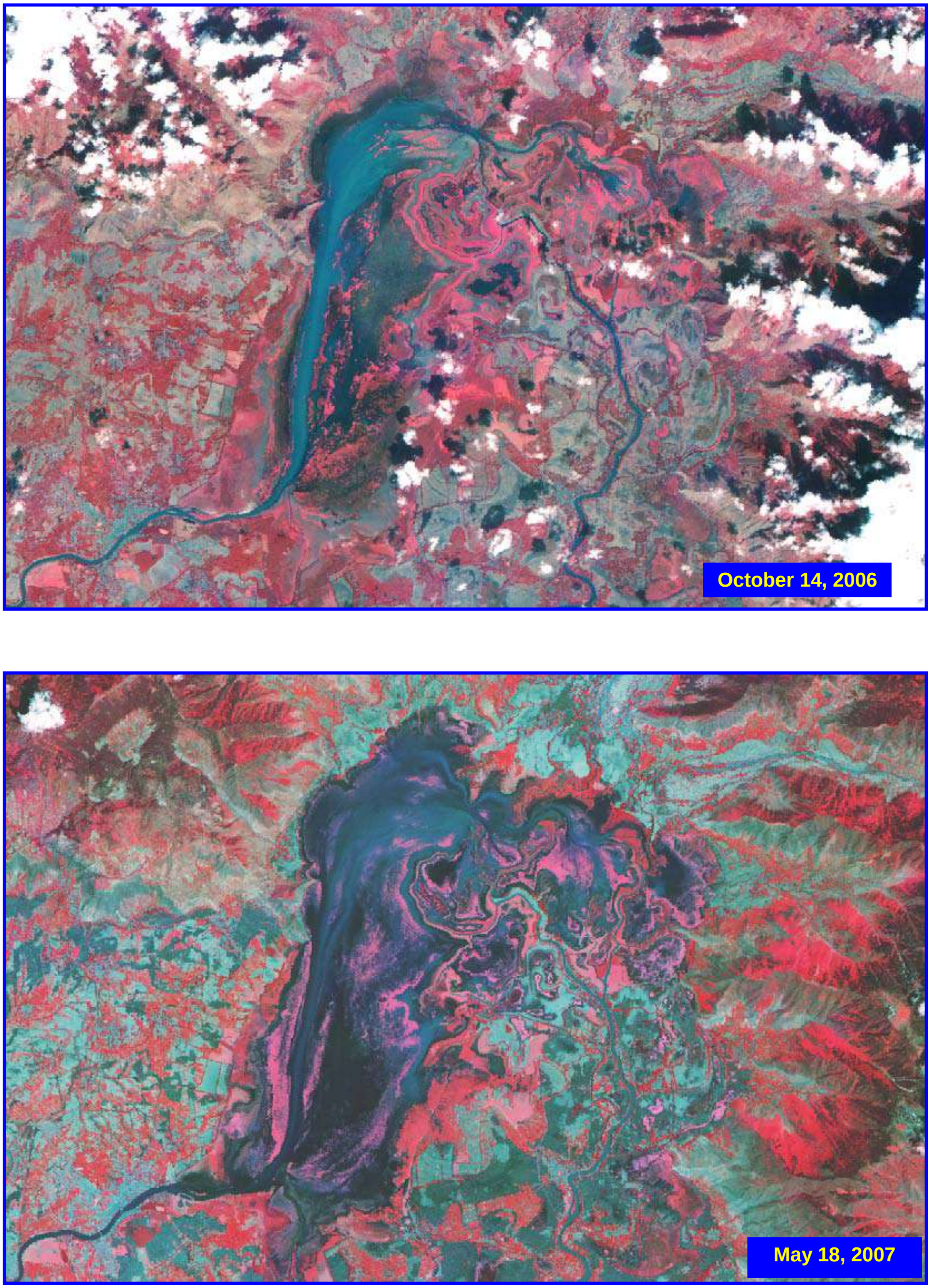


Figure 6: IRS LISS-III FCC (Post-monsoon and Pre-monsoon): Part of Jammu and Kashmir state

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 is followed and four corners of the 1:50,000 (15' x 15') grid is taken as the tics or registration points to create each map taking master grid as the reference. Spatial framework details are given in NWIA manual (Garg and Patel 2007). The spatial framework for Jammu and Kashmir 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 mapping of wetlands was done following digital classification and onscreen visual interpretation. Wetlands features include open water, surface aquatic vegetation (floating and emergent), quality of water (subjective) and the boundary of the wetland. In the present project, five indices known in literature that enhances various wetland characteristics were used (McFeetres, 1986; Xu Hanqiu, 2006; Lacaux *et al*, 2007; Townshend and Justice, 1986; Tucker and Sellers, 1986) as given below:

i) Normalised Difference Water Index (NDWI) = (Green-NIR) / (Green + NIR)
ii) Modified Normalised Difference Water Index (MNDWI) = (Green-MIR) / (Green + MIR)
iii) Normalised Difference Vegetation Index (NDVI) = (NIR - Red) / (NIR + Red)
iv) Normalised Difference Pond Index (NDPI) = (MIR – Green / MIR + Green)
v) Normalised Difference Turbidity Index (NDTI) = (Red – Green) / (Red + Green)

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

- Extraction of wetland extent :

  MNDWI, NDPI and NDVI image was used to extract the wetland boundary through suitable hierarchical thresholds.

- Extraction of open water :

  MNDWI was used within the wetland mask to delineate the water and no-water areas.

- Extraction of wetland vegetation :

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

- Turbidity information extraction :

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

Table 3: Qualitative turbidity ratings

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

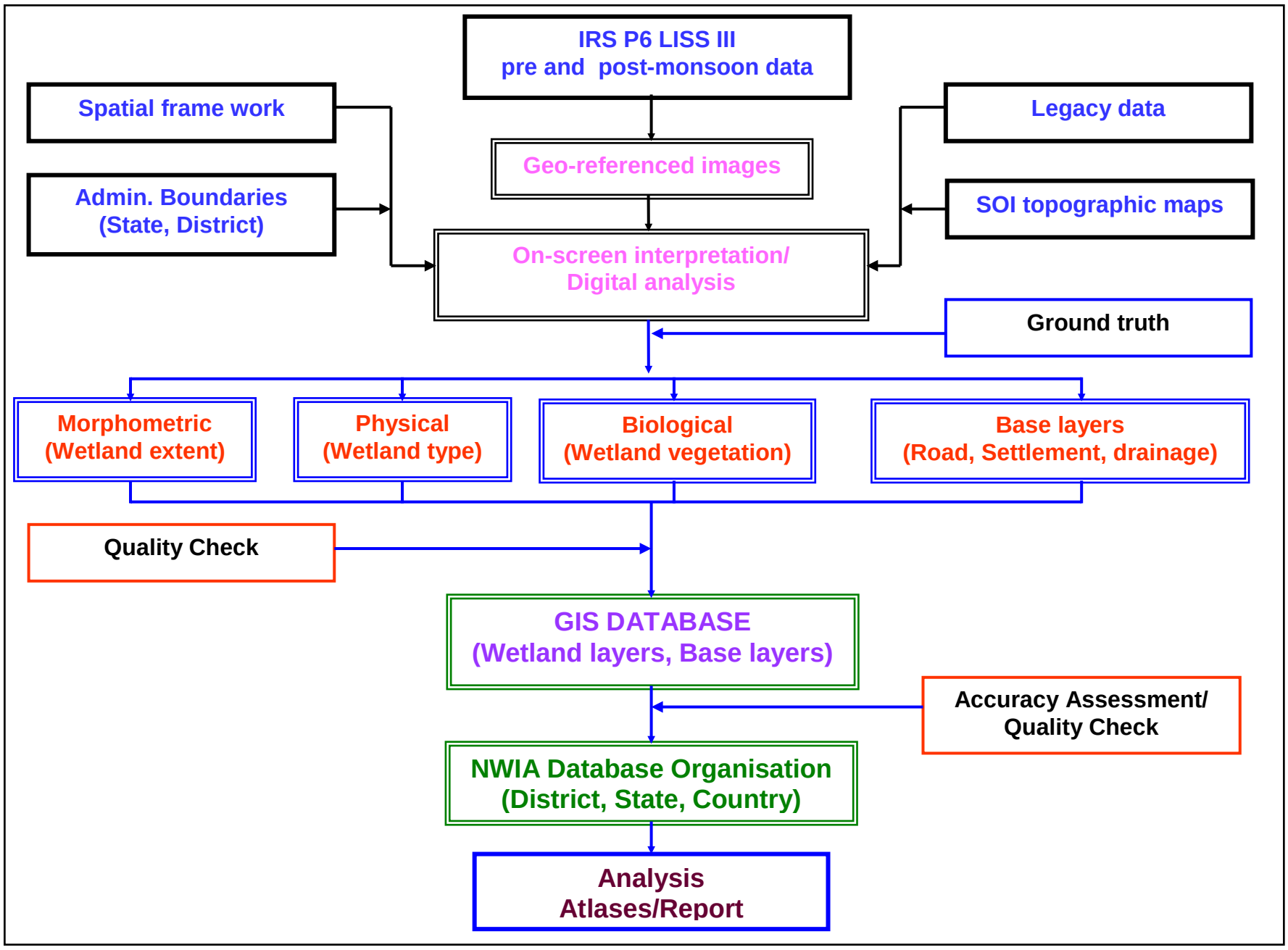


Figure 7: Flow chart of the methodology used

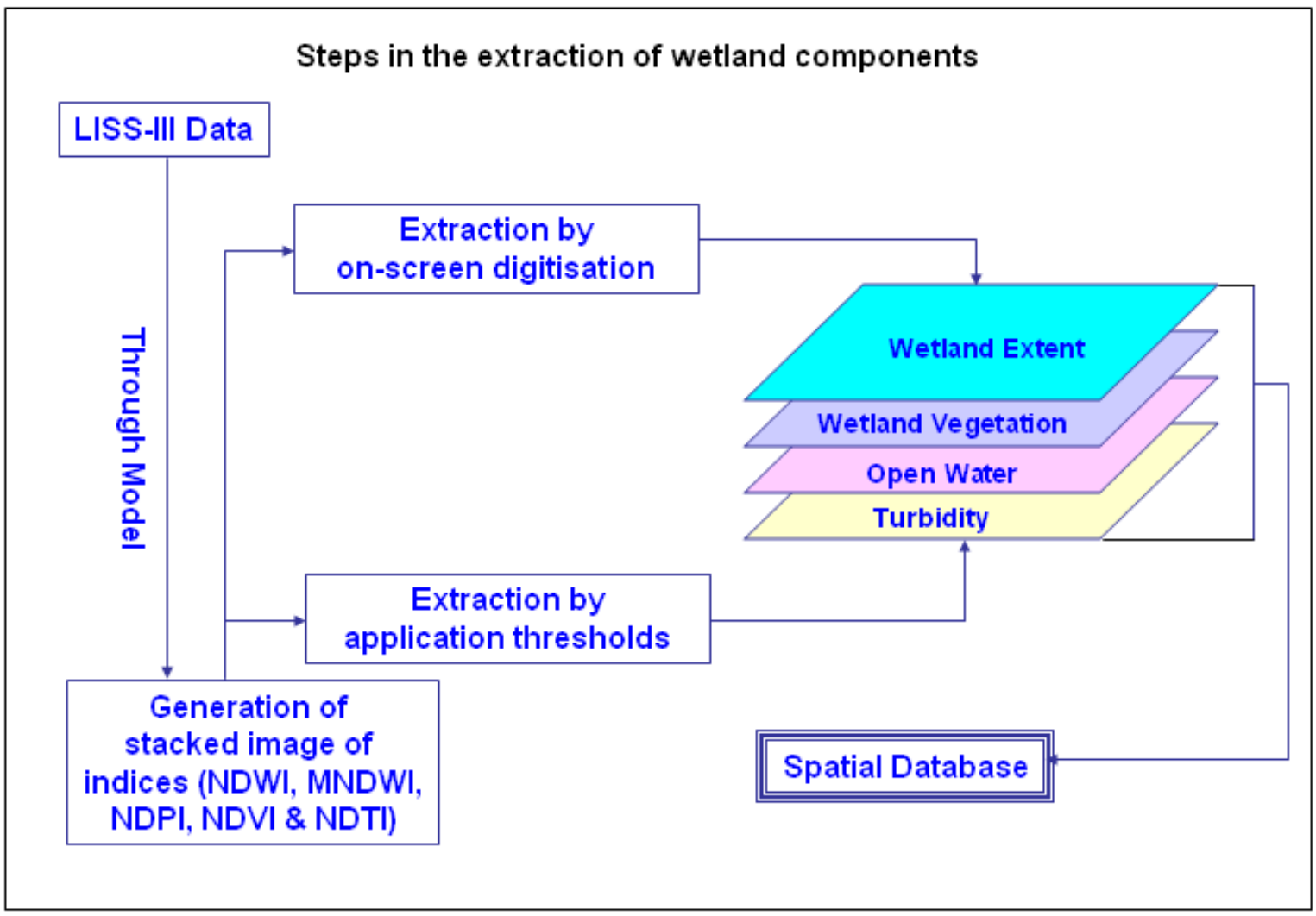


Figure 8: Steps in the extraction of wetland components

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.

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.

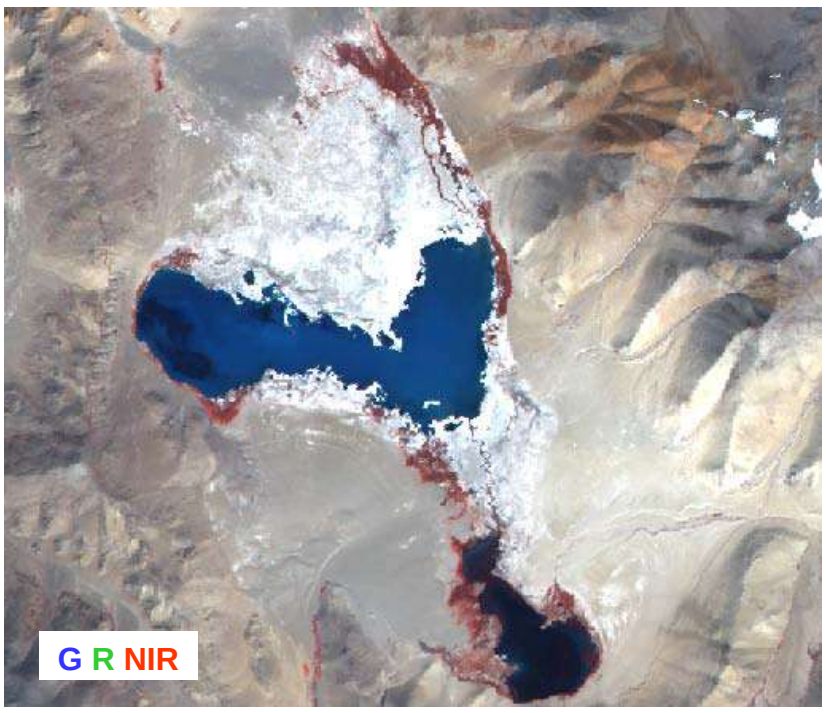
3. Wetland mapping using visual/digital interpretation techniques.

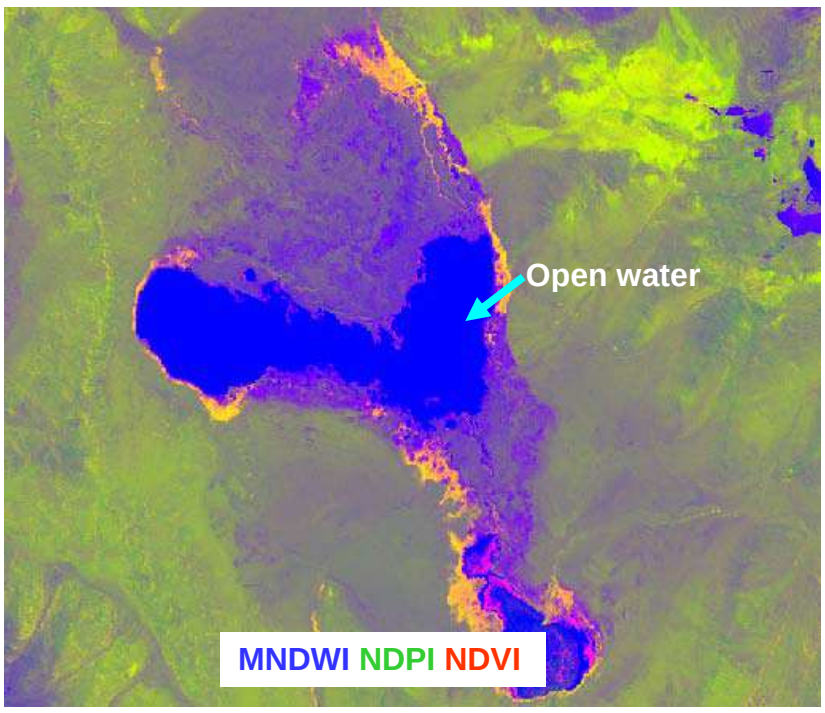
4. Geo-data base creation and organization

5. Output products.

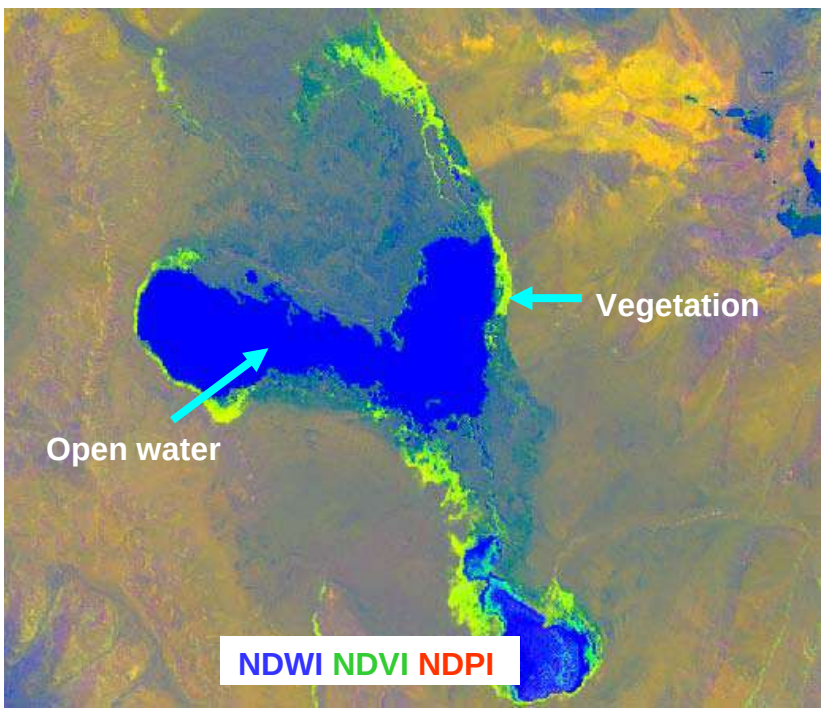
6.1 Data verification and quality assurance of output digital data files

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.

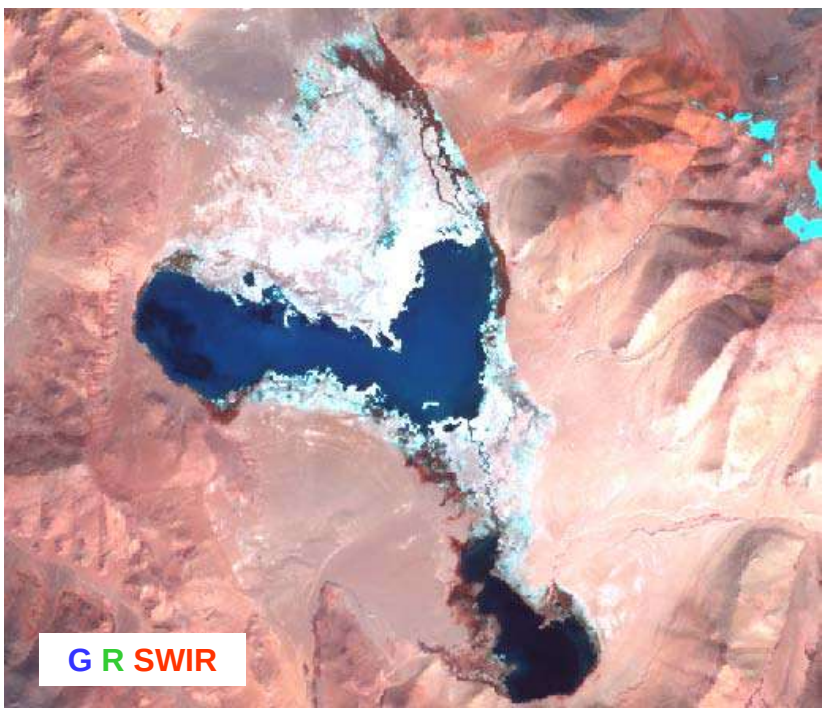


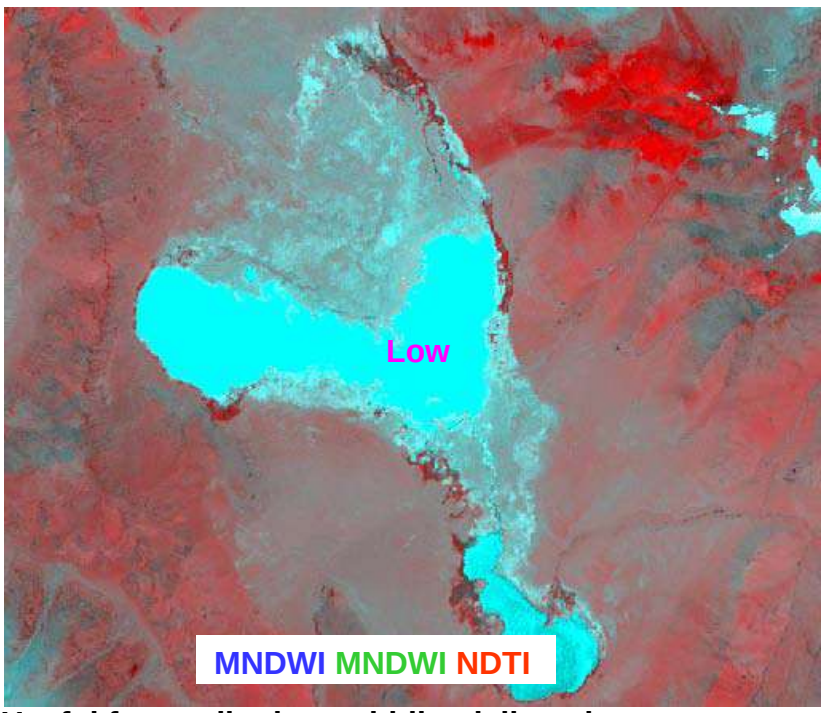


Useful for wetland boundary extraction/delineation



Useful for wetland vegetation & open water features





Useful for qualitative turbidity delineation

Part of Tso Kar,
IRS LISS III data, 5 October 2006

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

MAPS AND STATISTICS

7.0 WETLANDS OF JAMMU AND KASHMIR: MAPS AND STATISTICS

Area estimates of various wetland categories and structural components for Jammu and Kashmir have been carried out using GIS database. Structural components include wetland morphometry, wetland boundary, water-spread, aquatic vegetation and turbidity. A variety of wetland types were observed in the State of Jammu and Kashmir. Most of them are of glacial origin and mainly associated with riverine system.

Total 1411 wetlands are mapped in the state occupying 389261 ha area. In addition, 2240 small wetlands (< 2.25 ha) have been demarcated as point features. These are mainly high altitude wetlands. The Natural wetlands are in dominance in the state occupying around 93.0 % area. The major natural wetlands apart from Rivers/stream are High altitude wetlands. Total 1143 such wetlands are mapped having an area of 109170 ha (27.88%). There are 36 Lakes/ponds (3.5%). Reservoir/Barrage is the major man made wetland type. Total 4 of this category are mapped having 25132 ha area (6.4%). Detailed statistics is given in Table-4. Graphical distribution of wetland type is shown in Figure 10.

Area under aquatic vegetation varied from 19826 ha to 15434 ha during post and pre monsoon season respectively. Vegetation is mainly found in Lakes/Ponds, Riverine wetlands. The open water area of these wetlands does not show significant seasonal variation (301818 ha during post-monsoon season and 314209 ha in pre-monsoon season). Most of the wetlands are oligotrophic in nature and have low amount of particulate matter. Qualitative turbidity of water is in general low in both the seasons (Table-4).

Table 4: Area estimates of wetlands in Jammu and Kashmir

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	36	13762	3.52	3371	6821
2	1103	High altitude wetlands	1143	109170	27.88	105110	105072
3	1104	Riverine wetlands	88	9594	2.45	153	1639
4	1106	River/Stream	138	231597	59.16	170063	175550
	1200	**Inland Wetlands -Man-made**					
5	1201	Reservoirs/Barrages	4	25132	6.42	23115	25121
6	1202	Tanks/Ponds	2	6	0.00	6	6
		Sub-Total	**1411**	**389261**	**99.43**	**301818**	**314209**
		Wetlands (<2.25 ha)	2240	2240	0.57	-	-
		Total	**3651**	**391501**	**100.00**	**301818**	**314209**

Area under Aquatic Vegetation	19826	15434

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

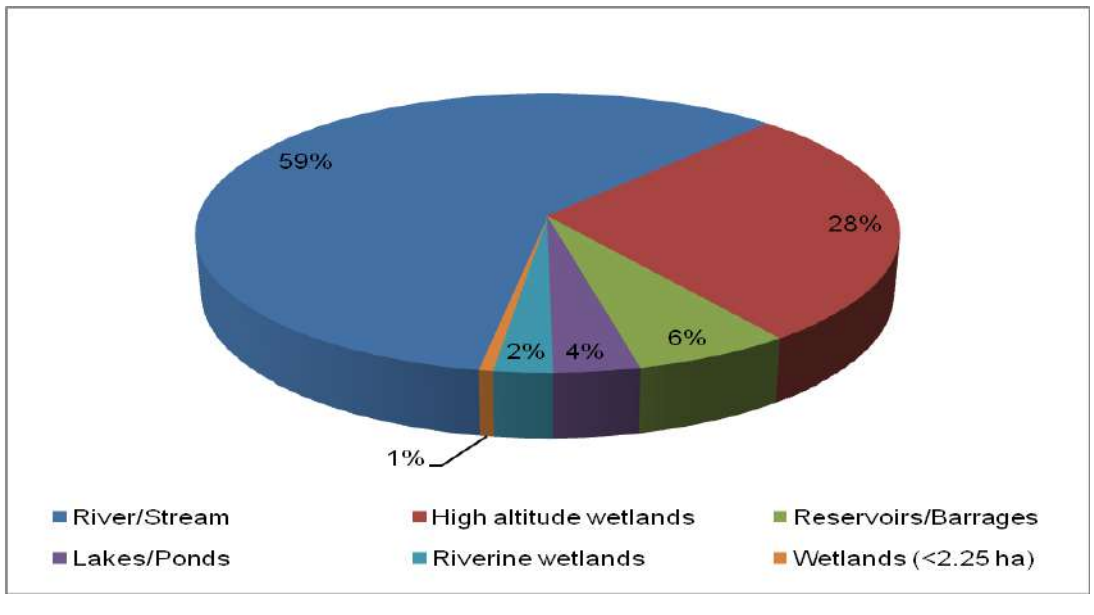


Figure 10: Type-wise wetland distribution in Jammu and Kashmir

7.1 DISTRICT-WISE WETLAND MAPS AND STATISTICS

The total numbers of districts in the state are twenty, with Leh having largest geographic area and Budgam, the lowest (Table-5). Leh has the highest area under wetlands (51.9%). This is mainly due to the large number of high altitude wetlands found in the area. Konu has the lowest wetland share (0.40%). Baramula, Jammu, Katua, Gilgit, and Mirpur are the districts having more than 4.0% wetlands. Geographic area wise, Kathua has highest percentage (8.13%) and Gilghit Wazara has lowest (0.45%). Table-5 & Figure 11 shows district-wise wetland distribution. District-wise wetland area estimates is given in Table-5. & Figure 11 shows district-wise wetland distribution.

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

The results of individual districts (map and statistics) are given in the following section. The numbering of the districts followed for this is as per Annexure.II.

Table-5: District-wise Wetland Area Estimates

Sr. No.	District	Geographic Area* (sq. km)	Wetland Area (ha)	% of total wetland area	% of district geographic area
1	Kupwara	3028	2384	0.61	0.79
2	Baramula	5183	16360	4.18	3.16
3	Srinagar	1865	10081	2.57	5.41
4	Badgam	1267	3402	0.87	2.69
5	Pulwama	1456	3561	0.91	2.45
6	Anantnag	3986	6875	1.76	1.72
7	Leh (Ladakh)	105306	203195	51.90	1.93
8	Kargil	16296	10380	2.65	0.64
9	Doda	11683	5667	1.45	0.49
10	Udhampur	4580	8326	2.13	1.82
11	Poonch	3826	7013	1.79	1.83
12	Rajauri	2628	4910	1.25	1.87
13	Jammu	3017	19638	5.02	6.51
14	Kathua	2675	21740	5.55	8.13
15	Gilghit	34380	29844	7.62	0.87
16	Konu	2773	1547	0.40	0.56
17	Gilghit Wazara	6098	2743	0.70	0.45
18	Chilas	4276	2200	0.56	0.51
19	Muzzafarabad	3711	4105	1.05	1.11
20	Mirpur	4077	27529	7.03	6.75
	TOTAL	**222111**	**391500**	**100.00**	**1.76**

* Source: GIS area

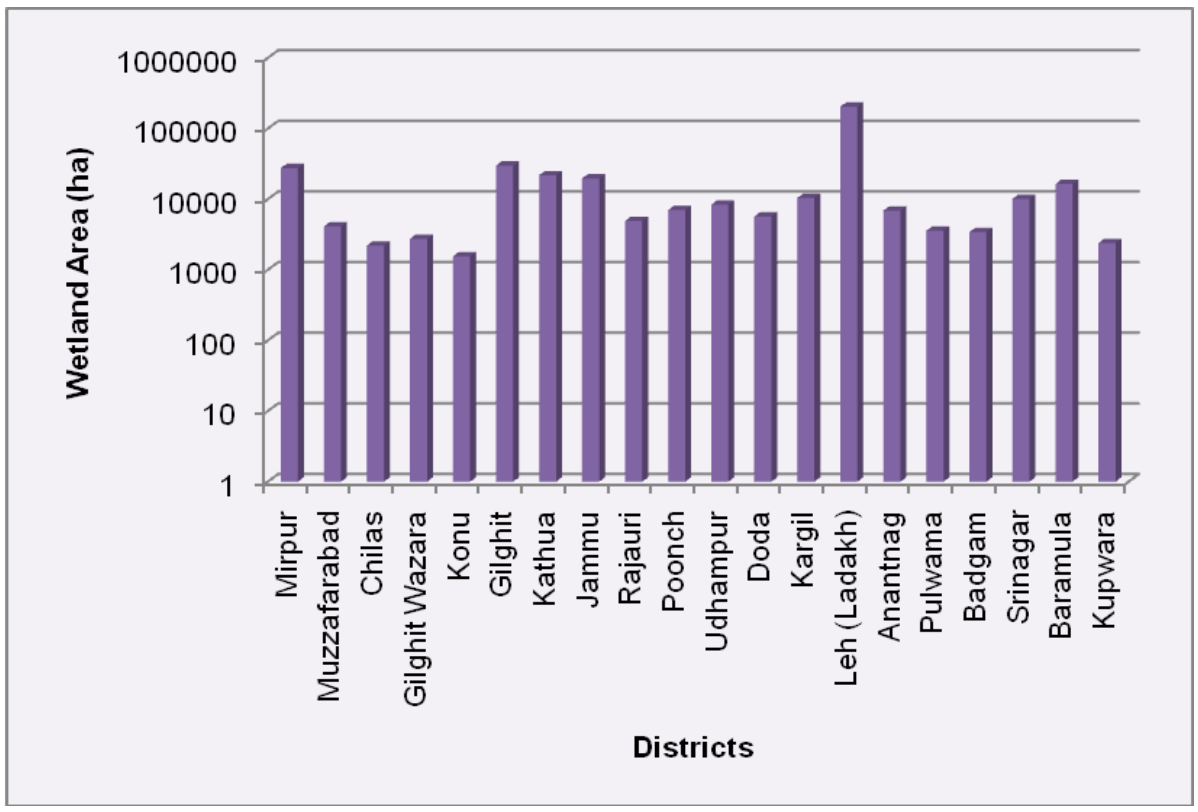
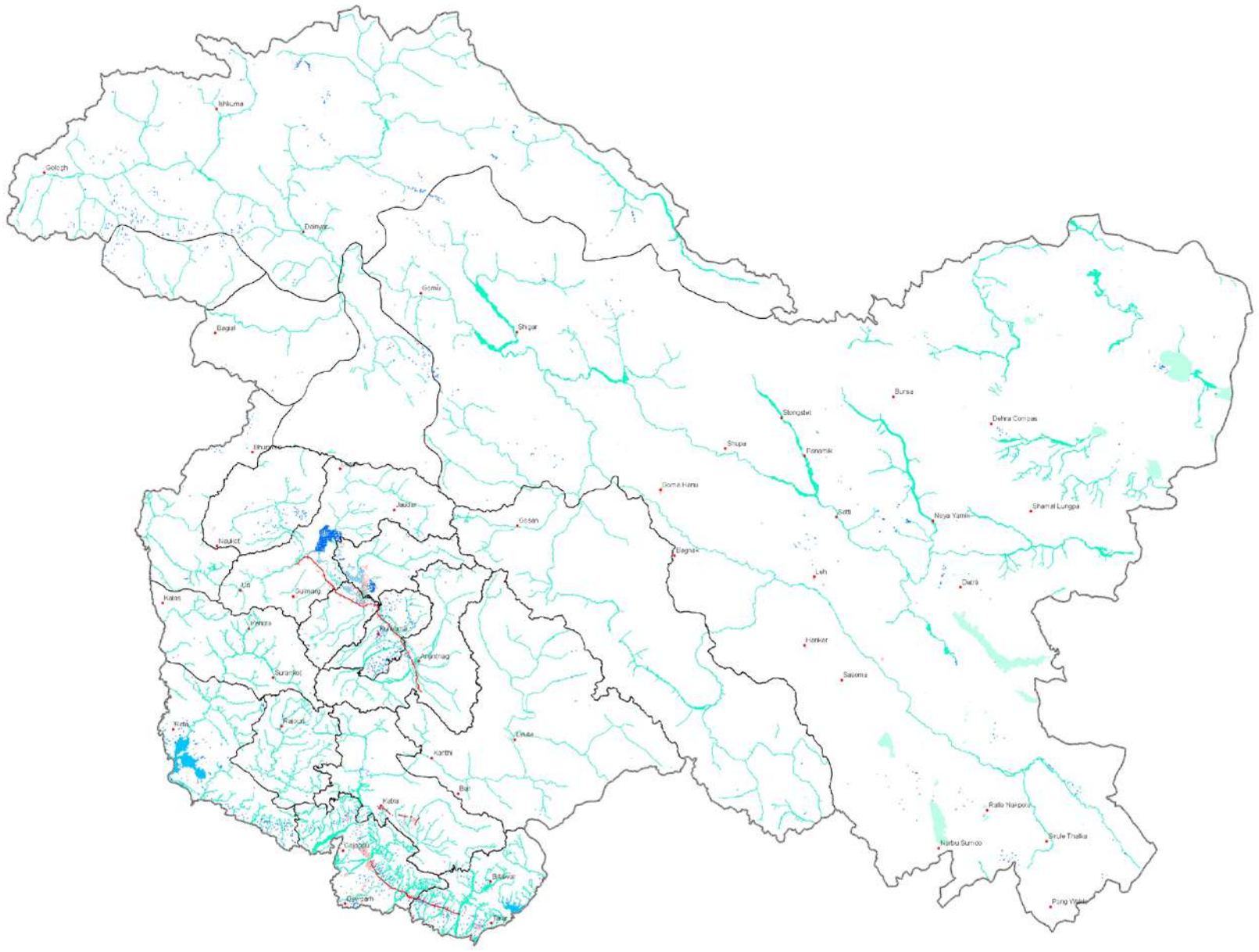


Figure 11: District-wise graphical distribution of wetlands

State : Jammu and Kashmir

WETLAND MAP



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

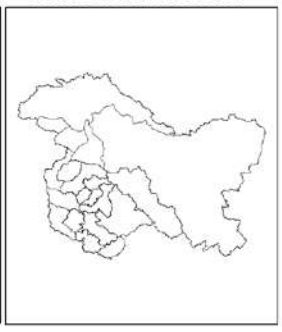
Legend

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

Location Map

India

Jammu and Kashmir



0 15 30 60 90 120 Kilometers

Data Source :

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

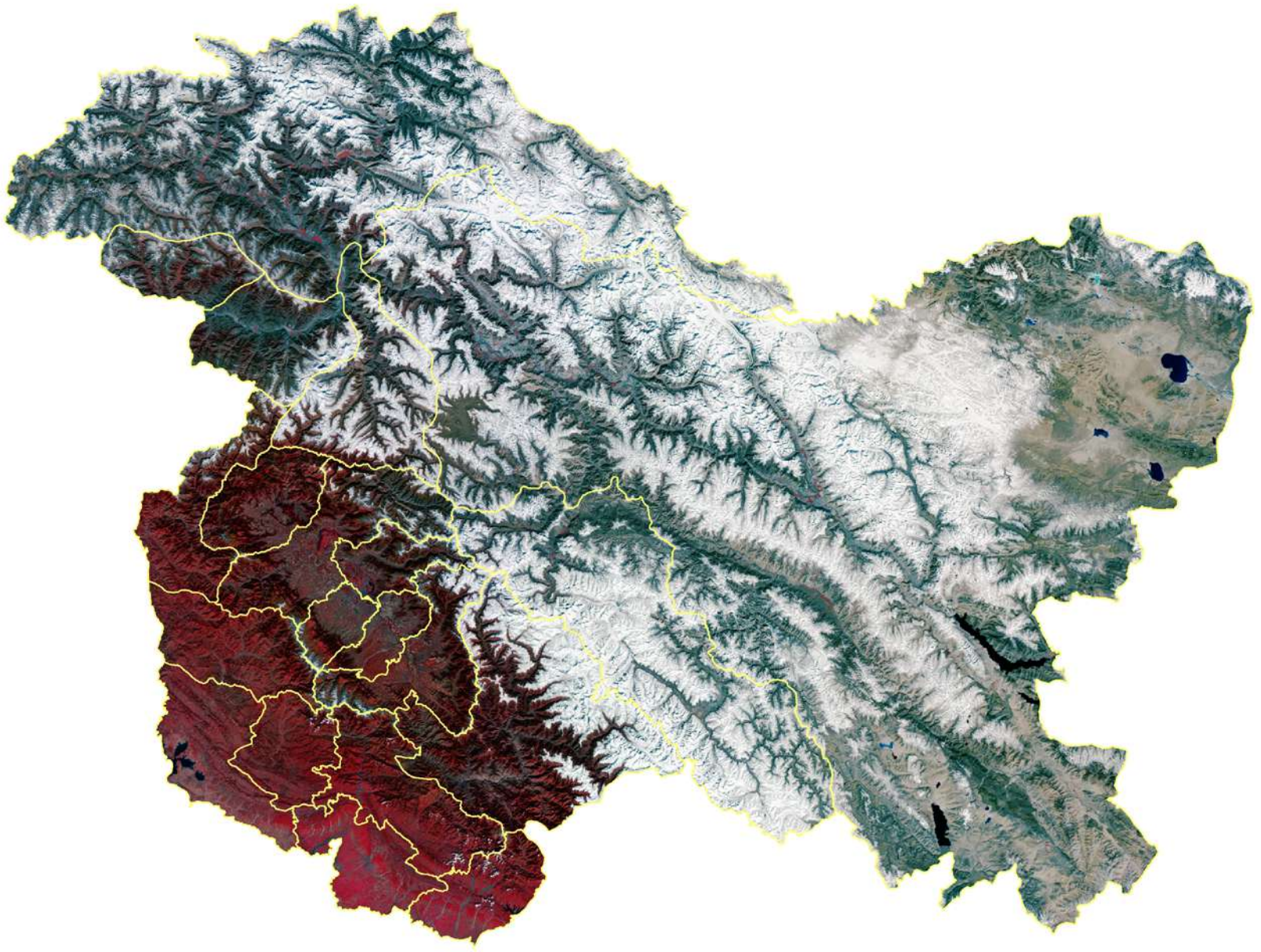
Prepared By :

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

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir



IRS P6 AWiFS Post-monsoon data (2005)

7.1.1 Kupwara

Kupwara district is situated at an altitude of 5,300 feet above sea level and is the northern-most district of the Kashmir valley. This district is endowed with rich dense forests. The river 'Kishan Ganga' originating from the Himalayas flows through the outer areas of the district from east to west. The geographical area of the district is 3,028 sq. km. with three tehsils, namely, Handwara, Karnah and Kupwara.

Total wetland area of the district is 2384 ha. River/stream is the major wetland type of the district with 2212 ha area and accounting for around 93 per cent wetland area of the district. Lakes/ponds are 18 in number and account for around 4 percent of the total wetland area of the district. No High altitude wetlands observed. In addition, 70 small wetlands (<2.25 ha area) are identified. The distribution of wetlands is mainly dominated in south and southeastern part of the district. The detail wetland statistics of the district is given in Table 6.

Aquatic vegetation is observed mainly in Lakes/pond wetlands and covers an area of 67 ha in post monsoon season and 44 ha in pre-monsoon season. There is slight seasonal variation in open water in the rivers, which could be attributed to seasonal variations in melting of glaciers. Qualitative turbidity of open water is mainly low in both the seasons.

Table 6: Area estimates of wetlands in Kupwara

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	18	96	4.03	33	53
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	2	6	0.25	6	5
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	5	2212	92.79	1721	2052
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**25**	**2314**	**97.06**	**1760**	**2110**
		Wetlands (<2.25 ha)	70	70	2.94	-	-
		Total	**95**	**2384**	**100.00**	**1760**	**2110**

Area under Aquatic Vegetation	67	44

Area under turbidity levels		
Low	1743	2074
Moderate	17	36
High	-	-

State : Jammu and Kashmir

WETLAND MAP

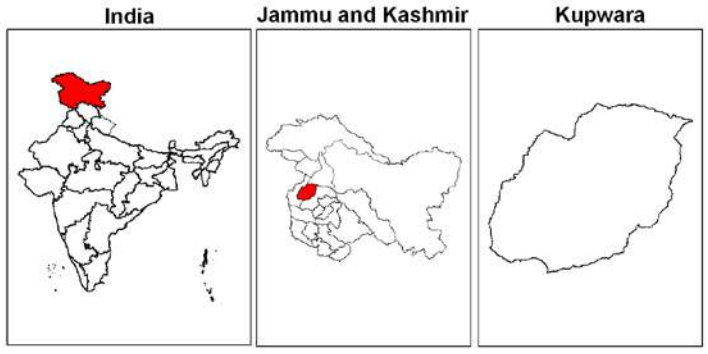
District : Kupwara

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

Legend

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

Location Map



0 2 4 8 12 16 Kilometers

Data Source :

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

Prepared By :

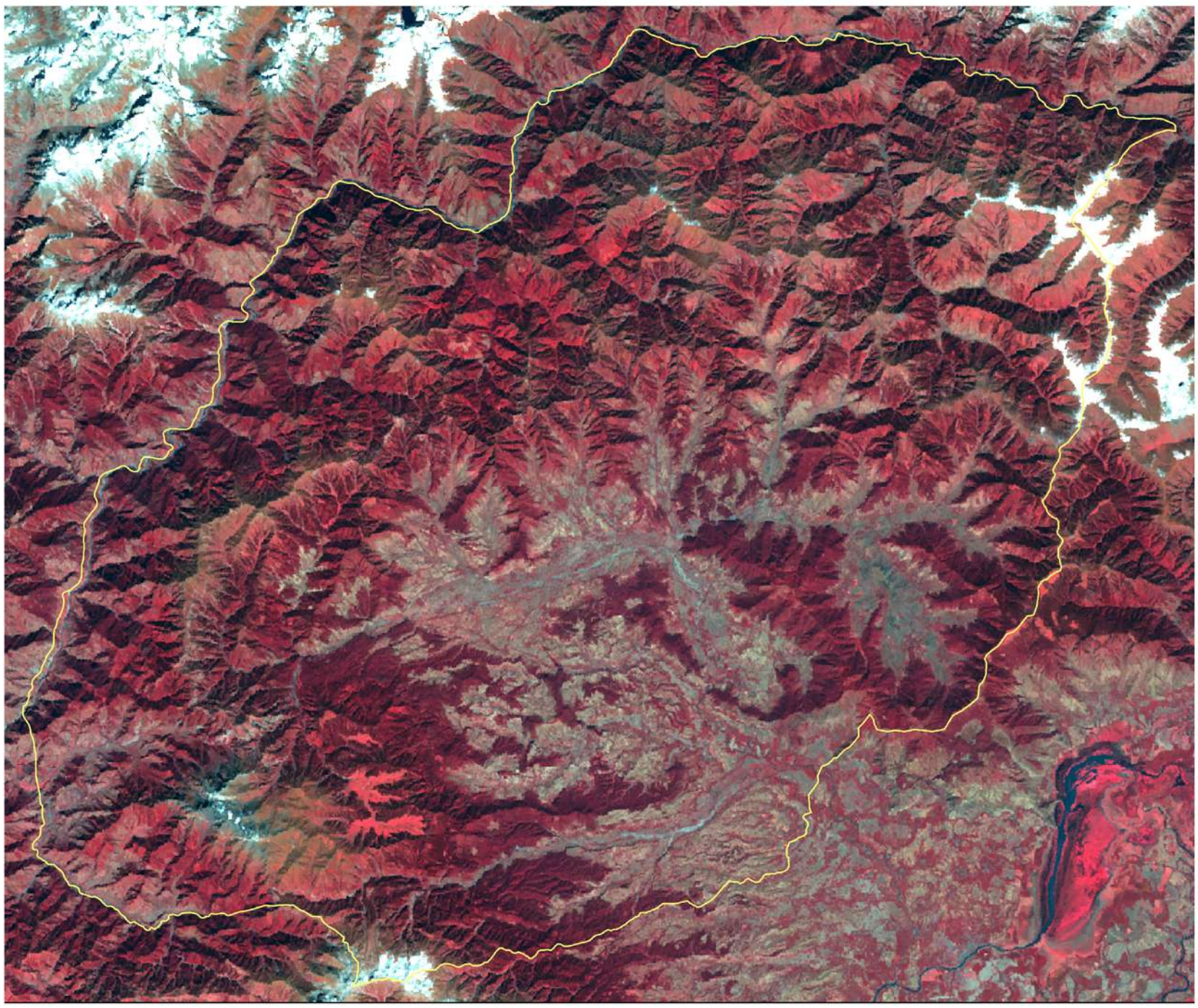
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Kupwara



IRS P6 AWiFS Post-monsoon data (2005)

7.1.2 Baramula

Baramulla district completely surrounds the district Kupwara and shares the border with Muzzafarabad at two places in the west as well as in the northeast. It also shares its border with Srinagar, Budgam and Poonch districts in the south and with Kargil in the east. The average height of the district is 5187 feet above sea level. The district has a flat topography and scenic beauty. The geographical area of the district is 5,183 sq. km. with six tehsils, namely, Bandipur, Sonawari, Sopore, Baramulla, Gulmarg and Uri Sopore tehsil is very famous for its apples.

Total wetland area of the district is 16360 ha. There are only two wetlands under the wetland category of Lake/ponds but they contribute almost 69 per cent of wetland area of the state. This is mainly due to the large Wulur Lake situated in this district. River/stream is the second major wetland type occupying 3146 ha area and contributes around 19 per cent wetland area of the district. Riverine wetland occupied 9.0% area. There are 38 high altitude wetlands in the district and the area under this category is 448 ha. There are no man-made wetlands mapped in the district. Total 15 small wetlands (<2.25 ha) are identified. The wetland statistics of the district is given in Table 7.

Aquatic vegetation is observed mainly in Lake/pond and Riverine wetlands. The area under aqatic vegetation is more (10922 ha) in post monsoon season than in pre-monsoon season (7532 ha). There is not much seasonal fluctuation in open water in rivers but lake/ ponds show significant variation. The qualitative turbidity of water is in general low in post monsoon, but high turbidity is observed in case of Lake/pond in pre monsoon.

Table 7: Area estimates of wetlands in Baramula

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	2	11273	68.91	1710	4966
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	38	448	2.74	448	448
4	1104	Riverine wetlands	29	1478	9.03	41	334
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	13	3146	19.23	2883	3059
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**82**	**16345**	**99.91**	**5082**	**8807**
		Wetlands (<2.25 ha)	15	15	0.09	-	-0
		Total	**97**	**16360**	**100.00**	**5082**	**8807**

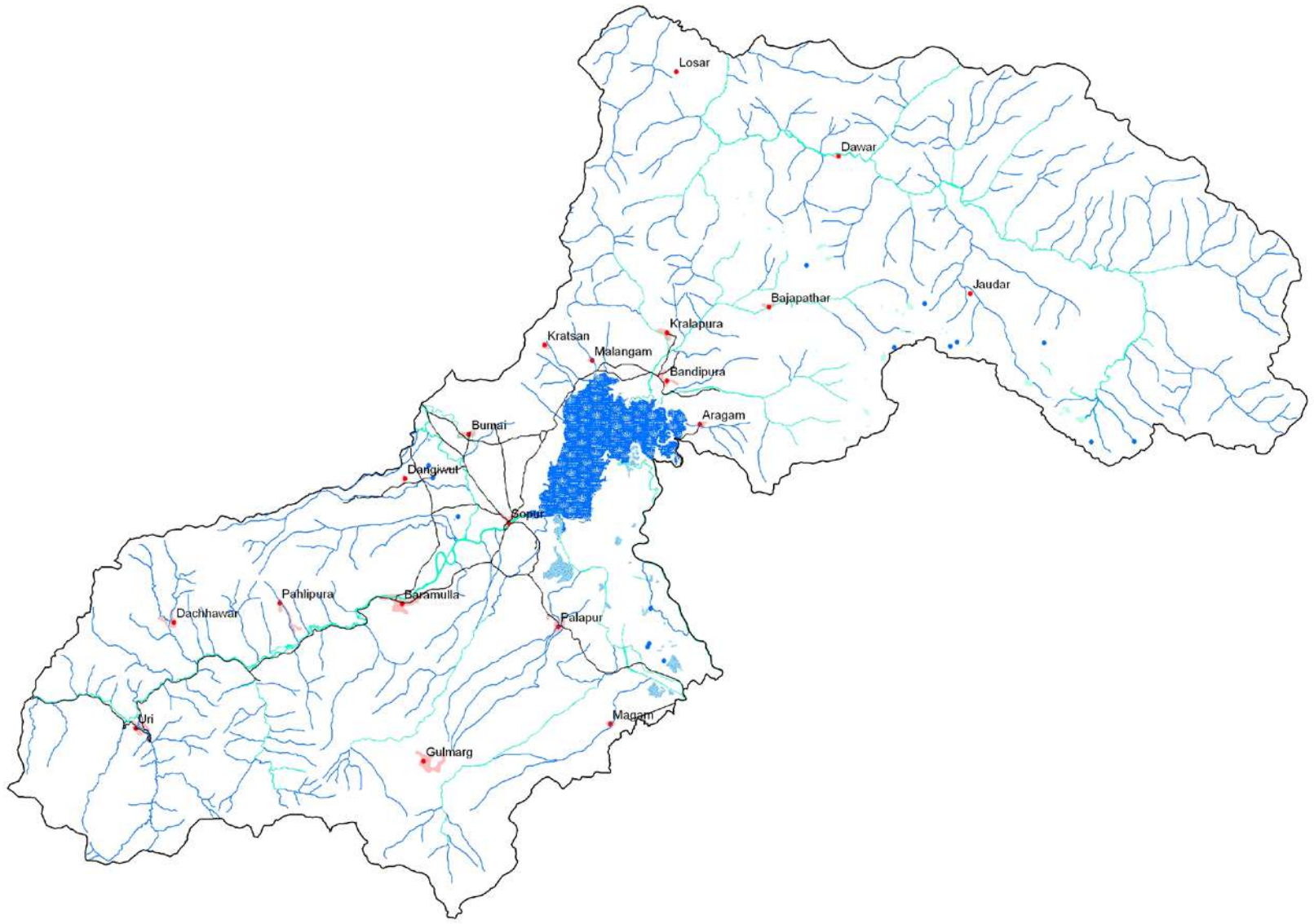
Area under Aquatic Vegetation	10922	7532

Area under turbidity levels		
Low	5058	3523
Moderate	8	15
High	16	5269

State : Jammu and Kashmir

WETLAND MAP

District : Baramulla

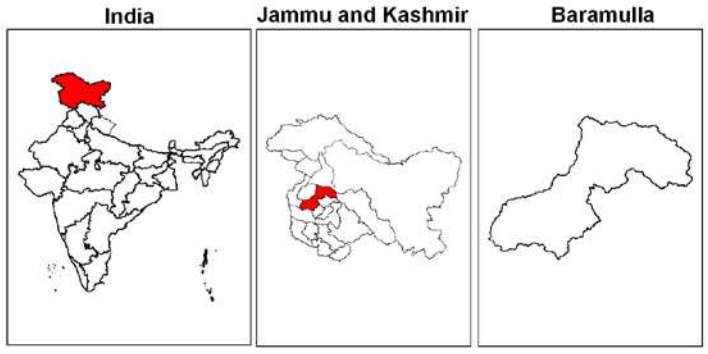


Symbol Typecode	Level I	Level II	Level III
	Inland Wetlands		
		Natural	
1101			Lakes/Ponds
1102			Ox-bow lakes/ Cut-off meanders
1103			High altitude wetlands
1104			Reverine wetlands
1105			Waterlogged
1106			River/Stream
		Man-made	
1201			Reservoirs/Barrages
1202			Tanks/Ponds
1203			Waterlogged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

Legend

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

Location Map



0 4.5 9 18 27 36 Kilometers

Data Source :

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

Prepared By :

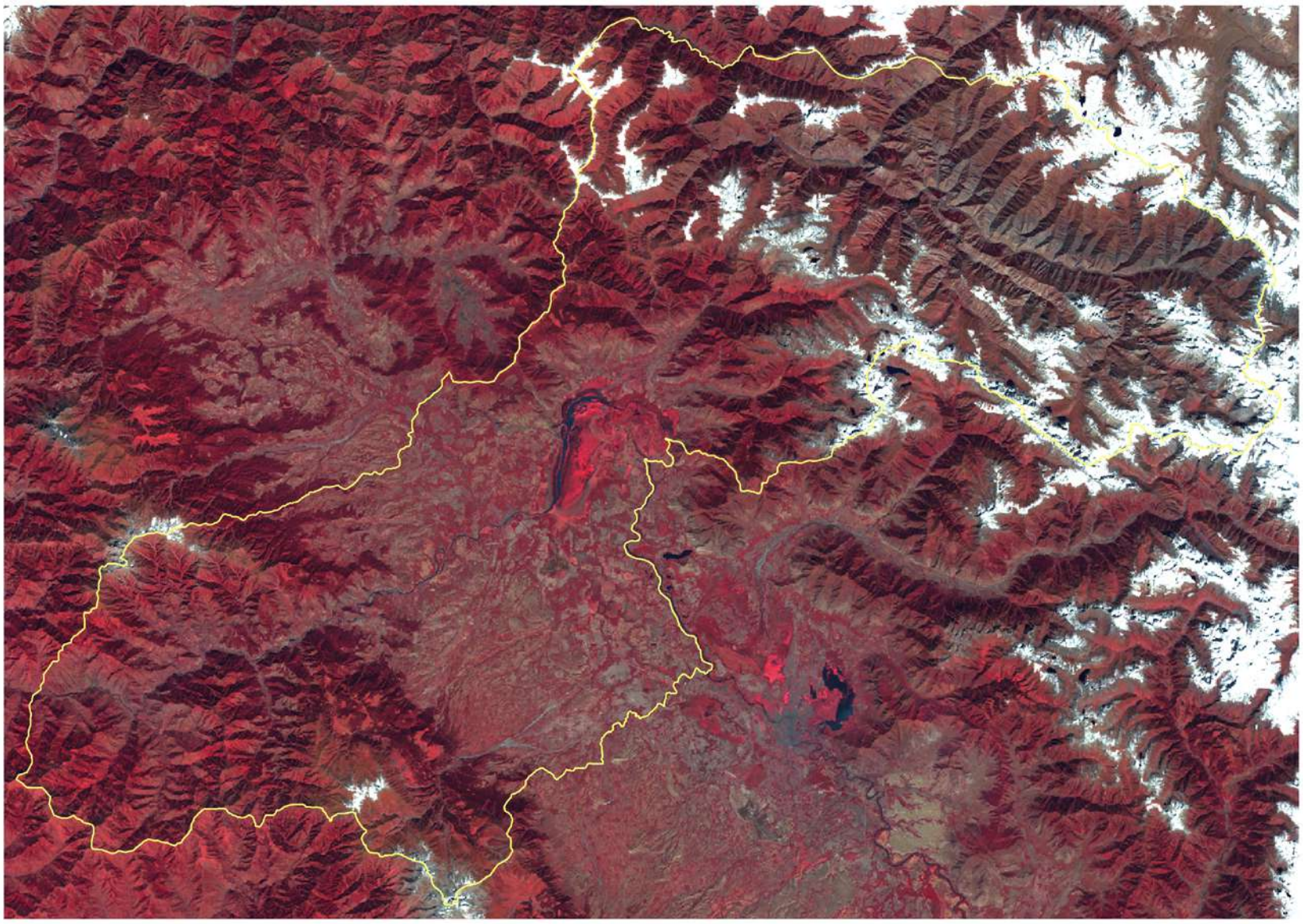
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Baramulla



IRS P6 AWiFS Post-monsoon data (2005)

7.1.3 Srinagar

Srinagar district shares its border with Baramulla, Budgam, Pulwama, Anantnag and Kargil districts from the west to east. The valley is surrounded by the Hurmukh mountain (16,903 feet) in the east, Tosh Maidan (4,000 feet) in the north and Snony Kazi Nag (12,125 feet) in the northwest and also the Mahadev Mountain. The valley is a land of lakes, clear streams and green meadows. The river Jhelum dissects the district diagonally from the southeast to the northwest. Srinagar is the state's summer capital. The geographical area of the district is 1,865 sq. km. with two tehsils, namely, Srinagar and Ganderbal.

