



NATIONAL WETLAND ATLAS: *NORTH-EASTERN STATES*



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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NORTH-EASTERN STATES

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Ministry of Environment and Forests, Government of India

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

Space Applications Centre (ISRO)
Ahmedabad

January 2011

First Publication: January 2011, Space Applications Centre (ISRO), Ahmedabad



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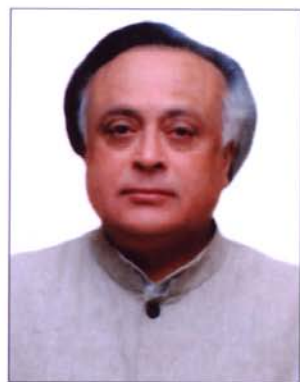
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Citation: National Wetland Atlas: North-Eastern States, SAC/EPISA/ABHG/NWIA/ATLAS/35/2011 Space Applications Centre (ISRO), Ahmedabad, India, 318p.

Available from: Space Applications Centre, ISRO, Ahmedabad – 380 015, India

Production: SAC, Ahmedabad carried out the work jointly with State Remote Sensing Applications Centres, Sponsored by Ministry of Environment and Forests, Govt. of India.

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18TH JANUARY 2010

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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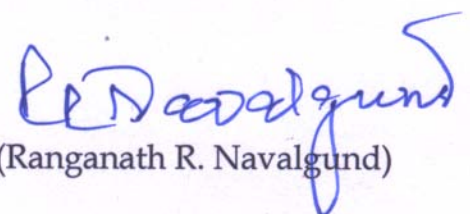
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FOREWORD

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

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

January 25, 2010


(Ranganath R. Navalgund)

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ACKNOWLEDGEMENTS

The project "National Wetland Inventory & Assessment (NWIA)", is sponsored by Ministry of Environment & Forestry (MoEF), Govt. of India and executed by Space Applications Centre, ISRO, Ahmedabad. We are grateful to Dr. Ranganath R. Navalgund, Director, Space Applications Centre, for his encouragement to take up this challenging task and formulation of the project team for timely implementation. Earnest thanks are also due to Dr. Jai Singh Parihar, Dy. Director, Earth, Ocean, Atmosphere, Planetary Sciences and Applications Area, Space Applications Centre, for providing overall guidance and support to the project. The present Atlas for the North-Eastern states is a part of the "National Wetland Atlas.

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. Pradeep 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, Coimbatore and Dr. R.K. Suri, Additional Director, Ministry of Environment and Forests, Govt. of India, New Delhi, and the database experts from ISRO who participated in the peer Review meeting to finalise the "Wetland Classification System" followed in this project

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

We are grateful to Dr G V Subramanyam, Adviser, MoEF, for his very active and positive role for implementation of the project. We are thankful to Dr Jag Ram, Director, MoEF and Dr Harendra Kharwal, MoEF for their support in budget and project management related issues. We are thankful to the "Technical Review" team of SAC for critical comments and suggestion to finalise the Atlas. We acknowledge the support received from Dr P S Roy, Dy Director, NRSC and Dr S Sudhakar, Head, LRD, NRSC in terms of valuable suggestions and providing the geo-referenced image of NRC-LU&LC project for use as master image in this project. We acknowledge the efforts put by Dr R D Shah, Mr Pragnesh Kumar Vaishnav and Ms Yatisha P Vaishnav, Geology Department, M G Science Institute, Ahmedabad in finalization of GIS database.


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CONTENTS

1.0	INTRODUCTION
1.1	Wetlands
1.2	Mapping and Geospatial Technique
1.3	Wetland Inventory of India
2.0	NATIONAL WETLAND INVENTORY AND ASSESSMENT
2.1	Wetland Classification System
2.2	Spatial framework and GIS database contents
3.0	STUDY AREA
3.1	Sikkim
3.2	Arunachal Pradesh
3.3	Nagaland
3.4	Manipur
3.5	Mizoram
3.6	Tripura
3.7	Meghalaya
3.8	Assam
4.0	DATA USED
4.1	Remote sensing data
4.2	Ground truth data
4.3	Other data
5.0	METHODOLOGY
5.1	Creation of Spatial Framework
5.2	Geo-referencing of Satellite Data
5.3	Mapping of Wetlands
5.4	Conversion of Raster (indices) into a Vector Layer
5.5	Generation of Reference Layers
5.6	Coding and Attribute Scheme
5.7	Map Composition and Output
6.0	ACCURACY ASSESSMENT
6.1	Data Verification and Quality Assurance of Output Digital Data Files
7.0	WETLANDS OF NORTH-EASTERN STATES: MAPS AND STATISTICS
7.1	Sikkim
7.1.1	North
7.1.2	West
7.1.3	South
7.1.4	East
7.2	Arunachal Pradesh
7.2.1	Tawang
7.2.2	West Kameng
7.2.3	East Kameng
7.2.4	Papum Pare
7.2.5	Lower Subansiri
7.2.6	Upper Subansiri
7.2.7	West Siang
7.2.8	East Siang
7.2.9	Upper Siang
7.2.10	Dibang Valley
7.2.11	Lohit
7.2.12	Changlang
7.2.13	Tirap

7.3 Nagaland

- 7.3.1 Dimapur
- 7.3.2 Kiphire
- 7.3.3 Kohima
- 7.3.4 Longleng
- 7.3.5 Mokokchung
- 7.3.6 Mon
- 7.3.7 Peren
- 7.3.8 Phek
- 7.3.9 Tuensang
- 7.3.10 Wokha
- 7.3.11 Zunheboto

7.3 Manipur

- 7.4.1 Senapathi
- 7.4.2 Tamelong
- 7.4.3 Churachandrapur
- 7.4.4 Bishnupur
- 7.4.5 Thoubal
- 7.4.6 Imphal West
- 7.4.7 Imphal East
- 7.4.8 Ukhrul
- 7.4.9 Chandel

7.5 Mizoram

- 7.5.1 Mamit
- 7.5.2 Kolasib
- 7.5.3 Aizawl
- 7.5.4 Champhai
- 7.5.5 Serchhip
- 7.5.6 Lunglei
- 7.5.7 Lawngtlai
- 7.5.8 Saiha

7.6 Tripura

- 7.6.1 West Tripura
- 7.6.2 South Tripura
- 7.6.3 Dhalai
- 7.6.4 North Tripura

7.7 Meghalaya

- 7.7.1 West Garo Hills
- 7.7.2 East Garo Hills
- 7.7.3 South Garo Hills
- 7.7.4 West Khasi Hills
- 7.7.5 Ri Bhoi
- 7.7.6 East Khasi Hills
- 7.7.7 Jaintia Hills

7.8 Assam

- 7.8.1 Kokrajhar
- 7.8.2 Dhubri
- 7.8.3 Goalpara
- 7.8.4 Bongaigaon
- 7.8.5 Barpeta
- 7.8.6 Kamrup
- 7.8.7 Nalbari
- 7.8.8 Darrang
- 7.8.9 Marigaon
- 7.8.10 Nagaon
- 7.8.11 Sonitpur
- 7.8.12 Lakhimpur

- 7.8.13 Dhemaji
- 7.8.14 Tinsukia
- 7.8.15 Dibrugarh
- 7.8.16 Sibsagar
- 7.8.17 Jorhat
- 7.8.18 Golaghat
- 7.8.19 Karbi Anglong
- 7.8.20 North Cachar Hills
- 7.8.21 Cachar
- 7.8.22 Karimganj
- 7.8.23 Hailakandi

8.0 MAJOR WETLAND TYPES OF NORTH-EASTERN STATES

9.0 IMPORTANT WETLANDS OF NORTH-EASTERN STATES

- 9.1 Gurudongmar Lake
- 9.2 Loktak Lake (Ramsar site)
- 9.3 Doyang Lake
- 9.4 Rudrasagar Lake (Ramsar site)
- 9.5 Umiam Lake
- 9.6 Deepor Beel (Ramsar Site)
- 9.7 Dhir Beel
- 9.8 Tamaranga Beel

REFERENCES

Annexure–I: Definitions of wetland categories used in the project.

Annexure–II: Details of district information followed in the atlas

List of Figures

- Figure 1: Spectral Signature of various targets
- Figure 2: Various land features as they appear in four spectral bands and in a typical three band FCC: Part of Tripura State
- Figure 3: Location map
- Figure 4a-g: Spatial framework of North-Eastern States
- Figure 5: IRS P6 LISS-III coverage of North-Eastern States
- Figure 6: IRS LISS-III FCC (Post-monsoon and Pre-monsoon), Part of North-Eastern States
- Figure 7: Flow chart of the methodology used
- Figure 8: Steps in the extraction of wetland components
- Figure 9: Various combinations of the indices/spectral bands used to discriminate wetland structural components
- Figure 10: State-wise wetland distribution in NE States
- Figure 11: Type-wise wetland distribution in NE States
- Figure 12: Type-wise wetland distribution in Sikkim
- Figure 13: District-wise wetland distribution in Sikkim
- Figure 14: Type-wise wetland distribution in Arunachal Pradesh
- Figure 15: District-wise wetland distribution in Arunachal Pradesh
- Figure 16: Type-wise wetland distribution in Nagaland
- Figure 17: District-wise wetland distribution in Nagaland
- Figure 18: Type-wise wetland distribution in Manipur
- Figure 19: District-wise wetland distribution in Manipur
- Figure 20: Type-wise wetland distribution in Mizoram
- Figure 21: District-wise wetland distribution in Mizoram
- Figure 22: Type-wise wetland distribution in Tripura
- Figure 23: District-wise wetland distribution in Tripura
- Figure 24: Type-wise wetland distribution in Meghalaya
- Figure 25: District-wise wetland distribution in Meghalaya
- Figure 26: Type-wise wetland distribution in Assam
- Figure 27: District-wise wetland distribution in Assam

List of Tables

Table 1: Wetland Classification System and coding
Table-2: Satellite data used
Table 3: Qualitative turbidity ratings
Table-4: State-wise wetland distribution in NE states
Table 5: Type-wise wetland distribution in NE states
Table 6: Area estimates of wetlands in Sikkim
Table-7: District-wise wetland area in Sikkim
Table 8: Area estimates of wetlands in North
Table 9: Area estimates of wetlands in West
Table 10: Area estimates of wetlands in South
Table 11: Area estimates of wetlands in East
Table 12: Area estimates of wetlands in Arunachal Pradesh
Table-13: District-wise wetland distribution in Arunachal Pradesh
Table 14: Area estimates of wetlands in Tawang
Table 15: Area estimates of wetlands in West Kameng
Table 16: Area estimates of wetlands in East Kameng
Table 17: Area estimates of wetlands in Papum Pare
Table 18: Area estimates of wetlands in Lower Subansiri
Table 19: Area estimates of wetlands in Upper Subansiri
Table 20: Area estimates of wetlands in West Siang
Table 21: Area estimates of wetlands in East Siang
Table 22: Area estimates of wetlands in Upper Siang
Table 23: Area estimates of wetlands in Dibang Valley
Table 24: Area estimates of wetlands in Lohit
Table 25: Area estimates of wetlands in Changlang
Table 26: Area estimates of wetlands in Tirap
Table 27: Area estimates of wetlands in Nagaland
Table 28: District-wise wetland area in Nagaland
Table 29: Area estimates of wetlands in Dimapur
Table 30: Area estimates of wetlands in Kiphire
Table 31: Area estimates of wetlands in Kohima
Table 32: Area estimates of wetlands in Longleng
Table 33: Area estimates of wetlands in Mokokchung
Table 34: Area estimates of wetlands in Mon
Table 35: Area estimates of wetlands in Peren District
Table 36: Area estimates of wetlands in Phek
Table 37: Area estimates of wetlands in Tuensang
Table 38: Area estimates of wetlands in Wokha
Table 39: Area estimates of wetlands in Zunheboto
Table 40: Area estimates of wetlands in Manipur
Table-41: District-wise wetland area in Manipur
Table 42: Area estimates of wetlands in Senapathi
Table 43: Area estimates of wetlands in Tamelong
Table 44: Area estimates of wetlands in Churachandrapur
Table 45: Area estimates of wetlands in Bishnupur
Table 46: Area estimates of wetlands in Thoubal
Table 47: Area estimates of wetlands in Imphal West
Table 48: Area estimates of wetlands in Imphal East
Table 49: Area estimates of wetlands in Ukhrul
Table 50: Area estimates of wetlands in Chandel
Table 51: Area estimates of wetlands in Mizoram
Table 52: District-wise wetland area in Mizoram
Table 53: Area estimates of wetlands in Mamit
Table 54: Area estimates of wetlands in Kolasib
Table 55: Area estimates of wetlands in Aizawl
Table 56: Area estimates of wetlands in Champhai
Table 57: Area estimates of wetlands in Serchhip
Table 58: Area estimates of wetlands in Lunglei
Table 59: Area estimates of wetlands in Lawngtlai
Table 60: Area estimates of wetlands in Saiha

Table 61: Area estimates of wetlands in Tripura
Table-62: District-wise wetland area in Tripura
Table-63: Area estimates of wetlands in West Tripura
Table-64: Area estimates of wetlands in South Tripura
Table-65: Area estimates of wetlands in Dhalai
Table-66: Area estimates of wetlands in North Tripura
Table 67: Area estimates of wetlands in Meghalaya
Table 68: District-wise wetland area in Meghalaya
Table 69: Area estimates of wetlands in West Garo Hills
Table 70: Area estimates of wetlands in East Garo Hills
Table 71: Area estimates of wetlands in South Garo Hills
Table 72: Area estimates of wetlands in West Khasi Hills
Table 73: Area estimates of wetlands in Ri Bhoi
Table 74: Area estimates of wetlands in East Khasi Hills
Table 75: Area estimates of wetlands in Jaintia Hills
Table-76: Area estimates of wetlands in Assam
Table-77: District-wise wetland distribution in Assam
Table-78: Area estimates of wetlands in Kokrajhar
Table-79: Area estimates of wetlands in Dhubri
Table-80: Area estimates of wetlands in Goalpara
Table-81: Area estimates of wetlands in Bongaigaon
Table-82: Area estimates of wetlands in Barpeta
Table-83: Area estimates of wetlands in Kamrup
Table-84: Area estimates of wetlands in Nalbari
Table-85: Area estimates of wetlands in Darrang
Table-86: Area estimates of wetlands in Marigaon
Table-87: Area estimates of wetlands in Nagaon
Table-88: Area estimates of wetlands in Sonitpur
Table-89: Area estimates of wetlands in Lakhimpur
Table-90: Area estimates of wetlands in Dhemaji
Table-91: Area estimates of wetlands in Tinsukia
Table-92: Area estimates of wetlands in Dibrugarh
Table-93: Area estimates of wetlands in Sibsagar
Table-94: Area estimates of wetlands in Jorhat
Table-95: Area estimates of wetlands in Golaghat
Table-96: Area estimates of wetlands in Karbi Anglong
Table-97: Area estimates of wetlands in North Cachar Hills
Table-98: Area estimates of wetlands in Cachar
Table-99: Area estimates of wetlands in Karimganj
Table-100: Area estimates of wetlands in Hailakandi

List of Plates

Plate 1a-1h: Major wetland types of North-Eastern States
Plate-2a-2i: Field photographs and ground truth data of wetland types
Plate 3: Gurudongmar Lake
Plate 4: Wetland map - 5 km buffer area of Gurudongmar Lake
Plate 5: IRS LISS III FCC - 5 km buffer area of Gurudongmar Lake
Plate 6: Loktak Lake
Plate 7: Wetland map - 5 km buffer area of Loktak lake
Plate 8: IRS LISS III FCC - 5 km buffer area of Loktak lake
Plate 9: Doyang Lake
Plate 10: Wetland map - 5 km buffer area of Doyang Lake
Plate 11: IRS LISS-III FCC - 5 km buffer area of Doyang Lake
Plate-12: Rudrasagar Lake
Plate 13: Wetland map - 5 km buffer area of Rudrasagar lake
Plate 14: IRS P6 LISS-III FCC of 5 km buffer area of Rudrasagar Lake
Plate 15: Umiam lake
Plate 16: Wetland map - 5 km buffer area of Umiam Lake
Plate 17: IRS P6 LISS-III FCC of 5 km buffer area of Umiam Lake
Plate 18: Deepor Beel
Plate 19: Wetland map - 5 km buffer area of Deepor Beel

Plate 20: IRS LISS III FCC - 5 km buffer area of Deepor Beel
Plate 21: Dhir Beel
Plate 22: Wetland map - 5 km buffer area of Dhir Beel
Plate 23: IRS LISS III FCC - 5 km buffer area of Dhir Beel
Plate 24: Tamaranga Beel
Plate 25: Wetland map - 5 km buffer area of Tamaranga Beel
Plate 26: IRS LISS III FCC - 5 km buffer area of Tamaranga Beel

1.0 INTRODUCTION

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

1.1 Wetlands

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

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

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

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

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

1.2 Mapping and Geospatial Technique

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

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

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

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

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

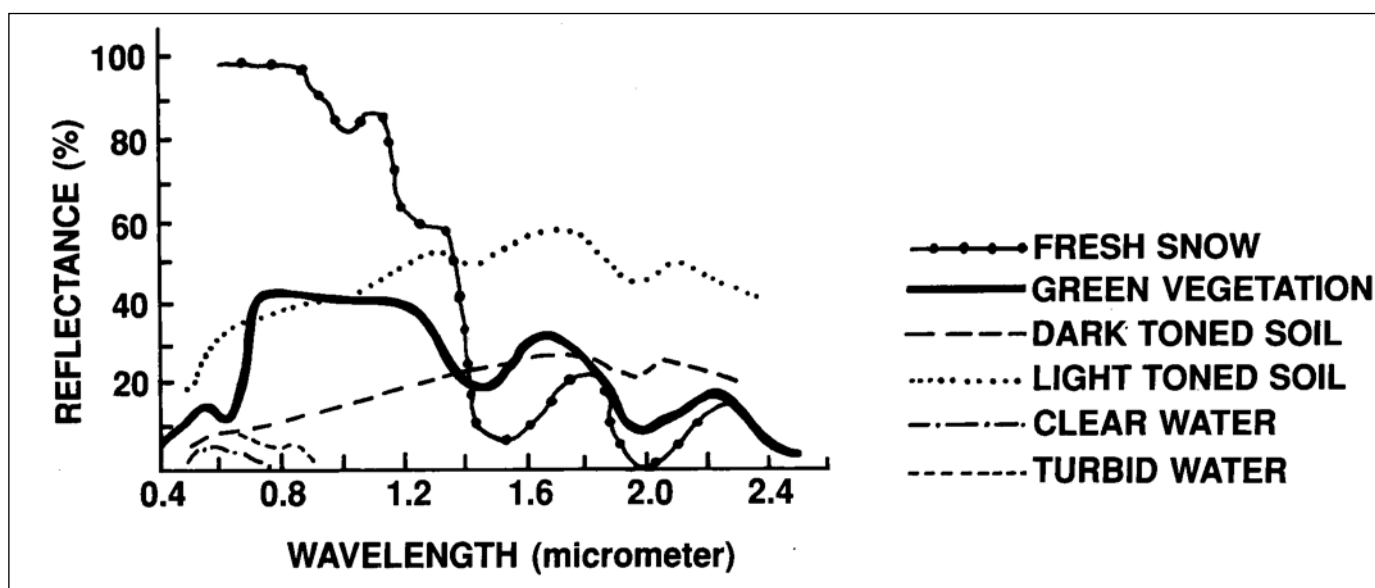
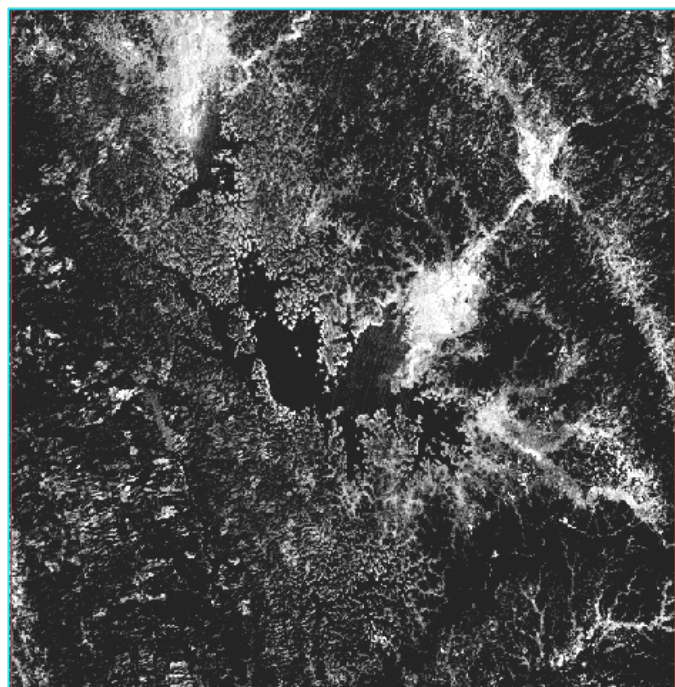
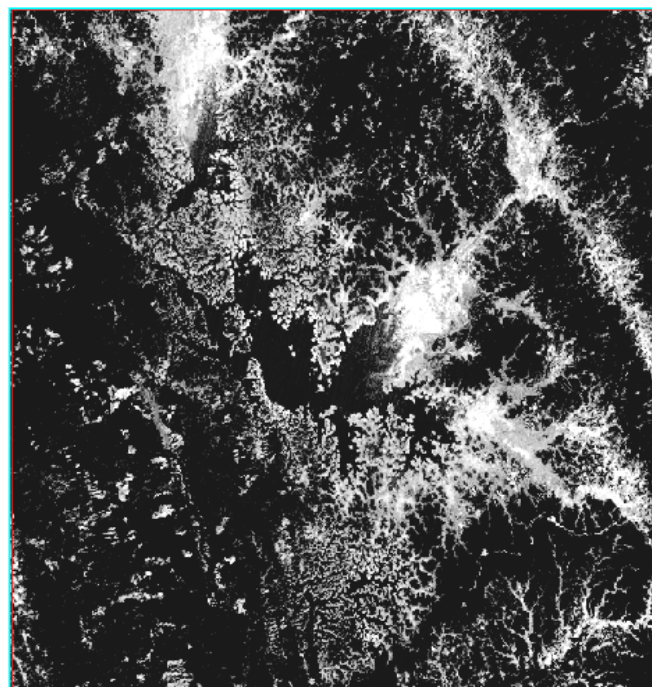


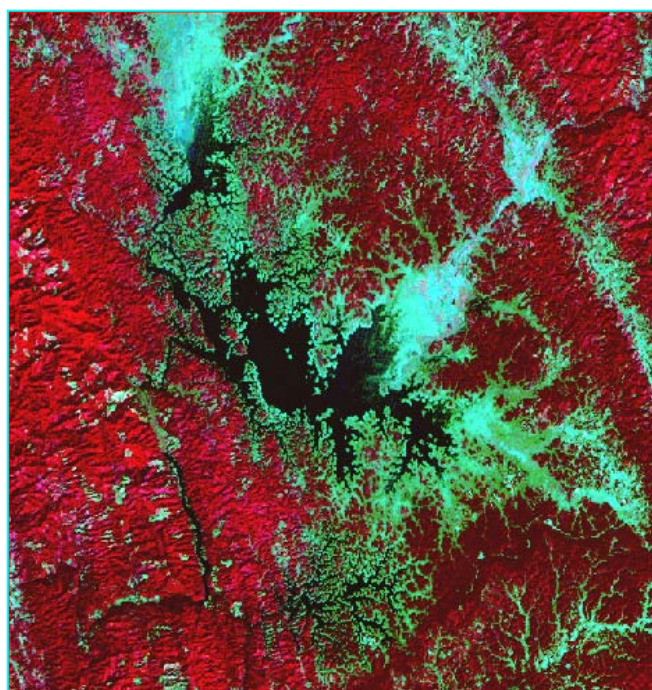
Figure 1: Spectral Signature of various targets



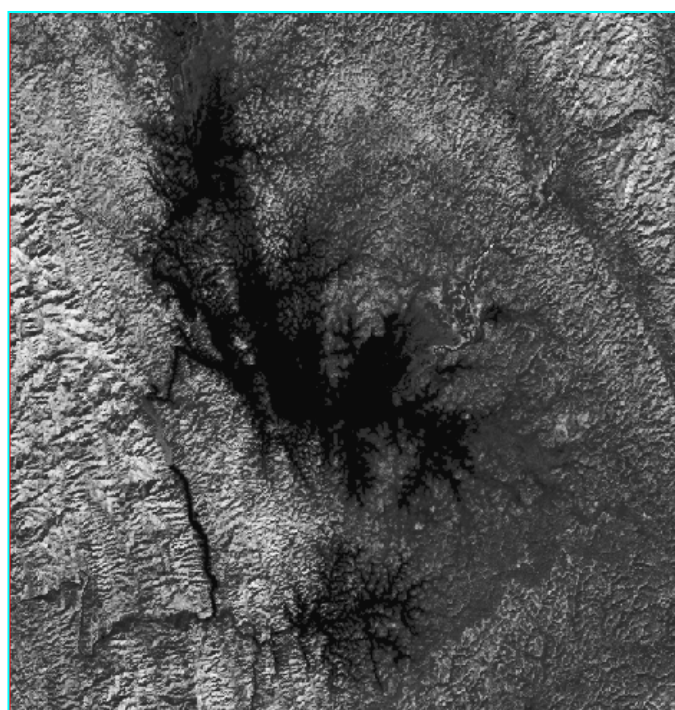
BAND1: GREEN



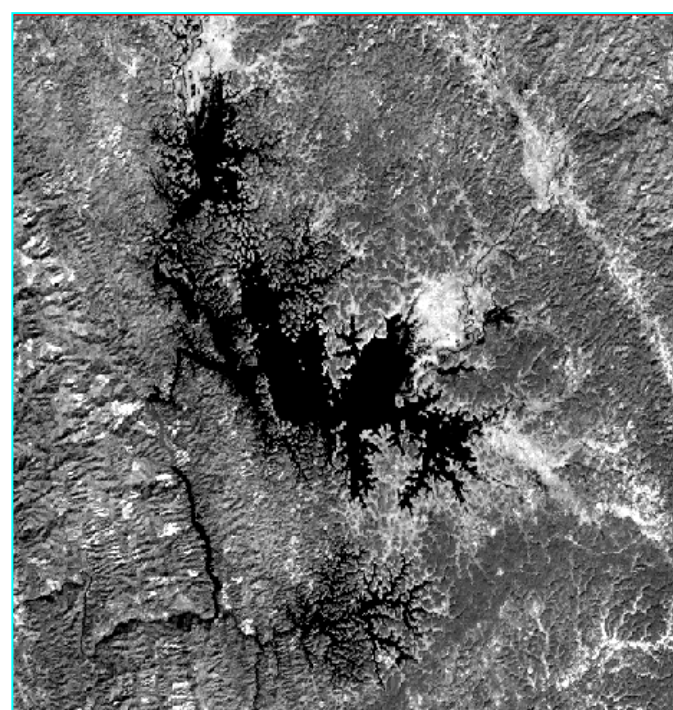
BAND2: RED



GREEN RED NIR
LISS-III FCC



BAND3: NIR



BAND4: SWIR

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

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, peat-lands, coral reefs, and numerous human-made wetland, such as fish and shrimp ponds, farm ponds, irrigated agricultural land, salt pans reservoirs, gravel pits, sewage farms, and canals. The Ministry of Environment and Forests has identified a number of wetlands for conservation and management under the National Wetland Conservation Programme and some financial assistance is being provided to State Governments for various conservation activities through approval of the Management Action Plans. The need to have an updated map database of wetlands that will support such actions has long been realized.

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

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

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

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

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

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

2.0 NATIONAL WETLAND INVENTORY AND ASSESSMENT (NWIA) PROJECT

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

The main objectives of the project are:

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

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

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 considered as wetland class. Definitions of wetland categories used in the project is given in Annexure-I.

2.2 Spatial Framework and GIS Database

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

Following wetland layers are generated for each inland wetland:

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

- Aquatic vegetation spread: The presence of vegetation in wetlands provides information about its trophic condition. As is known, aquatic vegetation is of four types, viz. Benthic, submerged, floating and emergent. It is possible to delineate last two types of vegetation using optical remote sensing data. A qualitative layer pertaining to presence of vegetation is generated for each season (as manifested on pre-monsoon and post-monsoon imagery).
- Turbidity of open water: A layer pertaining to a qualitative turbidity rating is generated. Three qualitative turbidity ratings (low, medium and high) is followed for pre- and post-monsoon turbidity of lakes, reservoirs, barrages and other large wetlands.
- Small wetlands (smaller than minimum mappable unit: < 2.25 ha) are mapped as point features.
- Base layers like major road network, railway, settlements, and surface drainage are created (either from the current image or taken from other project data base).

Table 1: Wetland Classification System and coding

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

* Wetland type code

3.0 STUDY AREA

The study area comprises the eight North-Eastern (NE) States in the country. Location map depicting North-Eastern state is shown in Figure 3. Census coding scheme have been followed for atlas preparation. Details of state and their code and area statistics are furnished below.

Sr. No.	State Code	Name of the State	Area (km ²)
1	11	Sikkim	7096
2	12	Arunachal Pradesh	83743
3	13	Nagaland	16579
4	14	Manipur	22327
5	15	Mizoram	21088
6	16	Tripura	11040
7	17	Meghalaya	22419
8	18	Assam	78438
		Total	262730

3.1 Sikkim

The Himalayan state of Sikkim is surely one of the mystic places on earth. The rugged terrain, pristine rivers, eye-soothing lakes, majestic mountains and rich cultural heritage makes it a paradise. The state borders Nepal in the west, China to the north and the east and Bhutan in the southeast. The Indian state of West Bengal borders Sikkim to its south. It lies between 27°04'46" N to 28°07'48"N latitude and 88°00'58" to 88°55'25"E longitude. The total geographical area of the state is 7,096 km² occupying an area of 0.67% of the total geographical area of the country. It is the second smallest state of India.

Physiographically it has a dynamic variety in its altitude ranging from one of the highest places on earth to as low as 240 m above mean sea level. On the basis of geographical features, the state is divided into four physiographical units; i) Lower hills, ii) Upper hills, iii) Alpine zones, and iv) Snow land. Among the four districts, North district is covered mainly by snow covered mountains, having the least population. World's 3rd highest mountain, Mount Khangchendzonga, (8598 m) gives a standing guard to this tiny though majestic state of Sikkim.

Sikkim has a very rugged and formidable topography and flat lands. The towering mountains that define this paradise of nature also create a barrier to efficient agriculture. These mountains fall directly in the path of the monsoon clouds making the state one of the wettest in the country. Most of the peaks above 6100 m lie towards the western border of Sikkim. The main mountains other than Khangchendzonga are Kabru, Siniolchu, Pandim, Rathong, Kokthang, Talung, Kanglakhang, Simvo and Jonsang. The central Sikkim traversed by another mountain ridge in the north to south direction. This mountain ridge separates the Tista and Rangit valley, and ends at the confluence of these two rivers. The gnarled topography tends, to smoothen out in the upper reaches of the Tista River in the Lachen valley where the Tibetan Plateau juts into Sikkim. The state of Sikkim also shelters many Glaciers (slow moving river of ice), mainly Zemu Glacier, Rathong Glacier and Lhonak Glacier. The mountain ranges are interspersed with passes which can be used to cross from one side to another. The important passes in east district are Nathula, Jelep, Bhutan la and Chola. The western part of the state has Chiwabhanjang and Kangla. In the North district of Sikkim, Chorten Nyimala, Kongra-la, Lungnala and Donkiala are important pass.

Along with the mountains, Glaciers and passes, the state of Sikkim also have many lakes though not of very large size. These lakes are both spring fed as well as river fed. The premier lakes of the state are Changu (Tsomgo), Khechodpalri, Gurudongmar, Cholamu, Memencho, Lampokhari, Samiti etc. These lakes also form the source of many rivers. The main river of Sikkim is Tista which originates from Lake Cholamu. Its main tributary is Rangit which originates from Rathong Glacier and meets Tista at the border between Sikkim and West Bengal. The Teista, described as the "lifeline of Sikkim", flows through the state from north to south. The river Ramam a tributary of Rangit, a part of Rangit itself and Rangpoo chu, a tributary of Tista define the southern border between Sikkim and West Bengal. The other smaller tributaries of the Tista River are Zemu chu, Lonak chu, Lachung chu, Talung chu and Bakcha chu. The state of Sikkim has many hot-springs known for their medicinal and therapeutic value. The most important are the ones located at Phurchachu (Reshi), Yumthang, Borang, Ralang, Taram-chu and Yumey Samdung. All these hot-springs have high sulphur content and are located near the river banks.

Sikkim is divided into four districts. The state is covered by nineteen 1:50,000 scale SOI topographical maps that form the spatial frame work for mapping (Figure 4a). The spatial framework was prepared using 15'x15' grid.

3.2 Arunachal Pradesh

Arunachal Pradesh, one of the seven North-Eastern states of India, and the easternmost state of India. It lies between 91° 32' E to 97° 26' E longitude and 26° 37' to 29° 28' N latitude. Total population of the state is 1,091,120 (census 2001) and geographical area is 83,743 sq km. Arunachal Pradesh borders with the Indian state of Assam to the south and Nagaland to the southeast. Burma/Myanmar lies towards the east, Bhutan towards the west, and the state is bordered on the north by the Tibet region of China. Itanagar is the capital of the state. A remote region, it includes part of the Eastern Himalayas and extends through mountainous highlands to the plains of Assam.

Arunachal Pradesh means "land of the dawn lit mountains" in Sanskrit. It is also known as "land of the rising sun" in reference to its position as the easternmost state of India. Arunachal Pradesh is entirely on the Eurasian Plate. Much of Arunachal Pradesh is covered by the Himalayas. However, parts of Lohit, Changlang and Tirap are covered by the Patkai hills. Kangto, Nyegi Kangsang, the main Gorichen peak and the Eastern Gorichen peak are some of the highest peaks in this region of the Himalayas. The Himalayan ranges that extend up to the eastern Arunachal separate it from China. The ranges extend toward Nagaland, and form a boundary between India and Burma in Changlang and Tirap district, acting as a natural barrier called Patkai Bum Hills. They are low mountains compared to the Greater Himalayas.

The climate of Arunachal Pradesh varies with elevation. Areas that are at a very high elevation in the Upper Himalayas close to the Tibetan border enjoy an alpine or Tundra climate. While below the Upper Himalayas are the Middle Himalayas, where people experience a climate which is temperate. Areas at the sub-Himalayan and sea-level elevation generally experience a humid sub-tropical climate, along with the hot summers and mild winters. Arunachal Pradesh receives heavy rainfall of 80 to 160 inches (2,000 to 4,100 mm) annually, most of it between May and September. The mountain slopes and hills are covered with alpine, temperate, and subtropical forests of rhododendron, oak, pine, maple, fir, and juniper; sal and teak are the main economic species.

Arunachal Pradesh attracts tourists from many parts of the world. Tourist attractions include the Namdapha tiger project in Changlang district, Sela lake near to Bomdila.

Agriculture is the primary driver of the economy. Jhum, the local word for shifting cultivation, which was widely practised among the tribal groups has come to be less practiced. Arunachal Pradesh has close to 61,000 square kilometers of forests, and forest products are the next most significant sector of the economy. Among the crops grown here are rice, maize, millet, wheat, pulses, sugarcane, ginger and oilseeds. Arunachal is also ideal for horticulture and fruit orchards. Its major industries are rice mills, fruit preservation units and handloom handicrafts. Arunachal Pradesh accounts for a large percent of India's untapped hydroelectric power production potential.

Arunachal Pradesh is divided into 13 districts, The state is covered by 172 Survey of India topographical maps on 1:50,000 scale that form the spatial frame work for mapping (Figure 4b).

3.3 Nagaland

Nagaland is located in the extreme North Eastern end of India. It is bounded by Myanmar in the East, Assam in the West, Arunachal Pradesh and a part of Assam in the North with Manipur in the south. Nagaland has a total geographical area of 16,579 sq. km and extends from 25°6' N to 27°4' N latitude and 93°20' E to 95°15' E longitude. The State of Nagaland is primarily a hilly terrain with rugged and rough hills with narrow alternating inter-mountain valleys. The altitude varies between 194 meters and 3048 meters above mean sea level. The hills have trends in NE to SW direction with moderate to steep slopes. The Naga Hills rise from the Brahmaputra Valley in Assam to about 2,000 feet (610 m) and rise further to the southeast, as high as 6,000 feet (1,800 m). Mount Saramati at an elevation of 12,552 feet (3,826 m) is the state's highest peak; this is where the Naga Hills merge with the Patkai Range in Burma. Based on Physiography, the State can be delineated into following altitudinal zones: Alluvial Plains, Low to moderate hills, Moderate hills and High hills. About one-sixth of Nagaland is under the cover of tropical and sub-tropical evergreen forests-including palms, bamboo, and rattan as well as timber and mahogany forests.

Nagaland has a largely monsoon climate with high humidity levels. Annual rainfall averages around 1,800–2,500 mm, concentrated in the months of May to September. There is not a single completely dry month in a year. Temperatures range from 21 °C to 40 °C. In winter, temperatures do not generally drop below 4 °C, but frost is common at high elevations.

The proximity to the Himalayan foothills and the torrential monsoon rains has resulted in the prosperity of the mighty rivers in Nagaland. The mountain region is the source of several streams and rivulets. There are four major river systems in the state, viz. Dhansiri, Doyang, Dikhu and Tizu. One of the chief tributaries of the Brahmaputra River is Dhansiri which originates in the mountainous Laisang peak in Nagaland. The districts of Nagaland receive water from the Dhansiri River prior to its confluence with the Brahmaputra River. Doyang river originates in the northern part of Manipur State i.e. in the SE of Kohima and it flows northwards, up to east of Wokha town and changes its direction thereafter to northwest. The rivers are not navigable in any season, deep valley navigation is also not possible due to the rocky terrain. The drainage pattern in Nagaland is mainly dendritic in nature with varying densities. Fine dendritic type of drainage is developed in the central part of the state between Mokokchung and Tuensang. A very fine dendritic pattern is noticed between Kohima and Mon. In other parts, the drainage pattern is coarse dendritic in nature.

The soils of the state have been derived from parent rock formations such as, shales, siltstones, mudstones, sandstone, alluvial and colluvial materials. The soils of the hill slopes have been genetically formed from shales and siltstones and that of valleys from alluvial and colluvial materials. The State, being generally a hilly area, composed of soils which are loamy to clayey in texture, highly acidic in reaction, possess high organic carbon content, low phosphorous and medium potash concentration.

The state capital of Nagaland is Kohima. Nagaland comprises of eleven districts namely Dimapur, Kiphire, Kohima, Longleng, Mokokchung, Mon, Peren, Phek, Tuensang, Wokha and Zunheboto. There are 14 tribes in Nagaland, with

Lothas, and Sumis being the largest Naga tribes. Almost all the tribes of Nagaland have their own language. English as the official language of Nagaland and is the medium for education in Nagaland. There are 52 administrative blocks and about 1317 villages in the state. The total population of the State according to 2001 census was 19, 88,636.

The state is covered by 43 Survey of India topographical maps on 1:50,000 scale that form the spatial frame work for mapping (Figure 4c). The spatial framework was prepared using 15' x 15' grid.

3.4 Manipur

Manipur is situated in the extreme North-Eastern boarder of India. It is bounded on the north by the state of Nagaland, on the east by the Upper Myanmar, on the south by the Chin Hills of Myanmar and the state of Mizoram and on the west by Cachar district of Assam. It lies between 92° 59' E to 92° 45' E longitude and 23° 50' to 25° 41' N latitude. The total geographic area of the state is 22,327 km² occupying an area of 0.67% of the total geographical area of the country and ranks 20th in terms of the aerial extent in the country.

On the basis of geographical features, the state is divided into two physiographical units; 1) hills and 2) valley plains. Geologically, Manipur state belongs to the young folded mountains of the Himalayan system. The soil in the state is mostly clay to clayey loam. Near Myanmar border the soil is sandy loam. The plains consisting of the Manipur valley covers and area of about 2,238 km². The Manipur state is drained by several small rivers and the drainage is mainly from north to south. The major rivers viz., Barak, Imphal, Iril and Thoubal are perennial and of great importance.

The mean maximum daily temperature is 31.1° C and the mean minimum daily temperature during the winter season is 11.8° C. The state has sub-tropical monsoon to temperature climate depending on the elevation. It receives rainfall from monsoon and the rainfall varies from 1016 to 1778 mm a year. The rainy season lasts from April to September and the amount of rainfall is more in hills than in the valley. The driest period is recorded from November to March. The maximum rainfall of the state is recorded in the month of July and August.

The total population of the Manipur was 23, 88, 634 during 2001 out of which 12, 07,338 are male and 11,81,296 are female. The urban population was 23.88%. Population density of the state is 107 per km². The literacy rate of the state is 68.87%.

There are nine districts in the state. The Imphal east, Imphal west, Thoubal and Bishnupur districts are valley districts and the remaining i.e. Tamenglong, Senapati, Chandel, Ukhrul and Churachandpur are hill districts. The four valley districts cover 1/10th of the total geographical area of the state whereas 9/10th of the total population settled there only.

Manipur is known for Loktak Lake. The Loktak lake covering and area of 24,672 ha is one of the 25 Ramsar sites in the country. The Keibul Lamjo National Park is a part of the lake where the world famous deer species "Sangai" the brow-antlered deer, *Cervus eldi eldi*, has its natural habitat. State government and many other organizations are attempting to preserve this largest fresh water lake which is the only home of endangered "Sangai or dancing deer".

The state is covered by forty-nine 1:50,000 scale SOI topographical maps that form the spatial frame work for mapping (Figure 4d). The spatial framework was prepared using 15' x 15' grid.

3.5 Mizoram

Mizoram lies in the southern part of the North-Eastern region. The geographical location of the state is between 92° 15' to 93° 29' N latitude and 21° 58' to 24° 35' E Longitude. The total geographical area of the state is 21,088 Sq km, extending 277 km from north to south and 121 km west to east. It is bounded on the north by Cachar district of Assam, on the north-east by Manipur and on the north-west by Tripura. The eastern and Southern boundary is the International border between India and Myanmar, whereas, the western part of the state is bounded by Bangladesh.

The geological formation and its resultant topography have lead to the creation of abundant drainage network in Mizoram. The state is blessed with number of perennial rivers and the major rivers run either in Northward or in Southward direction. Satellite imagery identifies the adaptation of streams along major and minor lineaments. The rivers flowing in northward direction drain into Barak river of Assam, where as, the rivers flowing towards the south fall into the Myanmar plain and those rivers in the western part fall into the Bangladesh plain.

Aizawl, the capital of Mizoram is bounded by two major rivers, Tuirial River in the east and Tlawng River in the west. It is linked with other states by air route and surface route (NH-54). There are eight districts in the state viz. Aizawl, Champhai, Kolasib, Mamit, Serchhip, Lunglei, Lawngtlai and Saiha district. There are about 791 villages in the state. The total population of the state is 8, 88,573. (Statistical hand book of Mizoram, 2008).

The major rivers of the state are Serlui, Tuirial, Tuivai, Langkaih, Tlawng, Teirei, Tuivawl, Tut, Khawthlangtuipui, Tiau, Tuichang, Tuipui, Mat, Mar, De, Kau, Kawrpui, Tuichawng, Phairuang, Chhimtuipui and Mengpui, etc. Chhimtuipui River is the largest river in Mizoram by volume and is navigable by small boat from Akyap (Myanmar) upto a considerable distance within the state. Where as, Tlawng river is the longest river of the state and is also navigable by small boat throughout the year and hence it provides water transport route with the neighbouring state Assam.

The state has eight districts and is covered by 47 Survey of India topographical maps on 1:50,000 scale that form the spatial frame work for mapping (Figure 4e). The spatial framework was prepared using 15' x 15' grid.

3.6 Tripura

Tripura is situated between 22°56' and 24°32' North Latitudes and between 91°10' and 92°22' East Longitudes. It is bounded on north by the Sylhet district of Bangladesh; on the south by the districts of Noakhali and Chittagong of Bangladesh; on the east by the district Cachar of Assam and the Mizoram; and on the west by the districts of Comilla and Noakhali (Bangladesh). It has an International boundary of about 850 km and is connected with the rest of India by a 201 km access road through the hills to the border of Cachar district of Assam. The length and breadth of Tripura are measuring 183.50 km and 112.70 km respectively. The total geographical area of the state is 11,040 Sq km accounting for 0.32% of the total land area of India and occupies the 22nd position in terms of area among the states and Union territories of India. Agartala, the capital of the state, is situated on the bank of the river Haora. Total population of the state is 3,191,168 as per 2001 census.

Tripura is predominantly a hilly country, with around 60% of its land being hilly. Even the plain land is broken by many low hills of 30 to 60 m in elevation, covered with trees and turf. There are five parallel ranges of hills increasing in height towards east, striking approximately in a north-south direction with an average interval of about 19 km. The increasing elevation from west to east shows a gentle gradient of land-form.

In general soil of Tripura can be divided into two broad types namely: (i) Soil of the uplands and (ii) Soil of the lowlands. Soil of the uplands is the product of disintegration of rocks, mainly sandstones and shales. Soil developed from the disintegration from sandstones are coarse in texture reddish brown to brown in colour, poor in humus and lime content. Soil developed from disintegration of shales are medium to fine grained in texture, dark brown to dark grey brown in colour, acidic and poor in permeability and lime content. Soils of the lowlands are mostly alluvial soil. It covers river valleys and flood plains. This soil is entirely a transported soil, brought down by innumerable rivers and chharas that drain them and deposited as sedimentary alluvium. This soil is deep, medium to fine grained and light grey in colour. The presence of organic matter in the soil is medium. These soils are intensively cultivated with rice, jute, pulses and other cereal crops.

Tripura enjoys warm humid tropical climate. Rainfall in Tripura is mostly derived from the southwest monsoon. The average annual rainfall in Tripura is around 2500 mm. In general, rainfall increases towards north and east and decreases towards south and west. Yearly variation of temperature is between 5°C and 38°C. The summer temperature ranges between 24°C and 35°C, where winter temperature varies between 5°C and 27°C. Fogs are frequent in winter and hail storms are observed occasionally.

The jungles of Tripura form impassible belts in low and swampy areas, and form the favorite habitat for the various wild lives. Many species of birds such as parrot, pigeon, snipe, quail, jungle fowl etc. found in Tripura. Altogether, 342 species of birds belonging to 51 families have been recorded from this state. Some migratory birds, mostly cranes and varieties of ducks of Himalayan origin visit Tripura every winter at different water sites and riverine tracts.

The state is divided into four administrative districts namely, North Tripura, West Tripura, South Tripura and Dhalai with the last one being created only in 1995. The entire Tripura is covered by twenty nine 1:50,000 scale SOI topographical maps that form the spatial frame work for mapping (Figure 4f).

3.7 Meghalaya

Meghalaya occupies the western position of the North eastern region. The North Eastern state of Meghalaya- the abode of clouds is predominantly a land of hills and valley. Owing to its natural beauty and grace it has been also named as 'Scotland of the East'. Geographical location of the state is between 89° 45' to 92° 48' and 25° 02' to 26° 05'. The total geographical area of the state is 22,419 Sq Km, extending 300 km west to east and 100 km from north to south. It is bounded on the north by Goalpara and Kamrup district of Assam, on the east by North Cachar and Karbi Anglong, the Western and Southern boundary is the International border between India and Bangladesh. The prevailing climate in the state is characterized by heavy rainfall, which favors the action of streams to a considerable extent.

The capital of Meghalaya state is in Shillong. There are total seven districts of Meghalaya state. There are about 5,782 villages in the state. The total population of the state is 2,318, 822 (Manorama year book 2009).

The major rivers of the state are Ganol, Ringgi, Krishnai, Manda, Darong, Bhogai, Simsang, Dareng, Umkhri, Umtrew, Umiam, Kopili, Kynshiang, Shella, Umngot, Myntdu, Lubha, etc. One of the marked features of River Kynshi in West Khasi Hills is the formation of River Island called Nongkhnum. Nongkhnum is not only India's but Asia's second largest river island. Ranikor situated in the West Khasi Hills district in the confluence of Kynshi and Rilang rivers is one of the best fishing spots. Meghalaya has the highest hydro – electric potential in the north-eastern region second only to Auranachal Pradesh. Hydel projects such as Umiam and Umtrew have caused construction of artificial lakes for the generation of electricity. Umiam Lake commonly called Barapani is formed by the damming of the Umiam River under the Umiam Hydro-Electric Project is a place of major tourist attraction and has great potentialities of recreation, aquatic sports, fishing etc. Meghalaya is also noted for a number of river cataracts and waterfall of great beauty located at different heights and scenic setting.

The state is covered by 54 Survey of India topographical maps on 1:50,000 scale that spatial framework for mapping (Figure 4g). The spatial framework was prepared using 15'x15' grid.

3.8 Assam

Assam is one of the 7 states of Northeast India. It extends between the latitudes of 24°8' N - 28°2' N and longitudes of 89°42' E - 96° 00' E. The T-shaped state is sprawled in an area of 78,438 km² (Figure-3). It is bordered by the Indian states of Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, Meghalaya, and West Bengal. The name "Assam" is derived from the term "Asom" which, in Sanskrit, refers to unequal or unrivalled. The uneven topography of the land, full of hills and plains might, have contributed to the name. The Mongolian Ahom dynasty that had ruled Assam for more than six hundred years might also be the cause for the name. Assam can be broadly divided into three distinct physical units, the Brahmaputra Valley in the north, the Barak Valley in the narrow protruding south, and the state's hilly region (Mikir and Cachar) separating the two valleys. Entering Assam, the Brahmaputra becomes a braided river and along with its tributaries, creates the flood plain of the Brahmaputra Valley. The Brahmaputra Valley in Assam is approximately 80 to 100 km wide and almost 1000 km long and the width of the river itself is 16 km at many places within the valley. The hills of Karbi Anglong and North Cachar and those in and around Guwahati and North Guwahati (along with the Khasi and Garo Hills) are originally parts of the South Indian Plateau system. These are eroded and dissected by the numerous rivers in the region. Average height of these hills in Assam varies from 300 to 400mt. The southern Barak Valley is separated by the Karbi Anglong and North Cachar Hills from the Brahmaputra Valley in Assam. The Barak originates from the Barail Range in the border areas of Assam, Nagaland and Manipur and flowing through the district of Cachar, it confluences with the Brahmaputra in Bangladesh. Barak Valley in Assam is a small valley with an average width and length of approximately 40 to 50 km.

Assam weather is characterized by heavy downpour and humidity. The hilly areas usually experience sub-alpine climatic condition, while excessive sultriness is observed in the plain lands of Assam. The humidity that is brought into Assam by the southwest monsoons, shower an average annual rainfall of 120 inches or more on the great Brahmaputra valley and the surrounding region. The temperature ranges from a maximum of 29° to a minimum of 16°. Assam's economy is based on agriculture and oil. Assam produces a significant part of the total tea production of the world. Assam produces more than half of India's petroleum.

The current state capital of Assam, Guwahati, was known in ancient time as Pragjyotishpura or The Eastern City of Light. Other major towns are Dhubri, Barpeta, Dibrugarh, Tinsukia, Jorhat, Nagaon, Sivasagar, Silchar, Tezpur. The population of Assam is 26.66 million according to 2001 census and is scattered over 26312 villages. Administratively, it is divided into 23 districts: Barpeta, Bongaigaon, Cachar, Darrang, Dhemaji, Dhubri, Dibrugarh, Goalpara, Golaghat, Hailakandi, Jorhat, Kamrup, Karbi Anglong, Karimganj, Kokrajhar, Lakhimpur, Marigaon, Nagaon, Nalbari, North Cachar Hills, Sibsagar, Sonitpur, and Tinsukia.

The spatial framework was prepared using 15' x 15' grid. The state is covered by 171 Survey of India topographic maps on 1:50,000 scale that form the spatial frame work for mapping (Figure 4h).

District information (code) for each state followed in the atlas is given in Annexure-II.