Total 76 wetlands are mapped and 23 small wetland (< 2.25 ha) are identified and demarcated as point feature. The total area of wetlands is 10081ha area. The wetland types found are Lakes/Ponds, high altitude lakes, riverine wetlands, and rivers. The dominant type of wetland in the district is riverine wetlands, which contribute around 54 per cent area of the state. There are 14 Lake/pond contributing 21.76%. There is a single man made tank/ pond located in the northern part of the Dal lake. It is used mainly to trap the sediments coming through the steam/river and domestic sewage. The detail of wetland statistics of the district is given in Table 8.

Aquatic vegetation is observed in Riverine wetlands and Lake/pond. Area under aquatic vegetation is 6254 ha in post-monsoon and 4999 ha in pre-monsoon. Seasonal fluctuations of open water in wetlands are not significant, except in case of Riverine wetlands, which varied from 14 ha in post monsoon to 1001 ha in pre monsoon. Qualitative turbidity of open water ranged from low to medium during post monsoon, but ranged from high to low during pre monsoon.

Table 8: Area estimates of wetlands in Srinagar

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	14	2194	21.76	1429	1603
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	29	392	3.89	392	392
4	1104	Riverine wetlands	25	5457	54.13	14	1001
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	7	2012	19.96	1910	1679
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	1	3	0.03	3	3
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**76**	**10058**	**99.77**	**3748**	**4678**
		Wetlands (<2.25 ha)	23	23	0.23	-	-
		Total	**99**	**10081**	**100.00**	**3748**	**4678**

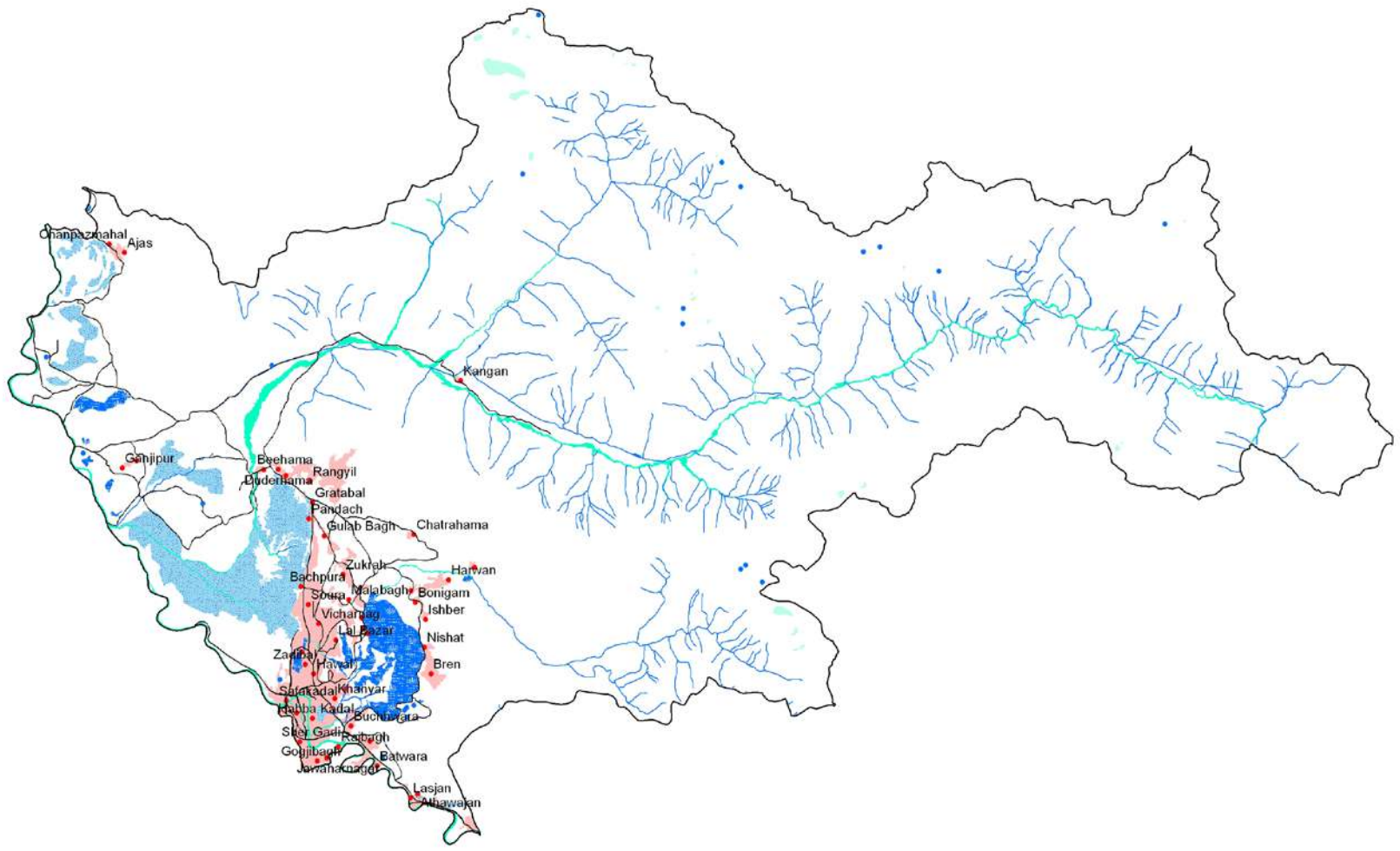
Area under Aquatic Vegetation	6254	4999

Area under turbidity levels		
Low	2523	2283
Moderate	1207	1388
High	18	1007

State : Jammu and Kashmir

WETLAND MAP

District : Srinagar

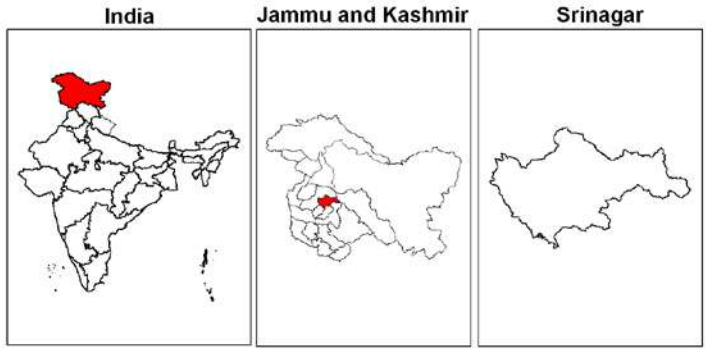


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 2 4 8 12 16 Kilometers

Data Source :

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

Prepared By :

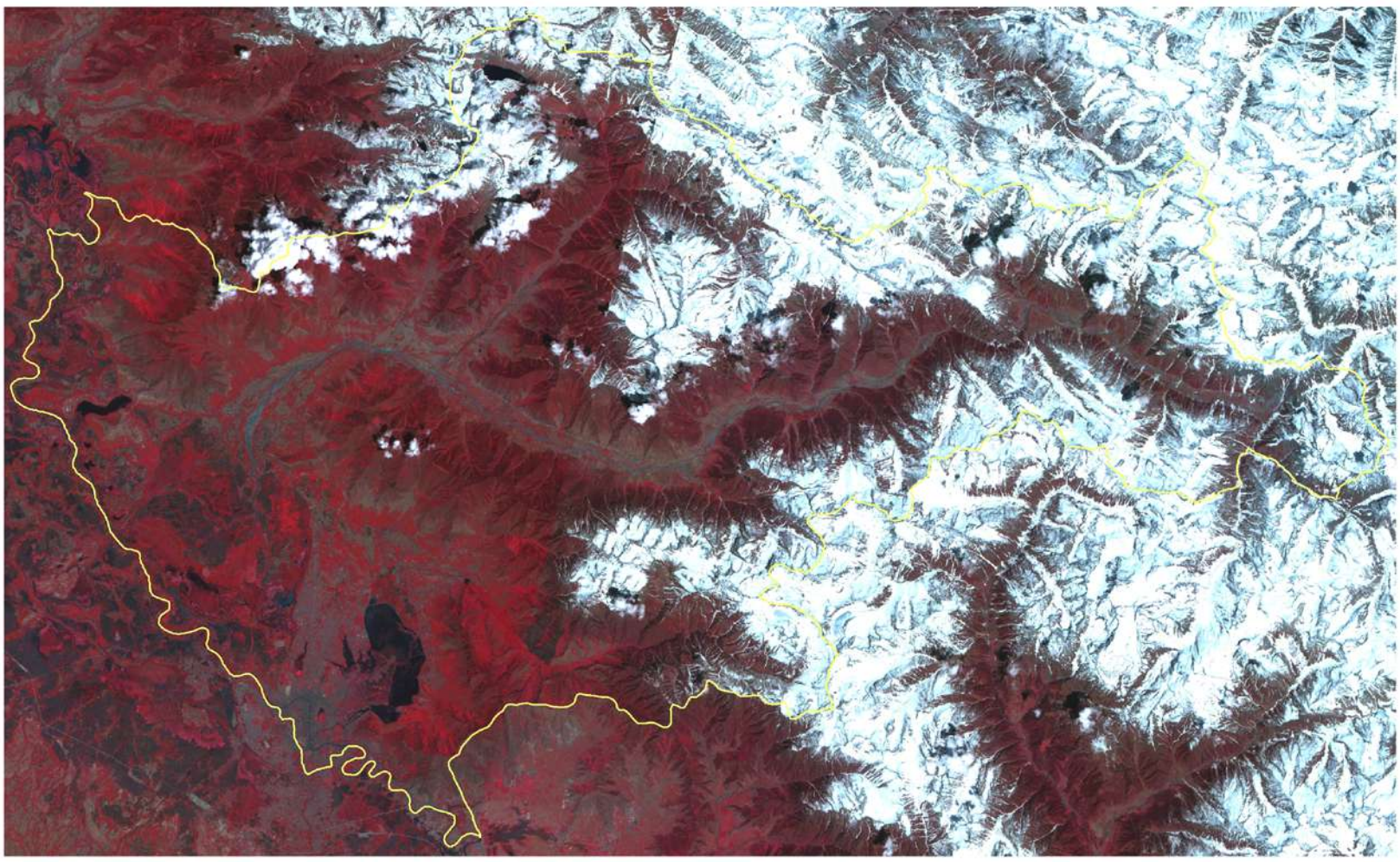
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Srinagar



IRS P6 LISS-III Pre-monsoon 2007 data

7.1.4 Budgam

Budgam district is centrally located in the Kashmir valley. It is bounded by Srinagar in the northeast, south and west by Poonch and in the north and northwest by Baramulla. Although the district has several high mountains, its average height is just 5,281 feet above sea level. The geographical area of the district is 1,267 sq. km. with three tehsils, namely, Chadura, Budgam and Beerwah. Agriculture is the main occupation of the people.

There are 32 wetlands mapped and 48 small wetlands (>2.25 ha) identified with wetland area of 3402 ha. The wetland types found are high altitude lakes, riverine wetlands, and rivers. The dominant type of wetland found in the district is riverine wetlands, which contribute around 57 per cent wetland area of the state. High altitude lakes are 11 but their size is smaller compare to lakes/ponds found in plain areas of the districts. A detail of the wetland statistics of the district is given in Table 9.

Around 1927 ha and 1914 ha area are under vegetation during post and pre monsoon season respectively. This is mainly due to vegetation observed in case of Riverine wetlands. Seasonal fluctuations of open water spread of River/stream and high altitude wetlands do not show variation. However, the open water spread of Riverine Wetlands is high (99 ha) during pre monsoon and low (26 ha) during post monsoon. Qualitative turbidity of open water is in general low in both the seasons.

Table 9: Area estimates of wetlands in Budgam

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	11	150	4.41	150	150
4	1104	Riverine wetlands	9	1932	56.79	26	99
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	12	1272	37.39	1244	1244
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**32**	**3354**	**98.59**	**1420**	**1493**
		Wetlands (<2.25 ha)	48	48	1.41	-	-
		Total	**80**	**3402**	**100.00**	**1420**	**1493**

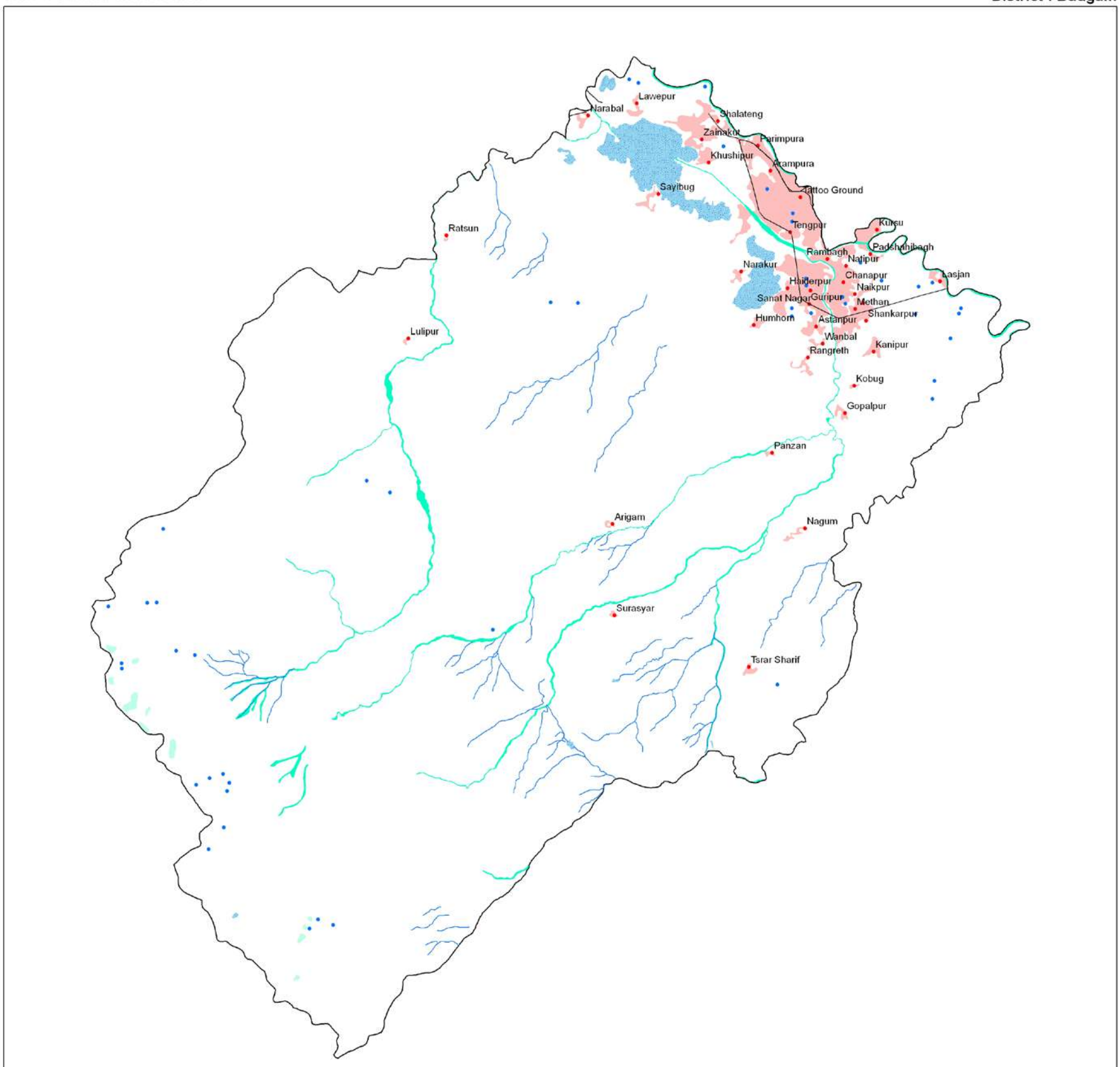
Area under Aquatic Vegetation	1927	1914

Area under turbidity levels		
Low	1400	1400
Moderate	20	93
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Budgam

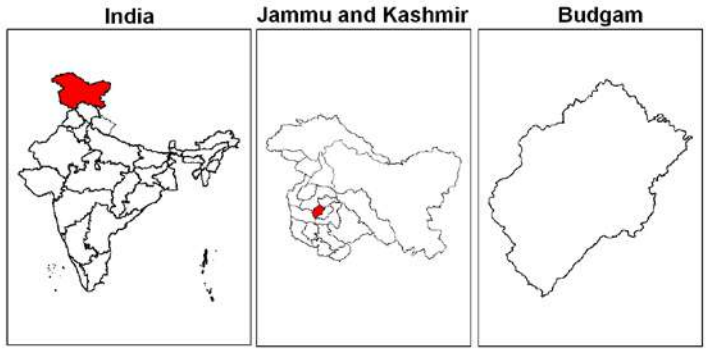


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 1.5 3 6 9 12 Kilometers

Data Source :

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

Prepared By :

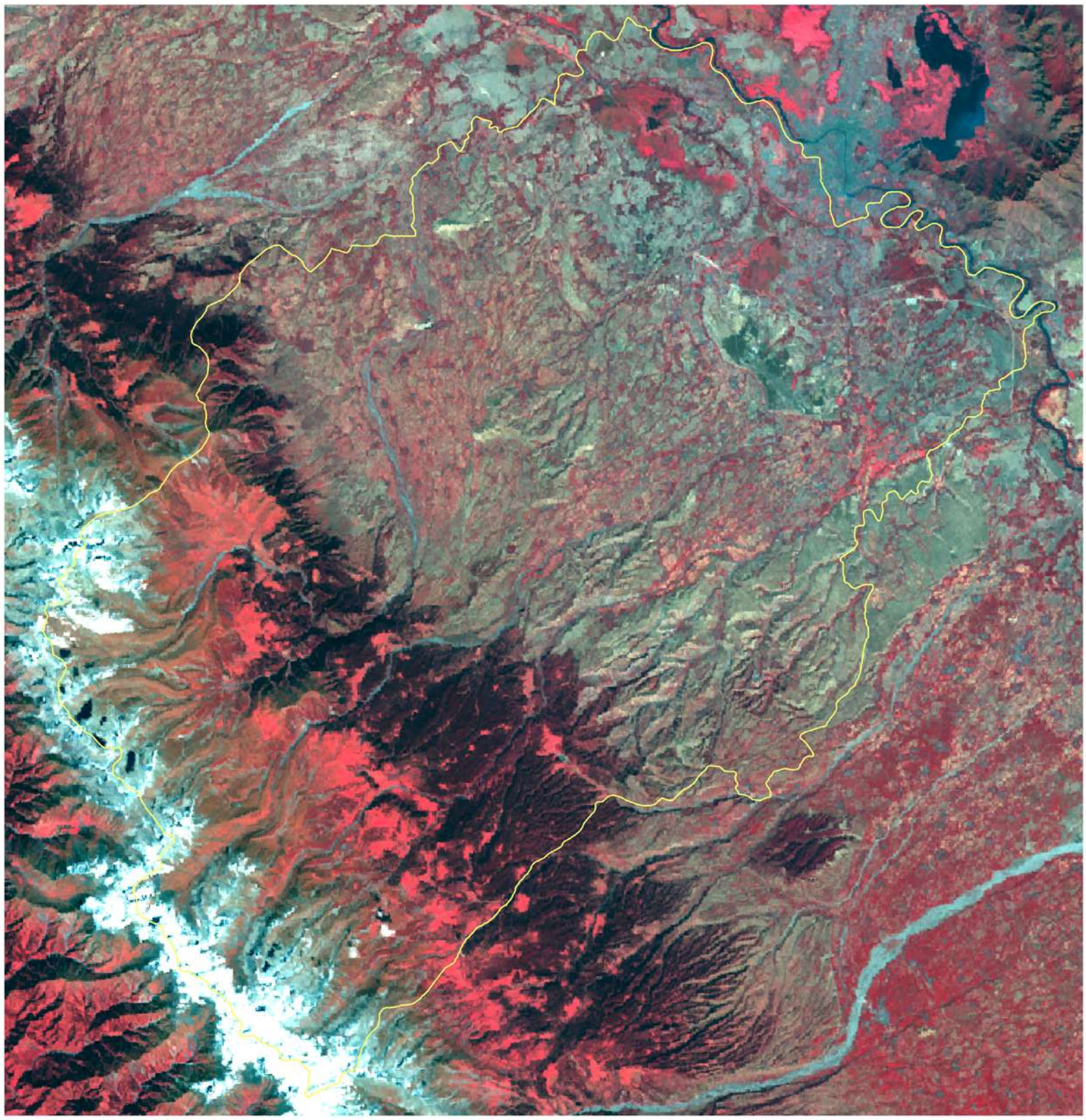
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Budgam



IRS P6 AWiFS Post-monsoon data (2005)

7.1.5 Pulwama

Pulwama district is situated in the southeastern part of the valley. It shares its borders with Srinagar and Budgam in the northwest and is bounded by the Anantnag district in the south and east. The geographical area of the district is 1,456 sq. km. with three tehsils, namely, Shopian, Pulwama and Tral.

Total 15 wetlands are mapped and 251 small wetlands (>2.25 ha) are identified with total wetland area of the district as 3561 ha. River /steam type contributed about 83.1 per cent wetland area of the district. Riverine wetlands contribute around 9.7 per cent wetland area of the district. A detail of the wetland statistics of the district is given in Table 10.

Presence of aquatic vegetation is observed in Riverine wetlands and the area under aquatic vegetation is 338 ha in post-monsoon and 259 ha in pre-monsoon. Seasonal fluctuations of water in Rivers/stream are not significant. In case of Riverine wetlands, the open water spread is high in pre monsoon. Low turbidity is found in most of the wetlands and covered an area of around 1700 ha in both the seasons.

Table 10: Area estimates of wetlands in Pulwama

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	2	4	0.11	4	4
4	1104	Riverine wetlands	7	347	9.74	10	88
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	5	2956	83.01	1728	1709
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	1	3	0.08	3	3
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**15**	**3310**	**92.95**	**1745**	**1804**
		Wetlands (<2.25 ha)	251	251	7.05	-	-
		Total	**266**	**3561**	**100.00**	**1745**	**1804**

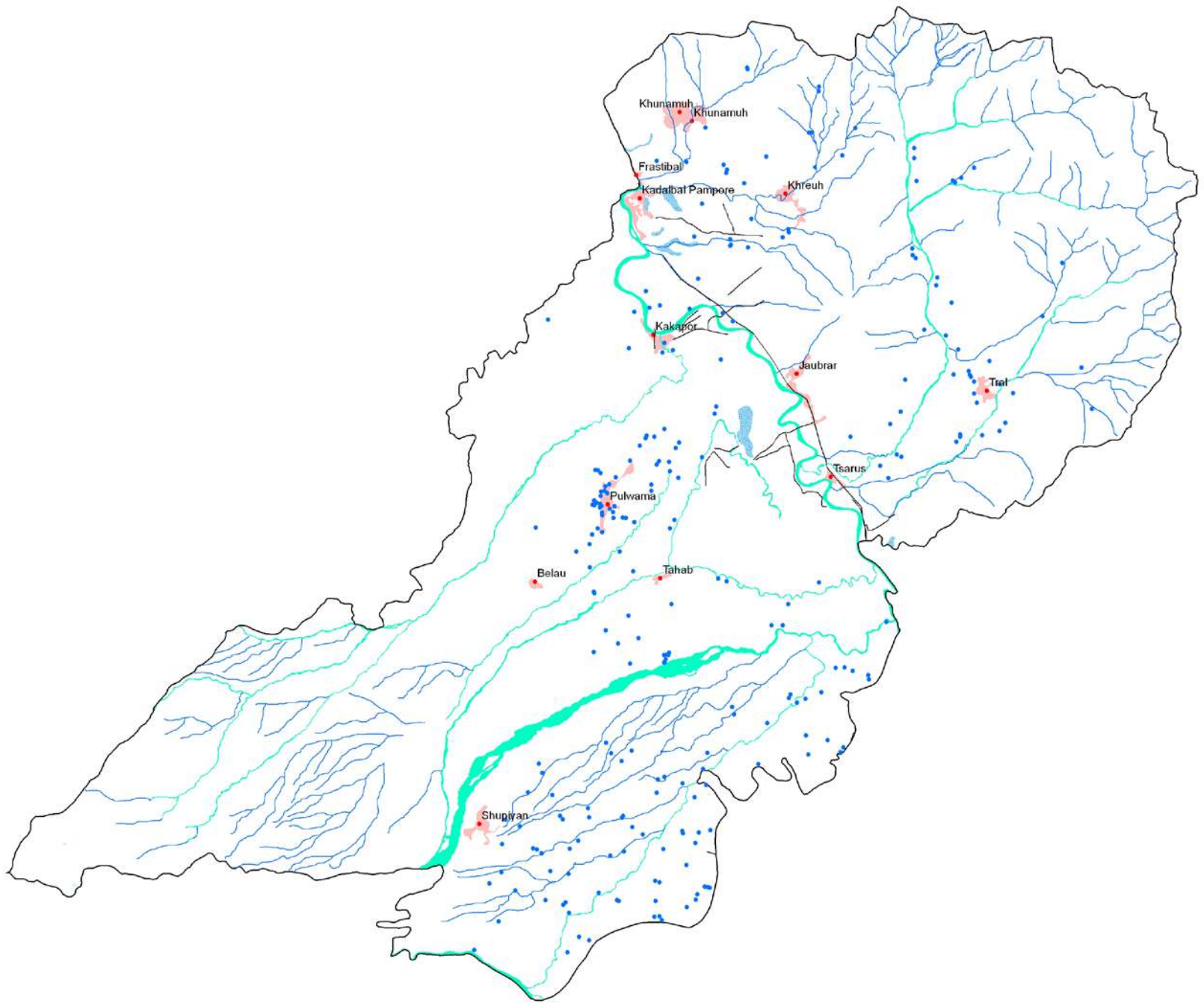
Area under Aquatic Vegetation	338	259

Area under turbidity levels		
Low	1732	1712
Moderate	4	4
High	9	88

State : Jammu and Kashmir

WETLAND MAP

District : Pulwama

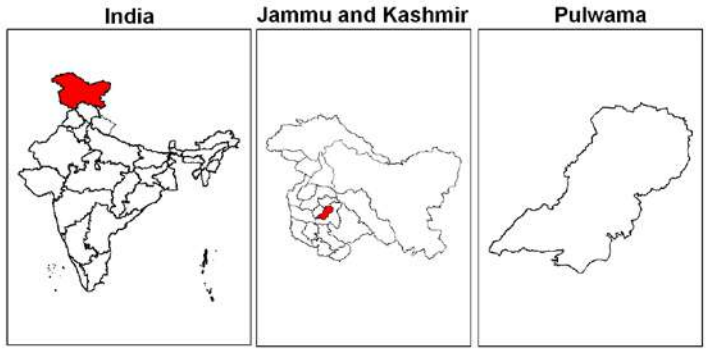


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 2 4 8 12 16 Kilometers

Data Source :

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

Prepared By :

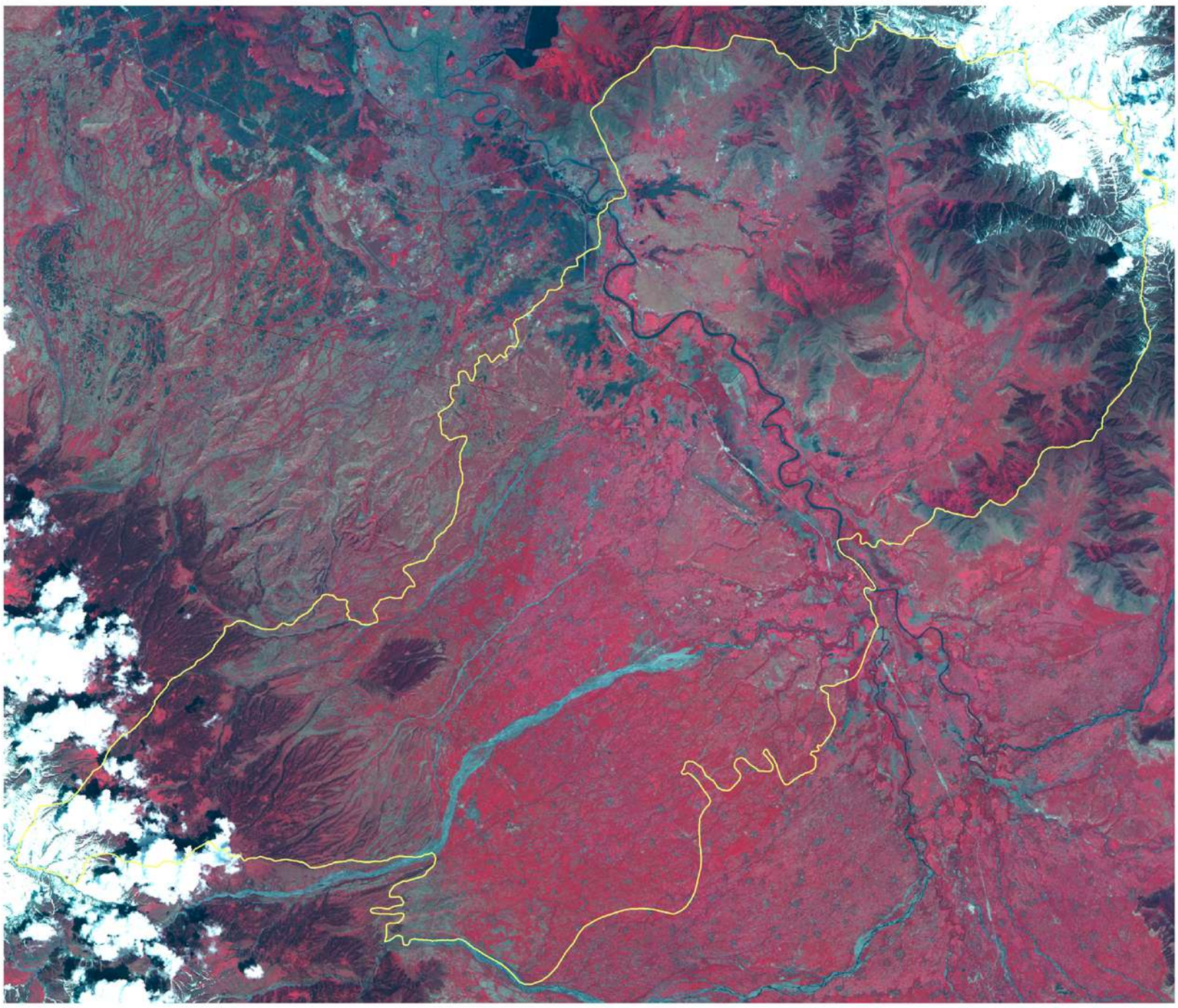
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Pulwama



IRS P6 LISS-III Pre-monsoon 2007 data

7.1.6 Anantnag

Anantnag is the southern most district of the valley. It shares its border with district Pulwama in the west and from south to east it is attached to Rajouri, Udhampur and Doda districts respectively. It borders Kargil in the north. The district is criss-crossed by a network of perennial rivers, streams and waterfalls. The geographical area of the district is 3,986 sq. km. with five tehsils, namely, Pahalgam, Anantnag, Doru, Kulgam and Bijbehara. The district, enriched with perennial streams with clean water has developed commercial fishing activities with a scattering of trout farms.

Total 95 wetlands were mapped and 23 small wetlands (>2.25 ha) were identified, with total area of wetlands of the district as 6875 ha. The major wetland category is River /steam contributing about 81 per cent wetland area of the district. High altitude wetlands cover an area of 1026 ha and accounts for 15 per cent wetland area of the district. A detail of the wetland statistics of the district is given in Table 10.

Presence of aquatic vegetation is observed in riverine wetlands and the area under aquatic vegetation is 273 ha in post-monsoon and 217 ha in pre-monsoon. Seasonal fluctuations in rivers/stream and High altitude wetlands are not very high. The turbidity of water is mainly low in both the seasons.

Table 10: Area estimates of wetlands in Anantnag district

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	69	1026	14.92	1026	1026
4	1104	Riverine wetlands	15	273	3.97	-	56
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	11	5553	80.77	3310	3428
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**95**	**6852**	**99.67**	**4336**	**4510**
		Wetlands (<2.25 ha)	23	23	0.33	-	-
		Total	**118**	**6875**	**100.00**	**4336**	**4510**

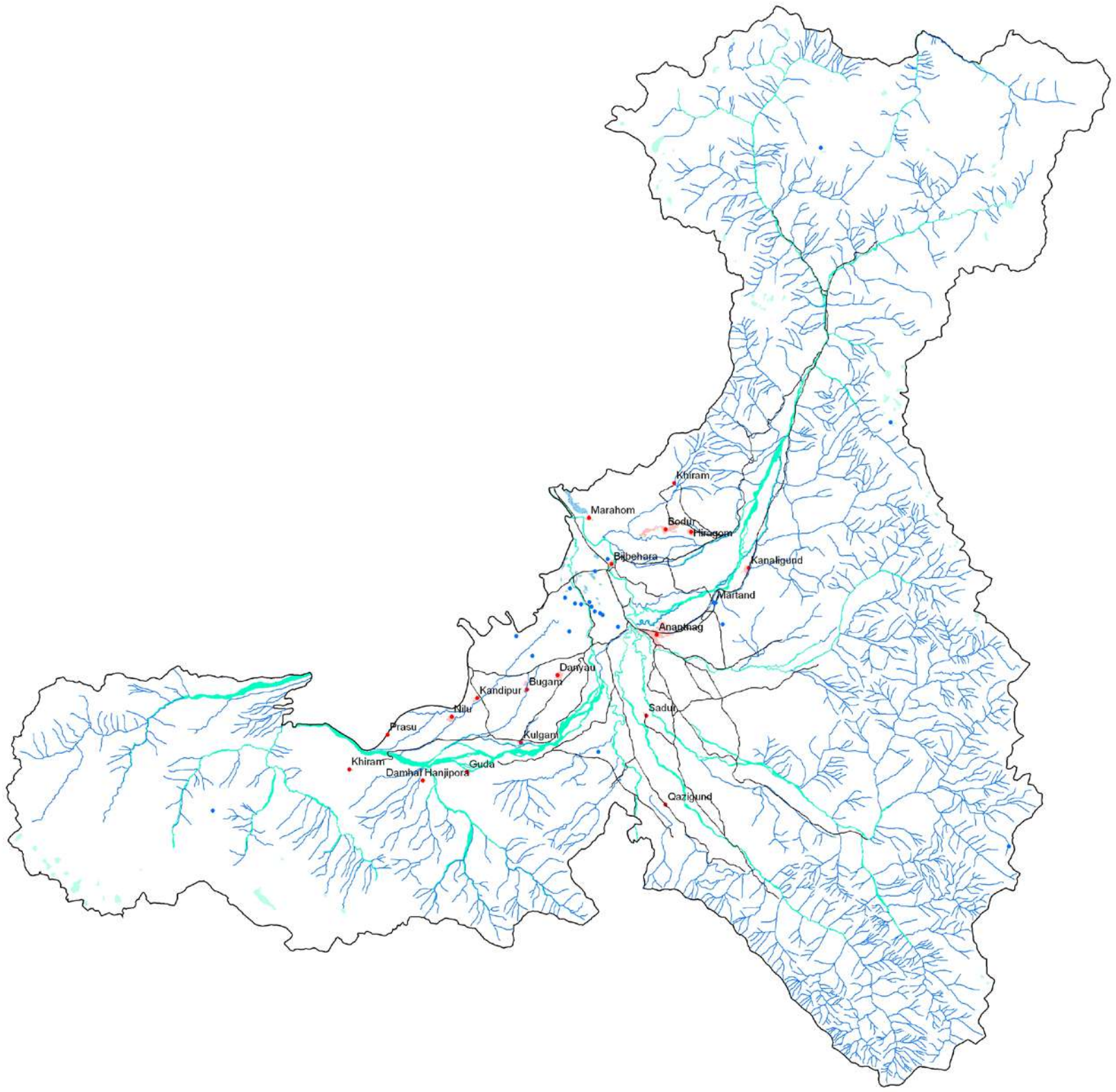
Area under Aquatic Vegetation	273	217

Area under turbidity levels		
Low	4297	4402
Moderate	39	108
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Anantnag

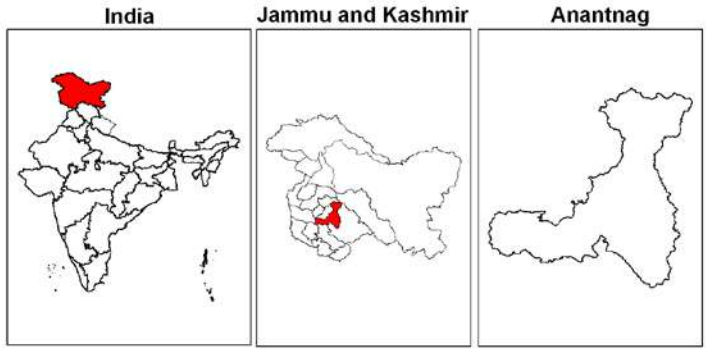


Symbol Typecode	Level I	Level II	Level III
	Inland Wetlands		
		Natural	
1101			Lakes/Ponds
1102			Ox-bow lakes/ Cut-off meanders
1103			High altitude wetlands
1104			Reverine wetlands
1105			Waterlogged
1106			River/Stream
		Man-made	
1201			Reservoirs/Barrages
1202			Tanks/Ponds
1203			Waterlogged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

Legend

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

Location Map



0 3 6 12 18 24 Kilometers

Data Source :

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

Prepared By :

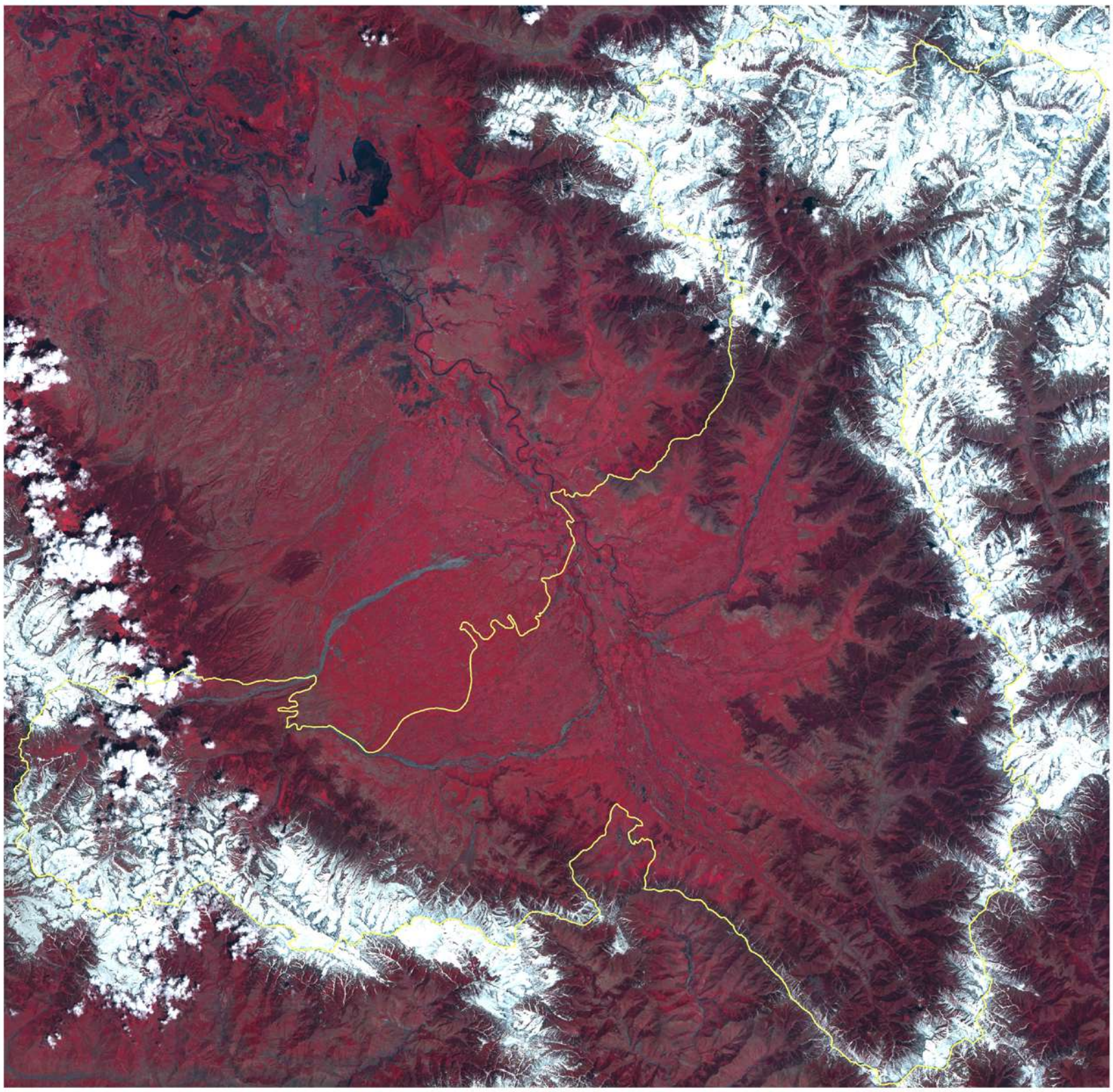
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Anantnag



IRS P6 LISS-III Pre-monsoon 2007 data

7.1.7 Leh (Ladakh)

Leh district is the northern as well as the eastern most part of Jammu and Kashmir. It is linked with the Kashmir valley by the Zojila pass (10,098 feet) and forms part of the outer Himalayas. It is one of the highest regions of the earth (altitude 8,800 feet to 18,000 feet approximately) with mountains running along parallel ranges. The climate is very cold and in winter, temperatures dip to minus 40 degrees centigrade. The district is bounded by the international border with China in the north and east, and with Pakistan in the north. The Geographical area of the district is 1,05,306 sq. km. Leh is the district headquarter. This district is famous for *pashmina* goat, which produces fiber used for high quality fabric *pashmina* wool.

There are 521 wetlands mapped and 440 small wetlands (>2.25 ha) identified in the district with 203195 ha area. The major wetland category is High altitude wetlands. Total 485 High altitude wetlands mapped with 102934 ha area and contribute about 51 percent of wetlands. In addition, the 440 small wetlands identified are mainly of High altitude ones. River /steam wetlands cover an area of 9921ha and accounts for 49 per cent wetland area of the district. A detail of the wetland statistics of the district is given in Table 11.

Presence of aquatic vegetation in wetlands is very less and observed during pre monsoon. Seasonal fluctuations in water spread are not significant both in case of River/stream and High altitude wetlands. Qualitative turbidity of water is low in both the seasons.

Table 11: Area estimates of wetlands in Leh (Ladakh) district

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	485	102934	50.66	98877	98839
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	36	99821	49.13	87270	87582
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**521**	**202755**	**99.78**	**186147**	**186421**
		Wetlands (<2.25 ha),	440	440	0.22	-	-
		Total	**961**	**203195**	**100.00**	**186147**	**186421**

Area under Aquatic Vegetation	-	424

Area under turbidity levels		
Low	186147	186421
Moderate	-	-
High	-	-

State : Jammu and Kashmir

WETLAND MAP

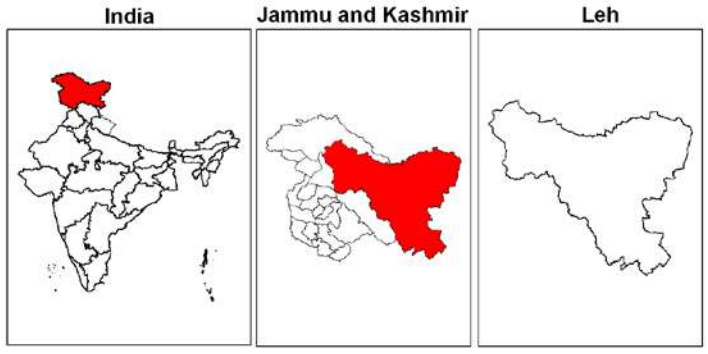
District : Leh

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

Legend

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

Location Map



Data Source :

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

Prepared By :

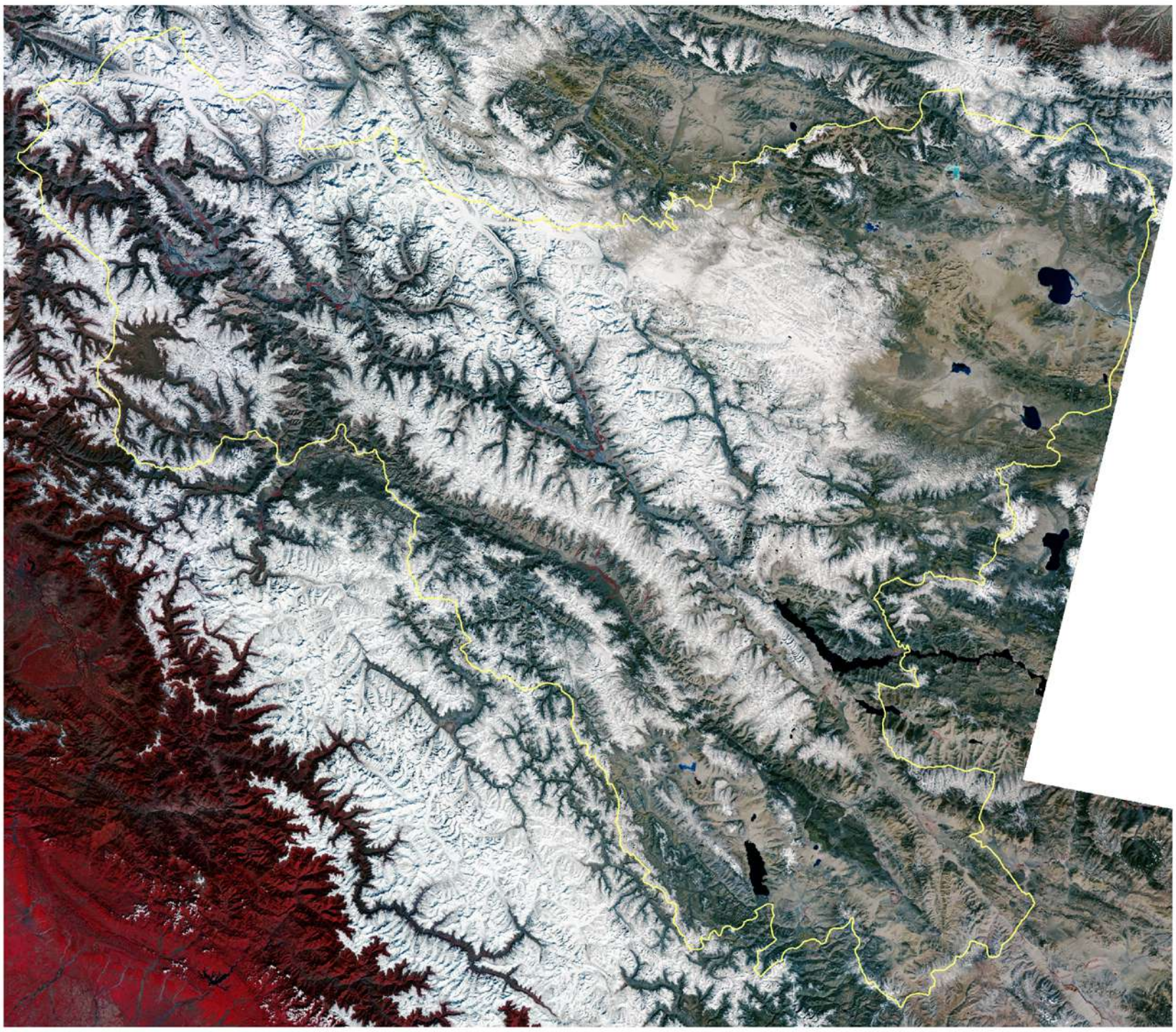
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Leh



IRS P6 AWiFS Post-monsoon data (2005)

7.1.8 Kargil

Kargil shares the boarder with Pakistan in the north and with Leh in the east and the Kashmir valley in the west. The geographical area of the district is 16,296 sq. km. The district has two tehsils as well as two assembly constituencies, namely, Kargil and Zanskar. The climate is very cold and in winter, and the snowfall around the Zojila pass and Drass region is very heavy. Most of the villages of the district are located at an average height of 10,000 feet above sea level. Agriculture is the main occupation and about 91 per cent of the population is engaged in it. Wheat and millet are the major crops.

Total 42 wetlands were mapped and 10 small wetland (>2.25 ha) identified with an area of 10380 ha. The major wetland type of the district is River/stream occupying around 98 per cent area. The other wetland type observed is high altitude wetlands. There are 33 High altitude wetlands mapped contributing 2 per cent of total wetland area. A detail of the wetland statistics of the district is given in Table 12.

Aquatic vegetation is absent in these wetlands. Seasonal fluctuations in water spread are nil in case of high altitudinal wetlands but the open water spread in River/stream is more during pre monsoon. All wetlands are having crystal clear water with low turbidity.

Table 12: Area estimates of wetlands in Kargil

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	33	219	2.11	219	219
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	9	10151	97.79	5500	7505
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**42**	**10370**	**99.90**	**5719**	**7724**
		Wetlands (<2.25 ha)	10	10	0.10	-	-
		Total	**52**	**10380**	**100.00**	**5719**	**7724**

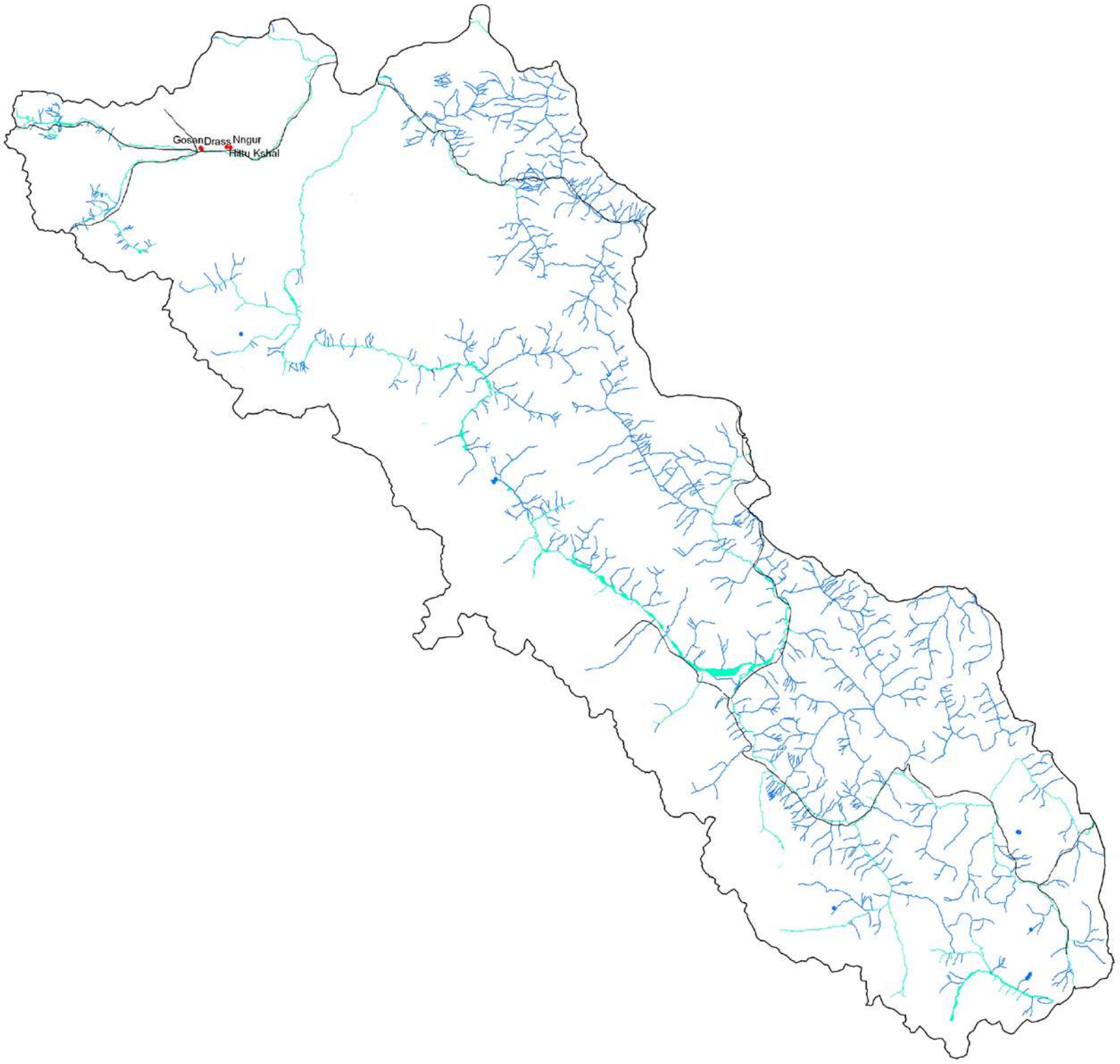
Area under Aquatic Vegetation	-	-

Area under turbidity levels		
Low	5719	7724
Moderate	-	-
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Kargil

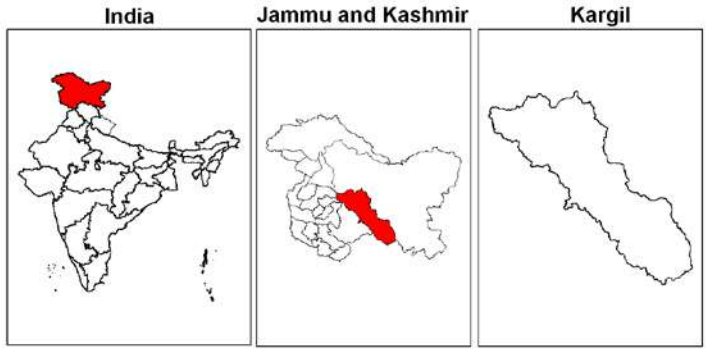


Symbol Typecode	Level I	Level II	Level III
	Inland Wetlands		
		Natural	
1101			Lakes/Ponds
1102			Ox-bow lakes/ Cut-off meanders
1103			High altitude wetlands
1104			Reverine wetlands
1105			Waterlogged
1106			River/Stream
		Man-made	
1201			Reservoirs/Barrages
1202			Tanks/Ponds
1203			Waterlogged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

Legend

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

Location Map



0 5 10 20 30 40 Kilometers

Data Source :

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

Prepared By :

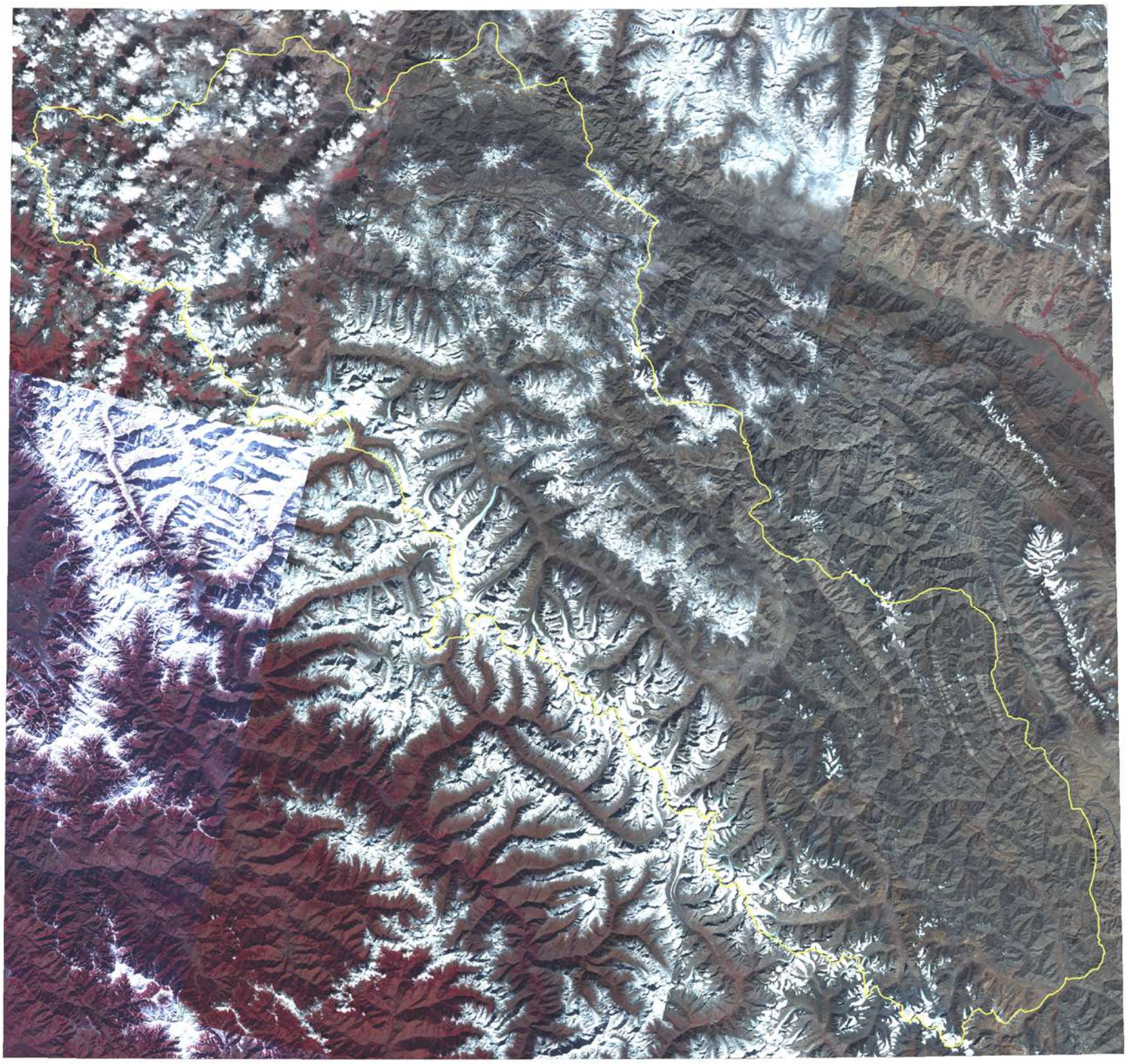
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Kargil



IRS P6 LISS-III Pre-monsoon 2007 data

7.1.9 Doda

Doda is the largest district in the Jammu region. The district shares borders with Anantnag district of Kashmir Valley and the Chamba district of Himachal Pradesh. The entire area is hilly. The area of the district is 11,683 sq. km. The district comprises six tehsils, namely, Doda, Kishtwar, Bhaderwah, Gandoh, Ramban and Banihal.

The number of wetlands mapped in the district are 13 and 21 small wetlands (>2.25 ha) identified. Total wetland area estimated is 5667 ha. There are 11 high altitude wetlands and accounted for 1.39 per cent wetland area of the district. River /steam cover an area of 5567 ha and accounts for 99 per cent wetland area of the district. A detail of the wetland statistics of the district is given in Table 13.

Aquatic vegetation is absent in these wetlands. Seasonal fluctuations in water spread are nil in case of High altitude wetlands, but marginally high in River/stream during pre monsoon. All wetlands are having crystal clear water with low turbidity.

Table 13: Area estimates of wetlands in Doda

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	11	79	1.39	79	79
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	2	5567	98.24	5186	5606
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**13**	**5646**	**99.63**	**5265**	**5685**
		Wetlands (<2.25 ha)	21	21	0.37	-	-
		Total	**34**	**5667**	**100.00**	**5265**	**5685**

Area under Aquatic Vegetation	-	-

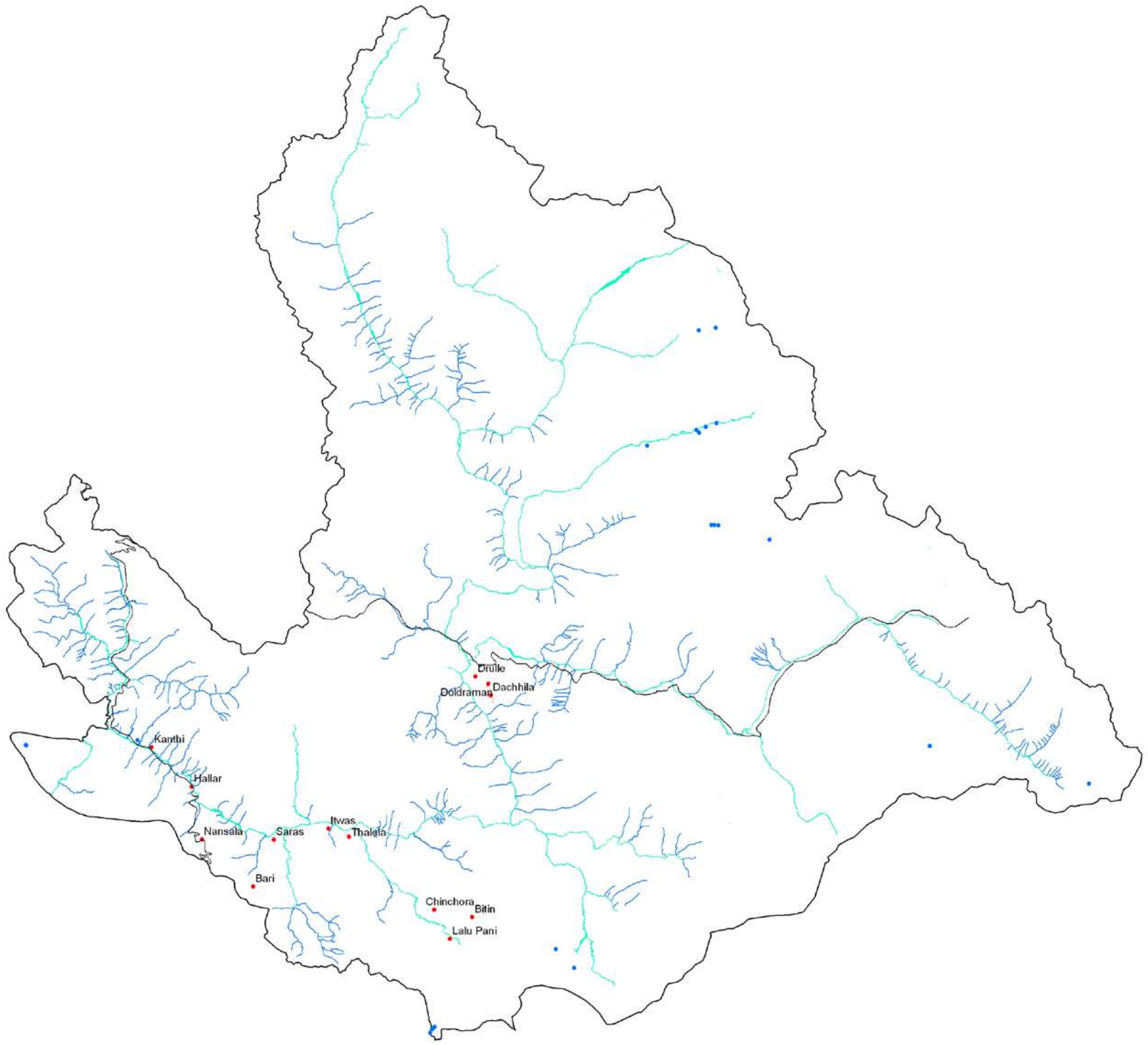
Area under turbidity levels		
Low	5265	5685
Moderate	-	-
High	-	-

.

State : Jammu and Kashmir

WETLAND MAP

District : Doda

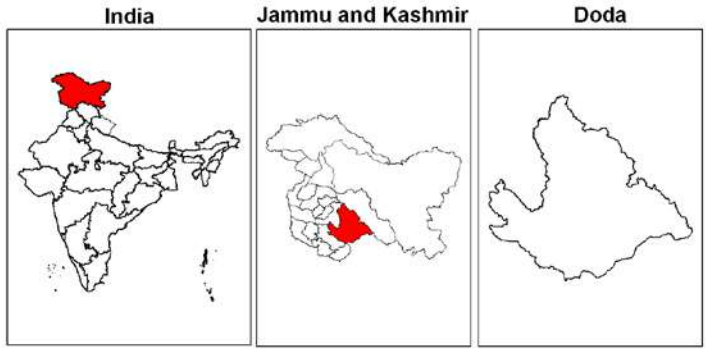


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 5 10 20 30 40 Kilometers

Data Source :

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

Prepared By :

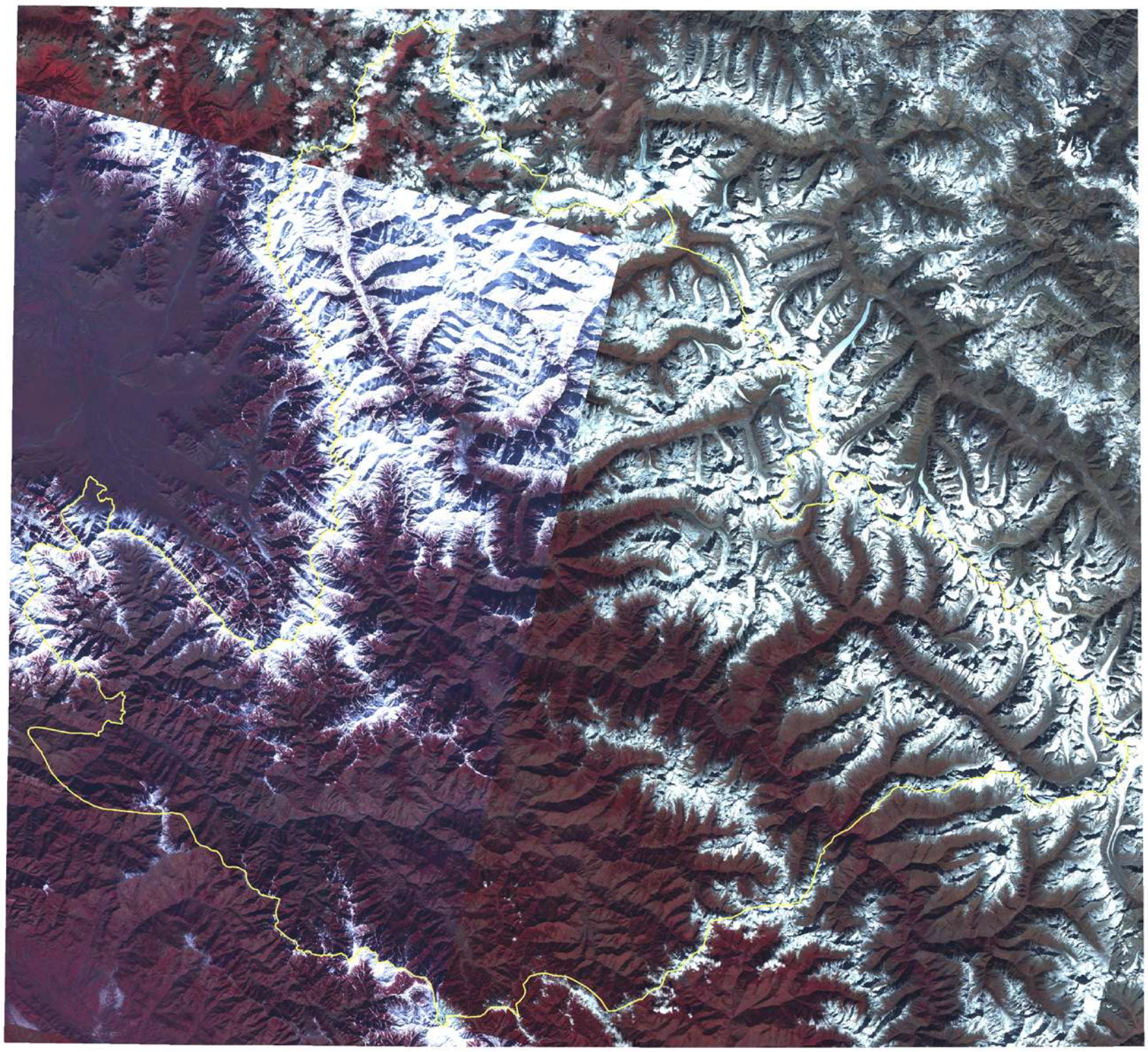
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Doda



IRS P6 LISS-III Post-monsoon 2006 data

7.1.10 Udhampur

Udhampur is the third largest district of Jammu and Kashmir and is situated at an altitude of 2,134 feet above sea level. Rajouri bounds the district in the west, Jammu in the southwest, Doda in the east and Kathua in the southeast, and Anantnag in the north. The geographical area of the district is 4,580 sq. km. with 5 tehsils, namely, Udhampur, Chenani, Ramnagar, Reasi and Mahore.

The number of wetlands mapped in the district is 30 and 43 small wetlands (>2.25 ha) identified as point feature. The total wetland area of the district is 8326 ha. The major wetland category both in number and area is river /steam covering an area of 7591 ha and accounting for 91.1 per cent wetland area of the district. There are only 3 High altitude wetlands, 3 Riverine wetlands and one Lake/pond mapped. A detail of the wetland statistics of the district is given in Table 14.

Aquatic vegetation is observed in Riverine wetlands in both the seasons. Seasonal Area under open water spread in River/stream is higher in pre monsoon. Qualitative turbidity of open water is low in both the seasons.

Table 14: Area estimates of wetlands in Udhampur

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	1	58	0.70	58	58
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	3	13	0.16	13	13
4	1104	Riverine wetlands	3	45	0.54	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	22	7591	91.17	4708	5818
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	1	576	6.92	576	567
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**30**	**8283**	**99.48**	**5355**	**6456**
		Wetlands (<2.25 ha)	43	43	0.52	-	-
		Total	**73**	**8326**	**100.00**	**5355**	**6456**

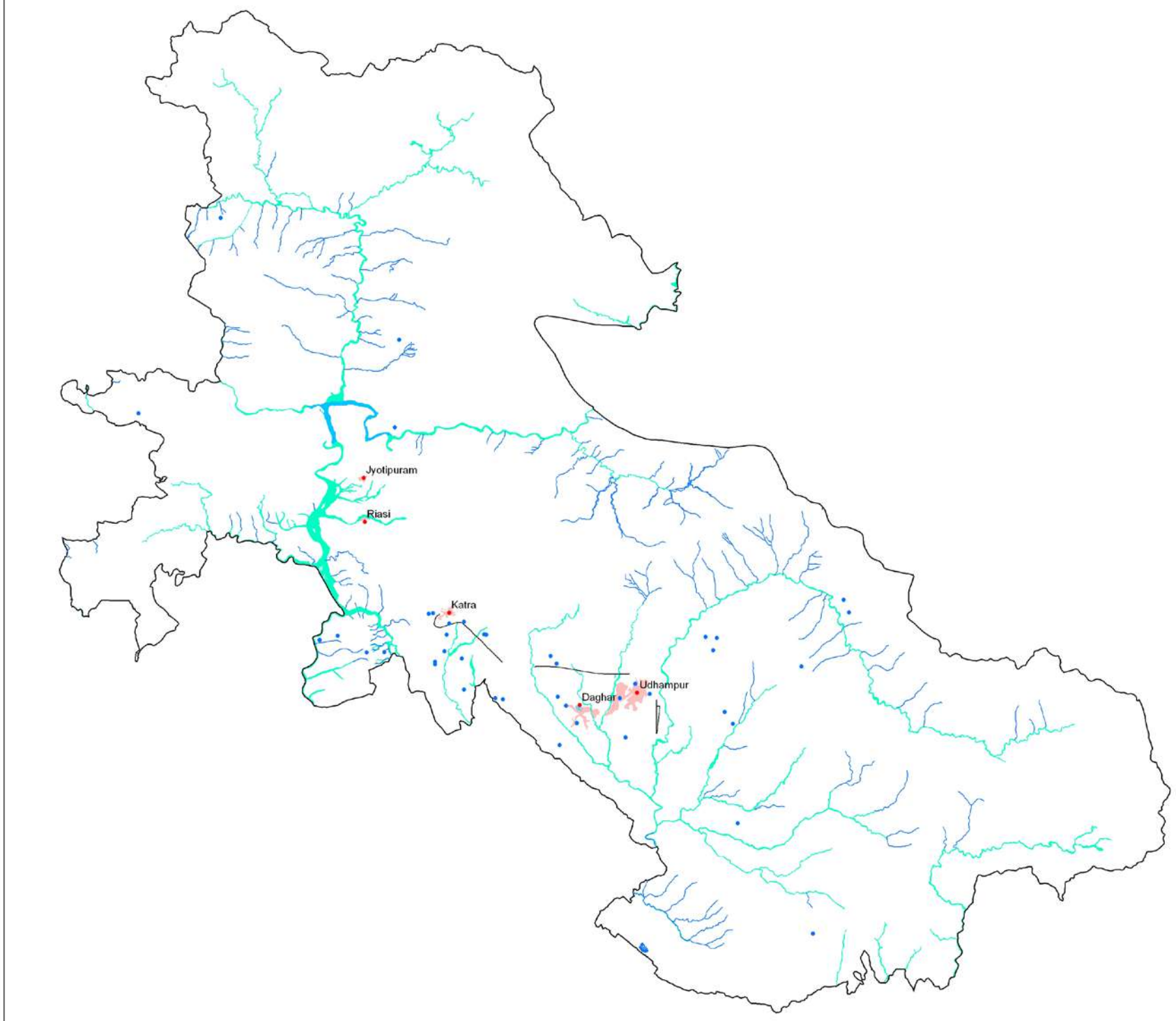
Area under Aquatic Vegetation	45	45

Area under turbidity levels		
Low	5355	6456
Moderate	-	-
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Udhampur

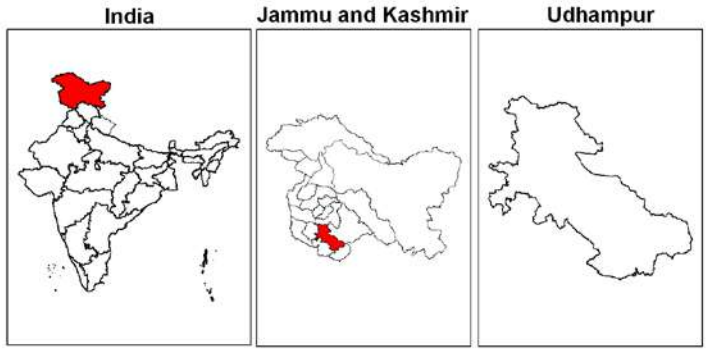


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 4 8 16 24 32 Kilometers

Data Source :

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

Prepared By :

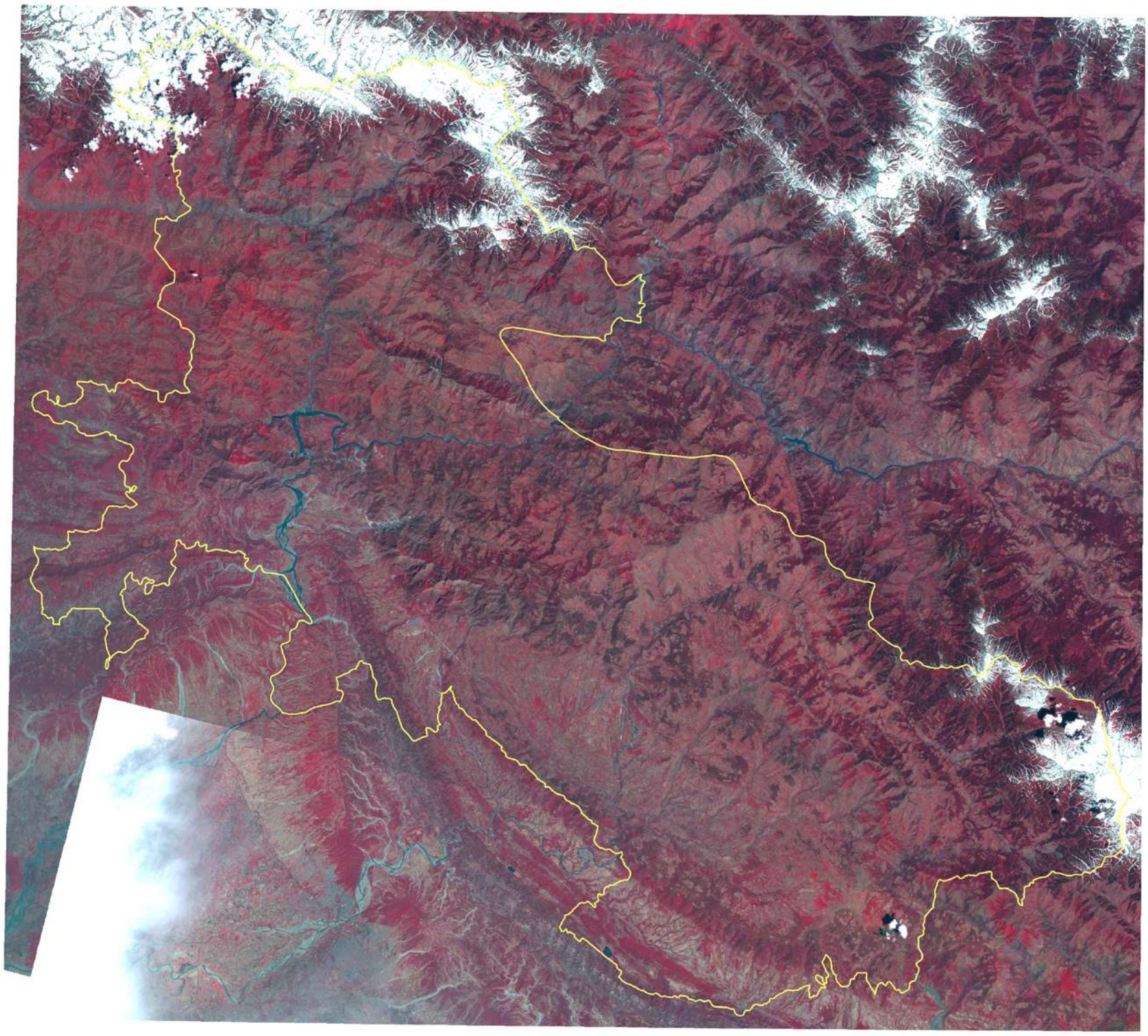
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Udhampur



IRS P6 LISS-III Pre-monsoon 2007 data

7.1.11 Poonch

Poonch is surrounded by the Pakistan on western part of the district and is separated from Kashmir Valley by the mighty Pir Panjal range in the north. The geographical area of the district is 3,826 sq. km., comprising three tehsils, viz., Mendhar, urankote, and Haveli (Poonch). The terrain is hilly with little fertile land.

Total 38 wetlands were mapped and 16 small wetlands (>2.25 ha) identified as point feature. The area under wetlands of the district is 7013 ha. The major wetland category is River/steam and they cover an area of 6932 ha and accounts for 98 per cent wetland area of the district. There are 10 High altitude wetlands with 59 ha area. A detail of the wetland statistics of the district is given in Table 15.

Wetlands are devoid of aquatic vegetation. Open water spread in River/stream is more during pre monsoon, no fluctuation of water spread area observed in case of High altitude wetlands. Turbidity of water is low in both seasons.

Table 15: Area estimates of wetlands in Poonch

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	10	59	0.84	59	59
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	6	6932	98.85	3901	4596
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**16**	**6991**	**99.69**	**3960**	**4655**
		Wetlands (<2.25 ha)	22	22	0.31	-	-
		Total	**38**	**7013**	**100.00**	**3960**	**4655**

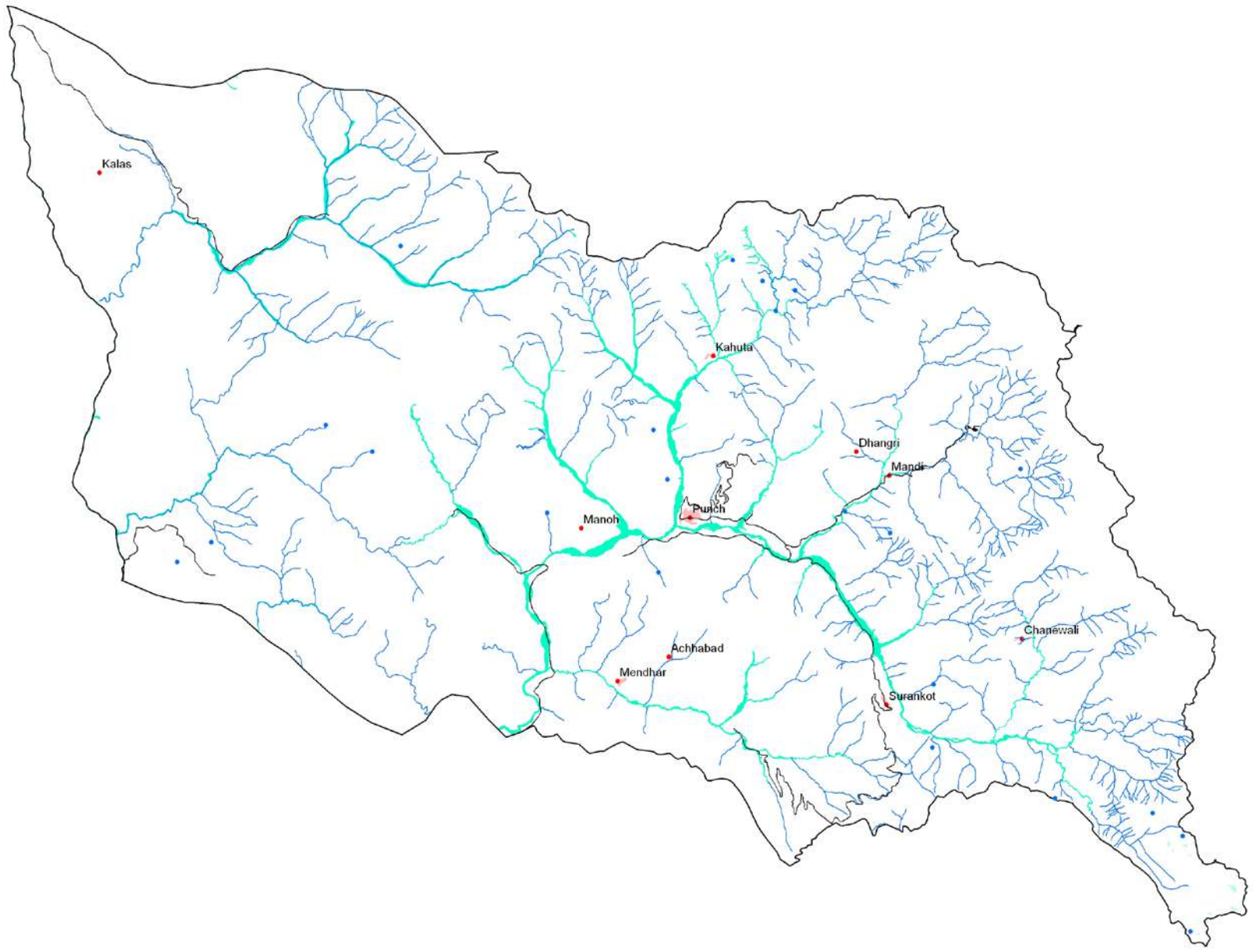
Area under Aquatic Vegetation	-	-

Area under turbidity levels		
Low	6960	4655
Moderate	-	-
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Poonch

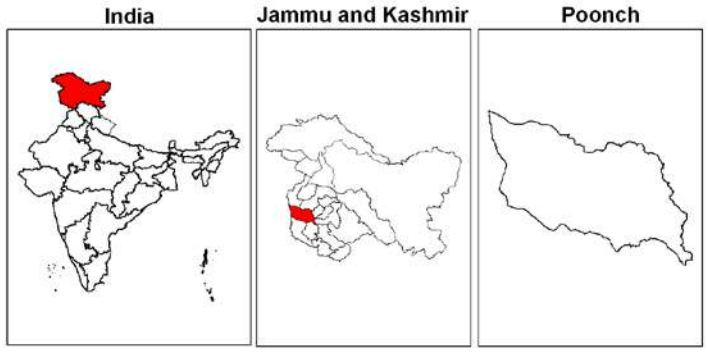


Symbol Typecode	Level I	Level II	Level III
	Inland Wetlands		
		Natural	
1101			Lakes/Ponds
1102			Ox-bow lakes/ Cut-off meanders
1103			High altitude wetlands
1104			Reverine wetlands
1105			Waterlogged
1106			River/Stream
		Man-made	
1201			Reservoirs/Barrages
1202			Tanks/Ponds
1203			Waterlogged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

Legend

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

Location Map



0 3 6 12 18 24 Kilometers

Data Source :

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

Prepared By :

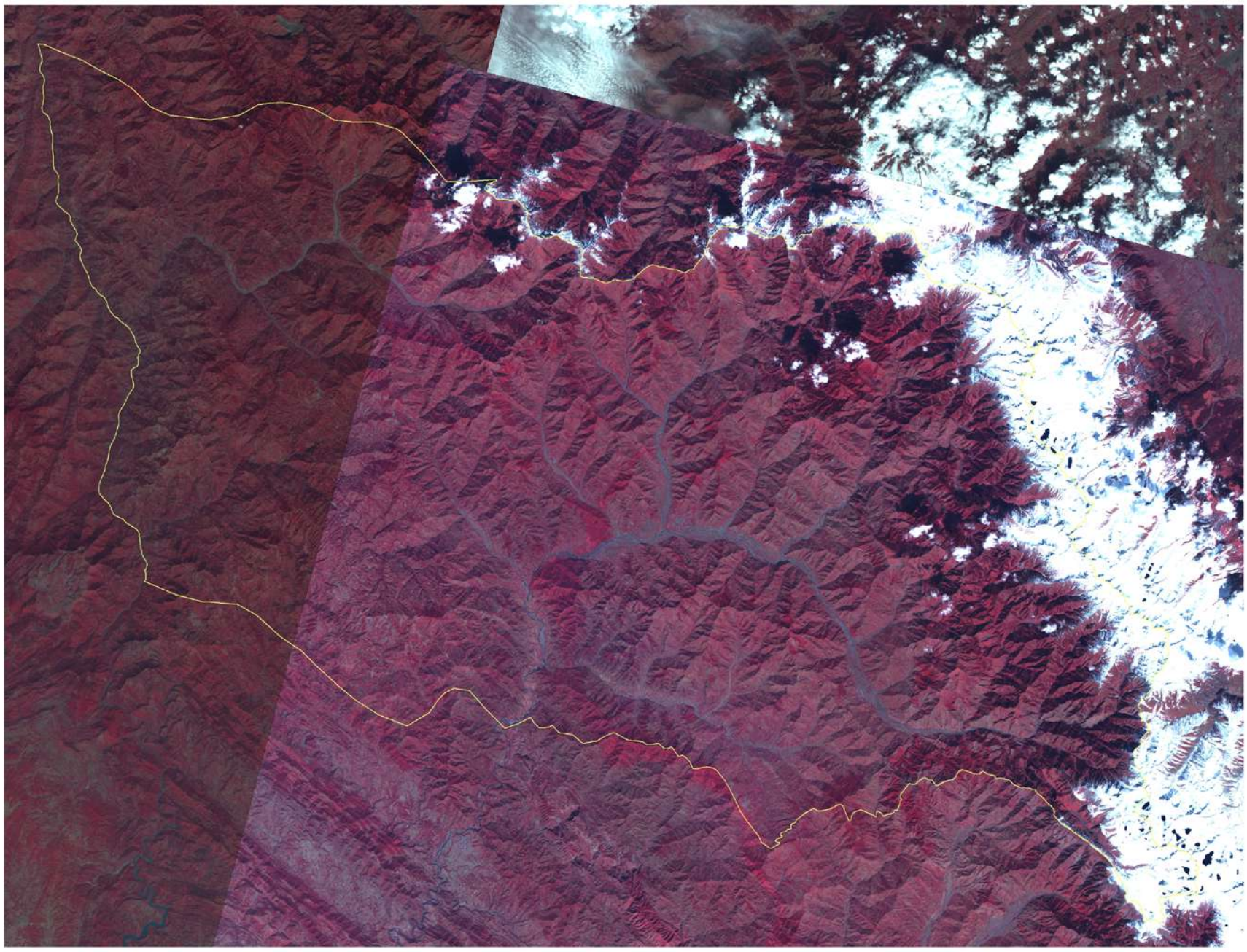
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Poonch



IRS P6 LISS-III Post-monsoon 2006 data

7.1.12 Rajauri

Rajouri district shares a long border from Sunderbani to Bhimbergali with Poonch district and Mirpur in the west. It is bounded by Udhampur district in the east and by Jammu in the southeast. The northern part of the district consists of hilly terrain. The geographical area of the district is 2,628 sq. km. It comprises of six tehsils, namely, Thanamandi, Rajouri, Budhal, Kalakote Sunderbani and Nowshera. Rearing livestock is the main source of income.

Total 15 wetlands were mapped and 38 small wetlands (>2.25 ha) identified with total wetland area of 4910 ha. The major wetland category is River /steam covering an area of 4835 ha and accounts for 98.4 per cent wetland area of the district. There are 6 small glacier lakes in the district and occupies an area of 37 ha. A detail of the wetland statistics of the district is given in Table 16.

No aquatic vegetation in wetland observed. Seasonal fluctuations in water spread are almost nil in many wetlands. Turbidity of water is low in both the sesons.

Table 16: Area estimates of wetlands in Rajauri

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	6	37	0.75	37	37
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	9	4835	98.47	4110	4131
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**15**	**4872**	**99.23**	**4147**	**4168**
		Wetlands (<2.25 ha), mainly Tanks	38	38	0.77	-	-
		Total	**53**	**4910**	**100.00**	**4147**	**4168**

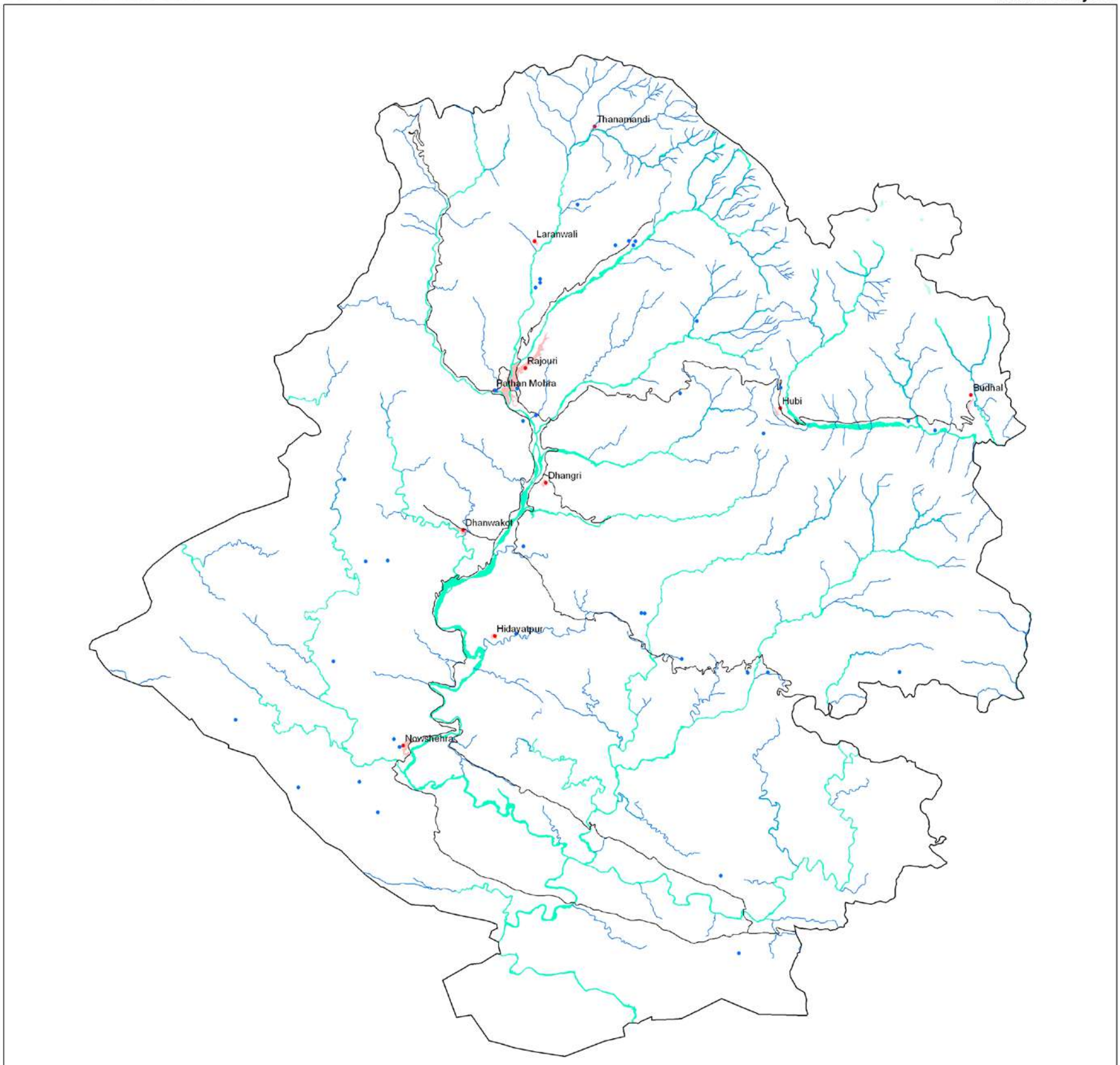
Area under Aquatic Vegetation	-	-

Area under turbidity levels		
Low	4147	4168
Moderate	-	-
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Rajouri

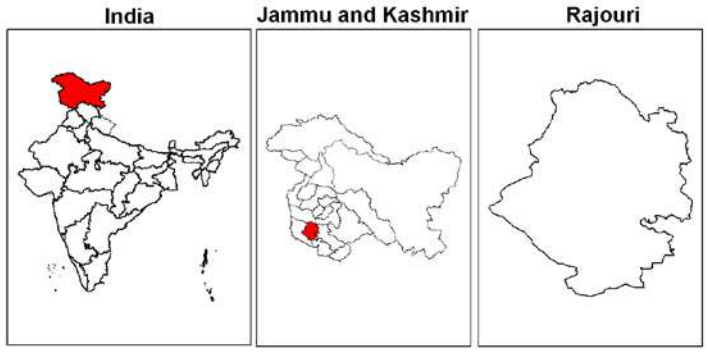


Symbol Typecode	Level I	Level II	Level III
	Inland Wetlands		
		Natural	
1101			Lakes/Ponds
1102			Ox-bow lakes/ Cut-off meanders
1103			High altitude wetlands
1104			Reverine wetlands
1105			Waterlogged
1106			River/Stream
		Man-made	
1201			Reservoirs/Barrages
1202			Tanks/Ponds
1203			Waterlogged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

Legend

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

Location Map



0 2 4 8 12 16 Kilometers

Data Source :

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

Prepared By :

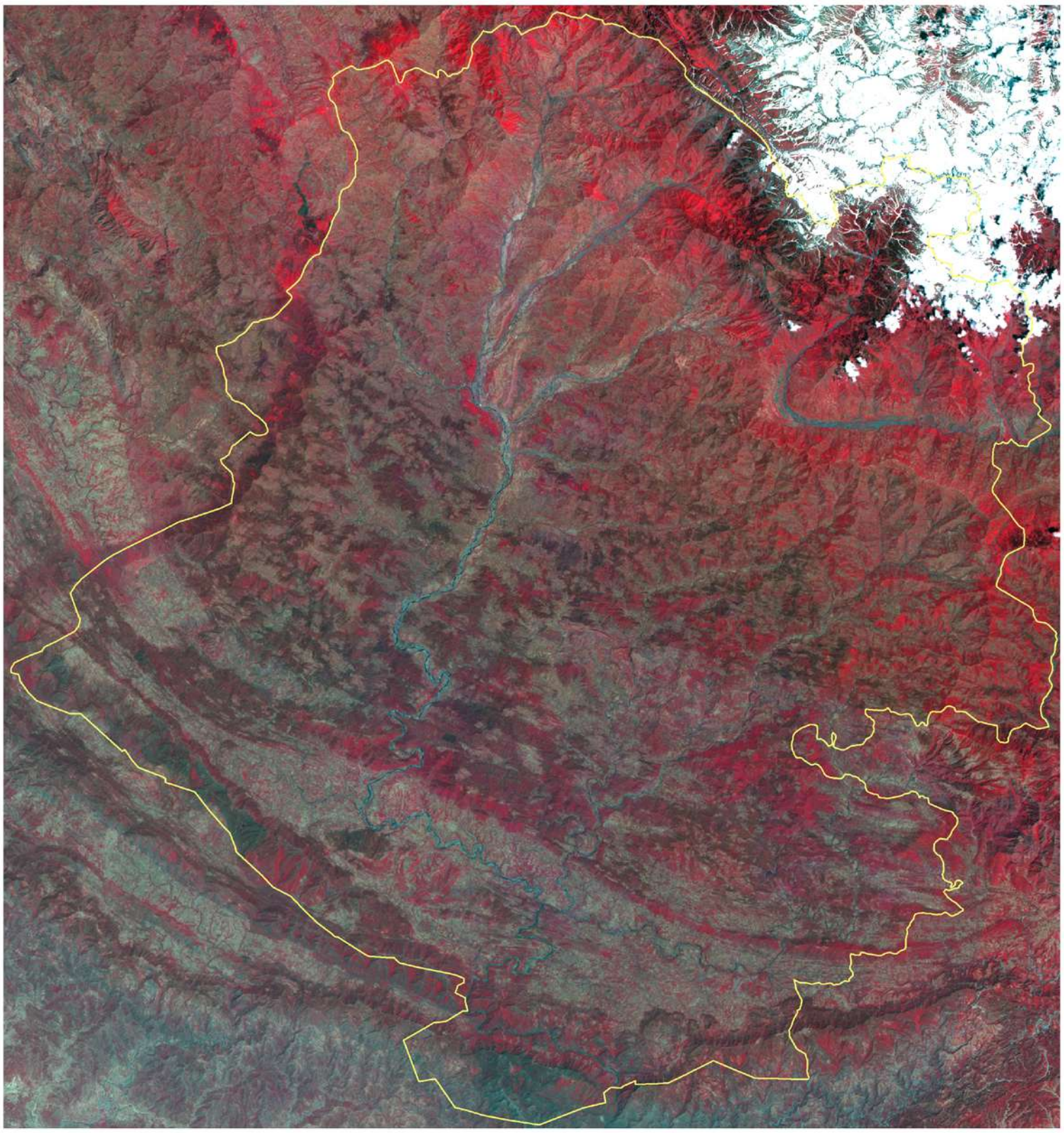
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Rajouri



IRS P6 LISS-III Pre-monsoon 2007 data

7.1.13 Jammu

Jammu district extends along the whole length of the international border with Pakistan in west. It shares its border with Rajouri, Udhampur and Kathua district in the north, in the east and in the southeast respectively. The geographical area of the district is 3017 sq. km. with 5 tehsils, namely, Jammu, Samba, Akhnoor, R.S. Pura and Bishnah.

Total 41 wetlands were mapped and 235 small wetlands (>2.25 ha) were identified with total 19638 ha under wetland in the district. The major wetland category s River /steam covering an area of 19372 ha and accounts for 99 per cent wetland area of the district. Only one Lake/pond mapped with 31 ha area. A detail of the wetland statistics of the district is given in Table 17.

No aquatic vegetation in wetlands observed. Seasonal fluctuation in water spread is negligible. The turbidity of water is low in both the seasons.