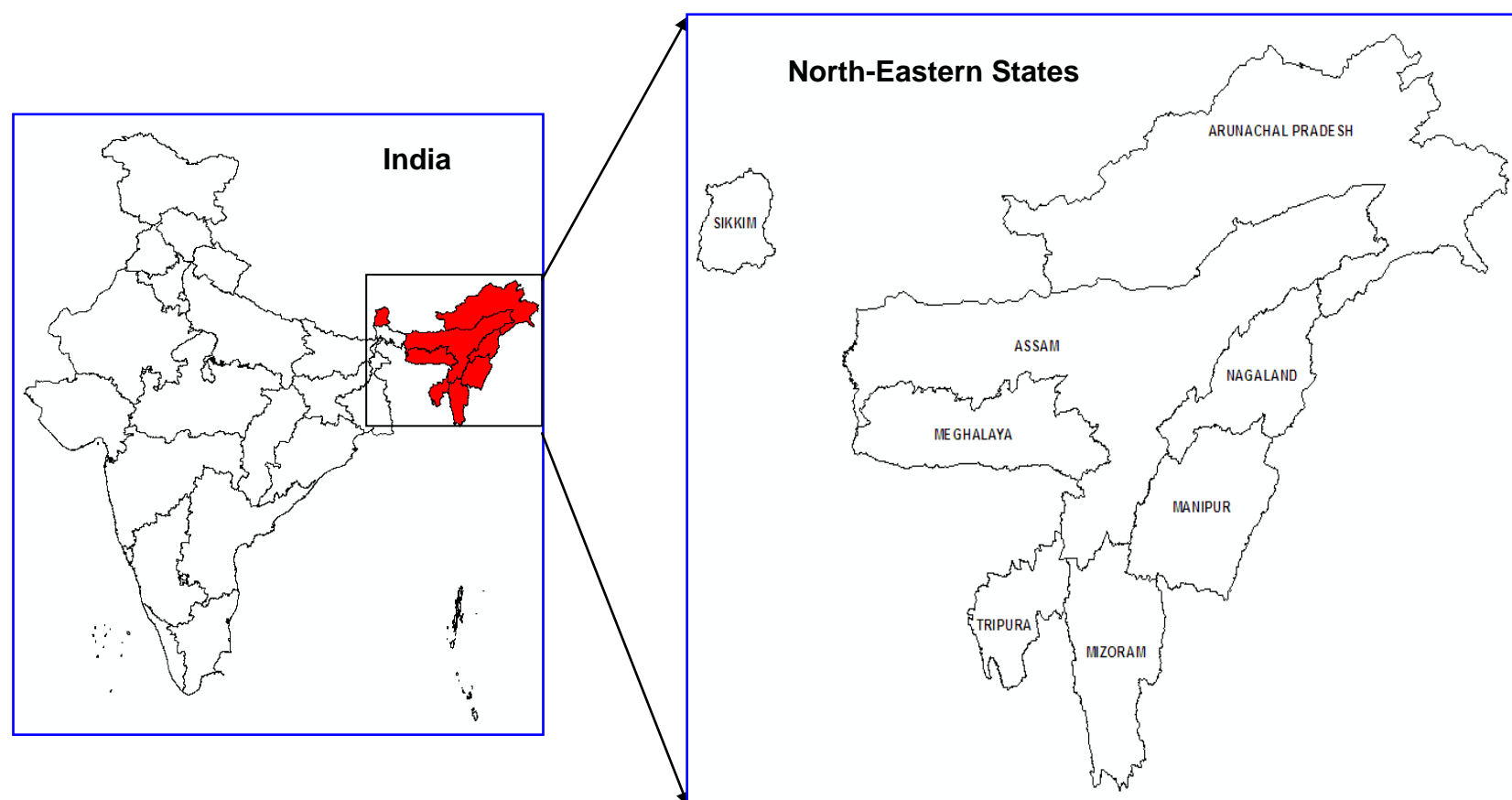


Figure 3: Location map

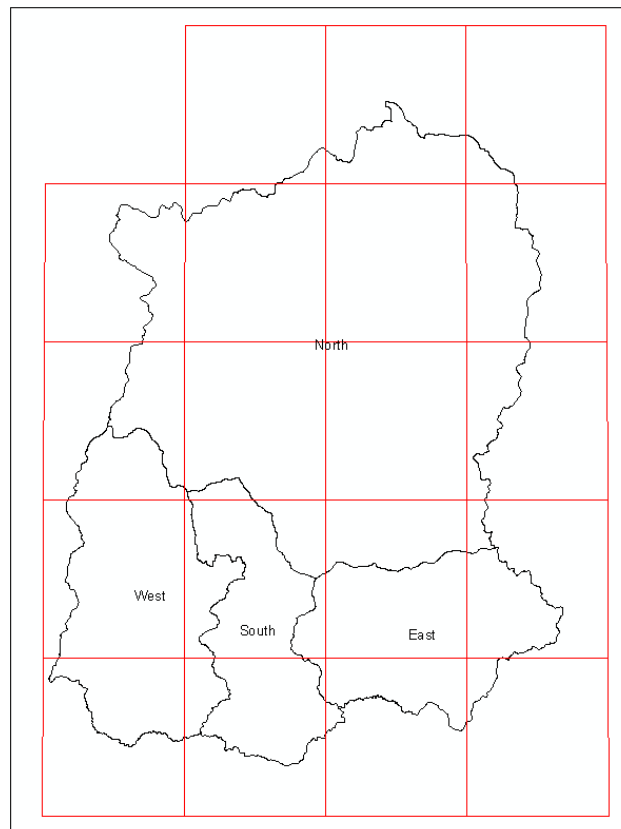


Figure 4a: Spatial Framework of Sikkim

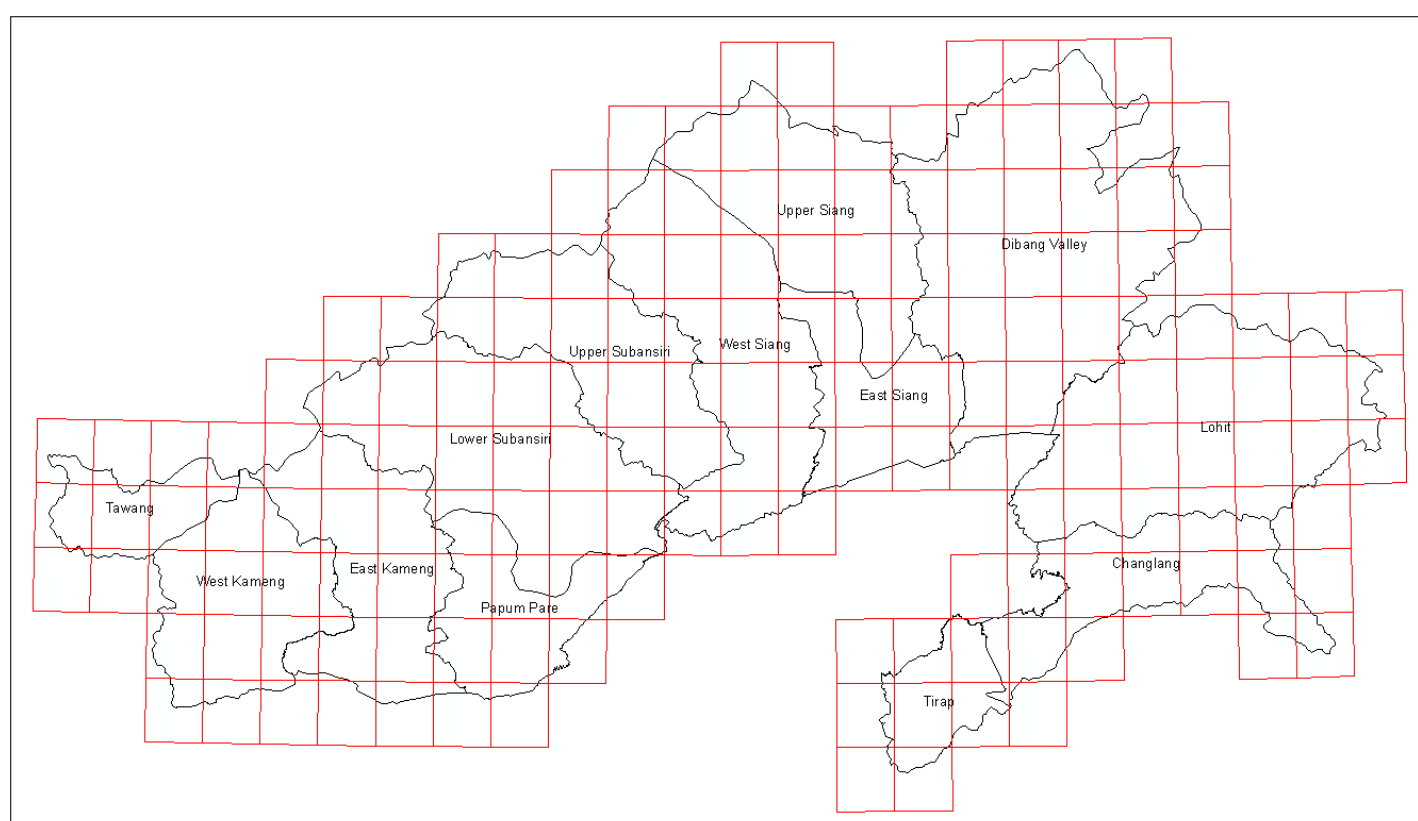


Figure 4b: Spatial framework of Arunachal Pradesh

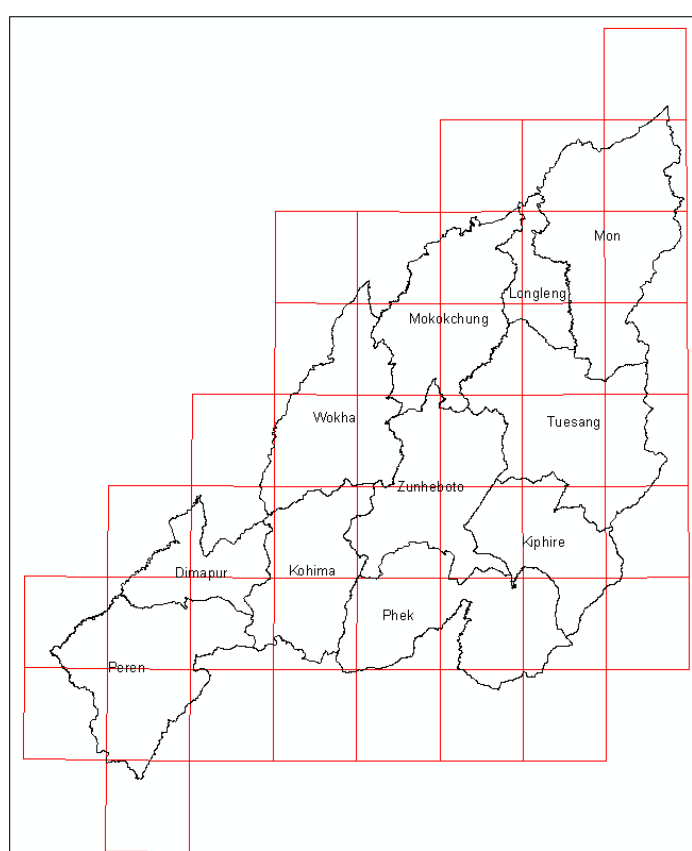


Figure 4c: Spatial framework of Nagaland

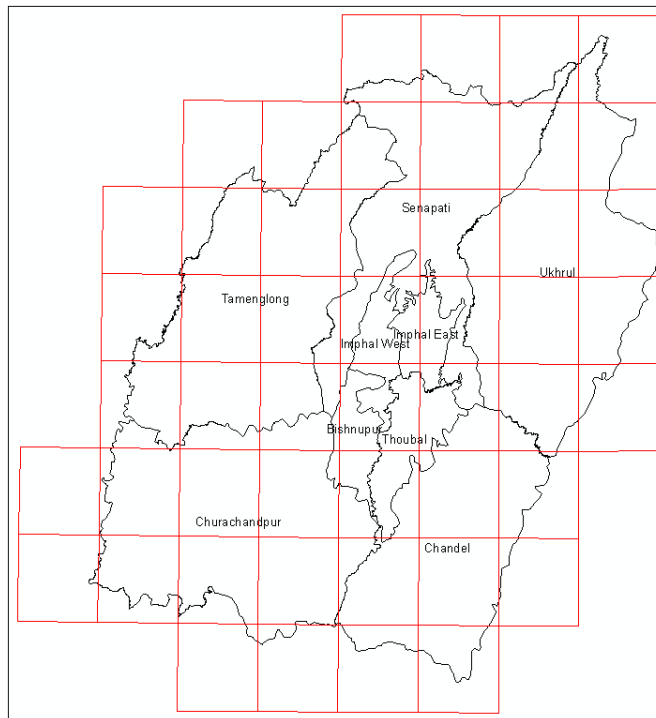


Figure 4d: Spatial framework of Manipur

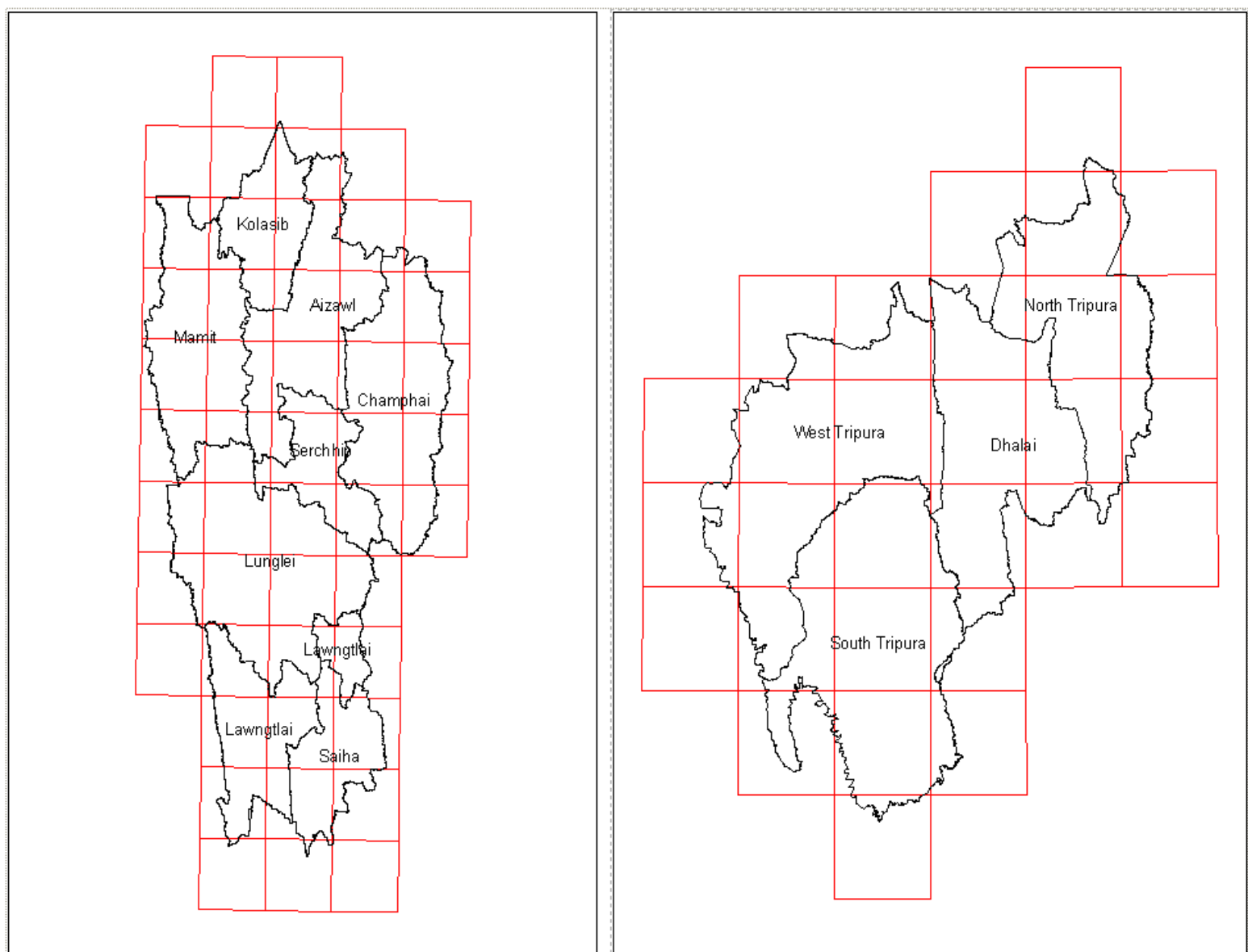


Figure 4e: Spatial framework of Mizoram

Figure 4f: Spatial framework of Tripura

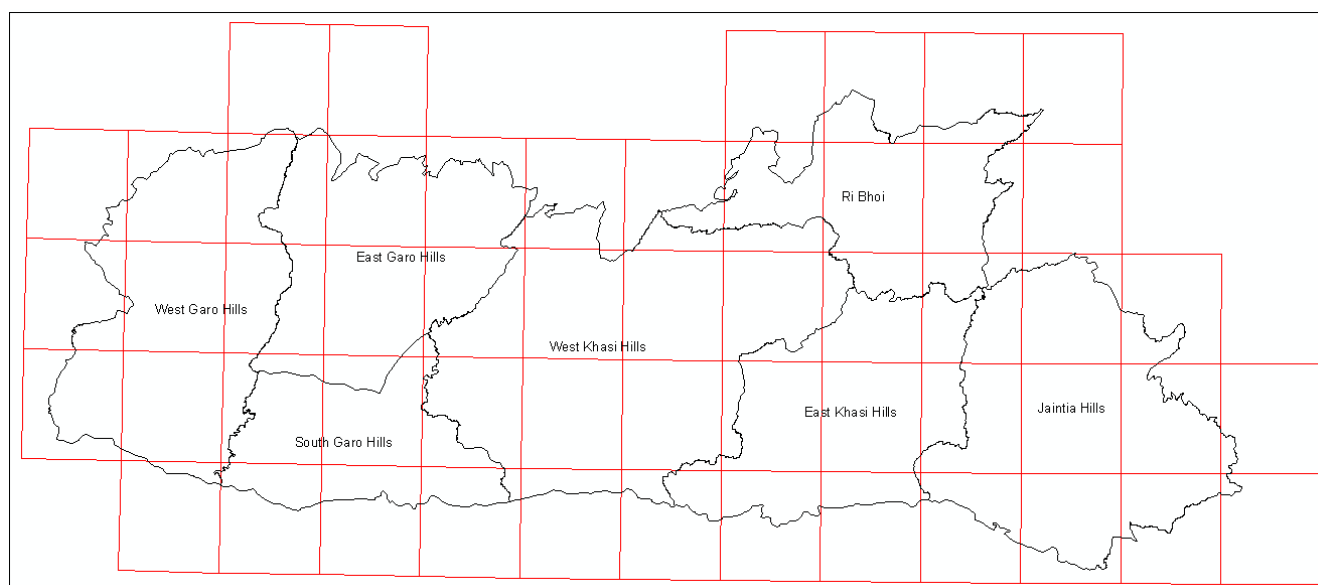


Figure 4g: Spatial framework of Meghalaya

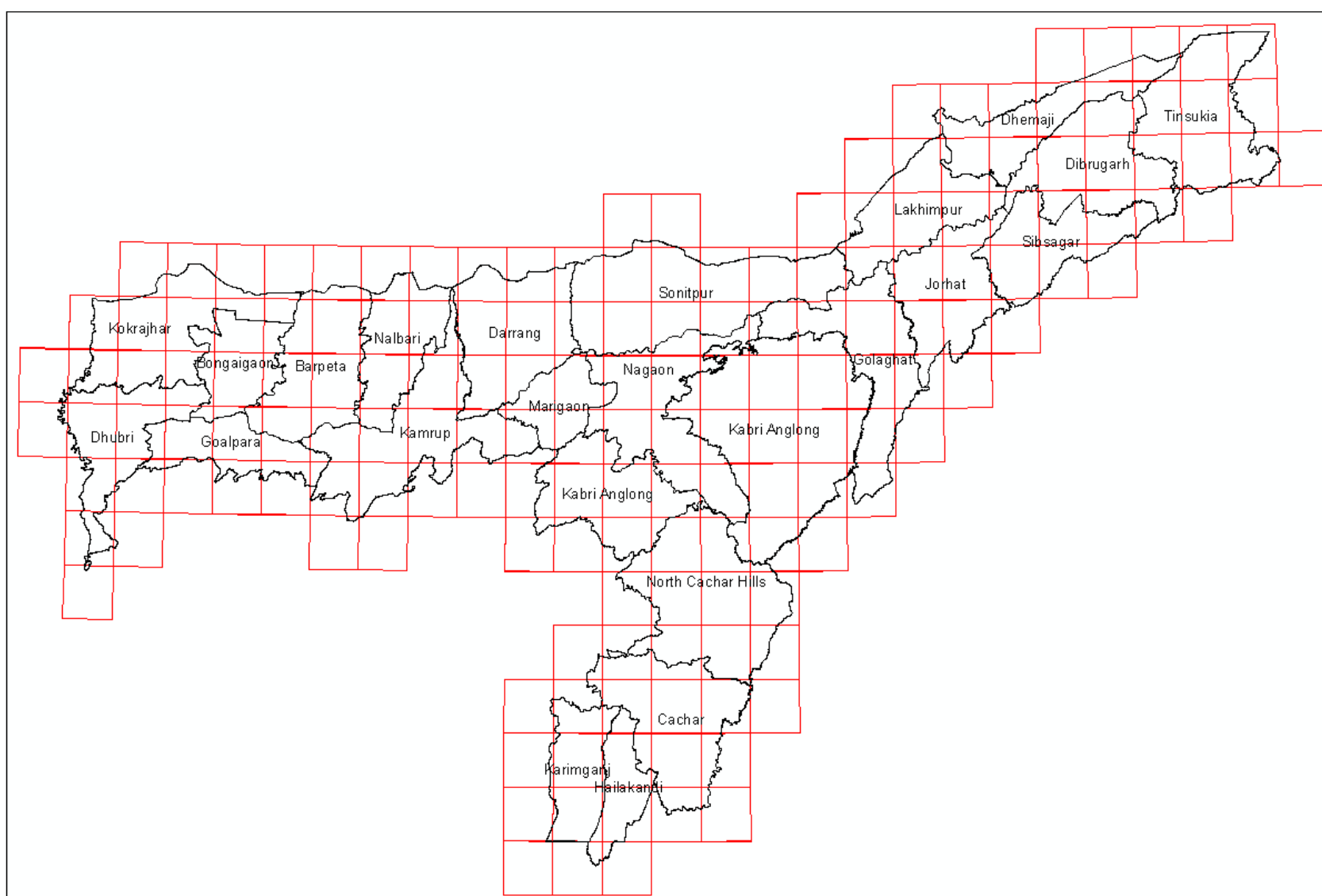


Figure 4h: Spatial framework of Assam

4.0 DATA USED

4.1 Remote sensing data

IRS P6 LISS III data were used to map the wetlands. IRS P6 LISS III provide data in 4 spectral bands; green, red, Near Infra Red (NIR) and Short wave Infra Red (SWIR), with 23.5 m spatial resolution and 24 day repeat cycle. The spatial resolution is suitable for 1:50,000 scale mapping. The North-Eastern States are covered in 32 IRS LISS III scene (Figures 5). Two date data were used to capture the pre-monsoon and post-monsoon hydrological variability of the wetlands respectively (Table-2). Figure 6 shows the overview of the part of North-Eastern States (part of Manipur state) as seen in the LISS III FCC of post-monsoon and pre-monsoon data respectively.

4.2 Ground truth data

Remote sensing techniques require certain amount of field observation called “ground truth” in order to convert into meaningful information. Such work involves visiting a number of test sites, usually taking the satellite images. The location of the features is recorded using the GPS. The standard 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 October and November 2008.

4.3 Other data

Survey of India topographical maps (SOI) were used for reference purpose. Lineage data of National Wetland Maps at 1:50,000 scale was used for reference.

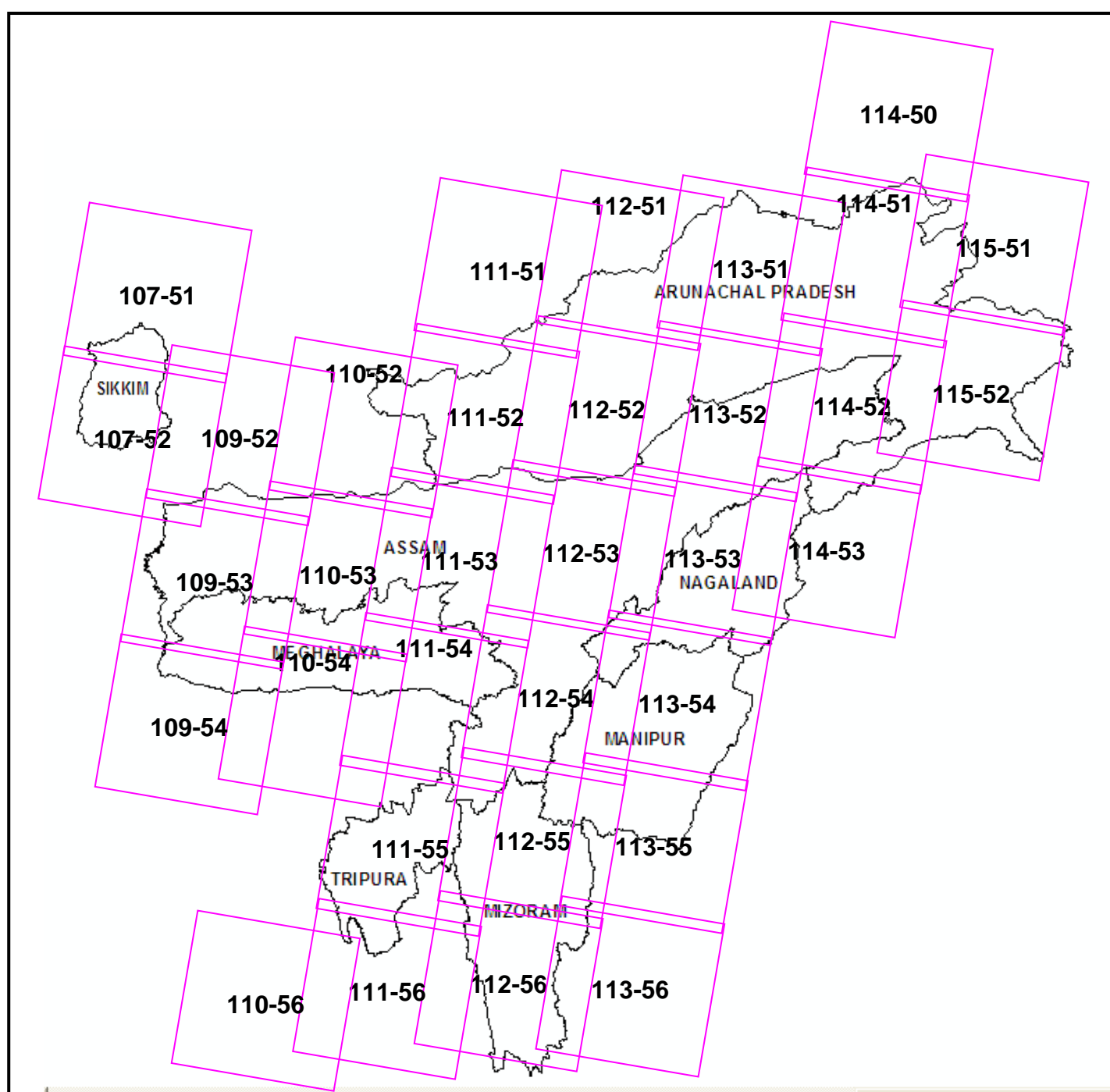


Figure 5: IRS P6 LISS-III coverage of North-Eastern States

Table-2: Satellite data used

Sl. No	IRS P6 LISS-III Path Row	Post-Monsoon	Pre-Monsoon
1	107-51	November 15, 2005 & January 26, 2006	April 13, 2005
2	107-52	November 15, 2005 & January 26, 2006	April 13, 2005
3	109-52	October 27, 2006	March 20, 2007
4	109-53	October 27, 2006	March 20, 2007
5	109-54	October 27, 2006	March 20, 2007
6	110-52	November 06, 2005	May 17, 2006
7	110-53	December 14, 2007 & November 01, 2006	March 25, 2007 & May 17, 2007
8	110-54	December 19, 2006	February 10, 2006
9	110-55	February 06, 2006	March 21, 2007
10	111-51	November 11, 2005	January 27, 2005
11	111-52	November 11, 2005	January 03, 2007 & January 3, 2005
12	111-53	November 30, 2006 & Nov 25, 2007	March 30, 2007 & January 22, 2006
13	111-54	November 30, 2006 & February 06, 2006	March 30, 2007
14	111-55	Dec 05, 2006 & Feb 06, 2006 & Nov. 11, 2005	March 11, 2007
15	111-56	December 20, 2006	March 02, 2007
16	112-51	December 5, 2006	January 27, 2006
17	112-52	December 05, 2006	January 27, 2006 & April 14, 2005
18	112-53	December 10, 2005 & December 05, 2006	March 11, 2007 & April 14, 2005
19	112-54	December 10, 2005 & December 05, 2006	January 22, 2007
20	112-55	December 05, 2006 & December 10, 2005	March 11, 2007
21	112-56	December 05, 2006	March 11, 2007
22	113-51	October 28, 2005	February 1, 2006
23	113-52	January 27, 2006	May 03, 2007
24	113-53	January 27, 2006	May 03, 2007
25	113-54	January 27, 2006	May 03, 2007
26	113-55	January 27, 2006	May 03, 2007
27	114-50	February 6, 2006	February 6, 2006
28	114-51	December 15, 2006	April 14, 2007
29	114-52	September 15, 2005	April 14, 2007
30	114-53	September 15, 2005	February 06, 2006
31	115-51	December 20, 2006	April 19, 2007
32	115-52	December 20, 2006	April 19, 2007

5.0 METHODOLOGY

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

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

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

5.1 Creation of Spatial Framework

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

5.2 Geo-referencing of Satellite Data

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

5.3 Mapping of Wetlands

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

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

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

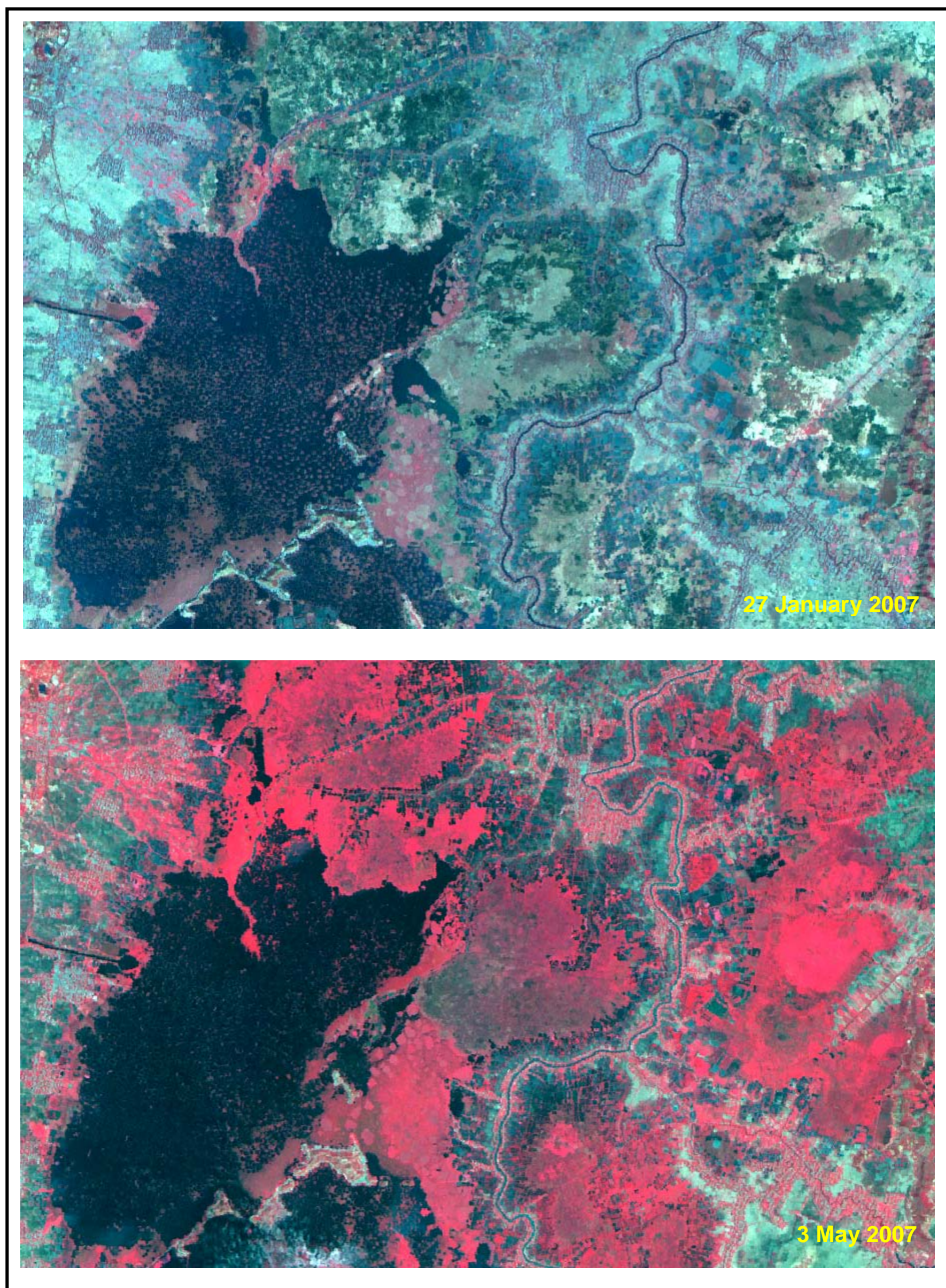


Figure 6: IRS LISS-III FCC (Post-monsoon and Pre-monsoon), Part of North-Eastern States

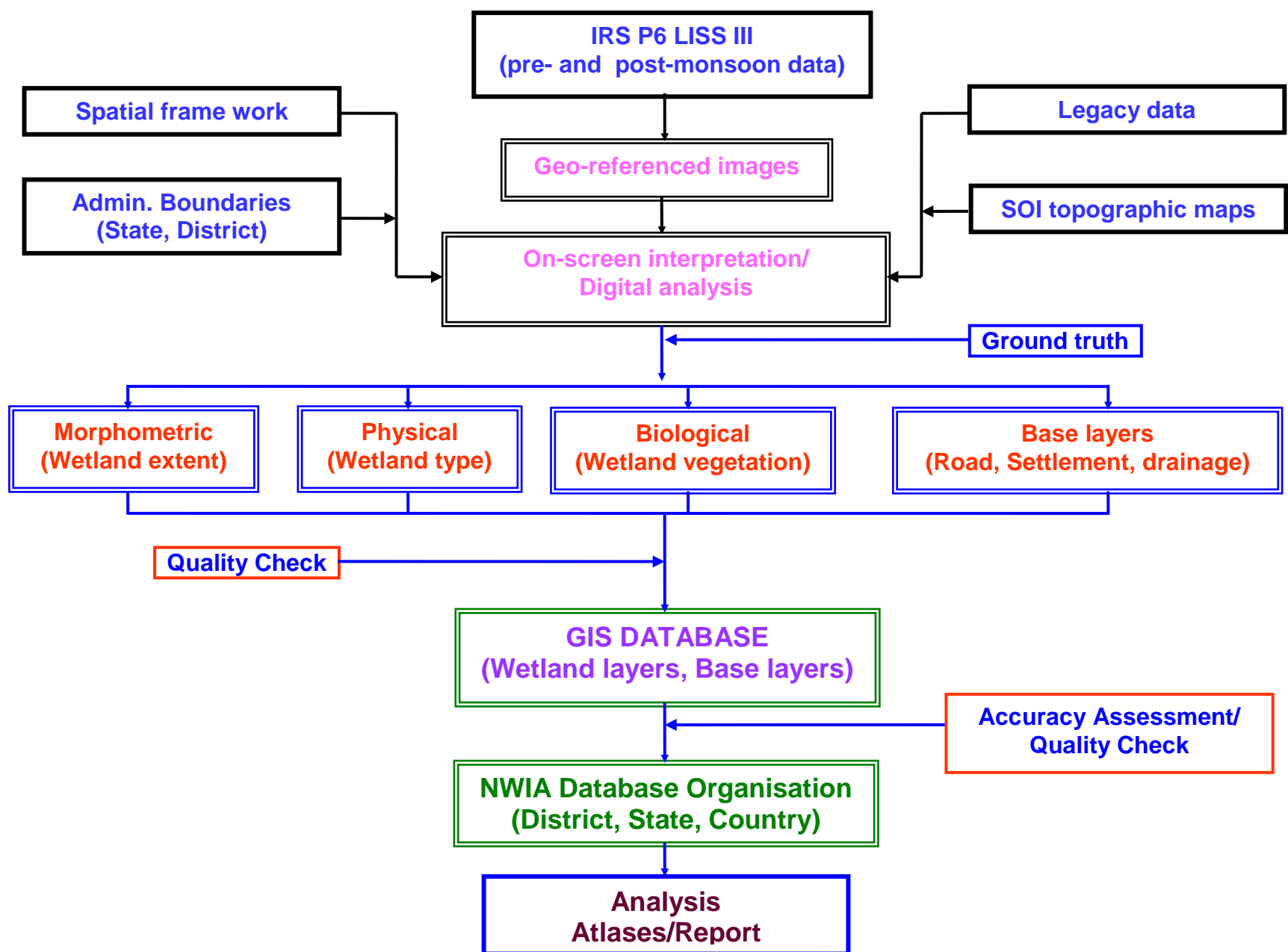


Figure 7: Flow chart of the methodology used

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 with in the wetland mask to delineate the water and no-water areas.
- Extraction of wetland vegetation :
NDPI and NDVI image was used to generate the vegetation and no-vegetation areas within a wetland using a suitable threshold.
- Turbidity information extraction :
MNDWI image was used to generate qualitative turbidity level (high, moderate and low) based on following steps:
 - a) Conversion of post- and pre-monsoon water spread polygons into Area of Interest (AoI).
 - b) Grouping of all AoIs excluding all non-wetland areas into a single entity.
 - c) Generate a signature statistics like minimum, maximum, mean and standard deviations.
 - d) Generate a raster turbidity image through a model for AoI only with *conditional* categorisation.
 - e) Convert the raster into vector and update the attributes or edit the water spread layer (copied as turbidity layer) in polygon mode so as to retain all the attributes.
 - f) Assign turbidity classes as per the table 3.

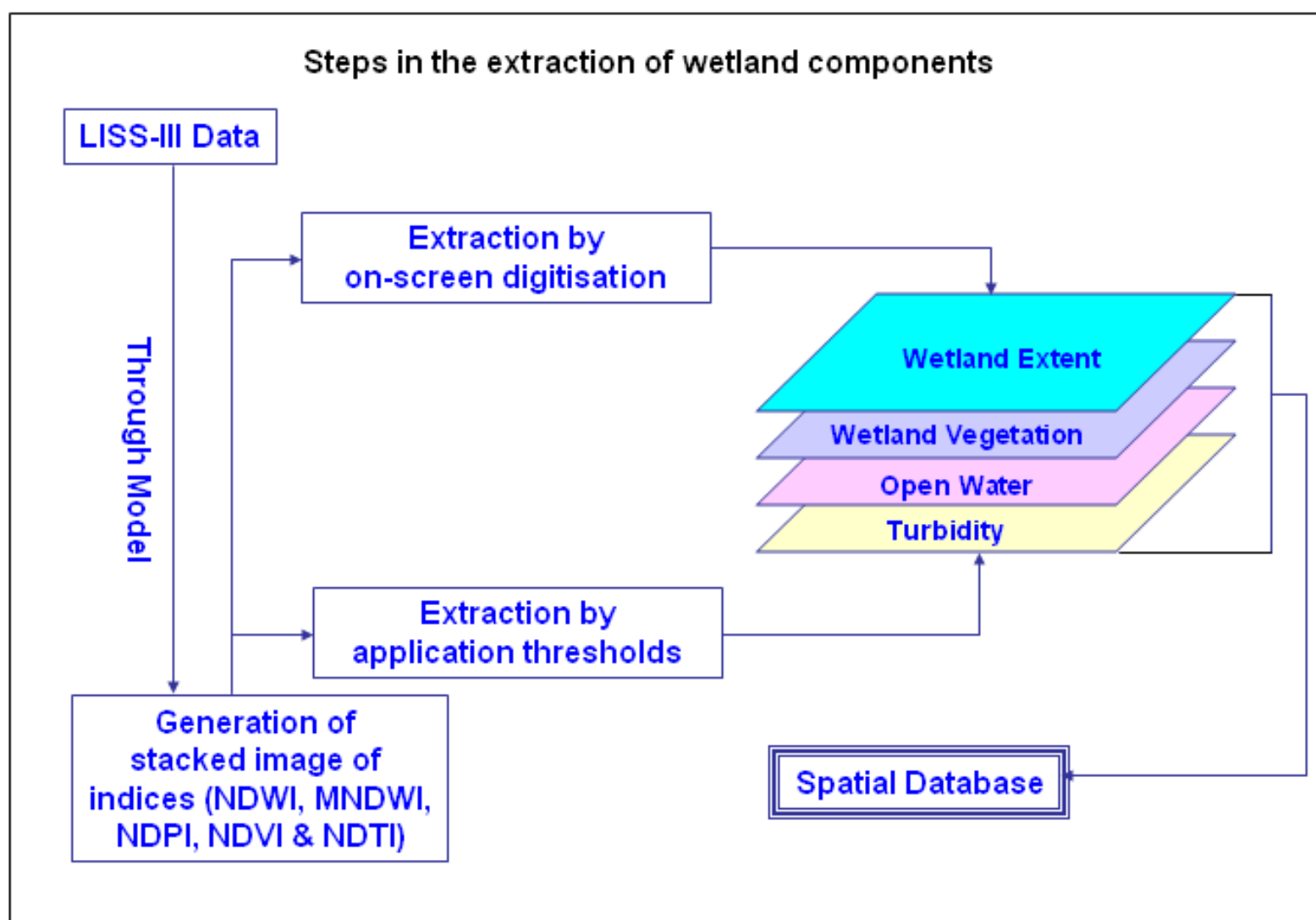


Figure 8: Steps in the extraction of wetland components

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	$> -1\sigma$ to $\leq +1\sigma$	Medium blue
3.	High/Bottom reflectance	$\leq \mu - 1\sigma$	Light blue/whitish blue

5.4 Conversion of the Raster (indices) into a Vector Layer

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

5.5 Generation of Reference Layers

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

5.6 Coding and Attribute Scheme

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

5.7 Map composition and output

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

6.0 ACCURACY ASSESSMENT

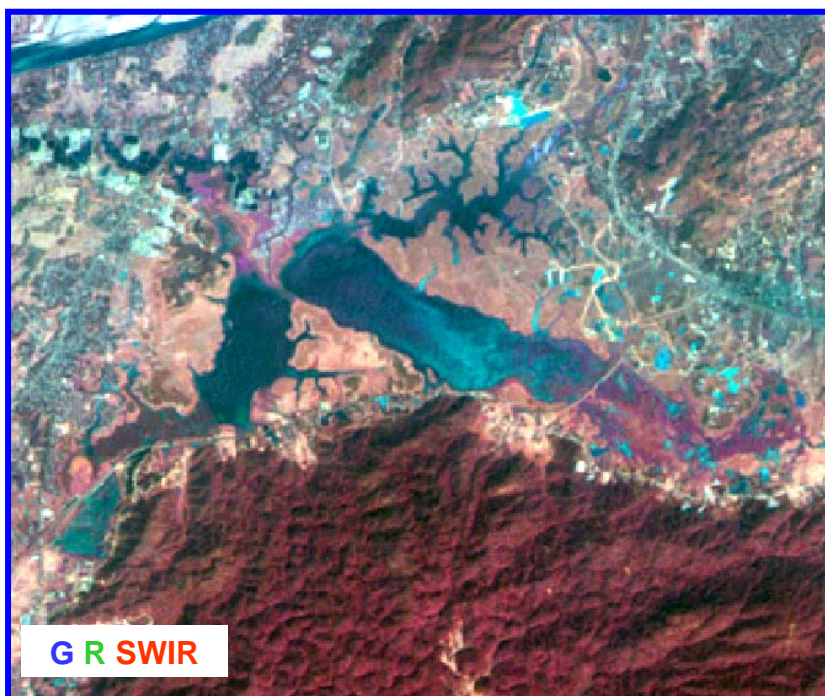
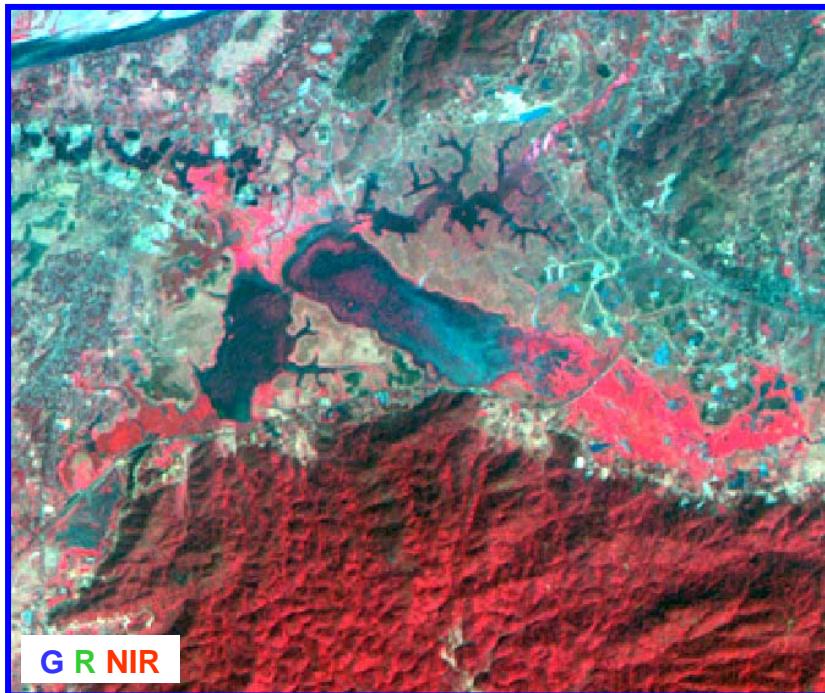
A comprehensive accuracy assessment protocol has been followed for determining the quality of information derived from remotely sensed data. Accuracy assessment involves determination of thematic (classification) as well as location accuracy. In addition, GIS database(s) contents have been also evaluated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

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

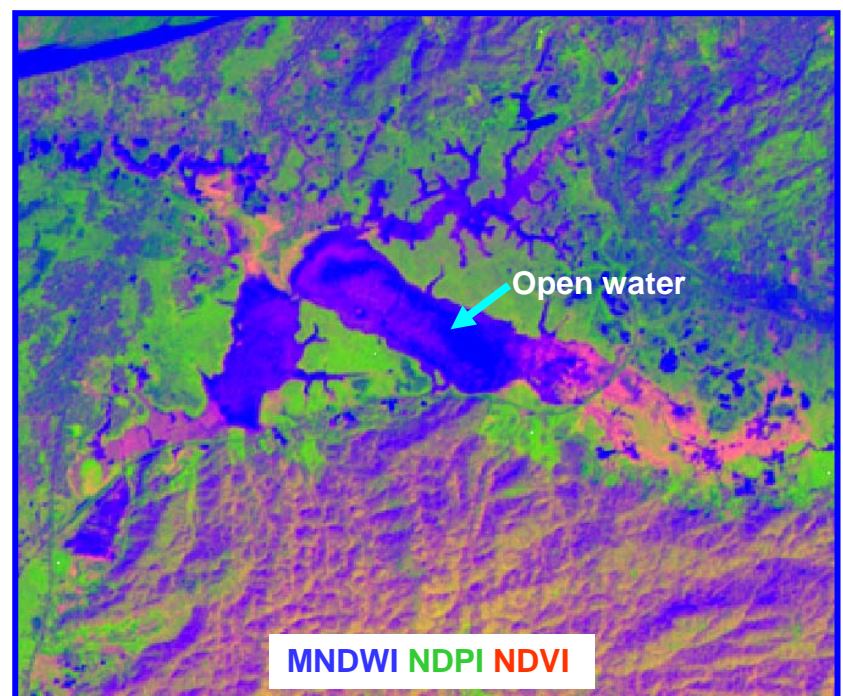
1. Image-Image Geo-referencing/Data generation
2. Reference layer preparation using NWIA post monsoon and pre-monsoon LISS-III data.
3. Wetland mapping using visual/digital interpretation techniques.
4. Geo-data base creation and organization
5. Output products.

6.1 Data verification and quality assurance of output digital data files

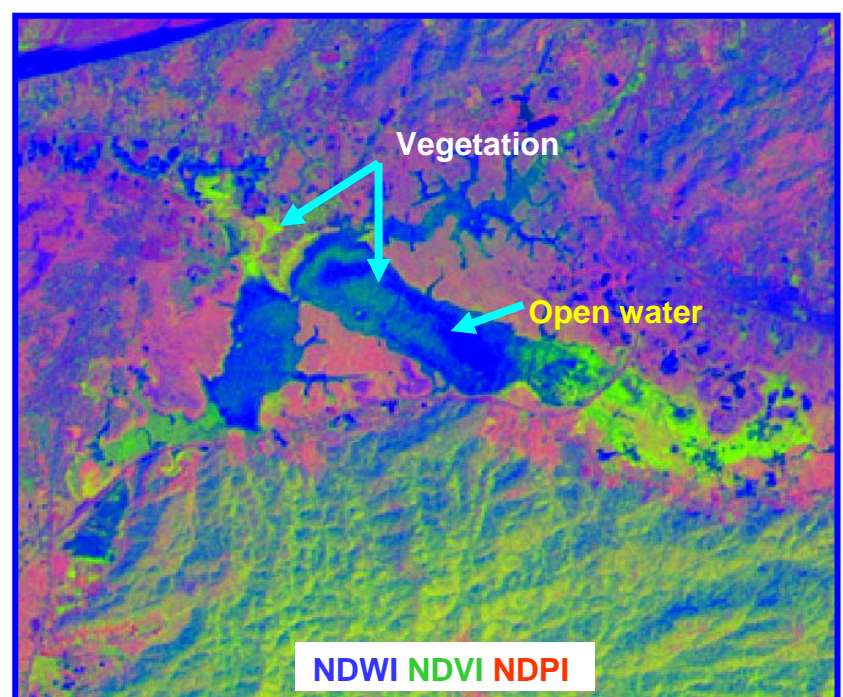
All digital data files were subjected to rigorous quality control inspections. Digital data verification included quality control checks that addressed the geospatial correctness, digital integrity and some cartographic aspects of the data. Implementation of quality checks ensured that the data conformed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



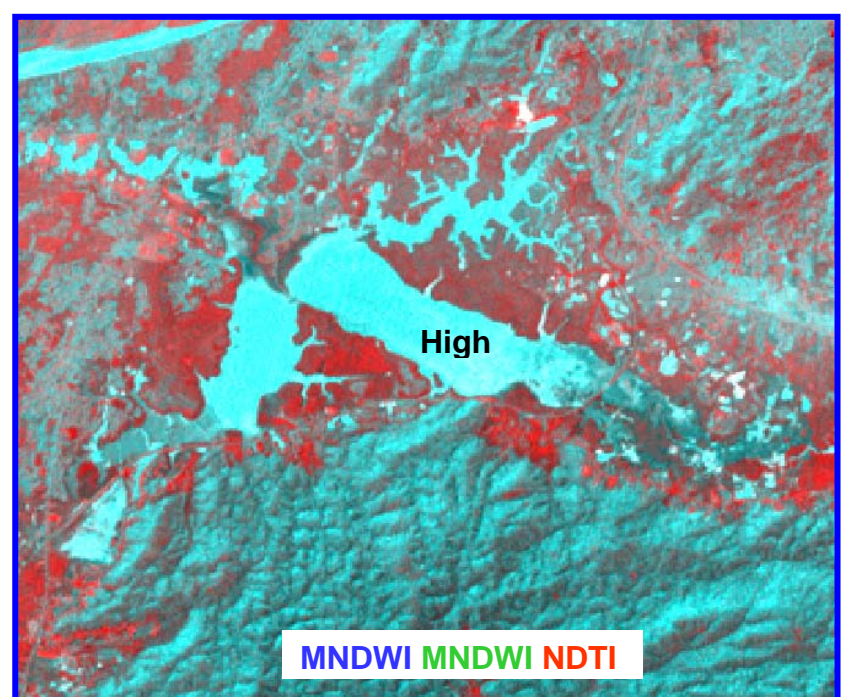
Deepor Beel,
IRS LISS III data, 01 November 2006



Useful for wetland boundary extraction/delineation



Useful for wetland vegetation & open water features



Useful for qualitative turbidity delineation

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

MAPS AND STATISTICS

7.0 WETLANDS OF NORTH-EASTERN STATES : MAPS AND STATISTICS

Area estimates of various wetland categories for North-Eastern states have been carried out using GIS layers encompassing wetland boundary, water-spread, aquatic vegetation and turbidity. Total wetland area estimated is 1074254 ha (1.07Mha) that is around 4.1 per cent of the geographic area. State-wise wetland summary is shown in Table 4. Analysis of wetland status in terms of open water showed around 57.2 % (614279 ha) and 52.2 % (560965 ha) during post monsoon and Pre-monsoon respectively. Aquatic vegetation (floating/emergent) occupies around 5.8 % (62217 ha) and 10.4 % (112190 ha) area of wetland during post and Pre-monsoon respectively. Graphical distribution of state-wise wetland area is shown in Figure 10

Table-4: State-wise wetland distribution in NE states

State code	State/UT	Geographic Area (sq. km.)	Wetland Area	% of total wetland area	% of state geographic area	Area in ha			
						Open water		Aquatic Vegetation	
						Post-monsoon	Pre-monsoon	Post-monsoon	Pre-monsoon
11	Sikkim	7096	7477	0.7	1.05	7189	5035	7	7
12	Arunachal Pradesh	83653	155728	14.5	1.86	66222	57516	6002	5924
13	Nagaland	16579	21544	2.01	1.3	20938	20650	7	604
14	Manipur	22327	63616	5.92	2.85	45304	39391	16756	23500
15	Mizoram	21087	13988	1.3	0.66	13799	13778	37	42
16	Tripura	11040	17542	1.63	1.59	9847	7023	1779	5232
17	Meghalaya	22420	29987	2.79	1.34	27912	27420	819	852
18	Assam	78438	764372	71.15	9.74	423068	390152	36817	76036
Total		262640	1074254	100.00	4.09	614279	560965	62224	112197

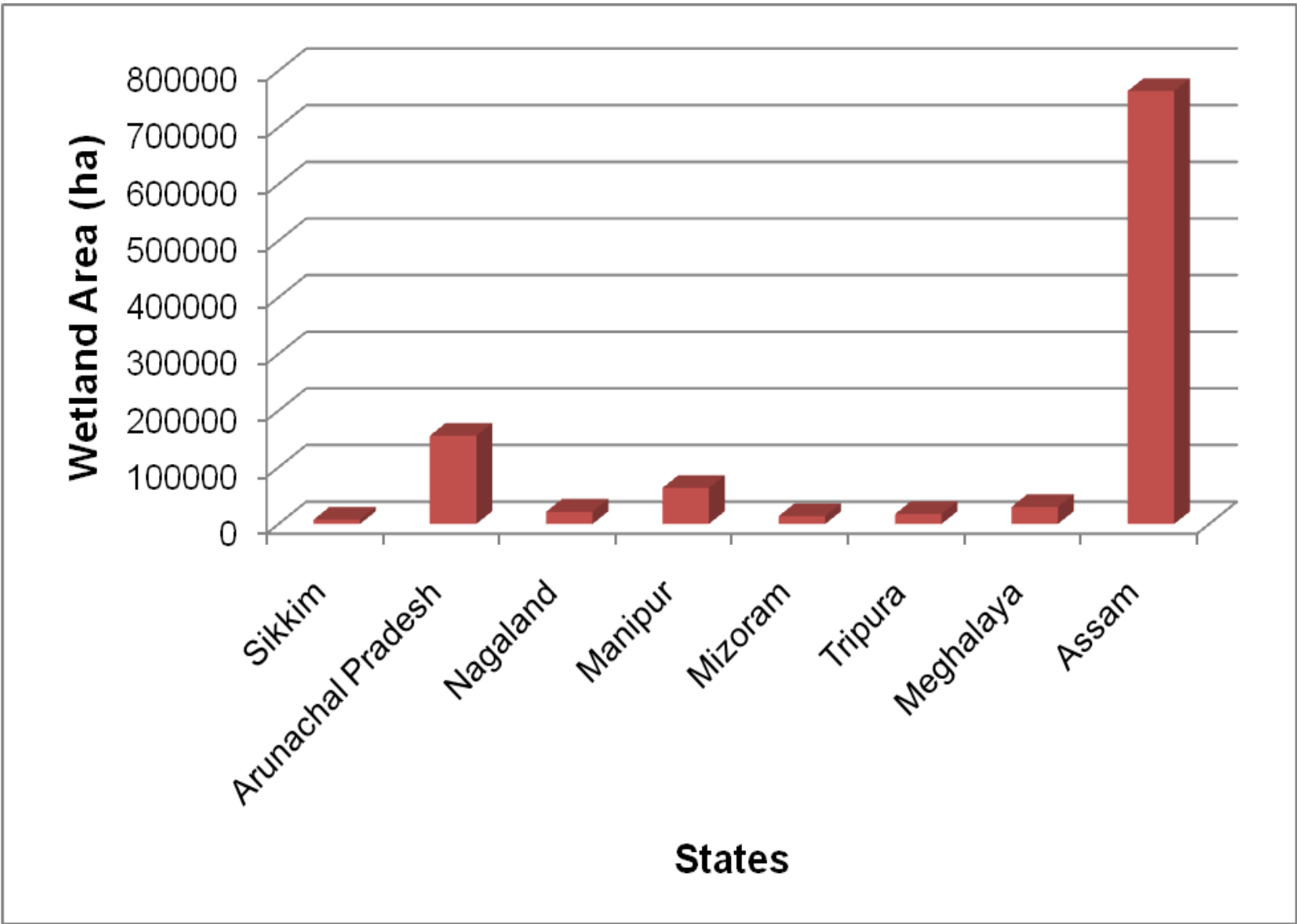


Figure 10: State-wise wetland distribution in NE States

In the NE states, 8018 wetlands have been delineated. In addition, 11585 small wetlands (< 2.25 ha) are also demarcated as point feature. The most dominant type of wetland is rivers/streams (857228 ha), occupying around 79.8 per cent of wetland area. The other major wetland types are lakes/ponds (91402 ha), waterlogged (63342 ha), ox-bow lakes (15614 ha). Though the high altitude lakes (14472 ha) is of minor category, they have significance in state of Arunachal Pradesh and Sikkim. Wetland type-wise summary is shown in Table 5. Graphical distribution of wetland type is shown in Figure 11.

Presence of aquatic vegetation is observed in many wetland types. The area under aquatic vegetation is significantly high during pre monsoon than that of post monsoon period. Qualitative turbidity analysis of the open water varied from moderate to low turbidity.

Table-5: Type-wise wetland distribution in NE states

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of Wetland Area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	1295	91402	8.51	57403	32288
2	1102	Ox-bow lakes/ Cut-off meanders	997	15614	1.45	8514	6231
3	1103	High altitude wetlands	1490	14472	1.35	10996	3880
4	1104	Riverine wetlands	143	5530	0.51	2505	2213
5	1105	Waterlogged	3057	63342	5.90	39588	16143
6	1106	River/Stream	610	857228	79.80	482167	490835
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	37	10309	0.96	8973	5448
8	1202	Tanks/Ponds	323	1580	0.15	1414	1285
9	1203	Waterlogged	55	549	0.05	336	303
		Total - Inland	8007	1060026	98.68	611896	558626
	2200	Coastal Wetlands - Man-made					
10	2201	Salt pans	-	-	-	-	-
11	2202	Aquaculture ponds	11	2643	0.25	2383	2339
		Total - Coastal	11	2643	0.25	2383	2339
		Sub-Total	8018	1062669	98.92	614279	560965
		Wetlands (<2.25 ha)	11585	11585	1.08	-	-
		Total	19603	1074254	100.00	614279	560965

Area under Aquatic Vegetation	62224	112197
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Area under turbidity levels		
Low	184443	126910
Moderate	415324	417666
High	14512	16390

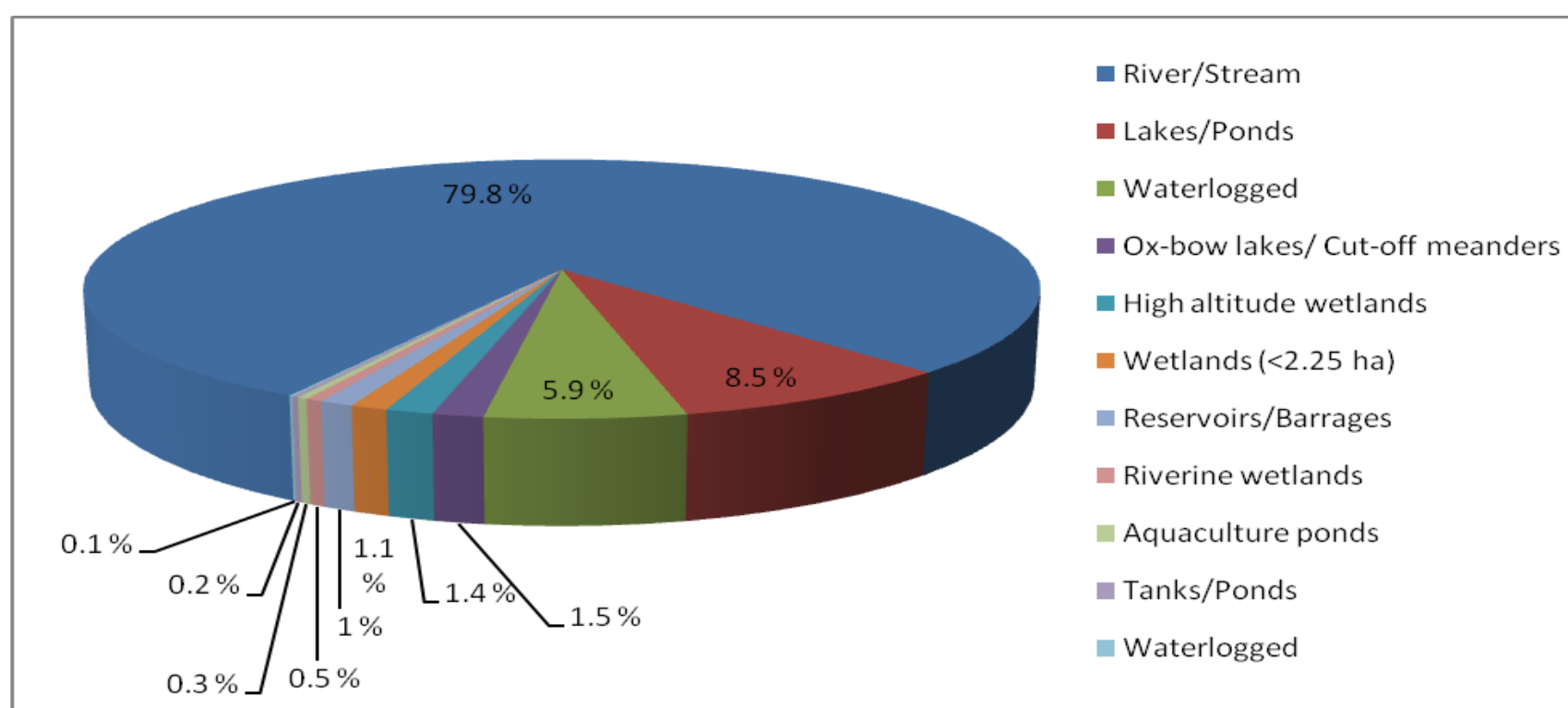


Figure 11: Type-wise wetland distribution in NE States

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

7.1 SIKKIM

Area estimates of various wetland categories for Sikkim have been carried out using GIS layers of wetland boundary, water-spread, aquatic vegetation and turbidity. Total 272 wetlands have been mapped at 1:50,000 scale in the state. In addition, 281 wetlands (smaller than 2.25 ha) have also been identified. Total wetland area estimated is 7477 ha accounting for about 1.05 per cent of the geographic area of state. The major wetland types are High altitude lakes accounting for 40.79 per cent of the wetlands (3050 ha), river/stream (4131 ha), Lake/ponds (15 ha). Graphical distribution of wetland type is shown in Figure 12.

For assessment of qualitative turbidity based on signature statistics of MNDWI image for open water features has been considered as explained in the methodology. Accordingly, wetlands where open water features have not been manifested on satellite data were excluded in spite of the fact that these wetlands are associated with water. Overall three wetland types are assessed for turbidity namely Lake/Pond, High altitude lake and River/Stream. Aquatic vegetation seen in lake/pond category having 7 ha in post- and pre-monsoon seasons

The extent of open water in post-monsoon of the year 2006 is 7189 ha which comprised 2380 ha of low and 4809 ha of moderate turbidity. The extent under turbidity classes changed considerably in the pre-monsoon of 2005 which is estimated as 885 ha of low and 4151 ha of moderate turbidity out of 5036 ha of open water features. Details of the wetland statistics of the district is given in Table 6.