Table 17: Area estimates of wetlands in Jammu

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	1	31	0.16	31	31
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	40	19372	98.65	3970	4655
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**41**	**19403**	**98.80**	**4001**	**4686**
		Wetlands (<2.25 ha)	235	235	1.20	-	-
		Total	**276**	**19638**	**100.00**	**4001**	**4686**

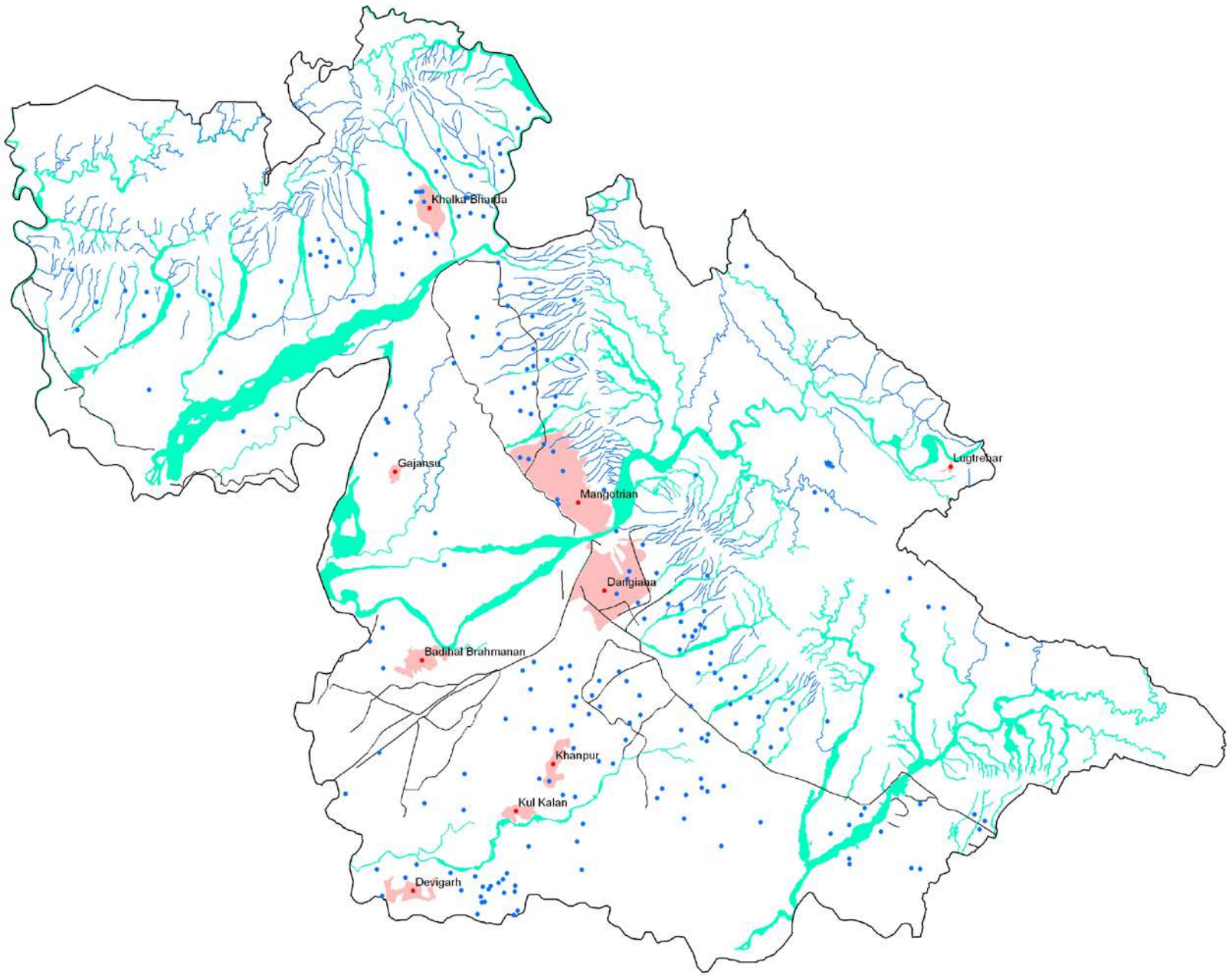
Area under Aquatic Vegetation	-	-

Area under turbidity levels		
Low	4001	4686
Moderate	-	-
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Jammu

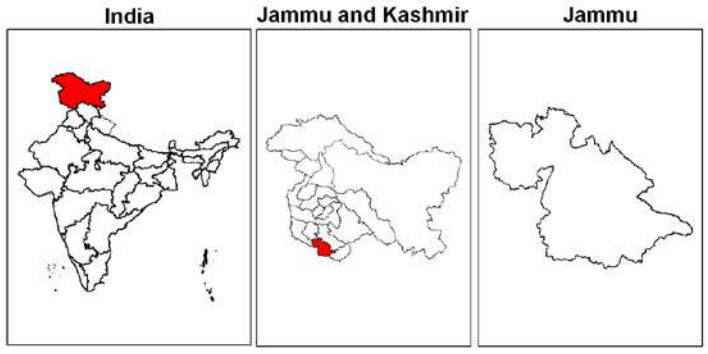


Symbol Typecode	Level I	Level II	Level III
	Inland Wetlands		
		Natural	
1101			Lakes/Ponds
1102			Ox-bow lakes/ Cut-off meanders
1103			High altitude wetlands
1104			Reverine wetlands
1105			Waterlogged
1106			River/Stream
		Man-made	
1201			Reservoirs/Barrages
1202			Tanks/Ponds
1203			Waterlogged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

Legend

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

Location Map



0 3 6 12 18 24 Kilometers

Data Source :

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

Prepared By :

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

Sponsored By:

Ministry of Environment and Forests
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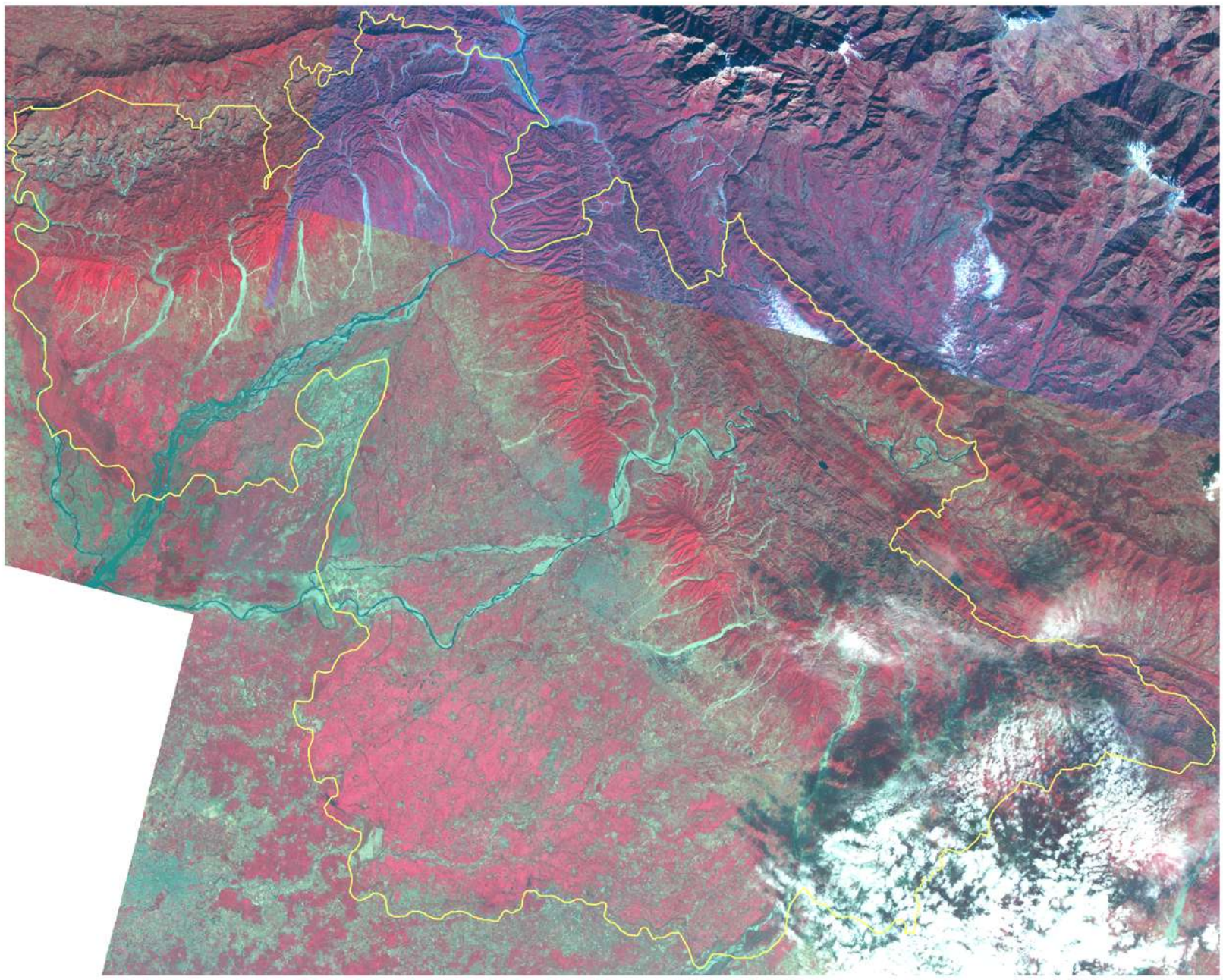
State : Jammu and Kashmir

District : Jammu



IRS P6 LISS-III Pre-monsoon 2007 data

7.1.14 Kathua

Kathua district shares its boundary with Punjab in the south, Himachal Pradesh in the east and Udhampur district of J&K in the north. The geographical area of the district is 2,675 sq. km. with four tehsils namely, Basholi, Bilawar, Kathua and Hiranagar. The majority of the population of the district is dependent on agriculture.

Total 21 wetlands are mapped and 200 small wetlands (<2.25 ha) identified as point feature. The wetland area of the district is 21740 ha. The major wetland category is River /stream and they cover an area of 16130 accounting for 74.2 per cent wetland area of the district. Two large Reservoirs/Barrages are mapped occupying around 25 per cent area. The 200 small wetlands identified are mainly concentrated in the southern pain area of district. A detail of the wetland statistics of the district is given in Table 18.

Wetlands are devoid of aquatic vegetation. Marginal fluctuation of water spread is observed in two seasons. The water spread of River/stream is slightly less in pre monsoon compared to post monsoon, while the reverse is observed in case of Reservoir/Barrage. Qualitative turbidity of water is low in both the season.

Table 18: Area estimates of wetlands in Kathua district

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	19	16130	74.20	3061	2088
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	2	5410	24.89	3393	5410
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**21**	**21540**	**99.08**	**6454**	**7498**
		Wetlands (<2.25 ha)	200	200	0.92	-	-
		Total	**221**	**21740**	**100.00**	**6454**	**7498**

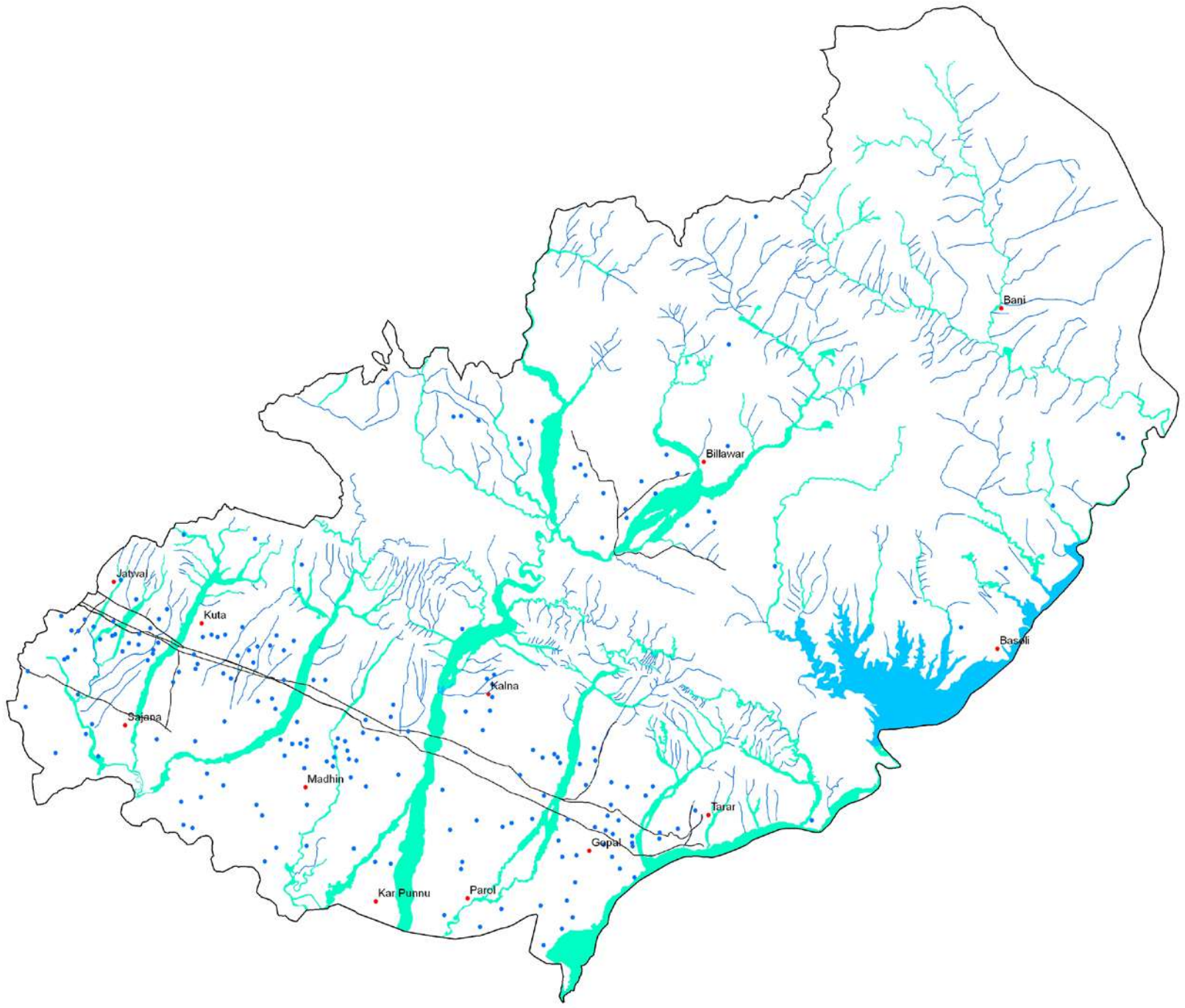
Area under Aquatic Vegetation	-	-

Area under turbidity levels		
Low	6454	7498
Moderate	-	-
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Kathua

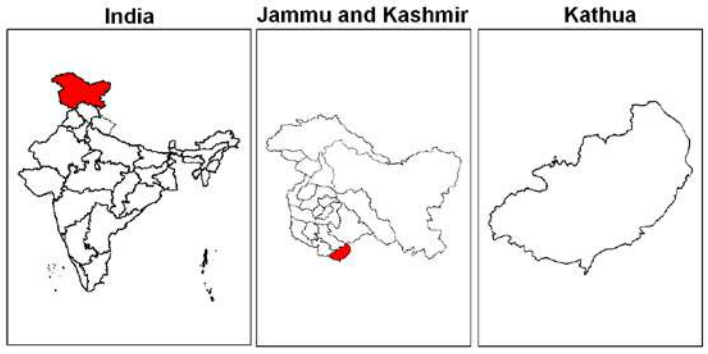


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 2 4 8 12 16 Kilometers

Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
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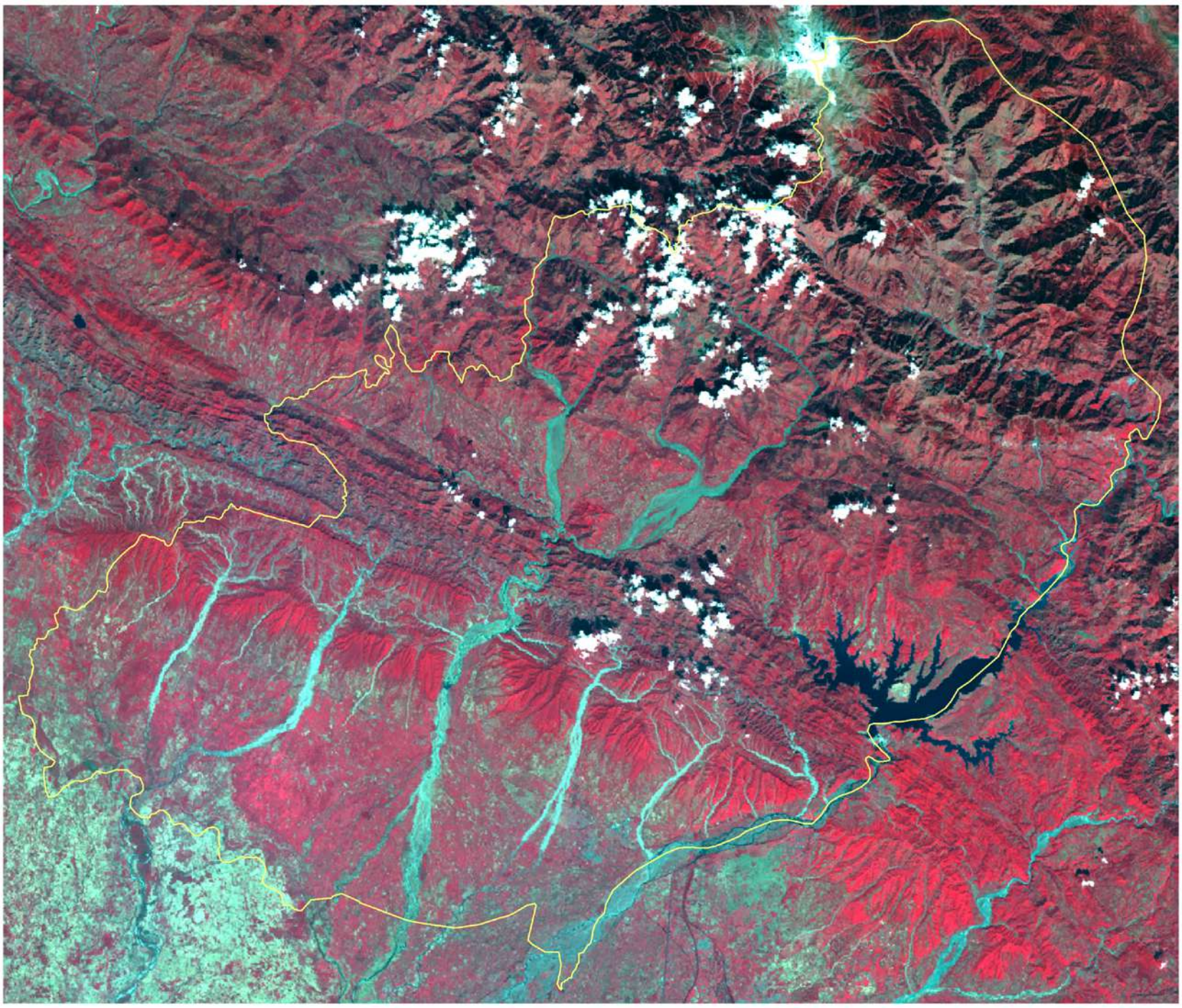
Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Kathua



IRS P6 AWiFS Post-monsoon data (2005)

7.1.15 Gilghit

This is the extreme North Western region of the state adjoining Pakistan in West. The geographical area of the district is 34,380 sq. km.

Total 302 wetlands are mapped and 393 small wetland (>2.25 ha) identified as point features. Total area of wetlands in the district is 29844 ha. The district has significant number of high altitude lakes. The number is 285 and covered an area of 2426 ha. The major wetland category is River/steam and they cover an area of 27025 ha accounting 90 per cent wetland area of the district. A detail of the wetland statistics of the district is given in Table 19.

No aquatic vegetation is observed in the wetlands. The seasonal fluctuation of water spread in wetlands is negligible. Qualitative turbidly of water is low in both the seasons.

Table 19: Area estimates of wetlands in Gilghit

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	285	2426	8.13	2424	2424
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	17	27025	90.55	26513	26734
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**302**	**29451**	**98.68**	**28937**	**29158**
		Wetlands (<2.25 ha)	393	393	1.32	-	-
		Total	**695**	**29844**	**100.00**	**28937**	**29158**

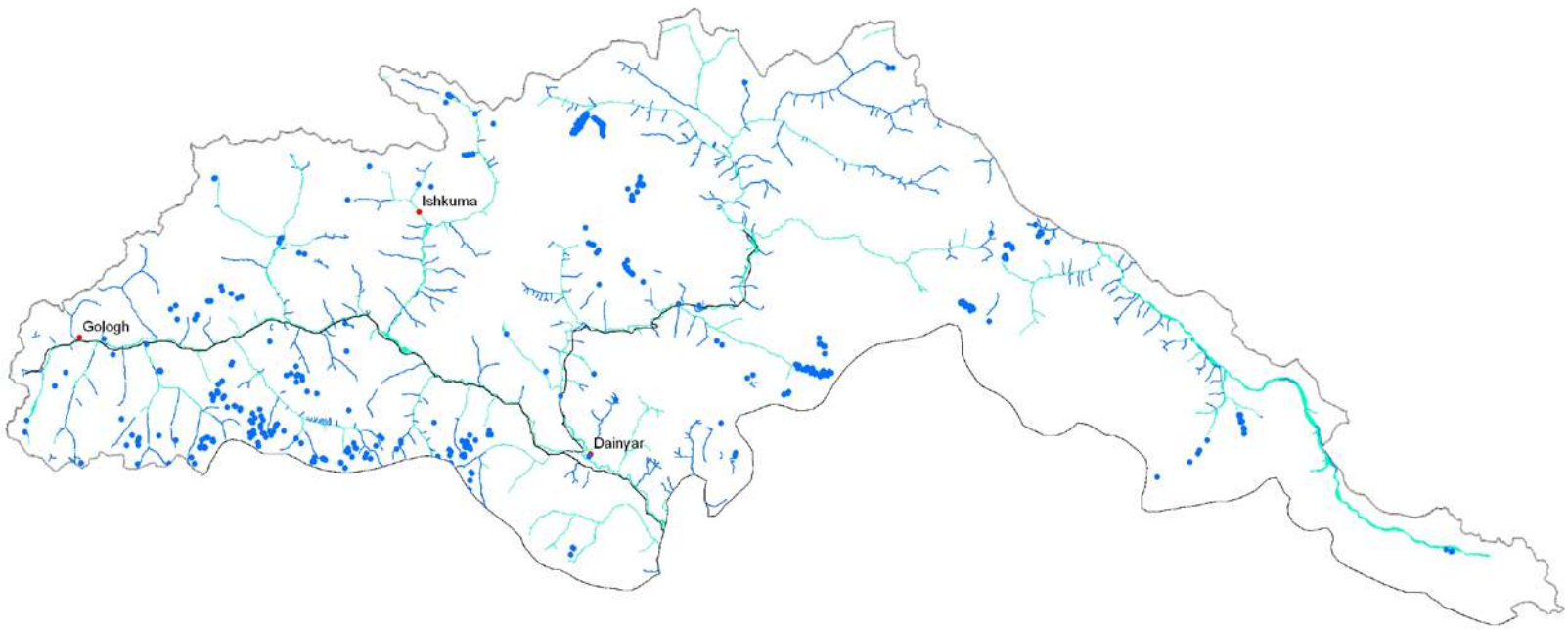
Area under Aquatic Vegetation	-	-

Area under turbidity levels		
Low	28937	29158
Moderate	-	-
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Gilghit

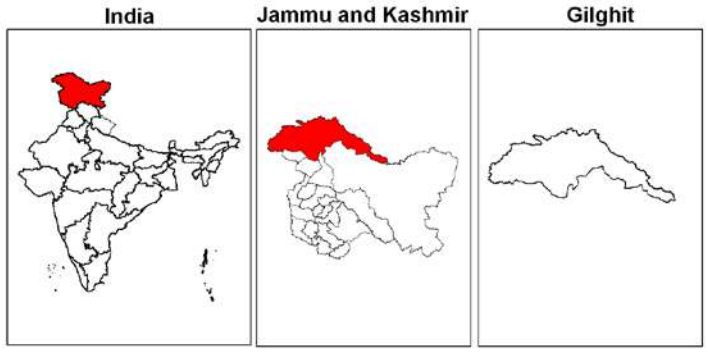


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 10 20 40 60 80 Kilometers

Data Source :

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

Prepared By :

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State : Jammu and Kashmir

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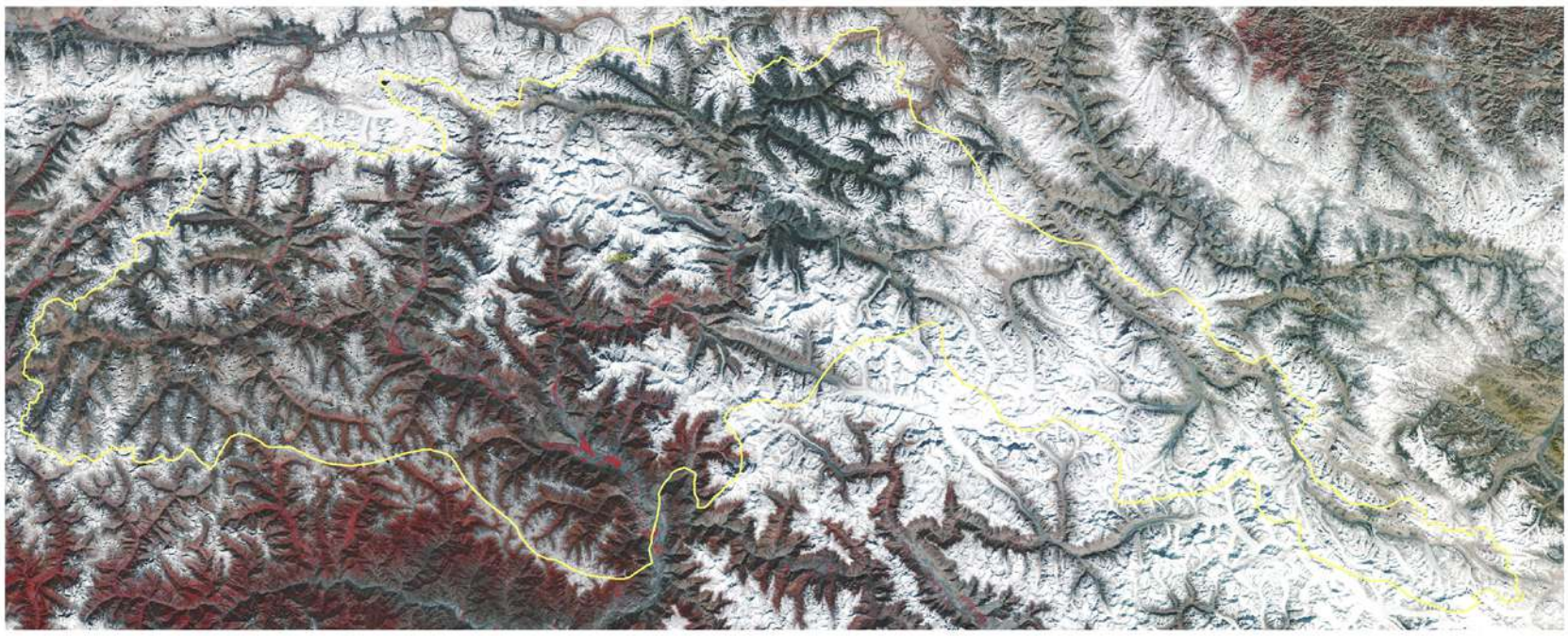


IRS P6 AWiFS Post-monsoon data (2005)

7.1.16 Konu

Konu is a small district with the geographical area of the district is 2,773 sq. km. It is surrounded by Gilghit in north, Chilas in the south and with Pakistan in the west.

The wetland area of the district is 1547 ha. The wetland types of the district belong to inland wetland – natural category. The major wetland category is River /stream covering an area of 903 ha and accounts for 58 per cent wetland area of the district. There are 73 High altitude wetlands covering an area of 585 ha and accounts for 37.8% area. In addition, 59 small wetlands (< 2.25 ha) are identified, which are mainly High altitude in nature. A detail of the wetland statistics of the district is given in Table 20.

No aquatic vegetation is observed in wetlands. Seasonal fluctuations in water spread are almost nil. Qualitative turbidly of water is low in both the season.

Table 20: Area estimates of wetlands in Konu

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	73	585	37.82	585	585
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	5	903	58.37	903	903
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**78**	**1488**	**96.19**	**1488**	**1488**
		Wetlands (<2.25 ha)	59	59	3.81	-	-
		Total	**137**	**1547**	**100.00**	**1488**	**1488**

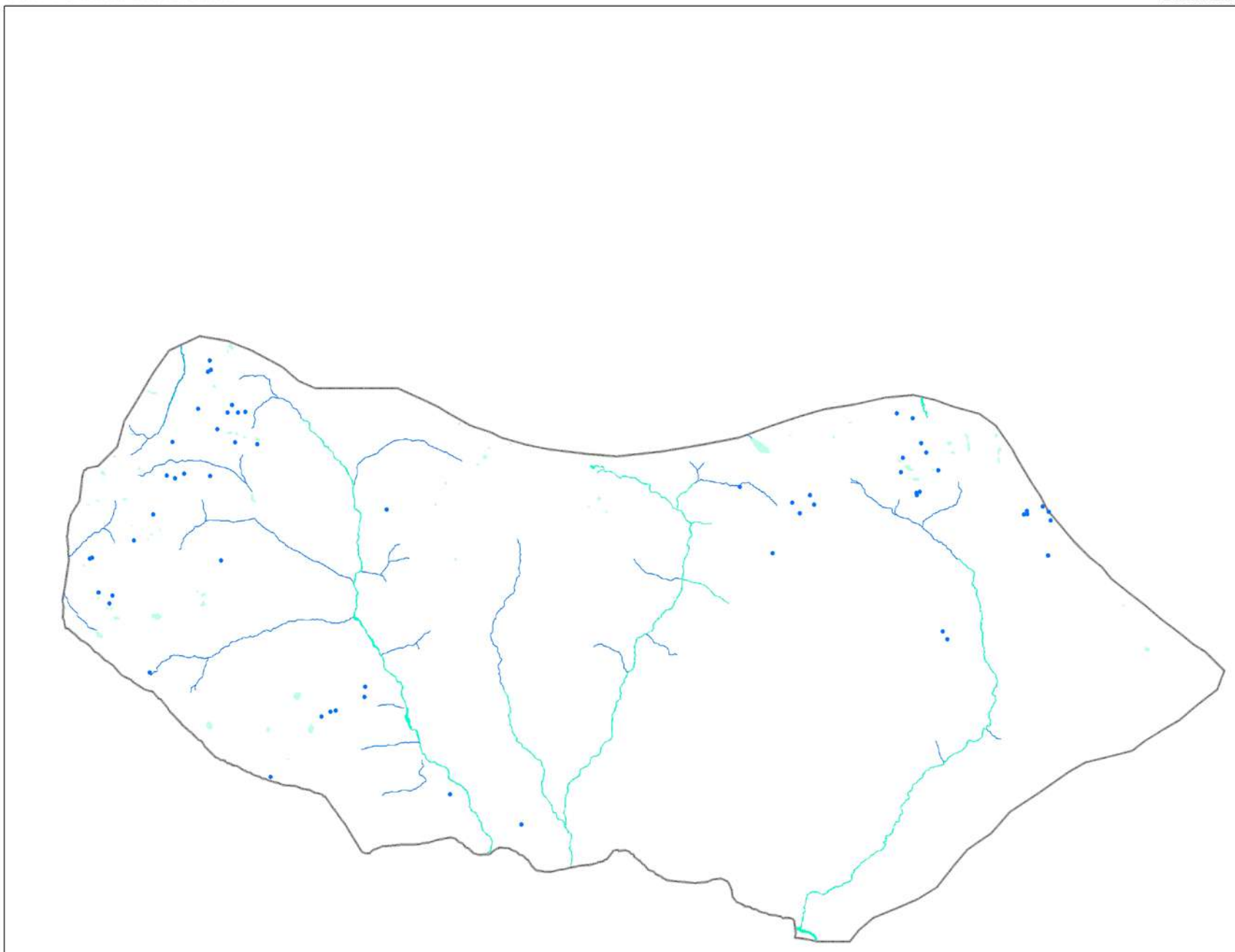
Area under Aquatic Vegetation	-	-

Area under turbidity levels		
Low	1488	1488
Moderate	-	-
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Konu

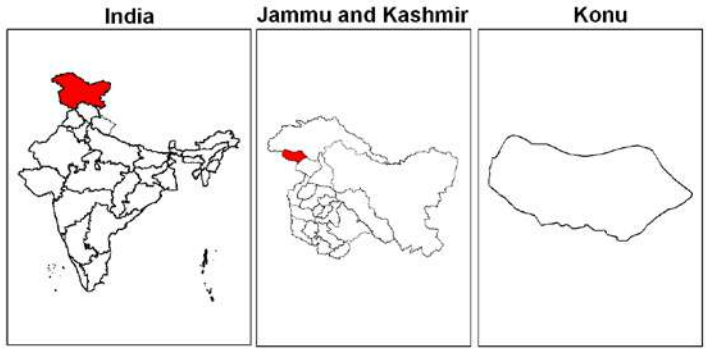


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 2 4 8 12 16 Kilometers

Data Source :

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

Prepared By :

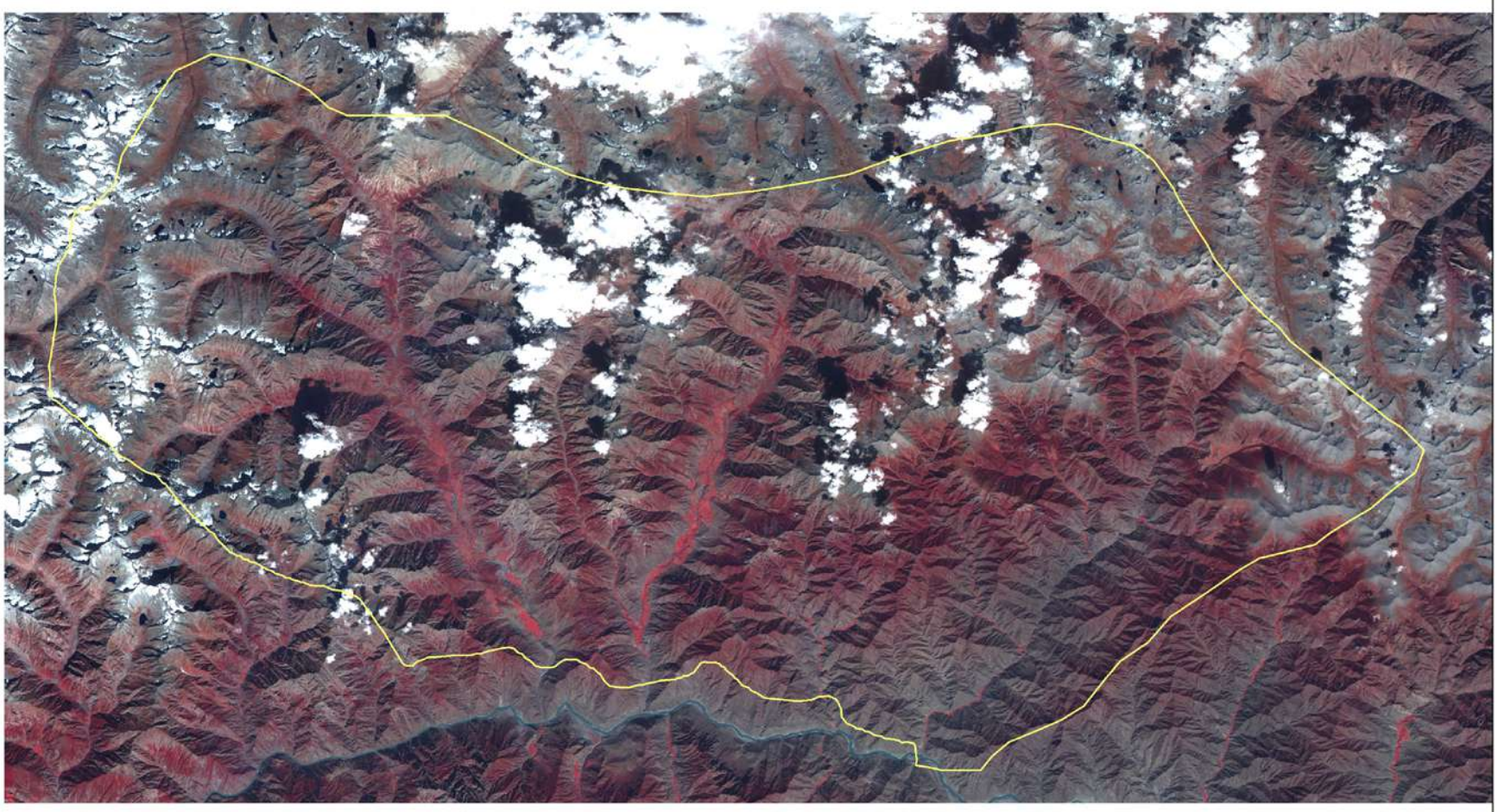
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Konu



IRS P6 LISS-III Pre-monsoon 2007 data

7.1.17 Gilghit Wazara

The geographical area of the district is 6,098 sq. km. This is the top most district of the state and shares international boundary with Afghanistan, Pakistan and China. The southern boundary is shared by Konu, Chilas, Wazara and Leh districts of J&K state.

The wetland area of the district is 2743 ha. The wetland types of the district mainly belong to inland wetland – natural category. The major wetland category is River /stream covering an area of 2233 ha and accounts for 81 per cent wetland area of the district. There are 63 High altitude wetlands mapped having 450 ha area and account 16.4% of wetlands in the district. In addition, 60 small wetlands (<2.25ha) are identified. These are mainly High altitude wetlands. A detail of the wetland statistics of the district is given in Table 21.

Aquatic vegetation is not observed in the wetlands. Seasonal fluctuation of water spread is nil. The water-spread area is 2566 ha in both the season. Qualitative turbidly of water is low in both the season.

Table 21: Area estimates of wetlands in Gilghit Wazara

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	63	450	16.41	450	450
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	11	2233	81.41	2116	2116
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**74**	**2683**	**97.81**	**2566**	**2566**
		Wetlands (<2.25 ha)	60	60	2.19	-	-
		Total	**134**	**2743**	**100.00**	**2566**	**2566**

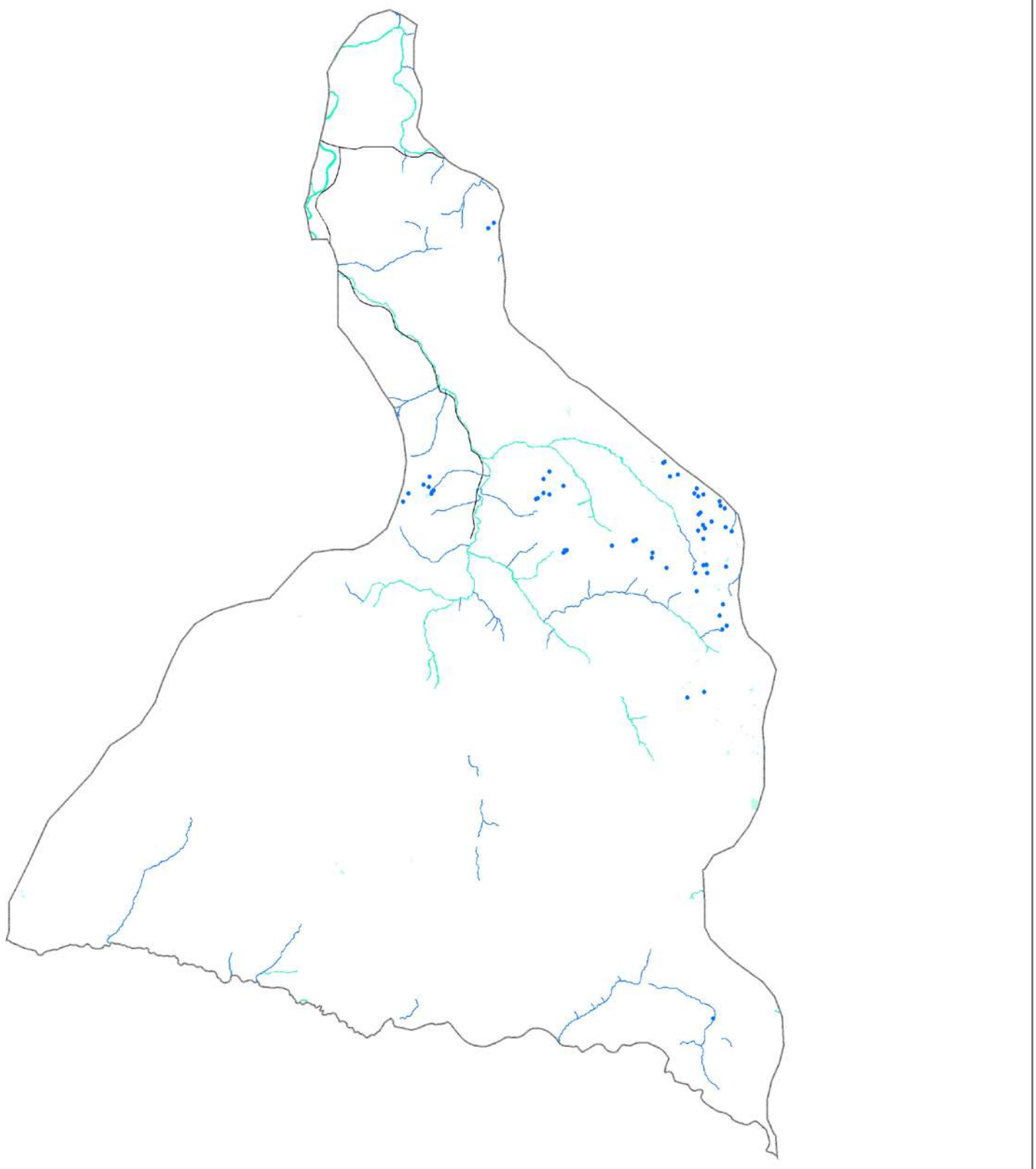
Area under Aquatic Vegetation	-	-

Area under turbidity levels		
Low	2566	2566
Moderate	-	-
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Gilghit Wazara

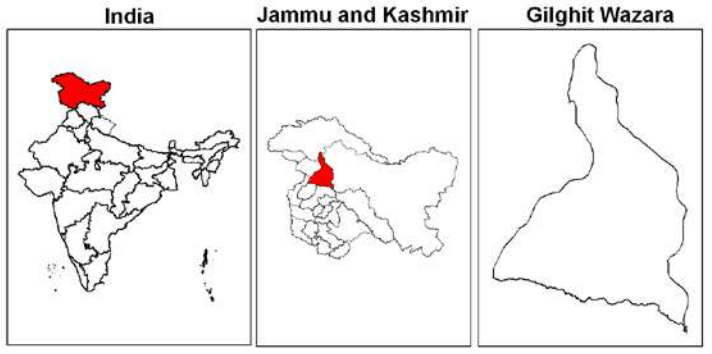


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 5 10 20 30 40 Kilometers

Data Source :

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

Prepared By :

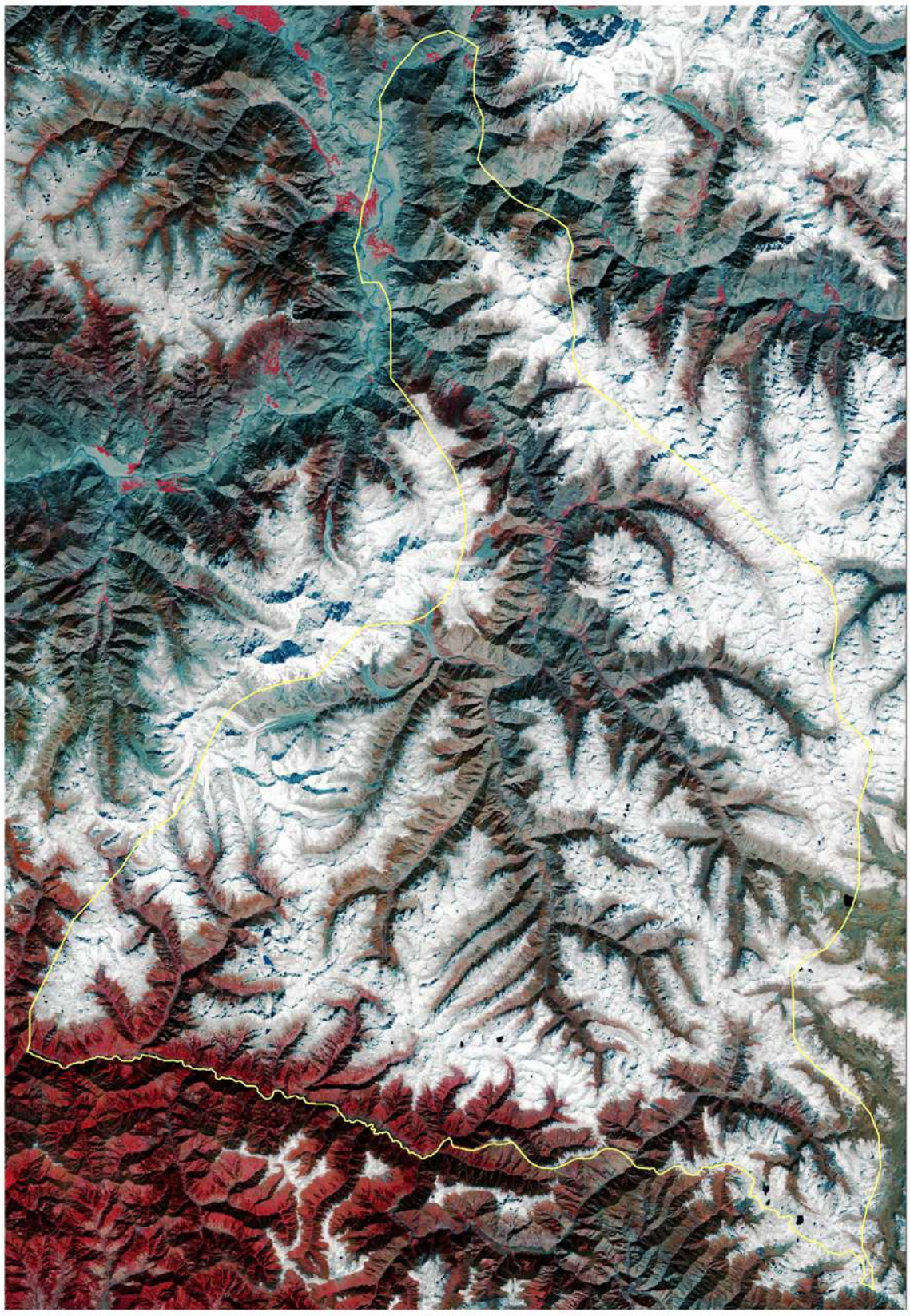
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Gilghit Wazara



IRS P6 AWiFS Post-monsoon data (2005)

7.1.18 Chilas

The geographical area of the district is 4,276 sq. km. This district is surrounded by Konu and Gilghit in the northern side. In south, it shares the boundary with Muzzafarbad and Wazara. It also shares the boundary with Pakistan in west.

The wetland area of the district is 2200 ha. The wetland types of the district mainly belong to inland wetland – natural category. In all the number of wetlands in the district are 27, which include 14 small wetlands (<2.25 ha). The major wetland category is River /steam covering an area of 2139 ha and accounts for 97 per cent wetland area of the district. There are 12 High altitude wetlands covering an area of 47 ha and accounts for 2.1% of wetlands of the district. A detail of the wetland statistics of the district is given in Table 22.

Aquatic vegetation is not observed in wetlands. The seasonal fluctuations of water spread in wetlands are almost nil. The water-spread area is 2186 ha in both the season. Qualitative turbidly of water is low in both the season.

Table 2: Area estimates of wetlands in Chilas

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	12	47	2.14	47	47
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	1	2139	97.23	2139	2139
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**13**	**2186**	**99.36**	**2186**	**2186**
		Wetlands (<2.25 ha)	14	14	0.64	-	-
		Total	**27**	**2200**	**100.00**	**2186**	**2186**

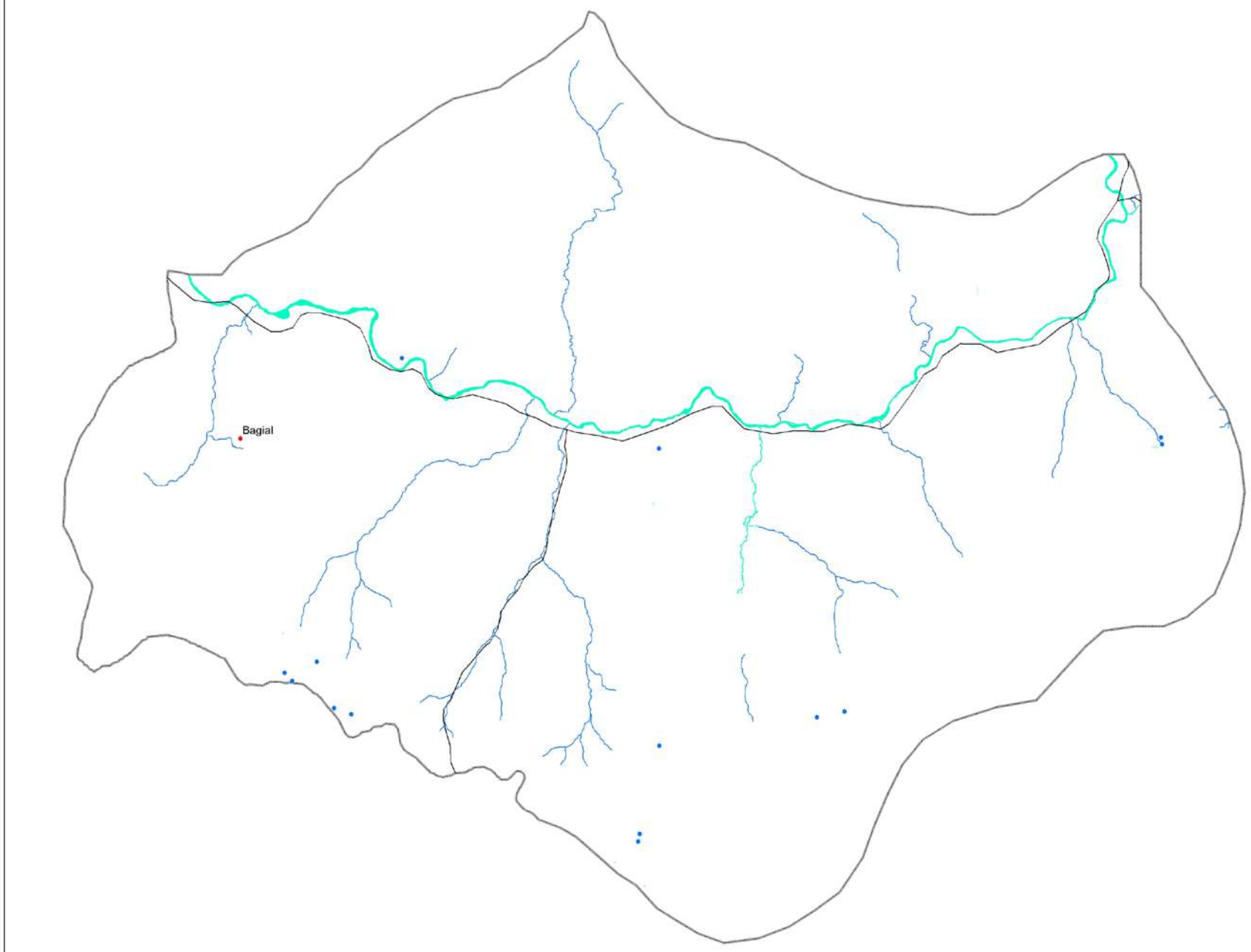
Area under Aquatic Vegetation	-	-

Area under turbidity levels		
Low	2186	2186
Moderate	-	-
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Chilas

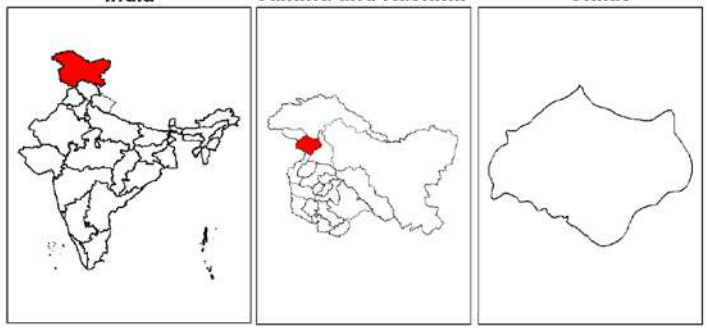


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 3 6 12 18 24 Kilometers

Data Source :

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

Prepared By :

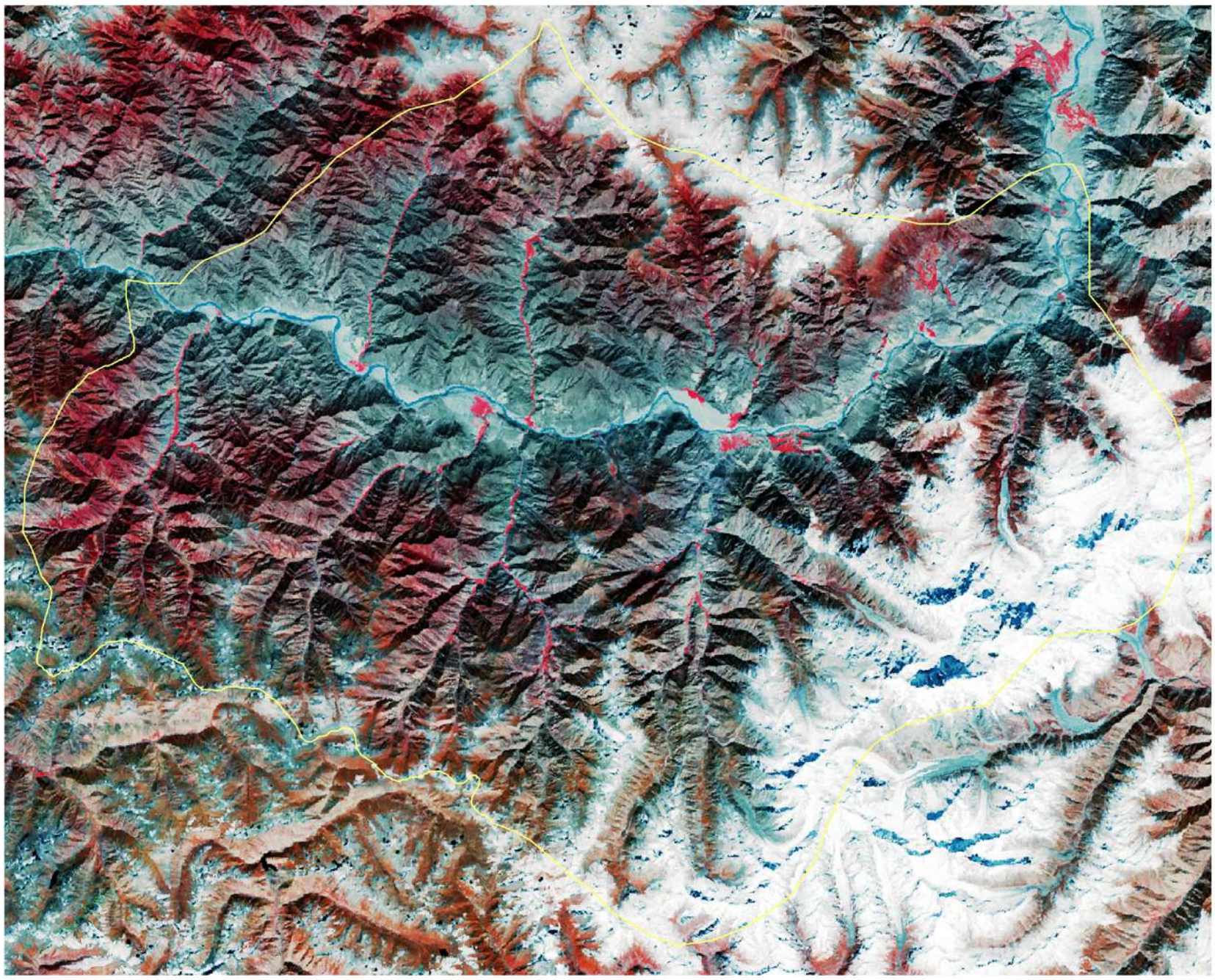
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Chilas



IRS P6 AWiFS Post-monsoon data (2005)

7.1.19 Muzzafarabad

The geographical area of the district is 3,711 sq. km. This district shares its boundary in the western side with Pakistan, while in south, it adjoins Poonch and Baramulla district. In the eastern side, it shares boundary with Kupwara district.

The wetland area of the district is 4105 ha. The wetland types of the district mainly belong to inland wetland – natural category. In all the number of wetlands in the district are 27, which include 27 small wetlands (<2.25 ha). The major wetland category is River /steam covering an area of 3677 ha and accounts for 90 per cent wetland area of the district. There are 23 high altitude wetlands in the district and contribute an area of 301 ha in district wetland area. This accounts for around 7.3 per cent wetland area of the district. Only one Lake/pond is mapped with 100 ha area. A detail of the wetland statistics of the district is given in Table 23.

No aquatic vegetation is observed in these wetlands in both the season. Seasonal fluctuations in water spread are almost nil. The water-spread area is 3596 ha in post- monsoon and 3805 in pre-monsoon season. Qualitative turbidly of water is low in both the season.