Table 6: Area estimates of wetlands in Sikkim

Area in ha							
Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	1	15	0.20	8	8
2	1103	High altitude wetlands	259	3050	40.79	3050	896
3	1106	River/Stream	12	4131	55.25	4131	4131
		Sub-Total	272	7196	96.24	7189	5035
		Wetlands (<2.25 ha)	281	281	3.76	-	-
		Total	553	7477	100.00	7189	5035

Area under Aquatic Vegetation	7	7
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Area under turbidity levels		
Low	2380	885
Moderate	4809	4151
High	-	-

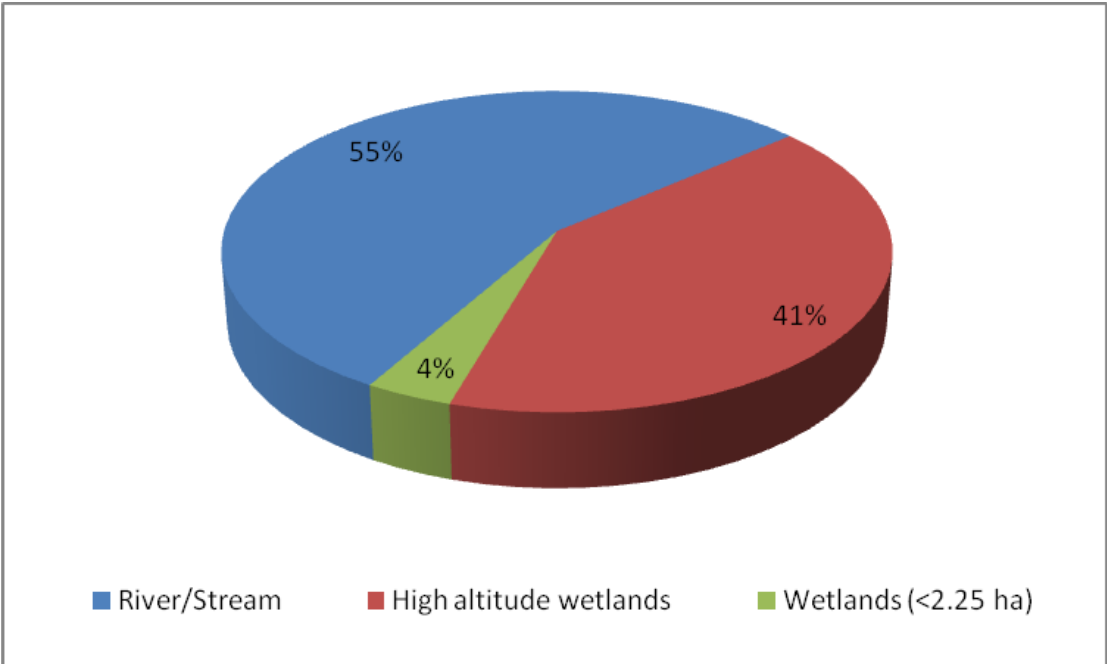


Figure 12: Type-wise wetland distribution in Sikkim

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

The state has four districts. District-wise distribution of wetlands showed that three districts can be called as wetland rich. North has highest concentration with around 63.72 percent of total wetland area in state and it share 1.13% of geographic area of district. This is mainly due to the location of the famous Gurudogmar Lake. The other two districts are: West and East with around 14.30 and 12.10 per cent area under wetland respectively. South district has the lowest area under wetland (9.88 per cent). Wetland category of High altitude was observed only in three districts. District-wise wetland area estimates is given in Table-7. Figure 13 shows district-wise graphical distribution of wetlands. The districts with very high concentration of small wetlands (< 2.25 ha) is North with 221 followed by East and West District with 42 and 16 respectively, while south district has lowest with 2 such wetlands.

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

Table-7: District-wise wetland area in Sikkim

District code	District	Geographic Area	Wetland Area	% of total wetland area	% of district geographic area	Open water		Aquatic Vegetation (ha)	
						Post-monsoon	Pre-monsoon	Post-monsoon	Pre-monsoon
		(sq. km.)	(ha)		(ha)	(ha)	(ha)	(ha)	(ha)
1	North	4226	4764	63.72	1.13	4543	2585	0	0
2	West	1166	1069	14.30	0.92	1046	963	7	7
3	South	750	739	9.88	0.99	737	737	0	0
4	East	954	905	12.10	0.95	863	750	0	0
	Total	7096	7477	100.00	1.05	7189	5035	7	7

* source : <http://sikkim.nic.in>

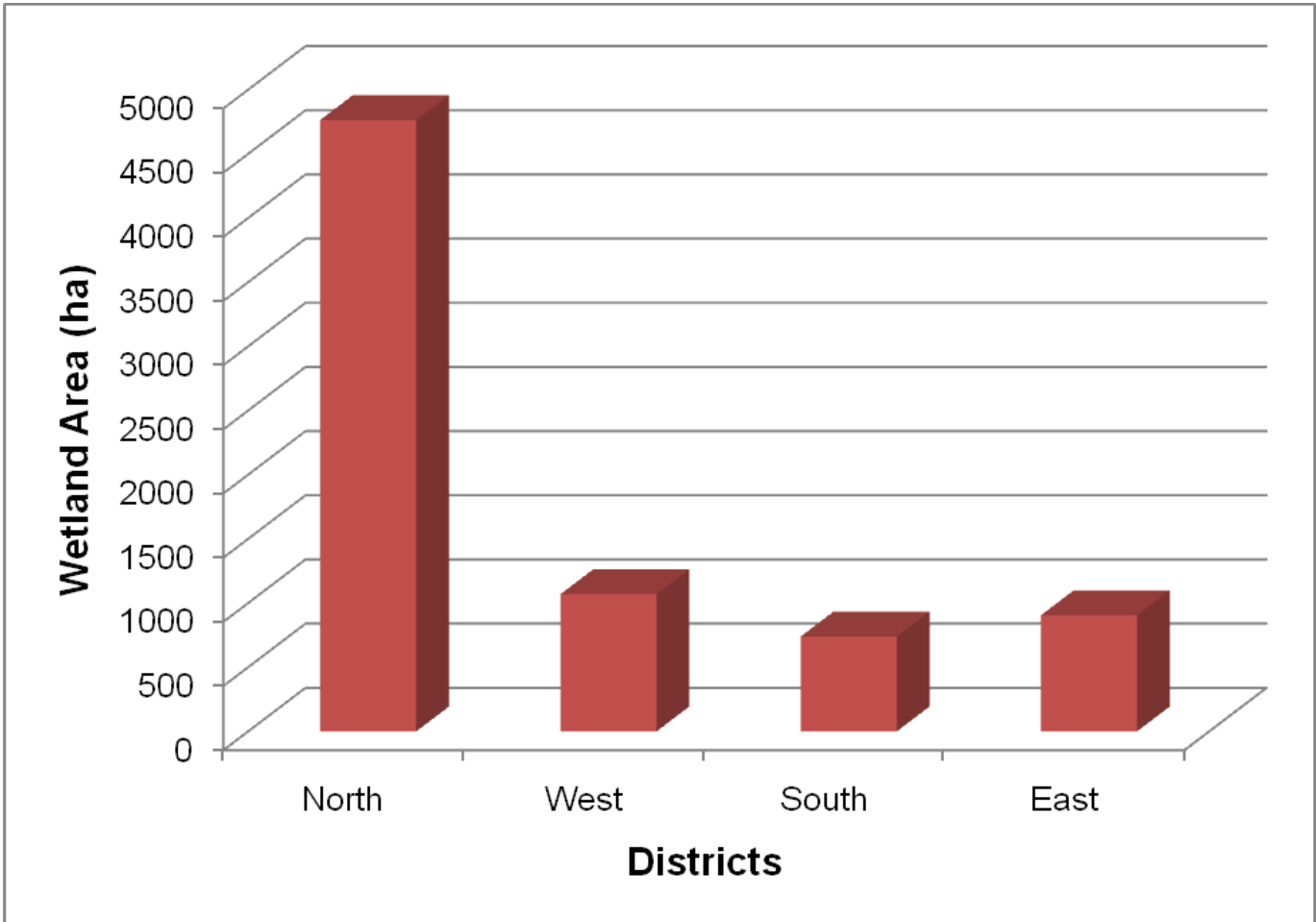
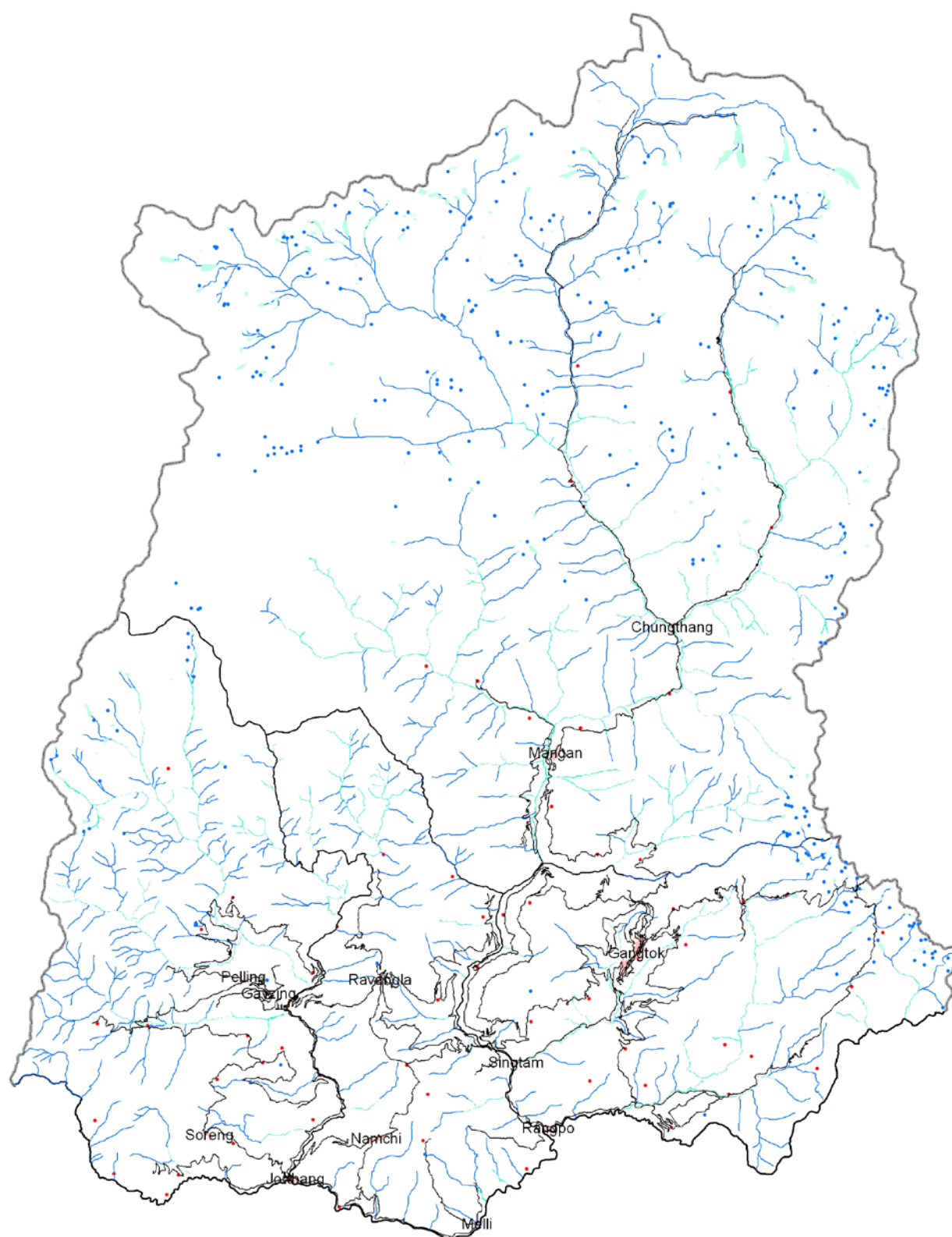


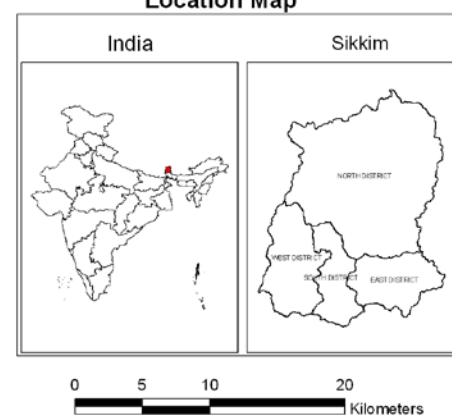
Figure 13: District-wise wetland distribution in Sikkim



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

Legend

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

Location Map

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

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

Sponsored By:
Ministry of Environment and Forests
Government of India

7.1.1 North

The North District lies between 88°07'00" E to 88°31'48" E Longitudes and 27°04'12" N and 27°33'00" N Latitudes and the total geographical area of the District is 4226 Sq. Km. It is bounded on the North by China, on the South by South West and East District, on the East by China. The total population of the district is 41030 (census 2001). The District is divided into two Sub-Divisions, viz (1) Mangan Sub-Division with its HQ at Mangan, and (2) Chungthang Sub-Division with its HQ at Chungthang. This district can be termed as the wetland district of the state as the wetland area estimated is 4764 ha, accounting for 1.13 per cent of geographic area. The wetland types found are High altitude lakes (wetland) and River/Stream. Small wetlands, which are less than minimum mapable units, are 221 in the district. The dominant type of wetland found in the North district is high altitude lakes (wetland) which account for around 56.13 per cent of the total wetland area of the district. Major part of the famous Gurudogmar Lake lies in this district. All the wetlands of this district comes under open water and there is no aquatic vegetation found in this district. The turbidity rating of the open water is observed to be mainly moderate. Details of the wetland statistics of the district is given in Table 8.

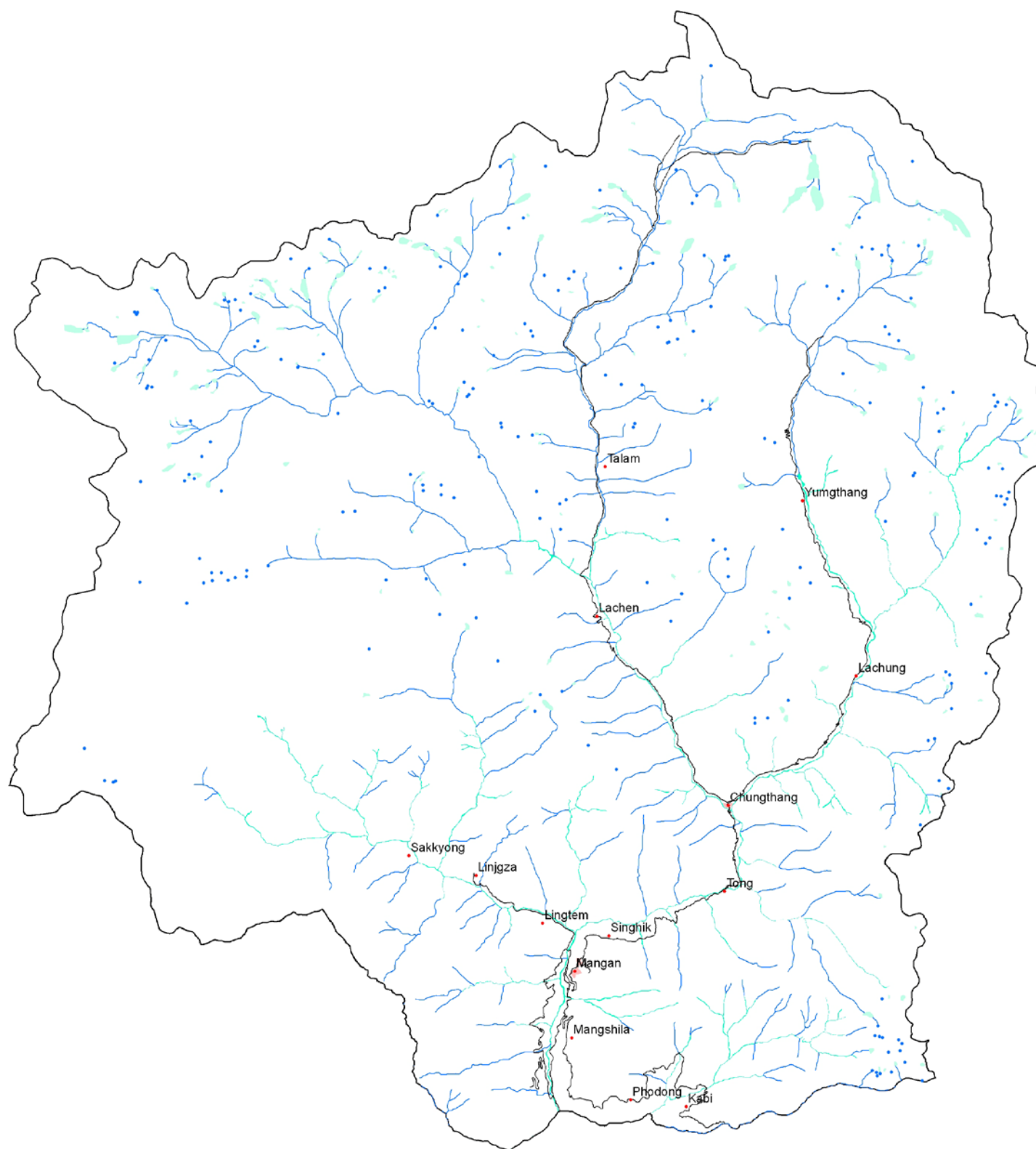
The extent of open water in post-monsoon of 2006 is 4543 ha which comprised 2171 ha of low and 2372 ha of moderate. The extent under turbidity classes changed considerably in the pre-monsoon of 2005 which is estimated as 598 ha of low and 1988 ha of moderate turbidity out of 2585 ha of open water features.

Table 8: Area estimates of wetlands in North

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1103	High altitude wetlands	207	2674	56.13	2674	716
3	1106	River/Stream	4	1869	39.23	1869	1869
		Sub-Total	211	4543	95.36	4543	2585
		Wetlands (<2.25 ha), mainly Tanks	221	221	4.64	-	-
		Total	432	4764	100.00	4543	2585

Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	2171	598
Moderate	2372	1987
High	-	-

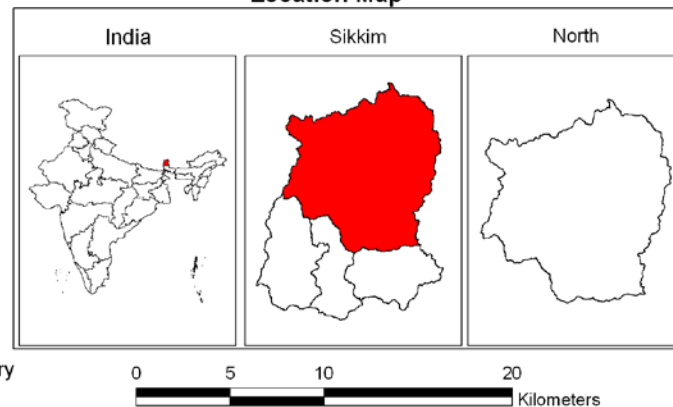


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



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

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

Sponsored By:
Ministry of Environment and Forests
Government of India

7.1.2 West

The west District lies in the western part of Sikkim at and 88°01'00" E to 88°21'00" E Longitude and 27°06'00" N to 27°36'00" N Latitude. It is the border district of the state. Its neighbors are Nepal in west, south district in the east, West Bengal on the south and North district of Sikkim on the north. The district headquarter is about 95 km away from Gangtok. The famous lake Khechodpalri lies in this district. The total geographical area of the district is 1166 sq. km. The district is divided into two subdivision viz. Gayzing and Soreng. As per Census 2001, the population of the district is 1, 23,256 with the density of population per sq. km. being 84. The wetland area estimated is 1069 ha. Small wetlands, which are less than minimum mapable units (MMU), are 16 in the district. The major wetland type is river/stream and high altitude lakes, which account for 80.45 % and 16.65 % (Table 10). There is only one lake/pond with 15 ha of extent. High altitude lakes have shown reduction in seasonal extent from post-monsoon (178 ha) to pre-monsoon (95 ha). Till the date of data acquisition (November 15, 2005) freezing has taken place and on the other hand in pre-monsoon (April 13, 2005) melting has not occurred which resulted in lower pre-monsoon open water extent compared to post-monsoon open water extent. Details of the wetland statistics of the district is given in Table 9.

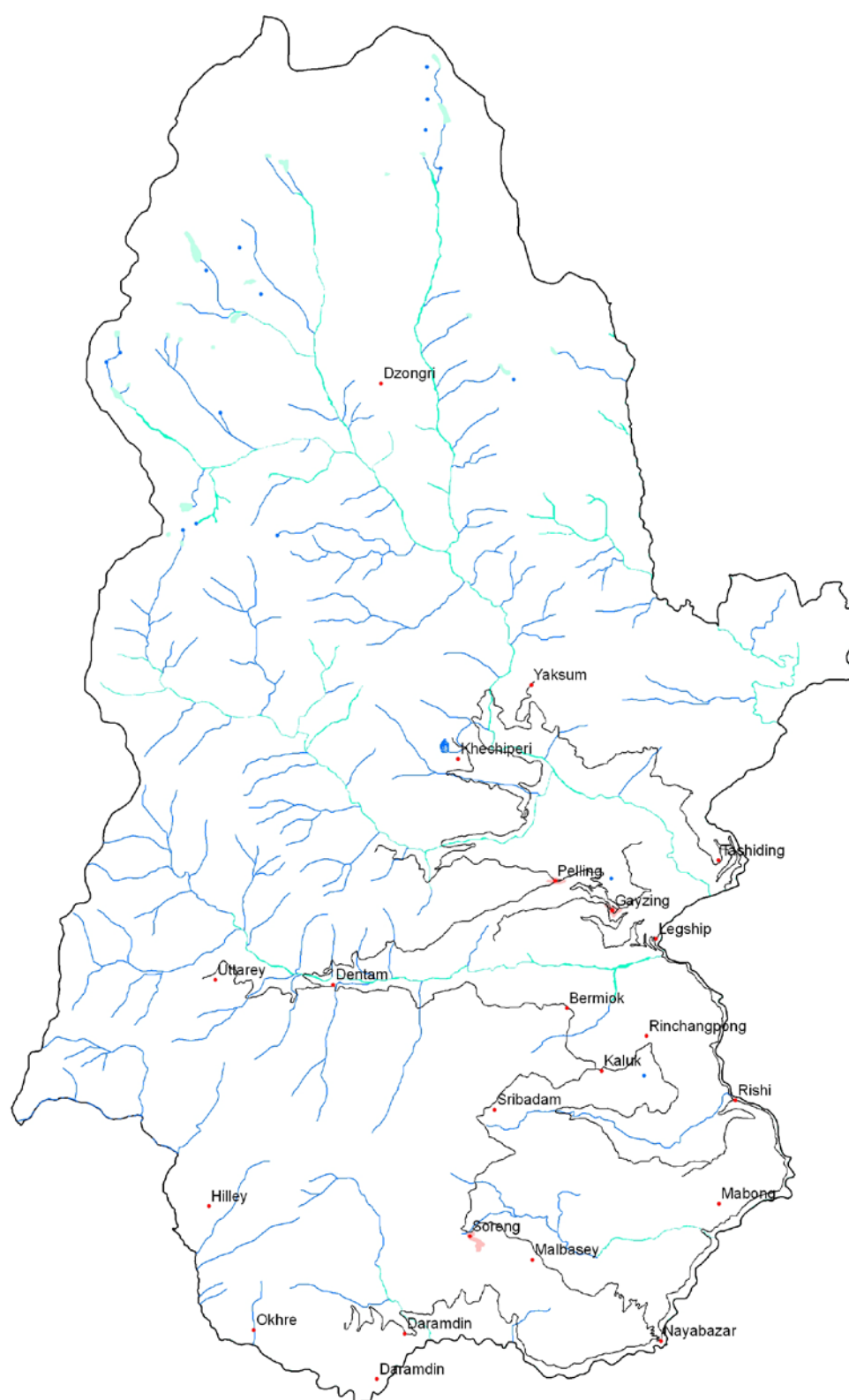
For assessment of qualitative turbidity based on signature statistics of MNDWI image for open water features has been considered as explained in the methodology. Accordingly, wetlands where open water features have not been manifested on satellite data were excluded in spite of the fact that these wetlands are associated with water. Overall three wetland types are assessed for turbidity namely lakes, High altitude wetlands and River/Stream. The extent of open water in post-monsoon of 2005 is 1046 ha which comprised 158 ha of low and 888 ha of moderate. The extent under turbidity classes changed considerably in the pre-monsoon of 2005 which is estimated as 235 ha of low and 728 ha of moderate turbidity out of 963 ha of open water features.

Table 9: Area estimates of wetlands in West

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	1	15	1.40	8	8
2	1103	High altitude wetlands	23	178	16.65	178	95
3	1106	River/Stream	4	860	80.45	860	860
		Sub-Total	28	1053	98.50	1046	963
		Wetlands (<2.25 ha), mainly Tanks	16	16	1.50	-	-
		Total	44	1069	100.00	1046	963

Area under Aquatic Vegetation	7	7
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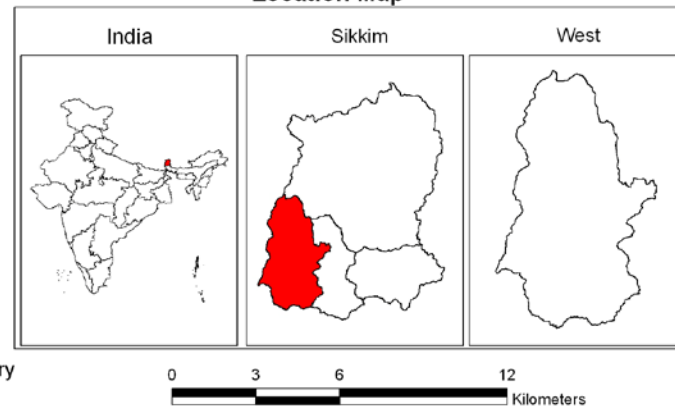
Area under turbidity levels		
Low	158	235
Moderate	888	728
High	-	-



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

Legend

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

Location Map**Data Source:**

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

Prepared By:Space Applications Centre (ISRO), Ahmedabad
and
Sikkim State Council of Science and Technology, DST**Sponsored By:**Ministry of Environment and Forests
Government of India

7.1.3 South

South District with its district headquarter at Namchi (85km from Gangtok), has the total geographic area of 750 sq km. Its location is 88°15'00" E to 88°32'00" E longitude and 27°04'00" N to 27°32'00" N latitude. The district is bounded by Tista River in the East, Rangit River in the south and west, Dzongu area of North district in the North. There are two subdivision viz. Namchi and Ravongla. Namchi is the fast growing town of Sikkim with the development of various tourist spots and other small scale industries. Agriculture is the main occupation of the people in the district. The total population of the district is 1, 31,525 (census 2001). The district receives least rainfall in comparison with the other district hence regarded as the driest district of Sikkim. The district has least presence of wetlands excepting river/stream. The wetland area estimated is 739 ha, which is only due to the presence of river/stream. Small wetlands, which are less than minimum mapable units, are 2 in the district. Due to perennial nature, the open water extents (737 ha) of river/stream have remained unchanged irrespective of seasons. Details of the wetland statistics of the district is given in Table 10.

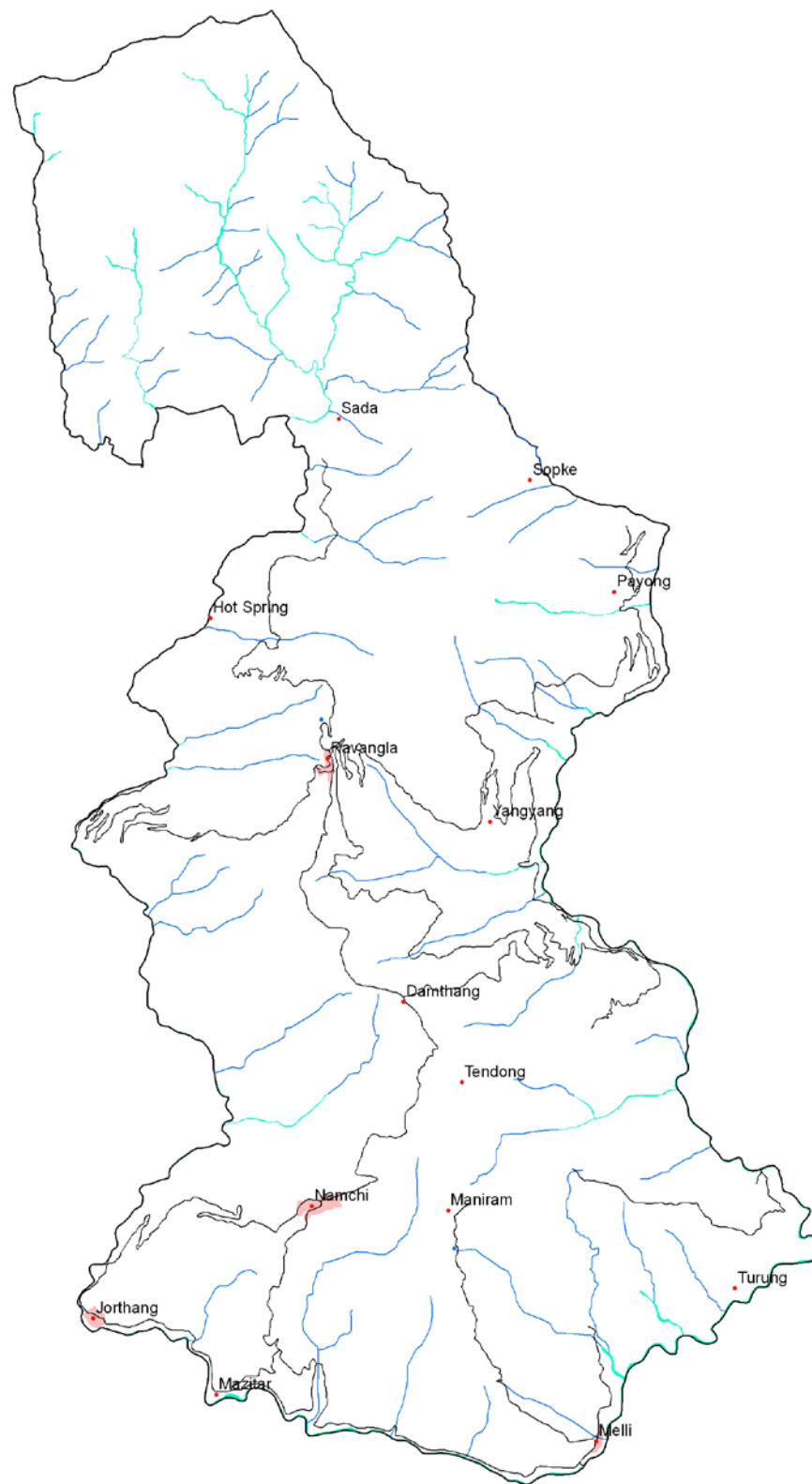
As mentioned earlier, wetlands where open water features have not been manifested on satellite data were excluded in spite of the fact that these wetlands are associated with water. Only wetland type is assessed for turbidity namely River/Stream. The extent of open water in post-monsoon of 2005 is 737 ha which comprised of moderate turbidity. The turbidity of open water remained moderately turbid in both seasons.

Table 10: Area estimates of wetlands in South

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1103	High altitude wetlands	-	-	-	-	-
3	1106	River/Stream	3	737	99.73	737	737
		Sub-Total	3	737	99.73	737	737
		Wetlands (<2.25 ha), mainly Tanks	2	2	0.27	-	-
		Total	5	739	100.00	737	737

Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	-	-
Moderate	737	737
High	-	-

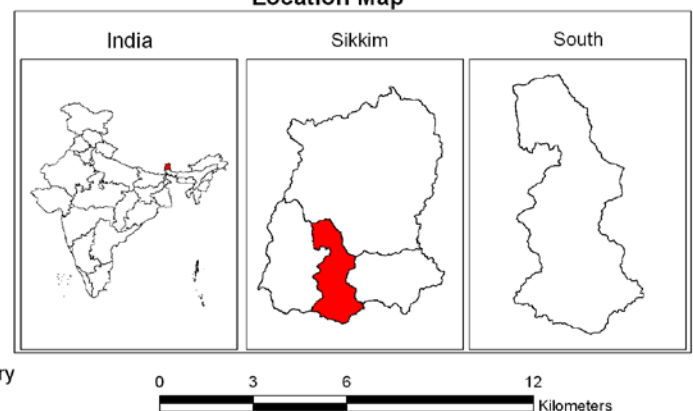


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



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

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

Sponsored By:
Ministry of Environment and Forests
Government of India

7.1.4 East

East District, located in the south eastern corner of Sikkim. Its location is 88°26'00" E to 88°55'00" E and 27°08'00" N to 27°25'00"N and has an area of 954 sq. km. According to 2001 census, the total population of the district is 2, 45,040. The district is divided into 3 revenue Sub-divisions, namely Gangtok subdivision, Pakyong subdivision and Rongli subdivision. The district is mainly drained by tributaries of Tista River, Rangpo chu, Ronghichu. Tshangu Lake is the important lake of the East District which attracts many tourists to the state. The wetland area estimated is 905 ha. Small wetlands, which are less than minimum mapable units (MMU), are 42 in the district. This is mainly due to presence of river/streams and high altitude lakes. River/stream dominates the wetland area comprising 73.48 % of area with perennial nature. High altitude lakes show reduction in extent of open water from post-monsoon to pre-monsoon owing to non-melting. Details of the wetland statistics of the district is given in Table 11.

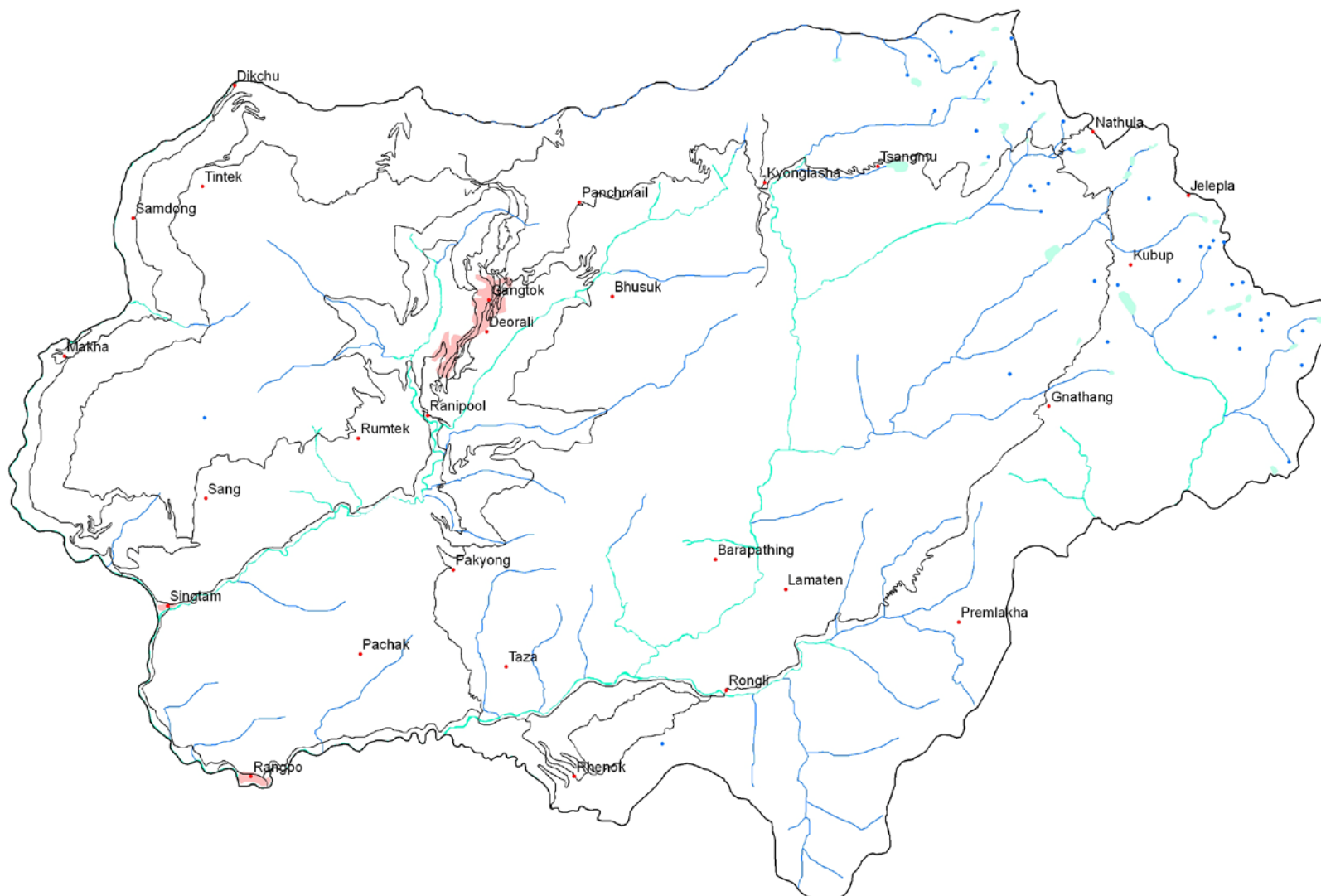
For assessment of qualitative turbidity based on signature statistics of MNDWI image for open water features has been considered as explained in the methodology. Accordingly, wetlands where open water features have not been manifested on satellite data were excluded in spite of the fact that these wetlands are associated with water. Overall two wetland types are assessed for turbidity namely lakes, High altitude wetlands and River/Stream. The extent of open water in post-monsoon of 2005 is 863 ha which comprised 51 ha of low and 812 ha of moderate turbidity. The extent under turbidity classes changed considerably in the pre-monsoon of 2005 which is estimated as 52 ha of low and 698 ha of moderate turbidity out of 750 ha of open water features.

Table 11: Area estimates of wetlands in East

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1103	High altitude wetlands	29	198	21.88	198	85
3	1106	River/Stream	6	665	73.48	665	665
		Sub-Total	35	863	95.36	863	750
		Wetlands (<2.25 ha), mainly Tanks	42	42	4.64	-	-
		Total	77	905	100.00	863	750

Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	51	52
Moderate	812	698
High	-	-

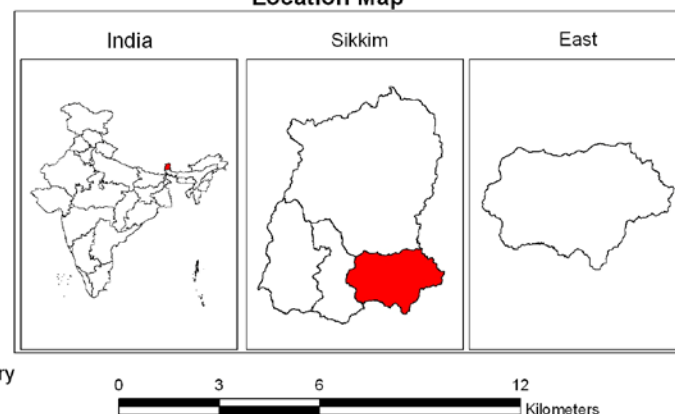


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
1101				Lakes/Ponds
1102				Ox-bow lakes/ Cut-off meanders
1103				High altitude wetlands
1104				Reverine wetlands
1105				Waterlogged
1106				River/Stream
			Man-made	
1201				Reservoirs/Barrages
1202				Tanks/Ponds
1203			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

Legend

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

Location Map



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

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

Sponsored By:
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7.2 ARUNACHAL PRADESH

Area estimates of various wetland categories for Arunachal Pradesh have been carried out using GIS layers of wetland boundary, water-spread, aquatic vegetation and turbidity. Total 1534 wetlands have been mapped at 1:50,000 scale in the state. In addition, 1119 wetlands (smaller than 2.25 ha) have also been identified. Total wetland area estimated is 155728 ha that is around 1.86 per cent of the geographic area (Table 12). The major wetland types are river/stream accounting for 86 percent of the wetlands (134244 ha), High altitude wetlands (11422 ha), and waterlogged (8146 ha). Graphical distribution of wetland type is shown in Figure 14.

Analysis of wetland status in terms of open water and aquatic vegetation showed that around 43 and 37 percent of wetland area is under open water category during post monsoon and Pre-monsoon respectively. Aquatic vegetation (floating/emergent) occupies around 3.8 and 3.3 per cent of wetland area during post-and Pre-monsoon respectively. Qualitative turbidity analysis of the open water showed that low and moderate turbidity prevail (around 85 and 12 percent respectively during Post-monsoon).

Table 12: Area estimates of wetlands in Arunachal Pradesh

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	3	18	0.01	16	-
2	1102	Ox-bow lakes/ Cut-off meanders	29	520	0.33	180	39
3	1103	High altitude wetlands	1231	11422	7.33	7946	2984
4	1105	Waterlogged	107	8146	5.23	60	7
5	1106	River/Stream	128	134244	86.20	57811	54354
	1200	Inland Wetlands -Man-made					
6	1201	Reservoirs/Barrages	4	164	0.11	162	124
7	1202	Tanks/Ponds	32	95	0.06	47	8
		Sub-Total	1534	154609	99.28	66222	57516
		Wetlands (<2.25 ha), mainly Tanks	1119	1119	0.72	-	-
		Total	2653	155728	100.00	66222	57516

Area under Aquatic Vegetation	6002	5924
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Area under turbidity levels		
Low	56471	45810
Moderate	7984	9541
High	1767	2165

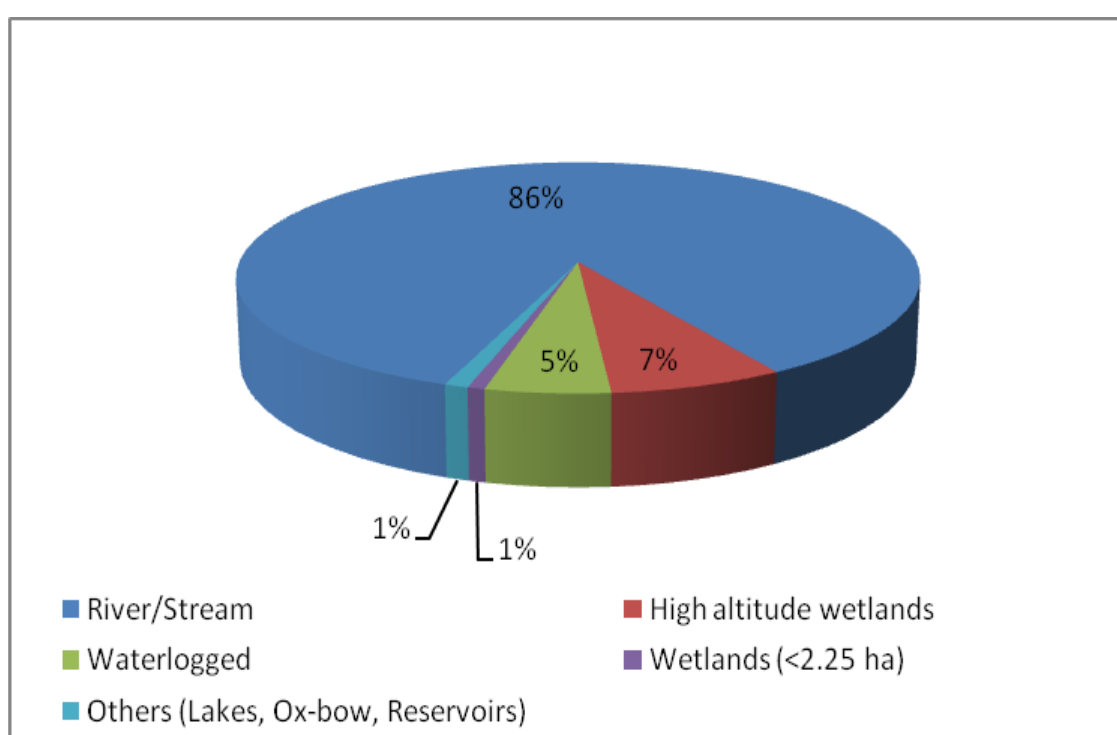


Figure 14: Type-wise wetland distribution in Arunachal Pradesh

The state has thirteen districts. District-wise distribution of wetlands showed that three districts can be called as wetland rich. Lohit has highest concentration with around 45719 ha of geographic area under wetland. This is mainly due to the large number of rivers/streams area. The other two districts are: Dibang valley and East Siang with around 37,602 ha and 25,512 ha area under wetland. Tirap district has the lowest area under wetland (around 1,262 ha). Wetland category of High Altitude lakes was observed in Dibang Valley(443), Lohit(204) and Tawang(204) districts. Few high altitude lakes are observed in West Kameng, East Kameng, West Siang Lower subansiri, Upper Subansiri and Upper Siang districts also. There are no major reservoirs exists in the state. District-wise wetland area estimates is given in Table-13. District-wise graphical distribution of wetlands in Arunachal Pradesh is shown in Figure 15.

The districts with very high concentration of small wetlands (< 2.25 ha) are Dibang Valley and Lohit with 266 and 240 numbers respectively, while East Kameng district has lowest with 12 such wetlands. Wetland statistics followed by wetland map and corresponding satellite data for each district is given to have a fairly good idea about the distribution pattern and density of wetlands in the district.

Table-13: District-wise wetland distribution in Arunachal Pradesh

District code	District	Geographic Area	Wetland Area	% of total wetland area	% of district geographic area	Open water		Aquatic Vegetation (ha)	
						Post-monsoon	Pre-monsoon	Post-monsoon	Pre-monsoon
		(sq. km.)	(ha)		(ha)	(ha)	(ha)	(ha)	(ha)
1	Tawang	2172	1822	1.17	0.84	1718	1661	0	0
2	West Kameng	7422	3825	2.46	0.52	2964	2969	0	0
3	East Kameng	4134	5443	3.50	1.32	3572	3524	0	0
4	Papum Pare	2875	2718	1.75	0.95	1748	2013	0	0
5	Lower Subansiri	10135	3607	2.32	0.36	3193	3023	0	0
6	Upper Subansiri	7032	3365	2.16	0.48	2924	2447	0	0
7	West Siang	8325	6147	3.95	0.74	4644	5007	0	0
8	East Siang	4005	25512	16.38	6.37	11041	7848	554	244
9	Upper Siang	6188	6686	4.29	1.08	5314	3884	0	0
10	Dibang Valley	13029	37605	24.15	2.89	12682	9623	382	23
11	Lohit	11402	45719	29.36	4.01	11676	10695	4208	4724
12	Changlang	4662	12017	7.72	2.58	3543	3642	851	928
13	Tirap	2362	1262	0.81	0.53	1203	1180	7	5
	Total	83743	155728	100.00	1.86	66222	57516	6002	5924

* source : <http://arunachalpradesh.nic.in>

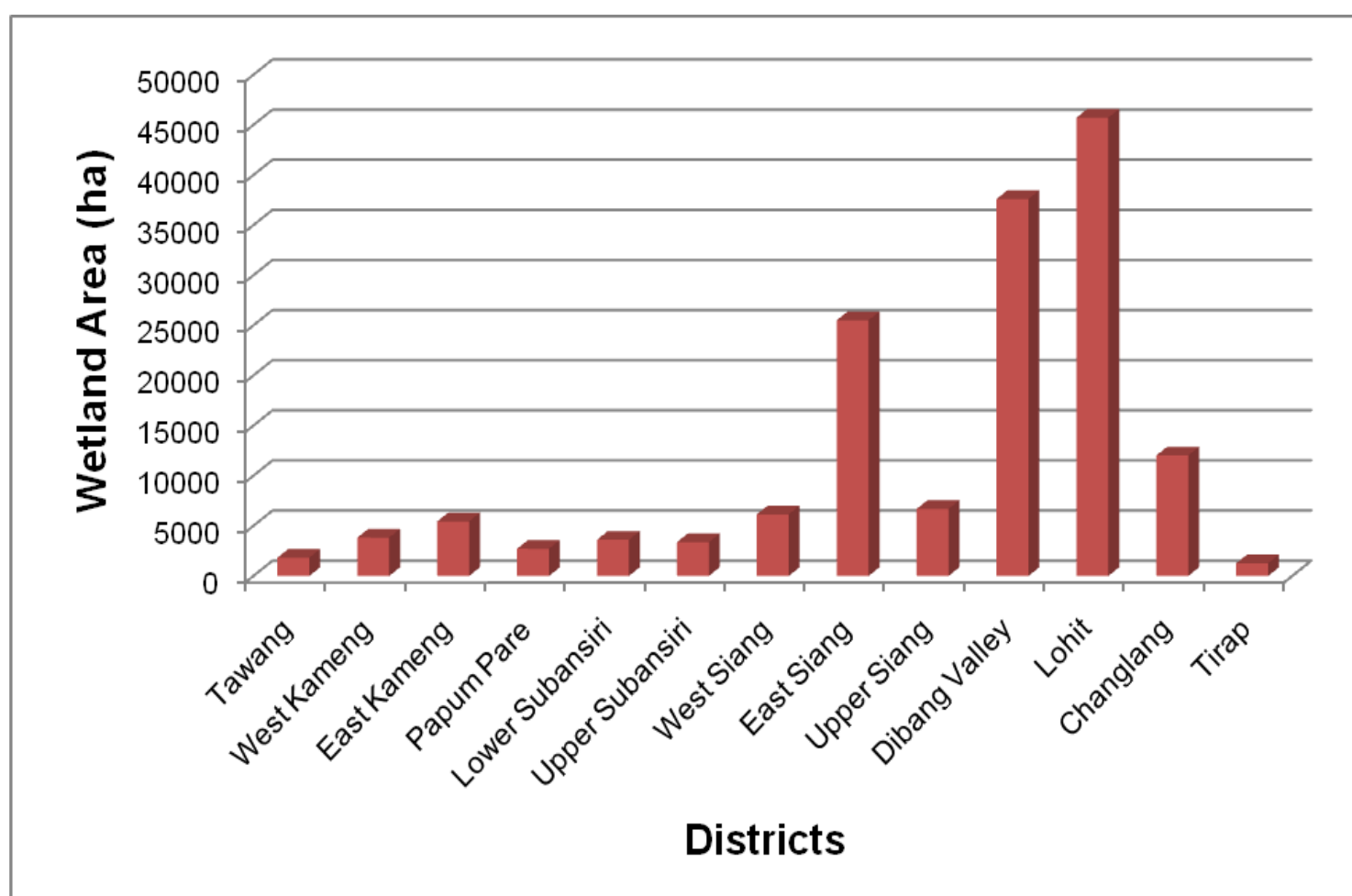
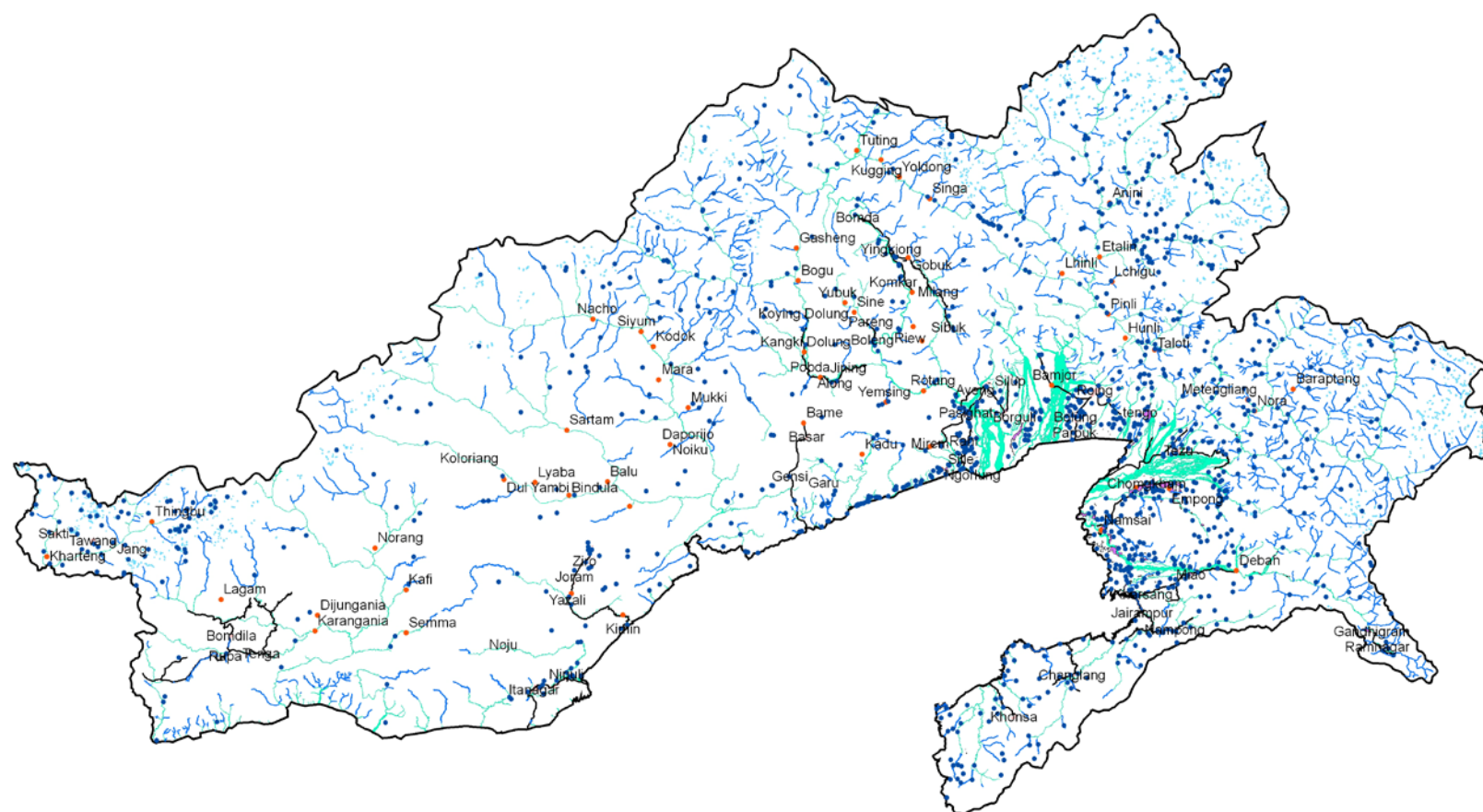



















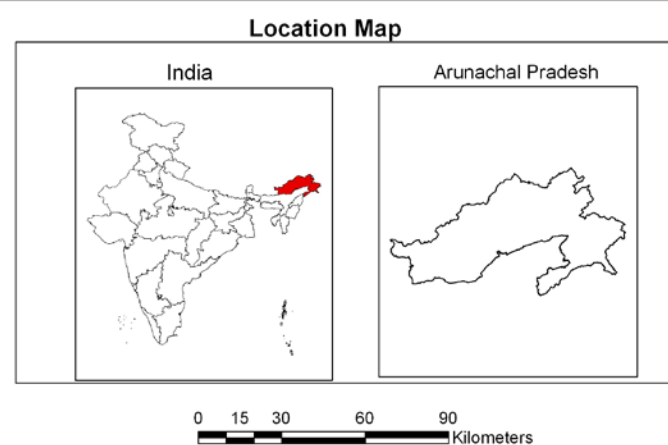


Figure 15: District-wise wetland distribution in Arunachal Pradesh



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

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- +— Railway
- Roads
- District Boundary
- Towns/Settlements



Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
Sponsored By:
Ministry of Environment and Forests Government of India

7.2.1 Tawang

Tawang Town is the district headquarters. The Tawang district is located around latitude 27° 45' N and longitude 90° 15' E at the northwest extremity of Arunachal Pradesh. Elevations range between 6,000 to 22,000 feet, and inhabitants are found in lower altitude, where they enjoy a cool temperate climate. The district was carved out of the West Kameng district, that adjoins it to the south and east. Bhutan borders The district occupies an area of 2085 square kilometers and has a population of 38,924 (as of 2001), almost 75% of which are considered "tribal", i.e. belonging to the native Monpa, Bhotia, Adi etc. In winter, Tawang frequently experiences heavy snowfall. Tawang district is further sub-divided into the Lumla, Jang and Tawang sub-divisions.

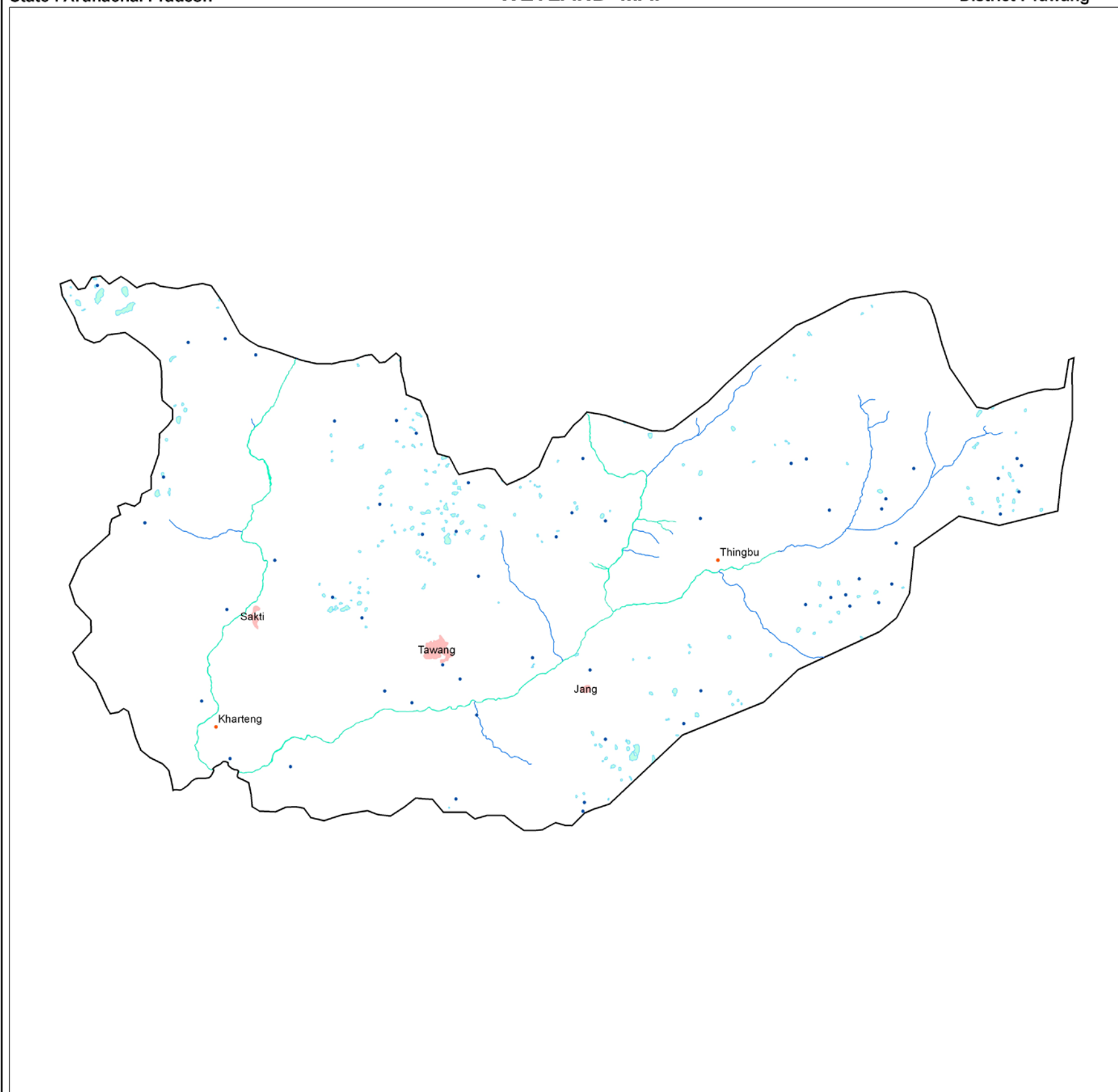
There are good number of high attitude wetlands exists in the district. Total wetland area estimated is 1822 ha. Small wetlands, which are less than minimum mapable units (MMU), are 58 in the district. The dominant type of wetland found in the district is high altitude wetlands. The turbidity rating of the open water is observed to be mainly low. Details of the wetland statistics of the district is given in Table 14.

Table 14: Area estimates of wetlands in Tawang

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1103	High altitude wetlands	204	1084	59.50	1072	981
2	1106	River/Stream	1	680	37.32	646	680
		Sub-Total	205	1764	96.82	1718	1661
		Wetlands (<2.25 ha), mainly Tanks	58	58	3.18	-	-
		Total	263	1822	100.00	1718	1661

Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	1698	1661
Moderate	2	-
High	18	-

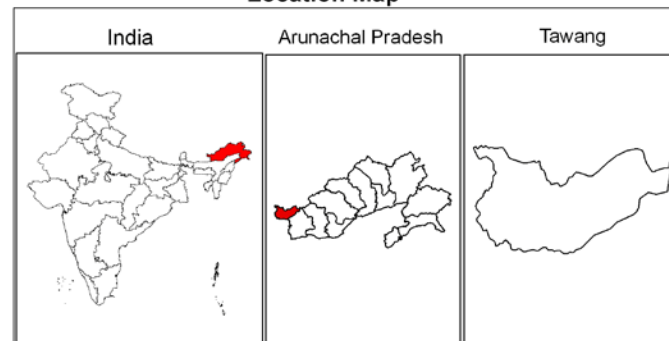


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map



0 2.5 5 10 15
Kilometers

Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad

Sponsored By :

Ministry of Environment and Forests
Government of India

7.2.2 West Kameng

West Kameng accounts for 8.86% of the total area of the state. The name is derived from the Kameng river, a tributary of the Brahmaputra, that flows through the district. The district headquarters are located at Bomdila. The district occupies an area of 7422 km² and has a population of 74,595 (as of 2001). West Kameng lies between 91° 30' to 92° 40' East longitudes and 26° 54' to 28° 01' North latitudes. The district shares an international border with Tibet in the north, Bhutan in the west, Tawang District in the northwest, and East Kameng district in the east. The southern border is shared with Sonitpur district and Darrang district of Assam. The Eaglenest Wildlife Sanctuary is located in West Kameng.

The topography is mostly mountainous. Much of West Kameng area is covered with the Himalayas. The highest peak in the district and state is Kangte. West Kameng district experiences an arid tundra or a cool temperate climate in the north. Snow fall occurs from mid-November to February.

The district is divided into three subdivisions, Thrizino, Rupa and Bomdila, and twelve administrative circles, including Dirang, Bomdila, Kalaktang, Balem, Bhalukpong, Jameri, Sinchung, Nafra, Thrizino, Rupa, Thembang, Shergaon. The four development blocks are Dirang, Kalaktang, Nafra-Buragaon, and Thrizino.

Like most of Arunachal Pradesh, Jhum, or shifting cultivation, is practised among the tribes who live in lower elevations where there is a temperate or subtropical climate. Horticulture is practised as well.

The district has very less wetlands. Total wetland area estimated is 3825 ha. Small wetlands, which are less than minimum mapable units (MMU), are 23 in the district. The major wetland types are River/Stream and high altitude wetlands (Table 15). The turbidity rating of the open water is observed to be mainly low.

Table 15: Area estimates of wetlands in West Kameng

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	1103	High altitude wetlands	96	421	11.01	275	159
2	1106	River/Stream	23	3381	88.39	2689	2810
		Sub-Total	119	3802	99.40	2964	2969
		Wetlands (<2.25 ha), mainly Tanks	23	23	0.60	-	-
		Total	142	3825	100.00	2964	2969
Area under Aquatic Vegetation						-	-
Area under turbidity levels							
Low						2673	2969
Moderate						239	-
High						52	-

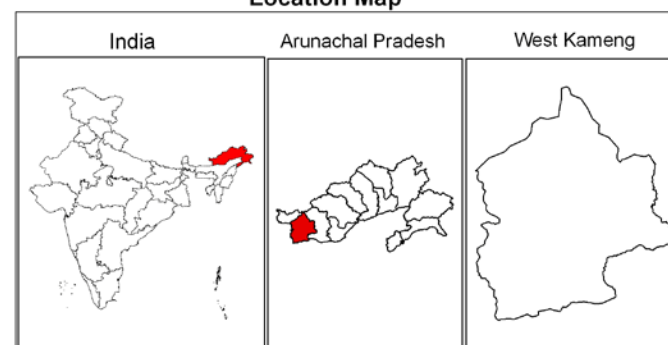


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map



0 3 6 12 18
Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

Sponsored By :
Ministry of Environment and Forests
Government of India

7.2.3 East Kameng

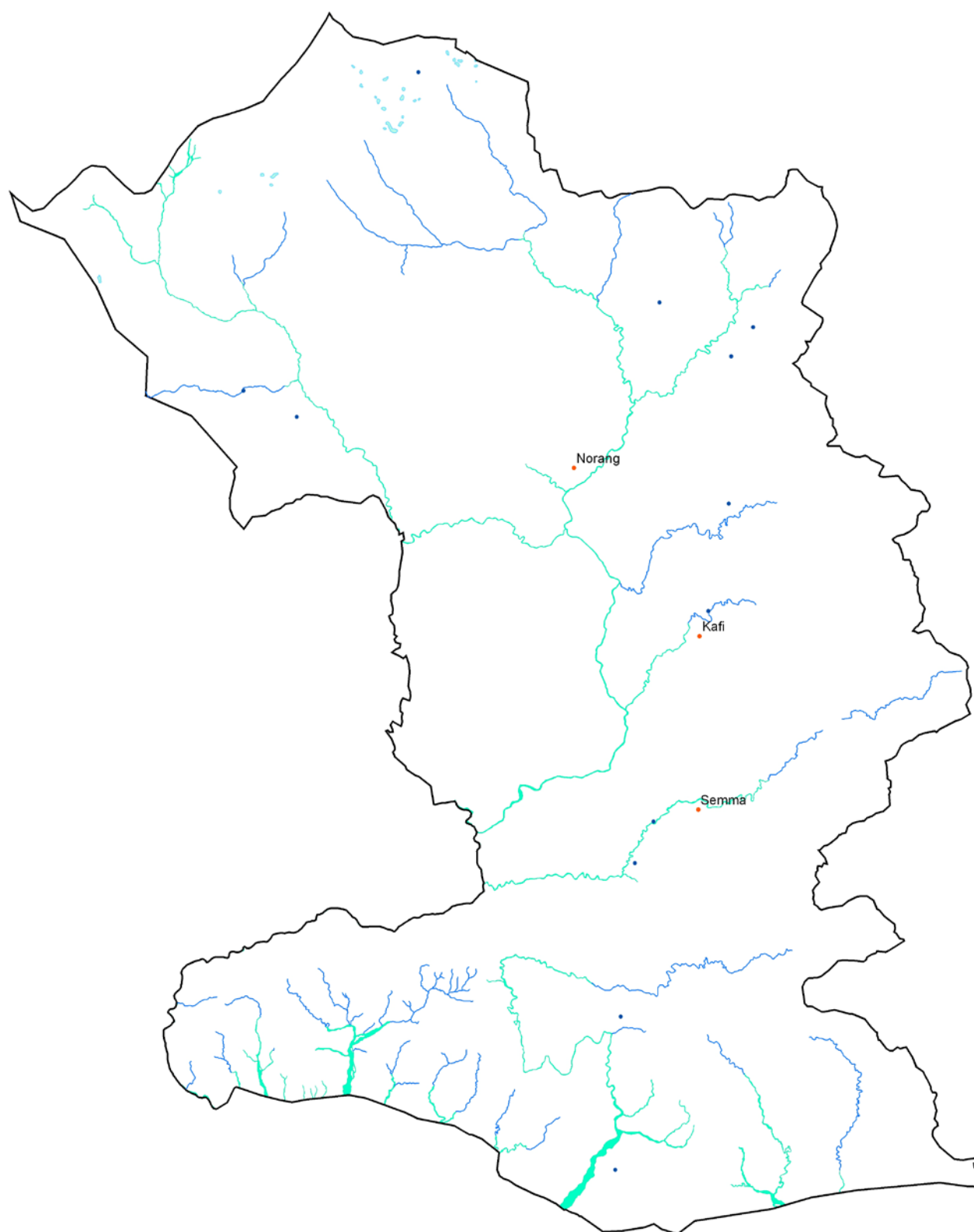
The wetland area estimated is 5443 ha. Small wetlands, which are less than minimum mapable units, are 12 in the district. This is mainly due to presence of river/streams. There are 27 high altitude lakes covering an area of 215 ha. One reservoir is located near Lamzang. Details of the wetlands are shown in Table-16.

Table 16: Area estimates of wetlands in East Kameng

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1103	High altitude wetlands	27	215	3.95	104	8
2	1106	River/Stream	20	5216	95.83	3468	3516
		Sub-Total	47	5431	99.78	3572	3524
		Wetlands (<2.25 ha), mainly Tanks	12	12	0.22	-	-
		Total	59	5443	100.00	3572	3524

Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	2505	3524
Moderate	724	-
High	341	-

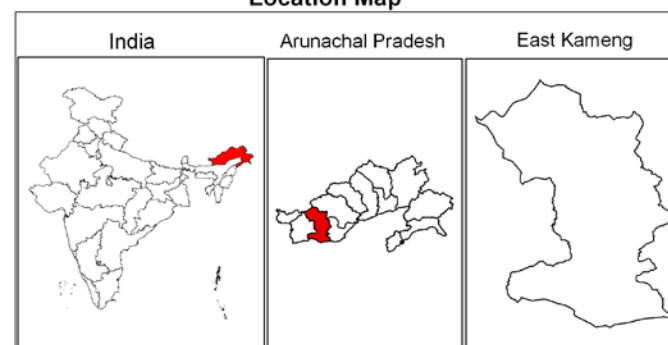


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map



0 3.5 7 14 21
Kilometers

Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
Sponsored By:
Ministry of Environment and Forests Government of India

7.2.4 Papum Pare

The district occupies an area of 2875 km² and has a population of 121,750 (as of 2001). The district headquarters are located at Yupia. Itanagar, which is state capital is also located at Papum Pare.

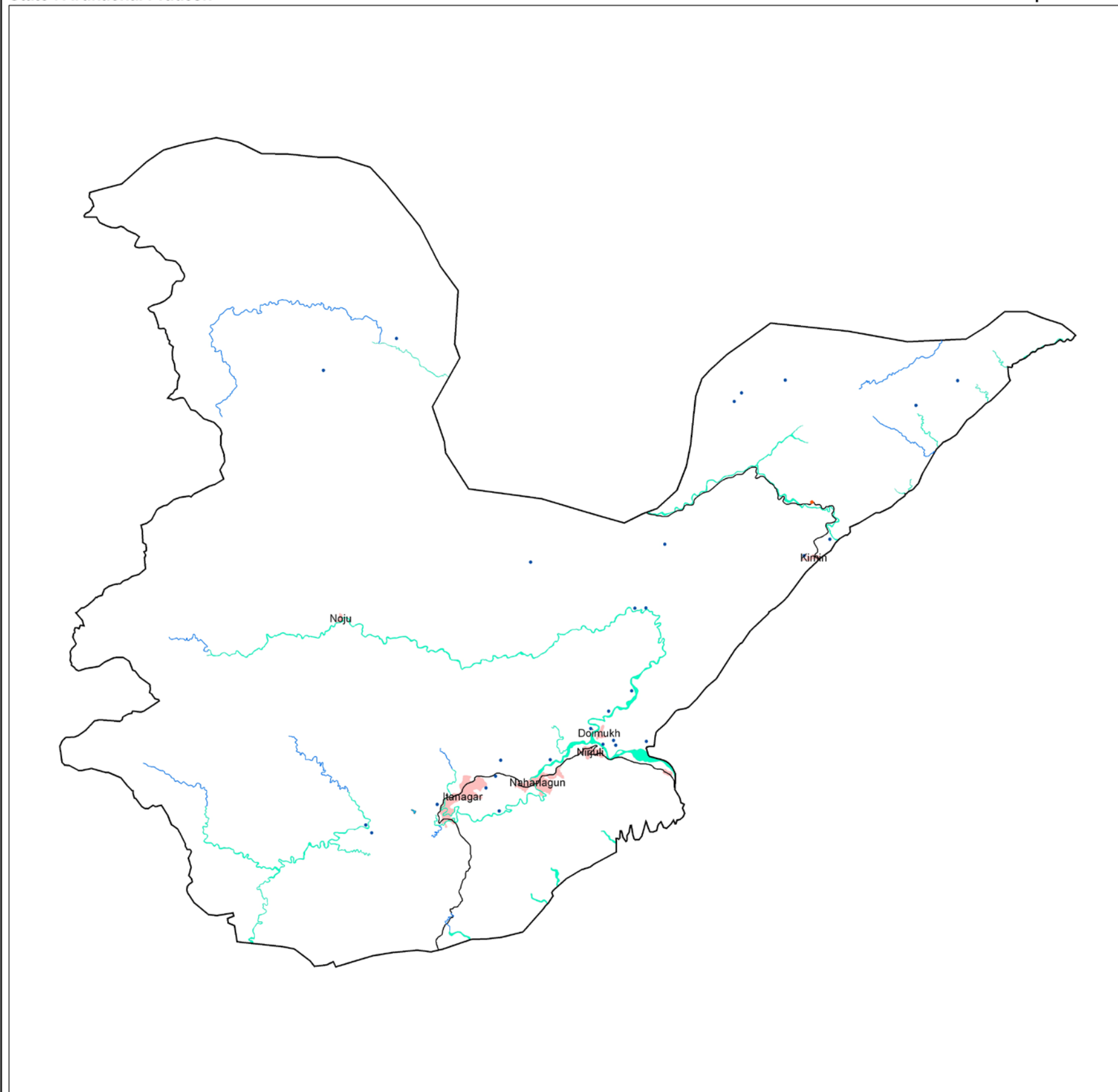
The wetland area estimated is 2718 ha. Small wetlands, which are less than minimum mapable units, are 28 in the district. The major wetland type is River/Streams. Details are given in Table 17.

Table 17: Area estimates of wetlands in Papum Pare

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1106	River/Stream	15	2681	98.64	1741	2005
	1200	Inland Wetlands -Man-made					
2	1201	Reservoirs/Barrages	1	9	0.33	7	8
		Sub-Total	16	2690	98.97	1748	2013
		Wetlands (<2.25 ha), mainly Tanks	28	28	1.03	-	-
		Total	44	2718	100.00	1748	2013

Area under Aquatic Vegetation	-	-
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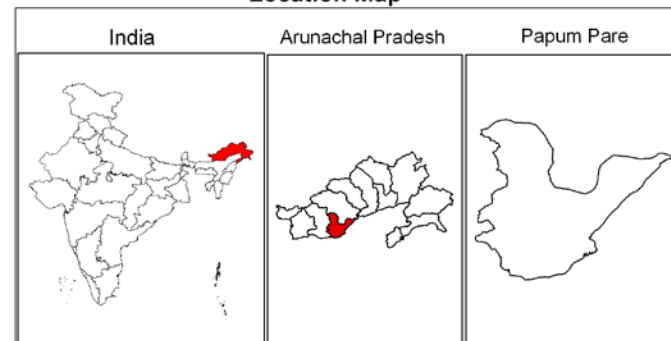
Area under turbidity levels		
Low	1390	1934
Moderate	202	79
High	156	-



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

Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map

0 3 6 12 18
Kilometers

Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad

Sponsored By:

Ministry of Environment and Forests
Government of India

7.2.5 Lower Subansiri

The district occupies an area of 10,135 km² and has a population of 97,614 (as of 2001). The district headquarters are located at Ziro. It is bounded on the North by China and Upper Subansiri District of Arunachal, on the South by Papum Pare District of Arunachal Pradesh and Assam, on the East by West Siang and some part of Upper Subansiri on the West by East Kameng Districts of Arunachal Pradesh.

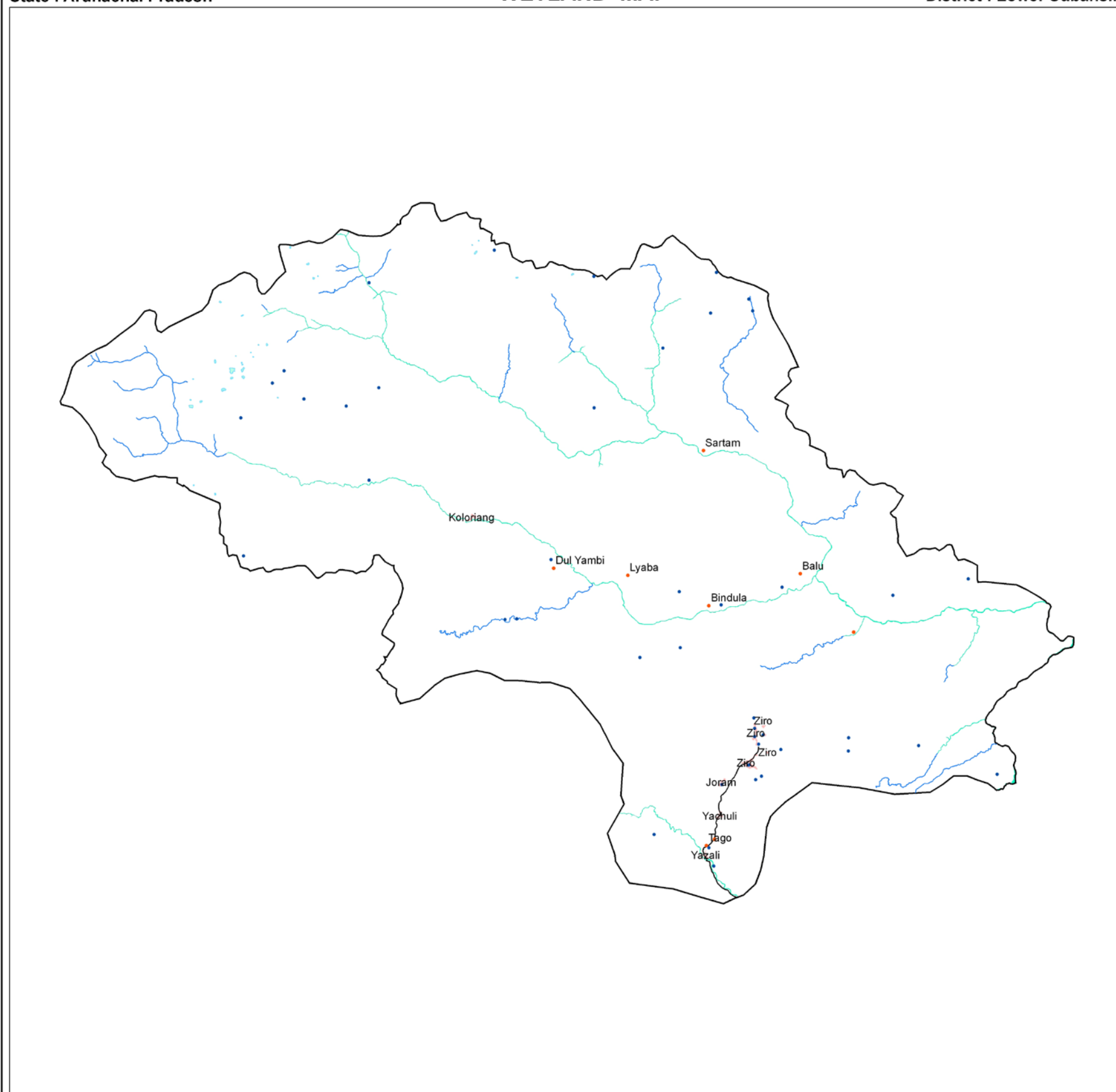
The wetland area estimated is 3607 ha. Small wetlands, which are less than minimum mapable units, are 44 in the district. The major wetland types are river/stream and high altitude lakes. The turbidity of the open water is mainly low. Details are given in Table 18.

Table 18: Area estimates of wetlands in Lower Subansiri

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1103	High altitude wetlands	31	241	6.68	237	-
2	1106	River/Stream	3	3322	92.10	2956	3023
		Sub-Total	34	3563	98.78	3193	3023
		Wetlands (<2.25 ha), mainly Tanks	44	44	1.22	-	-
		Total	78	3607	100.00	3193	3023

Area under Aquatic Vegetation	-	-
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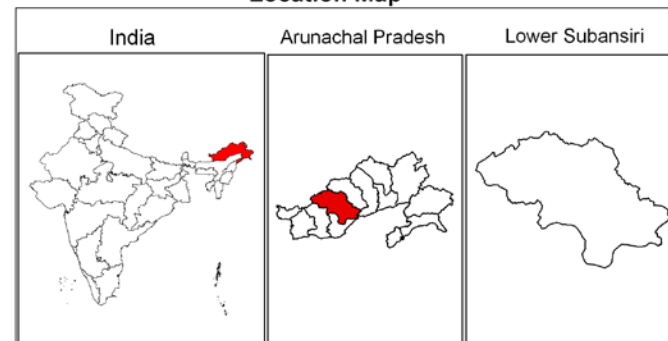
Area under turbidity levels		
Low	2665	3023
Moderate	271	-
High	257	-



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

Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map

0 5 10 20 30
Kilometers

Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
Sponsored By:
Ministry of Environment and Forests Government of India

7.2.6 Upper Subansiri

The district headquarters are located at Daporijo. The district occupies an area of 7032 km² and has a population of 54,995 (as of 2001). Members of the Tagin, Hill Miri and Adi tribal are found in the district

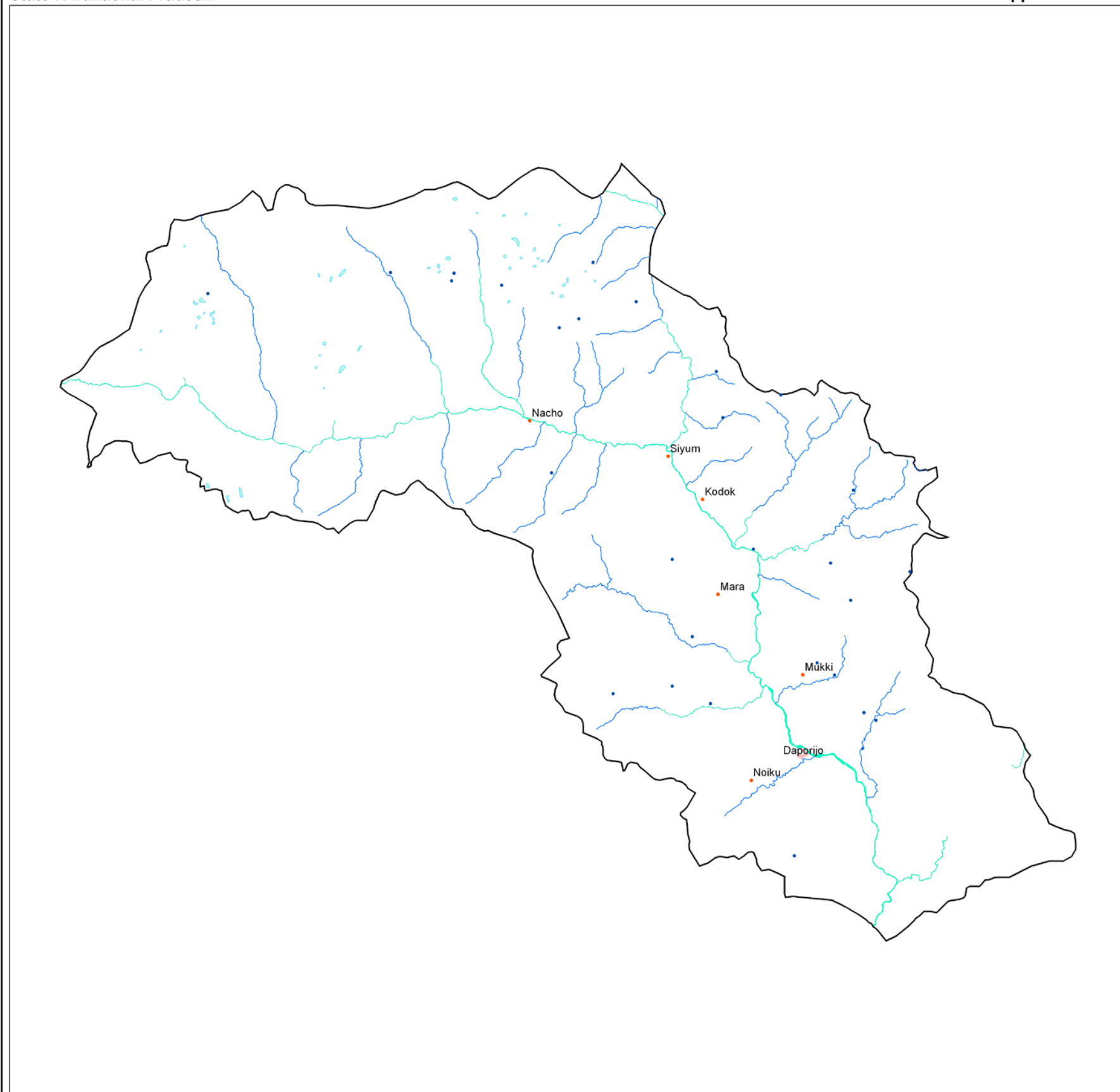
The wetland area estimated is 3365 ha. Small wetlands, which are less than minimum mapable units (MMU), are 28 in the district. The major wetland types are River/Streams and high altitude lakes. Details are given in Table 19.

Table19: Area estimates of wetlands in Upper Subansiri

						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	11	0.33	-	-
2	1103	High altitude wetlands	53	577	17.15	564	66
3	1106	River/Stream	3	2749	81.69	2360	2381
		Sub-Total	57	3337	99.17	2924	2447
		Wetlands (<2.25 ha), mainly Tanks	28	28	0.83	-	-
		Total	85	3365	100.00	2924	2447

Area under Aquatic Vegetation	-	-
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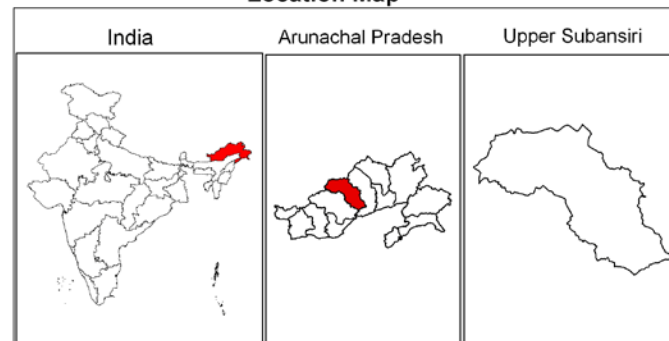
Area under turbidity levels		
Low	2800	2426
Moderate	109	21
High	15	-



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
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map

0 4 8 16 24
Kilometers

Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad

Sponsored By :

Ministry of Environment and Forests
Government of India

7.2.7 West Siang

The district headquarters are located at Aalo. The district occupies an area of 8325 km² and has a population of 103,575 (as of 2001). Various tribal groups of the Adi people, Memba and Khamba tribes live in the district.

The wetland area estimated is 6147 ha. Small wetlands, which are less than minimum mapable units (MMU), are 72 in the district. The major wetland types are High altitude lakes and River/Streams. Details are given in Table 20.

Table 20: Area estimates of wetlands in West Siang

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	1103	High altitude wetlands	57	368	5.99	282	123
2	1106	River/Stream	33	5703	92.78	4358	4880
	1200	Inland Wetlands -Man-made					
3	1202	Tanks/Ponds	1	4	0.07	4	4
		Sub-Total	91	6075	98.83	4644	5007
		Wetlands (<2.25 ha), mainly Tanks	72	72	1.17	-	-
		Total	163	6147	100.00	4644	5007

Area under Aquatic Vegetation	-	-
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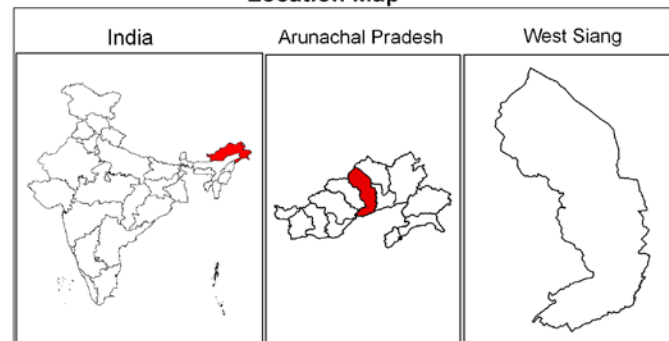
Area under turbidity levels		
Low	2291	3665
Moderate	2089	448
High	264	894



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

Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map

0 5 10 20 30
Kilometers

Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad

Sponsored By :

Ministry of Environment and Forests
Government of India

7.2.8 East Siang

The district headquarter is located at Pasighat. The district occupies an area of 4,005 square kilometres and has a population of 87,430 (as of 2001). Various tribal groups of the Adi people live in various parts of the district.

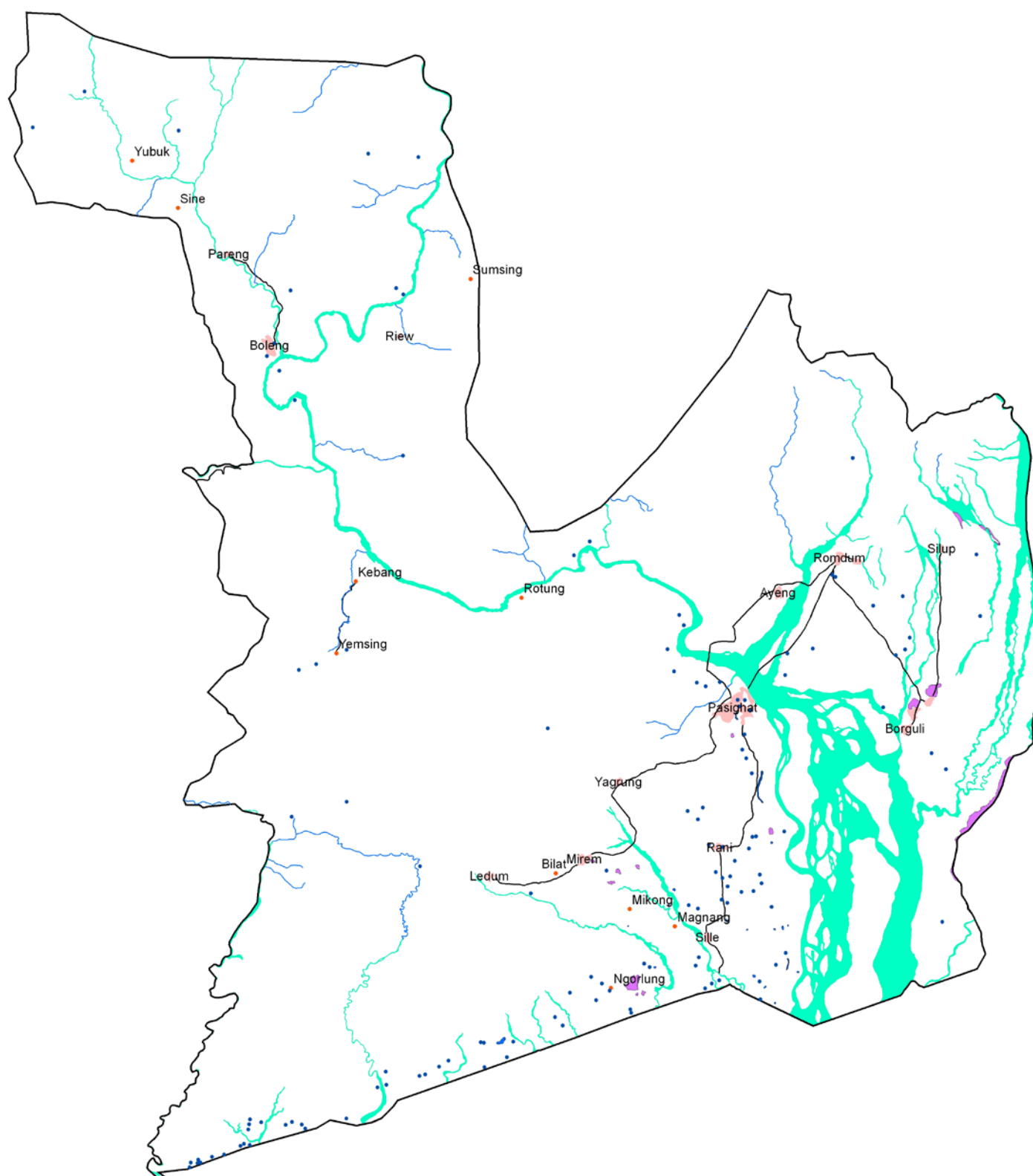
The wetland area estimated is 25,512 ha. Small wetlands, which are less than minimum mapable units (MMU), are 130 in the district. The major wetland types are Waterlogged, River/Streams and ox-bow lakes. The turbidity of the open water is mainly low. Details are given in Table 21.

Table 21: Area estimates of wetlands in East Siang

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1102	Ox-bow lakes/ Cut-off meanders	3	50	0.20	13	35
2	1105	Waterlogged	15	634	2.49	2	2
3	1106	River/Stream	26	24647	96.61	11010	7811
	1200	Inland Wetlands -Man-made					
4	1202	Tanks/Ponds	15	51	0.20	16	-
		Sub-Total	59	25382	99.49	11041	7848
		Wetlands (<2.25 ha), mainly Tanks	130	130	0.51	-	-
		Total	189	25512	100.00	11041	7848

Area under Aquatic Vegetation	554	244
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Area under turbidity levels		
Low	10720	7152
Moderate	321	321
High	-	375

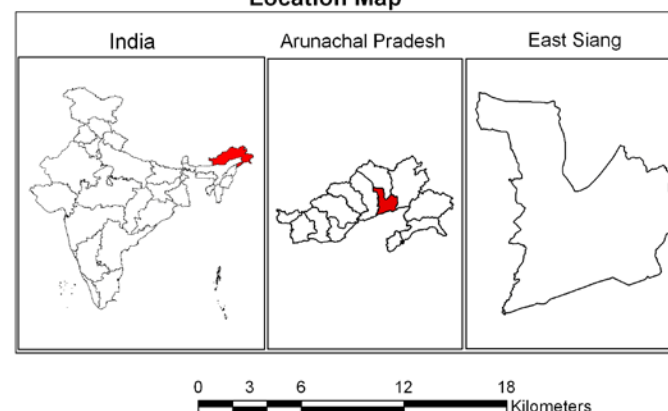


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map



Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad

Sponsored By :

Ministry of Environment and Forests
Government of India

7.2.9 Upper Siang

Upper Siang is an administrative district in the state of Arunachal Pradesh in India. The district headquarters are located at Yingkiong. The district occupies an area of 6188 km² and has a population of 33,146 (as of 2001). Various tribal groups of the Adi people and the Memba tribe live in the district. The district is the location of the massive Upper Siang Hydroelectric Project.

The wetland area estimated is 6,686 ha. Small wetlands, which are less than minimum mapable units (MMU), are 49 in the district. The major wetland types are River/Stream and high altitude lakes. The turbidity of the open water is mainly low. Details are given in Table 22.

Table 22: Area estimates of wetlands in Upper Siang

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	1103	High altitude wetlands	67	567	8.48	388	72
2	1106	River/Stream	6	6070	90.79	4926	3812
		Sub-Total	73	6637	99.27	5314	3884
		Wetlands (<2.25 ha), mainly Tanks	49	49	0.73	-	-
		Total	122	6686	100.00	5314	3884
Area under Aquatic Vegetation						-	-
Area under turbidity levels							
Low						3670	3260
Moderate						1538	619
High						107	4

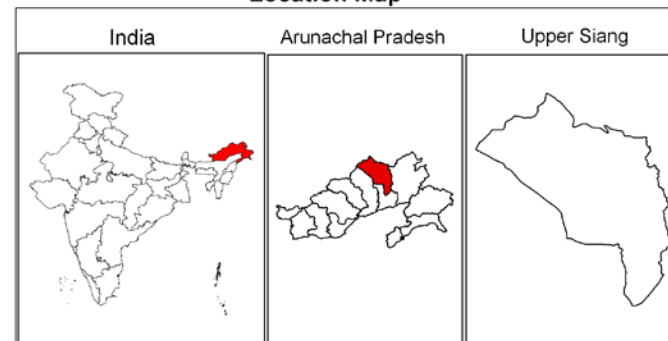


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map



0 4.5 9 18 27
Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

Sponsored By :
Ministry of Environment and Forests
Government of India

7.2.10 Dibang Valley

The Dibang Valley is a district of Arunachal Pradesh named after the Dibang River or the Talon as the Idus call it. The river originates in the mountains of China and flows through the length of the valley, named after it. The major population of this district consist of the Adis (padams) and the idus.

The district has been divided further into lower and upper Dibang Valley for administrative convenience. The headquarters of the two districts are Roing and Anini respectively. Roing is a newborn town in the plains of the Mishmi hills. It is a beautiful place with picturesque nature and beautiful climate.

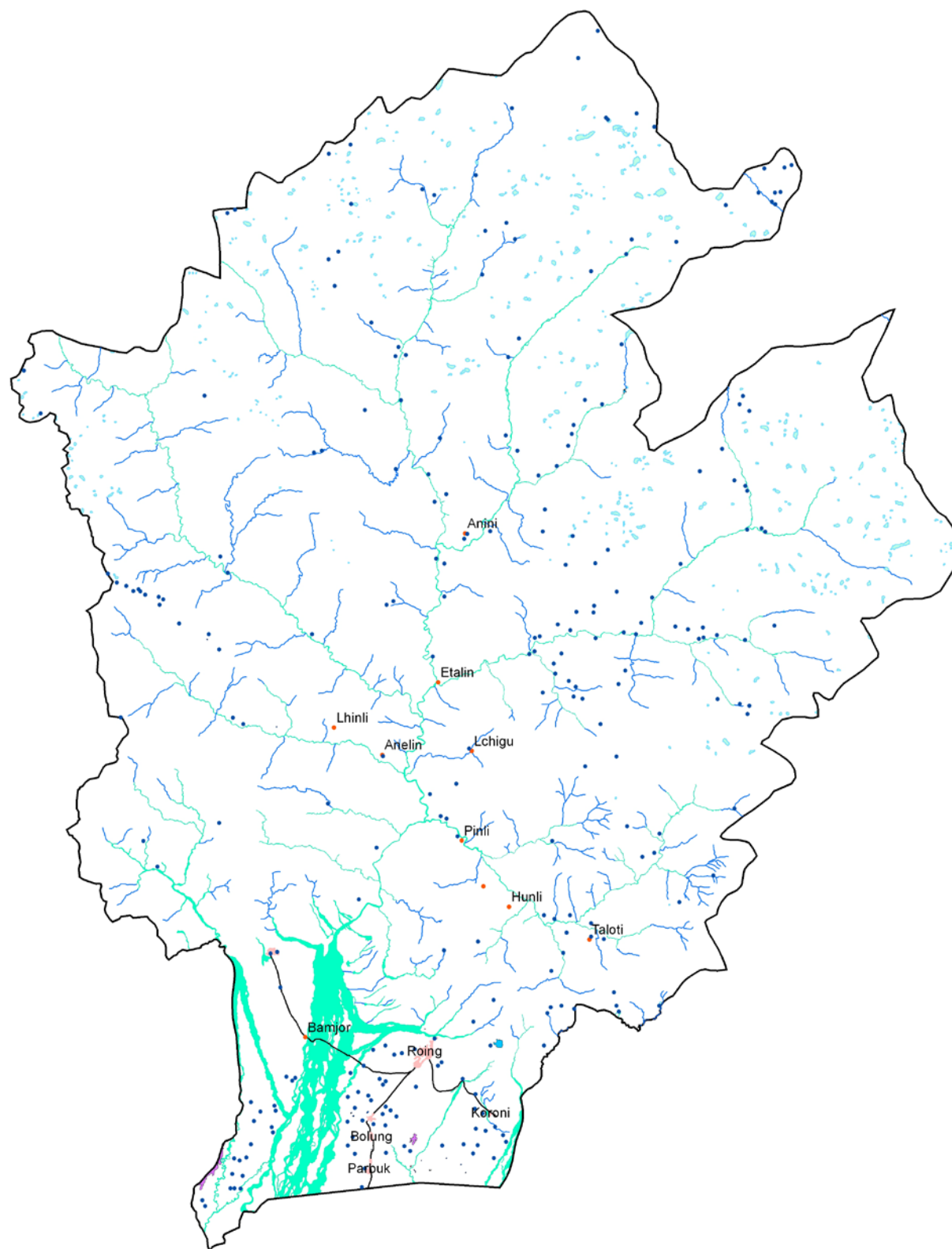
There are about 443 high altitude lakes exists in the districts. The wetland area of the district is 37,605 ha. Small wetlands, which are less than minimum mapable units (MMU), are 266 in the district. The major wetland types are River/Stream and high altitude lakes. The turbidity of the open water is mainly low. Details are given in Table 23.

Table 23: Area estimates of wetlands in Dibang Valley

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1102	Ox-bow lakes/ Cut-off meanders	3	7	0.02	5	1
2	1103	High altitude wetlands	443	5290	14.07	3631	1191
3	1106	River/Stream	23	31503	83.77	8912	8346
	1200	Inland Wetlands -Man-made					
4	1201	Reservoirs/Barrages	2	121	0.32	121	81
5	1202	Tanks/Ponds	11	21	0.06	13	4
		Sub-Total	484	37339	99.29	12682	9623
		Wetlands (<2.25 ha), mainly Tanks	266	266	0.71	-	-
		Total	750	37605	100.00	12682	9623

Area under Aquatic Vegetation	382	23
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Area under turbidity levels		
Low	10708	1103
Moderate	1927	7628
High	47	892

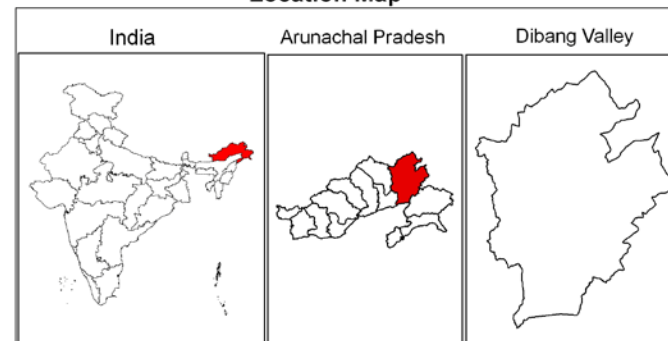


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map

0 5 10 20 30
Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

Sponsored By:
Ministry of Environment and Forests
Government of India

7.2.11 Lohit

Lohit is an administrative district in the state of Arunachal Pradesh in India. The district headquarters are located at Tezu. The district occupies an area of 11,402 km² and has a population of 143,478 (as of 2001). The district is named after the Lohit River, from the Sanskrit *Louhitya*, reddish- or rust-coloured, and consists of the river valley and hills/mountains to the North and South.

The area is highly inaccessible, and it is only in 2004 that a permanent bridge has been made operational across the Lohit at the holy site of Parashuram Kund, giving round-the-year connection to Tezu. East of Tezu (about 100 km.) lies the small town of Hayuliang, and this is slated to become the headquarters of a new district.

Lohit is the home of the Zekhring, Khampti, Deori, Singpho and Mishmi tribes. A small group of Tibetan refugees have settled in Lohit since the 1960s. The Zekhring are Tibetan Buddhists; the Khampti and Singpho are Theravada Buddhists, and the Mishmi are mainly Animists.

On 16 February, 2004, Anjaw district was carved out from the northern part of Lohit district bordering Tibet and Myanmar, with its Headquarters at Hawaii. Anjaw was carved out under The Arunachal Pradesh Re-organization of Districts Amendment Bill.

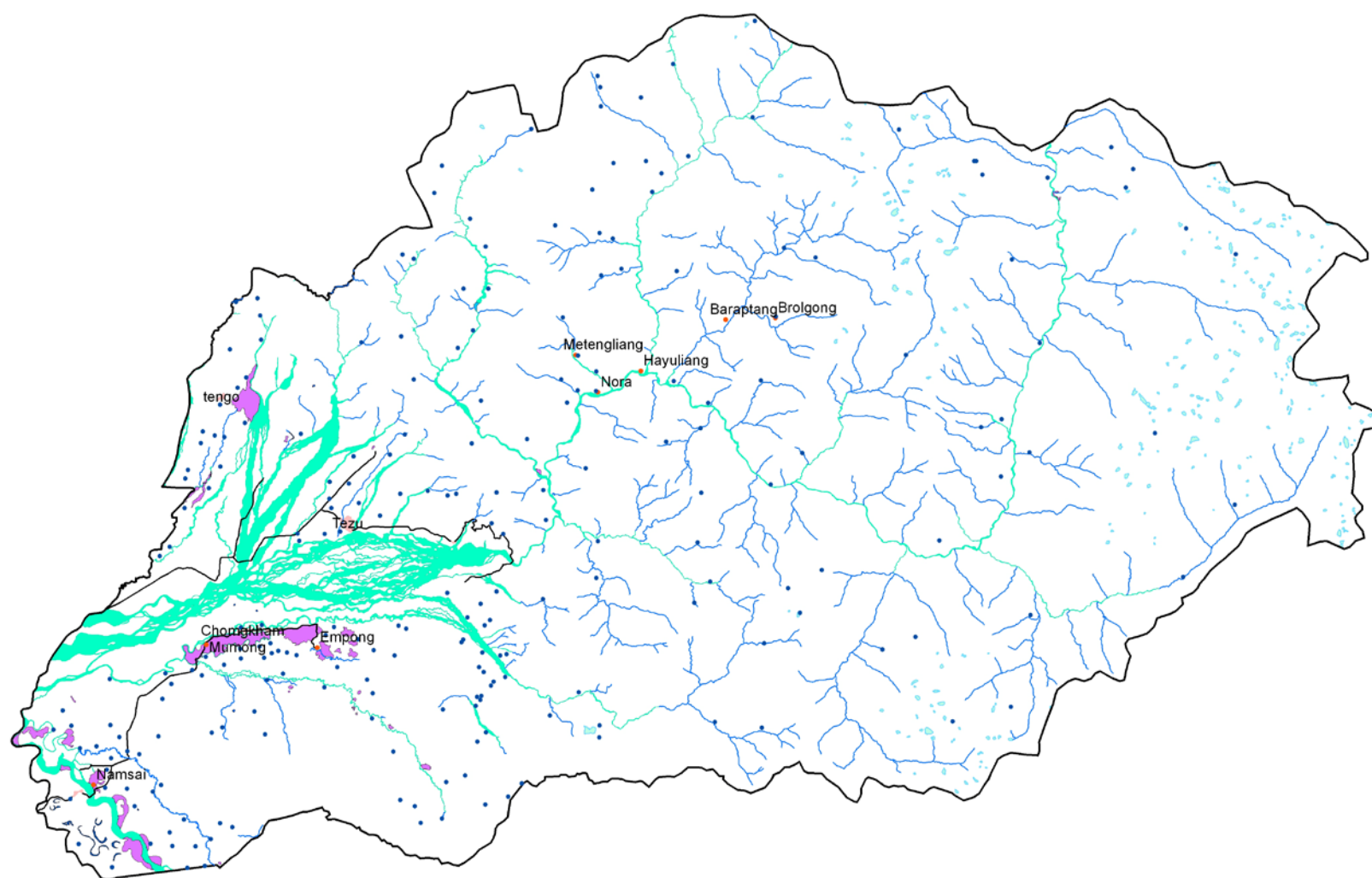
The wetland area estimated is 45,719 ha. Small wetlands, which are less than minimum mapable units (MMU), are 240 in the district. The major wetland types are River/Stream, high altitude lakes, waterlogged and ox-bow lakes. Details are given in Table 24.

Table 24: Area estimates of wetlands in Lohit

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	2	7	0.02	16	-
2	1102	Ox-bow lakes/ Cut-off meanders	11	290	0.63	54	3
3	1103	High altitude wetlands	256	2640	5.77	1378	383
4	1105	Waterlogged	37	5525	12.08	45	2
5	1106	River/Stream	14	36967	80.86	10138	10272
	1200	Inland Wetlands -Man-made					
6	1201	Reservoirs/Barrages	1	35	0.08	35	35
7	1202	Tanks/Ponds	3	15	0.03	10	-
		Sub-Total	324	45479	99.48	11676	10695
		Wetlands (<2.25 ha), mainly Tanks	240	240	0.52	-	-
		Total	564	45719	100.00	11676	10695

Area under Aquatic Vegetation	4208	4724
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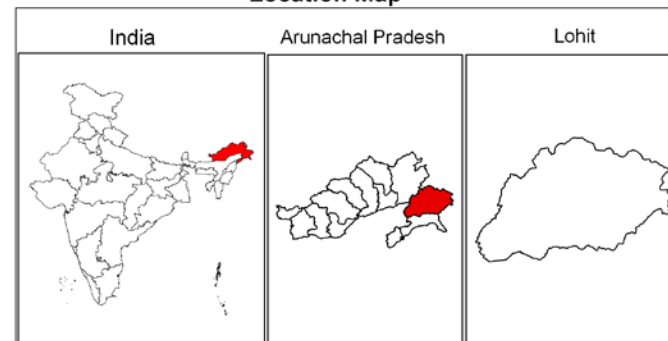
Area under turbidity levels		
Low	11496	10624
Moderate	180	71
High	-	-



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

Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map

0 4.5 9 18 27
Kilometers

Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
Sponsored By:
Ministry of Environment and Forests Government of India

7.2.12 Changlang

The Changlang district is located in Arunachal Pradesh, located south of the Lohit district and north of the Tirap district. Total geographic area of the district is 2362 sq km. The changlang town is a district head quarter. Total population of the district is 1,25,334(census 2001).

Changlang is populated by tribal groups, namely Tutsa, Tangsa, Nocte, Singpho and the Lisu. Sizeable communities of the Tibetans, Bodo Hajong and Chakma refugees do exist. The Tibetan refugees are clustered at Choephelling Tibetan Refugee settlement in Miao, which was set up in 1976 has hosts a population of 2200.

The Namdapha Tiger reserve is located in Miao town of this district. The other places to visit are World War II cemetery in Jairampur, Indo-Myanmar border town Nampong and Pangsau Pass.

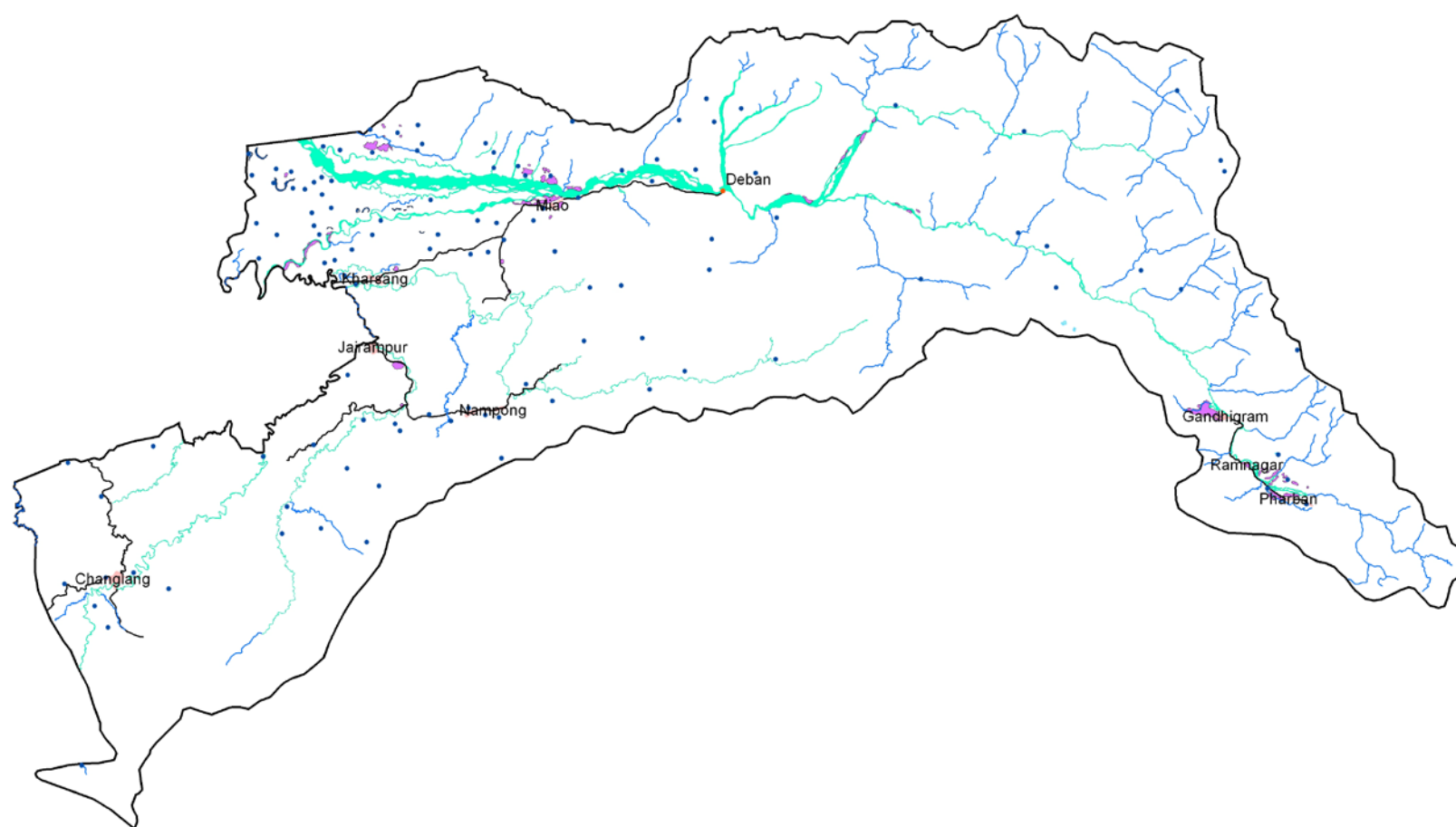
The wetland area estimated is 12,017 ha. Small wetlands, which are less than minimum mapable units (MMU), are 117 in the district. The major wetland type is River/Stream and waterlogged area. Details are given in Table 25.

Table 25: Area estimates of wetlands in Changlang

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1102	Ox-bow lakes/ Cut-off meanders	10	155	1.29	89	-
2	1103	High altitude wetlands	3	18	0.15	14	2
3	1105	Waterlogged	53	1583	13.17	13	3
4	1106	River/Stream	25	10144	84.41	3427	3637
		Sub-Total	91	11900	99.03	3543	3642
		Wetlands (<2.25 ha), mainly Tanks	117	117	0.97	-	-
		Total	208	12017	100.00	3543	3642

Area under Aquatic Vegetation	851	928
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Area under turbidity levels		
Low	2668	3289
Moderate	364	353
High	512	-

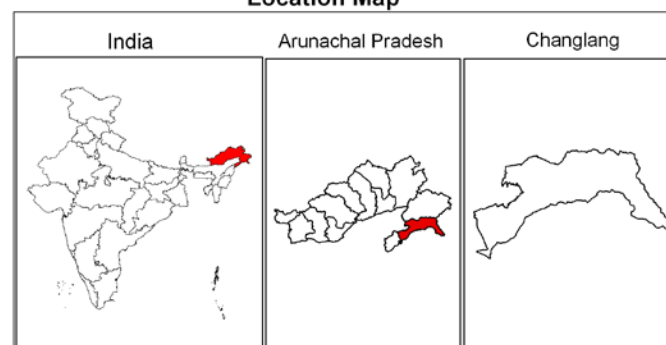


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map



0 4.5 9 18 27
Kilometers

Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad

Sponsored By :

Ministry of Environment and Forests
Government of India

7.2.13 Tirap

The Tirap district is located in the southeastern part of Arunachal Pradesh. The district occupies an area of 2362 km² and has a population of 100,227 (as of 2001). It shares a state border with Nagaland and Assam, an international border with Myanmar and a district border with Changlang. Khonsa Town is the district headquarters.

Much of the land lies not very far removed from those of the sea level, although a large portion of the district comprises the Patkoi Hills, which consists of the Namdhapa National Park. The park hosts a wide variety of wildlife species, from mithun to the Himalayan black bear, locally known as takin, to the wild goat. In Tirap District Nocte is the most populated tribe, they have the majority in the area.

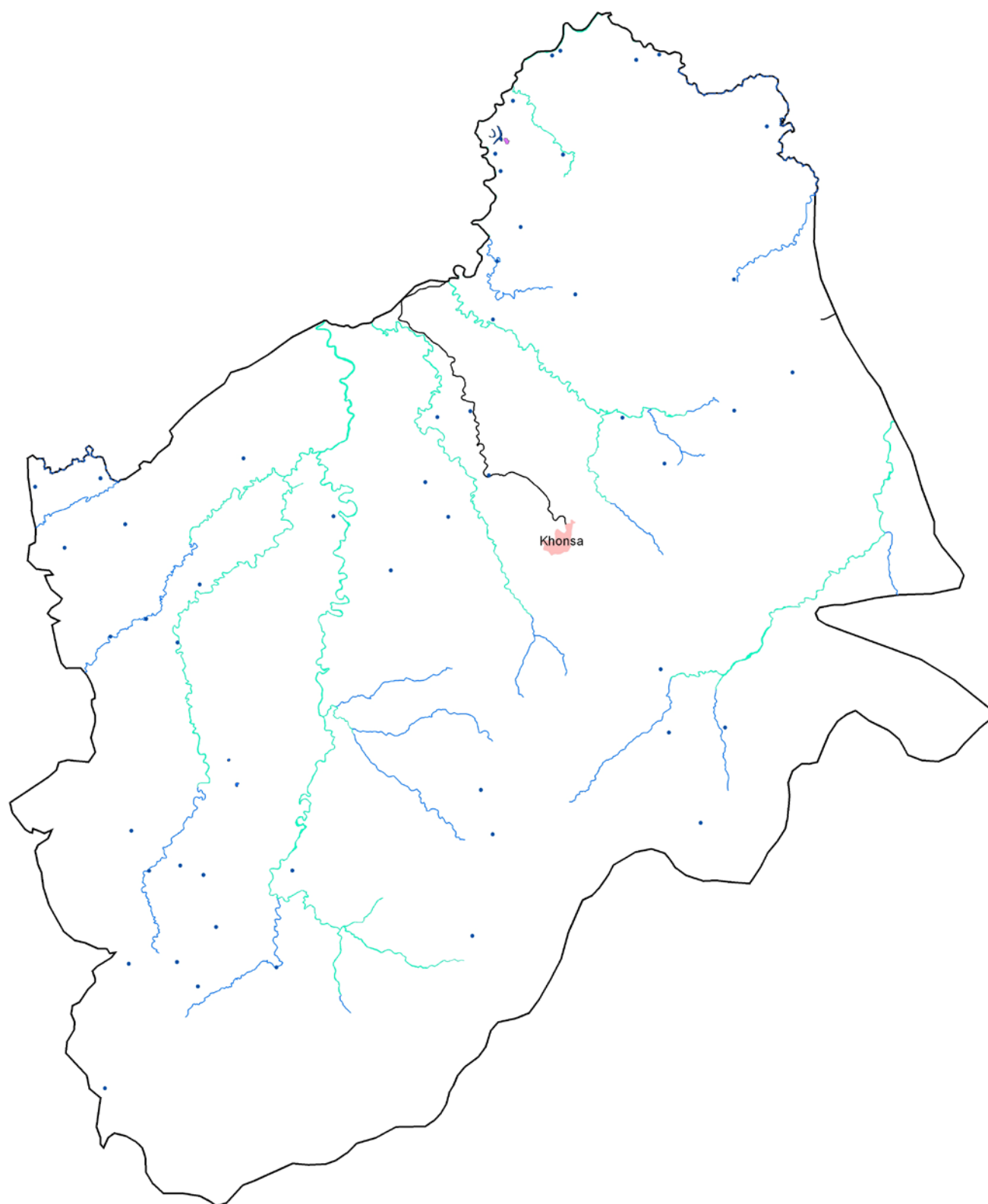
The wetland area estimated is 1262 ha. Small wetlands, which are less than minimum mapable units (MMU), are 52 in the district. The major wetland types are River/Stream and waterlogged area. Details are given in Table 26.