Table 23: Area estimates of wetlands in Muzzafarabad

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	1	100	2.44	100	100
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	23	301	7.33	301	301
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	3	3677	89.57	3195	3404
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**27**	**4078**	**99.34**	**3596**	**3805**
		Wetlands (<2.25 ha),	27	27	0.66	-	-
		Total	**54**	**4105**	**100.00**	**3596**	**3805**

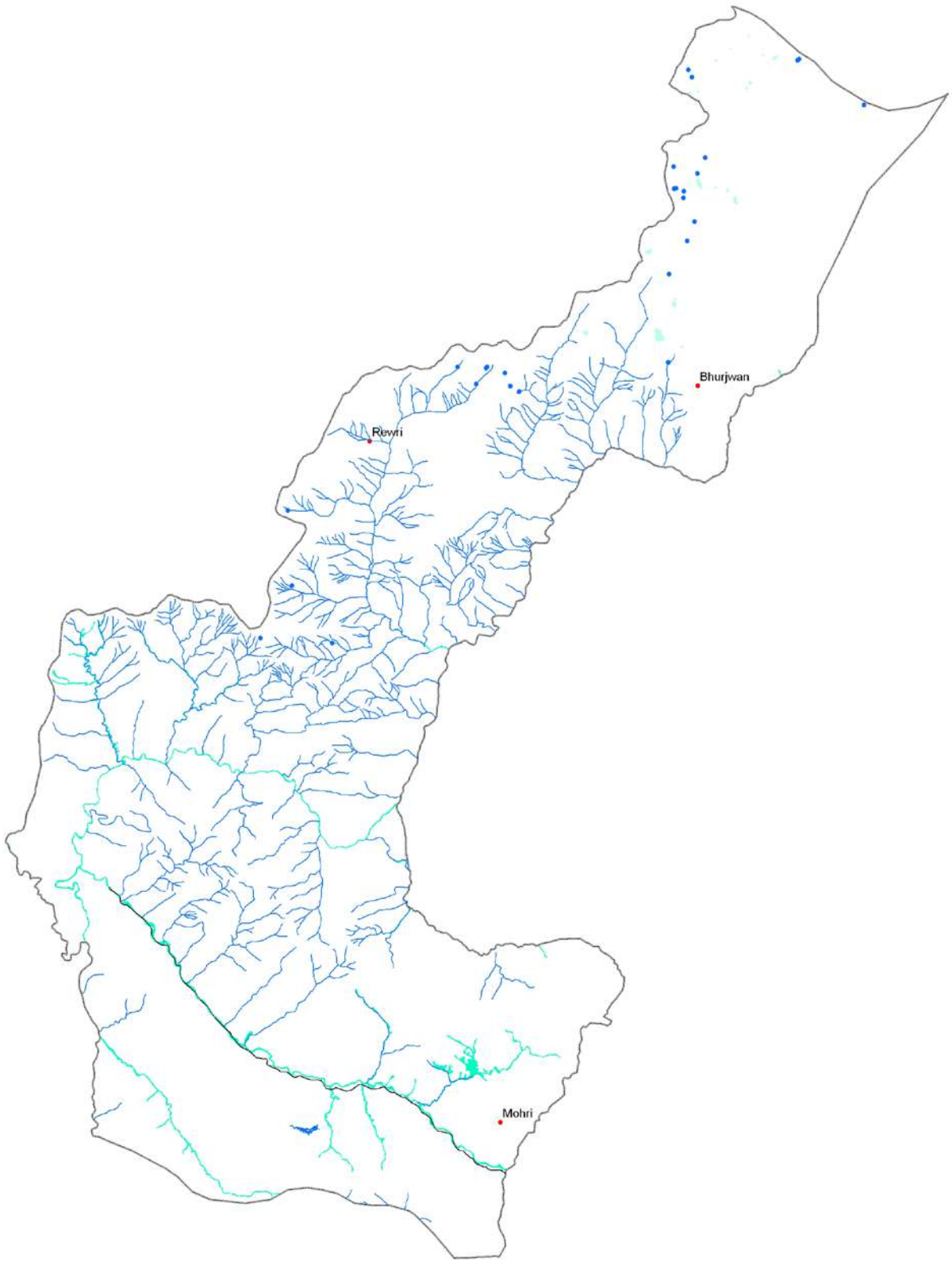
Area under Aquatic Vegetation	-	-

Area under turbidity levels		
Low	3596	3805
Moderate	-	-
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Muzzafarabad

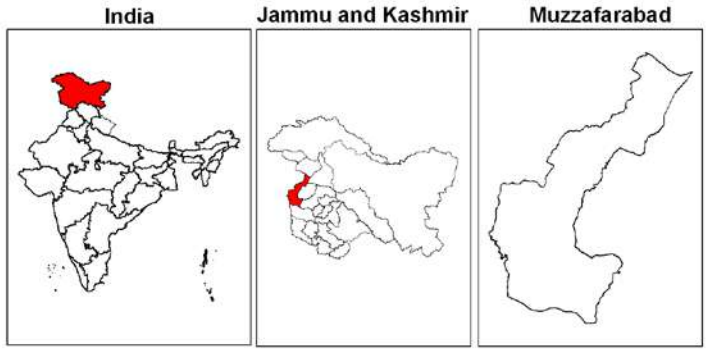


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 5 10 20 30 40 Kilometers

Data Source :

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

Prepared By :

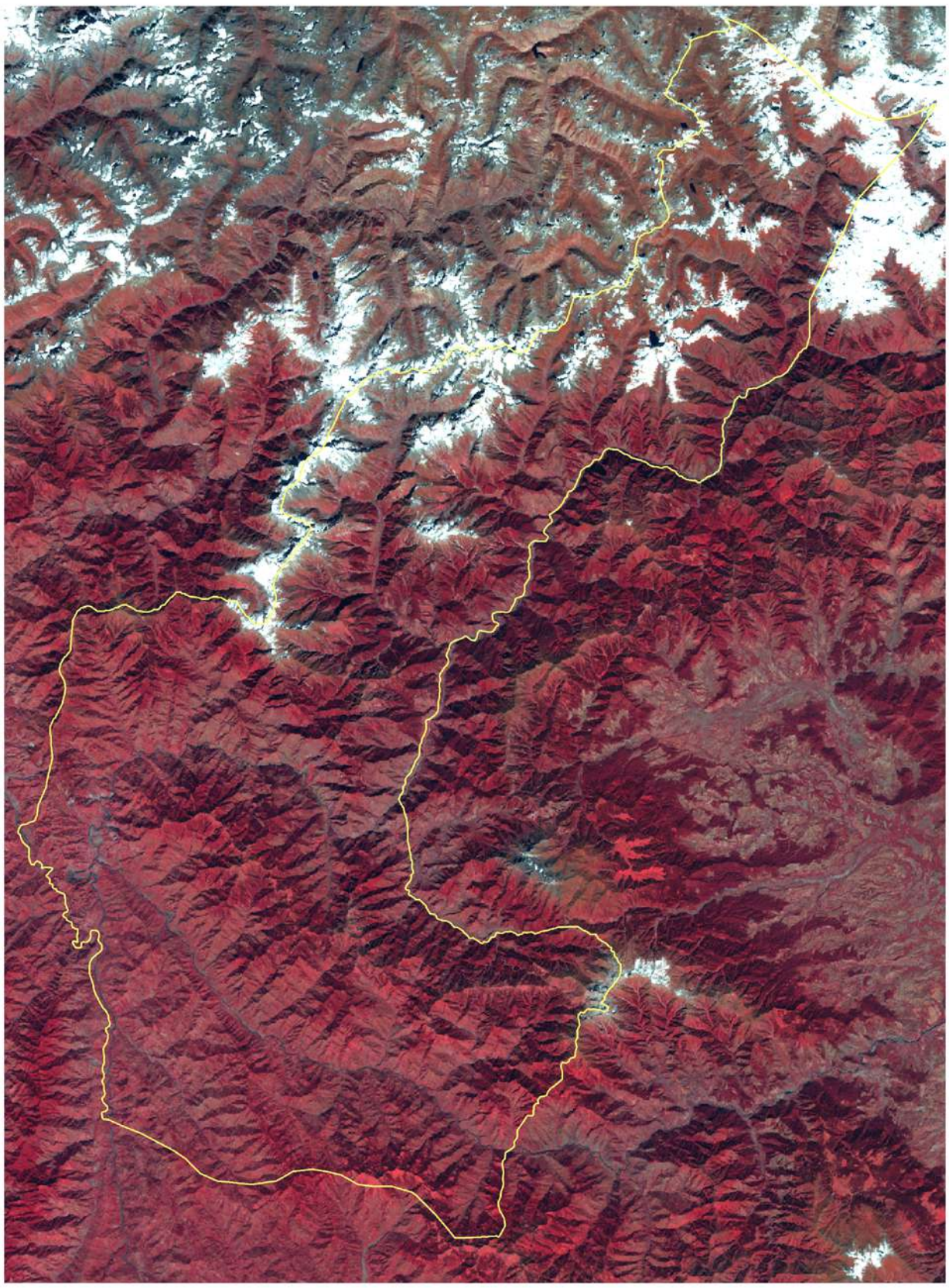
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Muzzafarabad



IRS P6 AWiFS Post-monsoon data (2005)

7.1.20 Mirpur

The geographical area of the district is 4,077 sq. km. This district is surrounded by Poonch in north, by Pakisthan in west and with Rajouri district in east.

The wetland area of the district is 27529 ha. In all the number of wetlands in the district are 269, which include 248 small wetlands (<2.25 ha). The major wetland category is Reservoir, followed by River /steam. There is only one reservoir, which is quite big with 19146 ha area and accounts for 69.6 per cent area. A detail of the wetland statistics of the district is given in Table 24.

No aquatic vegetation is observed in these wetlands in both the season. Seasonal fluctuations in water spread are almost nil in. Qualitative turbidly of water is low in both the season.

Table 24: Area estimates of wetlands in Mirpur

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	2	9	0.03	9	9
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	1	56	0.20	56	56
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	17	8070	29.31	4695	5103
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	1	19146	69.55	19146	19144
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**21**	**27281**	**99.10**	**23906**	**24312**
		Wetlands (<2.25 ha), mainly Tanks	248	248	0.90	-	-
		Total	**269**	**27529**	**100.00**	**23906**	**24312**

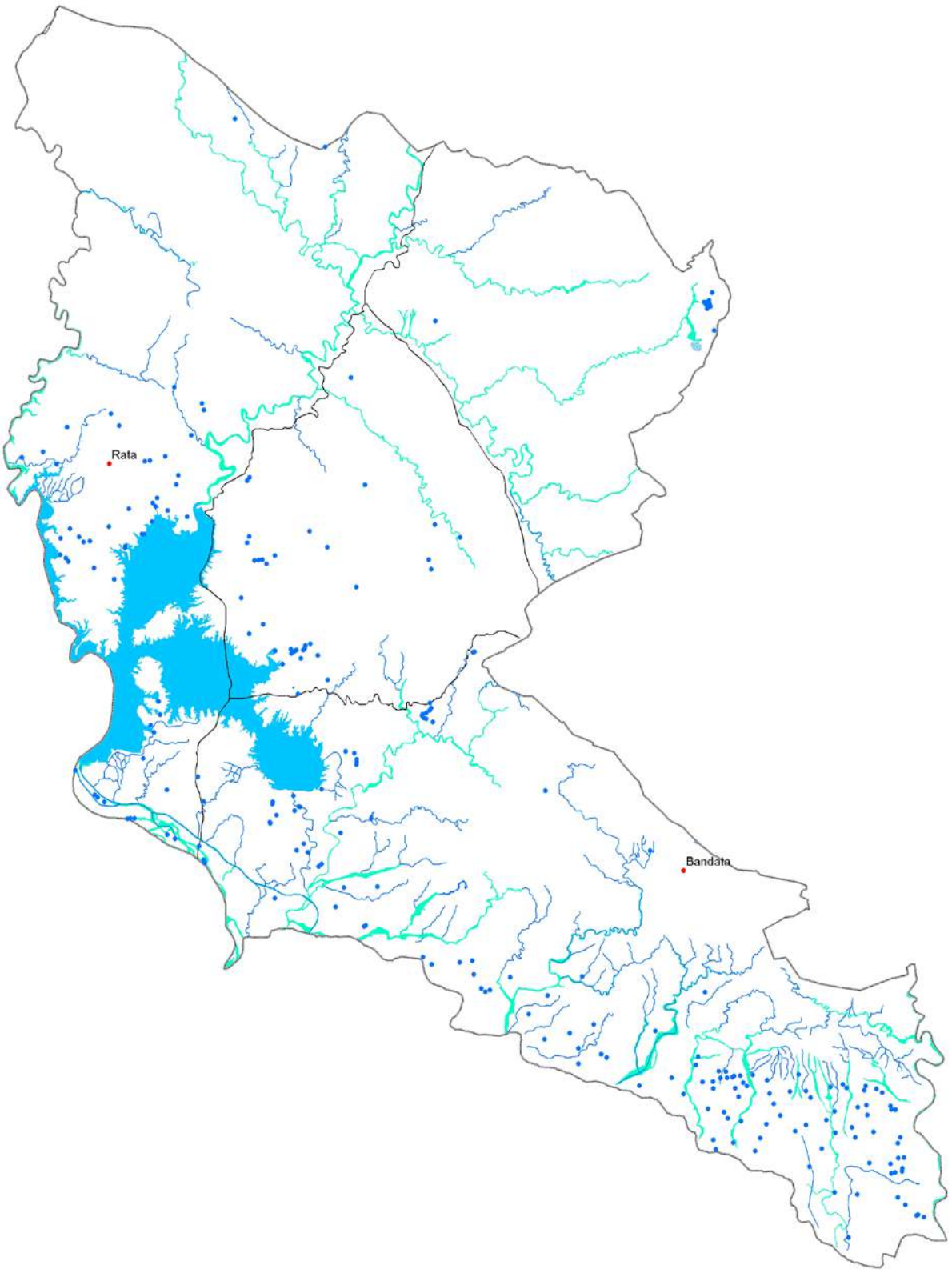
Area under Aquatic Vegetation	-	-

Area under turbidity levels		
Low	23906	24312
Moderate	-	-
High	-	-

State : Jammu and Kashmir

WETLAND MAP

District : Mirpur

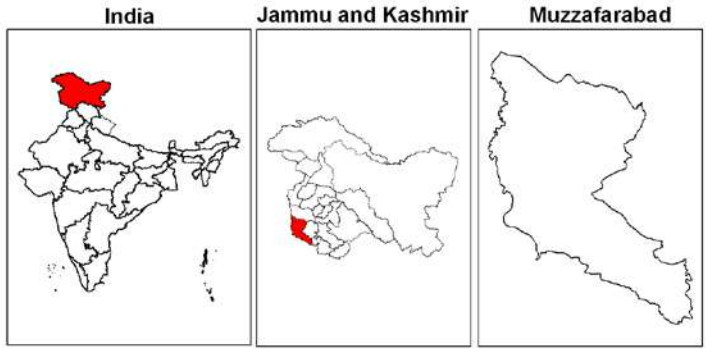


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 4.5 9 18 27 36 Kilometers

Data Source :

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

Prepared By :

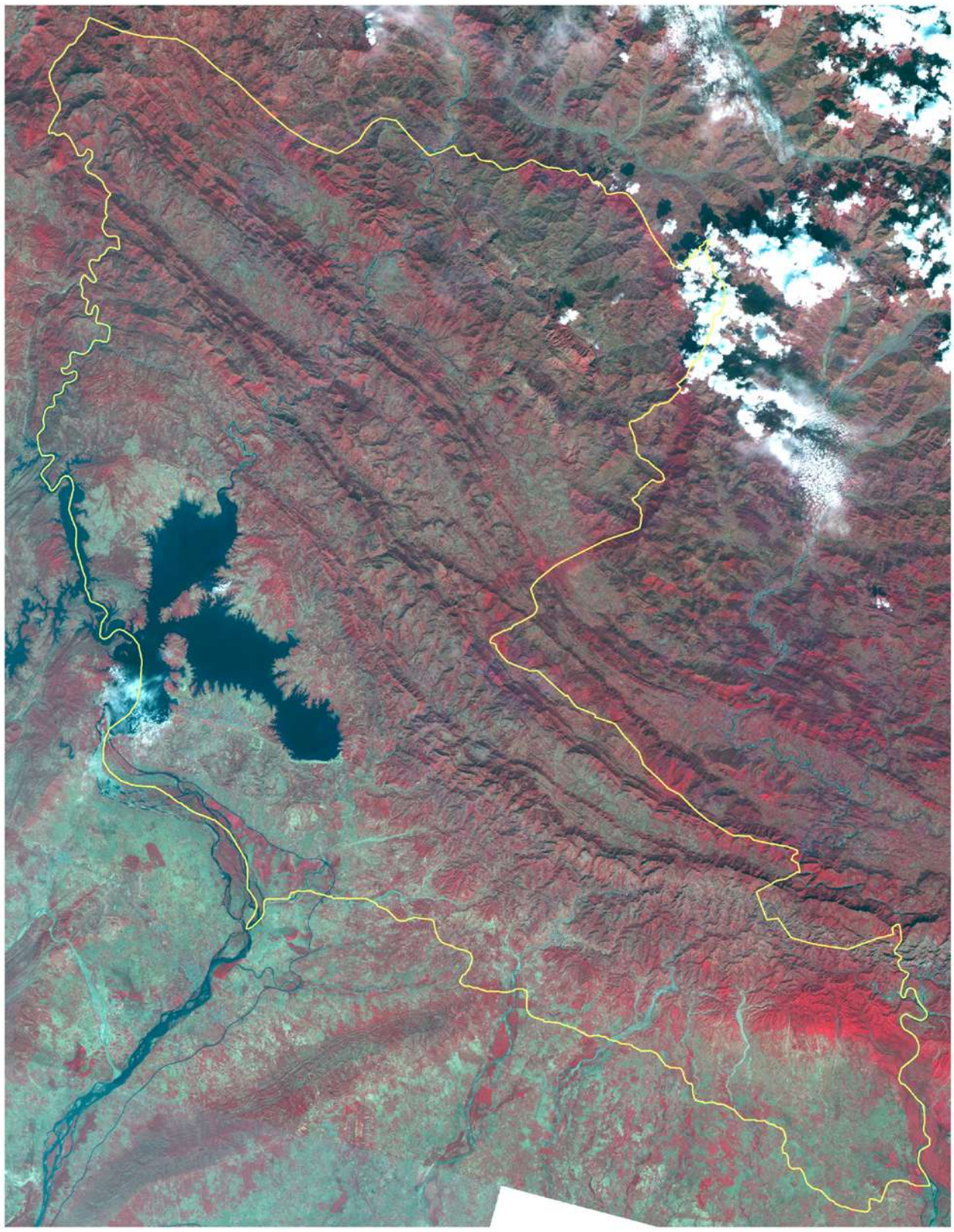
Space Applications Centre (ISRO), Ahmedabad
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

District : Mirpur



IRS P6 LISS-III Pre-monsoon 2007 data

MAJOR WETLAND TYPES

8.0 MAJOR WETLAND TYPES OF JAMMU AND KASHMIR

The state has two categories of wetlands viz: Inland-Natural and Inland-Manmade. The former category is the dominant type. Under the Inland-Natural wetland, though, rivers/stream dominated, the wetlands which area of particular significance are: the high altitude wetlands, riverine wetlands and the lakes. High altitude wetlands numbering 1143 occupied around 30.0 per cent area, followed by riverine wetlands and Lakes.

The manifestation of these wetlands in the satellite image is shown in Plate-1a and 1b.

The high altitude wetlands mainly occurred in the elevation range of > 3000 m to 6500 m. These lakes are in general devoid of any aquatic vegetation and the wetland boundary and open water spread is almost same. The clear and deep water is manifested in remote sensing image data as dark blue.

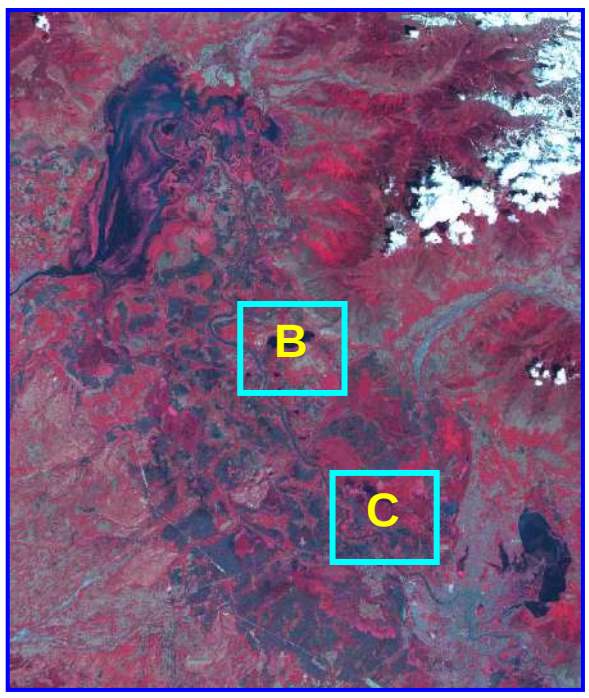
Maximum number of high altitude lakes are observed in the elevation range of 4000 m to 5000 m. Around 809 (out of 1104) wetlands are in this elevation range accounting for around 63 per cent area under this category. Only two lakes are mapped at the elevation range of 6000 to 6500 m. Tsokar, Tso Moriri and Pangong Tso are some of the well known high altitude lakes, in Ladakh region.

The riverine wetlands are found in comparatively low elevation areas and many of these wetlands harbor vegetation. Often, these wetlands are frequented by avifauna. The districts of Baramulla, Srinagar and Ananatnag are some of the major districts having prominence of riverine wetlands.

The natural lakes (low altitude <3000 m) are another major type of wetlands. The Dal, Wular, Hokesar are some of the well known lakes known for scenic beauty. Lakes dominated in the districts of Srinagar and Kupwara.

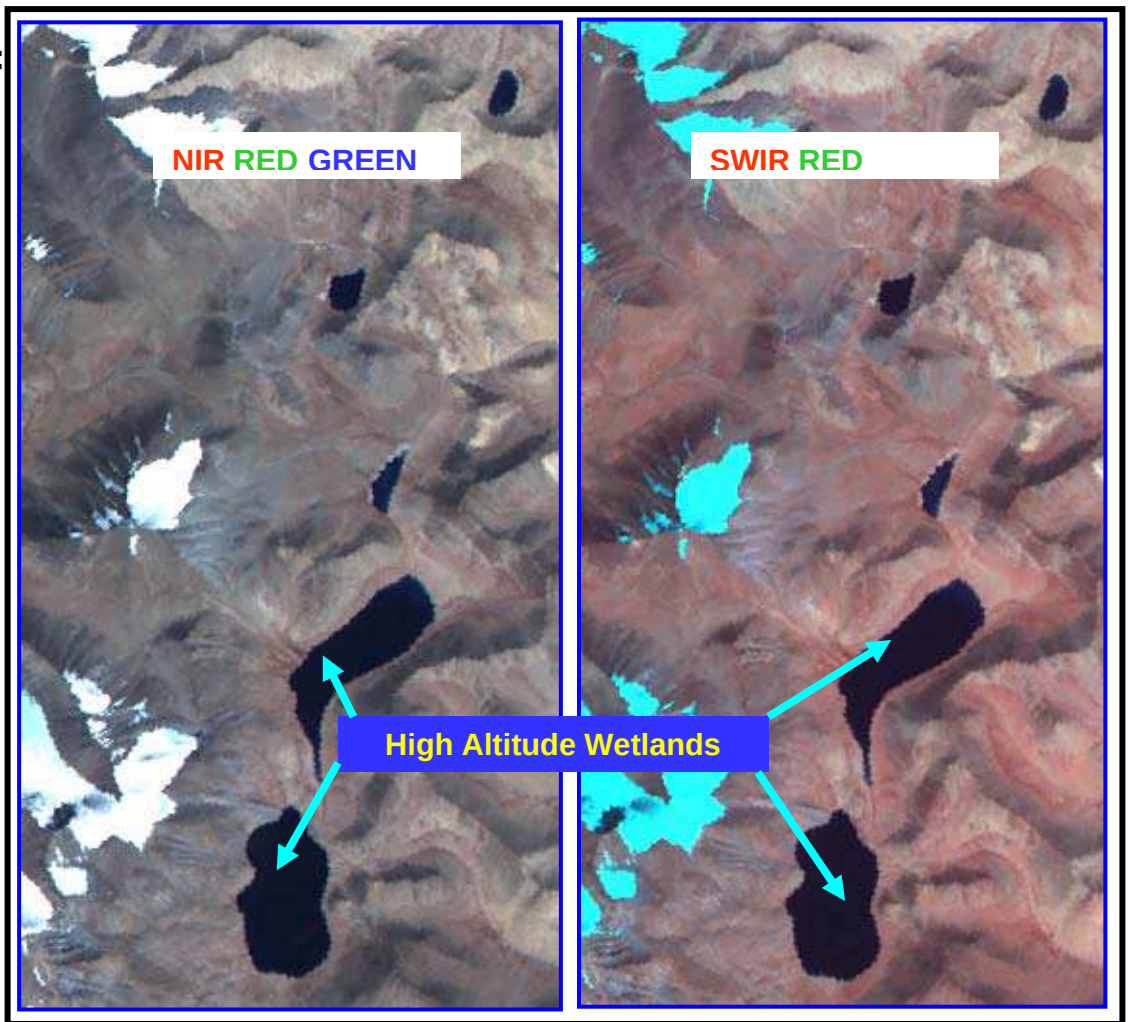
Ground truth data collected for representative wetland types in terms of field photographs showing the water quality (subjective), status of aquatic vegetation and water spread, the location of the features recorded using GPS are shown in Plates 2a, 2b, and 2c.

Part of Leh district
(IRS P6 LISS-III FCC, October 10, 2007)



Part of Shrinagar and Baramula District
(IRS P6 LISS-III FCC, May 18, 2007)

A :



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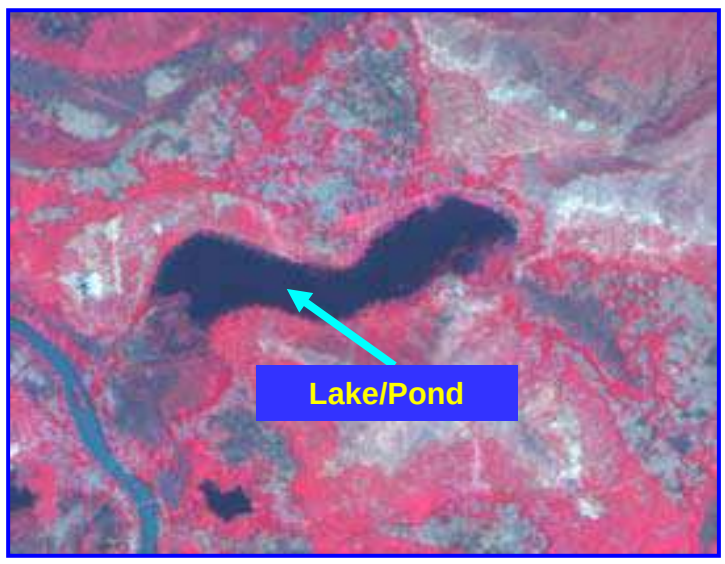

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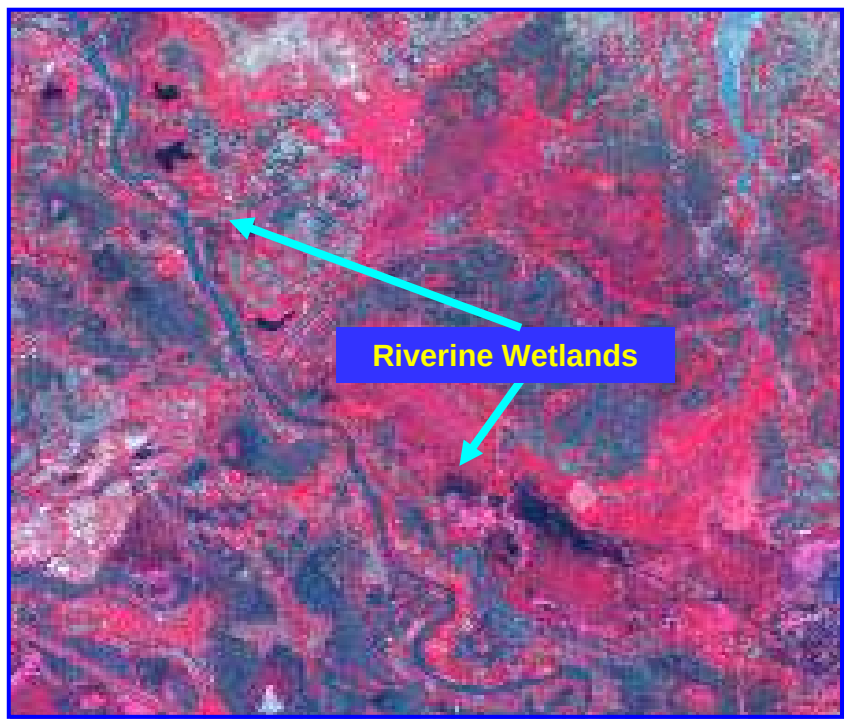
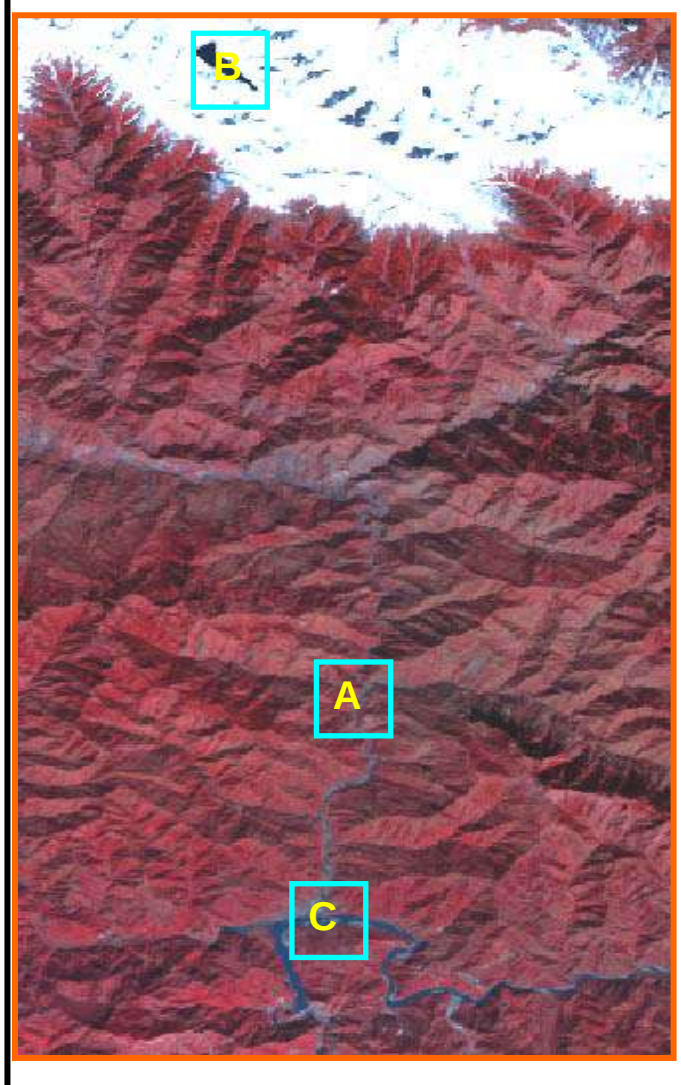


Plate – 1a: Major wetland types of Jammu and Kashmir



Central Part of Jammu-Kashmir
(IRS P6 LISS-III FCC, January 27, 2007)

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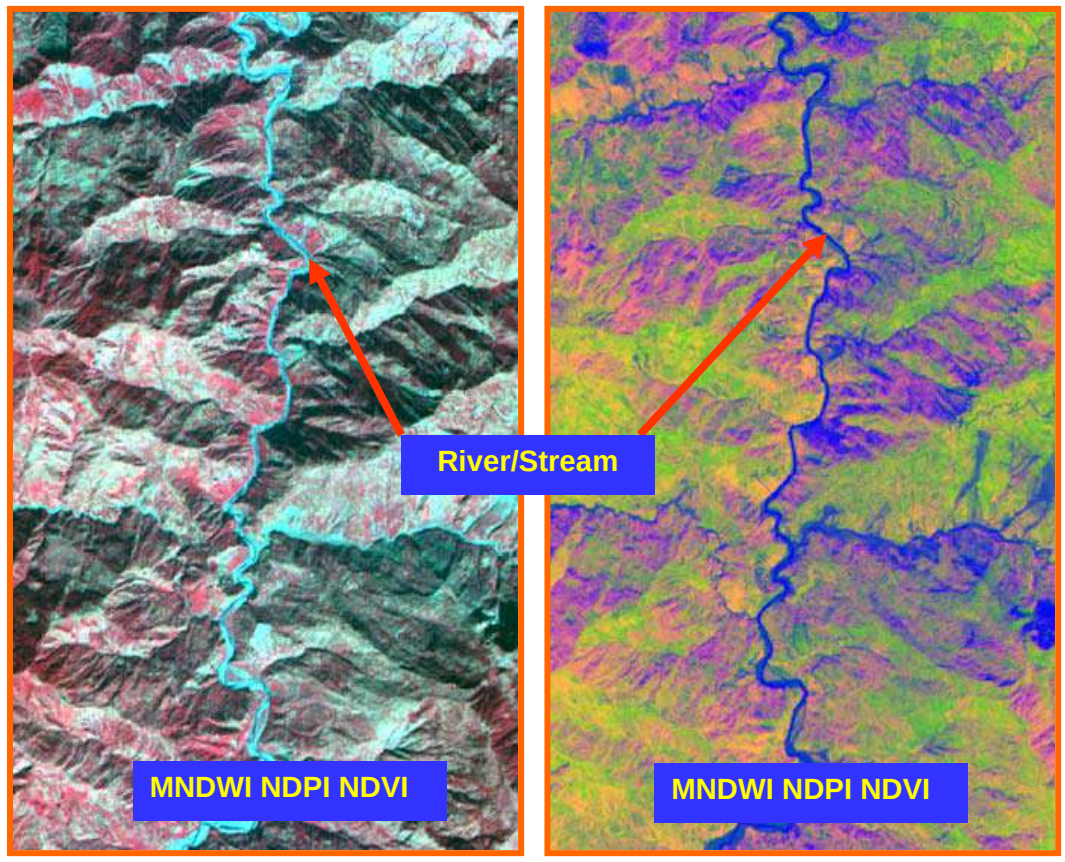

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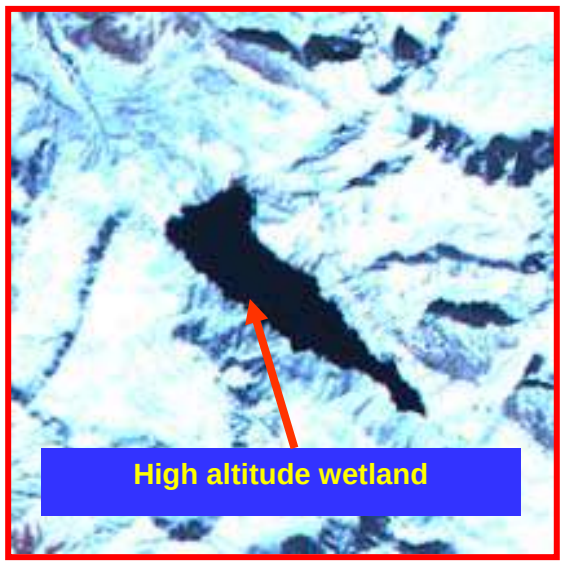

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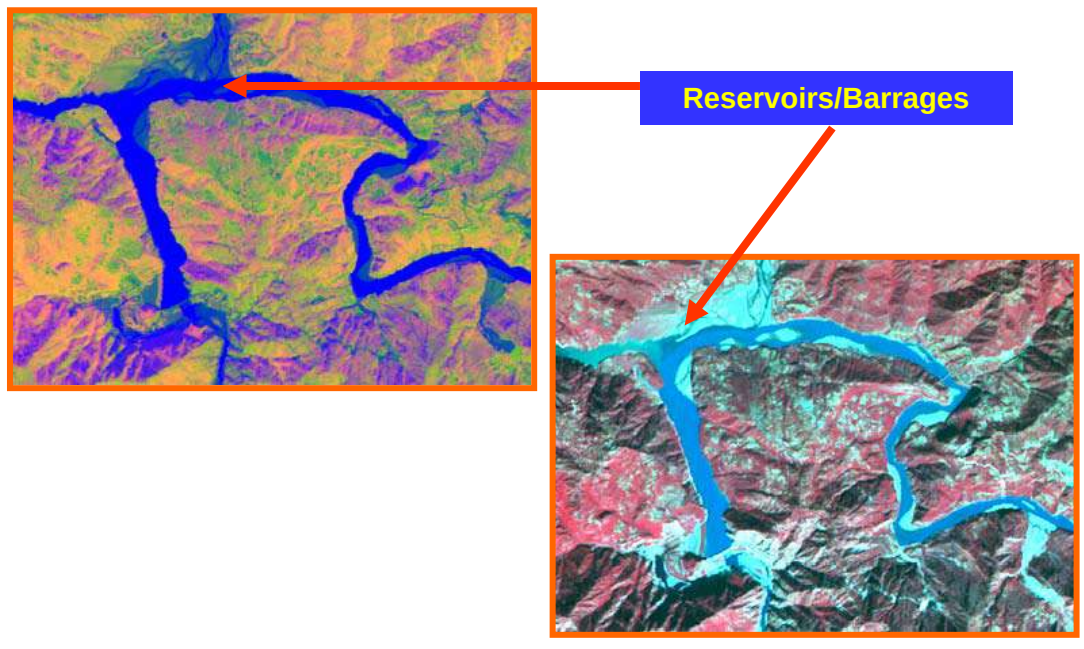


Plate – 1b: Major wetland types of Jammu and Kashmir

Sr. No.	Description	Field photograph
1	Wetland Type : Lake/Pond Location : longitude: 74^0 39’ 48” E latitude : 34^0 13’ 43” N Turbidity : High Aquatic Vegetation : Yes	
2	Wetland Type : Riverine wetlands Location : longitude: 74^0 47’ 37” E latitude : 34^0 08’ 50” N Turbidity : High Aquatic Vegetation : Yes	
3	Wetland Type : River/Stream Location : longitude: 75^0 18’ 50” E latitude : 33^0 10’ 32” N Turbidity : Low Aquatic Vegetation : No	
4	Wetland Type : High altitude wetlands Location : longitude: 78^0 31’ 19” E latitude : 33^0 52’ 29” N Turbidity : Low Aquatic Vegetation : No	

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

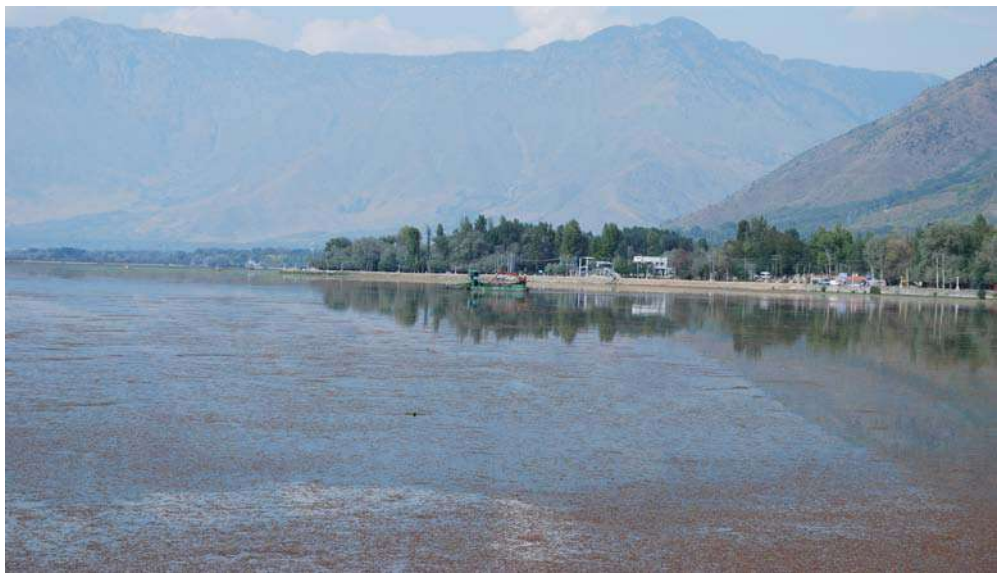
Sr. No.	Description	Field photograph
5	Wetland Type : Lake/Pond Location : longitude: 740 51’ 43” E latitude : 340 05’ 32” N Turbidity : Moderate Aquatic Vegetation : Yes	
6	Wetland Type : Riverine wetlands Location : longitude: 740 42’ 34” E latitude : 340 06’ 01” N Turbidity : Moderate Aquatic Vegetation : Yes	
7	Wetland Type : River/Stream Location : longitude: 740 46’ 58” E latitude : 330 42’ 00” N Turbidity : Low Aquatic Vegetation : No	
8	Wetland Type : Reservoirs / Barrages Location : longitude: 750 43’ 08” E latitude : 320 26’ 40” N Turbidity : Low Aquatic Vegetation : No	

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

Sr. No.	Description	Field photograph
9	Wetland Type : Lake/Pond Location : longitude: 74^0 39’ 48” E latitude : 34^0 13’ 43” N Turbidity : Low Aquatic Vegetation : No	
10	Wetland Type : Riverine wetlands Location : longitude: 74^0 41’ 17” E latitude : 34^0 06’ 36” N Turbidity : Moderate Aquatic Vegetation : Yes	
11	Wetland Type : River/Stream Location : longitude: 76^0 40’ 06” E latitude : 33^0 38’ 04” N Turbidity : Low Aquatic Vegetation : No	
12	Wetland Type : High altitude wetlands Location : longitude: 78^0 16’ 34” E latitude : 32^0 50’ 17” N Turbidity : Low Aquatic Vegetation : Yes	

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

IMPORTANT WETLANDS OF JAMMU AND KASHMIR

9.0 IMPORTANT WETLANDS OF JAMMU AND KASHMIR

A number of lakes are found in the State of Jammu and Kashmir. Most of them are of glacial origin. Some of the important wetlands of the state are as follows:

High Altitude Wetlands (> 3000 m altitude)

High altitude wetlands are crystal clear and mainly oligotrophic in nature. The Pangong lake at a height of 4,267 m above sea level is an important high altitude lake in Ladakh. It is a saline lake. The Sheshnag Lake situated near Vavjan, enroute to Shri Amarnath cave, at a distance of 28 km. from Pahalgam, the Neelang Lake, situated in tehsil Budgam at a distance of 10 km from Nagam are important high altitude lakes, along with Patlong, Thaled, Longzang, Pangor, Tso Kar and Tso Moriri in Ladakh. Tso Moriri has been designated as Ramsar Site.

Low altitude wetlands (< 3000 m altitude)

The Wular lake which is the largest freshwater lake in India. It is about 16 km long and 9.6 km wide with ill-defined shores. This lake lies between Bandipore and Sopore at a distance of 75 km. The lake was included in 1986 as a Wetland of National Importance under the Wetlands Programme of the Ministry of Environment and Forests, Government of India for intensive conservation and management purposes. Subsequently in1990, it was designated as a Wetland of International Importance under the Ramsar Convention.

The Dal Lake is a beautiful lake in the heart of Srinagar city. Floating gardens are found in the western part of the lake. These gardens are used for horticulture.

The Anchar *Lake* is a swampy area. It is about 8 km long and 3 km wide.

The Mansbal *Lake* is at a distance of 29 km from Srinagar and is situated at Sopore It is 5 km long and 1 km wide. It is connected with Jhelum by a canal near Sumbal.

The Harwan Lake is situated at a distance of 21 km. from Srinagar. It is 278 meters long, 137 meters wide and 18 meters deep. This lake is a source of water supply to Srinagar city.

The Hokarsar Lake lies on the Baramulla road about 13 km from Srinagar. It is about 5 km long and 1.5 km. wide. Willow trees are grown in abundance around its banks. Hokarsar has been designated as Ramsar Site.

The Surinsar and Mansar Lakes : The Surinsar Lake is located in Jammu district and Mansar Lake lies in Udhampur district. Surinsar Lake along with Mansar Lake has been designated as one under the Convention of Wetlands of International Importance.

Wetland maps prepared for 5km buffer area for some of the important wetlands of the state belonging to different category is shown in subsequent plates along with field data collected.

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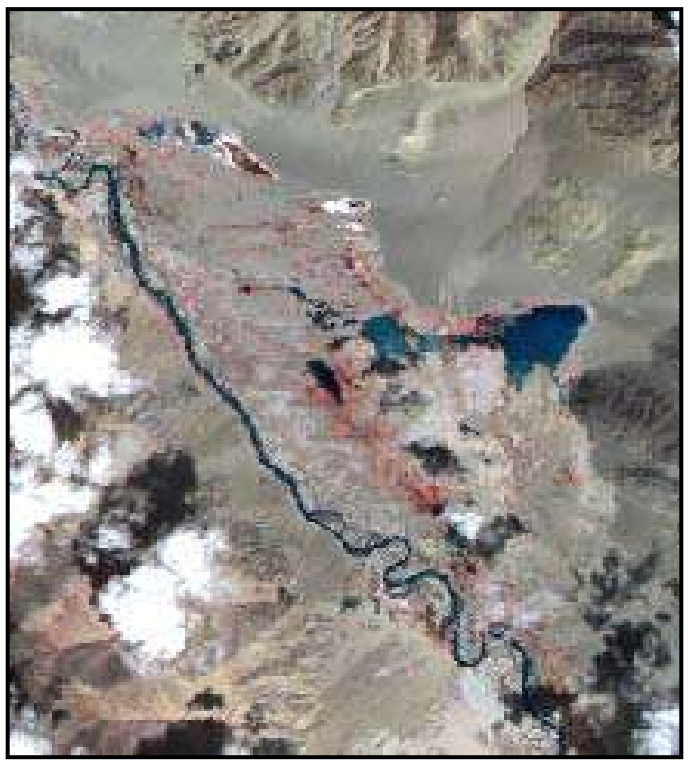
9.1 Chushul Marshes

Name	**Chushul Marshes**
Location	Between 33^0 00' N and 33^0 06' N latitudes and 79^0 04' E and 79^0 11' E longitudes
Area	675 ha
Altitude	4385 m
Climate	Average annual rainfall : 75 mm Temperature: -5^o to 30^o C.
Salient features	A complex of shallow ponds, marshes, and wet meadows in broad, sandy valley to the east (10000 ha) and west (1,000 ha) of Chusul, some 15 km south of Pangong Tso. The ponds and marshes are created by springs and streams flowing down into the valley from the Ladakh range to the southwest. Some streams terminate on the sandy plains in stagnant pools, which become saline as they evaporate; others carry sufficient water to flow into Pangong Tso and ultimately the Indus river. Small freshwater marshes have formed where these streams coalesce or where they reach a body of standing water. The average depth of the ponds here is one or two meters.
Turbidity	Low
Vegetation	Species of *Hydrilla, Myriophyllum, and Potamogeton* in the ponds, and *Carex sp*., other sedges, and grasses in the marshes. The surrounding arid steppe is dominated by *Caragana sp*.
Fauna	An important breeding area for several species of waterfowl, notably *Podiceps cristatus, Tadorna ferruginea, Charadrius mongolus, Tringa tetanus,* and *Sterna hirundo*. A number of Tibetans specialties occur on the surrounding dry plains, including Tibetan partridge (*Perdix hodgsoniae*), Tibetan sandgrouse (*Syrrhaptes tibetanus*), and wild ass (*Equus hemionus*).



Post-Monsoon 2006

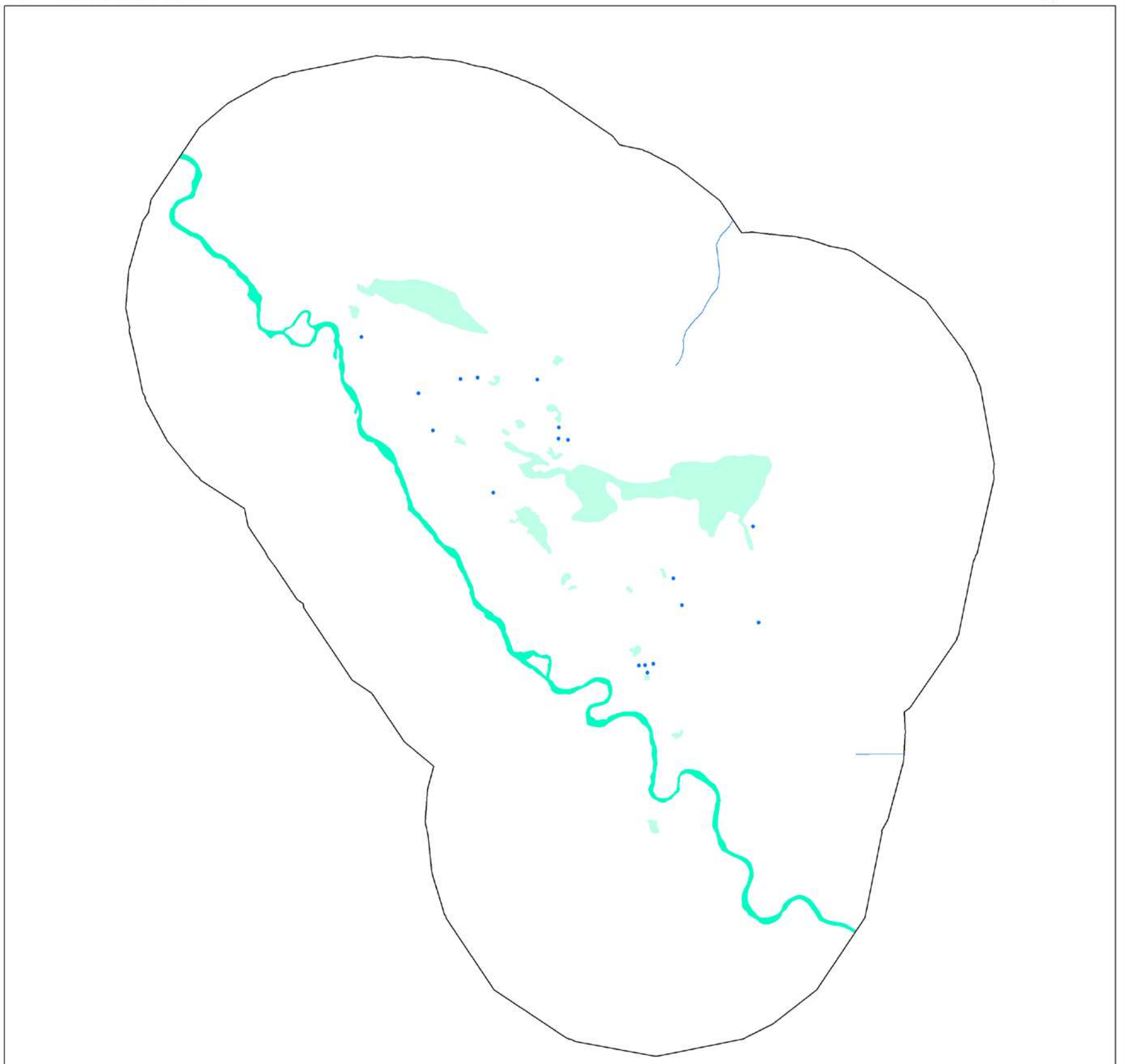
Pre-Monsoon 2007

Plate 3: Chushul marshes

State : Jammu and Kashmir

WETLAND MAP

Chushul_Marshes

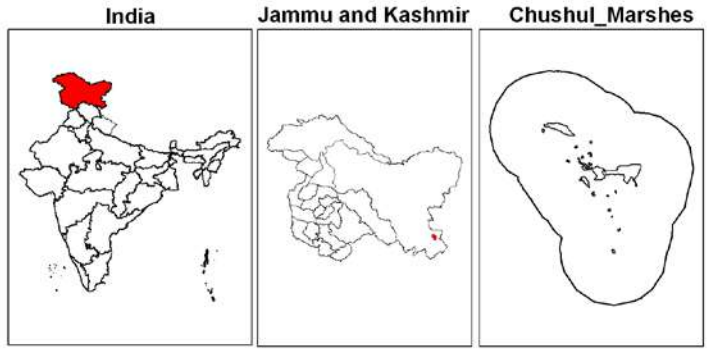


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



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
The University of Kashmir, Srinagar

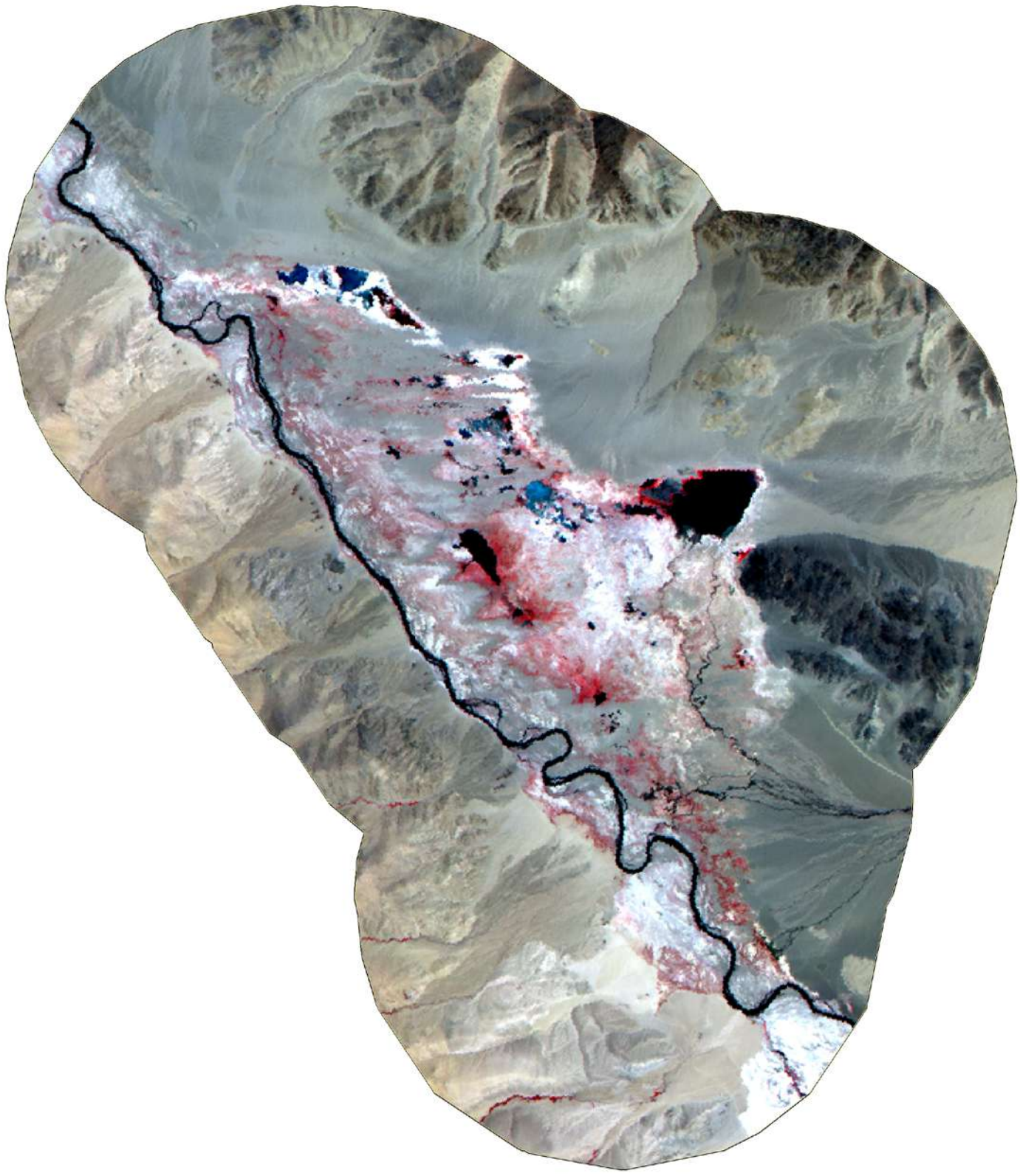
Sponsored By:

Ministry of Environment and Forests
Government of India

Plate 4: Wetland map - 5 km buffer area of Chushul Marshes

State : Jammu and Kashmir

Chushul_Marshes

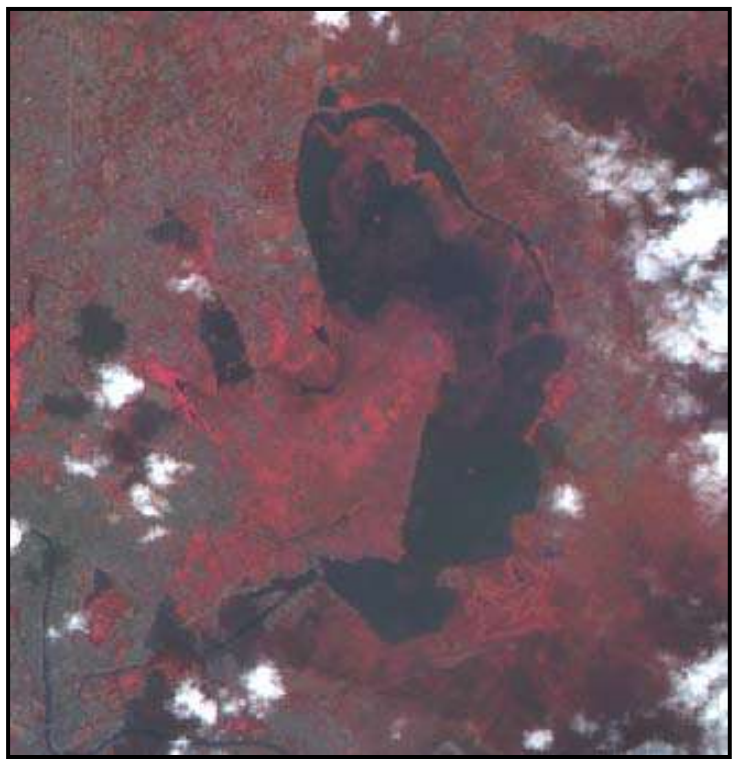


IRS P6 LISS-III Pre-monsoon 2007 data

Plate 5: IRS LISS III FCC - 5 km buffer area of Chushul Marshes

9.2 Dal Lake

Name	**Dal Lake**
Location	Between 34^0 04' N and 34^0 09' N latitudes and 74^0 49' E and 74^0 52' E longitudes
Area	1,670 ha
Altitude	1587 m
Climate	Average annual rainfall : 551 mm Temperature: -2^o to 35^o C.
Salient features	One of a series of freshwater lakes in the Kashmir Valley, Dal Lake is a multi-basined, ox bow type of lake, with shallow saucer-shaped basins (Hazratbal, Boddal, Gafribal, and Nagin) formed by the changing course of the river Jhelum. It is connected by a system of channels with Nagin and Anchar Lakes to the northwest. Regular inflow and outflow of water takes place through the channels. The main source of water for the lake is the Telbal Nalla in the Dachigam area, numerous springs arising from the bottom of the lake and outwash from the surrounding mountains on the western Boddal and Gagribal basin side. The outflow of the lake is on the western side into an arm of the Jhelum. Water flows out through a weir-and-lock system. The maximum depth is 6.5m, while the average depth is less than 3 m. Water levels, which fluctuate during the course of a year, are maximum in April and minimum in November. The pH values of the lake fall within the alkaline range.
Turbidity	Low to Moderate
Vegetation	Major aquatic vegetation species include *Ceratophyllum demersum, Potamogeton natans,* and *Nelumbonucifera.* One hundred and sixty seven taxa representing six classes of algae have been recorded. There is a dominance of Bacilloriophyceae and Chlorophyceae.
Fauna	Reported to be attracting waterfowl, though no census appears to have been conducted.