Table 26: Area estimates of wetlands in Tirap

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1102	Ox-bow lakes/ Cut-off meanders	2	18	1.43	18	-
2	1106	River/Stream	13	1180	93.50	1180	1180
	1200	Inland Wetlands -Man-made					
3	1202	Tanks/Ponds	2	5	0.40	5	-
		Sub-Total	18	1210	95.88	1203	1180
		Wetlands (<2.25 ha), mainly Tanks	52	52	4.12	-	-
		Total	70	1262	100.00	1203	1180

Area under Aquatic Vegetation	7	5
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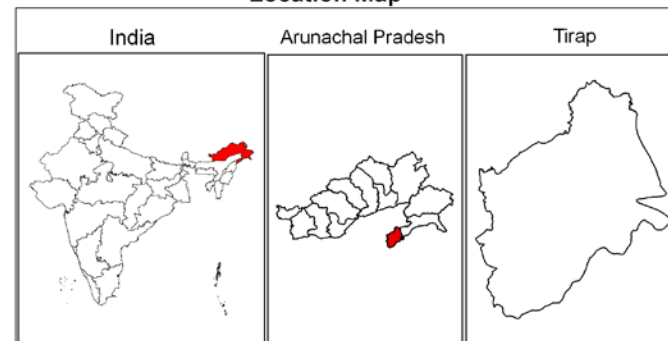
Area under turbidity levels		
Low	1185	1180
Moderate	18	-
High	-	-



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

Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map

0 2 4 8 12
Kilometers

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

Sponsored By:
Ministry of Environment and Forests
Government of India

7.3 NAGALAND

Area estimates of various wetland categories for Nagaland have been carried out using GIS layers of wetland boundary, water-spread, aquatic vegetation and turbidity. The estimated wetland area of the state is 21544 ha area, that includes 267 small wetlands (< 2.25 ha). River/stream is the single most dominant wetland of the state with 89.39% contribution. Among, other wetland types, reservoir/barrage is the major one. Two reservoirs are mapped with 1547 ha area (7.18%). Only one natural Lake/pond is mapped with 3 ha area. A detail of statistics of wetlands in the state is given in Table 27. Graphical distribution of wetland type is shown in Figure 16.

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

Table 27: Area estimates of wetlands in Nagaland

							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	3	0.01	1	1
2	1102	Ox-bow lakes/ Cut-off meanders	3	9	0.04	9	3
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	90	423	1.96	351	283
6	1106	River/Stream	50	19254	89.37	19254	19254
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	2	1547	7.18	1287	1083
8	1202	Tanks/Ponds	8	41	0.19	36	26
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	154	21277	98.76	20938	20650
		Wetlands (<2.25 ha), mainly Tanks	267	267	1.24	-	-
		Total	421	21544	100.00	20938	20650

Area under Aquatic Vegetation	7	604
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Area under turbidity levels		
Low	2243	1065
Moderate	8071	7926
High	10624	11659

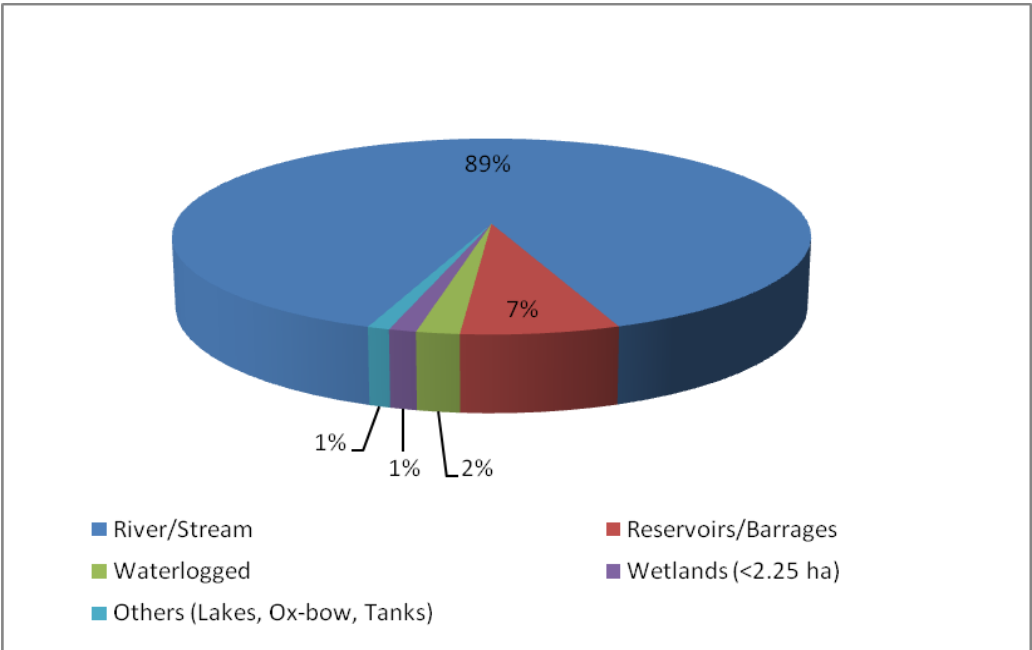


Figure 16: Type-wise wetland distribution in Nagaland

The state has eleven districts. The geographic area of the districts varied from 56321 ha (Longleng) to 216188 ha (Mon). District Wokha has highest concentration of wetlands with 2946 ha area. District Kiphire has lowest concentration of wetland with 860 ha area. Dimapur district has highest concentration of small wetlands (<2.25 ha area). District-wise wetland area estimates is given in Table-28. The graphical distribution of district-wise wetland area is shown in Figure 17. Details of district level wetlands are described in this chapter.

Table 28: District-wise wetland area in Nagaland

District code	District	Geographic Area	Wetland Area	% of total wetland area	% of district geographic area	Open water		Aquatic Vegetation	
						Post-monsoon	Pre-monsoon	Post-monsoon	Pre-monsoon
		(sq. km.)	(ha)		(ha)	(ha)	(ha)	(ha)	(ha)
1	Dimapur	927	2013	9.34	2.17	1835	1756	4	105
2	Kiphire	1162	860	3.99	0.74	857	857	0	0
3	Kohima	1322	1173	5.44	0.89	1162	1162	0	2
4	Longleng	563	974	4.52	1.73	971	971	0	0
5	Mokokchung	1605	1747	8.11	1.09	1722	1720	1	12
6	Mon	2162	2820	13.09	1.30	2802	2797	0	5
7	Peren	1740	2324	10.79	1.34	2291	2296	0	1
8	Phek	2026	2414	11.20	1.19	2407	2407	0	3
9	Tuensang	2142	2015	9.35	0.94	2013	2013	0	0
10	Wokha	1618	2946	13.67	1.82	2636	2429	2	476
11	Zunheboto	1255	2258	10.48	1.80	2242	2242	0	0
	Total	16521	21544	100.00	1.30	20938	20650	7	604

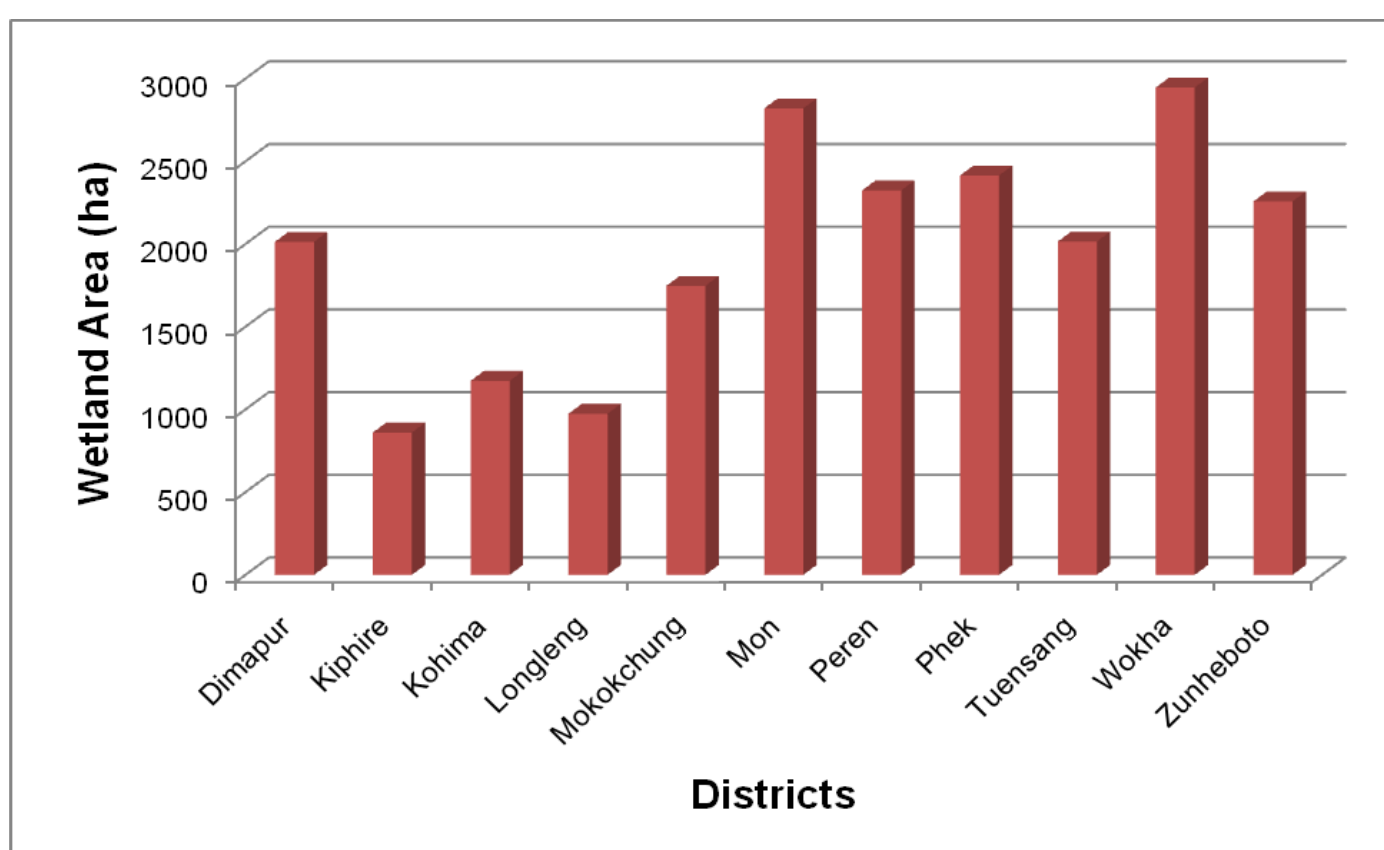
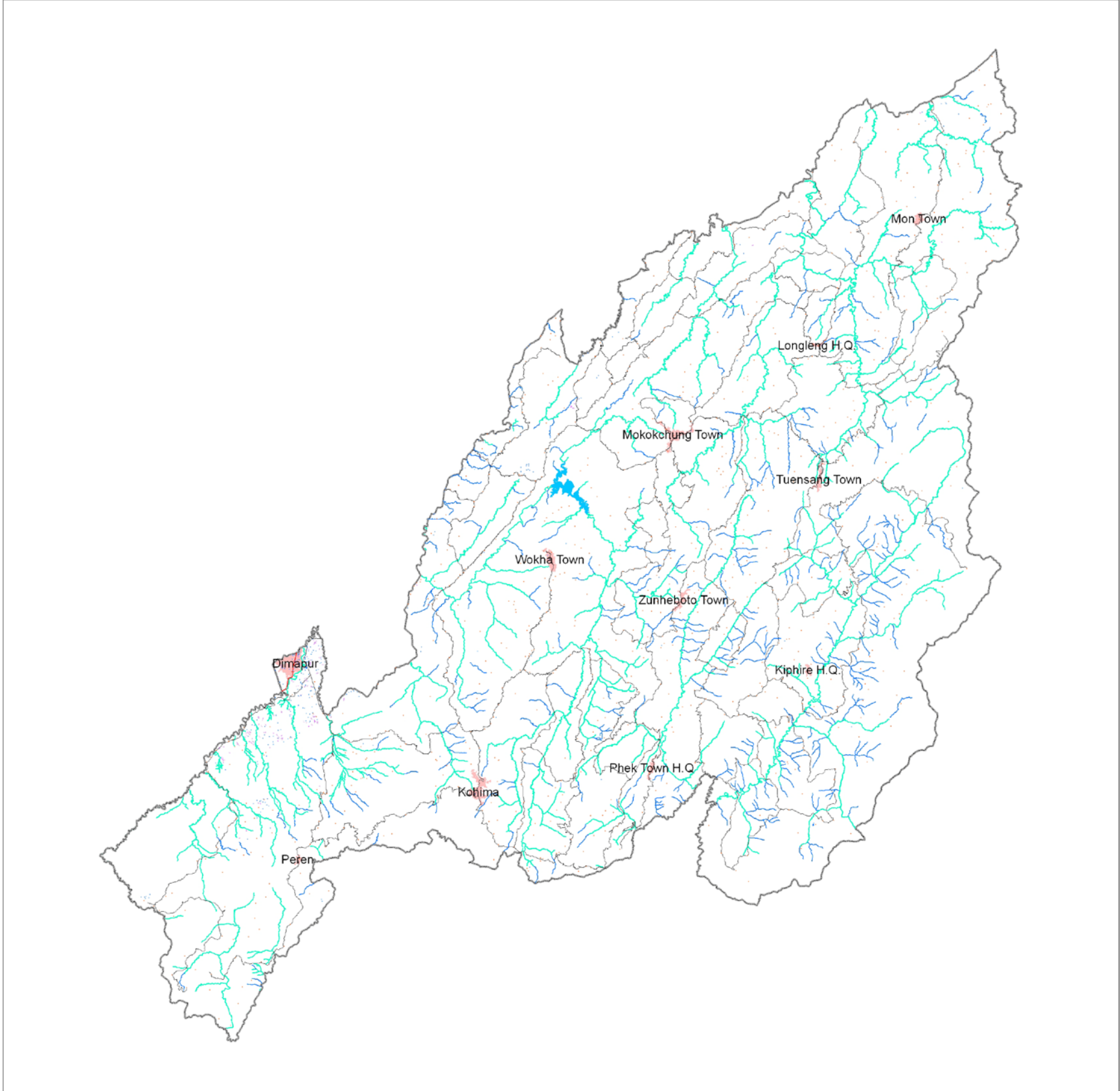


Figure 17: District-wise wetland distribution in Nagaland



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

India

Nagaland

District

25 12.5 0 25 Kilometers

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

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

Sponsored by:
Ministry of Environment and Forests
Government of India

7.3.1 Dimapur

Dimapur, the gateway of Nagaland was officially inaugurated in April, 1988. The district name is derived from a Kachari word “Dimasa” after the river which flows through it. The district headquarter is located at Chumukedima. This fast developing district is also the commercial centre of the state. The total geographic area of Dimapur district is 92700 ha. The topography of the district is plains and valleys with average altitude of 145 metres above sea level. As per 2001 census, the district is home to 3,08,382 people.

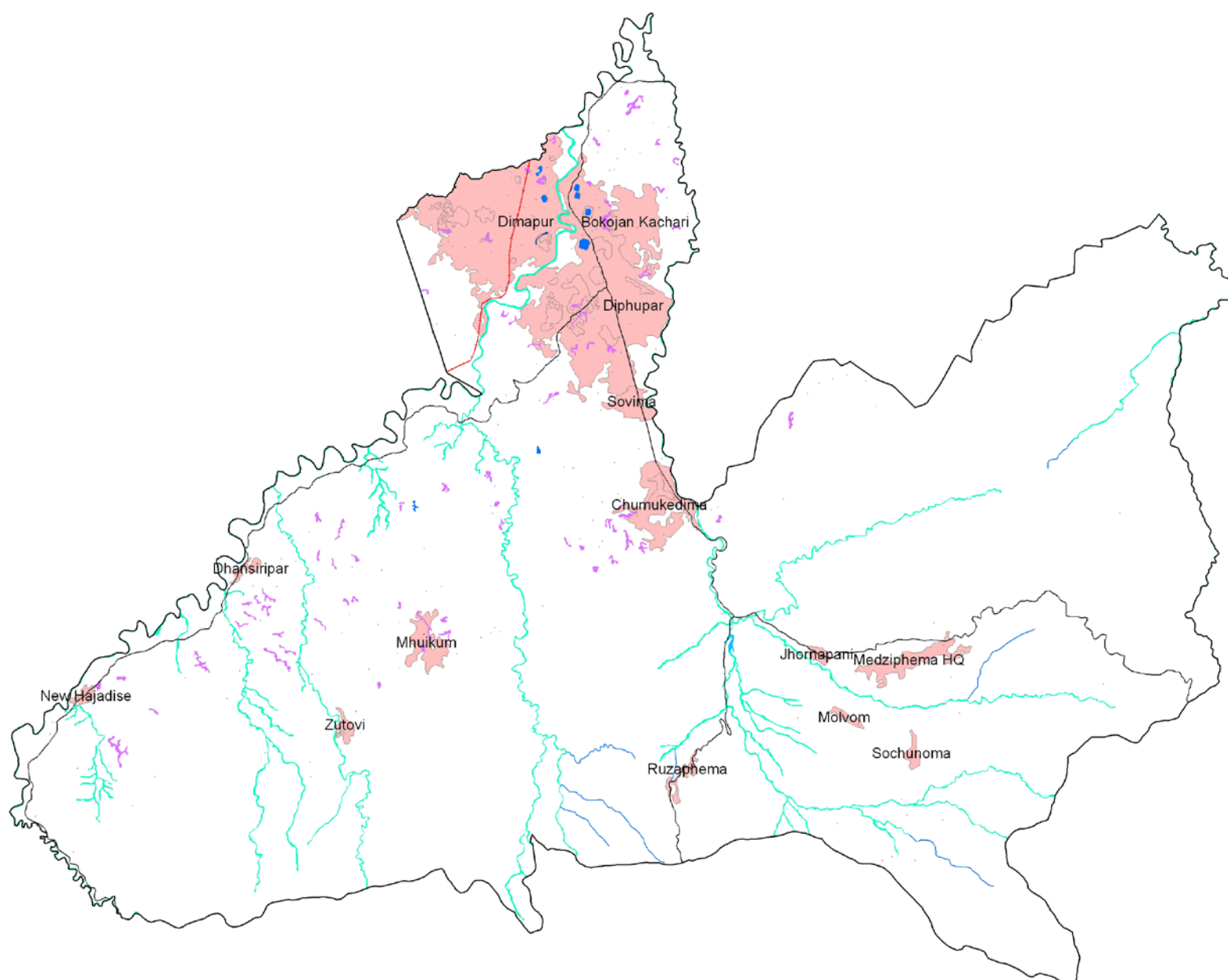
Total 220 wetlands are mapped in the district including 130 small wetlands (<2.25 ha). The total wetland area estimated is 2013 ha. The major wetland type is River/Stream contributing 74.22%. Waterlogged (natural) is the second major wetland with 334 ha area (16.59%). Total 8 Tank/pond wetland type is mapped with 41 ha area (2.04%). Details of wetland statistics of the district is given in Table 29.

Table 29: Area estimates of wetlands in Dimapur

Sr. No	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of Wetland Area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	-	-	-	-	-
2	1102	Ox-bow lakes/ Cut-off meanders	1	3	0.15	3	2
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	71	334	16.59	295	228
6	1106	River/Stream	9	1494	74.22	1494	1494
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	1	11	0.55	7	6
8	1202	Tanks/Ponds	8	41	2.04	36	26
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	90	1883	93.54	1835	1756
		Wetlands (<2.25 ha), mainly Tanks	130	130	6.46	-	-
		Total	220	2013	100.00	1835	1756

Area under Aquatic Vegetation	4	105
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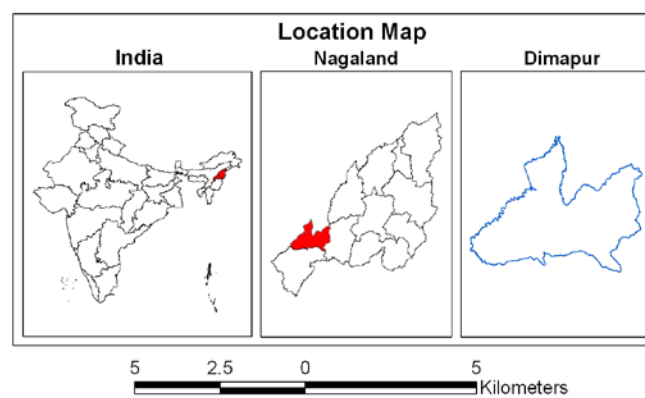
Area under turbidity levels		
Low	25	20
Moderate	1446	1403
High	364	333



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



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

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

Sponsored by:
Ministry of Environment and Forests
Government of India

7.3.2 Kiphire

Kiphire was carved out of Tuensang district on January 24th 2004 by upgrading the sub-division Kiphire. It is home to the Sema, Sangtam and Yimchunger tribes. The district headquarter is Kiphire. The district is bounded by Tuensang district in the north, Myanmar in the East, Zunheboto in the West and Phek district in the south. The physiography of the district is generally denudated hills with high hillslope. Saramati, with 3840 metre, which is the highest peak in Nagaland is located in this district. Fakim wildlife sanctuary, established in 1983 close to the Myanmar border is also located in this district which is 641 ha in area. The Likimro Hydel project is situated in the district towards Moya village under Pungro sub-division. The total geographic area of Kiphire district 116185 ha.

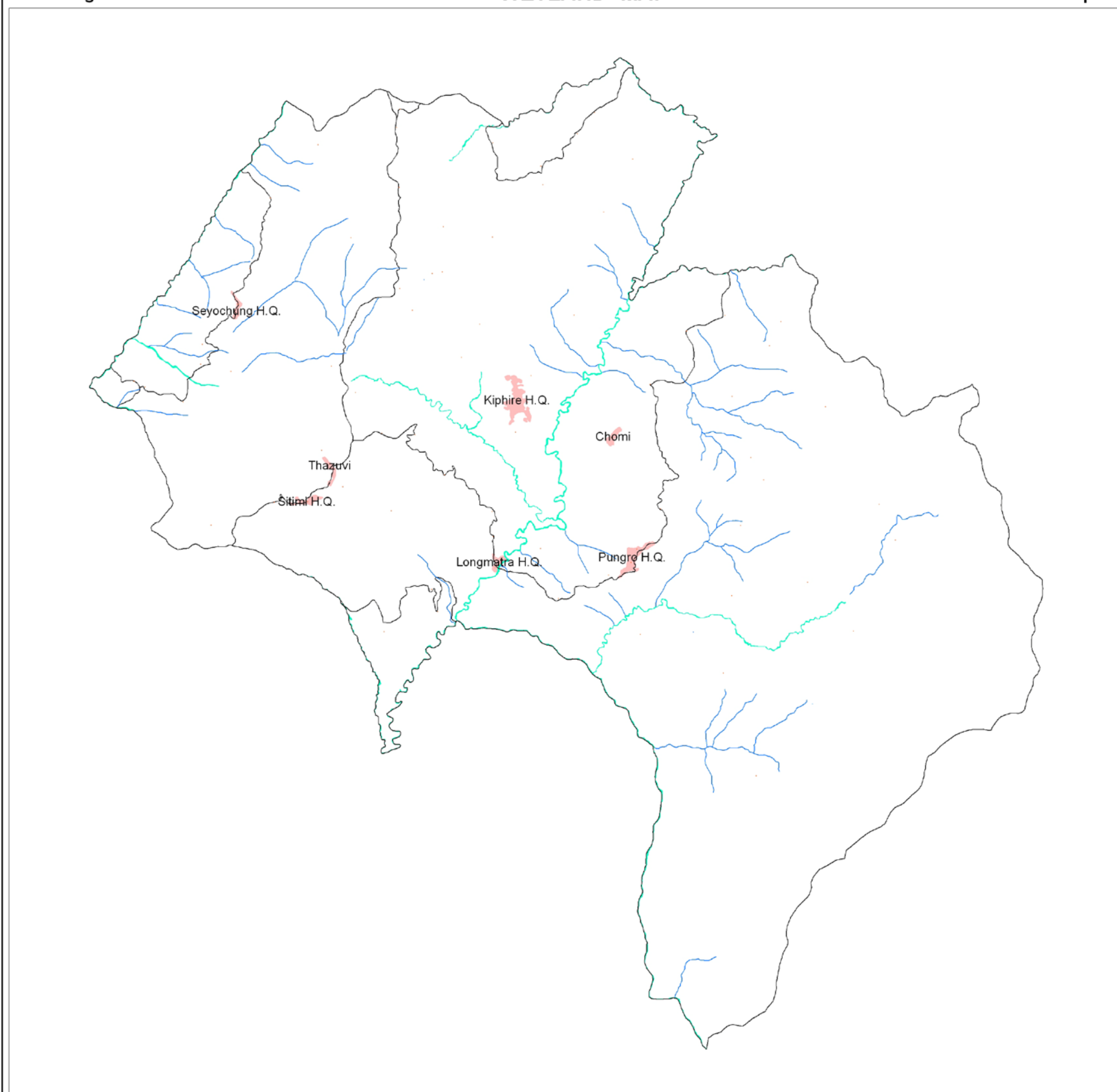
Total 8 wetlands are mapped in the district including 3 small wetlands (<2.25 ha). The total wetland area estimated is 860 ha. The major wetland type is River/Stream contributing 99.65%. No other wetland type is observed, except 3 small wetlands which are mainly tank/pond type. Details of wetland statistics of the district is given in Table 30. The open water spread of river/stream is same in both the seasons. The turbidity of water is high to moderate. No aquatic vegetation observed.

Table 30: Area estimates of wetlands in Kiphire

Sr. No	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of Wetland Area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	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	5	857	99.65	857	857
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	5	857	99.65	857	857
		Wetlands (<2.25 ha), mainly Tanks	3	3	0.35	-	-
		Total	8	860	100.00	857	857

Area under Aquatic Vegetation	-	-
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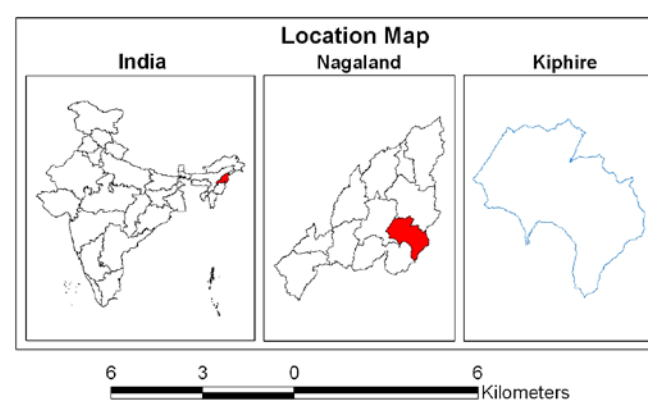
Area under turbidity levels		
Low	-	-
Moderate	267	267
High	590	590



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



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

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

Sponsored by:
Ministry of Environment and Forests
Government of India

7.3.3 Kohima

The very name of the state capital, Kohima was derived from a Tenyidie dialect Kewheimia meaning “people living in the hills.” of 132176.00 ha, with its district headquarter at Kohima town with an altitude of 1,444.12 meters above sea level. Kohima district is bounded in the east by Phek, west by Dimpaur, South by Manipur and North by Wokha. Japfii peak, which is the second highest peak in the state, stands at 3,015.60 meters above sea level in the south western part of the Capital town. The whole district is full of rugged and undulating terrains with the exception of the deep gorges and narrow valleys carved out by the rivers.

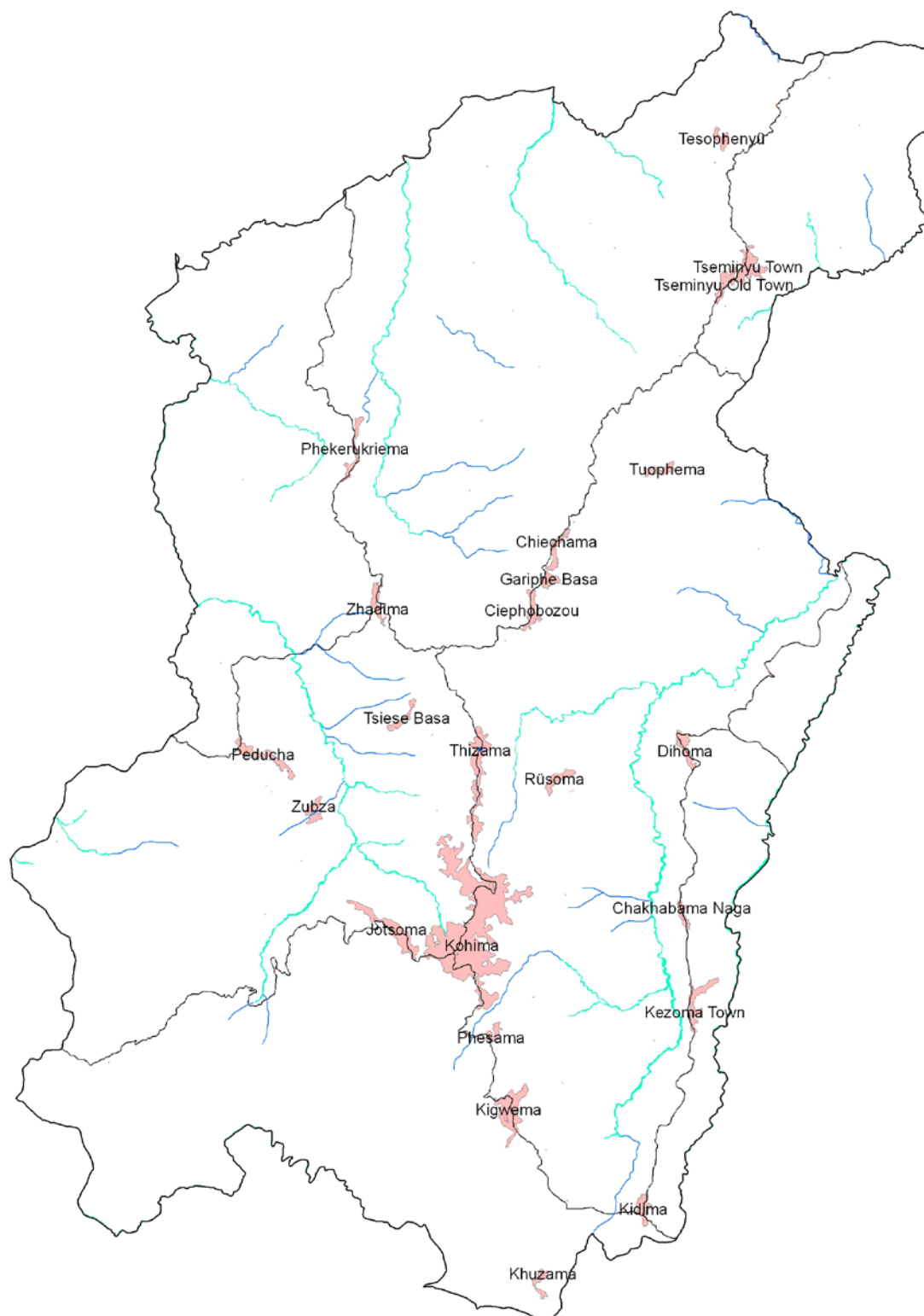
The major wetland type of the district is rivers /streams with 98.98%. Nine small wetlands (< 2.25 ha) are identified as point features. The open water spread of river/stream is same in both the seasons. The turbidity of water is Aquatic vegetation is nil in post monsoon, while 2 ha is observed, mainly in the one Lkae/pond mapped in the district. A detail of statistics of wetlands of the district is given in Table-31.

Table 31: Area estimates of wetlands in Kohima

Table 6.17: Area Estimates of Wetlands in Kollam							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	3	0.26	1	1
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	10	1161	98.98	1161	1161
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	11	1164	99.23	1162	1162
		Wetlands (<2.25 ha), mainly Tanks	9	9	0.77	-	-
		Total	20	1173	100.00	1162	1162

Area under Aquatic Vegetation	-	2
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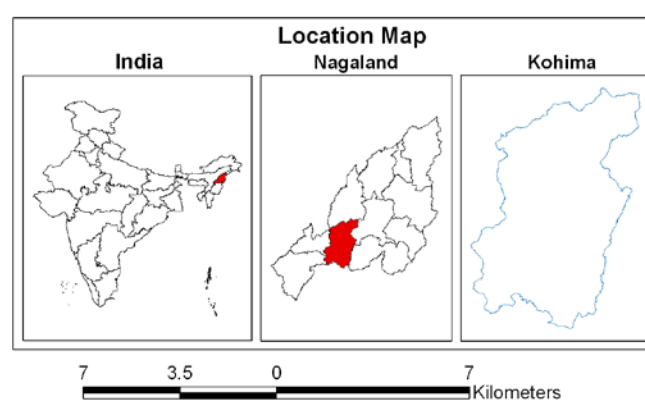
Area under turbidity levels		
Low	42	42
Moderate	613	408
High	507	712



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



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

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

Sponsored by:
Ministry of Environment and Forests
Government of India

7.3.4 Longleng

Longleng district was carved out from Tuensang district on 26th January 2004. Longleng town is the district headquarters with an altitude of 1,063.39 meters above sea level. It has a total geographic area of 56321.50 ha. It is bounded in the east by Mon, North by Assam, West by Mokokchung and South by Tuensang. The indigenous inhabitants of the district are the Phom. The physiography of the district is mainly made up of denudated, low hill slopes. Its major rivers are Dikhu and Yangnyu. The river Dikhu enters Tuensang district through Longleng and then turns towards Brahmaputra river in the plains of Assam.

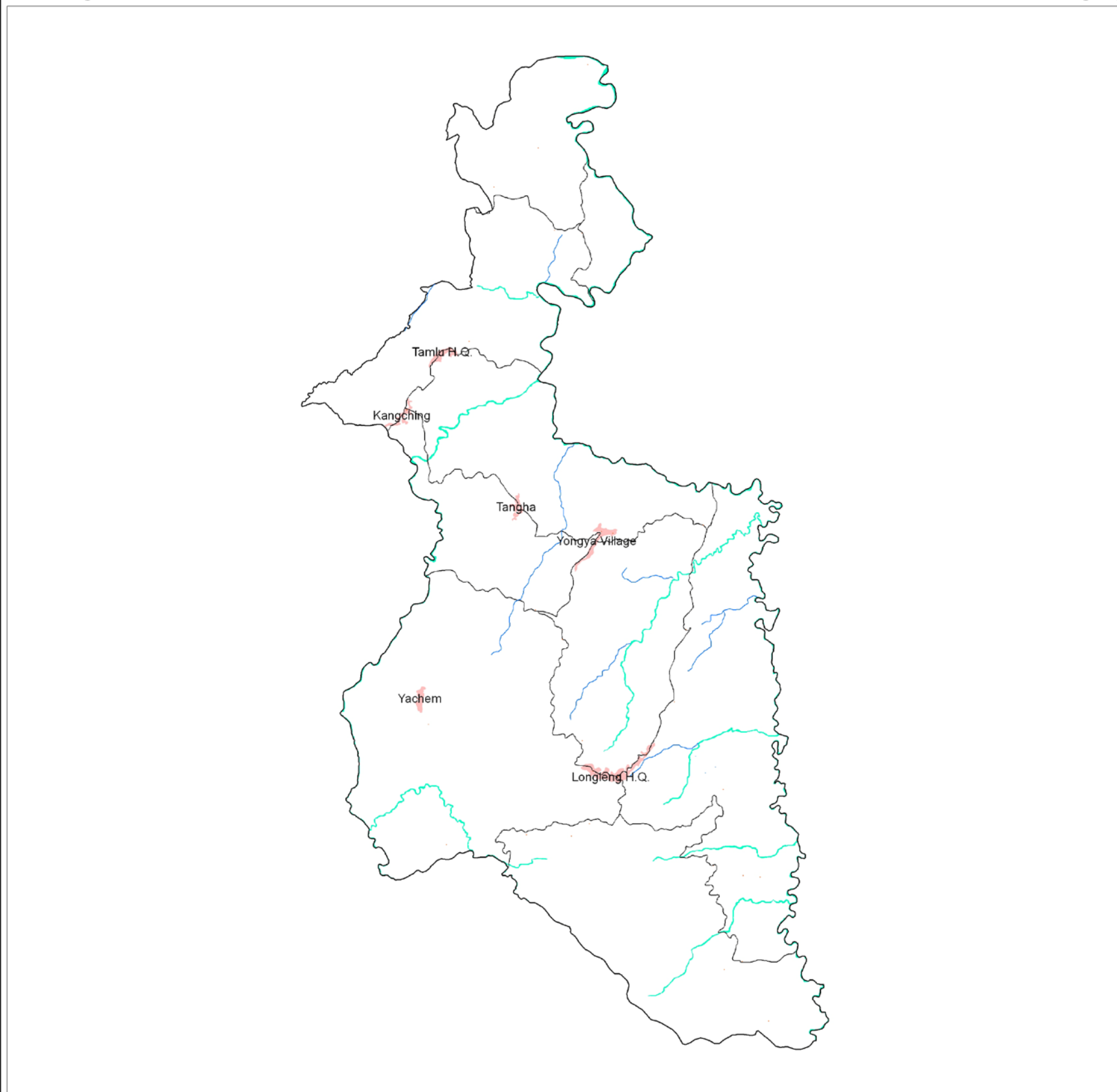
The total wetland area of Longleng is 974 ha with 3 wetlands less than 2.25 ha. The major wetland type is river/stream with 99.66% area. The open water spread of river/stream is same in both the seasons. The turbidity of open water of rivers is high to moderate in both the seasons. No aquatic vegetation is observed. A detail of statistics of wetland of the district is given in Table-32.

Table 32: Area estimates of wetlands in Longleng

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	3	971	99.69	971	971
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	3	971	99.69	971	971
		Wetlands (<2.25 ha), mainly Tanks	3	3	0.31	-	-
		Total	6	974	100.00	971	971

Area under Aquatic Vegetation	-	-
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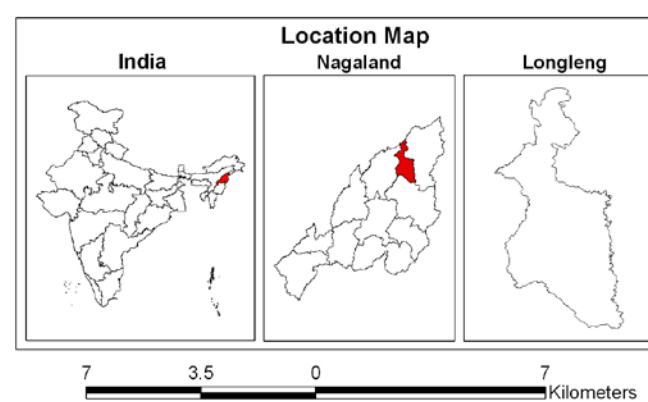
Area under turbidity levels		
Low	-	-
Moderate	465	465
High	506	506



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



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

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

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7.3.5 Mokokchung

The Mokokchung District is surrounded by Zunheboto in the south, Tuensang and Longleng in the east and Assam in the North and Wokha in the west. The district is the cultural centre of the Ao Nagas. The total geographic area of the district is 160504.00 ha. The district headquarter is Mokokchung with an altitude of 1325.08 meters above sea level. The physiography of the district is made up of Highly dissected hillslope. The major rivers are Tsiira or Tiru river, Dikhu river, etc.

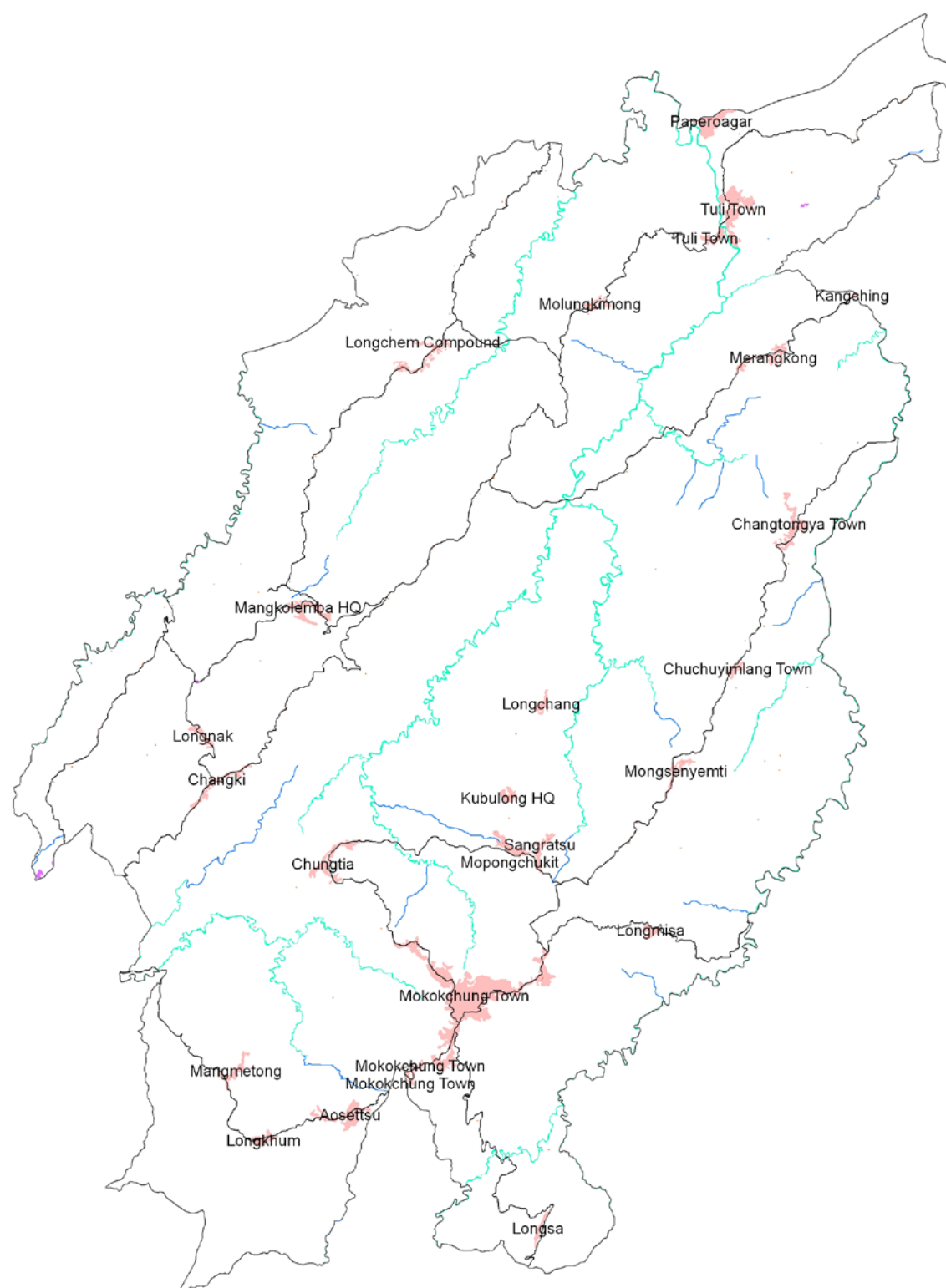
The total wetland area of the district is 1747 ha with 14 wetlands smaller than 2.25 ha. The major wetland types are River/Stream (98.05%). Details of wetland statistics of the district is given in Table-33.

Table 33: Area estimates of wetlands in Mokokchung

Sr. No	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of Wetland Area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	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	4	20	1.14	9	7
6	1106	River/Stream	6	1713	98.05	1713	1713
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	10	1733	99.20	1722	1720
		Wetlands (<2.25 ha), mainly Tanks	14	14	0.80	-	-
		Total	24	1747	100.00	1722	1720

Area under Aquatic Vegetation	1	12
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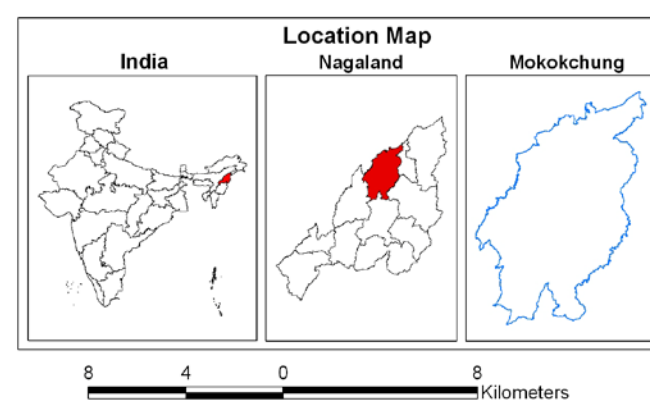
Area under turbidity levels		
Low	5	6
Moderate	524	521
High	1193	1193



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



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

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7.3.6 Mon

The district Mon is bounded by Assam on the North, Tuensang on the South, Myanmar on the East and Longleng on the West. The district headquarter is Mon with an altitude of 897.64 meters above sea level. The total geographic area of the district is 216188.00 ha. The indigenous inhabitants of the district are the Konyak. The district is rich in coal and other mineral resources. The physiography is generally denudated hill slope.

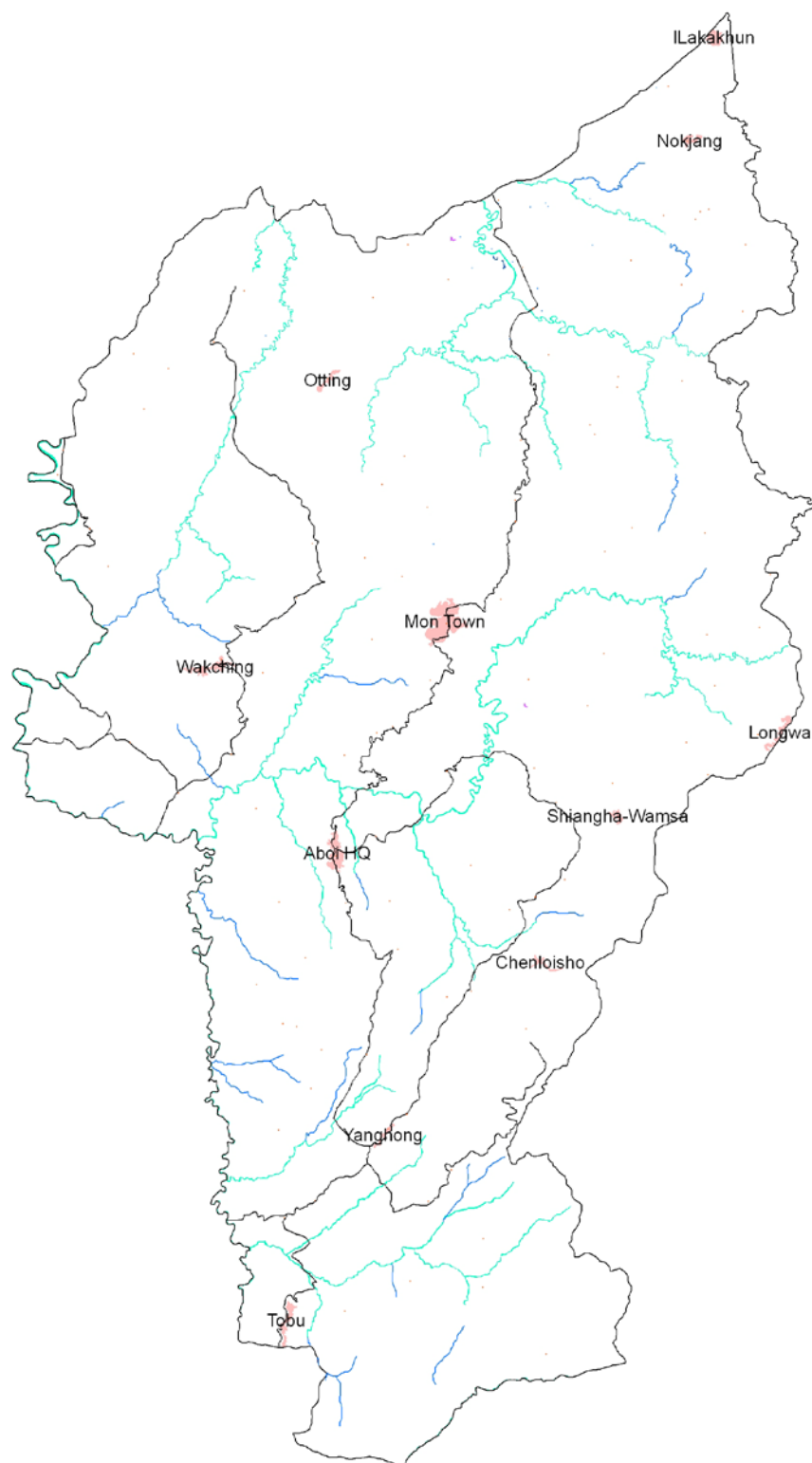
Total 28205 ha wetland area is estimated. River/stream is the dominant wetland with 99.01% area. 16 small wetlands (< 2.25 ha), that are mainly tank/pond type are delineated as point features. The open water spread of rivers is same in both the seasons. The turbidity of water is mainly high in both the seasons. Details of wetland statistics of the district is given in Table-34.

Table 34: Area estimates of wetlands in Mon

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	2	6	0.21	6	2
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	2	6	0.21	4	3
6	1106	River/Stream	13	2792	99.01	2792	2792
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	17	2804	99.43	2802	2797
		Wetlands (<2.25 ha), mainly Tanks	16	16	0.57	-	-
		Total	33	2820	100.00	2802	2797

Area under Aquatic Vegetation	-	5
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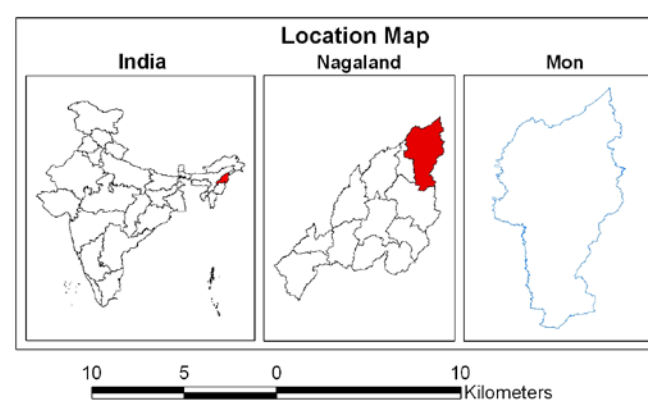
Area under turbidity levels		
Low	2	-
Moderate	288	285
High	2512	2512



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



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

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7.3.7 Peren

The district was carved out from Kohima district in the year 2004 and is home to the Zeliang and Kuki tribe. The district headquarter is Peren with an altitude of 1445.36 metre. The topography of the district is highly dissected with undulating upland. It is bounded in north by Dimapur district, west by Assam and south by Manipur state and Kohima in the east. The total geographical area of the district is 173958.00 ha. It is an important link between Haflong in Assam and Nagaland.

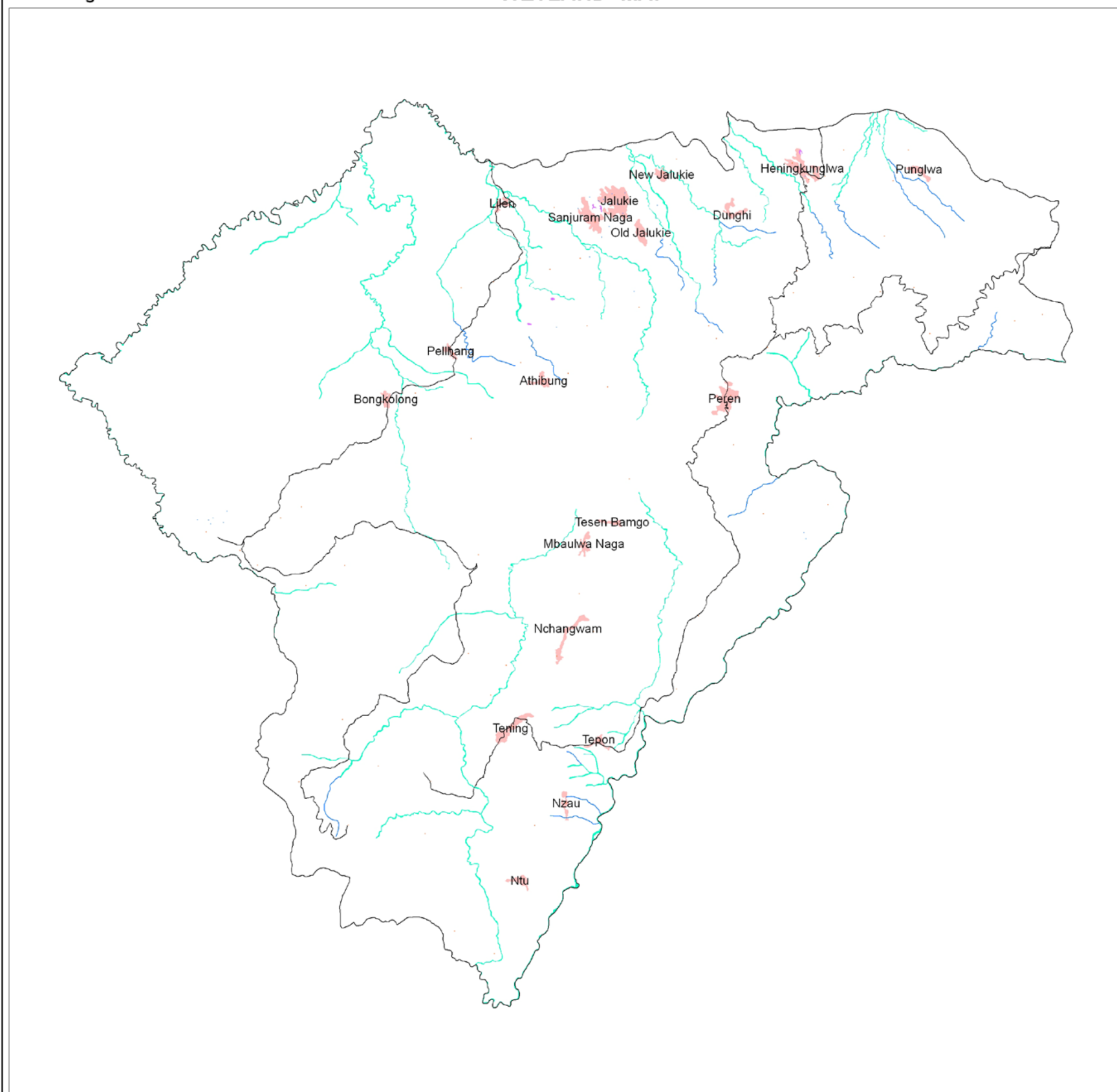
Total 2324 ha wetland area is estimated. River/stream is the dominant wetland with 98.15% area. 5 sites of waterlogged (natural) is mapped with 16 ha area. Total 27 small wetlands (< 2.25 ha), that are mainly tank/pond type are delineated as point features. The open water spread of rivers is same in both the seasons. The turbidity of water is high to moderate in both the seasons. Details of wetland statistics of the district is given in Table-35.

Table 35: Area estimates of wetlands in Peren 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	5	16	0.69	10	15	
6	1106	River/Stream	12	2281	98.15	2281	2281	
	1200	Inland Wetlands -Man-made						
7	1201	Reservoirs/Barrages	-	-	-	-	-	
8	1202	Tanks/Ponds	-	-	-	-	-	
9	1203	Waterlogged	-	-	-	-	-	
10	1204	Salt pans	-	-	-	-	-	
		Sub-Total	17	2297	98.84	2291	2296	
		Wetlands (<2.25 ha), mainly Tanks	27	27	1.16	-	-	
		Total	44	2324	100.00	2291	2296	

Area under Aquatic Vegetation	-	1
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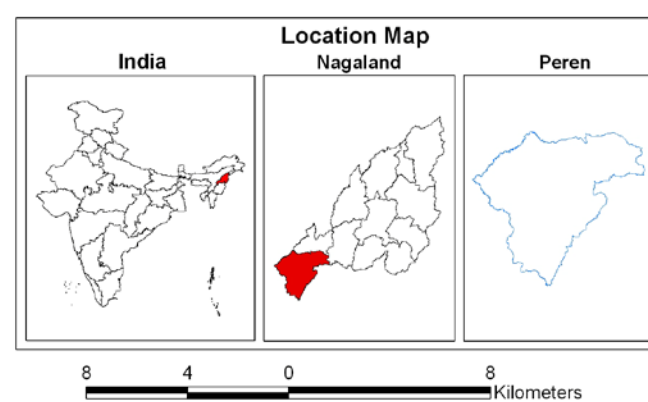
Area under turbidity levels		
Low	1	1
Moderate	1068	1073
High	1222	1222



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



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

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7.3.9 Phek

Phek district was carved out of Kohima district on 21st Dec. 1973. It is bounded by Manipur in the South, Kohima in the West, Zunheboto and Kiphire on the North and Myanmar in the East. The principal inhabitants of the district are the Chakhesangs and Pochuries. Phek, with an altitude of 1,524 metre above sea level, is the district headquarter. The topography of the district is composed of high hillslope and denudational hillslope. The total geographical area of the district is 2,02,600.00 ha. Tizu is the major river flowing through the district.

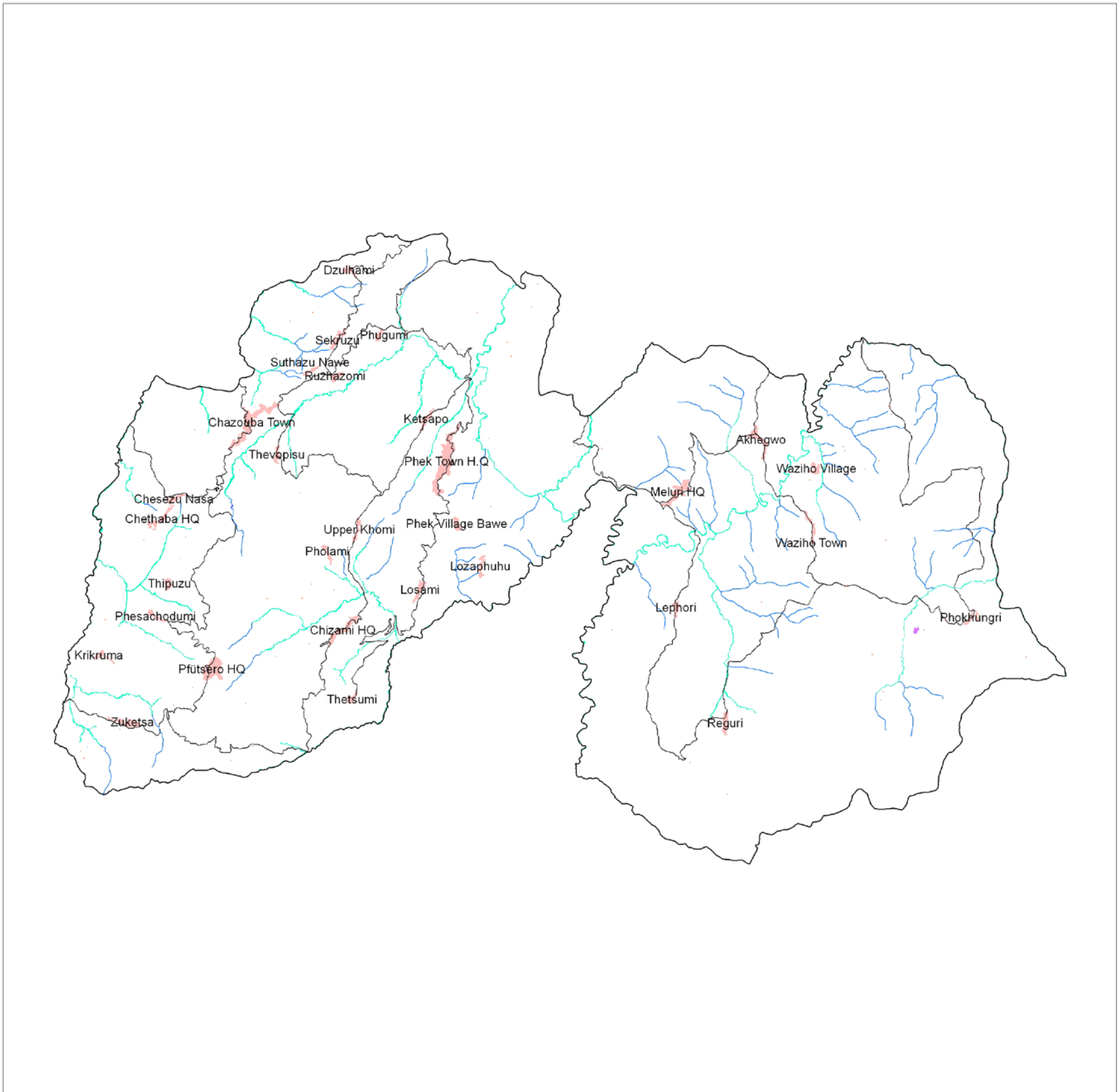
Total wetland area estimated is 2,414 ha. The major wetland types are River/Stream with 99.17% area. In addition, 5 small wetlands (< 2.25 ha.) are mapped as point features. The open water spread of the rivers is same in both the seasons. The turbidity of water is high to moderate. Details of wetland statistics of the district is given in Table-36.

Table 36: Area estimates of wetlands in Phek

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	2	15	0.62	13	13
6	1106	River/Stream	14	2394	99.17	2394	2394
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	16	2409	99.79	2407	2407
		Wetlands (<2.25 ha), mainly Tanks	5	5	0.21	-	-
		Total	21	2414	100.00	2407	2407

Area under Aquatic Vegetation	-	3
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Area under turbidity levels		
Low	4	4
Moderate	1139	1139
High	1264	1264



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

India Nagaland Phek

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

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7.3.10 Tuensang

Tuensang district has a total geographical area of 2, 14,192.00 ha. It is bounded in the north by Longleng and Mon, West by Mokokchung, South by Kiphire and Myanmar in the East. Tuensang is the district headquarters with an altitude of 1,371.60 meter above sea level. The principal inhabitants of this district are Changs, Phoms, Sangtams, Yimchungers and Khiamuingans. Zungki is the major river flowing through the district.

Total wetland area estimated is 2,015 ha. The major wetland types are River/Stream with 99.9% area. In addition, 2 small wetlands (< 2.25 ha.) are mapped as point features. The open water spread of the rivers is same in both the seasons. The turbidity of water is high to moderate. Details of wetland statistics of the district is given in Table-37.

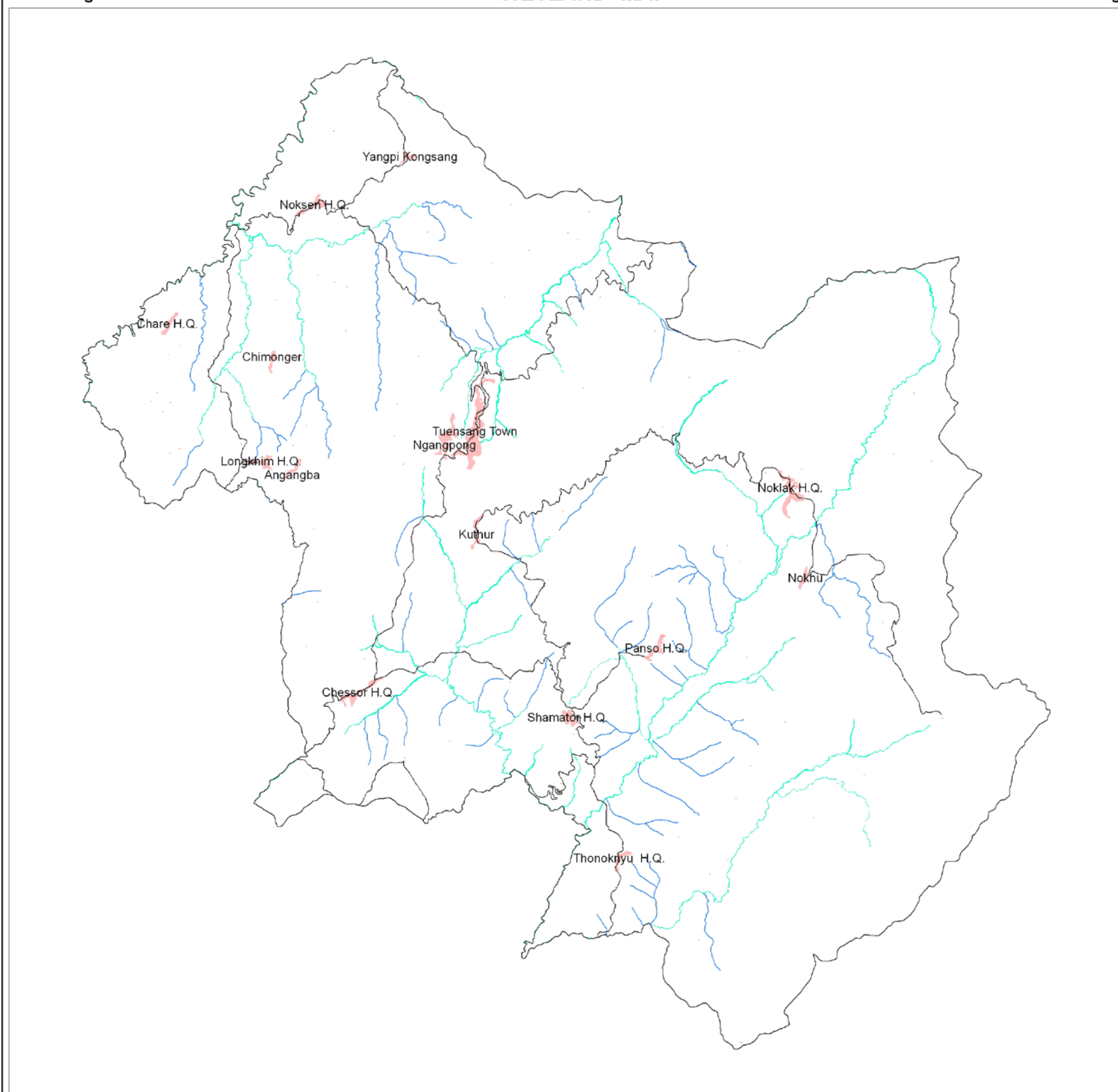
Table 37: Area estimates of wetlands in Tuensang

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	9	2013	99.90	2013	2013
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	9	2013	99.90	2013	2013
		Wetlands (<2.25 ha), mainly Tanks	2	2	0.10	-	-
		Total	11	2015	100.00	2013	2013

Area under Aquatic Vegetation	-	-
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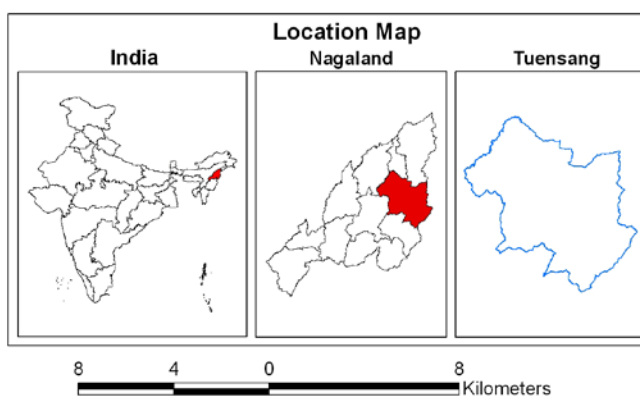
Area under turbidity levels		
Low	-	-
Moderate	409	409
High	1604	1604



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



Data Source:
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7.3.11 Wokha

Wokha literally means census and is the district headquarter with an altitude of 1313.69 meters above sea level. The Lothas are the principal inhabitants of the district. The total area of the district is 161782.00 ha. The biggest river of Nagaland, Doyang, flow through the middle of this district. The area is made up highly dissected hill slope.

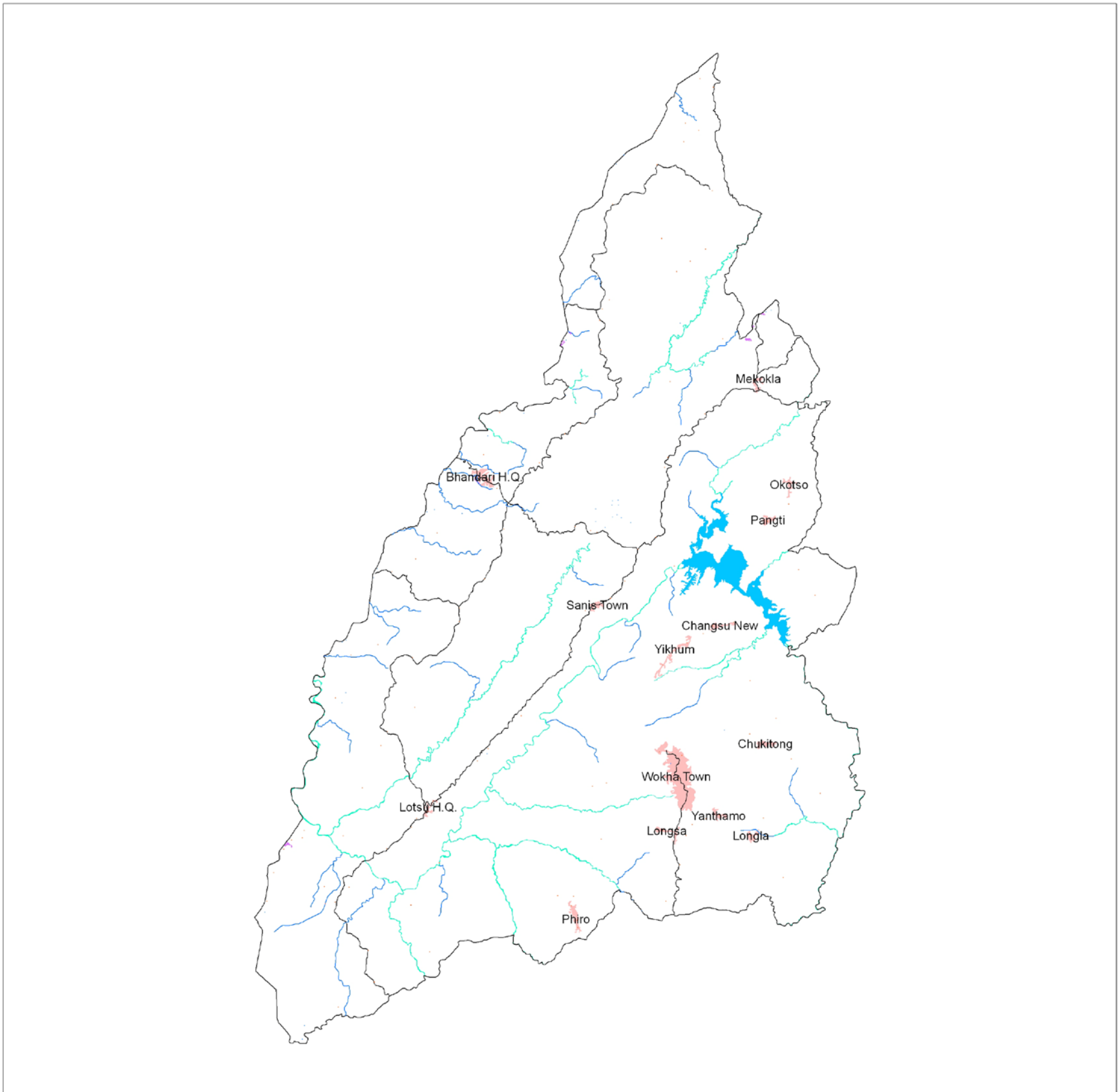
Total wetland area estimated is 2946 ha area. Reservoir/barrage is the major wetland type of this district. One reservoir/barrage wetland type, the Doyang hydel power project reservoir is mapped with 1536 ha area occupying 52.54% area. The other wetland types are river/stream with 45.35% area, and waterlogged (natural) with 32 ha area . In addition, 42 small wetlands (< 2.25 ha.) are mapped as point features. The open water spread of the rivers is same in both the seasons. However, the open water spread of the reservoir is slightly more during post monsoon. The turbidity of water is moderate to low. Aquatic vegetation is observed in the reservoir wetland fringes during pre monsoon when water spread shrinks. Details of wetland statistics of the district is given in Table-38.

Table 38: Area estimates of wetlands in Wokha

Table 66: Area estimates of Wetlands in Wernia							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	7	32	1.09	20	17
6	1106	River/Stream	11	1336	45.35	1336	1336
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	1	1536	52.14	1280	1076
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	19	2904	98.57	2636	2429
		Wetlands (<2.25 ha), mainly Tanks	42	42	1.43	-	-
		Total	61	2946	100.00	2636	2429

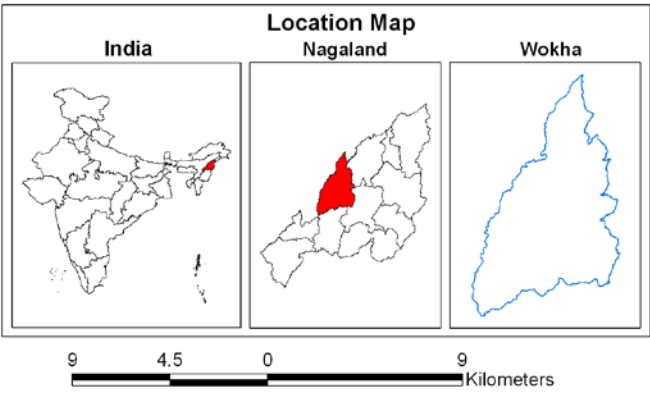
Area under Aquatic Vegetation	2	476
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Area under turbidity levels		
Low	1310	138
Moderate	1207	1311
High	119	980



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
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Data Source:
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7.3.12 Zunheboto

This district is bounded by Phek in the south, Kohima and Wokha in the west, Mokokchung in the north and Tuensang and Kiphire in the east. Zunheboto is the district headquarters with an altitude of 1874.22 metre above sea level. It has total geographical area of 1, 25,500.00 ha. The district is the home of the sema tribe. Physiographically, the district is made up of high to low hill slope.

Total wetland area estimated is 2,258 ha area. The major wetland types are River/Stream with 99.29% area. In addition, 16 small wetlands (< 2.25 ha.) are mapped as point features. The open water spread of the rivers is same in both the seasons. The turbidity of water ranged from low, moderate to high. Details of wetland statistics of the district is given in Table-39.

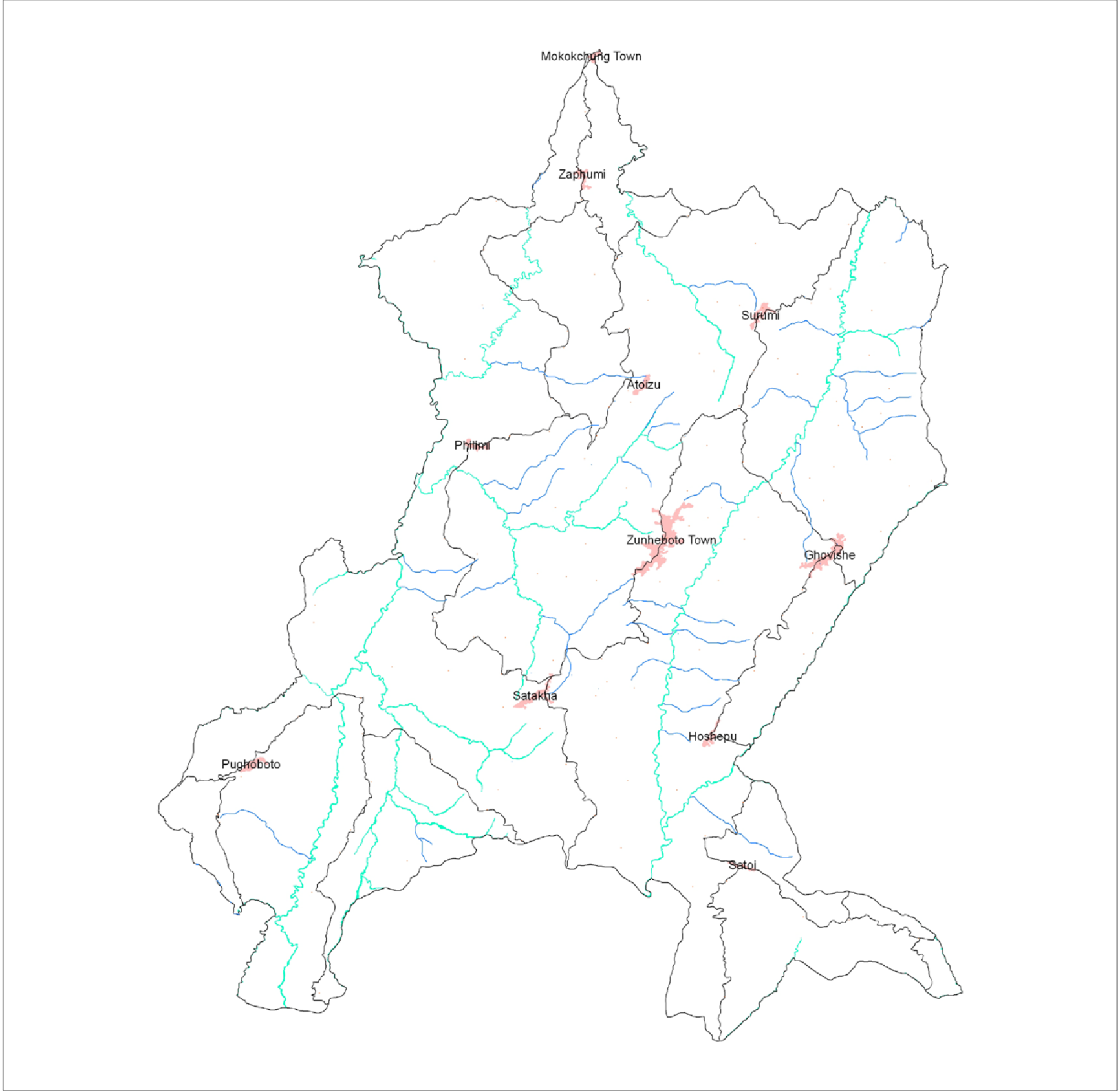
Table 39: Area estimates of wetlands in Zunheboto

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	10	2242	99.29	2242	2242
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	10	2242	99.29	2242	2242
		Wetlands (<2.25 ha), mainly Tanks	16	16	0.71	-	-
		Total	26	2258	100.00	2242	2242

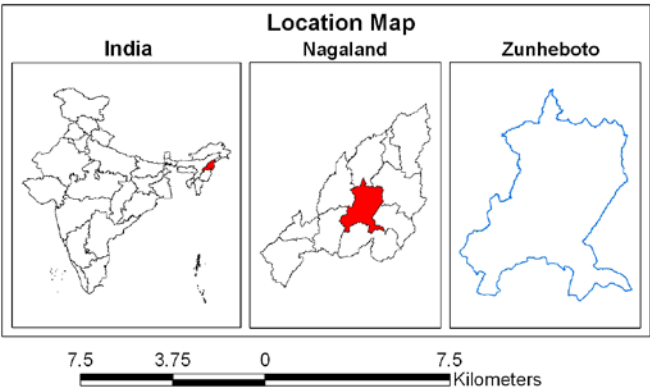
Area under Aquatic Vegetation	-	-
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Area under turbidity levels	-	-
Low	854	854
Moderate	645	645
High	743	743



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



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

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

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7.4 MANIPUR

Area estimates of various wetland categories for Manipur have been carried out using GIS layers of wetland boundary, water-spread, aquatic vegetation and turbidity. Total 167 wetlands have been mapped at 1:50,000 scale in the state. In addition, 541 wetlands (smaller than 2.25 ha) have also been identified. Total wetland area estimated is 63616 ha that is around 2.85 per cent of the geographic area (Table 40). The major wetland types are lakes/ponds accounting for 62 percent of the wetlands (39124 ha), river/stream (16677 ha), waterlogged (3525 ha) and Aquaculture ponds (2643 ha). Graphical distribution of wetland type is shown in Figure 18.

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

Table 40: Area estimates of wetlands in Manipur

Area in ha							
Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	15	39123	61.50	22300	17276
2	1102	Ox-bow lakes/ Cut-off meanders	9	64	0.10	59	64
3	1105	Waterlogged	61	3525	5.54	2845	2191
4	1106	River/Stream	15	16677	26.22	16677	16677
	1200	Inland Wetlands -Man-made					
5	1201	Reservoirs/Barrages	3	856	1.35	856	657
6	1202	Tanks/Ponds	53	187	0.29	184	187
		Total - Inland	156	60432	94.99	42921	37052
	2200	Coastal Wetlands - Man-made					
7	2202	Aquaculture ponds	11	2643	4.15	2383	2339
		Total - Coastal	11	2643	4.15	2383	2339
		Sub-Total	167	63075	99.15	45304	39391
		Wetlands (<2.25 ha), mainly Tanks	541	541	0.85	-	-
		Total	708	63616	100.00	45304	39391

Area under Aquatic Vegetation	16756	23500
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Area under turbidity levels		
Low	17866	17261
Moderate	26911	21841
High	527	289

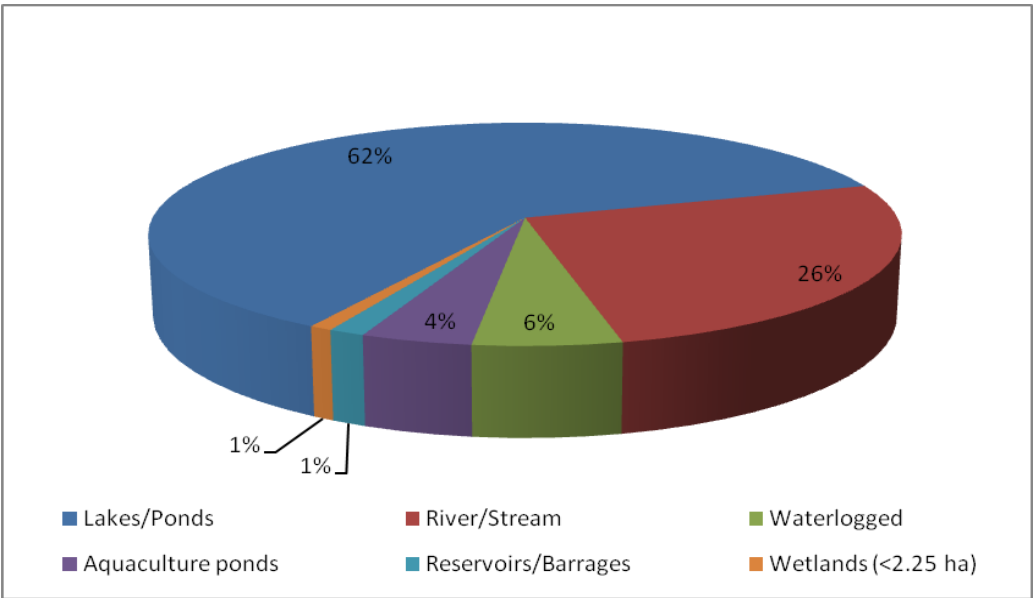


Figure 18: Type-wise wetland distribution in Manipur

The state has nine districts. District-wise distribution of wetlands showed that three districts can be called as wetland rich. Bishnupur has highest concentration with around 43.9 percent of geographic area under wetland. This is mainly due to the location of the famous Loktok lake. The other two districts are: Thoubal and Imphal West with around 30.6 and 16.3 per cent area under wetland. Ukhrul district has the lowest area under wetland (around 0.5 per cent). Wetland category of Aquaculture pond was observed only in Bishnupur and Imphal West district, mainly due to the presence of the Loktak lake. Only three reservoirs/barrages are observed. District-wise wetland area estimates is given in Table-41. Figure 19 shows district-wise graphical distribution of wetlands.

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

Table-41: District-wise wetland area in Manipur

District code	District	Geographic Area	Wetland Area	% of total wetland area	% of district geographic area	Open water		Aquatic Vegetation	
						Post-monsoon	Pre-monsoon	Post-monsoon	Pre-monsoon
		(sq. km.)	(ha)		(ha)	(ha)	(ha)	(ha)	(ha)
1	Senapati	496	1911	3.01	3.85	1791	1784	0	0
2	Tamelong	3313	5086	8.02	1.54	5039	5039	0	0
3	Churachandrapur	4570	4102	6.47	0.90	4046	3854	0	0
4	Bishnupur	709	21753	34.29	30.68	14108	13872	7541	7943
5	Thoubal	519	15718	24.78	30.29	9610	3509	5907	12136
6	Imphal West	3271	8418	13.27	2.57	4795	5186	3011	3231
7	Imphal East	4391	2098	3.31	0.48	1569	1801	297	190
8	Ukhrul	514	2355	3.71	4.58	2355	2355	0	0
9	Chandel	4544	1991	3.14	0.44	1991	1991	0	0
	Total	22327	63432	100.00		45304	39391	16756	23500

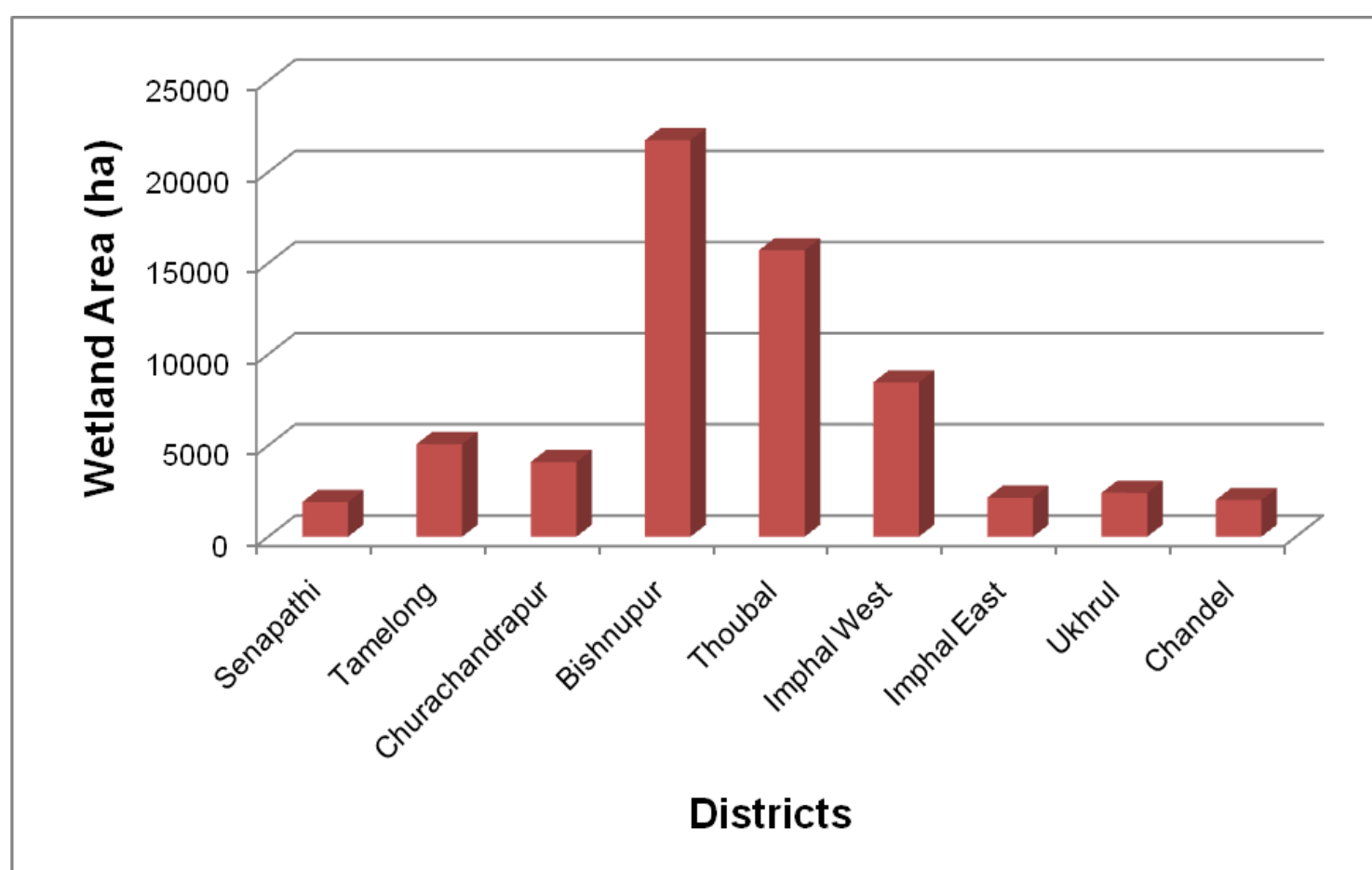
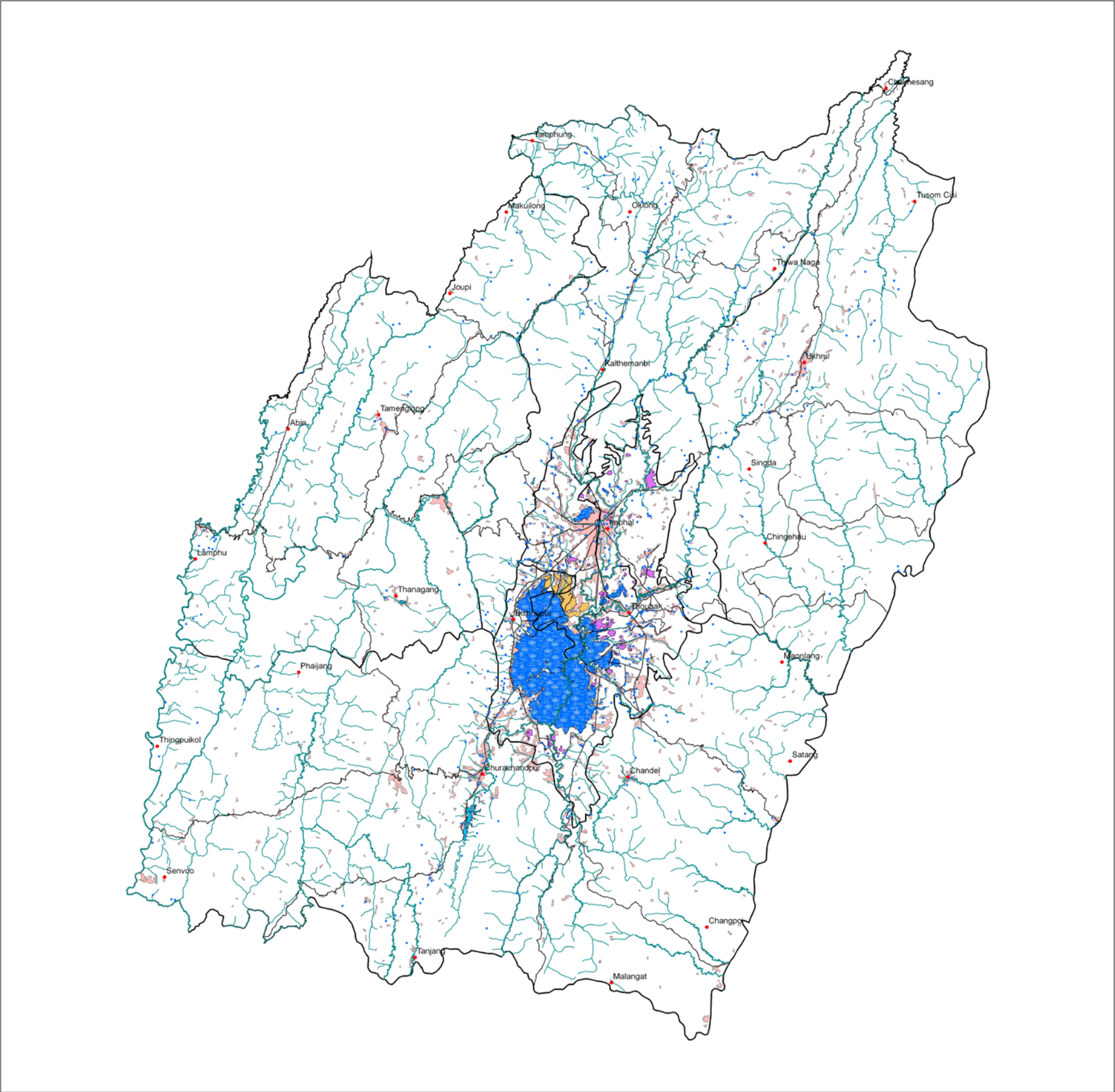
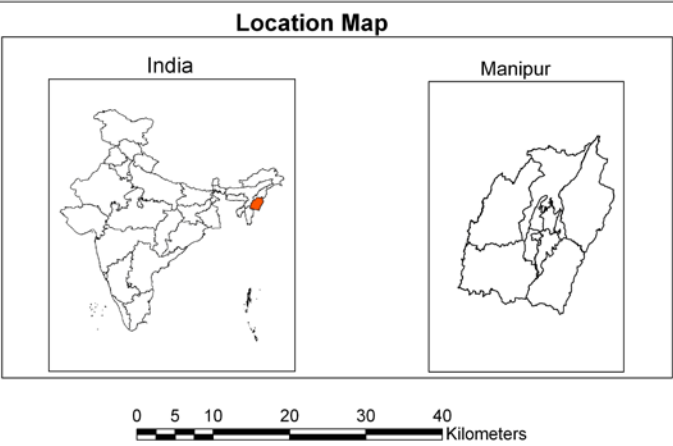


Figure 19: District-wise wetland distribution in Manipur



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

- Legend**
- Wetlands (<2.25ha)
 - Roads
 - Drainage (line)
 - Settlements
 - Town/Settlements



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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

Sponsored By:
Ministry of Environment and Forests
Government of India

7.4.1 Senapati

The Senapati District is located in the northern part of Manipur. The head quarter is Senapati town. It is bounded on the east by Ukhrul District, on the west by Tamenglong District, on the north by Phek District of Nagaland and on the south by Imphal East District and Imphal West District. The District is at an altitude varying from 1061 m to 1788 m above mean sea level. The hills run along the north south direction and gradually slope down towards south and meet the Imphal valley. The District is endowed with kaleidoscopic landscape of blue hills, green valleys, serpentine streams and rivers flowing through mountains and deep gorges. The total geographic area of the district is 3,271 sq km. The total population of the district is 3,79,214 (census 2001).

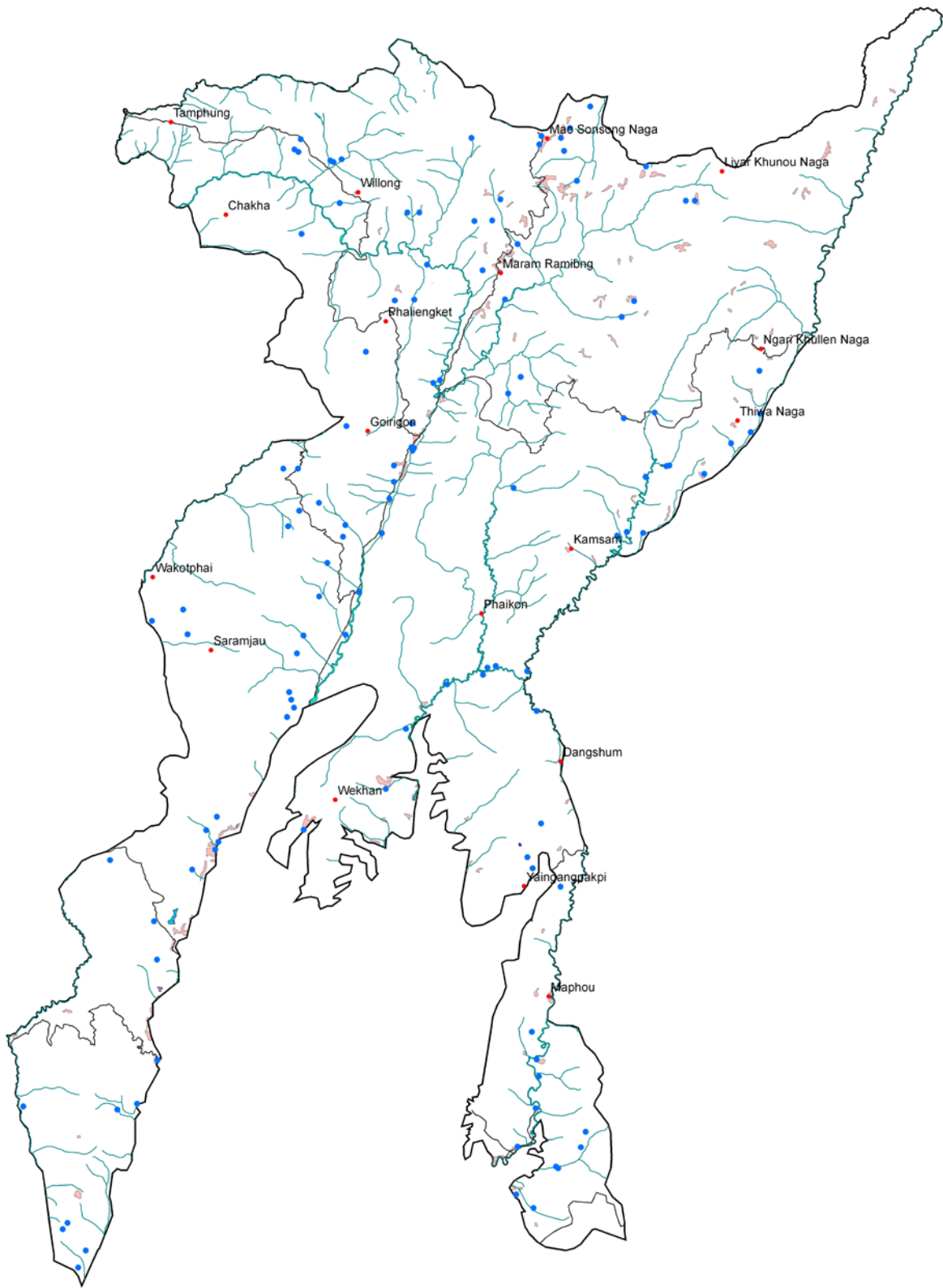
The wetland area estimated is 1911 ha. Small wetlands, which are less than minimum mapable units (MMU), are 120 in the district. The major wetland types are River/Streams and Reservoir. Details are given in Table 42.

Table 42: Area estimates of wetlands in Senapati

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1105	Waterlogged	2	13	0.68	13	13
2	1106	River/Stream	19	1723	90.16	1723	1723
	1200	Inland Wetlands -Man-made					
3	1201	Reservoirs/Barrages	1	43	2.25	43	36
4	1202	Tanks/Ponds	4	12	0.63	12	12
		Sub-Total	26	1791	93.72	1791	1784
		Wetlands (<2.25 ha), mainly Tanks	120	120	6.28	-	-
		Total	146	1911	100.00	1791	1784

Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	1767	1760
Moderate	24	24
High	-	-

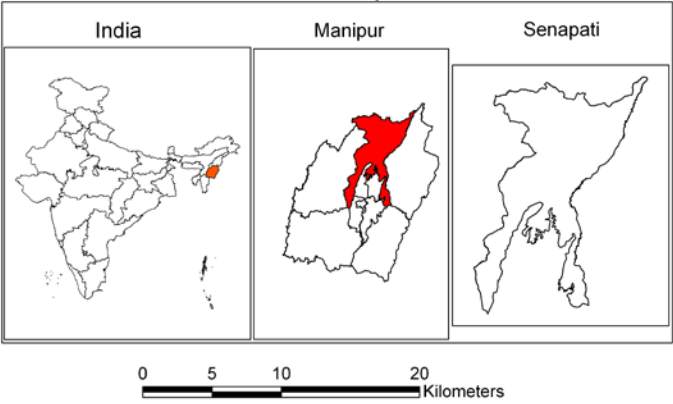


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

- Wetlands (<2.25ha)
- Roads
- Drainage (line)
- Settlements
- Town/Settlements

Location Map



Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
Sponsored By:
Ministry of Environment and Forests
Government of India

7.4.2 Tamenglong

Tamenglong is located along the western boundary of the state. Tamenglong is entirely composed of hills, ranges and narrow valleys. The hilltops and valley sides are dotted with small hamlets, located at strategic points. The total geographic area of Tamenglong district is 4,391 sq km. The total population of the district is 1,11,493 (census 2001). The head-quarter of the district is Tamenglong town.

The wetland area estimated is 5086 ha. Small wetlands, which are less than minimum mapable units, are 47 in the district. The major wetland types are River/Streams. Details are given in Table 43.

Table 43: Area estimates of wetlands in Tamenglong

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1106	River/Stream	7	4959	97.50	4959	4959
	1200	Inland Wetlands -Man-made					
2	1201	Reservoirs/Barrages	1	73	1.44	73	73
3	1202	Tanks/Ponds	3	7	0.14	7	7
		Sub-Total	11	5039	99.08	5039	5039
		Wetlands (<2.25 ha), mainly Tanks	47	47	0.92	-	-
		Total	58	5086	100.00	5039	5039

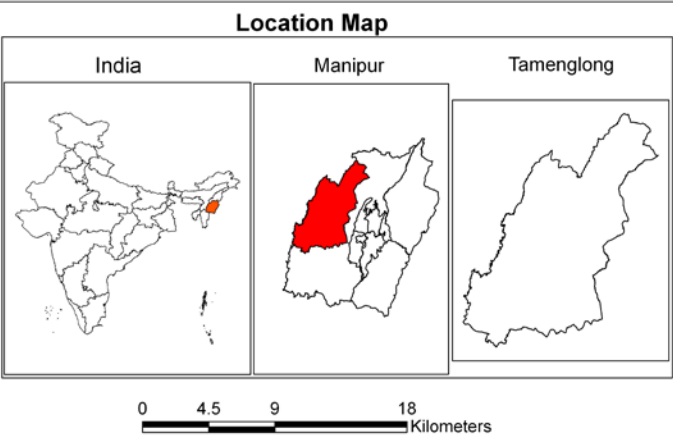
Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	4959	4959
Moderate	80	80
High	-	-



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

- Legend**
- Wetlands (<2.25ha)
 - Roads
 - Drainage (line)
 - Settlements
 - Town/Settlements



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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

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Ministry of Environment and Forests
Government of India

7.4.3 Churachandrapur

Churachandpur District, in the southwestern corner of Manipur, has an area of 4570 sq.km. Its location is 23⁰55' to 24⁰30' North and 92⁰59' to 93⁰50' east. It is a hilly district with a very small percentage of the area being plain. According to 2001 census, the total population of the district is 2,28,707 and inhabited by several tribes, mainly belonging to the Kuki-Chin-Mizo group. The district is divided into 5 Revenue Sub-divisions, namely Churachandpur, Singngat, Thanlon, Parbung (Tipaimukh) and Henglep. The head-quarter of the district is Churachandrapur town.

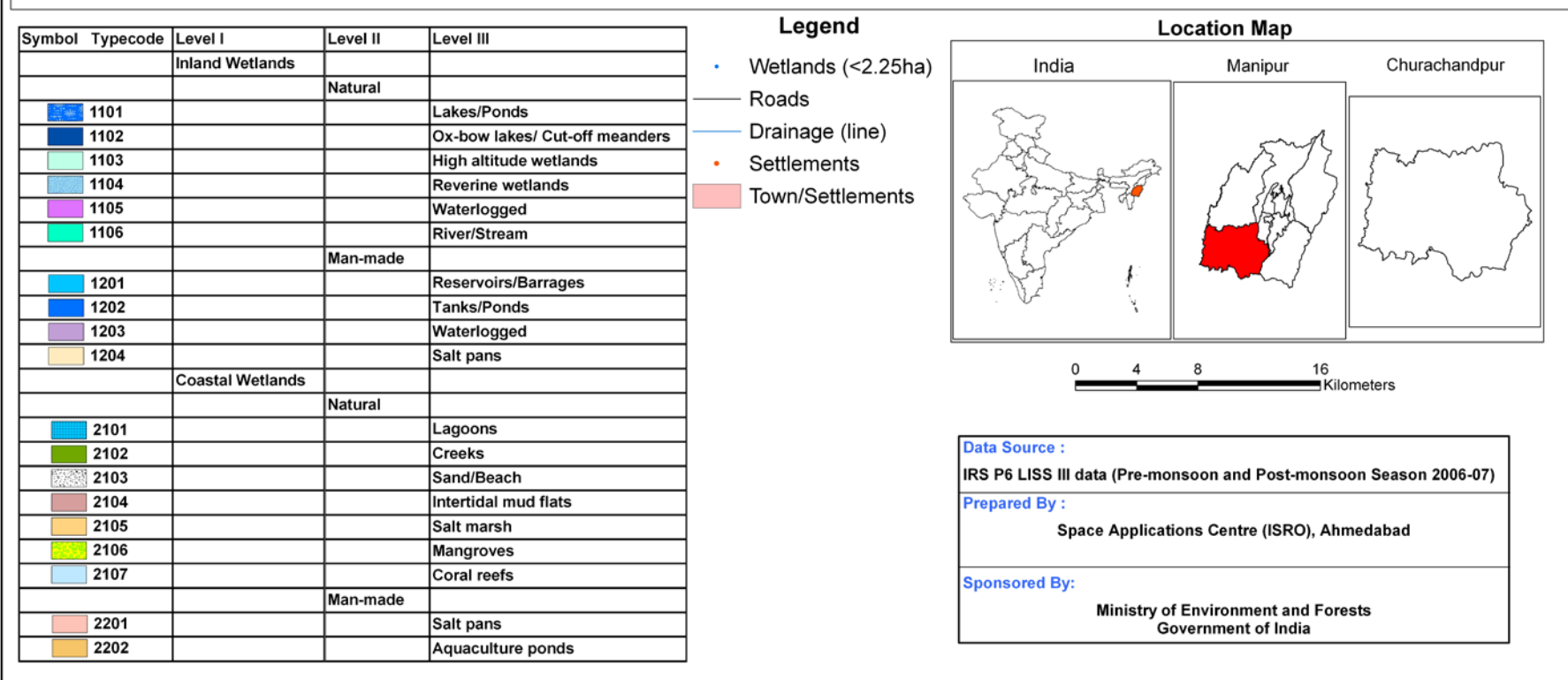
The wetland area estimated is 4102 ha. Small wetlands, which are less than minimum mapable units, are 56 in the district. This is mainly due to presence of river/streams. One reservoir is located near Lamzang. Details of the wetlands are shown in Table 44.

Table 44: Area estimates of wetlands in Churachandrapur

Area in ha							
Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1102	Ox-bow lakes/ Cut-off meanders	1	8	0.20	8	8
2	1106	River/Stream	19	3294	80.30	3294	3294
	1200	Inland Wetlands -Man-made					
3	1201	Reservoirs/Barrages	1	740	18.04	740	548
4	1202	Tanks/Ponds	1	4	0.10	4	4
		Sub-Total	22	4046	98.63	4046	3854
		Wetlands (<2.25 ha), mainly Tanks	56	56	1.37	-	-
		Total	78	4102	100.00	4046	3854

Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	4034	3842
Moderate	4	4
High	8	8



7.4.4 Bishnupur

The Bishnupur with its headquarter at Bishnupur (27 Km. from Imphal) lies between 93.43° E and 93.53° E Longitudes and 24.18° N and 24.44° N Latitudes and the total geographical area of the District is 496 Sq. Km. It is bounded on the North by Imphal West District, on the South by Churachandpur District, on the East by Imphal and Thoubal Districts. The total population of the district is 2,05,907 (census 2001). The head-quarter of the district is Bishnupur town.

This district can be termed as the wetland district of the state as the wetland area estimated is 21,753 ha, accounting for 43.9 per cent of geographic area. Small wetlands, which are less than minimum mapable units, are 43 in the district. The wetland types found are Lakes/Ponds, Waterlogged area, Aquaculture ponds and River/Stream.

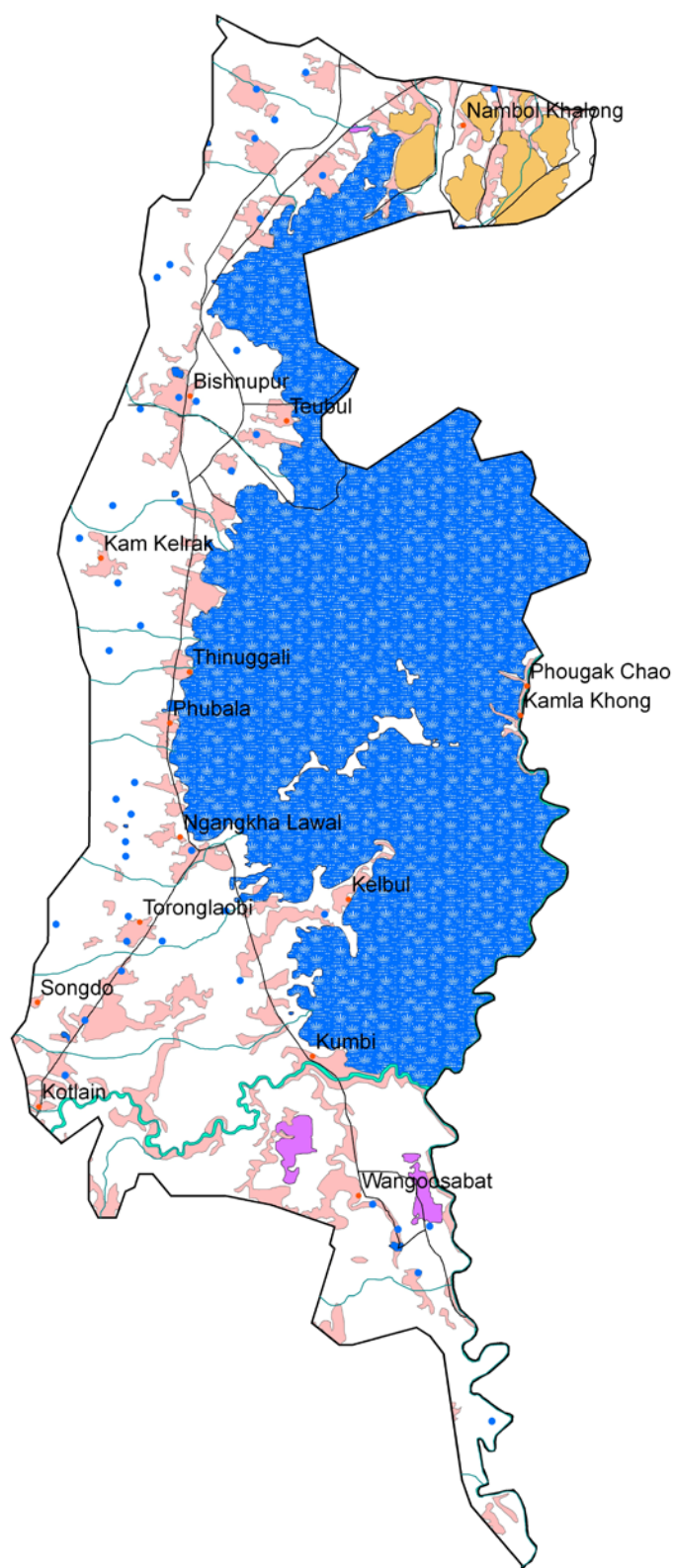
The dominant type of wetland found in the state is Lake/ponds which account for around 91 percent of the total wetland area of the district. Major part of the famous Loktak Lake lies in this district. Around 64 percent area of wetlands is under open water and 35 per cent having aquatic vegetation (floating and emergent type) during Post-monsoon. The turbidity rating of the open water is observed to be mainly moderate. Details of the wetland statistics of the district is given in Table 45.

Table 45: Area estimates of wetlands in Bishnupur

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	2	19900	91.48	12437	12178
2	1105	Waterlogged	4	283	1.30	173	167
3	1106	River/Stream	2	369	1.70	369	369
	1200	Inland Wetlands -Man-made					
4	1202	Tanks/Ponds	10	37	0.17	37	37
		Total - Inland	18	20589	94.65	13016	12751
	2200	Coastal Wetlands - Man-made					
5	2202	Aquaculture ponds	8	1121	5.15	1092	1121
		Total - Coastal	8	1121	5.15	1092	1121
		Sub-Total	26	21710	99.80	14108	13872
		Wetlands (<2.25 ha), mainly Tanks	43	43	0.20	-	-
		Total	69	21753	100.00	14108	13872

Area under Aquatic Vegetation	7541	7943
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Area under turbidity levels		
Low	369	369
Moderate	13739	13503
High	-	-

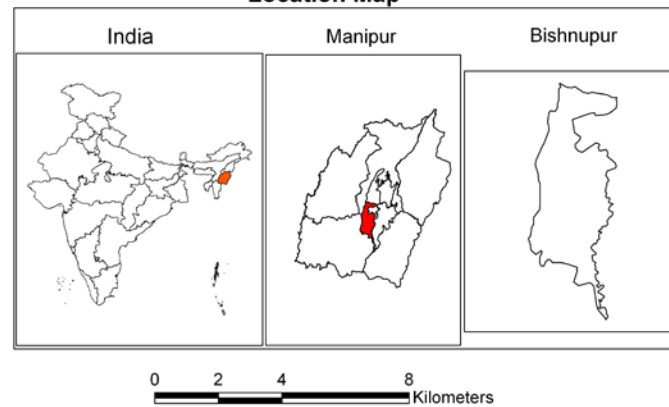


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

- Wetlands (<2.25ha)
- Roads
- Drainage (line)
- Settlements
- Town/Settlements

Location Map



Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad

Sponsored By :

Ministry of Environment and Forests
Government of India

7.4.5 Thoubal

The district of Thoubal, lies between 23° 45' N and 24°45' N latitude and 93°45' E and 94°15' E longitude. The total geographic area of Thoubal district is 514 sq km. The head-quarter of the district is Thoubal town. It is bounded on the north by Imphal district, on the east by Ukhrul and Chandel districts, on the south by Chandel and Churachandpur districts and on the west by the districts of Imphal and Bishnupur. The total population of the district is 3,66,341 (census 2001). Many rivers flow through the district and many lakes dot its surface. Important rivers that flow through the district are the Imphal and the Thoubal. The Thoubal river originates in the hill ranges of Ukhrul and is an important tributary of the Imphal river. On its course, it passes through Yairipok and Thoubal before joining the Imphal at Irong near Mayang Imphal. The Imphal river rises in the hills of Senapati district and flows south. It forms the boundary demarcating line of Thoubal district on its north and the west. Many important lakes of Manipur are in this district. The south-western portion of the district is a low-land forming a part of the Loktak Lake region and this area has a number of shallow and rain fed lakes, the important ones being Kharung, Ikop, Pumlen, and Khoidum. On the northern portion there are Wathou, Usholpam and Aongokham lakes. These lakes drain into the Imphal river.

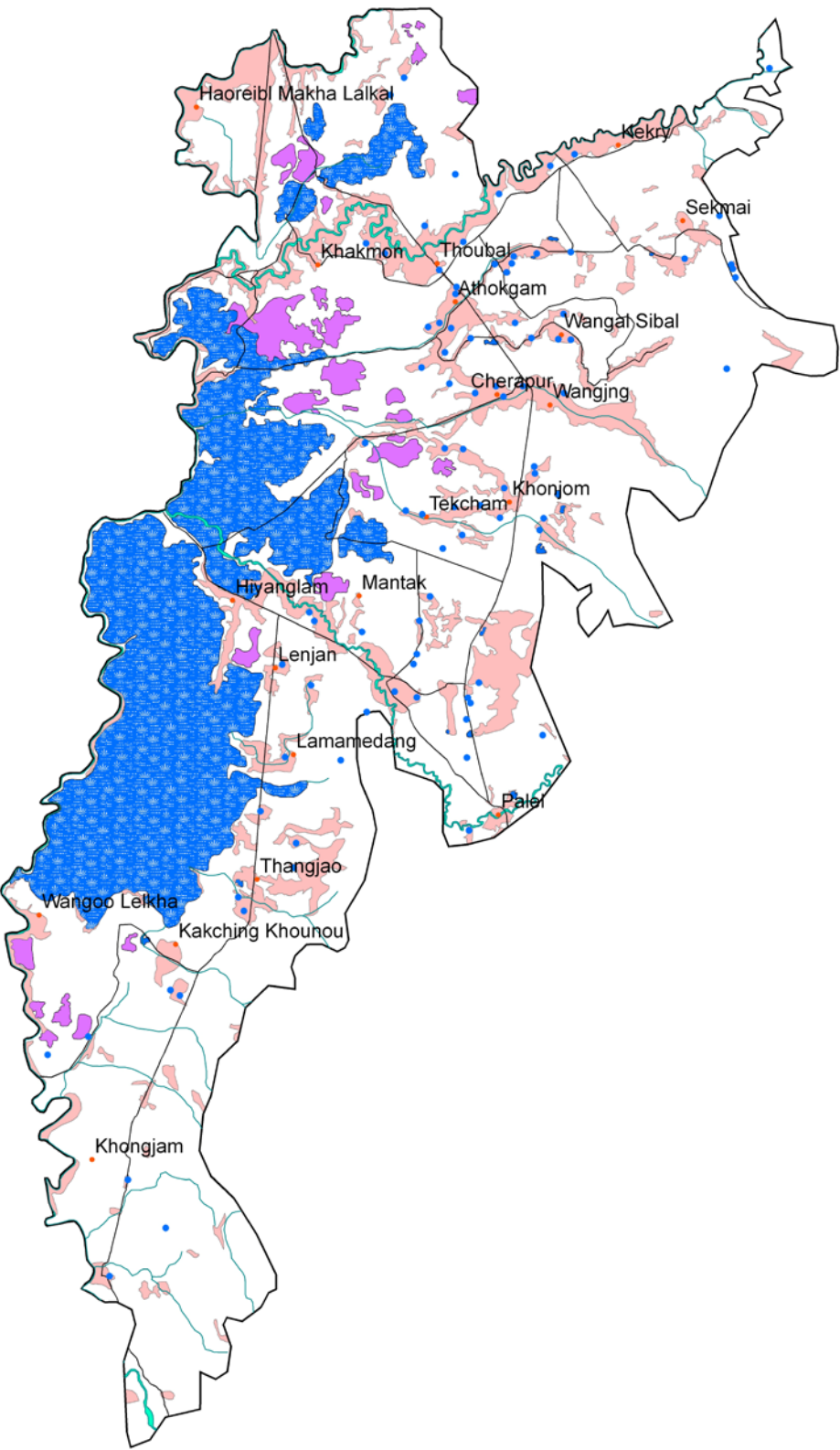
The wetland area estimated is 15,718 ha. Small wetlands, which are less than minimum mapable units, are 91 in the district. The major wetland types are Lakes/Ponds, Waterlogged and River/Streams. The wetlands are highly eutrophic. The turbidity of the open water is mainly moderate. Details are given in Table 46.

Table 46: Area estimates of wetlands in Thoubal

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	7	12875	81.91	6895	1678
2	1105	Waterlogged	30	1829	11.64	1792	908
3	1106	River/Stream	11	854	5.43	854	854
	1200	Inland Wetlands -Man-made					
4	1202	Tanks/Ponds	14	69	0.44	69	69
		Sub-Total	62	15627	99.42	9610	3509
		Wetlands (<2.25 ha), mainly Tanks	91	91	0.58	-	-
		Total	153	15718	100.00	9610	3509

Area under Aquatic Vegetation	5907	12136
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Area under turbidity levels		
Low	1259	854
Moderate	8110	2655
High	241	-

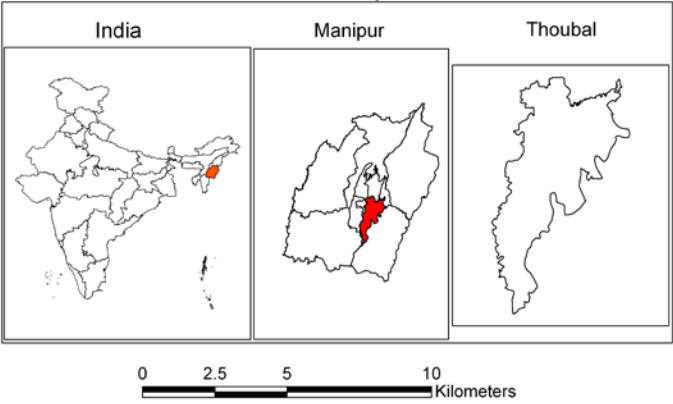


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

- Wetlands (<2.25ha)
- Roads
- Drainage (line)
- Settlements
- Town/Settlements

Location Map



Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
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7.4.6 Imphal West

The Imphal West District falls in the Category of Manipur valley region. It is a tiny plain at the centre of Manipur surrounded by Plains of other districts. Imphal City, the State Capital is the nodal functional centre of this District. The whole district is under the influence of the monsoons characterised by hot and humid rainy seasons during the summer, and cool and dry seasons during the winter. Temperature ranges from minimum of 0° C to maximum of 36°C. The total geographic area of Imphal West district is 519 sq km. The total population of the district is 4,39,532 (census 2001).