Post-Monsoon 2007

Pre-Monsoon 2007

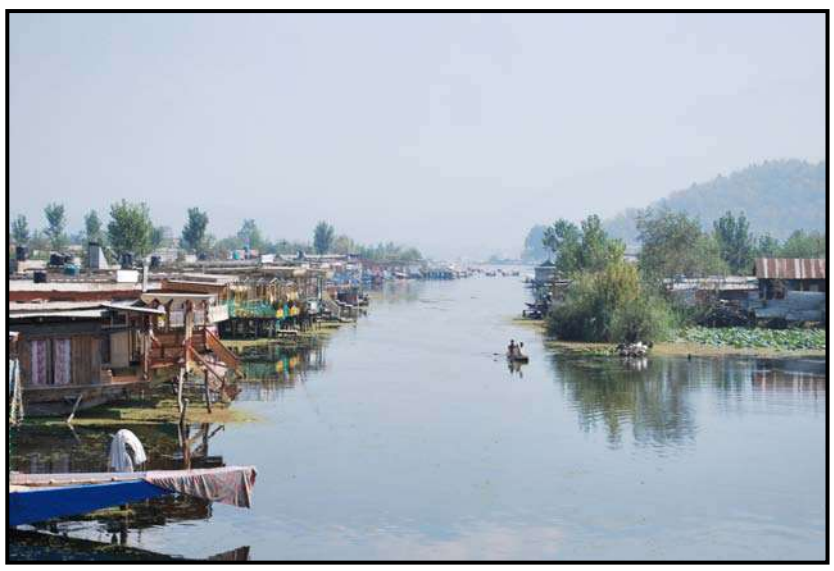
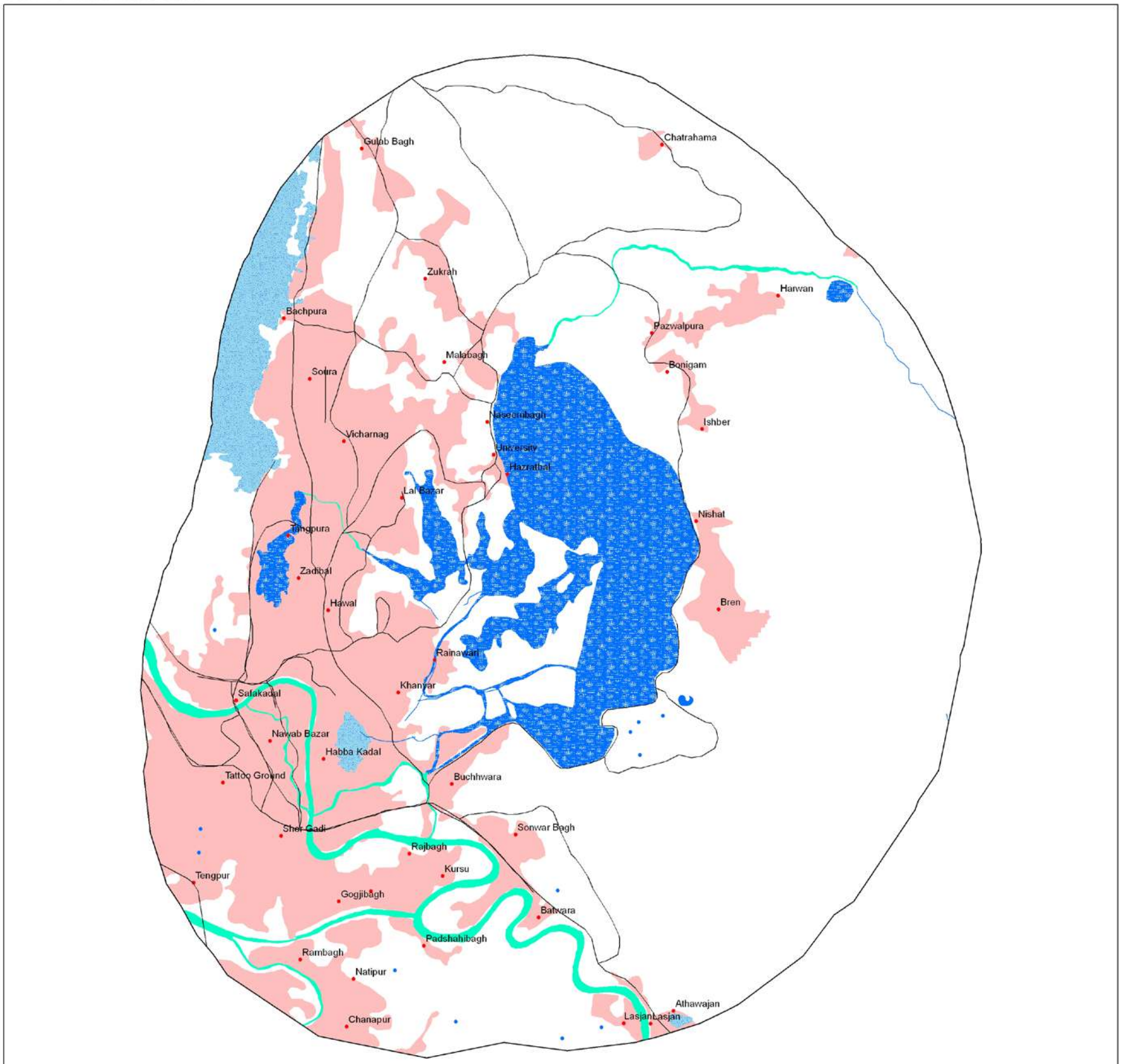


Plate 6: Dal Lake

State : Jammu and Kashmir

WETLAND MAP

Dal Lake

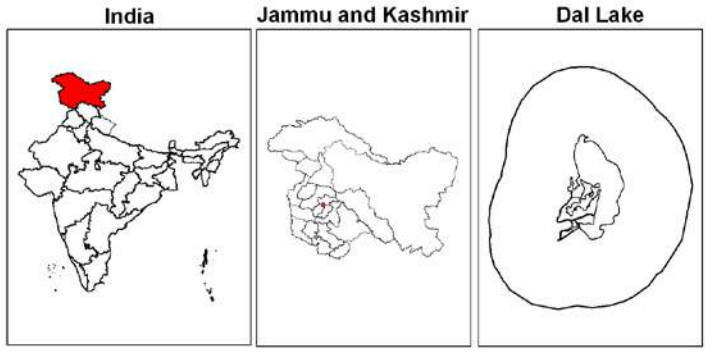


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



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
The University of Kashmir, Srinagar

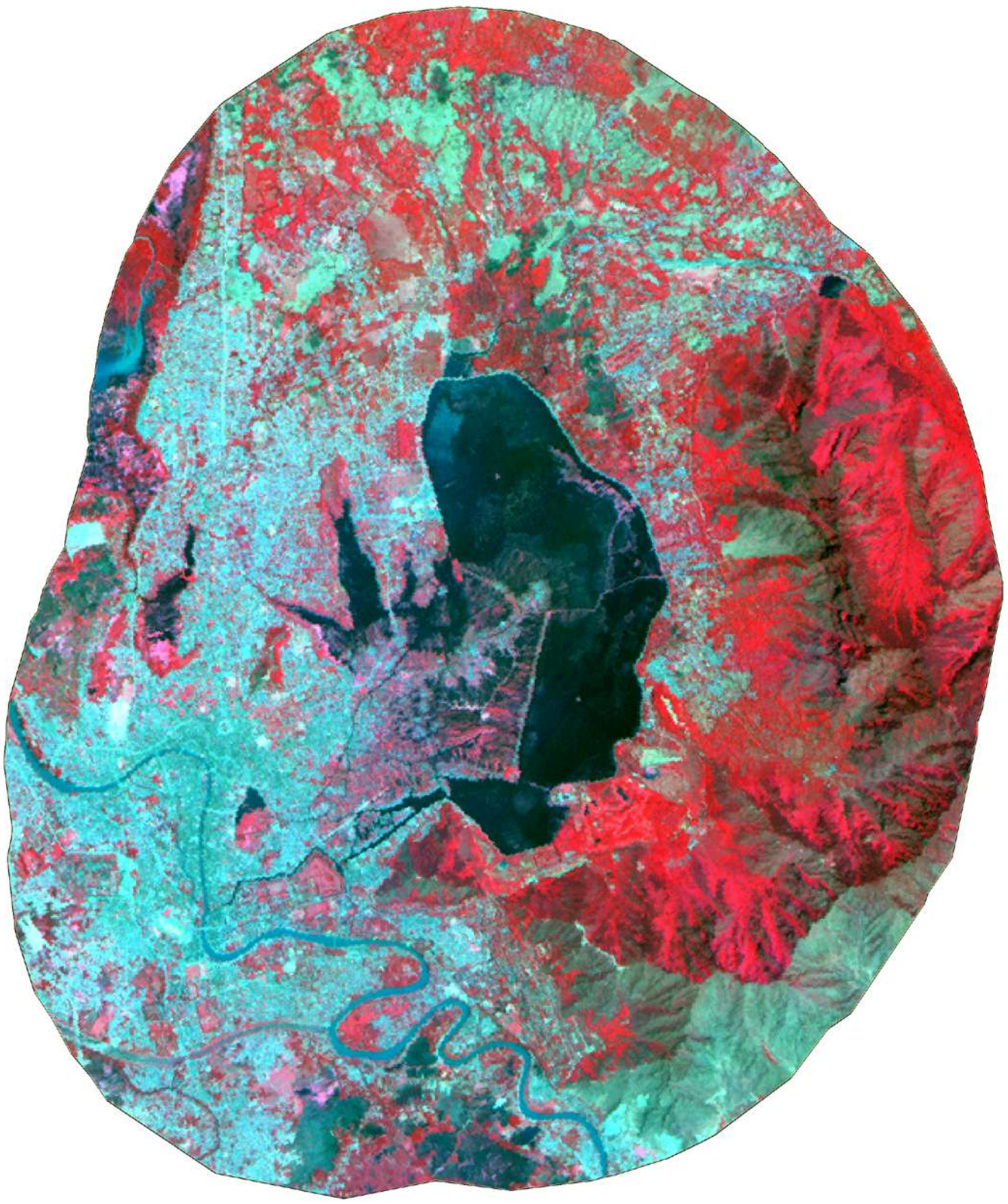
Sponsored By:

Ministry of Environment and Forests
Government of India

Plate 7: Wetland map - 5 km buffer area of Dal Lake

State : Jammu and Kashmir

Dal Lake

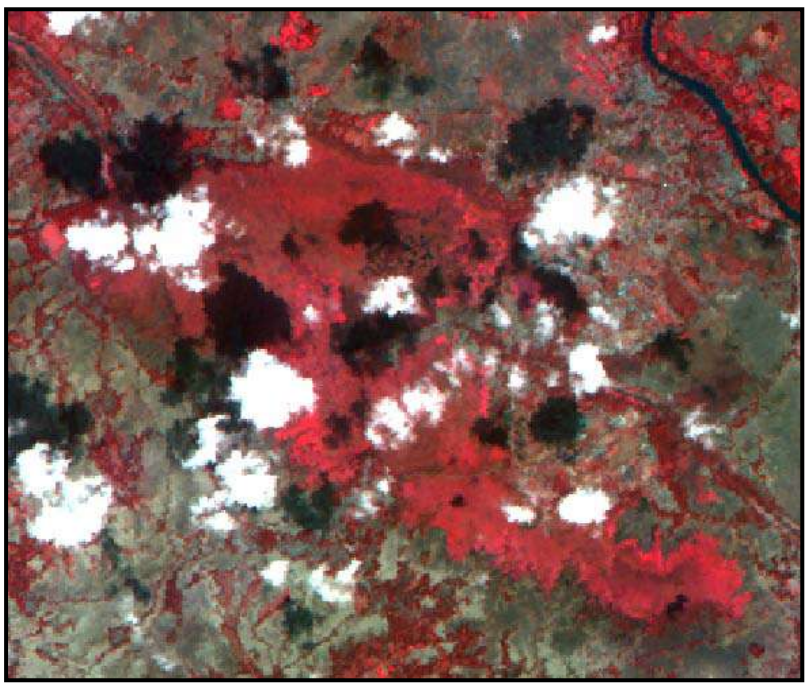


IRS P6 LISS-III Pre-monsoon 2007 data

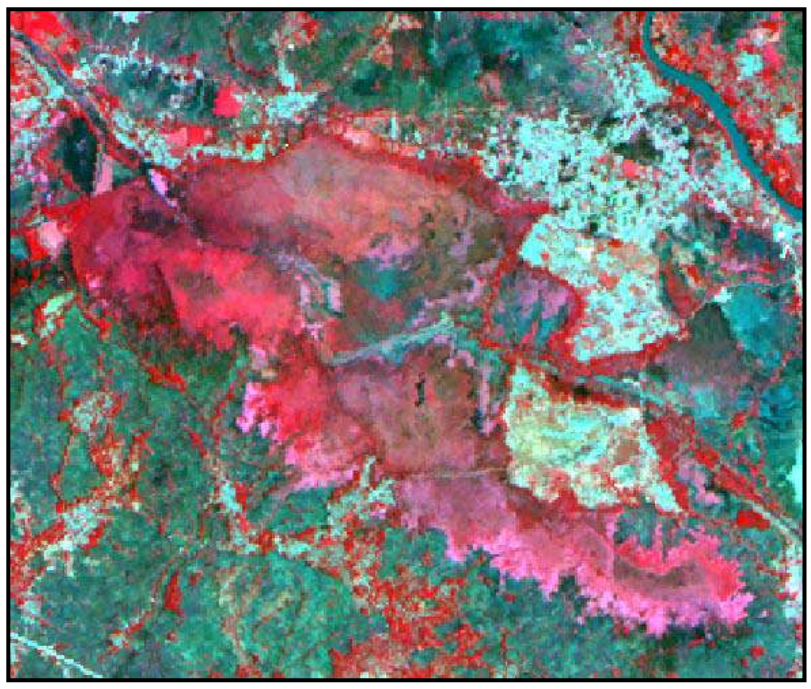
Plate 8: IRS LISS III FCC - 5 km buffer area of Dal Lake

9.3 Hokarsar

Name	Hokarsar
Location	Between 34^0 03' N and 34^0 0641' N latitudes and 74^0 40' E and 74^0 45' E longitudes
Area	1,300 ha
Altitude	1580 m
Climate	Average annual rainfall : 678 mm Temperature: -5^o C to 37^o C.
Salient features	Hokarsar is a riverine wetland. It is highly eutrophic and drained by a channel to the Jhelum Maximum depth is 2.5 m and minimum of 0.7 m in autumn. Open water is very turbid. Nutrient load is very high. Anaerobic conditions were also reported during autum. It is an important wetland for both resident and migratory waterfowl.
Turbidity	Low - Moderate
Vegetation	Marsh vegetation dominated by *Typha angustata, T. laxmanii, Phragmites communes. Eleocharis palustris, and Butomus umbellatus, Azola sps.* occurs in open-water areas. At least 156 species of phytoplankton have been recorded, with Chlorophyceae predominating. There are many floating gardens in the lake, plantations of *Salix alba* along the shoreline, and paddy fields in surrounding areas.
Fauna	The lake is particularly important as a wintering area for migratory ducks and an ideal breeding area for herons, egrets, and rails. Up to 25,000 wintering ducks have been recorded. The otter *(Lutra lutra*) is still fairly common in the lake. The lake supports a rich fish fauna, including *Cyprinus carpio, Crossocheilus sp., Puntius conchonius*, and *Gambusia affinis*. The zooplankton includes at least 44 species of *protozans,* 18 *rotiferans*, and 38 crustaceans (mainly *Cladocera and Rhizopoda*).



Post-Monsoon 2007



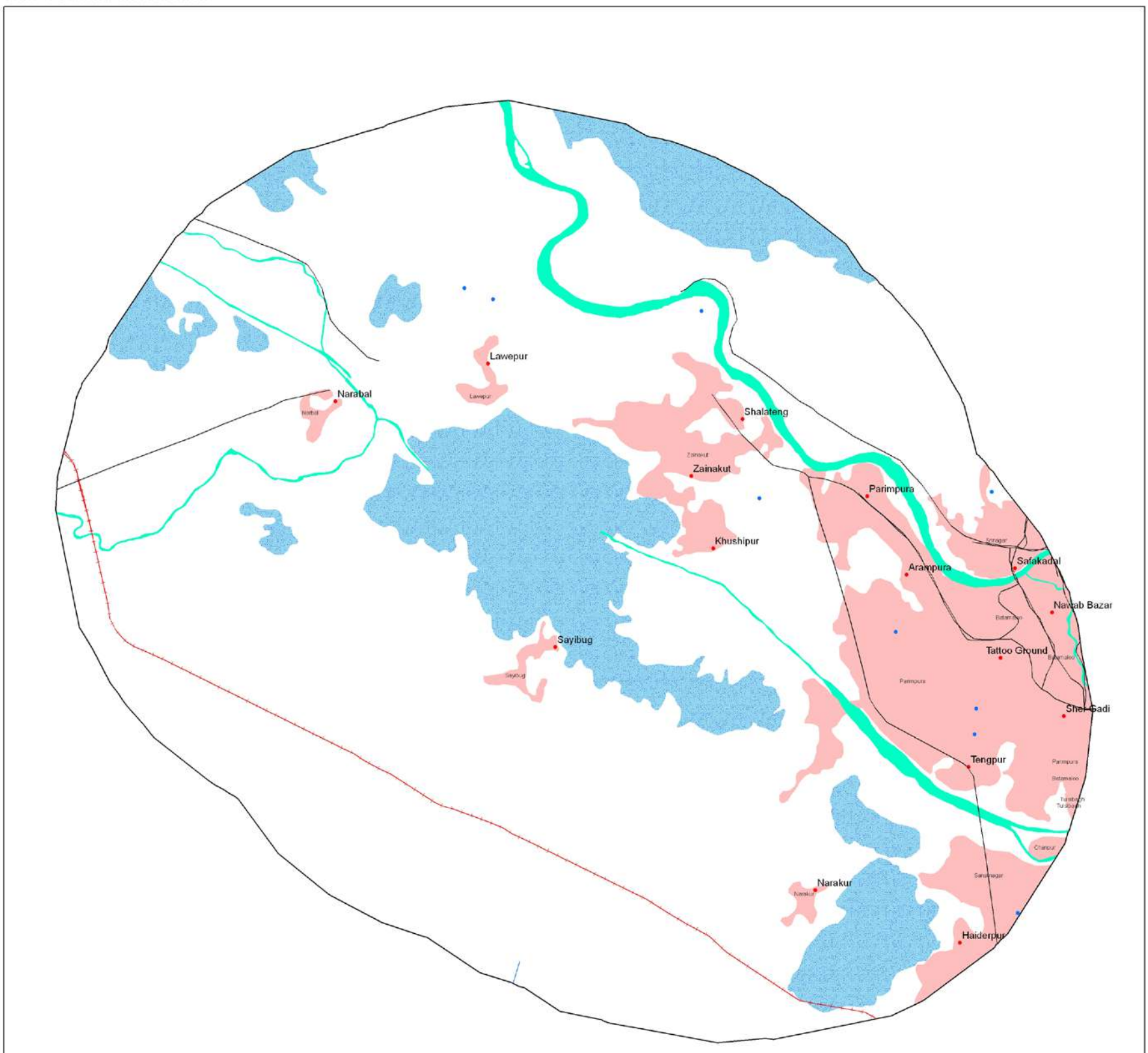
Pre-Monsoon 2007

Plate 9: Hokarsar

State : Jammu and Kashmir

WETLAND MAP

Hokarsar



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

Legend

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

Location Map

India | Jammu and Kashmir | Hokarsar

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
The University of Kashmir, Srinagar

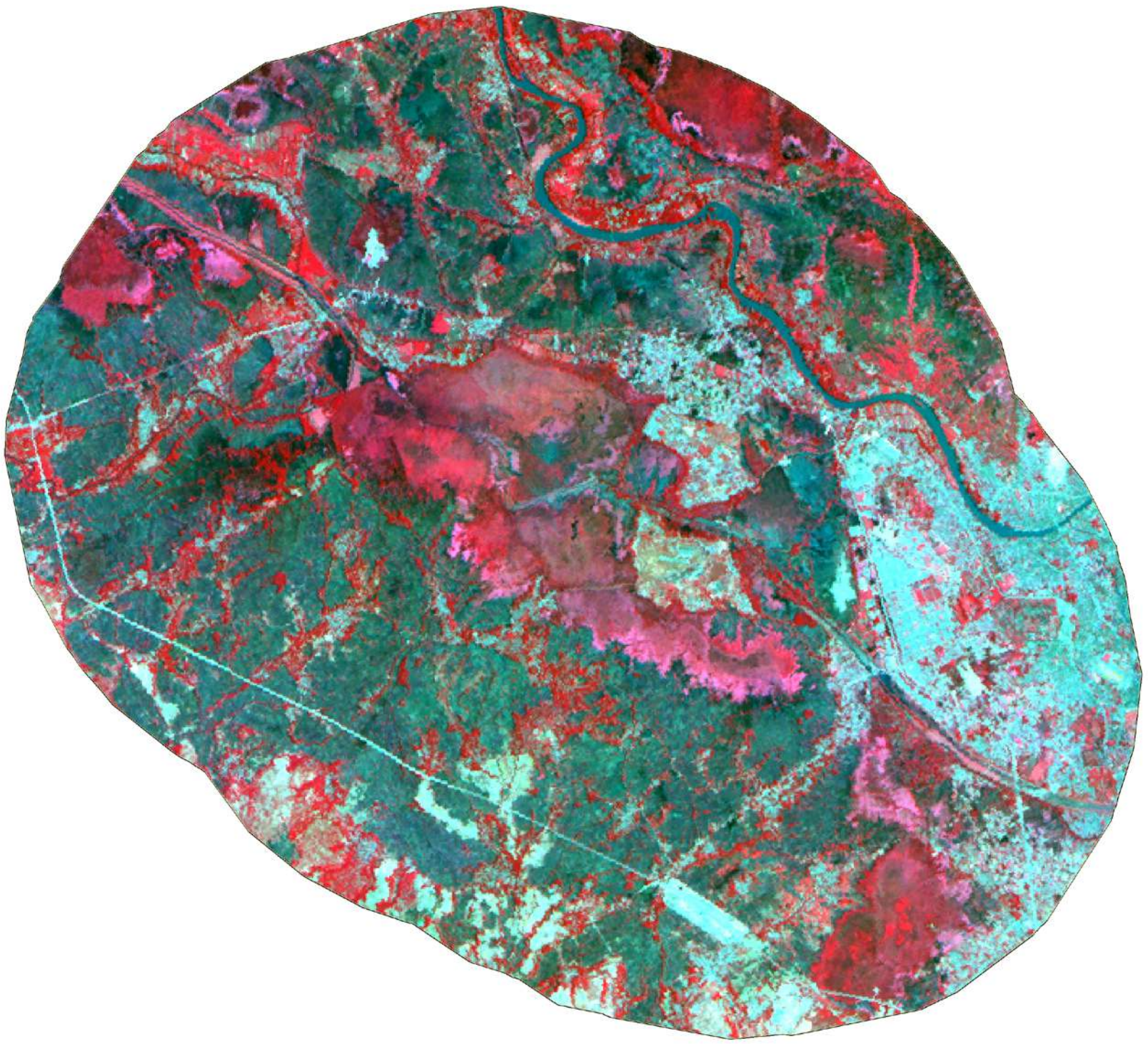
Sponsored By:

Ministry of Environment and Forests
Government of India

Plate 10: Wetland map - 5 km buffer area of Hokarsar

State : Jammu and Kashmir

Hokarsar



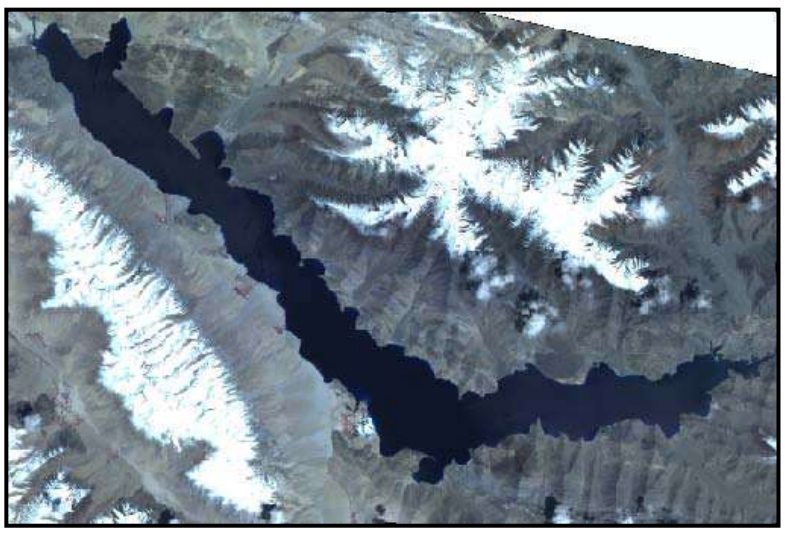
IRS P6 LISS-III Pre-monsoon 2007 data

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

9.4 Pangong Tso

Name	Pangong Tso
Location	Between 33^0 40' N and 33^0 58' N latitudes and 78^0 24' E and 79^0 01' E longitudes
Area	29,345 ha
Altitude	4350 m
Climate	The lake falls in Ladakh division falls in arid zone, is extremely cold and as such is also known as cold desert. Temperature ranges from minimum of -3^{o}C to a maximum of 30^{o}C in summer and minimum of -20^{o}C to a maximum of 15^o C in winter.
Salient features	Pangong Tso is a long, narrow, brackish water lake spanning the Indian/Chinese border, in a high mountain valley in the upper drainage basin of the Indus river, at the east end of the Karakoram Range. Only the westernmost third of the Jake lies in Indian territory. The lake is actually a chain of four interconnecting water bodies and is probably of very recent origin, having been formed by natural damming of the valley. Five rivers, fed by perennial springs and snow-melt, flow into the Indian portion of the lake; the outlet at the west end flows northwest into the Shyok river, a tributary of the Indus. There are some brackish to saline marshes near the western end, with adjacent wet meadows.
Turbidity	Low
Vegetation	Brackish to saline marshes and alpine meadows at the west end of the lake. The lake itself is reported to the devoid of macro-vegetation. Surrounding hillsides, support low, thorn scrub and perennial herbs.
Fauna	A great diversity of ichthiological fauna is recorded from this lake. It also an ideal breeding and nesting place of migratory birds. This lake is High Altitude Cold Desert National Park and habitat of snow leopard. The region around the lake supports a number of species of wildlife including the Kiang and the Marmot .

Post-Monsoon 2006



Pre-Monsoon 2007

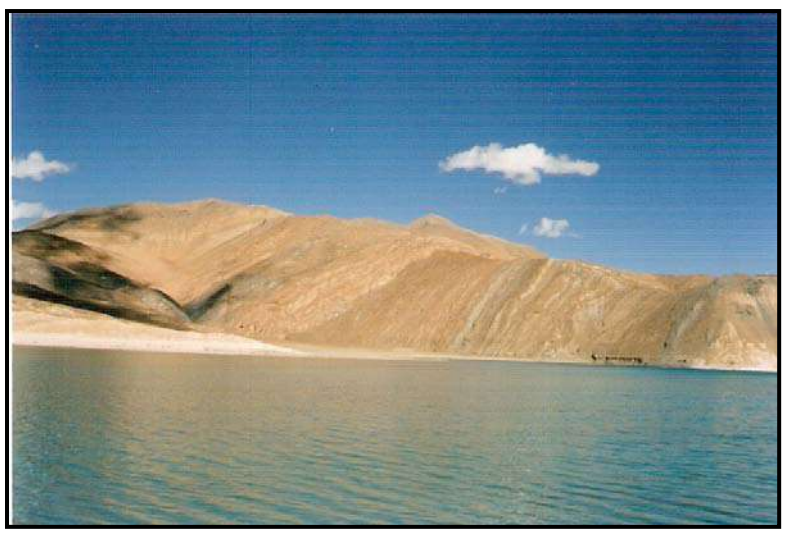
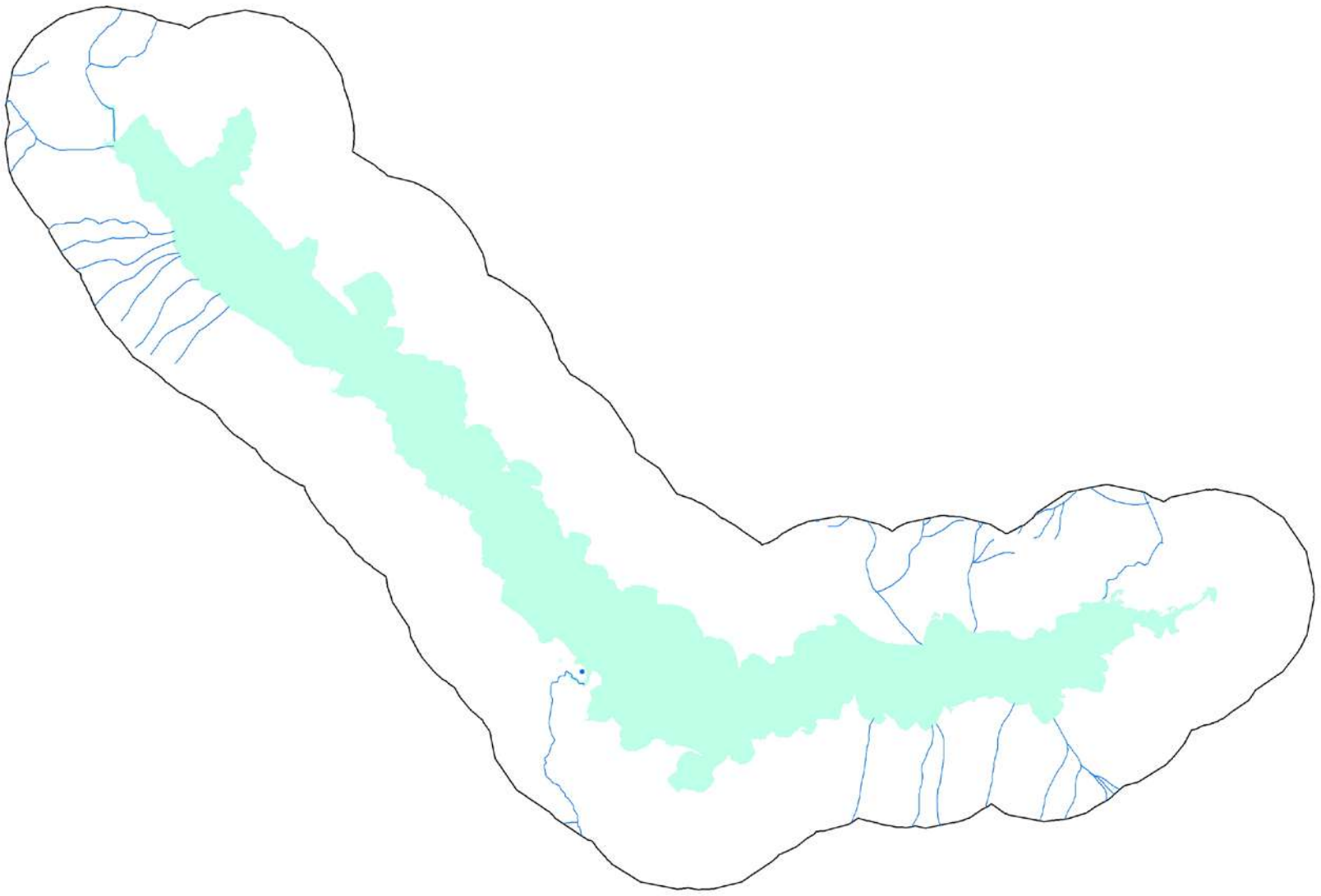


Plate 12: Pangong Tso

State : Jammu and Kashmir

WETLAND MAP

Pangong_Tso



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

Legend

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

Location Map

India | Jammu and Kashmir | Pangong_Tso

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
and
The University of Kashmir, Srinagar

Sponsored By:

Ministry of Environment and Forests
Government of India

Plate 13: Wetland map - 5 km buffer area of Pangong Tso

State : Jammu and Kashmir

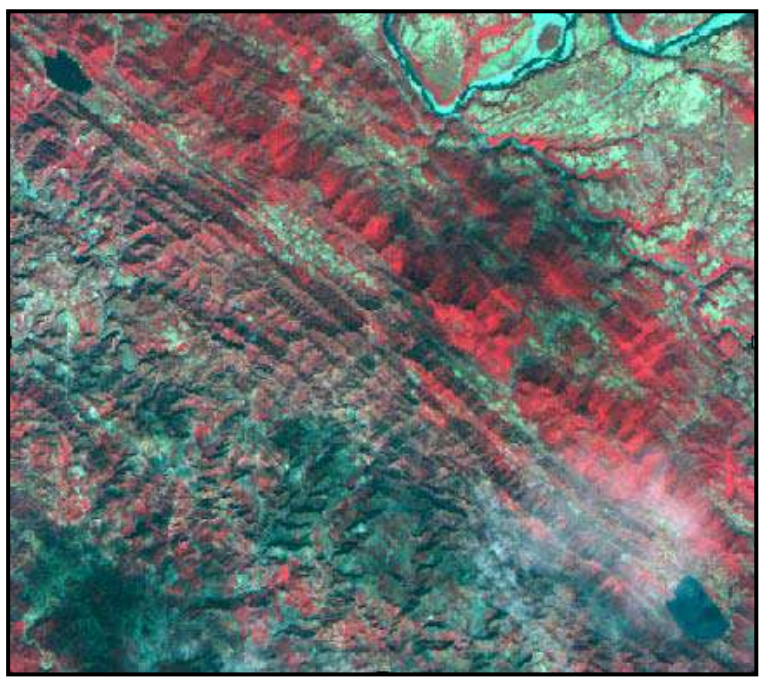
Pangong_Tso

IRS P6 LISS-III Pre-monsoon 2007 data

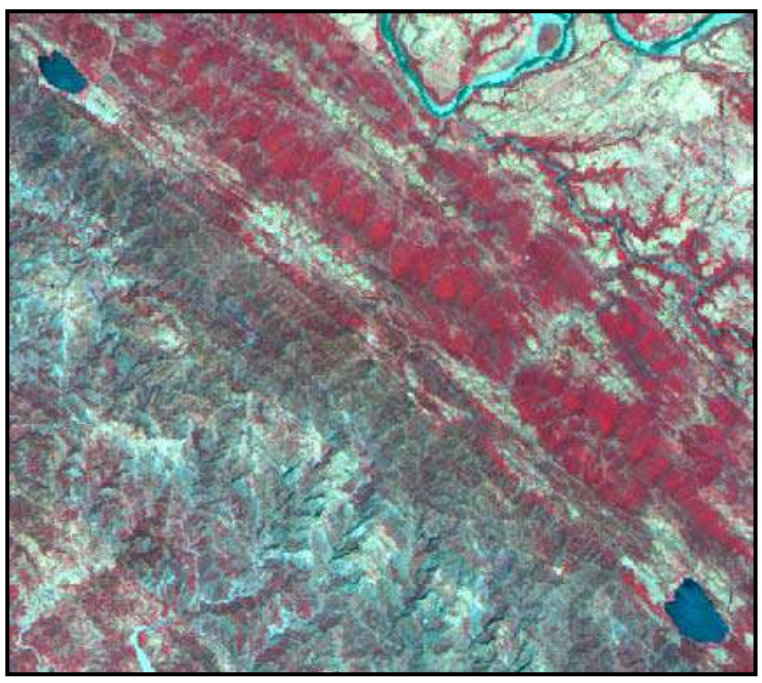
Plate 14: IRS LISS III FCC - 5 km buffer area of Pangong Tso

9.5 Surinsar & Mansar Lakes

Name	**Surinsar & Mansar Lakes**
Location	Surinsar Lake : 32^0 46' 16" N latitude and 75^0 2' 28" E longitude Mansar Lake : 32^0 41' 52" N latitude and 75^0 8' 40" E longitude
Area	Surinsar Lake - 30.5 ha and Mansar Lake - 58 ha
Altitude	Surinsar Lake - 605m and Mansar Lake – 678 m
Climate	Average annual rainfall : 107 mm Temperature: 0^o to 35^o C.
Salient features	Lake Surinsar is almost oval-shaped with a deep notch on its northwestern side and a small island in its waters. it is 40 km northeast of Jammu city. The lake is rain-fed, and has no permanent inlet or outlet (closed ecosystem). Lake Mansar is also semi-oval shaped water body, without any distinct regular inlet or outlet.
Turbidity	Low
Vegetation	Surinsar Lake- *Ipomoea sp*., *Nelumbo sp*., *Hydrilla sp*., *Ceratophyllum sp*., and *Potamogeton sp*. comprise the dominant aquatic vegetation. Mansar lake - A rich growth of microphytes and macrophytes in the shallow, littoral zone is a unique feature of this lake indicating high amount of nutrients and availability of solar radiation. Among the macrophytes *Typha sp*., *Polygonum sp*., and *Phragmites sp*., are dominant.
Fauna	Surinsar - An important area for resident and migratory waterfowl. No census has been carried out in this lake. Microscopic fresh water medusae (*Mansariella lacustris*) are observed in this lake which is a rare species. Mansar lake - An attractive habitat for migratory waterfowl.



Post-Monsoon 2006



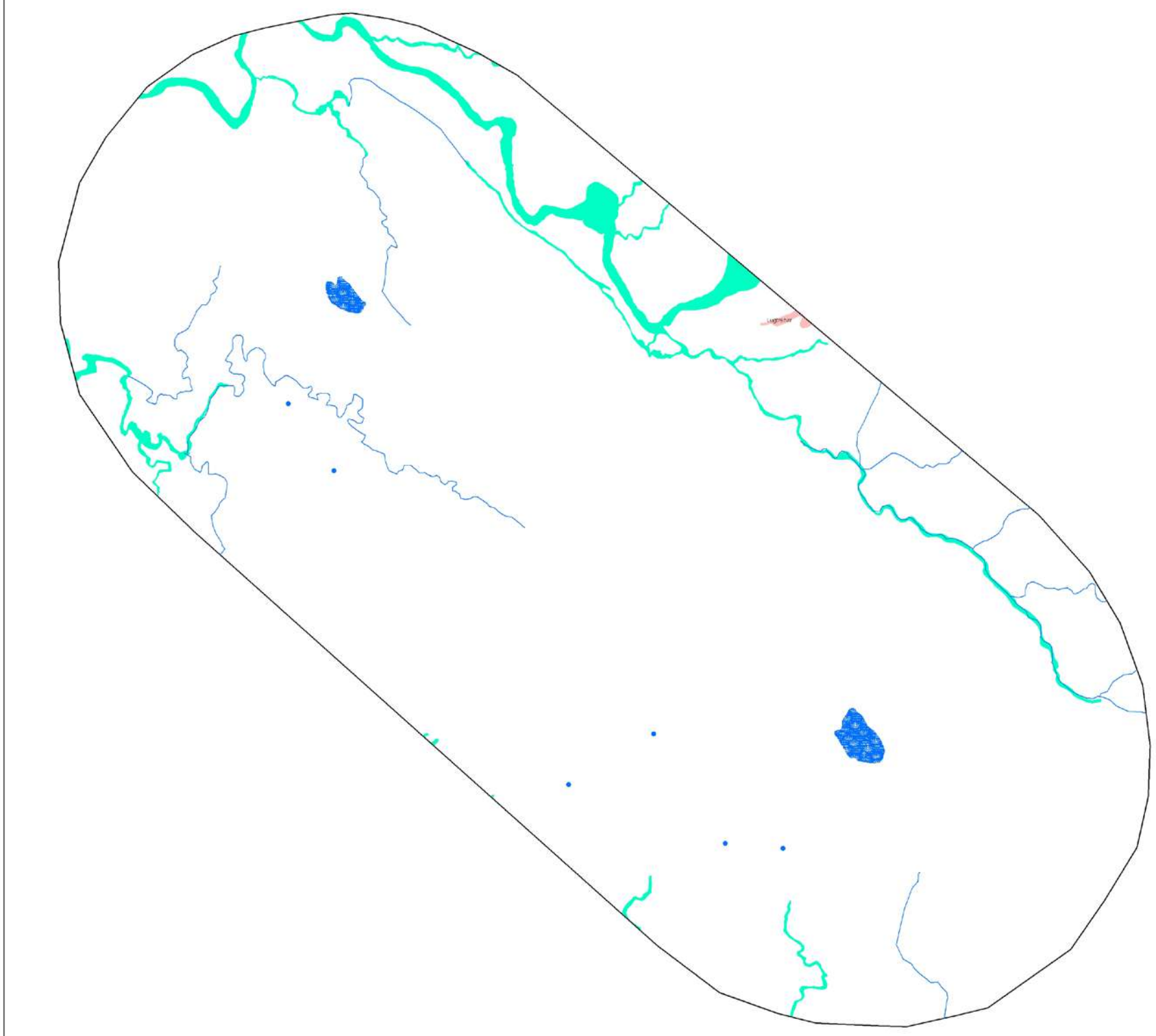
Pre-Monsoon 2007

Plate 15: Surinsar & Mansar Lakes

State : Jammu and Kashmir

WETLAND MAP

Surinsar_and_Mansar_Lakes



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

Legend

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

Location Map

India | Jammu and Kashmir | Surinsar_and_Mansar_Lakes

0 1.25 2.5 5 Kilometers

Data Source :

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

Prepared By :

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

Sponsored By:

Ministry of Environment and Forests
Government of India

Plate 16: Wetland map - 5 km buffer area of Surinsar & Mansar Lakes

State : Jammu and Kashmir

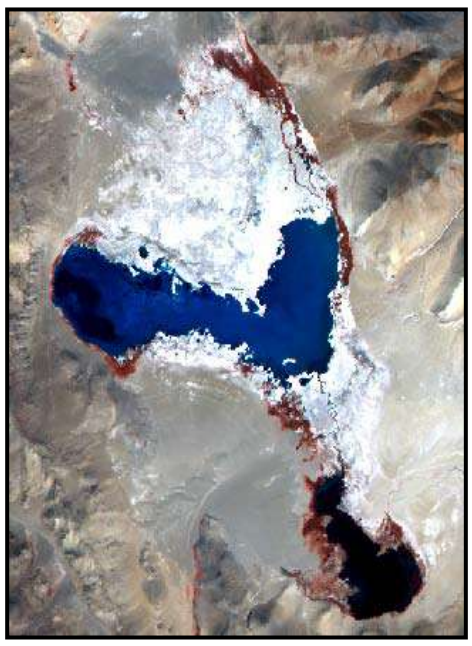
Surinsar_and_Mansar_Lakes

IRS P6 LISS III pre-monsoon data (2006)

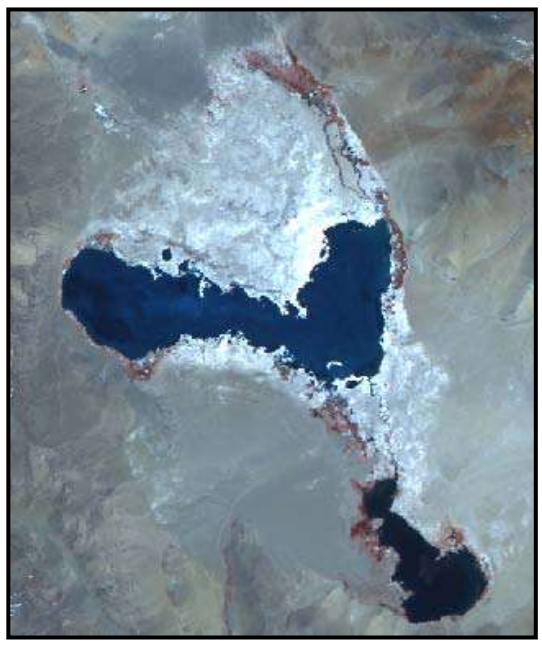
Plate 17: IRS LISS III FCC - 5 km buffer area of Surinsar & Mansar Lakes

9.6 Tso Kar

Name	**Tso Kar**
Location	Between 33^0 14' N and 33^0 22' N latitudes and 77^0 57' E and 78^0 03' E longitudes
Area	6,179 ha
Altitude	4760 m
Climate	Average annual rainfall : 75 mm Temperature: 0^o to 30^o C during summer and -40^o to -10^o C during winter
Salient features	In a very remote and sparsely populated area, the Tso kar Basin, a land locked basin of a former large freshwater lake has contracted into two principal water bodies. Frosting and heaving are the two major geological activities associated with low and high temperatures. The shrinkage of the lake is mainly attributed to these activities. The availability of calcium bicarbonates is also very high in this area.
Turbidity	Low
Vegetation	In the fresher parts of the basin, the pools have aquatic vegetation composed of *Potamogeton sp.* And *Hydrilla sp.* These plants die back in winter to form floating mats of weed in spring. The adjacent freshwater marshes and damp meadows support a mixture of *Carex sp*. and *Ranunculus sp*. The arid steppe vegetation of surrounding areas is dominated by species of *Astragalus and Caragana*.
Fauna	The basin is a major breeding area for *Podiceps cristatus*, Barheaded goose, Brahminy duck, brown-headed gull, and common tern. One pair of black-necked cranes breeds in the area. As many as 100 Tibetan Sand grouse come to drink water each morning at the shallow pool in the meadows to the west of Tso Kar. Wild ass and Tibetan gazelles for- age in the marshes and meadows, and *Canis lupus* and *Vulpes sp* occur in the surrounding hills. Marmots (*Marmota bobak*) are commonly found around the lakes they prepare small mounds while making burrows.