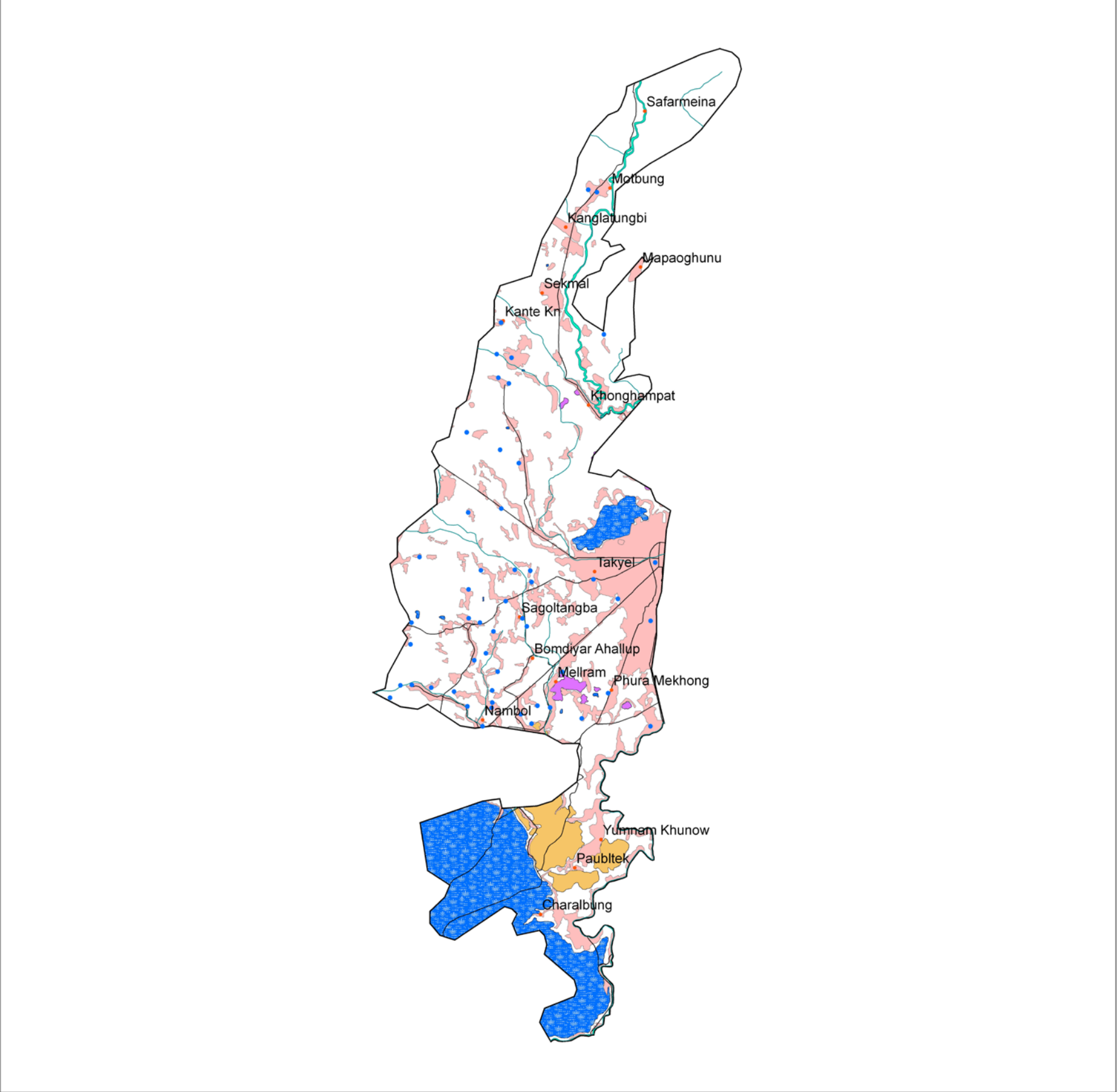
The wetland area estimated is 8470 ha. Small wetlands, which are less than minimum mapable units, are 52 in the district. The major wetland types are Lakes/pond, aquaculture ponds and waterlogged. A large part of Loktak lake lies in this district. Around 38 per cent area are under aquatic vegetation (floating and emergent). The turbidity of the open water is mainly moderate. Details are given in Table 47.

Table 47: Area estimates of wetlands in Imphal West

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	6	6242	73.70	2862	3314
2	1105	Waterlogged	9	223	2.63	211	223
3	1106	River/Stream	3	418	4.94	418	418
	1200	Inland Wetlands -Man-made					
4	1202	Tanks/Ponds	6	13	0.15	13	13
		Total - Inland	24	6896	81.42	3504	3968
	2200	Coastal Wetlands - Man-made					
5	2202	Aquaculture ponds	6	1522	17.97	1291	1218
		Total - Coastal	6	1522	17.97	1291	1218
		Sub-Total	30	8418	99.39	4795	5186
		Wetlands (<2.25 ha), mainly Tanks	52	52	0.61	-	-
		Total	82	8470	100.00	4795	5186

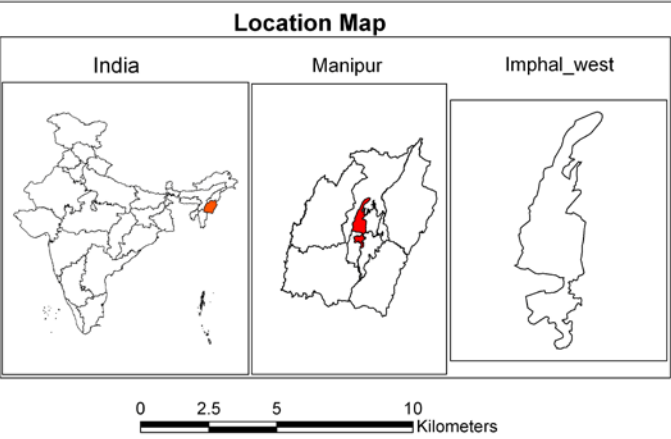
Area under Aquatic Vegetation	3011	3231
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Area under turbidity levels		
Low	418	417
Moderate	4150	4544
High	227	225



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

- Legend**
- Wetlands (<2.25ha)
 - Roads
 - Drainage (line)
 - Settlements
 - Town/Settlements



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

7.4.7 Imphal East

Imphal East District is situated in two separate valleys of the state namely Central Valley and Jiribam Valley. The total geographic area of Imphal East district is 709 sq km. The head quarters is Porompat . The District is situated at an altitude 790 metres above the M.S. Level. The minimum temperature goes down to 0.6⁰ C in winter and 41⁰ C in summer. The District is connected with N.H. 39, N.H. 53 and N.H. 150. Agriculture is the main occupation of the people in the district. The total population of the district is 3, 93,780 (census 2001). In the district there are around 31000 ha area under rice cultivation.

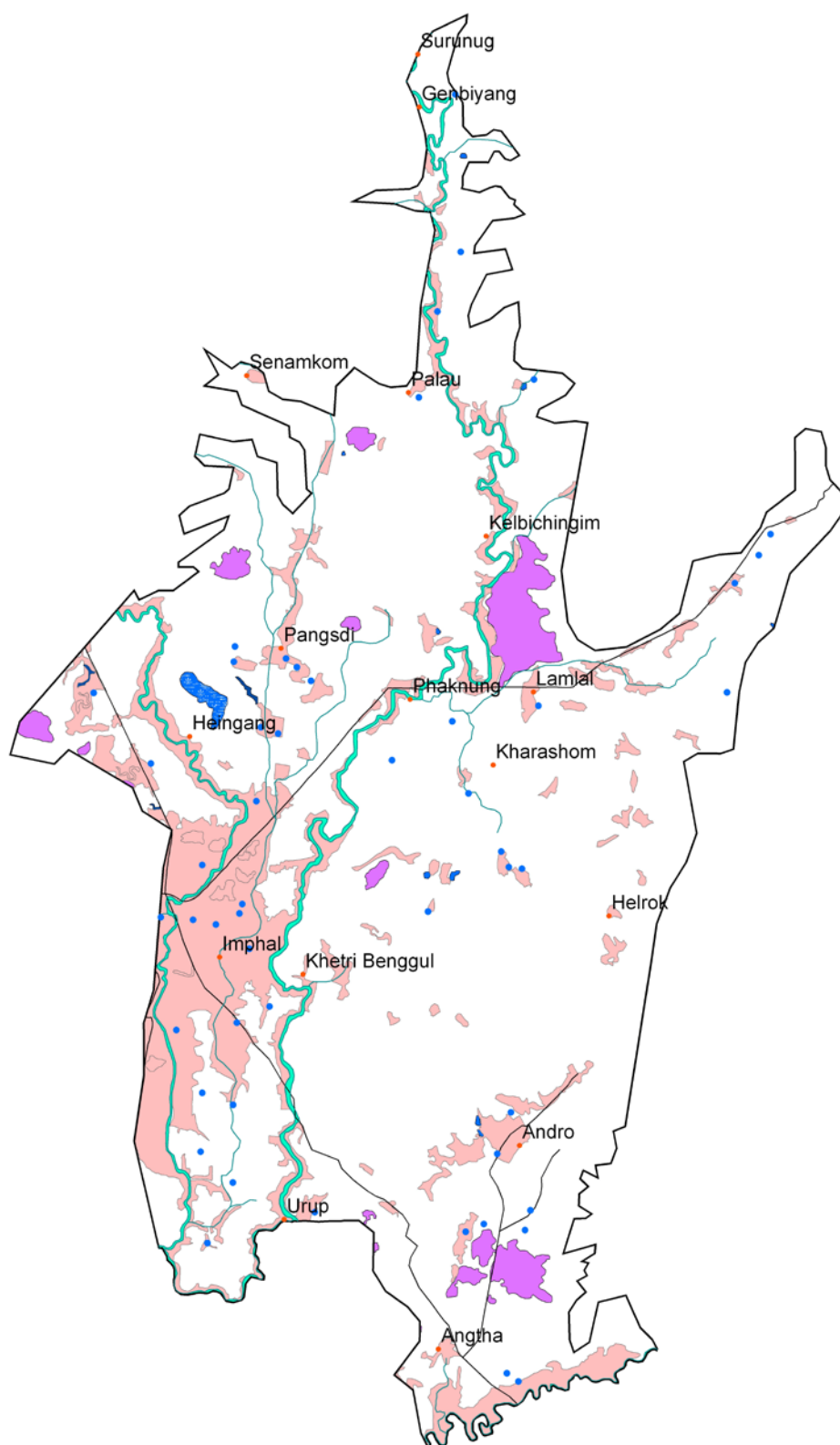
The wetland area estimated is 2149 ha. Small wetlands, which are less than minimum mapable units, are 51 in the district. The major wetland type is Waterlogged (21 numbers) followed by River/Streams. Details are given in Table 48.

Table 48: Area estimates of wetlands in Imphal East

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	2	106	4.93	106	106
2	1102	Ox-bow lakes/ Cut-off meanders	6	42	1.95	37	42
3	1105	Waterlogged	21	1177	54.77	656	880
4	1106	River/Stream	7	737	34.30	737	737
	1200	Inland Wetlands -Man-made					
5	1202	Tanks/Ponds	13	36	1.68	33	36
		Sub-Total	49	2098	97.63	1569	1801
		Wetlands (<2.25 ha), mainly Tanks	51	51	2.37	-	-
		Total	100	2149	100.00	1569	1801

Area under Aquatic Vegetation	297	190
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Area under turbidity levels		
Low	737	737
Moderate	795	1022
High	37	42

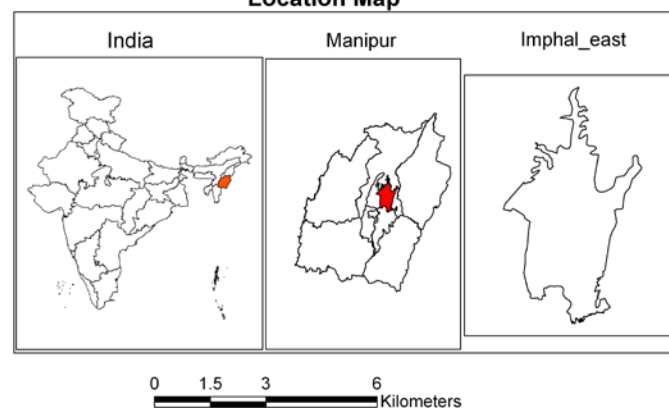


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

- Wetlands (<2.25ha)
- Roads
- Drainage (line)
- Settlements
- Town/Settlements

Location Map



Data Source :

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

Prepared By :

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7.4.8 Ukhurul

Ukhurul District is bounded by Myanmar in the East, Chandel District in the South, Imphal East and Senapati Districts in the West and Nagaland State in the North. The terrain of the district is hilly with a varying heights of 913 m to 3114 m (MSL). The head-quarter of the district is Ukhurul town. The climate of the district is of temperate nature with a minimum and maximum degrees of 3° C to 33° C. The total geographic area of Ukhurul district is 4,544 sq km. The total population of the district is 1,40,946 (census 2001).

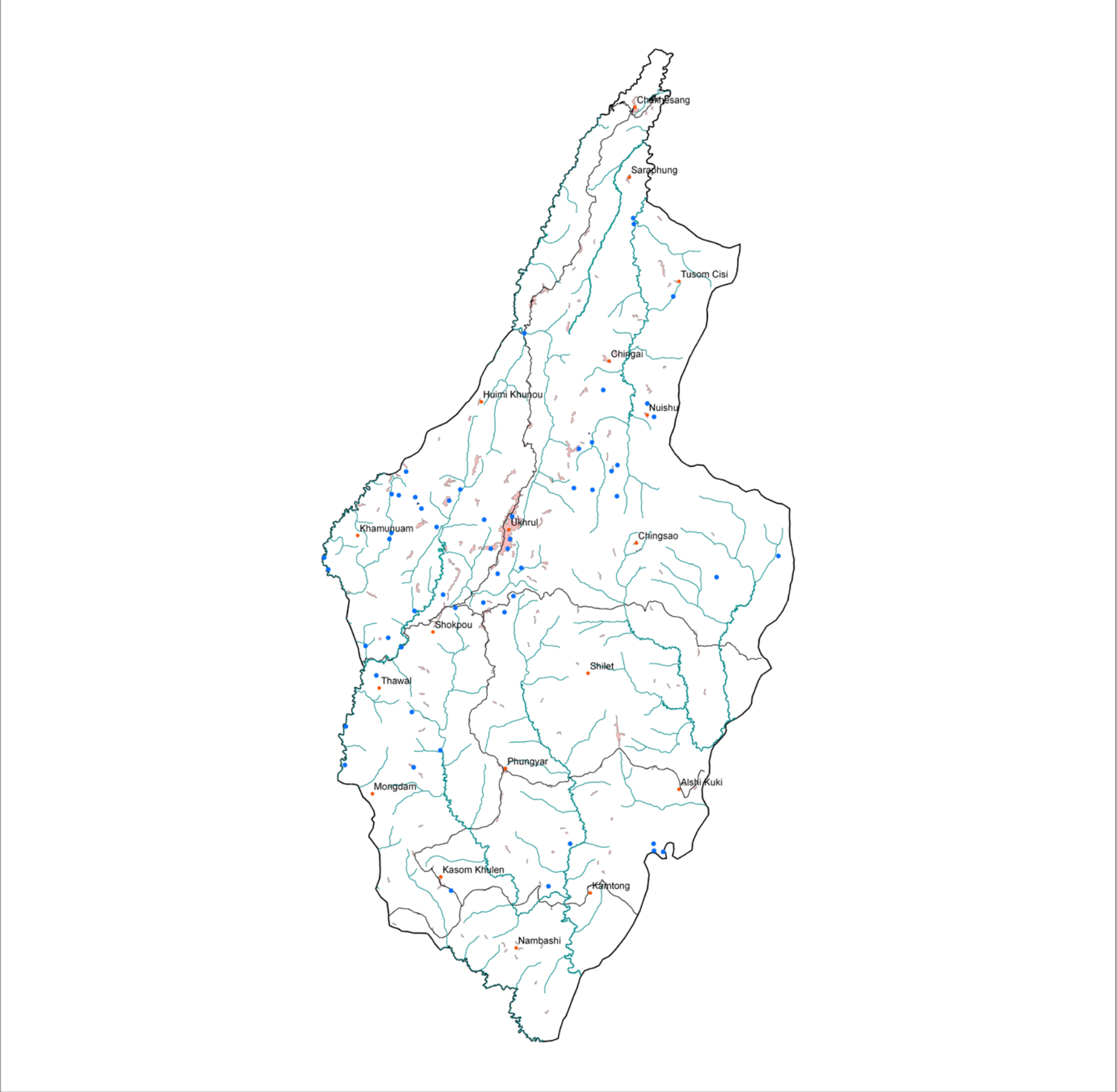
The wetland area estimated is 2,411 ha. Small wetlands, which are less than minimum mapable units, are 56 in the district. The major wetland type is River/Stream. Details are given in Table 49.

Table 49: Area estimates of wetlands in Ukhurul

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1106	River/Stream	14	2348	97.39	2348	2348
	1200	Inland Wetlands -Man-made					
2	1202	Tanks/Ponds	2	7	0.29	7	7
		Sub-Total	16	2355	97.68	2355	2355
		Wetlands (<2.25 ha), mainly Tanks	56	56	2.32	-	-
		Total	72	2411	100.00	2355	2355

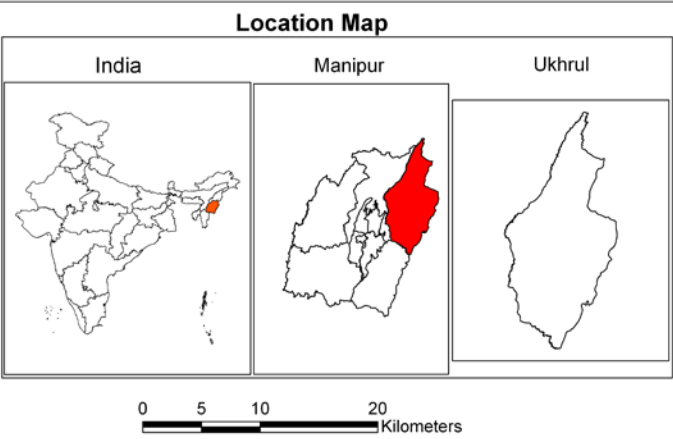
Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	2348	2348
Moderate	7	7
High	-	-



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

- Legend**
- Wetlands (<2.25ha)
 - Roads
 - Drainage (line)
 - Settlements
 - Town/Settlements



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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

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7.4.9 Chandel

The Chandel District lies in the south-eastern part of Manipur at 24°40' N Latitude and 93°50' E Longitude. It is the border district of the state. Its neighbors are Myanmar (erstwhile Burma) on the south, Ukhrul district on the east, Churachandpur district on the south and west, and Thoubal district on the north. It is about 64 km. away from Imphal. The National Highway No. 39 passes through this district. The Moreh town, the international trade centre of the state, lies on the southernmost part of the district. The head-quarter of the district is Chandel town. It is a hill district with an area of 3,313 sq. km. It is sparsely inhabited by about 20 different tribes. As per Census 2001, the population of the district is 1,34,462 with the density of population per sq. km. being 41.

The district has very less wetlands. The wetland area estimated is 2,016 ha. Small wetlands, which are less than minimum mapable units, are 25 in the district. The major wetland type is River/Stream (Table - 50).

Table 50: Area estimates of wetlands in Chandel

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1102	Ox-bow lakes/ Cut-off meanders	2	14	0.69	14	14
2	1106	River/Stream	10	1975	97.97	1975	1975
	1200	Inland Wetlands -Man-made					
3	1202	Tanks/Ponds	1	2	0.10	2	2
		Sub-Total	13	1991	98.76	1991	1991
		Wetlands (<2.25 ha), mainly Tanks	25	25	1.24	-	-
		Total	38	2016	100.00	1991	1991

Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	1975	1975
Moderate	2	2
High	14	14

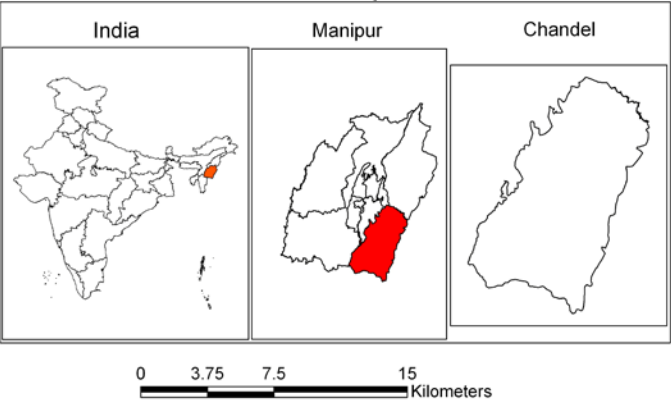


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

- Wetlands (<2.25ha)
- Roads
- Drainage (line)
- Settlements
- Town/Settlements

Location Map



Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
Sponsored By :
Ministry of Environment and Forests
Government of India

7.5 MIZORAM

Area estimates of various wetland categories for Mizoram have been carried out using GIS layers of wetland boundary, water-spread, aquatic vegetation and turbidity. In the state of Mizoram, 88 wetlands have been delineated. Small wetlands, which are less than minimum mapable units (MMU), are 146 in the district. Total wetland area estimated is 13988 ha (Table 51). Graphical distribution of wetland type is shown in Figure 20.

Table 51: Area estimates of wetlands in Mizoram

Area in ha							
Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	25	185	1.32	153	149
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	15	133	0.95	122	105
6	1106	River/Stream	46	13497	96.49	13497	13497
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	2	27	0.19	27	27
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	88	13842	98.96	13799	13778
		Wetlands (<2.25 ha), mainly Tanks	146	146	1.04	-	-
		Total	234	13988	100.00	13799	13778

Area under Aquatic Vegetation	37	42
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Area under turbidity levels		
Low	13755	13722
Moderate	44	56
High	-	-

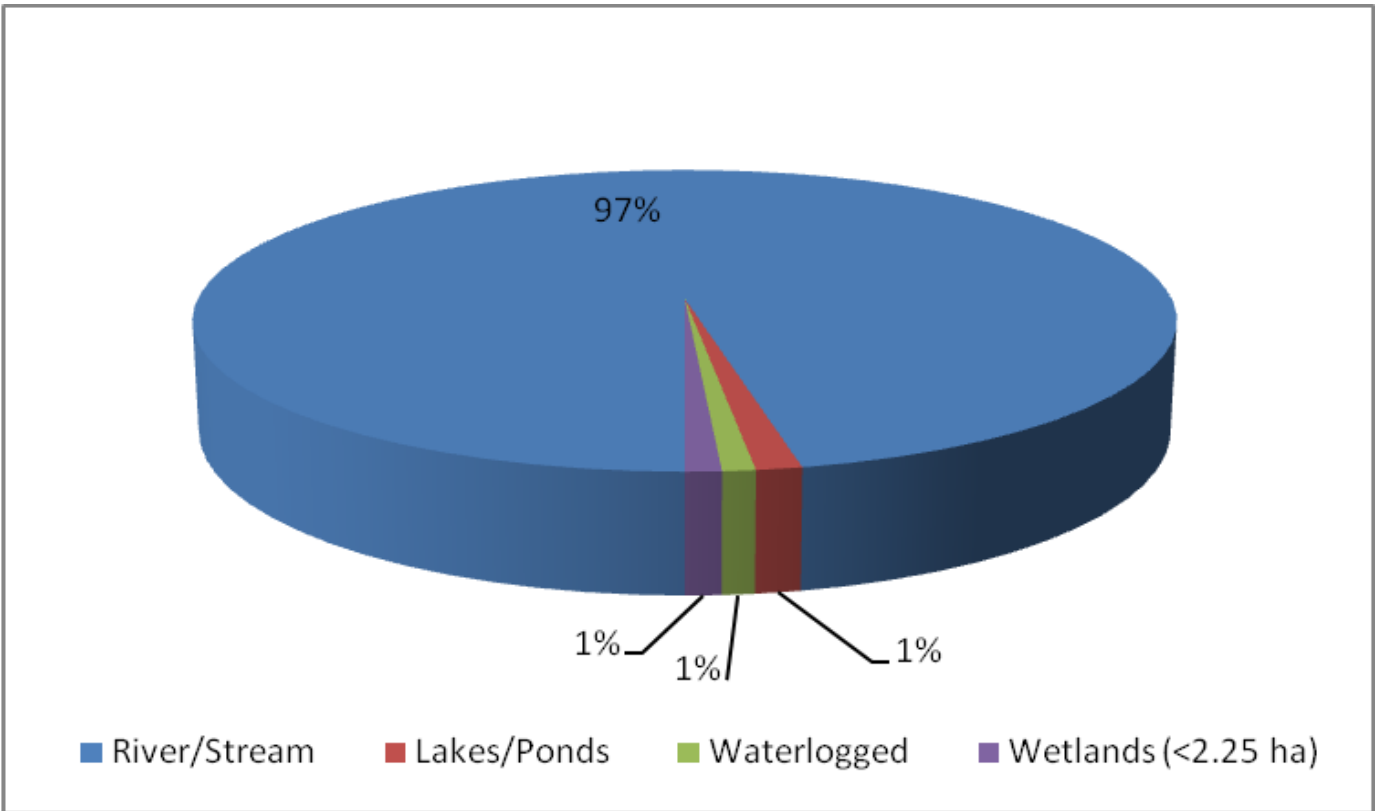


Figure 20: Type-wise wetland distribution in Mizoram

The state has eight districts. District-wise wetland area estimates is given in Table-52. Luinglei district covers the maximum wetland area (22.78%). A major portion of wetland areas are observed in Mamit, Lawngtlai, Saiha and in Aizawl. Champhai, Serchhip and Kolasib district covers small portion of wetland area. The graphical distribution of district-wise wetland area is shown in Figure 21.

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

Table 52: District-wise wetland area in Mizoram

District code	District	Geographic Area *	Wetland Area	% of total wetland area	% of district geographic area	Open water		Aquatic Vegetation	
						Post-monsoon	Pre-monsoon	Post-monsoon	Pre-monsoon
		(sq. km.)	(ha)		(ha)	(ha)	(ha)	(ha)	(ha)
1	Mamit	3026	2167	15.49	0.72	2103	2101	0	0
2	Kolasib	1383	884	6.32	0.64	834	820	0	0
3	Aizawl	3576	1646	11.77	0.46	1639	1639	0	0
4	Champhai	3186	1520	10.87	0.48	1517	1517	0	0
5	Serchhip	1422	928	6.63	0.65	927	927	0	0
6	Lunglei	4538	3186	22.78	0.70	3158	3153	12	17
7	Lawngtlai	2557	1998	14.28	0.78	1989	1989	0	0
8	Saiha	1400	1659	11.86	1.19	1632	1632	25	25
	Total	21088	13988	100.00	0.66	13799	13778	37	42

* Data Source: Census 2001

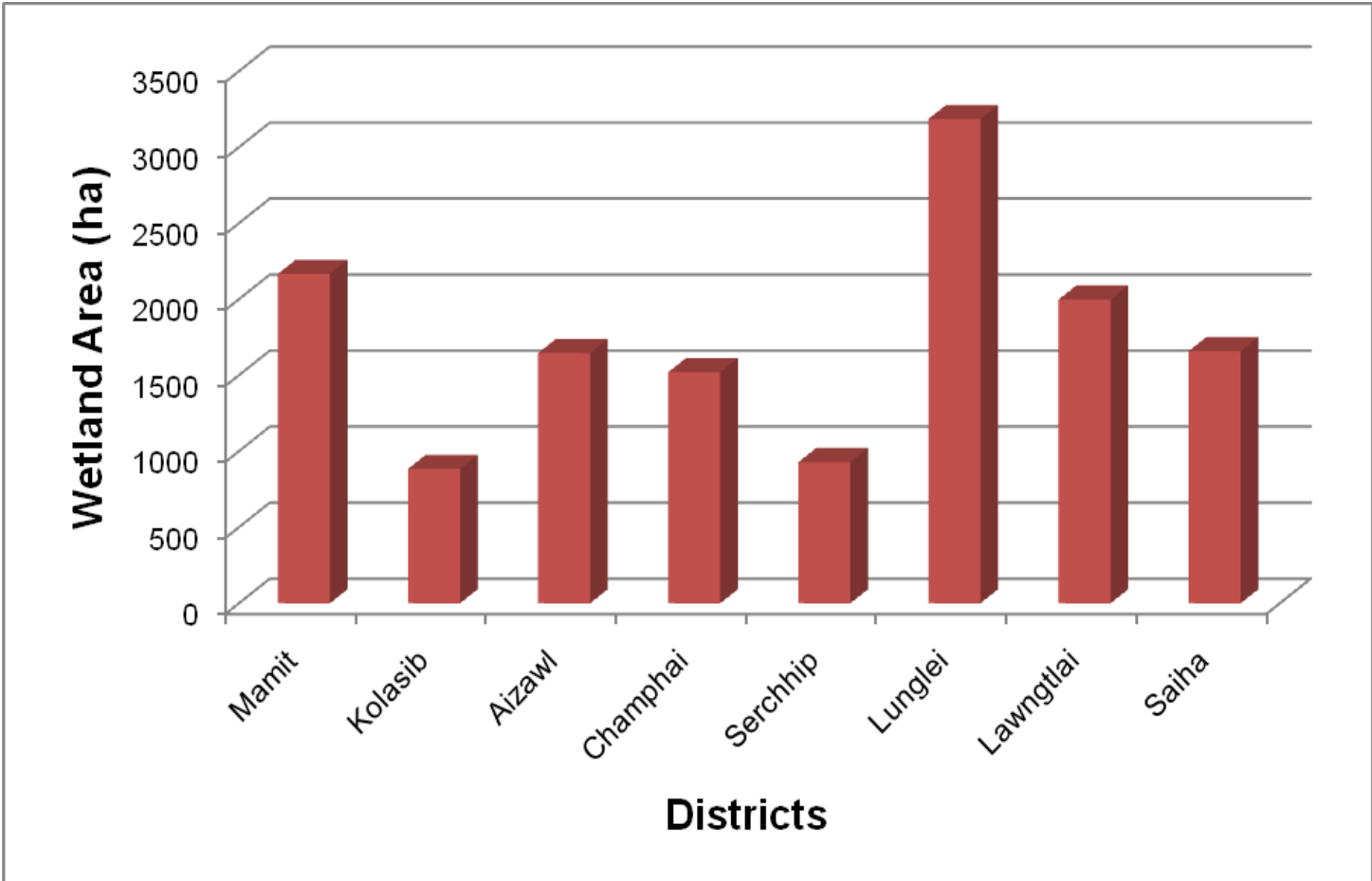
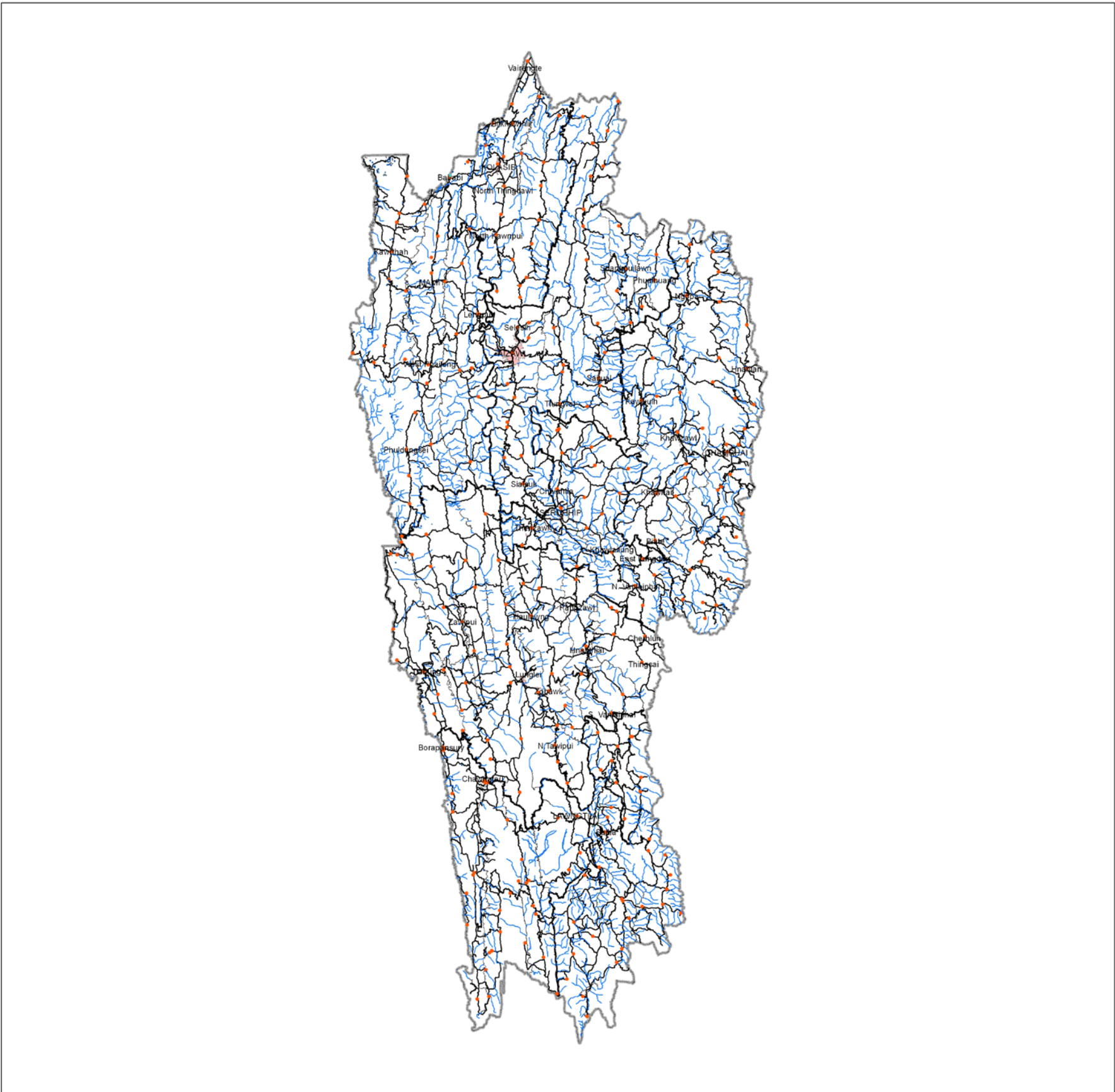


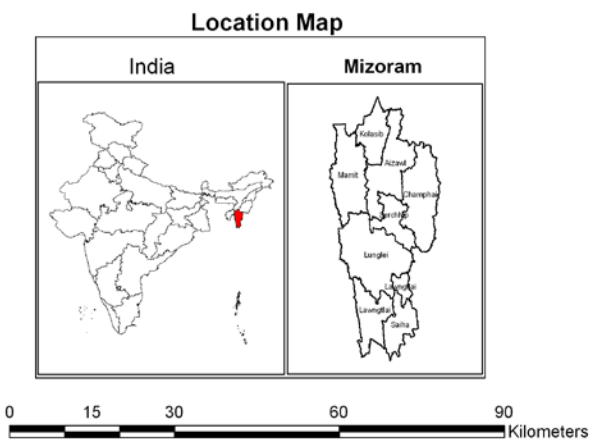
Figure 21: District-wise wetland distribution in Mizoram

WETLAND MAP



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

- Legend**
- Wetlands (<2.25 ha)
 - Settlements
 - Drainage(line)
 - Railway
 - Roads
 - District Boundary
 - State Boundary
 - Towns/Settlements



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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Mizoram Remote Sensing Application Centre (MIRSAC)

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7.5.1 Mamit

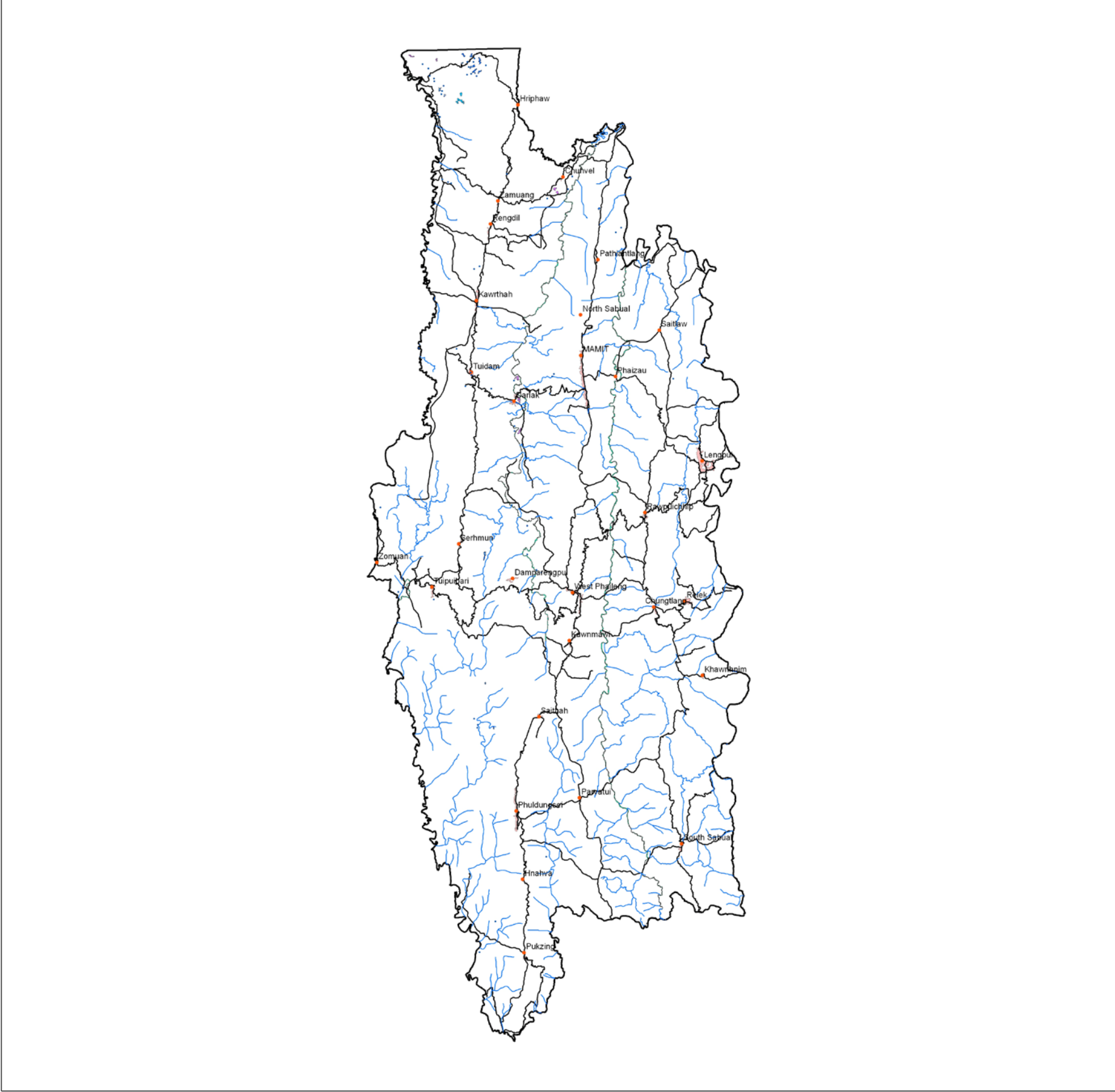
Mamit district lies in the north western part of the state and share a boundary with Bangladesh and Agartala. The north western part of the district comprises more or less low lying area while the eastern part is made up of medium to high structural hills. The major rivers within the district are Tut, Tlawng, Mar, Teirei and Khawthlangtuipui rivers. The average annual rainfall is 2692 mm. The total geographic area of Mamit district is 302575 ha. The wetland area estimated is 2167 ha. Details are given in Table 53. Small wetlands, which are less than minimum mapable units (MMU), are 58 in the district. The major wetland types are River/Stream, Lakes/Ponds, reservoirs/barrages and waterlogged areas.

Table 53: Area estimates of wetlands in Mamit

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	13	84	3.88	79	84
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	7	47	2.17	46	39
6	1106	River/Stream	6	1951	90.03	1951	1951
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	2	27	1.25	27	27
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	28	2109	97.32	2103	2101
		Wetlands (<2.25 ha), mainly Tanks	58	58	2.68	-	-
		Total	86	2167	100.00	2103	2101

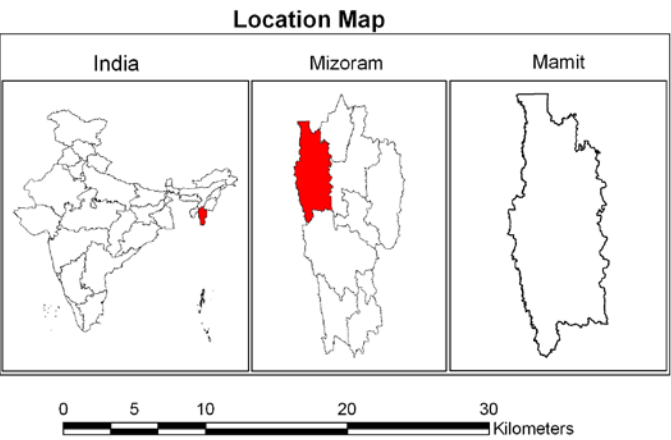
Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	2097	2083
Moderate	6	18
High	-	-



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

- Legend**
- Wetlands (<2.25 ha)
 - Settlements
 - Canal
 - Drainage(line)
 - Railway
 - Roads
 - District Boundary
 - Towns/Settlements



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

Prepared By:
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7.5.2 Kolasib

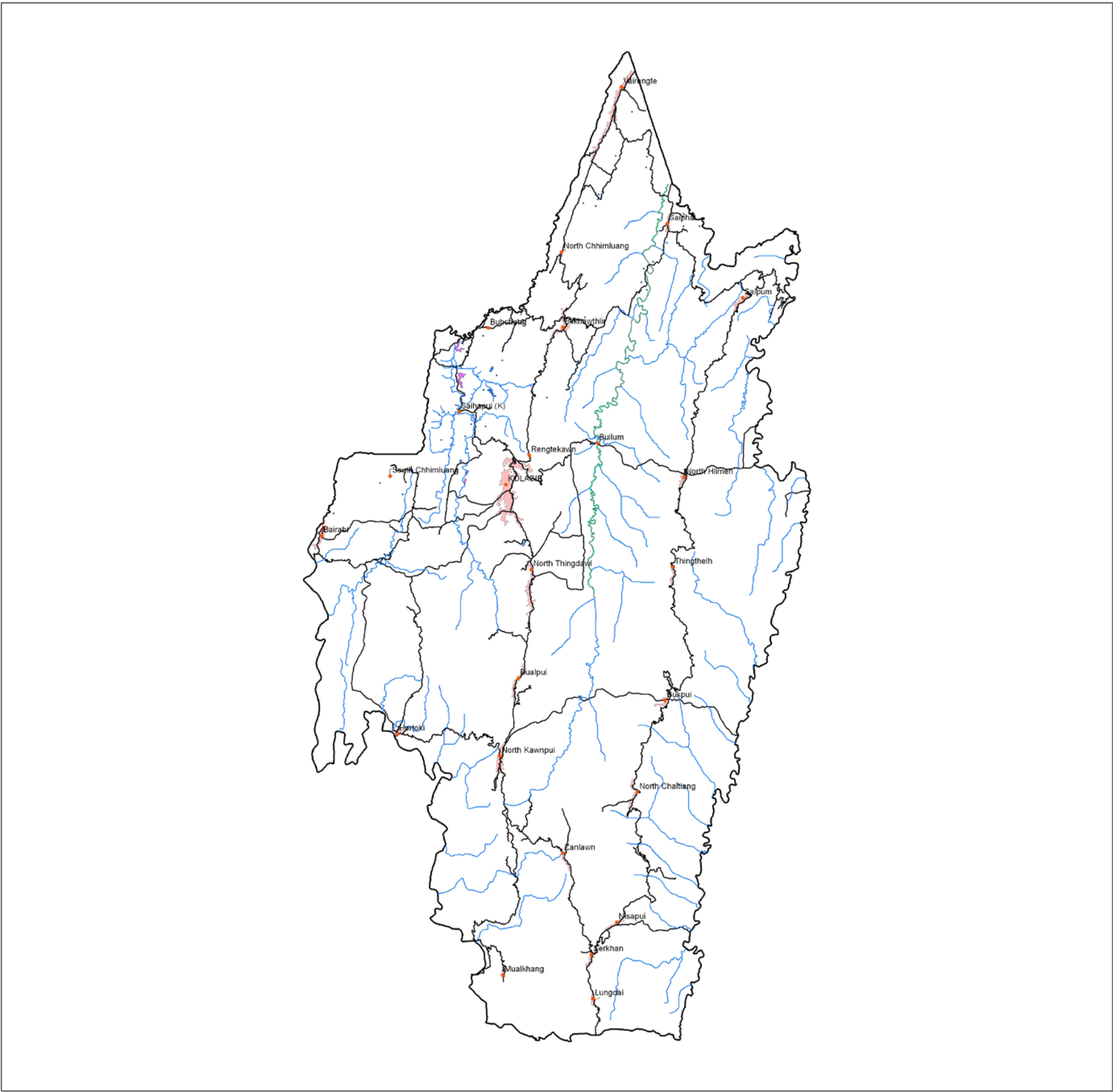
Kolasib district lies in the Northern-most part of the state and it shared a common boundary with Cachar district of Assam. The major rivers within the district are Tuirial, Serlui and Tlawng rivers. The average annual rainfall is 2667.6 mm. The total geographic area of Kolasib district is 138251 ha. The wetland area estimated is 884 ha. Details are given in Table 54. Small wetlands, which are less than minimum mapable units, are 50 in the district. The major wetland types are River/Stream, lakes/ponds and waterlogged areas.

Table 54: Area estimates of wetlands in Kolasib

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	5	26	2.94	26	25
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	6	64	7.24	64	51
6	1106	River/Stream	3	744	84.16	744	744
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	14	834	94.34	834	820
		Wetlands (<2.25 ha), mainly Tanks	50	50	5.66	-	-
		Total	64	884	100.00	834	820

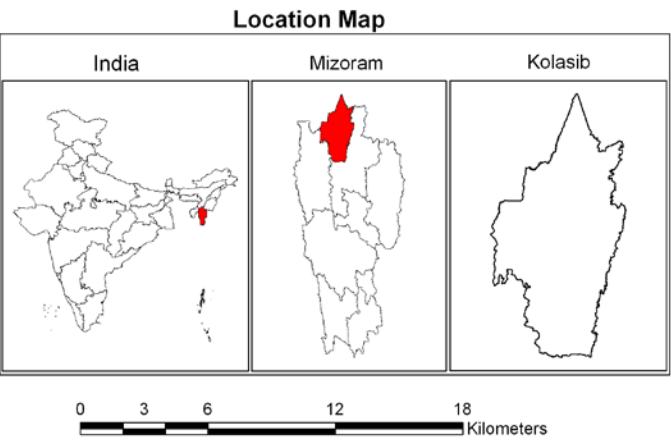
Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	834	820
Moderate	-	-
High	-	-



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

- Legend**
- Wetlands (<2.25 ha)
 - Settlements
 - Canal
 - Drainage(line)
 - Railway
 - Roads
 - District Boundary
 - Towns/Settlements



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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Mizoram Remote Sensing Application Centre (MIRSAC)

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7.5.3 Aizawl

Aizawl district lies in the northern part of the state. The major rivers within the district are Tlawng, Tuirial, Tuivawl and Tuivai rivers. The average annual rainfall is 2795.5 mm. The total geographic area of Aizawl district is 357631ha. The wetland area estimated is 1646 ha. Details are given in Table 55. Small wetlands, which are less than minimum mapable units (MMU), are 7 in the district. The major wetland types are River/Stream and lakes/ponds.

Table 55: Area estimates of wetlands in Aizawl

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	10	0.61	10	10
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	5	1629	98.97	1629	1629
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	7	1639	99.57	1639	1639
		Wetlands (<2.25 ha), mainly Tanks	7	7	0.43	-	-
		Total	14	1646	100.00	1639	1639

Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	1639	1639
Moderate	-	-
High	-	-

7.5.4 Champhai

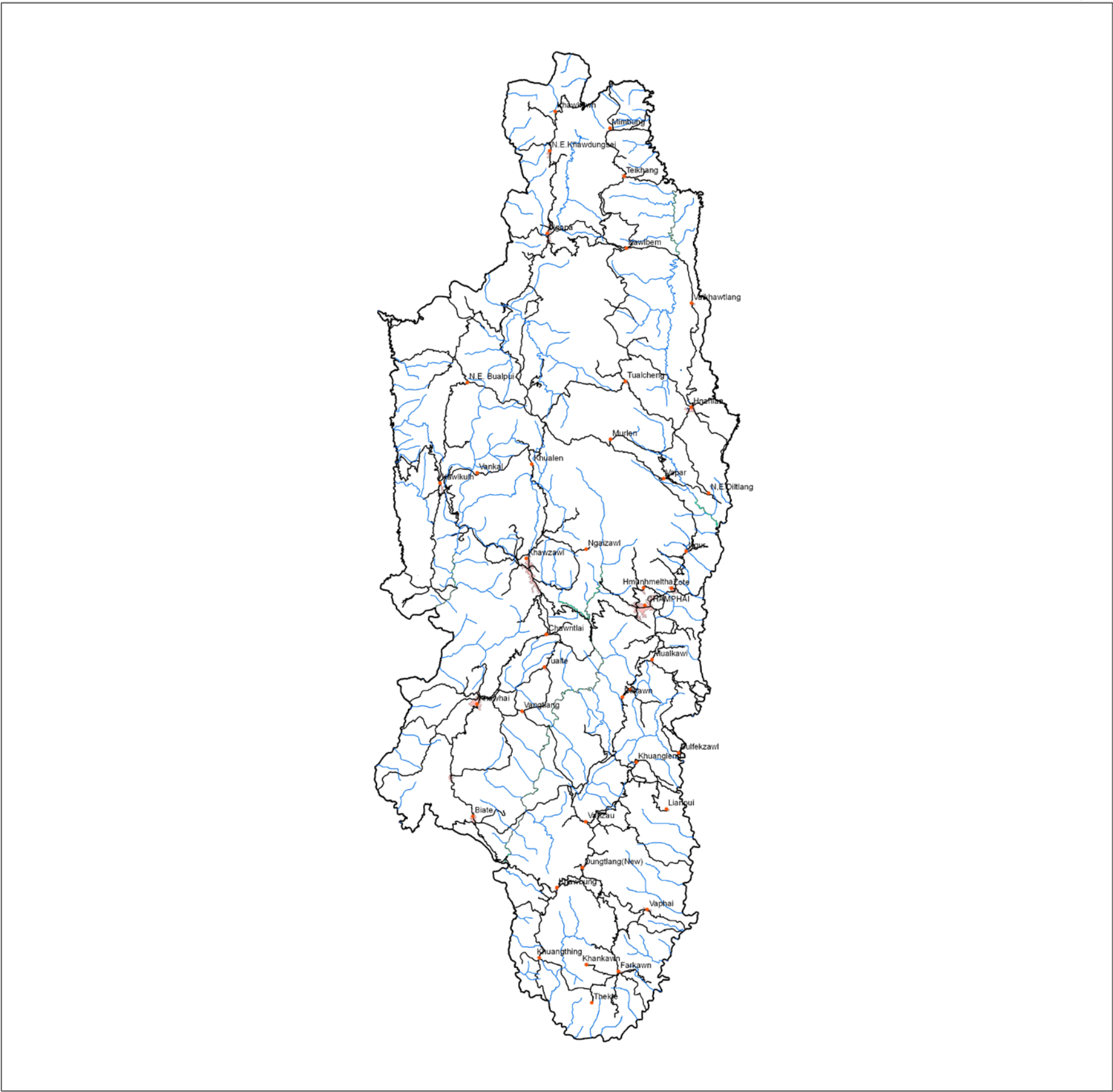
Champhai district lies in the Eastern-most part of the state and shared an international boundary with Myanmar. The major rivers within the district are Tiau, Tuichang, Tuipui, Tuivawl and Tuivai rivers. The average annual rainfall is 2149.8 mm. The total geographic area of Champhai district is 318583 ha. The wetland area estimated is 1520 ha. Details are given in Table 56. Small wetlands, which are less than minimum mapable units (MMU), are 3 in the district. The major wetland types are River/Stream.

Table 56: Area estimates of wetlands in Champhai

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	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	7	1517	99.80	1517	1517
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	7	1517	99.80	1517	1517
		Wetlands (<2.25 ha), mainly Tanks	3	3	0.20	-	-
		Total	10	1520	100.00	1517	1517

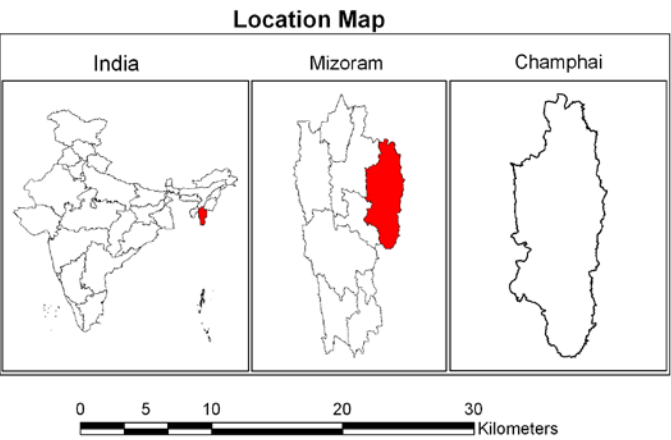
Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	1517	1517
Moderate	-	-
High	-	-



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

- Legend**
- Wetlands (<2.25 ha)
 - Settlements
 - Canal
 - Drainage(line)
 - Railway
 - Roads
 - District Boundary
 - Towns/Settlements



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

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7.5.5 Serchhip

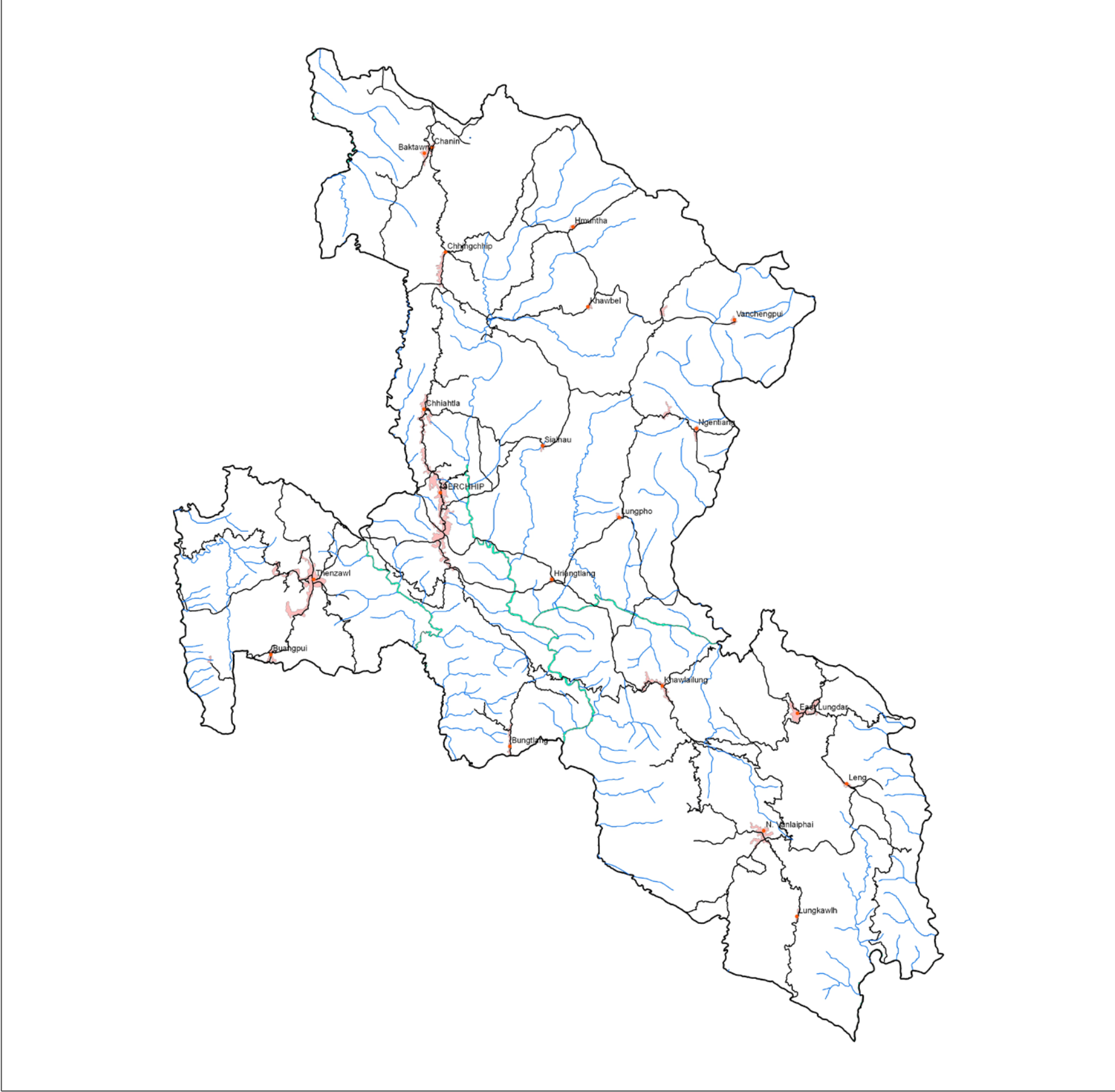
Serchhip district lies in the central part of the state. The largest lake of the state- Palak lake is located within this district. The major rivers within the district are Tuipui, Mat, Tlawng and Tuichang rivers. The average annual rainfall is 2481.5 mm. The total geographic area of Serchhip district is 142160 ha. The wetland area estimated is 928 ha (Table 57). Small wetlands, which are less than minimum mapable units (MMU), are 1 in the district. The major wetland types are River/Stream.

Table 57: Area estimates of wetlands in Serchhip

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	7	927	99.89	927	927
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	7	927	99.89	927	927
		Wetlands (<2.25 ha), mainly Tanks	1	1	0.11	-	-
		Total	1	928	100.00	927	927

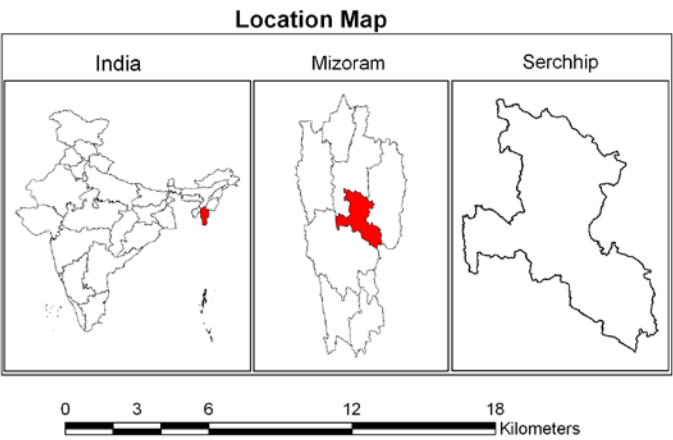
Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	927	927
Moderate	-	-
High	-	-



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

- Legend**
- Wetlands (<2.25 ha)
 - Settlements
 - Canal
 - Drainage(line)
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Data Source:
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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7.5.6 Lunglei

Lunglei district lies almost at the central part of the state and is the largest district. It shared an international boundary with Bangladesh in the west and with Myanmar in the east. The major rivers within the district are Chhimtuipui, Tlawng and Khawthlangtuipui rivers. The average annual rainfall is 2527.7 mm. The total geographic area of Lunglei district is 453800 ha. The wetland area estimated is 3186 ha. Details are given in Table 58. Small wetlands, which are less than minimum mapable units (MMU), are 16 in the district. The major wetland types are River/Stream, lakes/ponds and waterlogged areas.