Post-Monsoon 2007



Pre-Monsoon 2007

Plate 18: Tso Kar

State : Jammu and Kashmir

WETLAND MAP

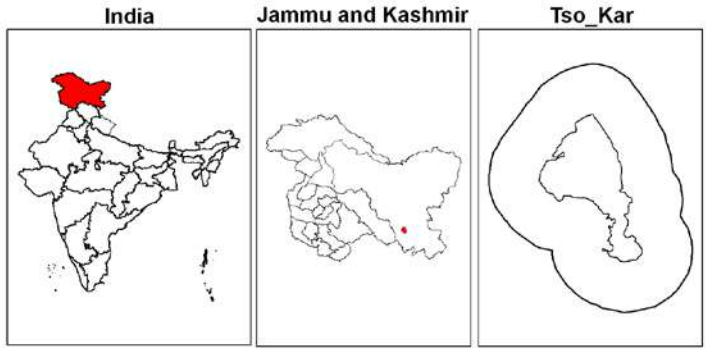
Tso_Kar

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

Legend

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

Location Map



0 1.5 3 6 Kilometers

Data Source :

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

Prepared By :

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

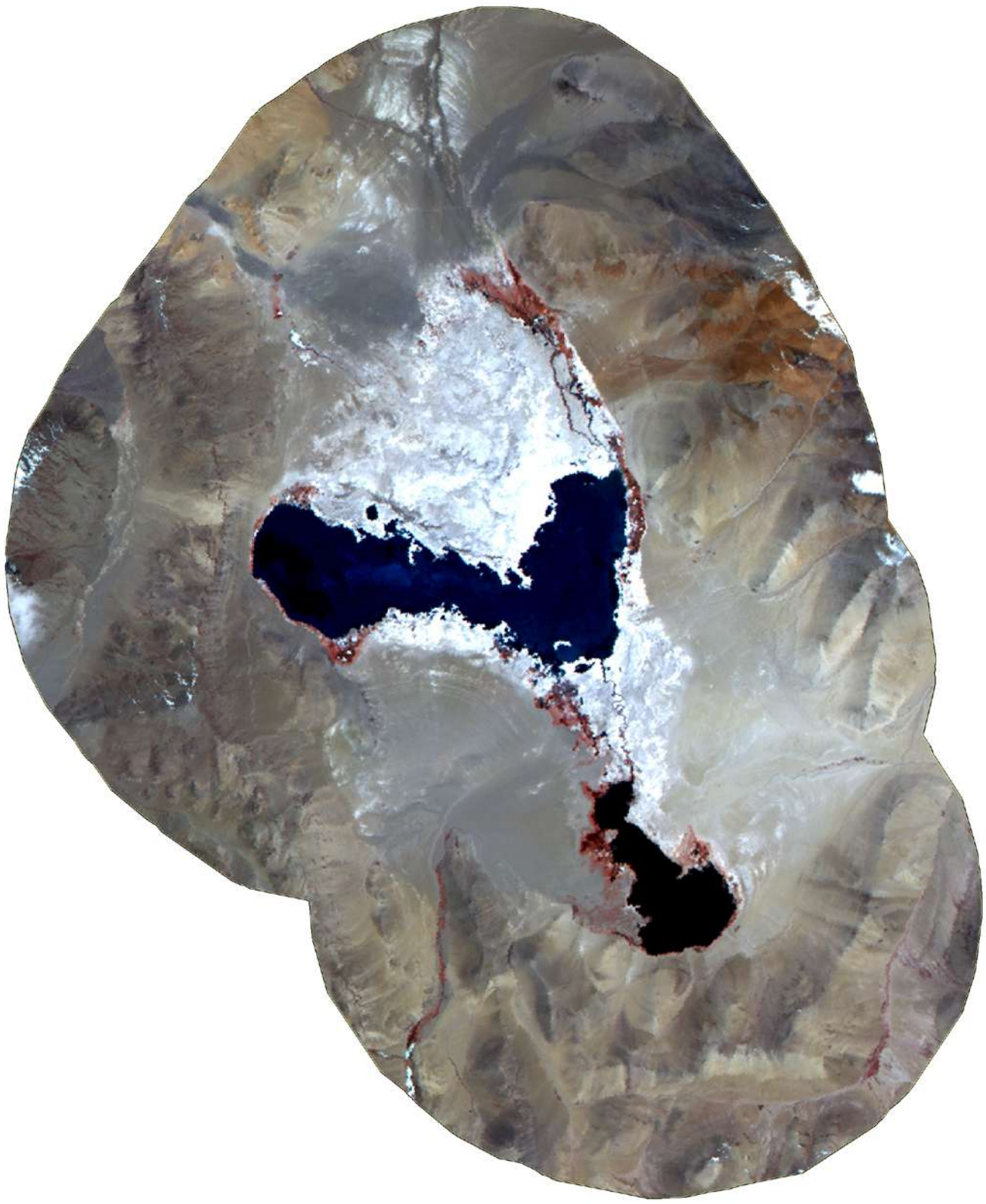
Sponsored By:

Ministry of Environment and Forests
Government of India

Plate 19: Wetland map - 5 km buffer area of Tso Kar

State : Jammu and Kashmir

Tso_Kar



IRS P6 LISS-III Pre-monsoon 2007 data

Plate 20: IRS LISS III FCC - 5 km buffer area of Tso Kar

9.7 Tso Morari

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

Post-Monsoon 2007

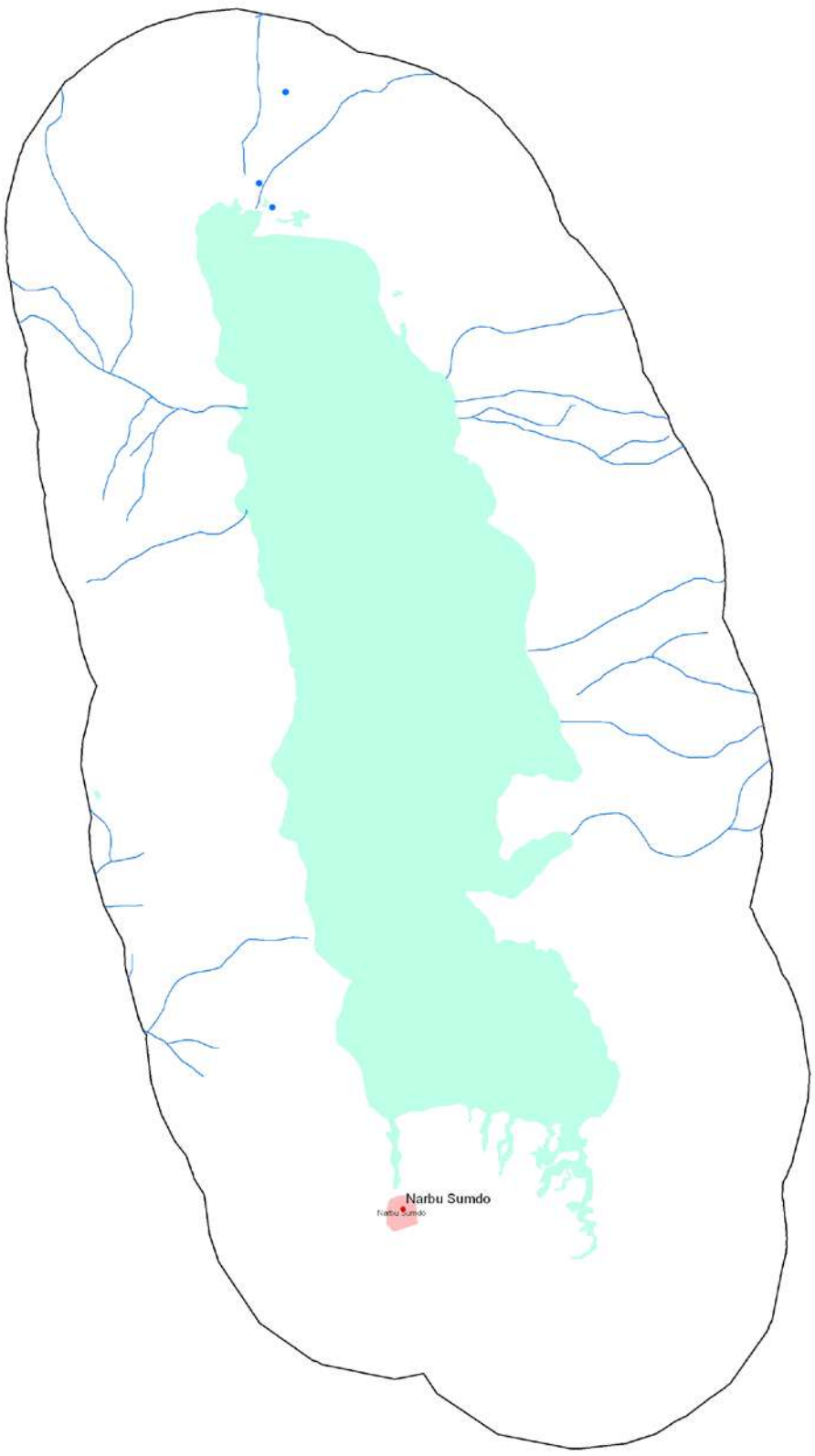
Pre-Monsoon 2007

Plate 21: Tso Morari

State : Jammu and Kashmir

WETLAND MAP

Tso_Morari

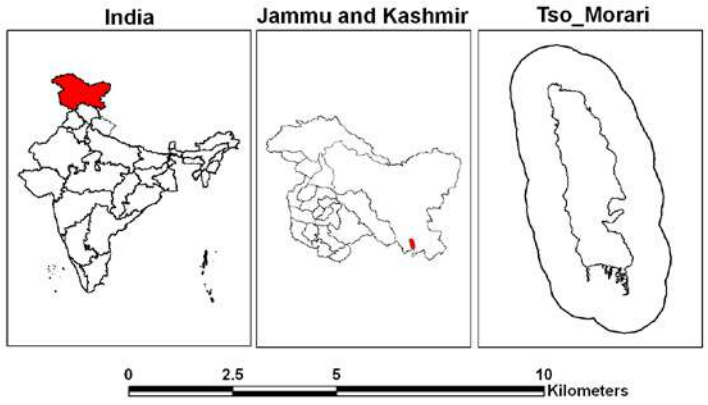


Symbol Typecode	Level I	Level II	Level III
	Inland Wetlands		
		Natural	
1101			Lakes/Ponds
1102			Ox-bow lakes/ Cut-off meanders
1103			High altitude wetlands
1104			Reverine wetlands
1105			Waterlogged
1106			River/Stream
		Man-made	
1201			Reservoirs/Barrages
1202			Tanks/Ponds
1203			Waterlogged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

Legend

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

Location Map



Data Source :

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

Prepared By :

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

Sponsored By:

Ministry of Environment and Forests
Government of India

Plate 22: Wetland map - 5 km buffer area of Tso Morari

State : Jammu and Kashmir

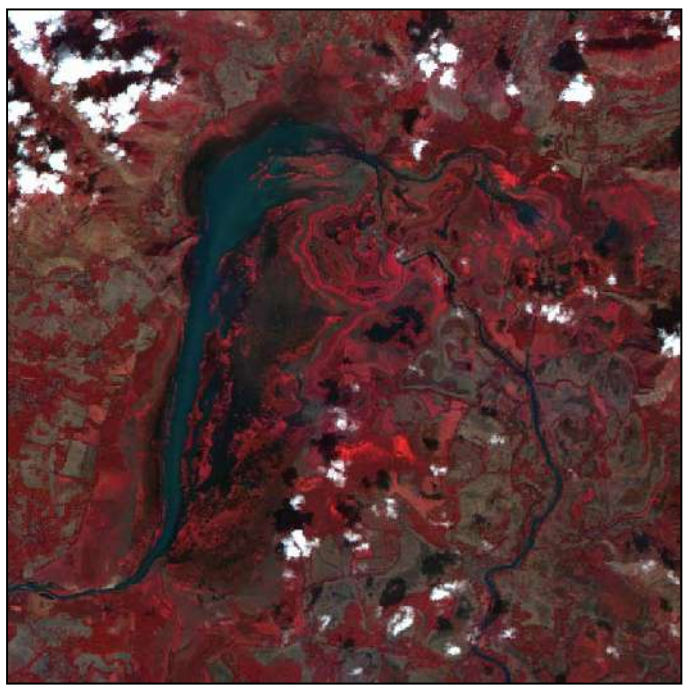
Tso_Morari

IRS P6 LISS-III pre-monsoon 2007 data

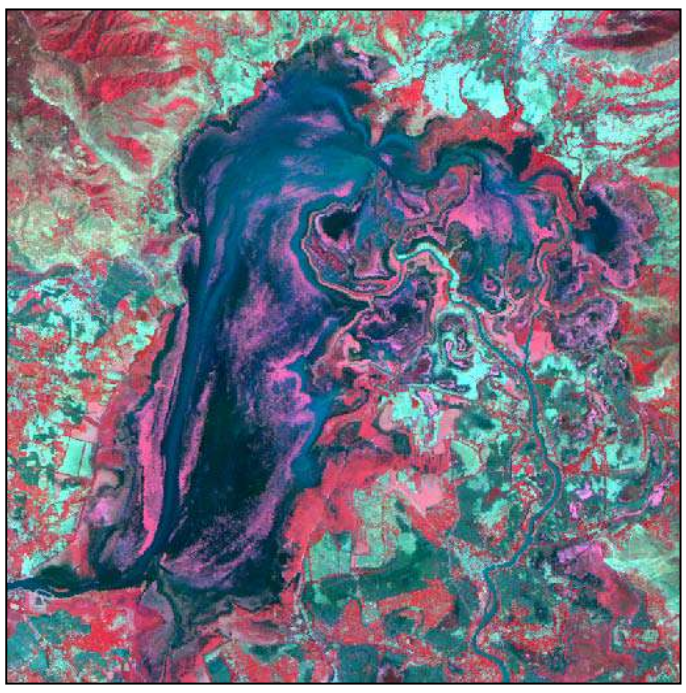
Plate 23: IRS LISS III FCC - 5 km buffer area of Tso Morari

9.8 Wular Lake

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



Post-Monsoon 2007



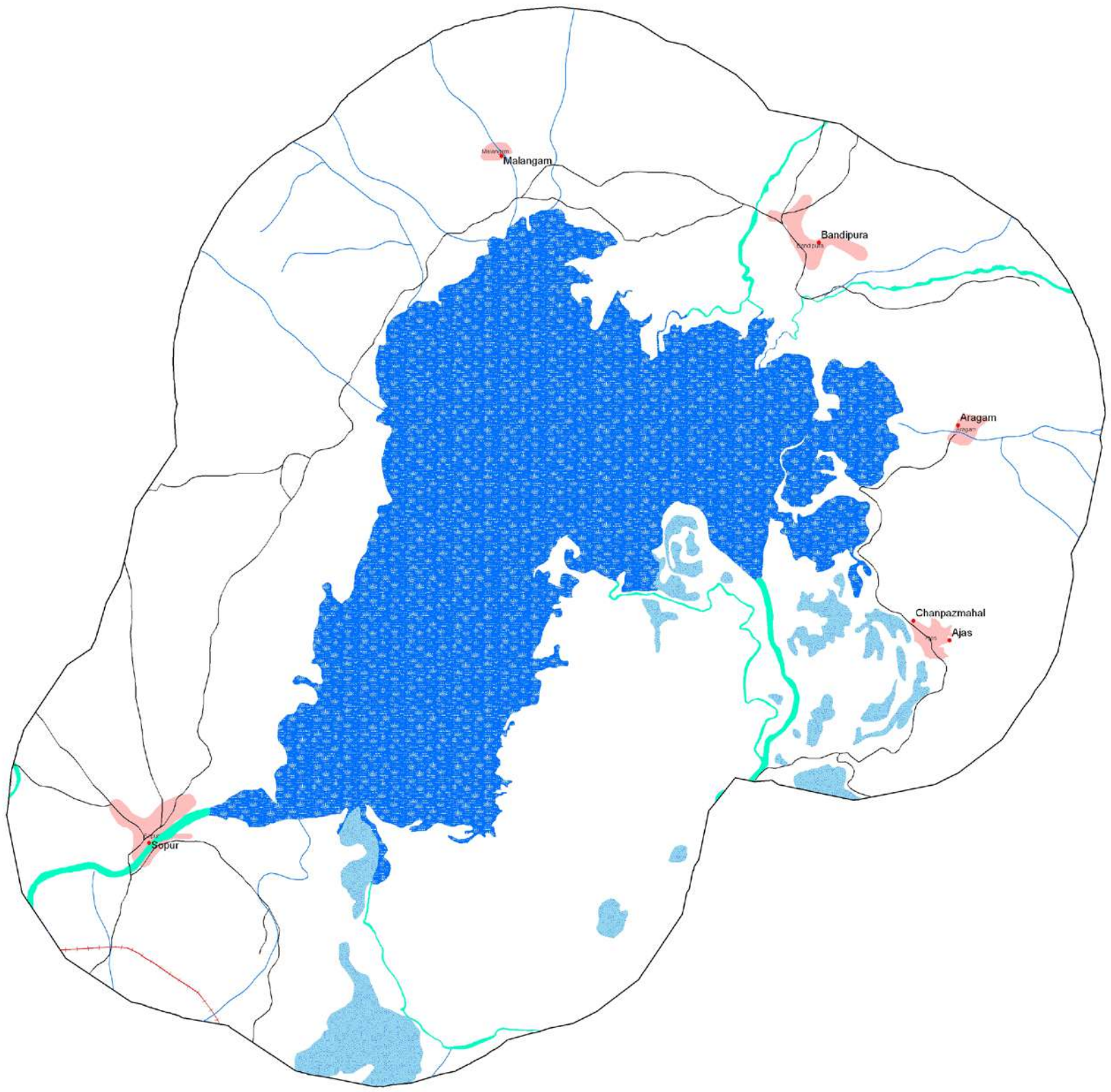
Pre-Monsoon 2007

Plate 24: Wular Lake

State : Jammu and Kashmir

WETLAND MAP

Wular_Lake

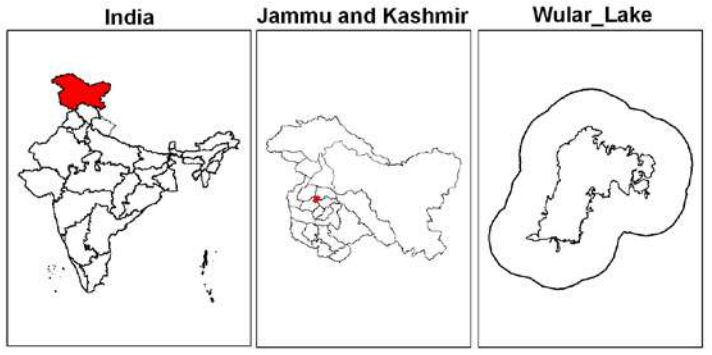


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



Data Source :

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

Prepared By :

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

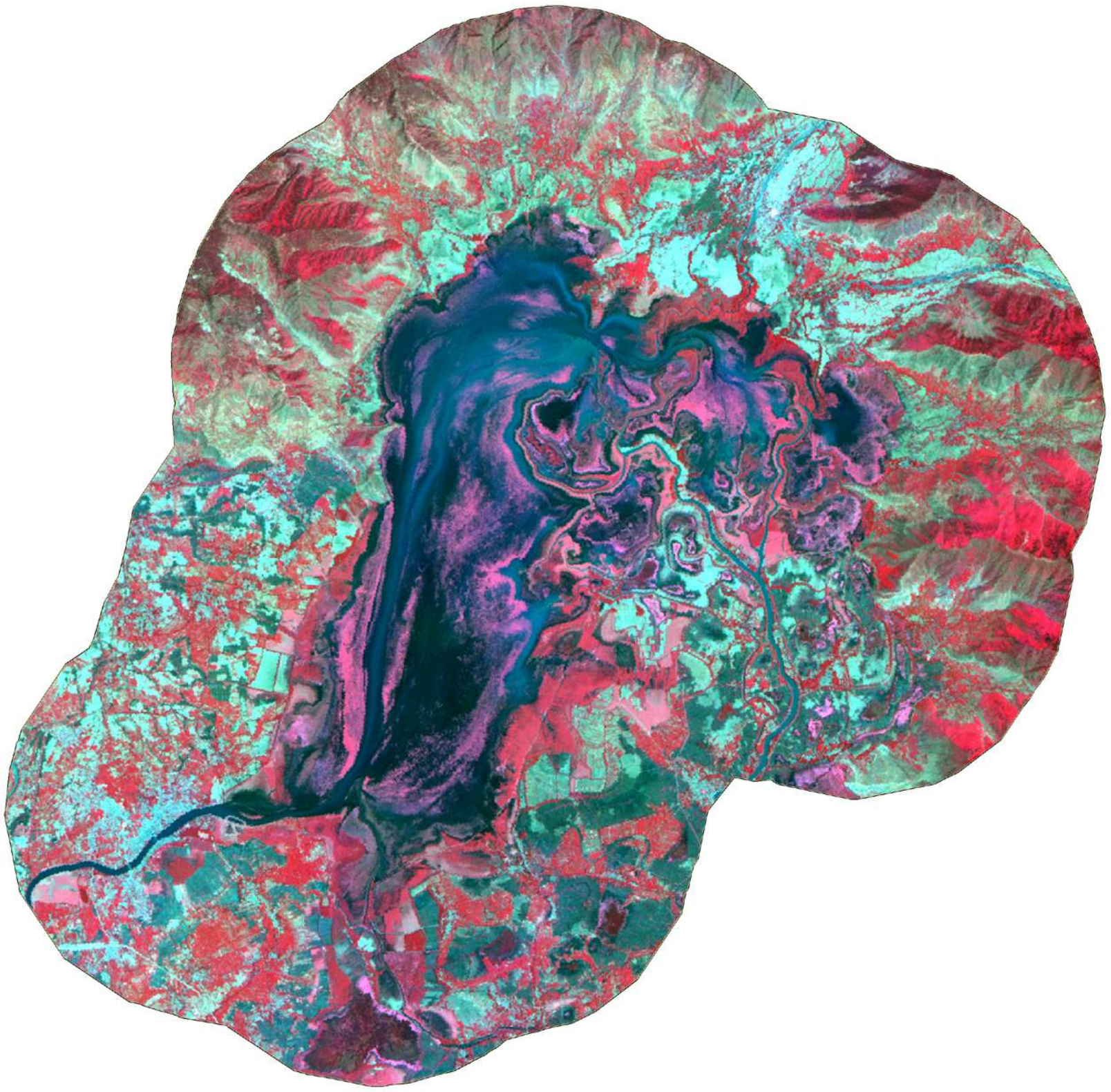
Sponsored By:

Ministry of Environment and Forests
Government of India

Plate 25: Wetland map - 5 km buffer area of Wular Lake

State : Jammu and Kashmir

Wular_Lake



IRS P6 LISS-III Pre-monsoon 2007 data

Plate 26: IRS LISS III FCC - 5 km buffer area of Wular Lake

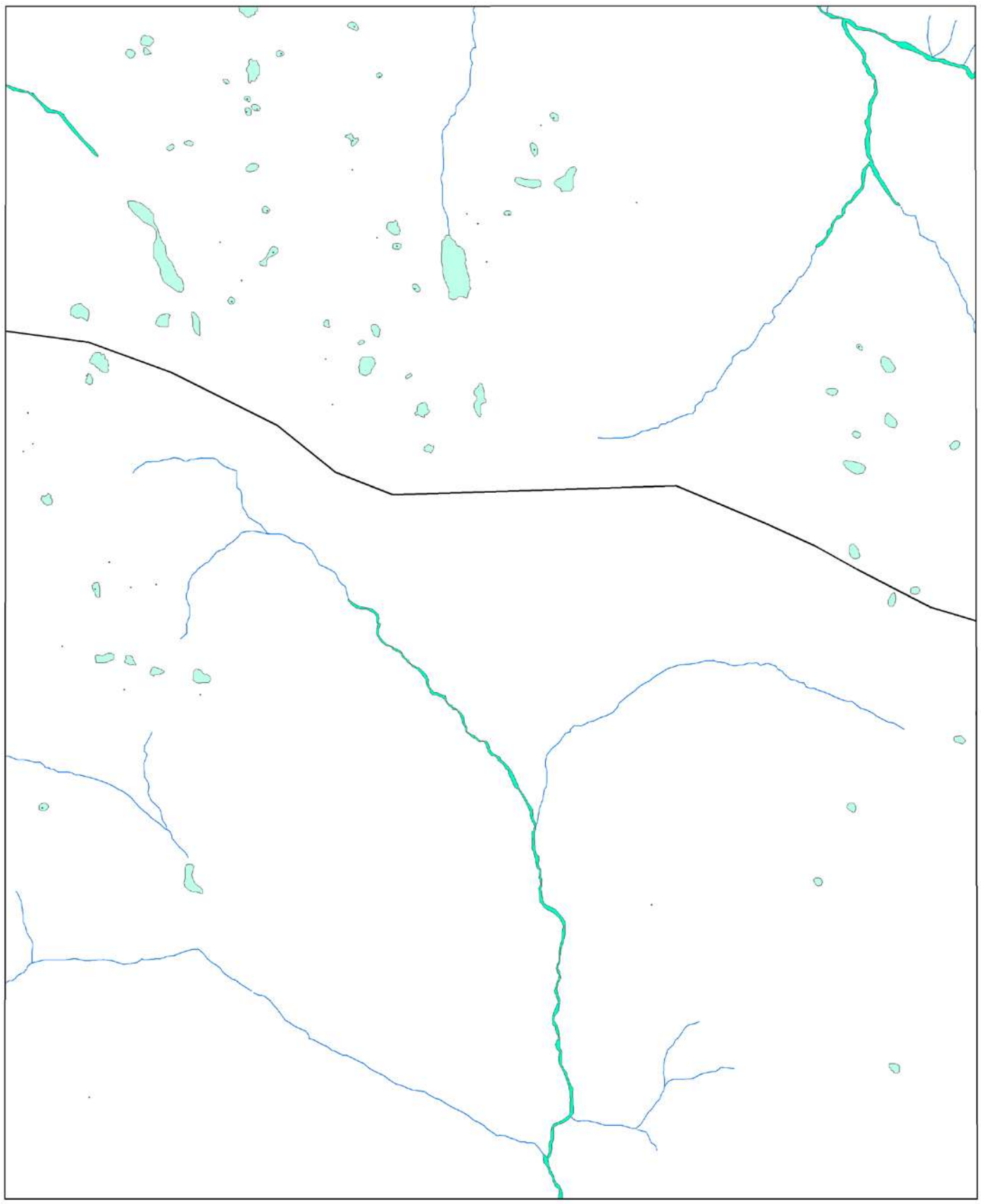
SOI MAP-SHEET WISE WETLAND MAPS

(Selected)

State : Jammu and Kashmir

WETLAND MAP

Map No. : 43 E/05



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
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	1105			Waterlogged
	1106			River/Stream
			Man-made	
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	1203			Waterlogged
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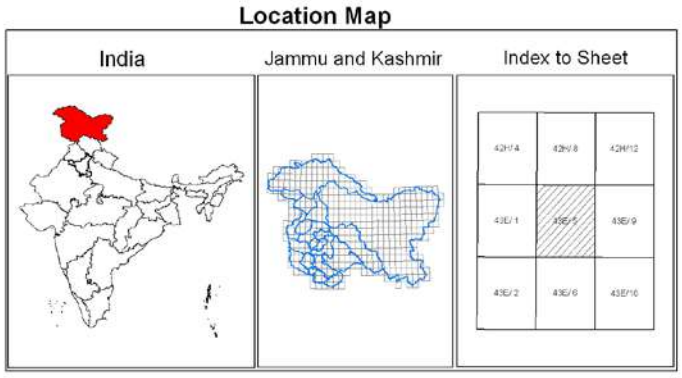
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

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

Location Map



0 1 2 4 6 Kilometers

Data Source :

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

Prepared By :

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

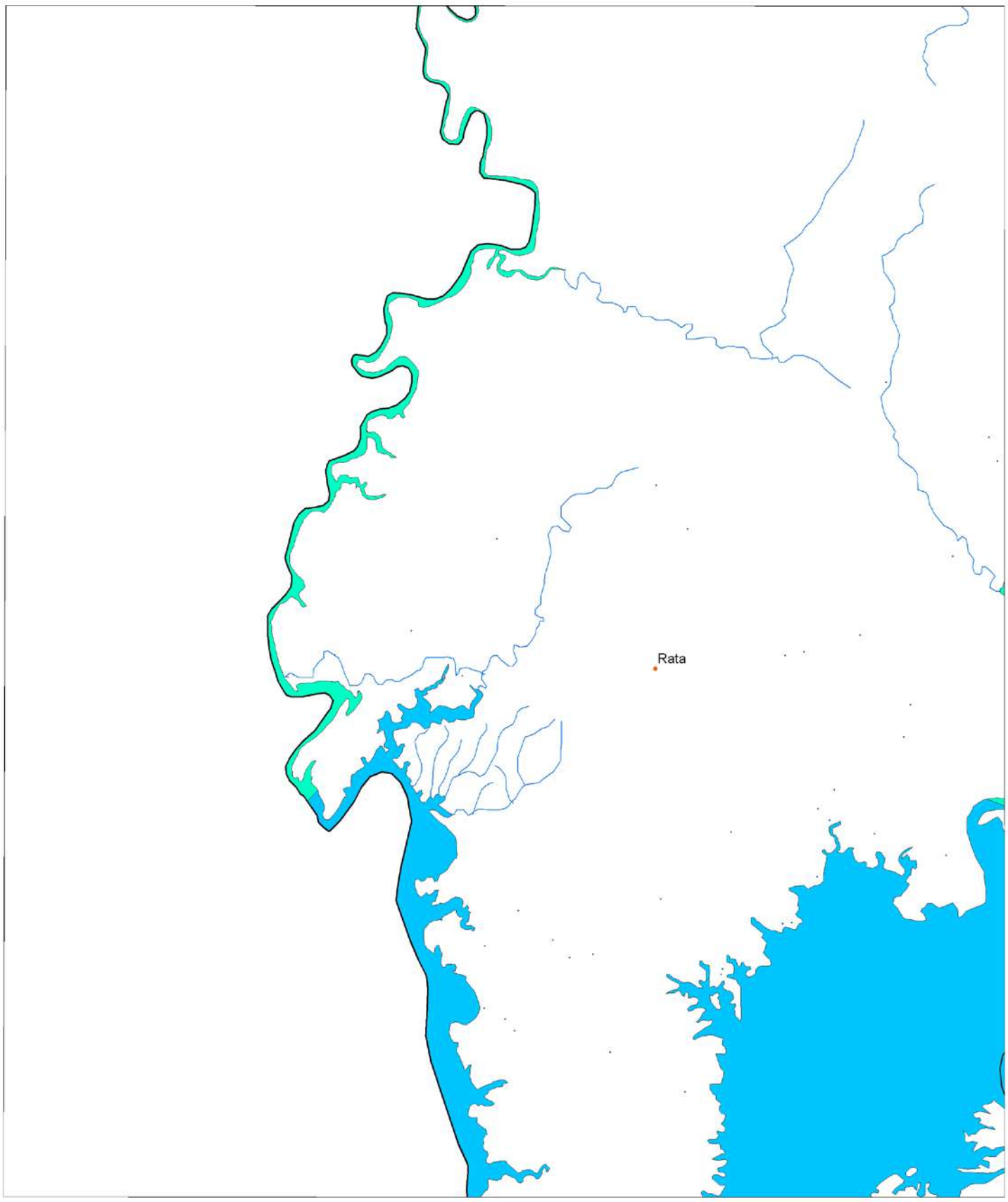
Sponsored By :

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

WETLAND MAP

Map No. : 43 G/11



Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
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			Man-made	
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			Natural	
	2101			Lagoons
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	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

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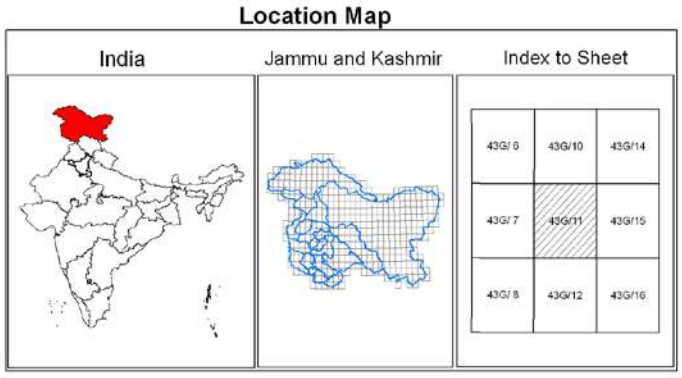
- District Boundary
- State Boundary
- International Boundary

Location Map



Data Source :

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

Prepared By :

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

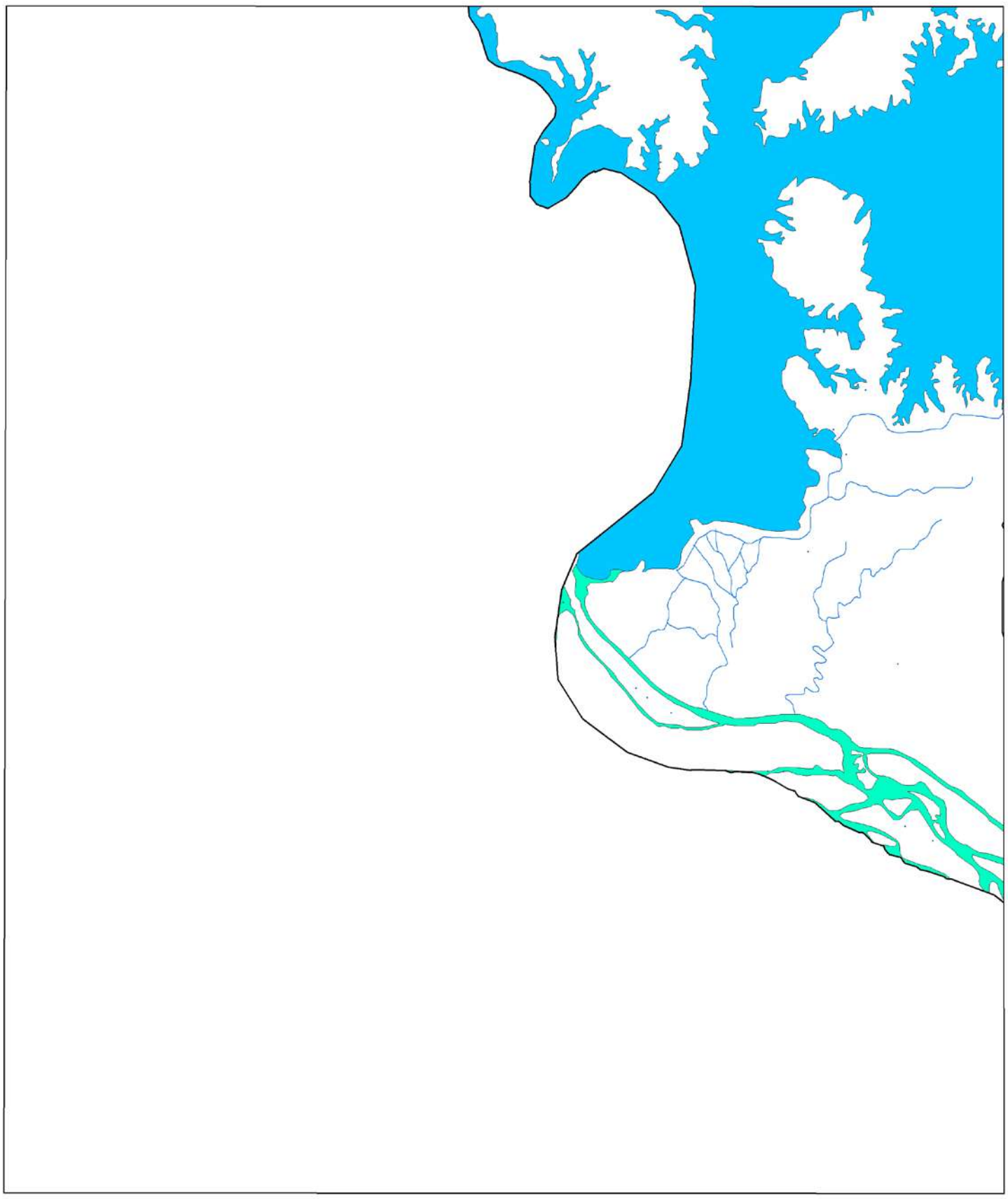
Sponsored By :

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

WETLAND MAP

Map No. : 43 G/12



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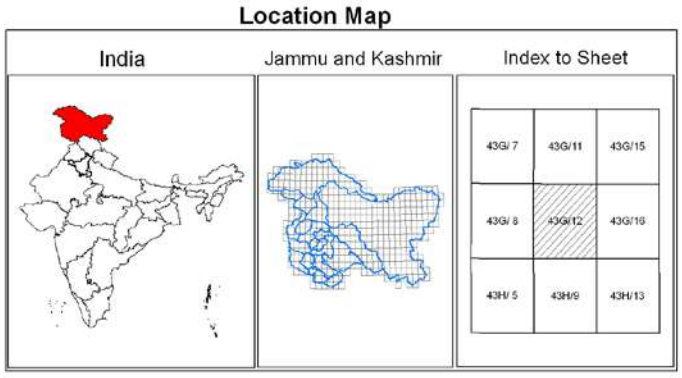
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

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

Location Map



Data Source :

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

Prepared By :

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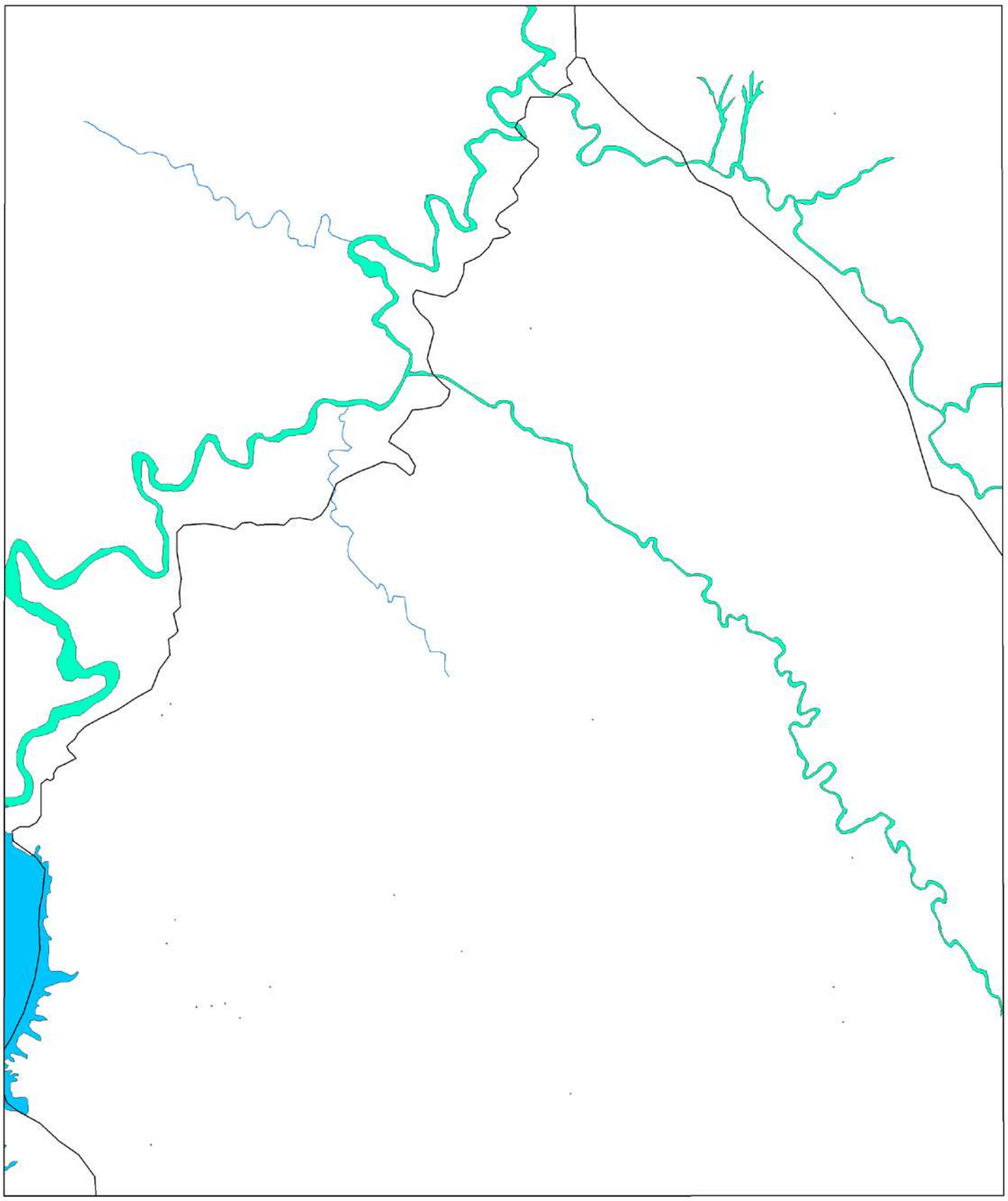
Government of India

State : Jammu and Kashmir

WETLAND MAP

Map No. : 43 G/15

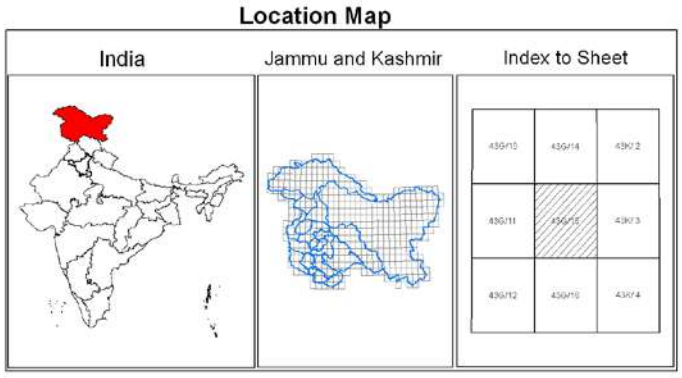


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 1 2 4 6 Kilometers

Data Source :

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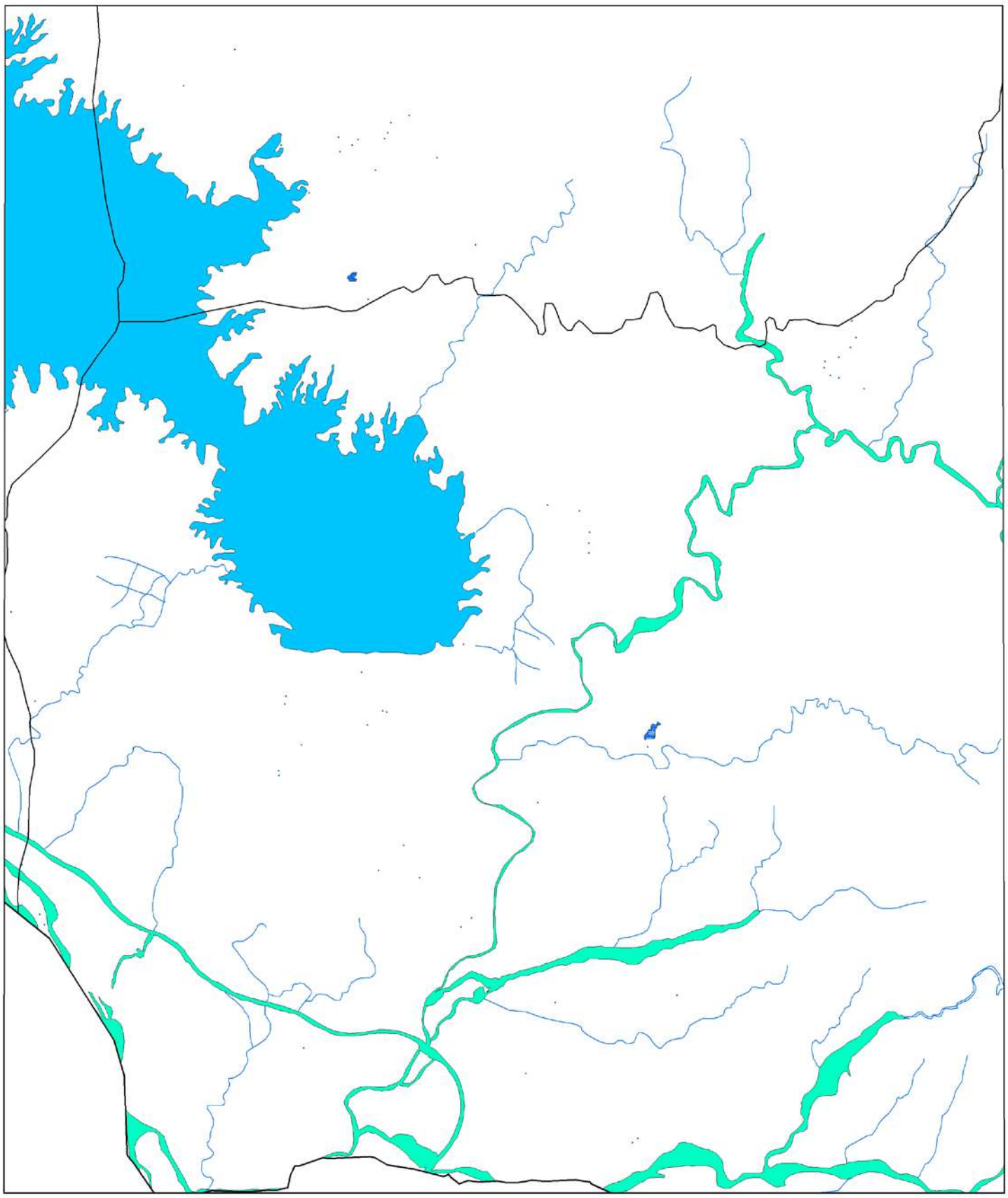
Government of India

State : Jammu and Kashmir

WETLAND MAP

Map No. : 43 G/16

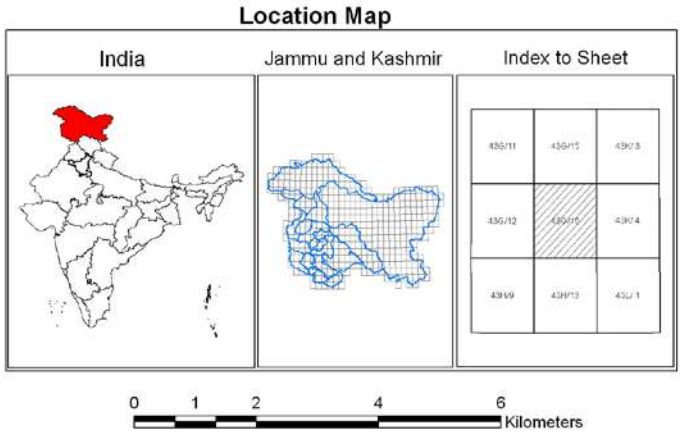


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



Data Source :

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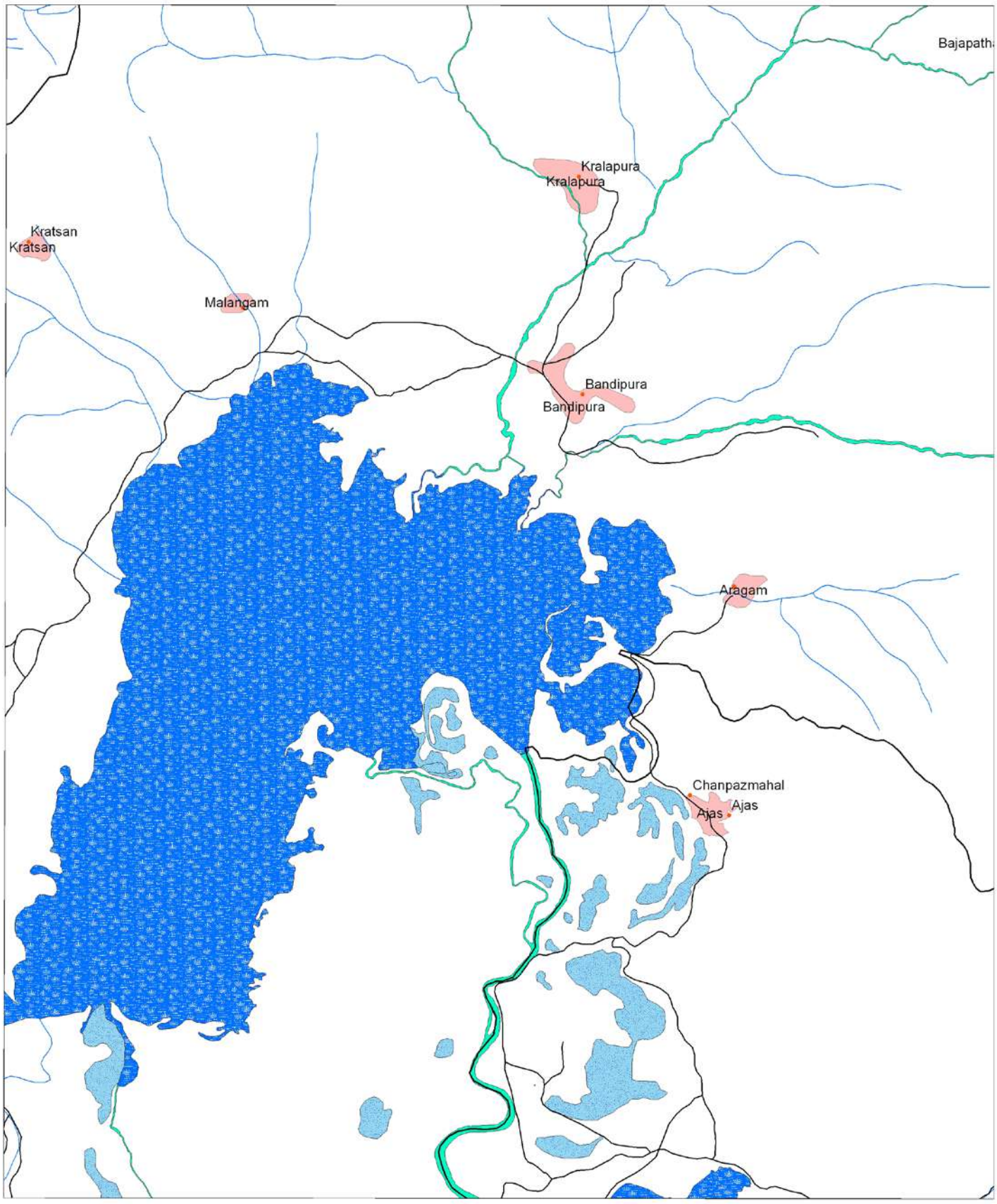
WETLAND MAP

Map No. : 43 J/11

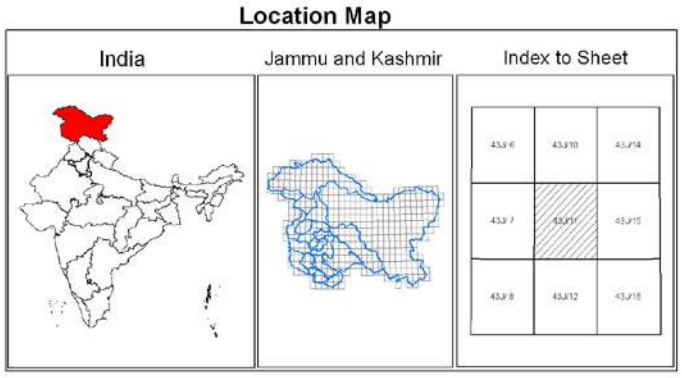


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



Data Source :

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

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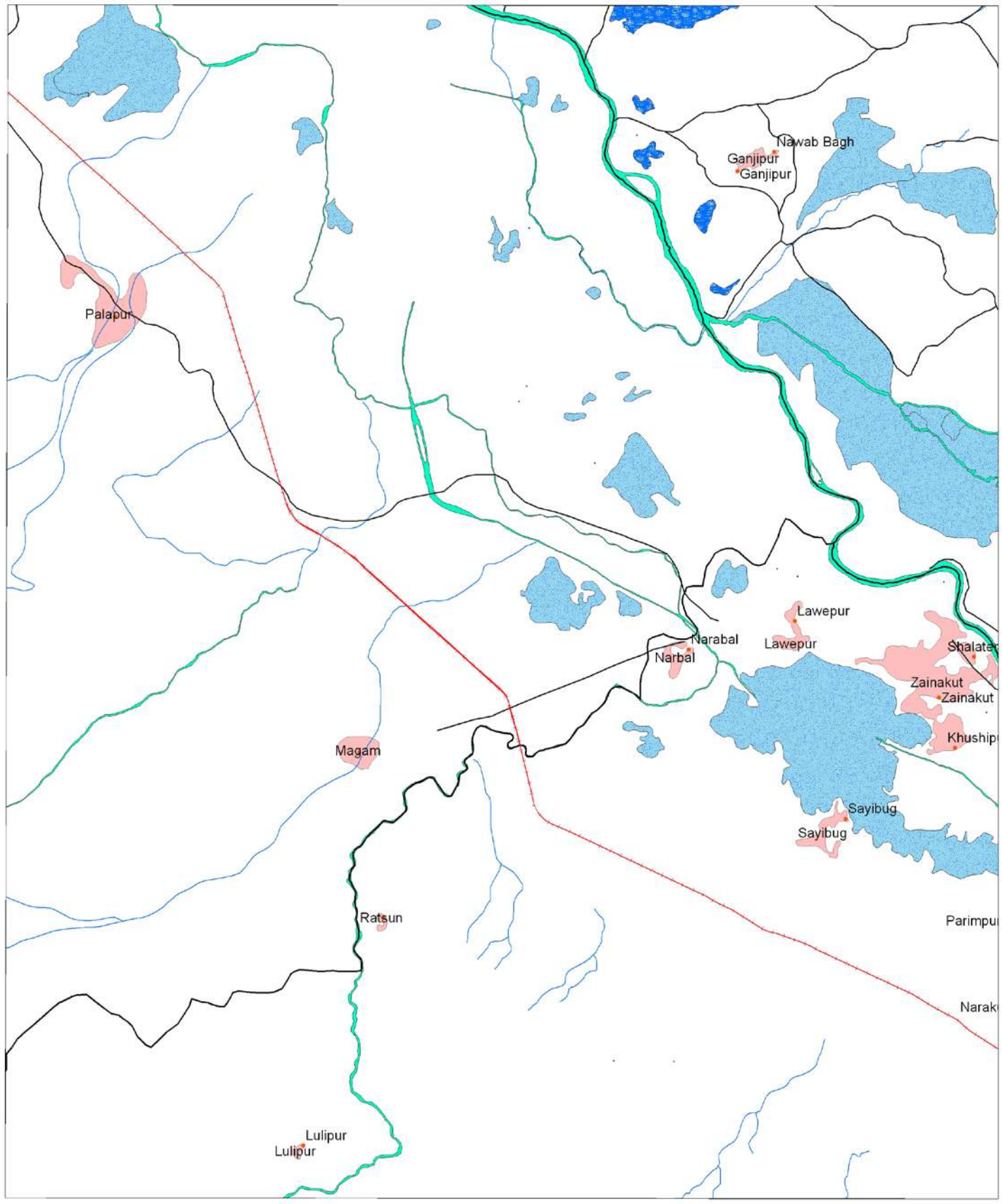
Government of India

State : Jammu and Kashmir

WETLAND MAP

Map No. : 43 J/12

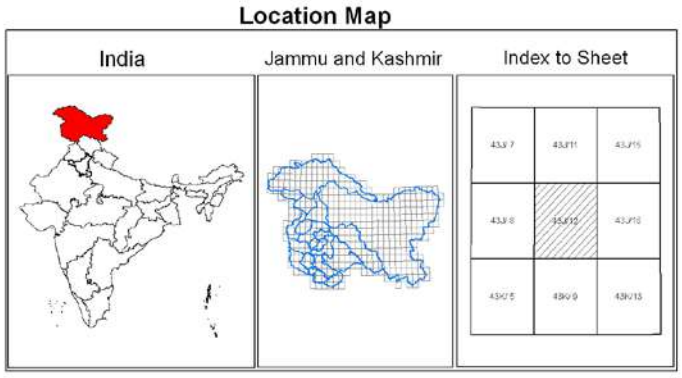


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



Data Source :

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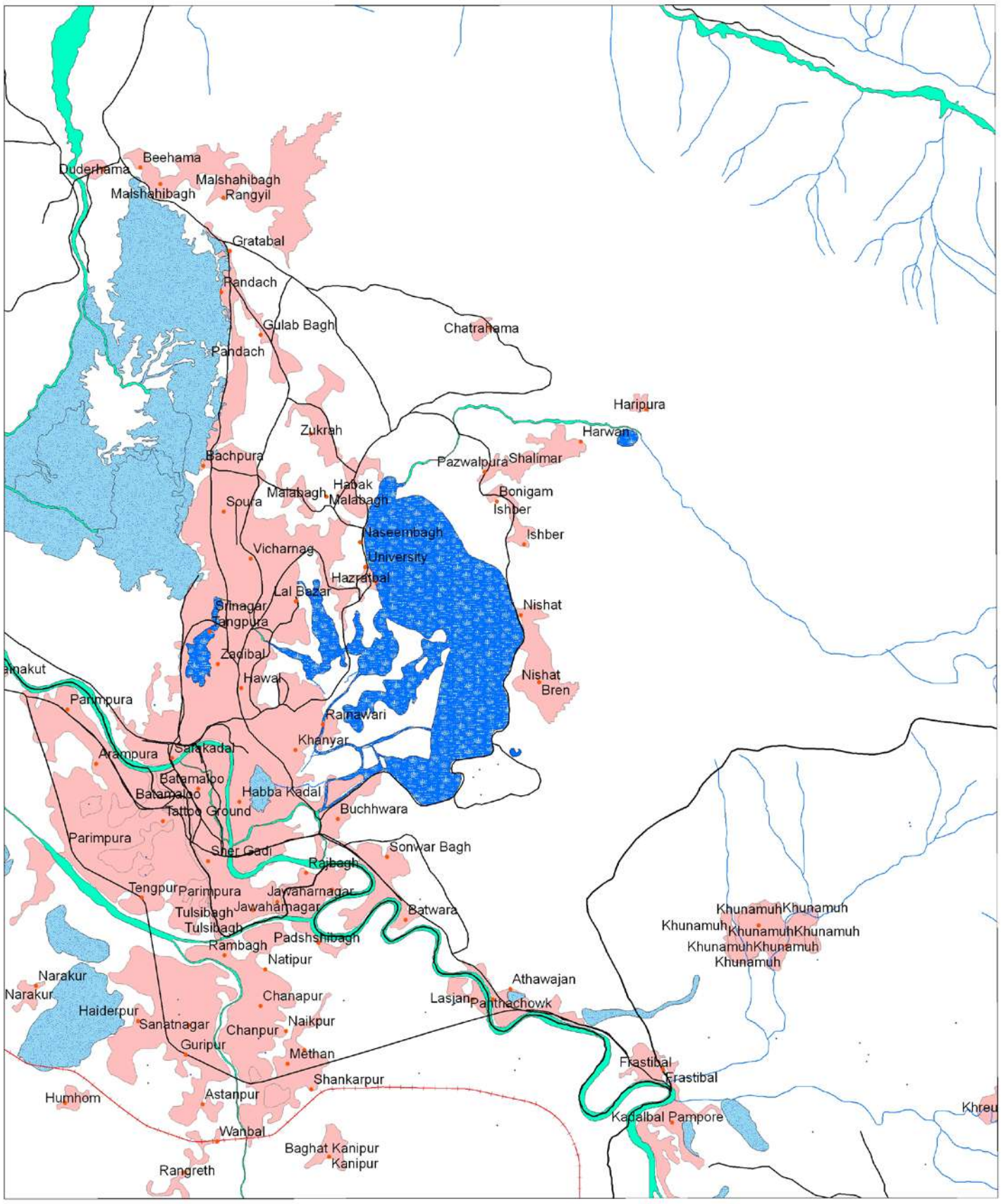
State : Jammu and Kashmir

WETLAND MAP

Map No. : 43 J/16



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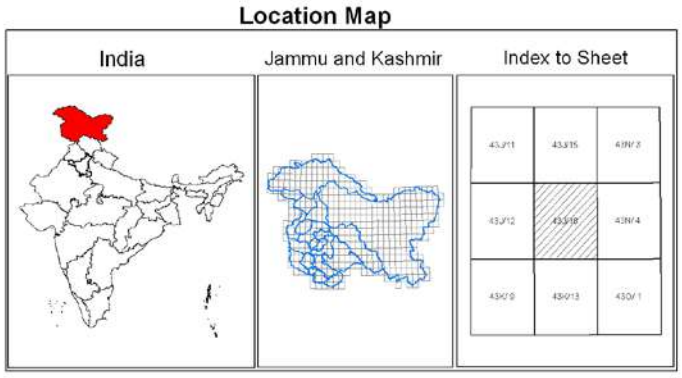
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

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

Location Map



Data Source :

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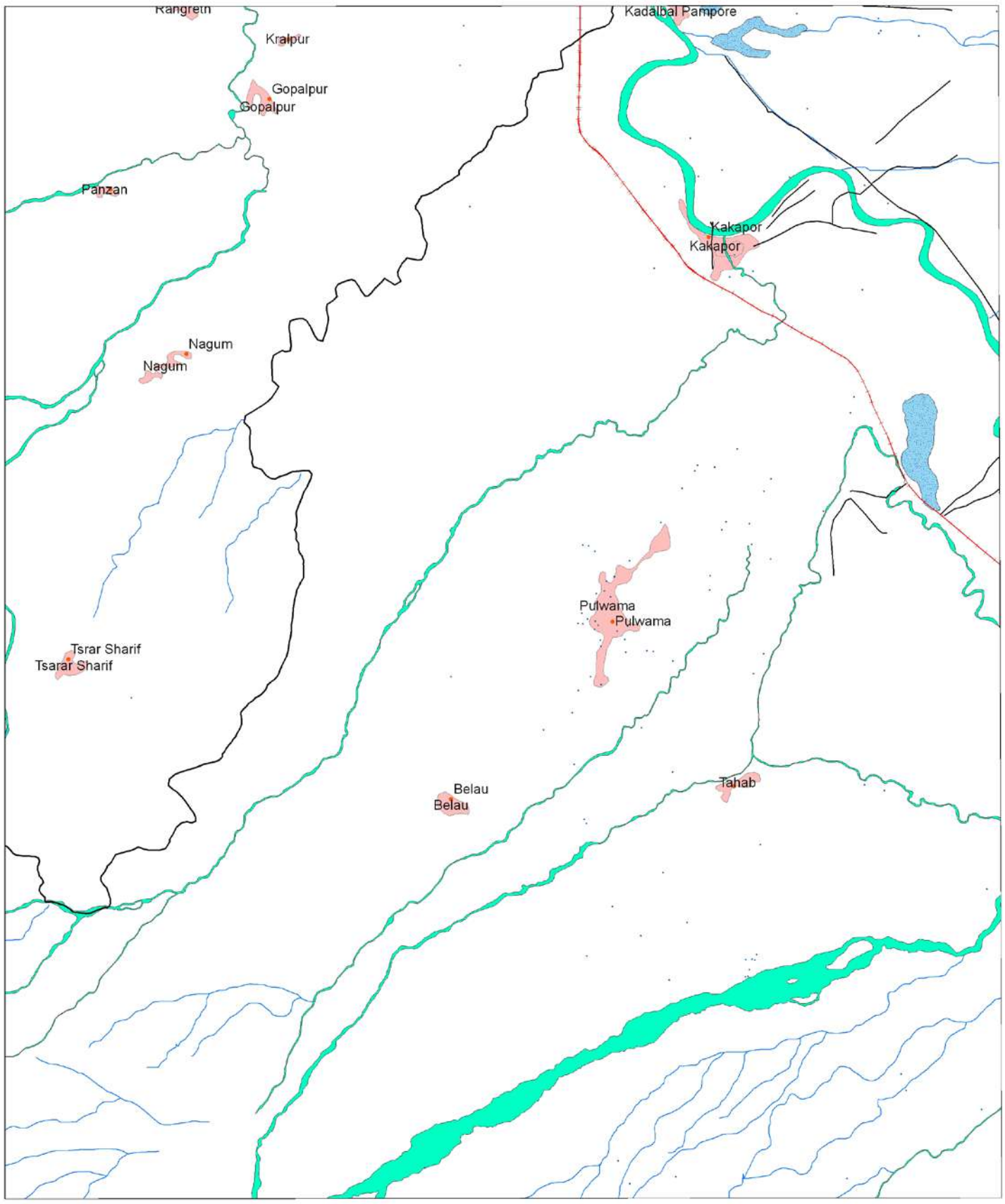
State : Jammu and Kashmir

WETLAND MAP

Map No. : 43 K/ 13



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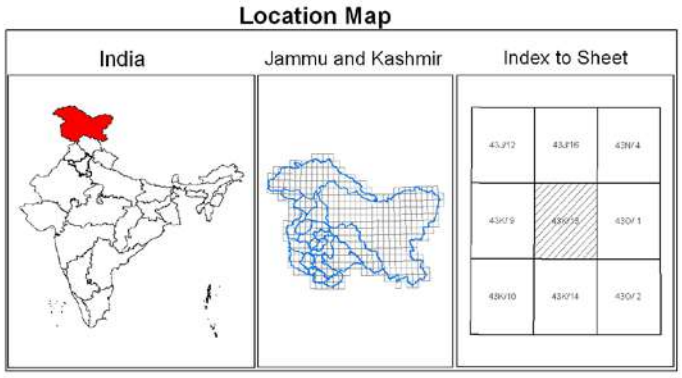
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

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

Location Map



Data Source :

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Prepared By :

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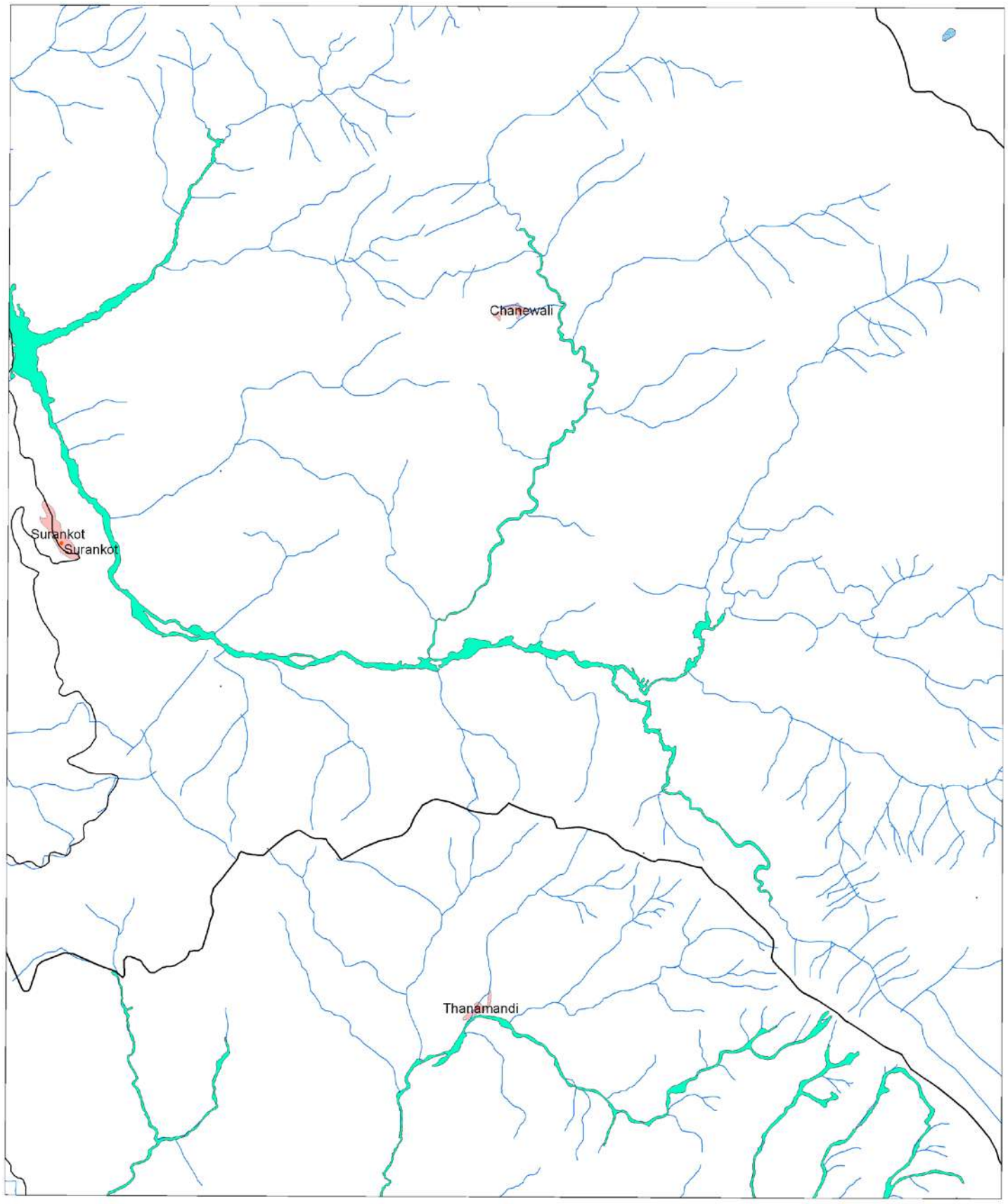
Government of India

State : Jammu and Kashmir

WETLAND MAP

Map No. : 43 K/ 16



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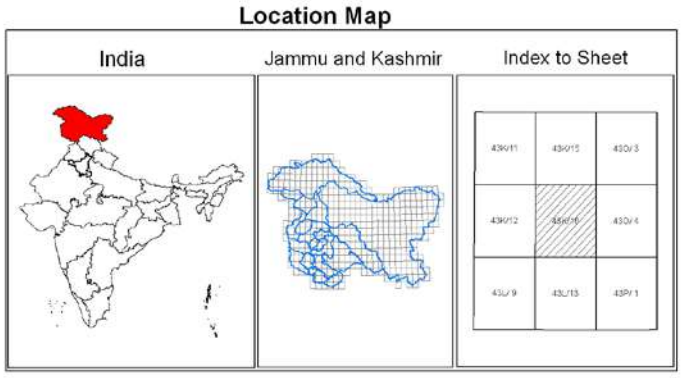
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

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

Location Map



Data Source :

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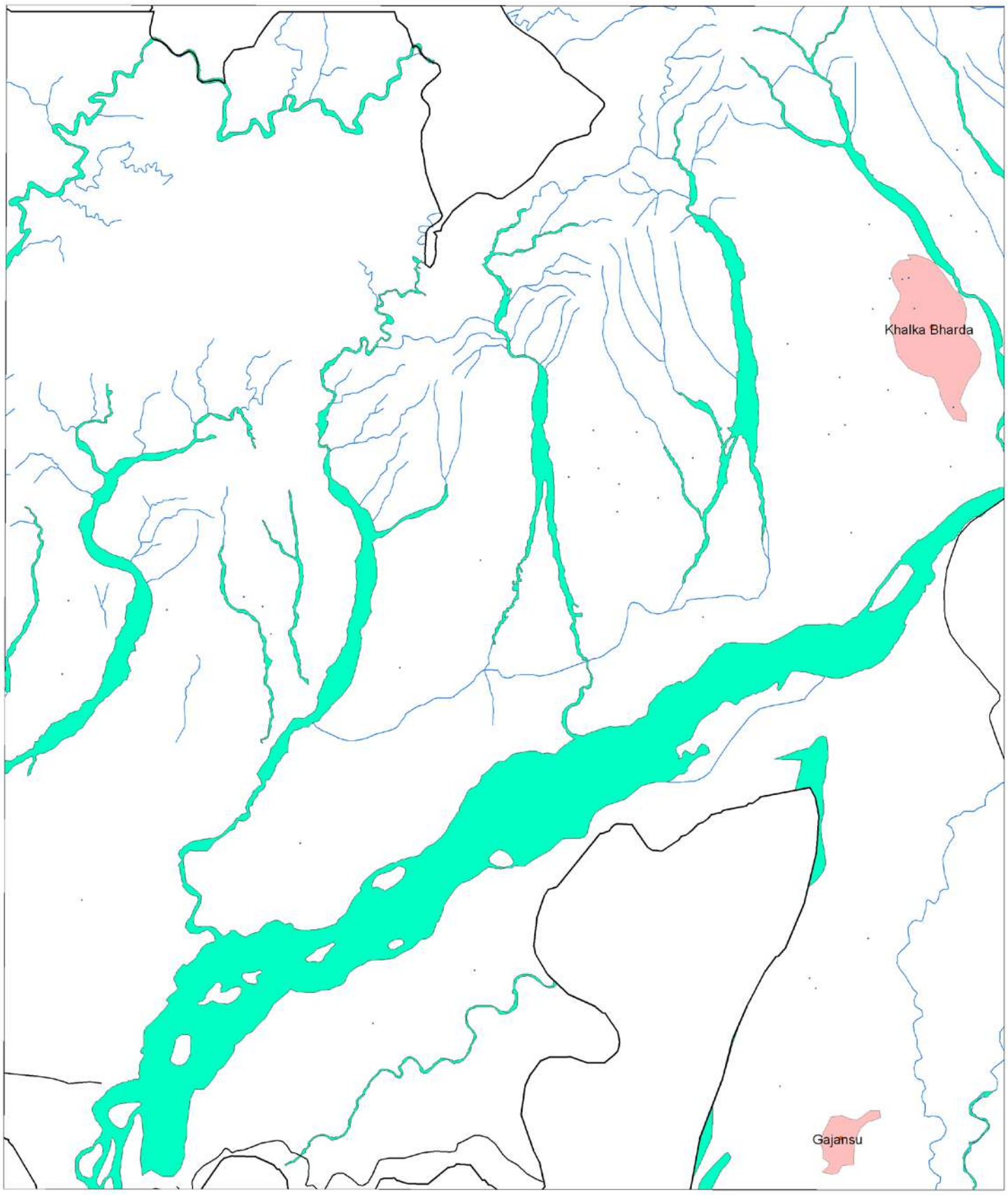
State : Jammu and Kashmir

WETLAND MAP

Map No. : 43 L/ 09



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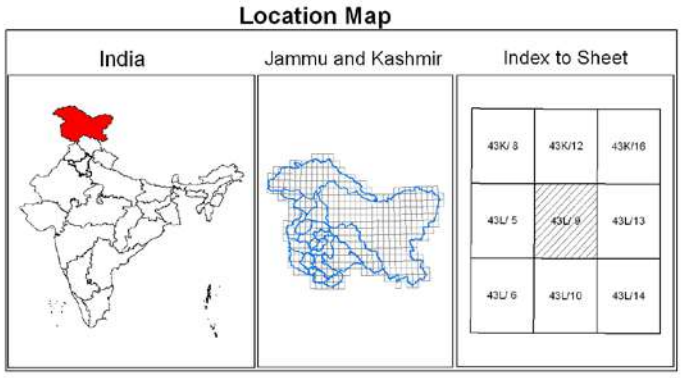
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

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

Location Map



Data Source :

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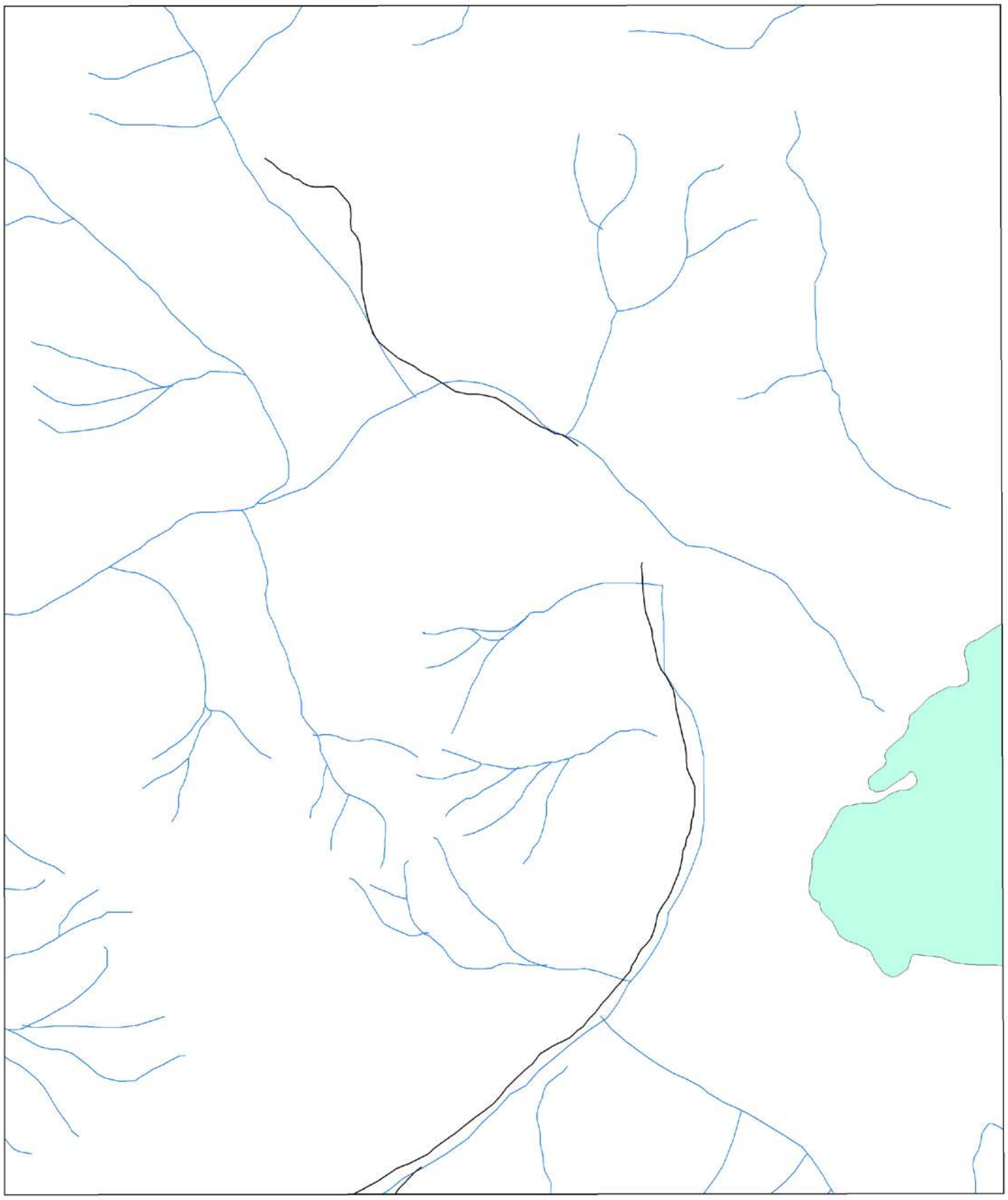
Government of India

State : Jammu and Kashmir

WETLAND MAP

Map No. : 52 G/ 15



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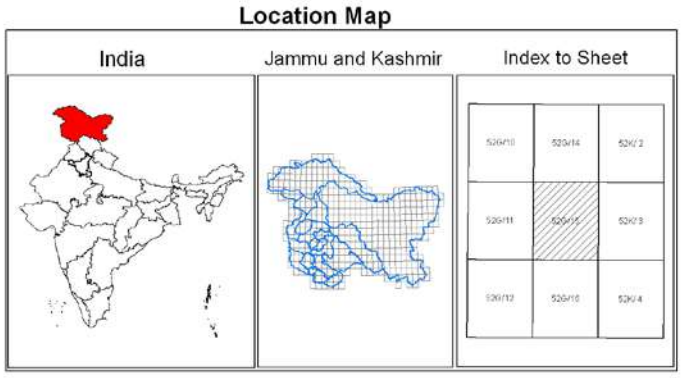
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

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

Location Map



0 1 2 4 6 Kilometers

Data Source :

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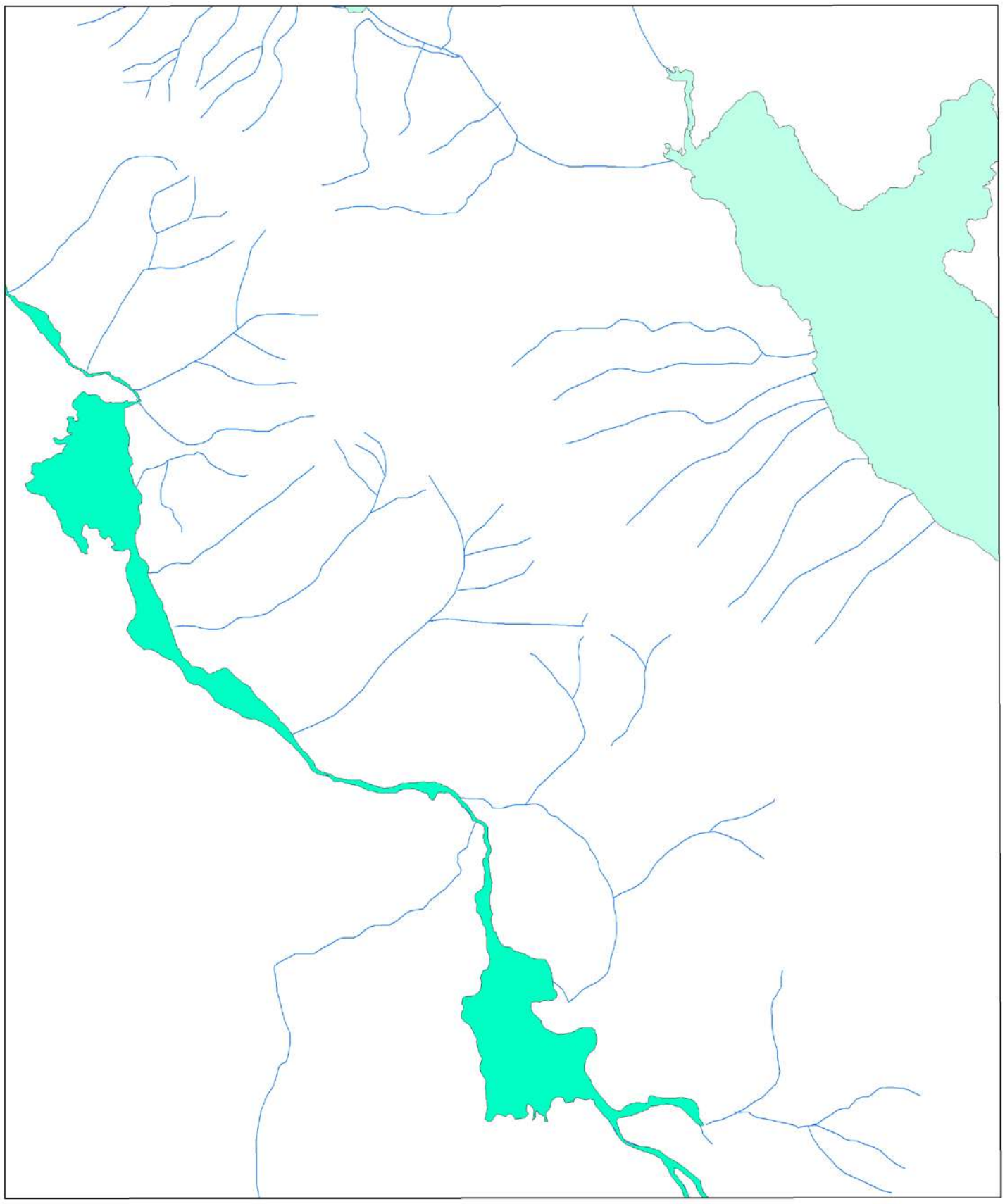
State : Jammu and Kashmir

WETLAND MAP

Map No. : 52 K/ 05



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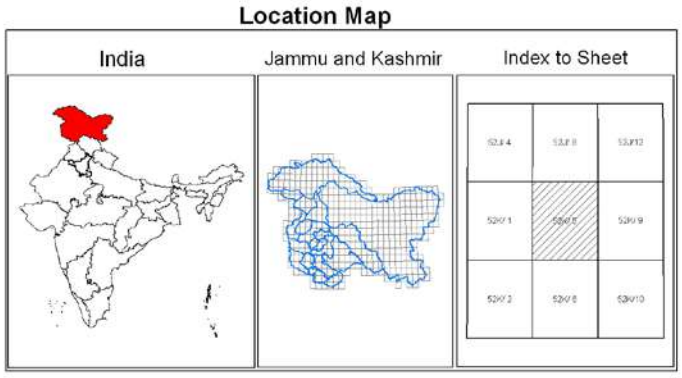
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

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

Location Map



0 1 2 4 6 Kilometers

Data Source :

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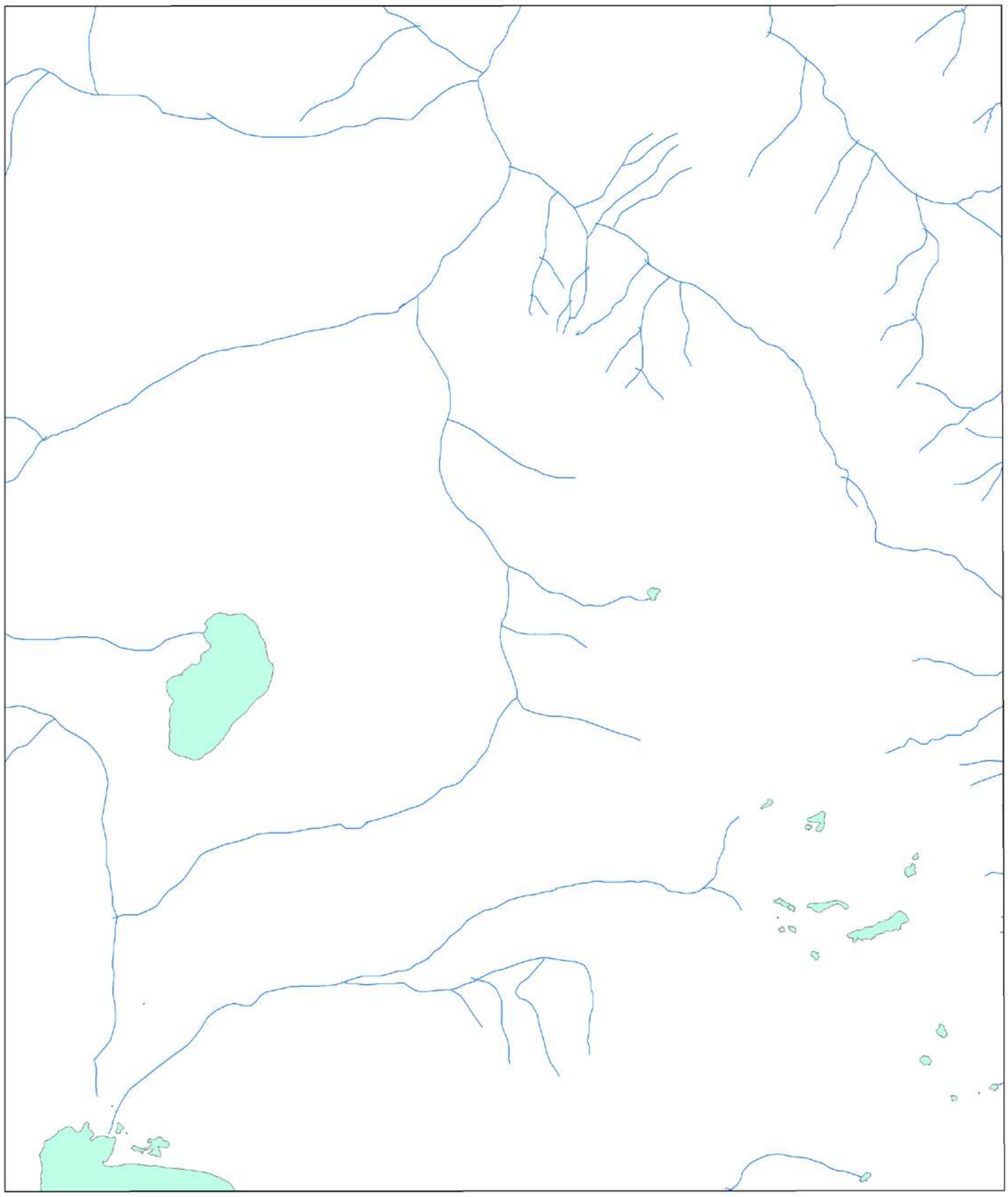
State : Jammu and Kashmir

WETLAND MAP

Map No. : 52 K/ 08



Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
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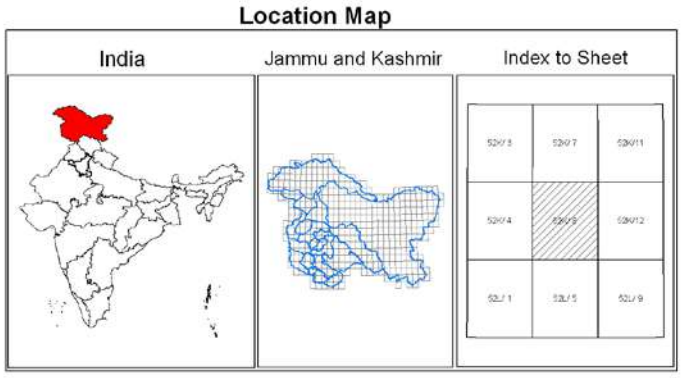
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

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

Location Map



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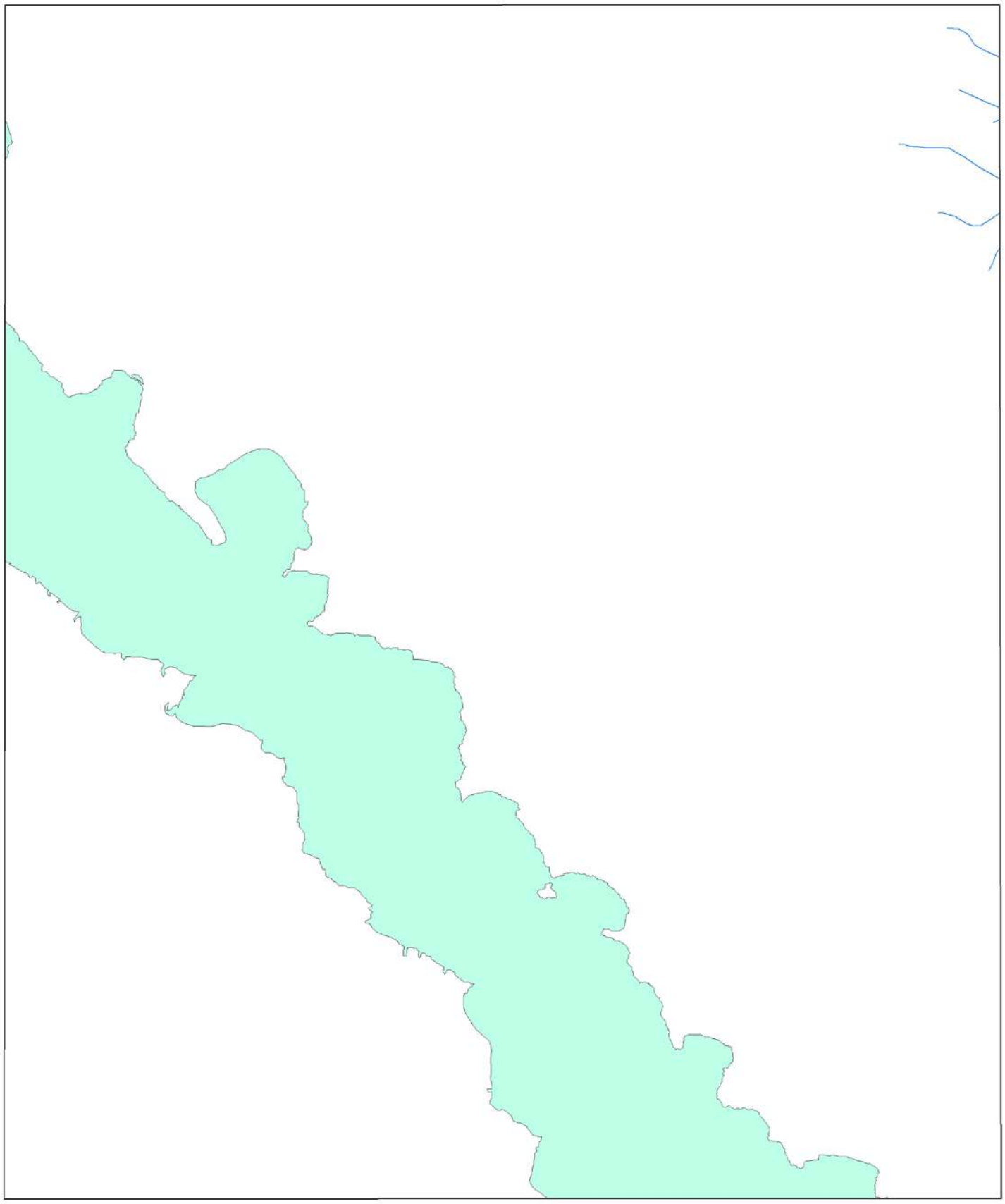
Government of India

State : Jammu and Kashmir

WETLAND MAP

Map No. : 52 K/ 09

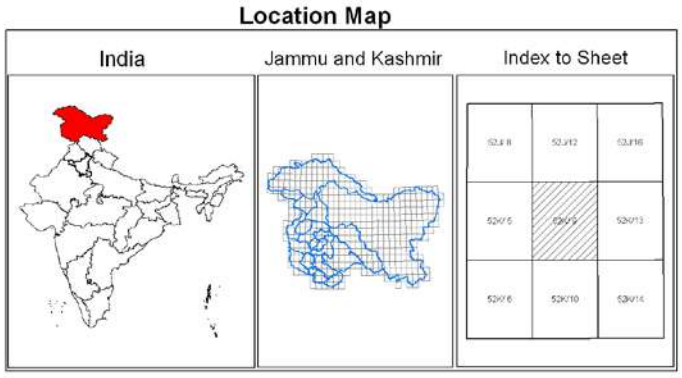


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



0 1 2 4 6 Kilometers

Data Source :

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

Prepared By :

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

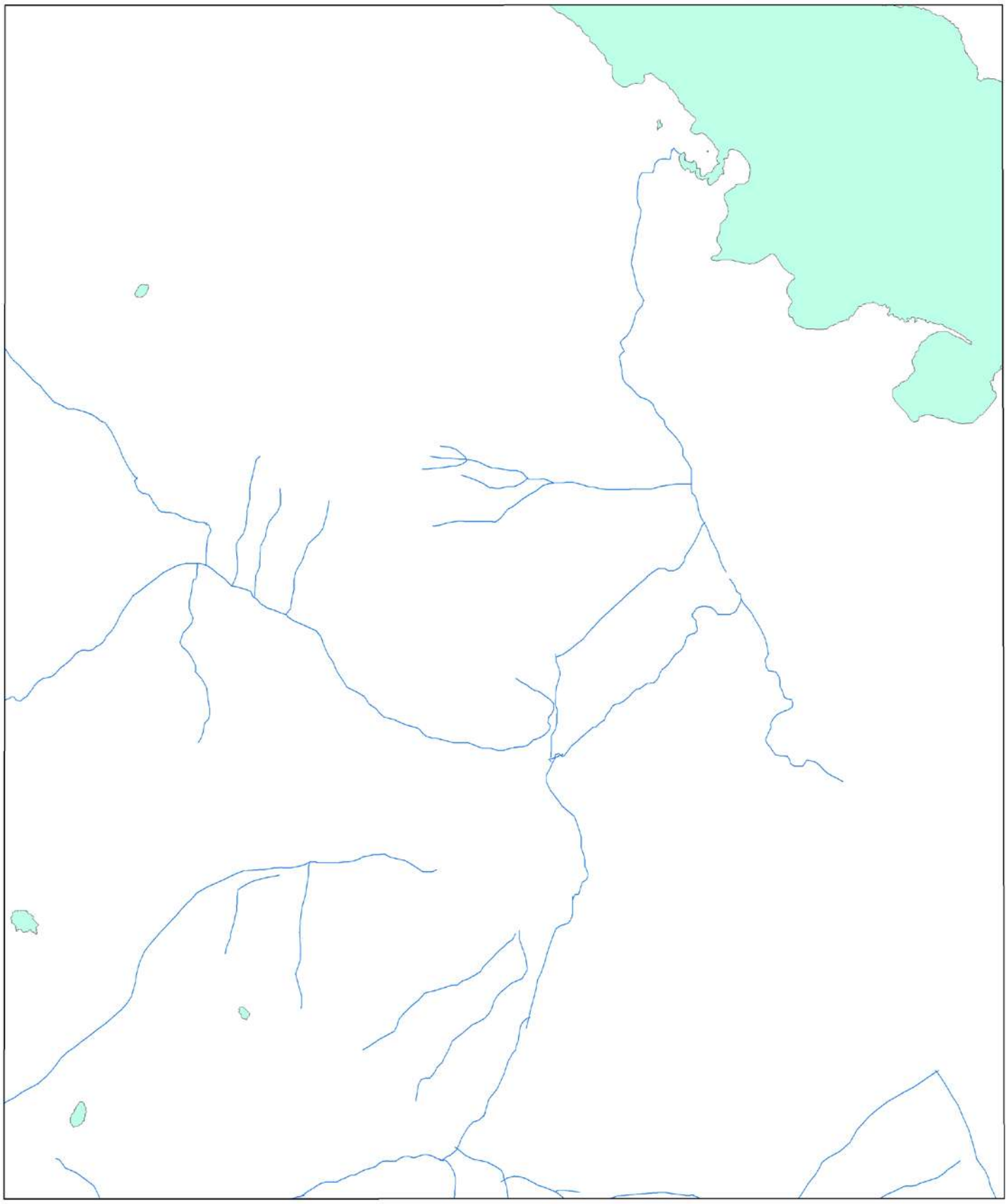
Sponsored By :

Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

WETLAND MAP

Map No. : 52 K/ 10



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

Legend

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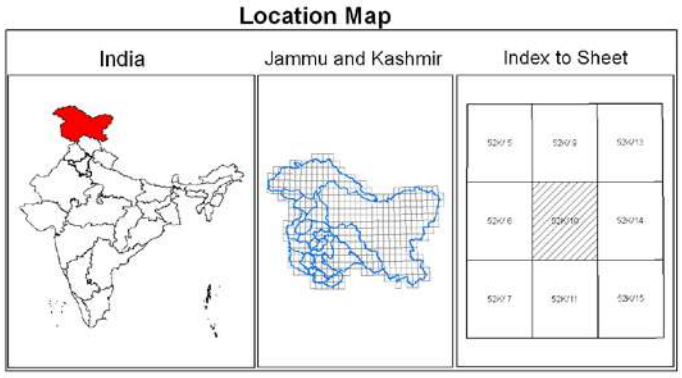
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map



0 1 2 4 6 Kilometers

Data Source :

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

Prepared By :

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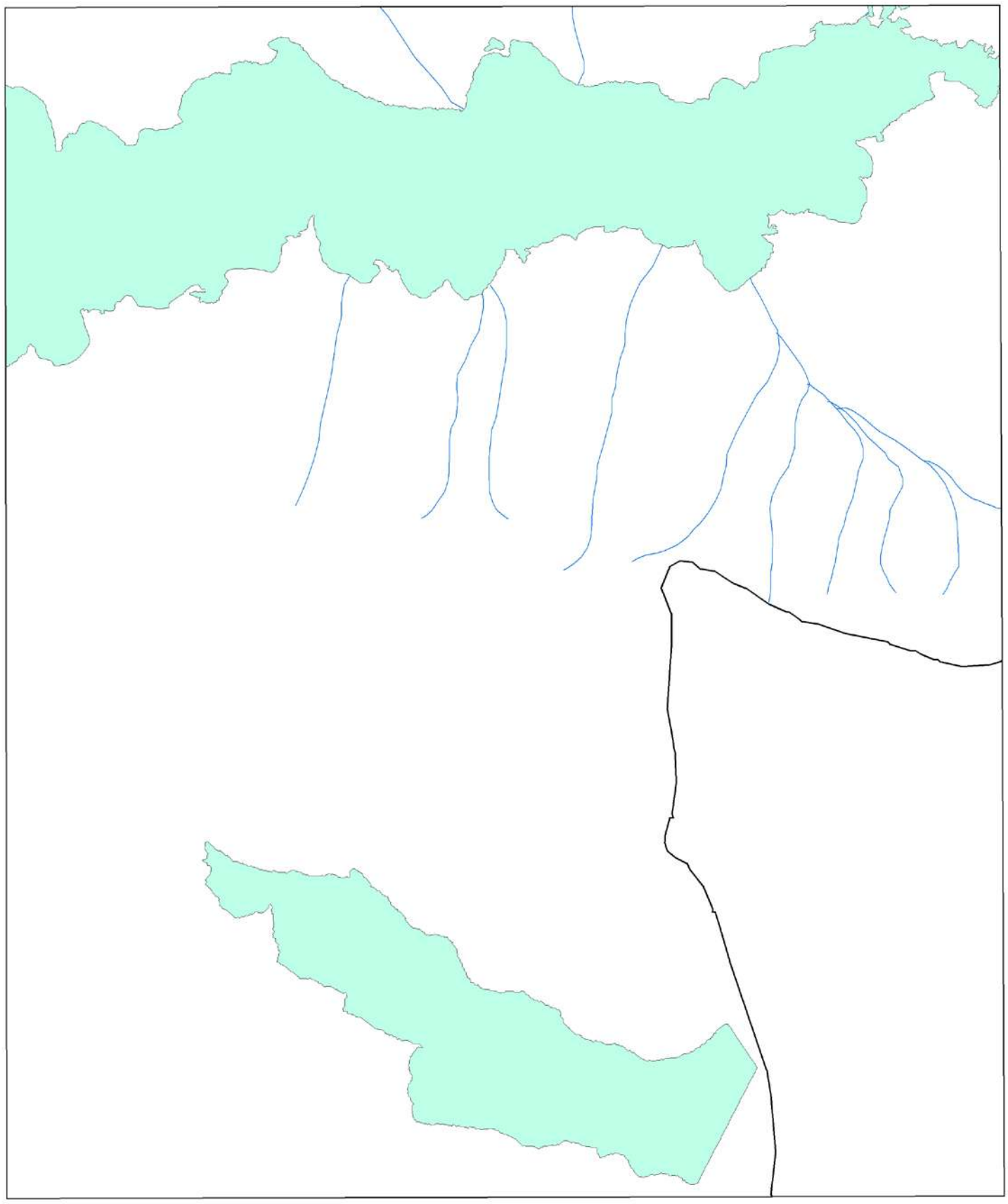
Government of India

State : Jammu and Kashmir

WETLAND MAP

Map No. : 52 K/ 14



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

Legend

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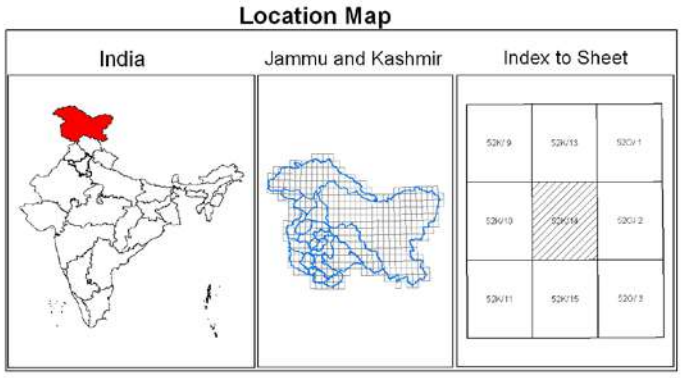
- District Boundary
- State Boundary
- International Boundary

Location Map



0 1 2 4 6 Kilometers

Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
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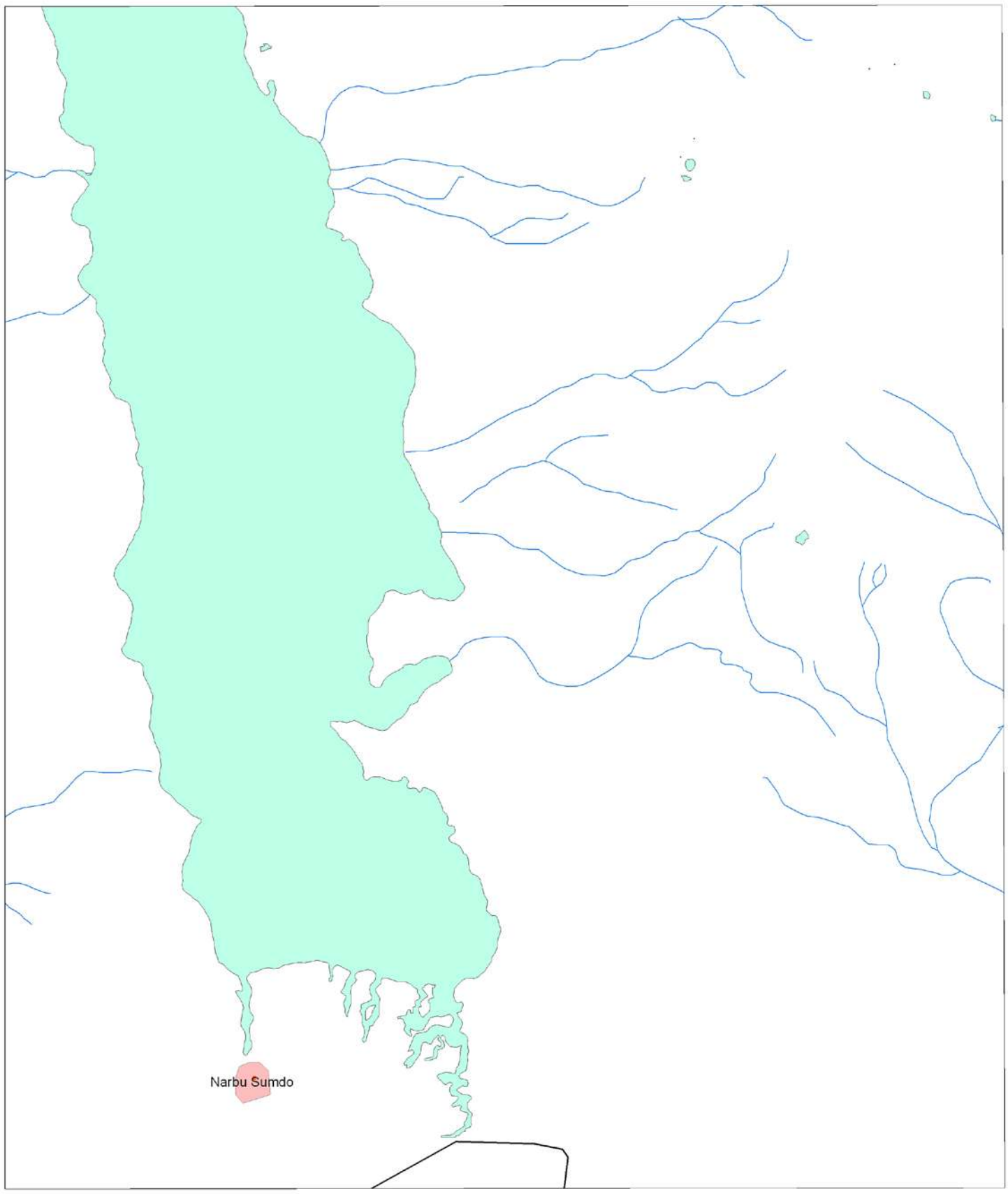
Government of India

State : Jammu and Kashmir

WETLAND MAP

Map No. : 52 L/05



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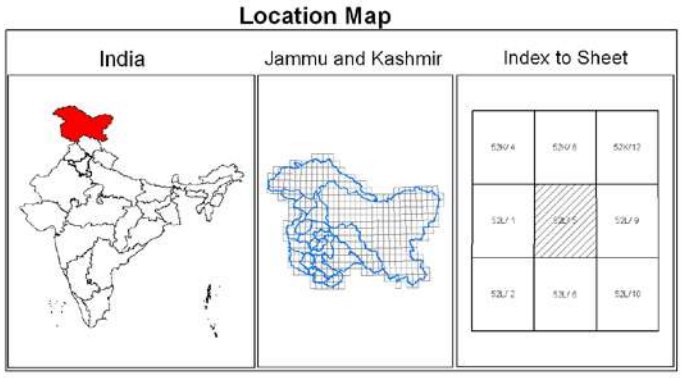
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

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

Location Map



Data Source :

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

Prepared By :

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Ministry of Environment and Forests
Government of India

State : Jammu and Kashmir

WETLAND MAP

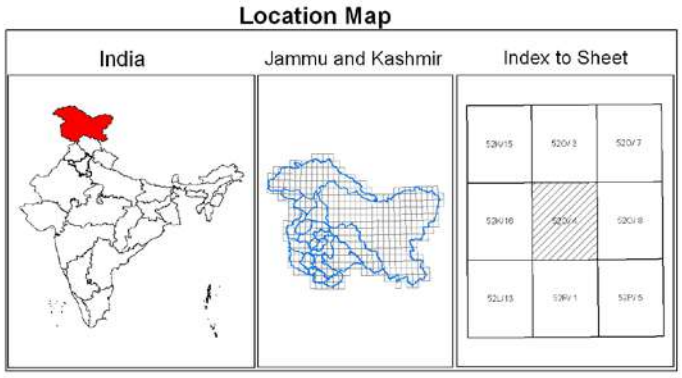
Map No. : 52 O/04

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

Legend

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

Location Map



0 1 2 4 6 Kilometers

Data Source :

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

Prepared By :

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Sponsored By :

Ministry of Environment and Forests
Government of India

REFERENCES

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

Annexure I
Definitions of wetland categories used in the project

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

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

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

Annexure – II

Details of District information followed in the atlas

State : Jammu and Kashmir

District Boundary Map

List of Districts

District code	District name
01	Kupwara
02	Baramula
03	Srinagar
04	Badgam
05	Pulwama
06	Anantnag
07	Leh (Ladakh)
08	Kargil
09	Doda
10	Udhampur
11	Punch
12	Rajauri
13	Jammu
14	Kathua
15	Gilghit
16	Konu
17	Gilghit Wazara
18	Chilas
19	Muzzafarabad
20	Mirpur

Legend

State Boundary

District Boundary

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

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

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

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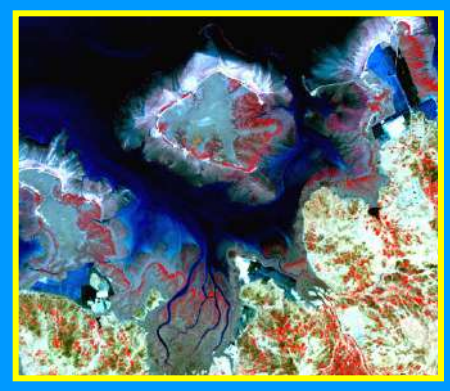

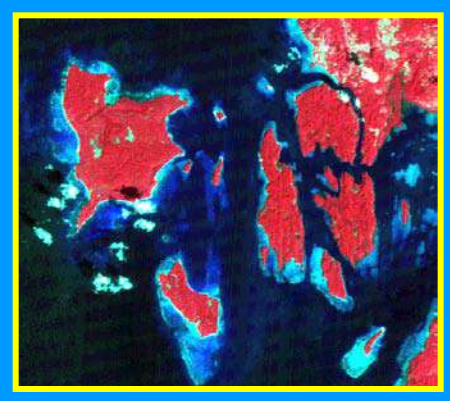

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Ahmedabad – 380 015