Table 58: Area estimates of wetlands in Lunglei

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	3	22	0.69	20	12
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	2	22	0.69	12	15
6	1106	River/Stream	16	3126	98.12	3126	3126
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	21	3170	99.50	3158	3153
		Wetlands (<2.25 ha), mainly Tanks	16	16	0.50	-	-
		Total	37	3186	100.00	3158	3153

Area under Aquatic Vegetation	12	17
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Area under turbidity levels		
Low	3138	3135
Moderate	20	18
High	-	-

7.5.7 Lawngtlai

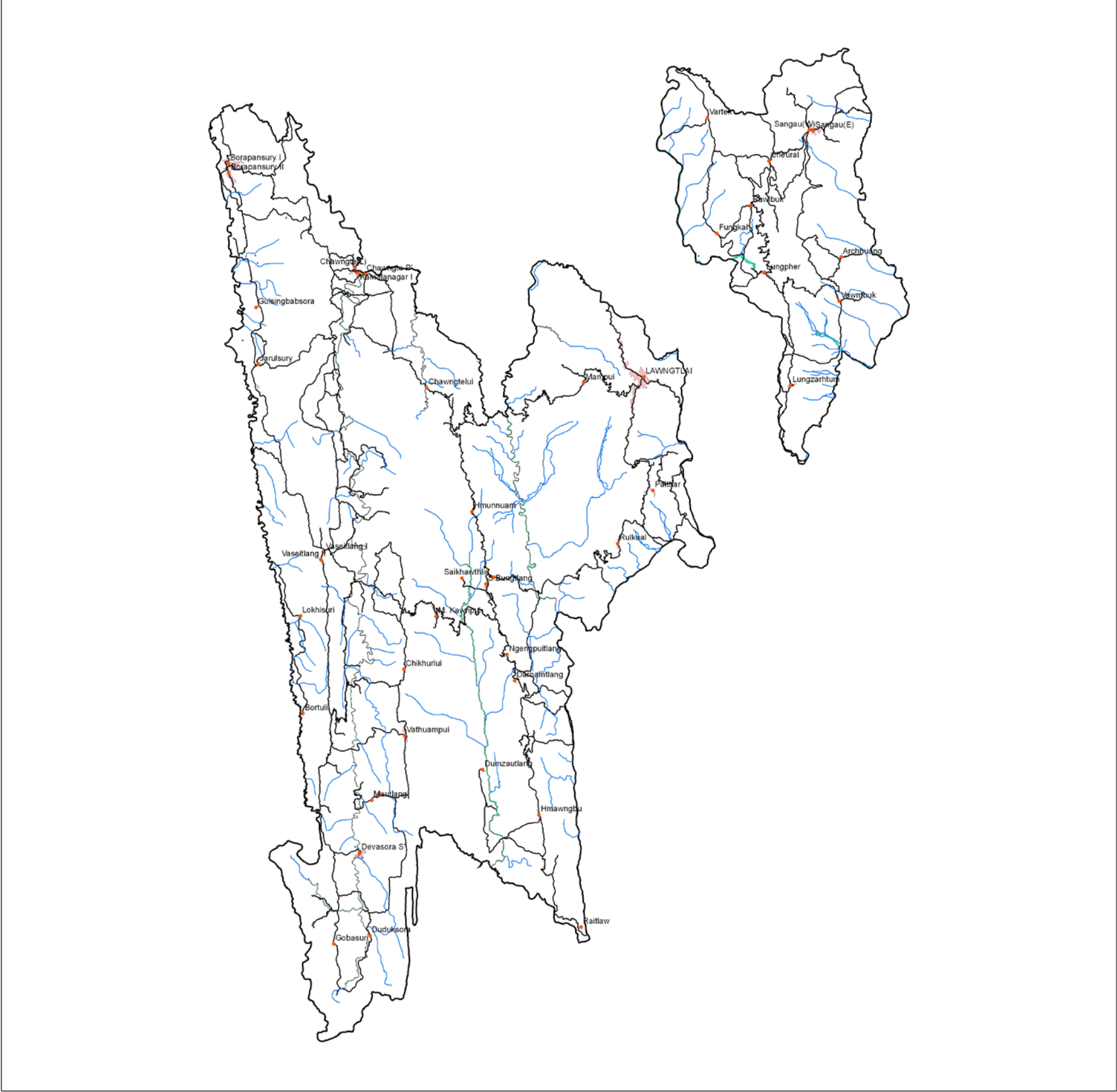
Lawngtlai district lies in the South-western part of the state and shared an international boundary with Bangladesh. The major rivers within the district are Chhimtuipui, Tlawng and Sekul rivers. The western part of the district Comprise low lying areas to some extend. The average annual rainfall is 2532.4 mm. The total geographic area of Lawngtlai district district is 255710ha. The wetland area estimated is 1998 ha. Details are given in Table 59. Small wetlands, which are less than minimum mapable units (MMU), are 9 in the district. The only wetland types is River/Stream.

Table 59: Area estimates of wetlands in Lawngtlai

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	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	9	1989	99.55	1989	1989
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	9	1989	99.55	1989	1989
		Wetlands (<2.25 ha), mainly Tanks	9	9	0.45	-	-
		Total	18	1998	100.00	1989	1989

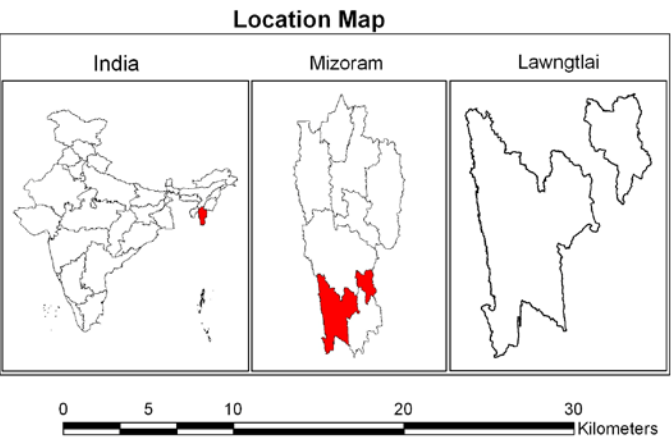
Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	1989	1989
Moderate	-	-
High	-	-



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

- Legend**
- Wetlands (<2.25 ha)
 - Settlements
 - Canal
 - Drainage(line)
 - Railway
 - Roads
 - District Boundary
 - Towns/Settlements



Data Source:
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7.5.8 Saiha

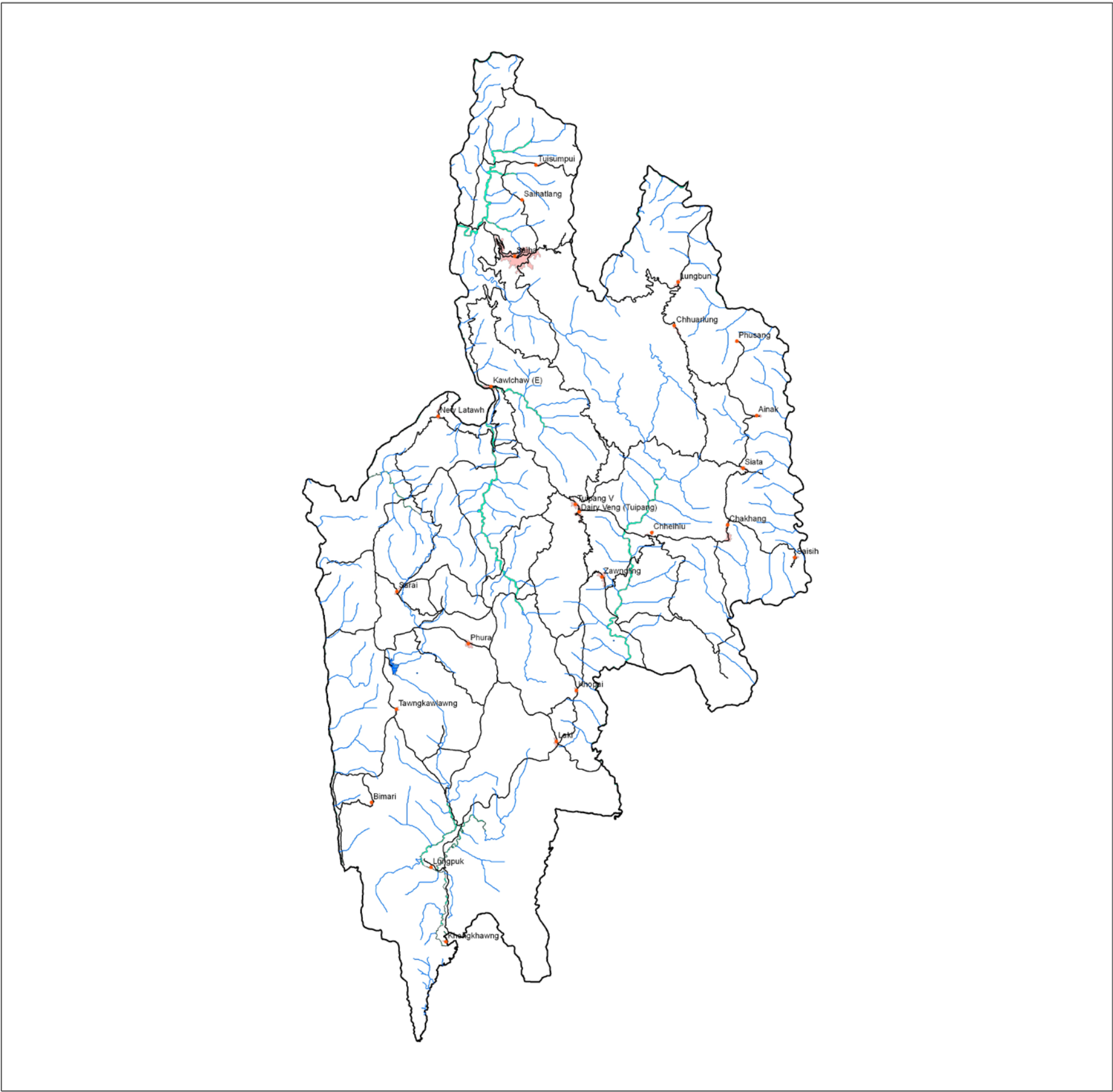
Saiha district lies in the south eastern part of the state and share an international boundary Myanmar. Almost the whole district is made up of medium to high structural hills. The largest lake of the state- Palak lake is located within this district. The major rivers within the district are Chhimtuipui, Kawlawh and Palak rivers. The average annual rainfall is 2642 mm. The total geographic area of Saiha district is 139990 ha. The wetland area estimated is 1659 ha. Details are given in Table 60. Small wetlands, which are less than minimum mapable units (MMU), are 2 in the district. The major wetland type is River/Stream.

Table 60: Area estimates of wetlands in Saiha

Sr. No.	Wettcode	Wetland Category	Number of wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	1	43	2.59	18	18
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	10	1614	97.29	1614	1614
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	11	1657	99.88	1632	1632
		Wetlands (<2.25 ha), mainly Tanks	2	2	0.12	-	-
		Total	13	1659	100.00	1632	1632

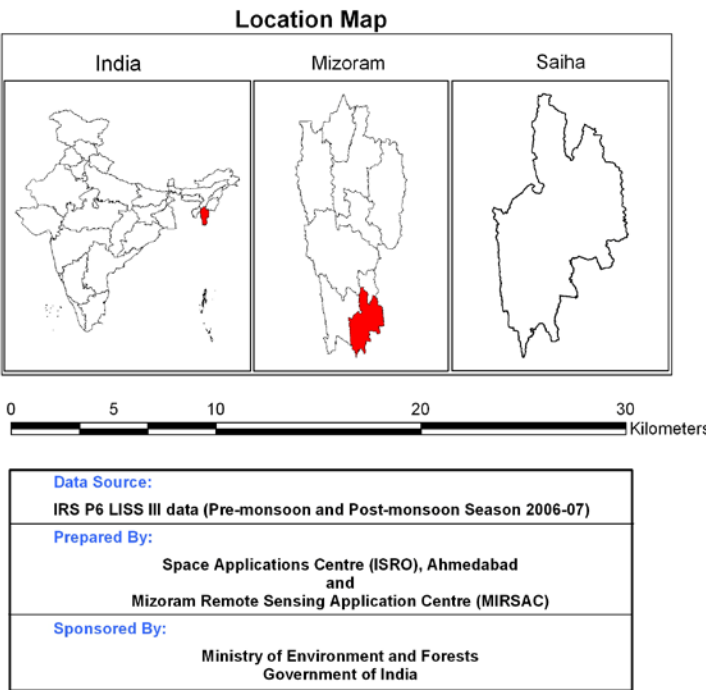
Area under Aquatic Vegetation	25	25
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Area under turbidity levels		
Low	1614	1612
Moderate	18	20
High	-	-



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

- Legend**
- Wetlands (<2.25 ha)
 - Settlements
 - Canal
 - Drainage(line)
 - Railway
 - Roads
 - District Boundary
 - Towns/Settlements



7.6 TRIPURA

Area estimates of various wetland categories for Tripura have been carried out using GIS layers of wetland boundary, water-spread, aquatic vegetation and turbidity. In the state, 432 wetlands have been mapped and 2983 small wetlands (< 2.25 ha) identified. Total wetland area estimated is 17542 ha (Table 61). Inland natural wetlands dominated in the state with 63% share. The major natural wetland types are; River/stream (42.30 %) and waterlogged (16.79 %). There are 60 Lake/Pond with about 2.0% area. Under manmade wetlands, Reservoir/Barrage is the major wetland type with 18.93% share. Graphical distribution of wetland type is shown in figure 22.

In terms of open water area, the natural wetlands showed 9847 ha in Post-monsoon and 7023 ha in Pre-monsoon seasons. The reduction in open water area is mainly due to change in Waterlogged. In case of man-made wetlands, the open water is 3078 ha and 938 ha respectively for post- and Pre-monsoon. The reduction in open water in Pre-monsoon is significant in Reservoir/Barrage. The details of type-wise aerial extents of wetland is given in the table 61.

Table 61: Area estimates of wetlands in Tripura

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon area	Pre-monsoon area
	1100	Inland Wetlands – Natural					
1	1101	Lakes/Ponds	60	300	1.71	180	153
2	1102	Ox-bow lakes/ Cut-off meanders	78	387	2.21	229	170
3	1105	Waterlogged	244	2946	16.79	1872	647
4	1106	River/Stream	17	7420	42.30	4488	5115
	1200	Inland Wetlands -Man-made					
5	1201	Reservoirs/Barrages	12	3320	18.93	2936	796
6	1202	Tanks/Ponds	21	186	1.06	142	142
		Sub-Total	432	14559	83.00	9847	7023
		Wetlands (<2.25 ha), mainly Tanks	2983	2983	17.00	-	-
		Total	3415	17542	100.00	9847	7023

Area under Aquatic Vegetation	1779	5232
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Area under turbidity levels		
Low	2672	641
Moderate	7148	6329
High	27	53

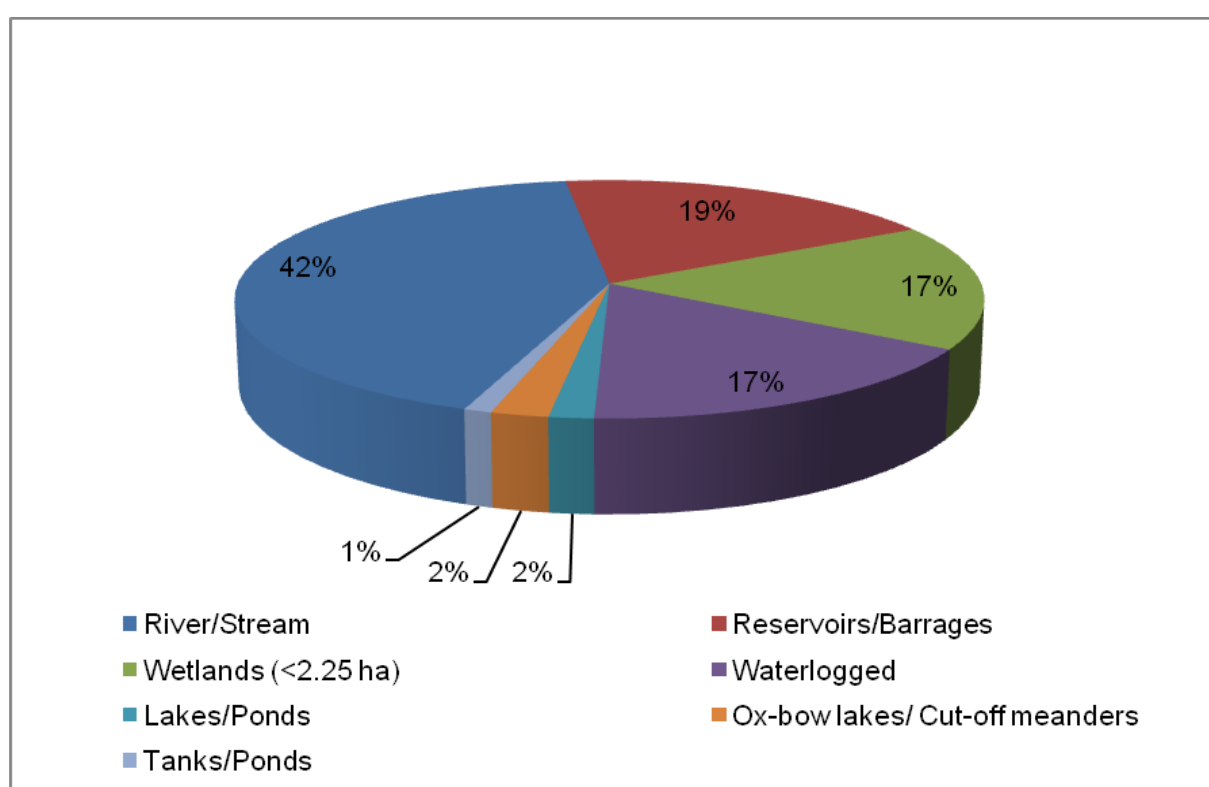


Figure 22: Type-wise wetland distribution in Tripura

Tripura is comprised of four districts namely; West Tripura, South Tripura, Dhalai and North Tripura. The geographical extents of these districts ranging from 2152 km² (South Tripura) to 3544 km² (West Tripura). The wetlands are more or less equally distributed among the districts (Figure 23) except in North Tripura where they constitute 3404 ha. In terms of per cent geographical area of district, the variation is about 1 ranging from a minimum of 1.21 in North Tripura to 2.13 in South Tripura (Table 62).

Table-62: District-wise wetland area in Tripura

District code	District	Geographic Area	Wetland Area	% of total wetland area	% of district geographic area	Open water		Aquatic Vegetation	
						Post-monsoon	Pre-monsoon	Post-monsoon	Pre-monsoon
		(sq. km.)	(ha)		(ha)	(ha)	(ha)	(ha)	(ha)
1	West Tripura	3544	4749	27.07	1.34	2430	1876	637	1435
2	South Tripura	2152	4574	26.07	2.13	2474	1799	526	1412
3	Dhalai	2523	4815	27.45	1.91	3361	1864	344	1983
4	North Tripura	2821	3404	19.40	1.21	1582	1484	272	402
	Total	11040	17542	100.00	1.59	9847	7023	1779	5232

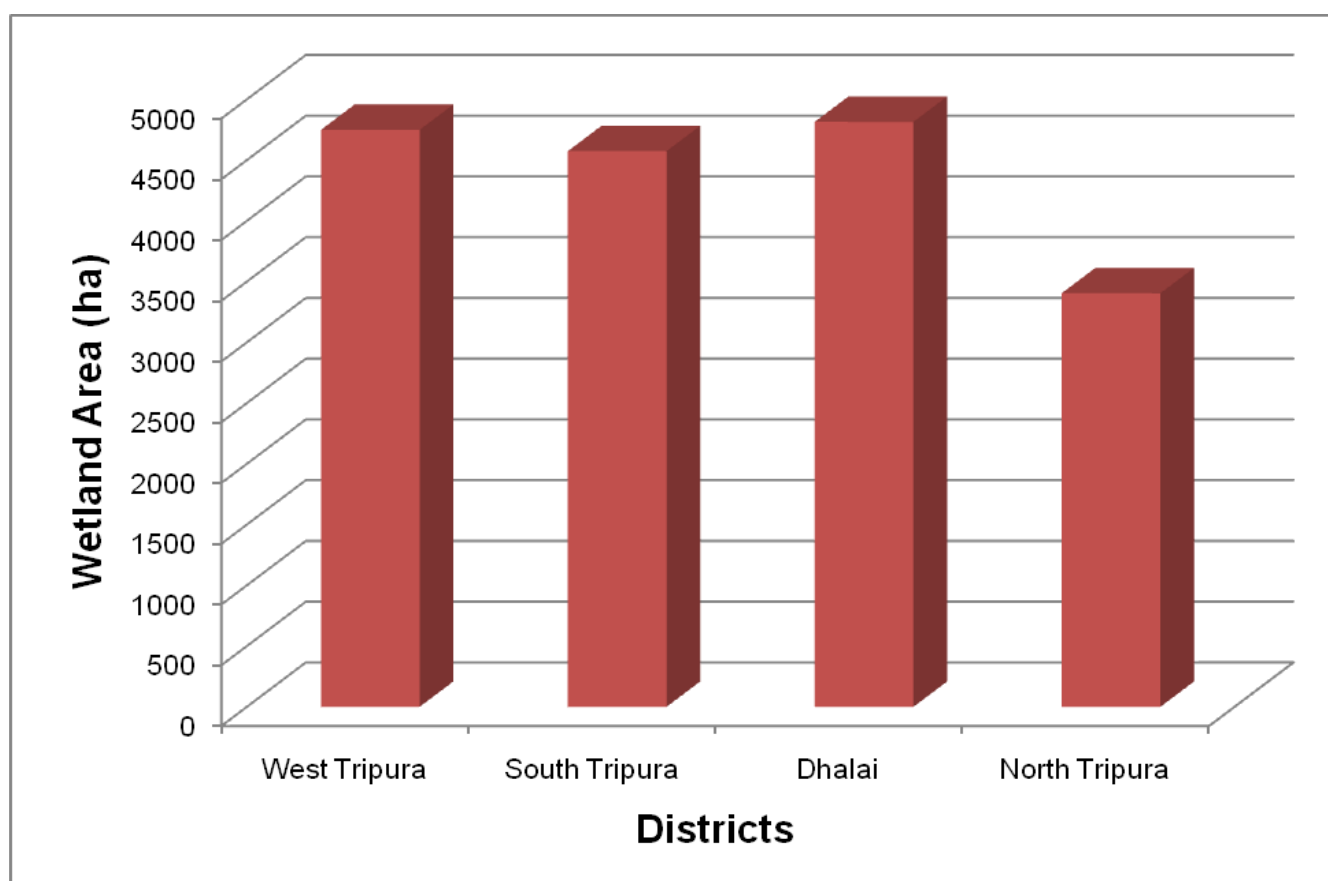
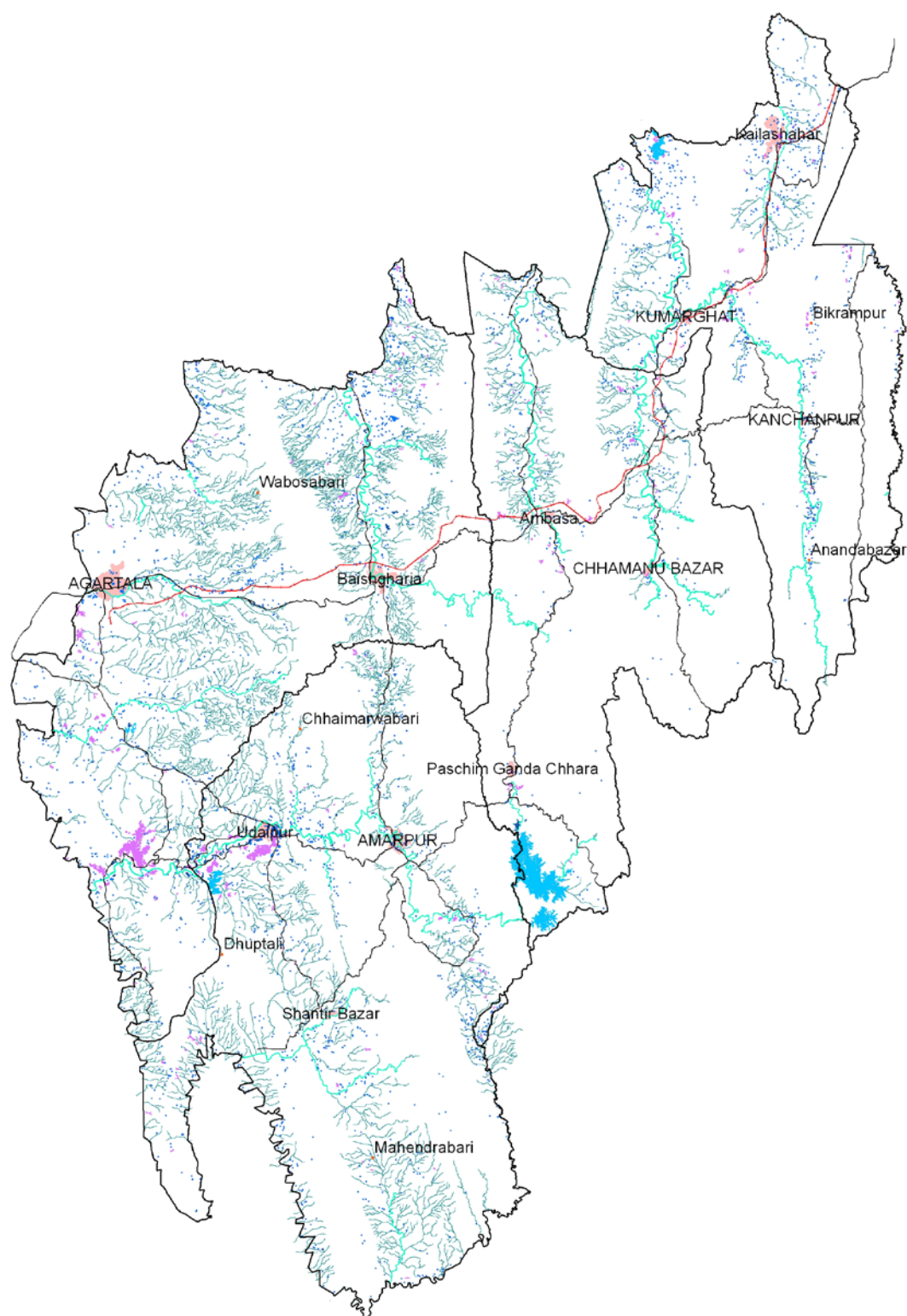


Figure 23: District-wise wetland distribution in Tripura

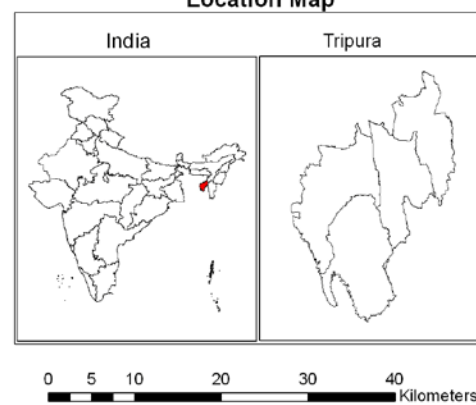


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

7.6.1 West Tripura

The district of West Tripura (2997 km²) lies at a longitude of 91° 09' to 91° 47' E and at a latitude of 23°16' to 24°14' N. The district is bordered by North Tripura in the east, by South Tripura in the south and Bangladesh in the north. The geographic area of the district is 3544 Sq. km. The capital of the state of Tripura, Agartala, is also the district headquarter of West Tripura. The area is having many rivers. Rising from the Baramura range River Howrah has a number of tributaries including, Dhobatilachhara, Bangeswargang, Dowraigang, Ghoramara, Charupanadi and Debda. River Burigang originates from the Baramura range and flows west into Bangladesh. The colossal alluvial deposit of this river creates a number of river valleys which are extremely fertile. River Gumti formed by the confluence of two rivulets, the Raimas and Sarma, is the principal river of West Tripura. Total 162 wetlands have been mapped and 1075 small wetlands (< 2.25 ha) identified. The inland-Natural wetlands comprise about 75.9 %. The Waterlogged occupies the largest area (1527 ha) next to River/Stream (1764 ha). The other major natural wetland types are Lake/pond and Ox-Bow lakes. Total 43 Lakes/Ponds are mapped occupying 225 ha area (4.8 %). Detailed wetland statistics of the district is given in table-63. The open water spread area is significantly more during Post-monsoon (2430 ha) than that of Pre-monsoon (1876 ha). Considerable reduction in water spread is observed in case of Waterlogged during Pre-monsoon (281 ha) than that of Post-monsoon (1032 ha).

Aquatic vegetation is observed in all types of wetlands except River/stream. Area under wetland vegetation is more during Pre-monsoon (1434 ha) than that of Post-monsoon (637 ha). This is mainly due to increased area in vegetation in natural Waterlogged wetland type which has shown dominating presence and increased from 495 ha in Post-monsoon to 1244 ha in Pre-monsoon.

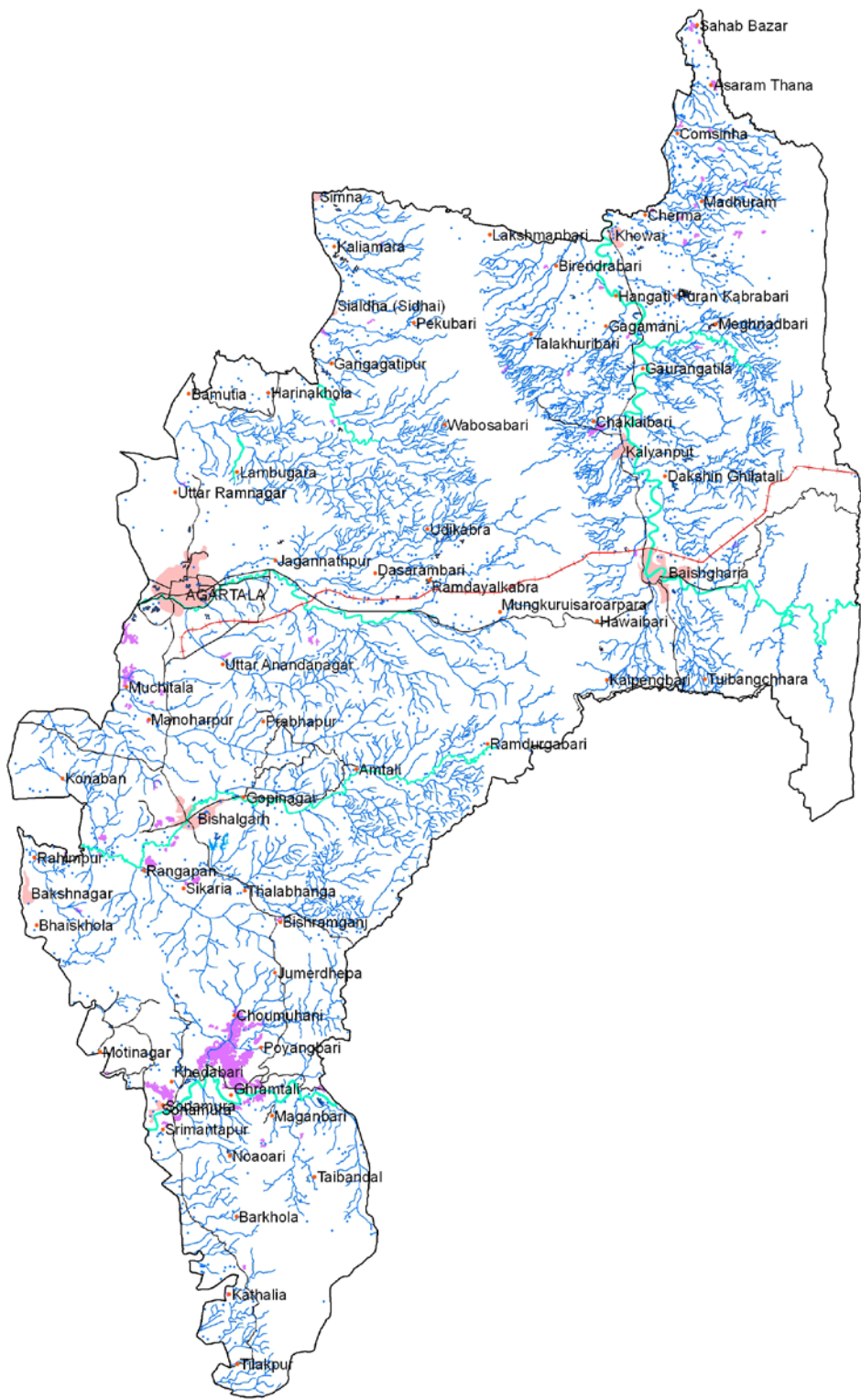
Qualitative turbidity of open water is in general medium in both the seasons. Extent under low turbidity decreased from 528 ha in Post-monsoon to 199 ha in Pre-monsoon. Extent under high turbidity is insignificant in both the seasons. Moderate turbidity is dominant and accounts for 78 % and 87 % in post- and Pre-monsoon seasons respectively. In terms of per cent extent, the low turbidity comprised about 22 % of open water in post-monsoon and has got reduced to half (about 11 %).

Table 63: Area estimates of wetlands in West Tripura

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon area	Pre-monsoon area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	43	225	4.74	137	115
2	1102	Ox-bow lakes/ Cut-off meanders	14	88	1.85	55	36
3	1105	Waterlogged	90	1527	32.15	1032	281
4	1106	River/Stream	6	1764	37.14	1158	1400
	1200	Inland Wetlands -Man-made					
5	1201	Reservoirs/Barrages	5	57	1.20	36	32
6	1202	Tanks/Ponds	4	13	0.27	12	12
		Sub-Total	162	3674	77.36	2430	1876
		Wetlands (<2.25 ha), mainly Tanks	1075	1075	22.64	-	-
		Total	1237	4749	100.00	2430	1876

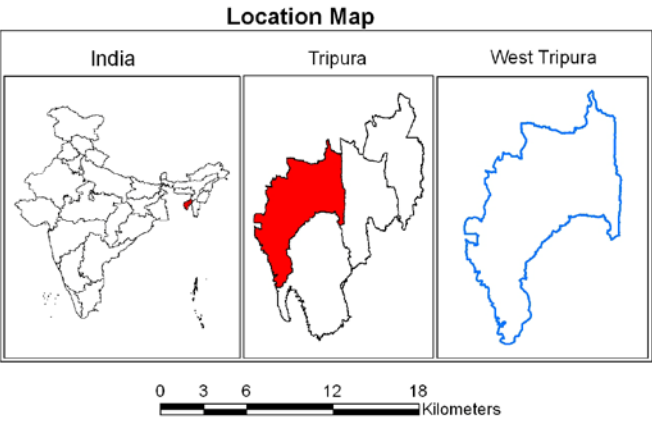
Area under Aquatic Vegetation	637	1435
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Area under turbidity levels		
Low	528	199
Moderate	1891	1625
High	11	52



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



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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

Sponsored By :
Ministry of Environment and Forests
Government of India

7.6.2 South Tripura

The district of South Tripura is situated at a longitude of 91°18' and 91°59' East and at a latitude of 22°56' and 23°45' N. Covering a total geographical area of 2152 Sq. km, South Tripura is bordered by the Dalai district, West Tripura and Bangladesh. Udaipur is the district headquarter of South Tripura. Like most other parts of Tripura, the district of South Tripura is also dotted with a number of rivers and mountain ranges. There are a number of rivers that criss cross the district of South Tripura, the most important among them are Feni, Muhuri and Gumti. Total 116 wetlands have been delineated in addition to the 824 small wetlands (< 2.25 ha) identified. The inland-Natural wetlands comprise about 65 %. The major natural wetlands are River/stream (41.74 %), followed Waterlogged (19.09 %) and Ox-bow Lakes (2.93 %). Reservoir/Barrage is the major man-made wetlands. Total 4 such wetland types mapped with 625 ha area occupying 13.66 % of wetlands. Detailed statistics of wetlands of South Tripura district is given in table 64. The open water spread area is more in Post-monsoon (2474 ha) than in Pre-monsoon (1799 ha). The reduction in open water spread area in Pre-monsoon is more significant in case of Reservoir/Barrages and Waterlogged types.

Wetland vegetation is observed in all types of wetlands except River/stream. Area under aquatic vegetation is more during Pre-monsoon (1412 ha) compared to Post-monsoon (526 ha). This is mainly due to significant increase in vegetation area in case of Waterlogged wetlands and Reservoir/Barrage. Man-made wetlands have significantly lower extents (185 ha and 574 ha) of aquatic vegetation in both the seasons compared to natural wetlands (341 ha and 838 ha).

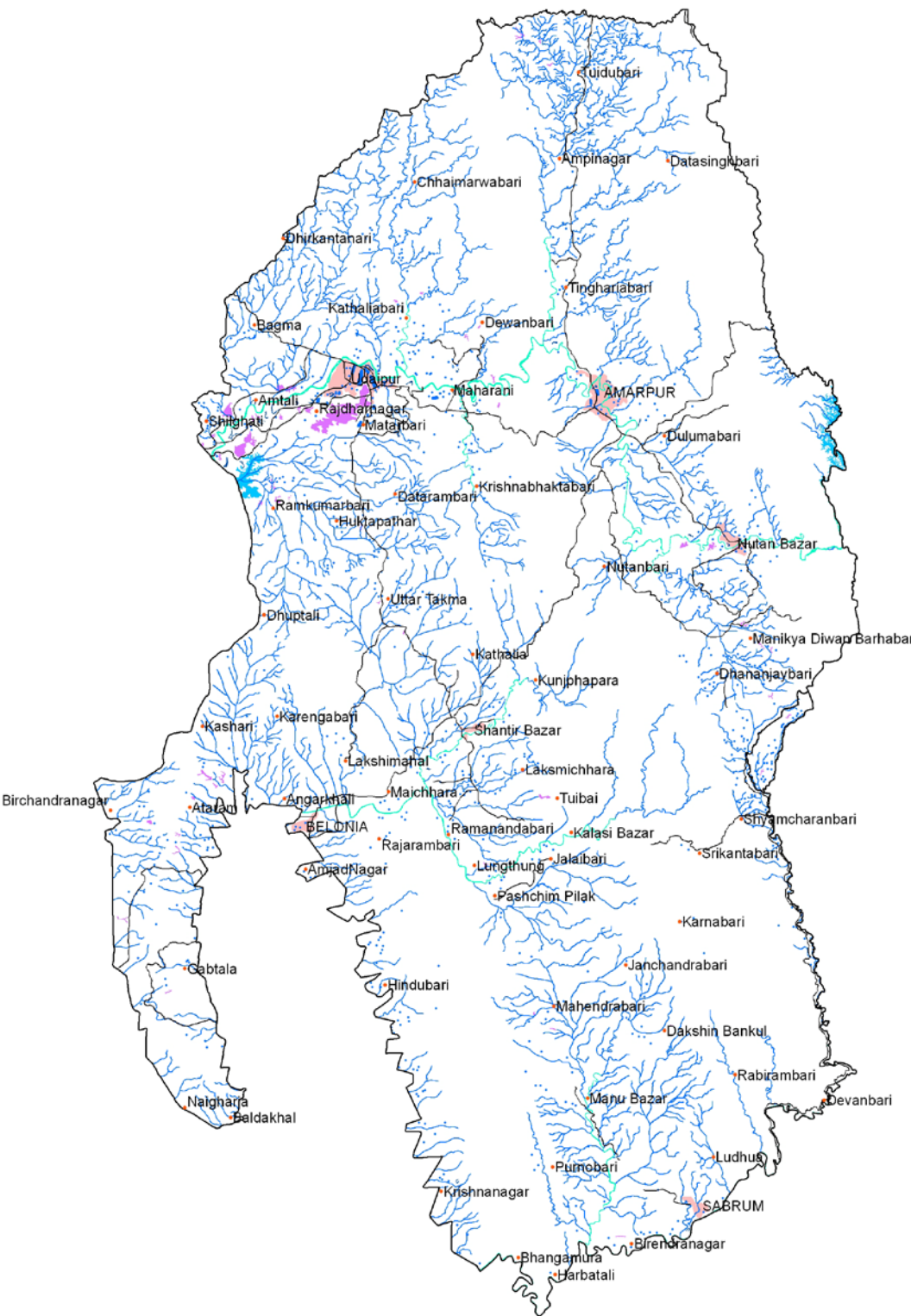
Moderate turbidity dominated the open water features of wetlands in this district accounting for 74 % (Post-monsoon) and 88 % (Pre-monsoon), which is observed to be mainly due to river/stream category. Low turbidity in Post-monsoon (633 ha) was found to have decreased to 210 ha in Pre-monsoon. High turbidity areas are insignificant in Post-monsoon and absent in Pre-monsoon.

Table 64: Area estimates of wetlands in South Tripura

Area in ha							
Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	1100	Inland Wetlands – Natural					
1	1101	Lakes/Ponds	9	41	0.90	25	20
2	1102	Ox-bow lakes/ Cut-off meanders	29	134	2.93	85	68
3	1105	Waterlogged	55	873	19.09	598	122
4	1106	River/Stream	4	1909	41.74	1159	1370
	1200	Inland Wetlands -Man-made					
5	1201	Reservoirs/Barrages	3	625	13.66	482	94
6	1202	Tanks/Ponds	16	168	3.67	125	125
		Sub-Total	116	3750	81.99	2474	1799
		Wetlands (<2.25 ha), mainly Tanks	824	824	18.01	-	-
		Total	940	4574	100.00	2474	1799

Area under Aquatic Vegetation	526	1412
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Area under turbidity levels		
Low	633	210
Moderate	1830	1589
High	11	0

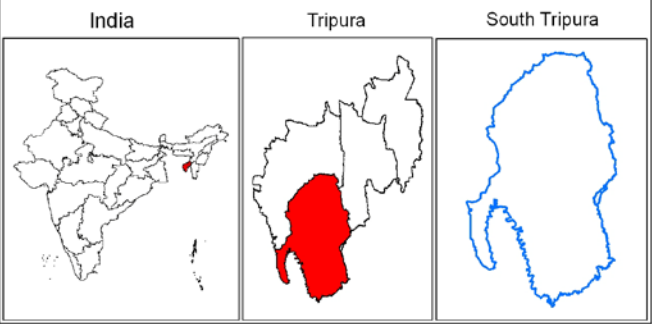


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
				Lakes/Ponds
	1101			Ox-bow lakes/ Cut-off meanders
	1102			High altitude wetlands
	1103			Reverine wetlands
	1104			Waterlogged
	1105			River/Stream
	1106			
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203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

Legend

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

Location Map



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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

Sponsored By :
Ministry of Environment and Forests
Government of India

7.6.3 Dhalai District

Dhalai District of Tripura occupies a total area of 2523 Sq. km and has population of around 307,417. This is the youngest district of Tripura and Ambassa is its headquarter. The general topography of this district of Tripura is hilly and around 70% area is covered with forests. The major rivers of Dhalai District are Khowai, Manu, and Dhalai. Total 77 wetlands mapped 349 small wetlands (<2.25ha) delineated as point features. The total wetland area is 4815 ha. The inland-Natural wetlands comprise about 43 % and inland-Man-made wetlands comprise about 50 % of wetland area. Reservoir/Barrage occupies the largest area (2383 ha) followed by River/Stream (1751 ha). The other major wetland types are waterlogged (264 ha) followed by Ox-Bow lakes (54 ha). Details of wetland statistics is given in Table-65. The open water spread of River/stream does not show significant seasonal change. However, in case of Reservoir/Barrage, the open water is significantly reduced during Pre-monsoon (587 ha) compared to Post-monsoon (2211 ha).

Aquatic vegetation is observed in Lake/Pond, Ox-Bow Lakes/ Cut-Off Meanders, Waterlogged, Reservoir/Barrage and Tank/Pond wetland types. Area under aquatic vegetation (floating and emergent) is less (344 ha) during Post-monsoon season than that of Pre-monsoon (1983 ha). This is mainly due to increase in vegetation in the Reservoir/ Barrage wetland types.

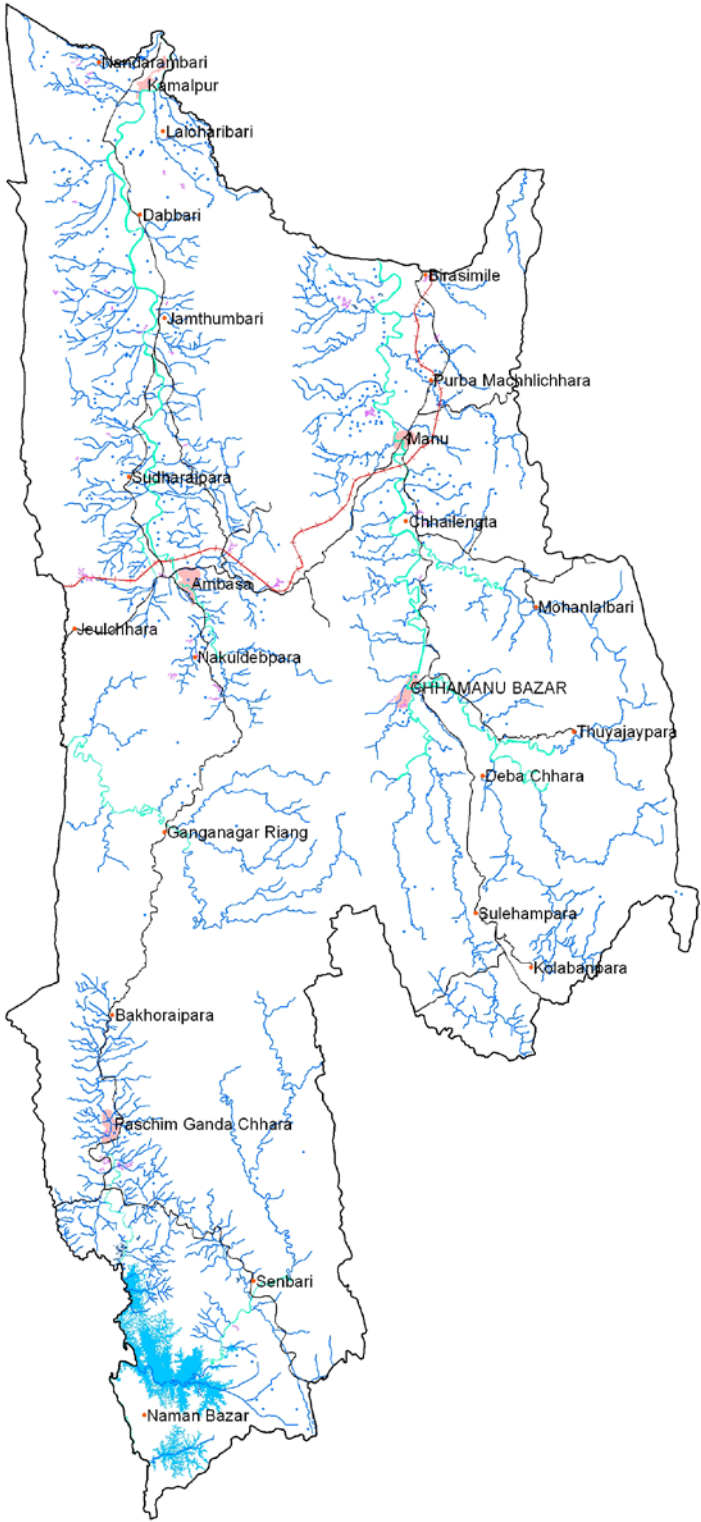
The qualitative turbidity of open water in wetlands is in general moderate during Pre-monsoon. Moderate turbidity is significant (61 %) in Post-monsoon, which has become dominant in Pre-monsoon (91 %). Low turbid open water features account for 39 % in Post-monsoon got reduced to 9 in Pre-monsoon. High turbidity is insignificant in Post-monsoon and is absent in Pre-monsoon. The turbidity of open water in case of Reservoirs/ Barrages is low (1261 ha) to moderate (951 ha) and is mainly responsible overall moderate turbidity of open water features in this district.

Table 65: Area estimates of wetlands in Dhalai 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	9	0.19	6	5
2	1102	Ox-bow lakes/ Cut-off meanders	13	54	1.12	34	19
3	1105	Waterlogged	50	264	5.48	114	118
4	1106	River/Stream	6	1751	36.37	991	1130
	1200	Inland Wetlands -Man-made					
5	1201	Reservoirs/Barrages	5	2383	49.49	2211	587
6	1202	Tanks/Ponds	1	5	0.10	5	5
		Sub-Total	77	4466	92.75	3361	1864
		Wetlands (<2.25 ha), mainly Tanks	349	349	7.25	-	-
		Total	426	4815	100.00	3361	1864

Area under Aquatic Vegetation	344	1983
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Area under turbidity levels		
Low	1309	166
Moderate	2047	1697
High	5	1

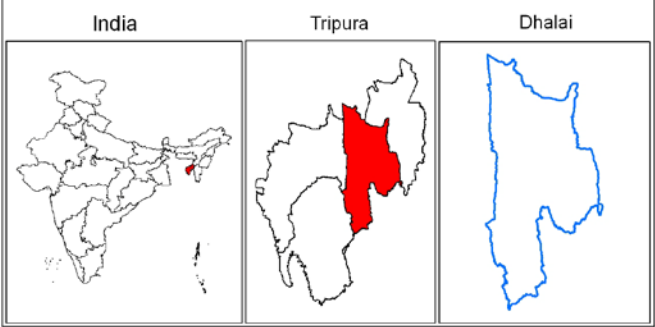


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

Sponsored By :
Ministry of Environment and Forests
Government of India

7.6.4 North Tripura

The North District of Tripura covers a total area of 2821 Sq. km with Kailasahar as the district headquarters. This district is sub divided into three divisions, Kailashahar, Dharmanagar and Kanchanpur. The total geographic area of North Tripura is 2821 km². In the North Tripura district, 92 wetlands have been delineated in addition to 735 small wetlands (<2.25 ha) identified. The inland-Natural wetlands comprise about 70.9 % of total wetland area. River/stream is the dominant wetland type (58.6 %), followed by Waterlogged (8.3 %). The other major natural wetland type is Ox-Bow lakes (111 ha). Reservoir/Barrage is the major Man made wetland type. Total 3 are mapped under this category with 255 ha area that turns out to be 7.5 %. Detailed wetland statistics is given in table-66. The open water spread in wetlands does not show significant seasonal variation, except for Reservoir/Barrages. The water spread in Reservoirs/Barrages reduced significantly (83 ha) during Pre-monsoon compared to Post-monsoon (206 ha).

Lake/Pond, Ox-Bow Lakes/ Cut-Off Meanders, Waterlogged and Reservoir/Barrage are the only wetland types that have vegetation. Area under aquatic vegetation mapped is 272 ha in Post-monsoon season which increased to 402 ha in Pre-monsoon. This is mainly due to change in wetland vegetation area in Reservoir/ Barrages.

The turbidity of open water is in mainly moderate in both the seasons. It was observed to 87 % of the open water features in Post-monsoon got increased to 96 % in Pre-monsoon. Low turbidity was observed to be 13 % in Post-monsoon has reduced to mere 4 % in Pre-monsoon. High turbidity has not been exhibited by wetlands in this district in both the seasons. However, in case of Reservoir/ Barrages, the turbidity of water is low (43 ha) to moderate (40 ha) during Pre-monsoon, while mainly moderate (133 ha) during Post-monsoon.

Table 66: Area estimates of wetlands in North Tripura

Table 66: Area estimates of Wetlands in North Tripura						Area in ha	
Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	6	25	0.73	12	13
2	1102	Ox-bow lakes/ Cut-off meanders	26	111	3.26	55	47
3	1105	Waterlogged	51	282	8.28	128	126
4	1106	River/Stream	6	1996	58.64	1180	1215
	1200	Inland Wetlands -Man-made					
5	1201	Reservoirs/Barrages	3	255	7.49	207	83
		Sub-Total	92	2669	78.41	1582	1484
		Wetlands (<2.25 ha), mainly Tanks	735	735	21.59	-	-
		Total	827	3404	100.00	1582	1484

Area under Aquatic Vegetation	272	402
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Area under turbidity levels		
Low	202	66
Moderate	1380	1418
High	-	-

7.7 MEGHALAYA

Area estimates of various wetland categories for Meghalaya have been carried out using GIS layers of wetland boundary, water-spread, aquatic vegetation and turbidity. In the state of Meghalaya, 135 (excluding rivers/streams) wetlands have been delineated. Total wetland area estimated is 29987 ha. (Table 67). Small wetlands, which are less than minimum mapable units (MMU), are 167 in the district. The major wetland types are River/Stream (24841 ha) and Reservoirs (1562 ha). Graphical distribution of wetland type is shown in Figure 24.

Table 67: Area estimates of wetlands in Meghalaya

Area in ha							
Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	15	501	1.67	337	175
2	1102	Ox-bow lakes/ Cut-off meanders	1	461	1.54	316	107
3	1104	Riverine wetlands	4	1272	4.24	836	1271
4	1105	Waterlogged	77	1028	3.43	678	280
5	1106	River/Stream	124	24841	82.84	24112	24051
	1200	Inland Wetlands -Man-made					
6	1201	Reservoirs/Barrages	8	1562	5.21	1520	1415
7	1202	Tanks/Ponds	29	150	0.50	113	121
8	1203	Waterlogged	1	5	0.02	-	-
		Sub-Total	259	29820	99.44	27912	27420
		Wetlands (<2.25 ha), mainly Tanks	167	167	0.56	-	-
		Total	426	29987	100.00	27912	27420

Area under Aquatic Vegetation	819	852
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Area under turbidity levels		
Low	24919	24692
Moderate	1928	1168
High	1065	1560

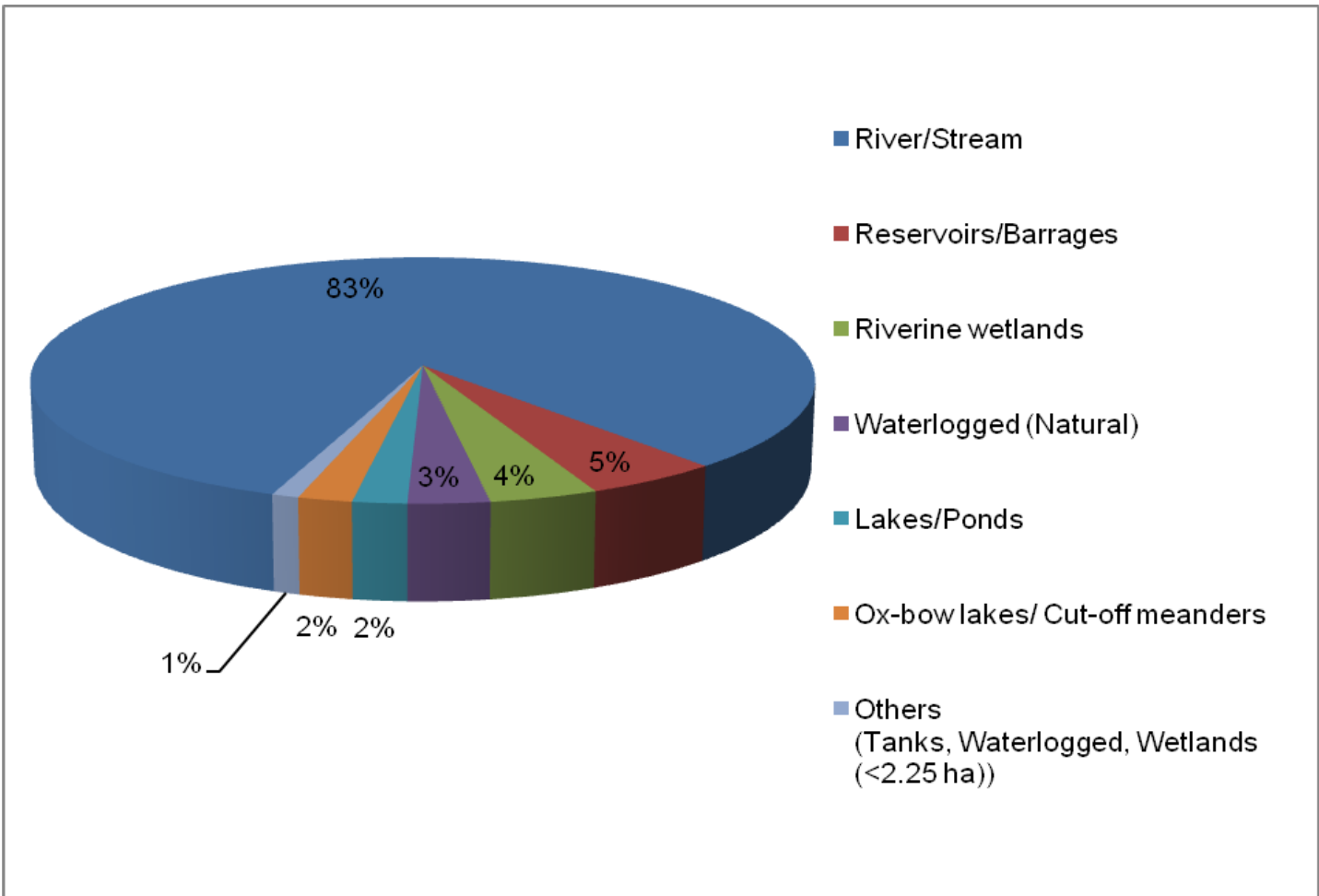


Figure 24: Type-wise wetland distribution in Meghalaya

The state has seven districts. District-wise wetland area estimates is given in Table-68. Wetland statistics followed by wetland map and corresponding satellite data for each district is given to have a fairly good idea about the distribution pattern and density of wetlands in the district.

Table 68: District-wise wetland area in Meghalaya

District code	District	Geographic Area	Wetland Area	% of total wetland area	% of district geographic area	Open water		Aquatic Vegetation	
						Post-monsoon	Pre-monsoon	Post-monsoon	Pre-monsoon
		(sq. km.)	(ha)		(ha)	(ha)	(ha)	(ha)	(ha)
1	West Garo Hills	3439	7196	38.01	2.09	6496	5672	630	778
2	East Garo Hills	2869	2649	13.99	0.92	2607	2607	28	10
3	South Garo Hills	1871	3169	16.74	1.69	3168	3168	0	0
4	West Khasi Hills	5225	5920	31.27	1.13	5529	5731	60	4
5	Ri Bhoi	2370	1945	10.27	0.82	1971	1948	8	30
6	East Khasi Hills	2852	4796	25.33	1.68	4685	4898	93	30
7	Jaintia Hills	3793	4302	22.72	1.13	3456	3396	0	0
	Total	13404	18934	100.00		17800	17178	718	792

(* Source: Census 2001)

West Garo Hills district of Meghalaya covers the maximum wetland area (24 %). A major portion of wetland areas are observed in West khasi Hills, East Khasi Hills and in Jaintia Hills. East Garo Hills and Ribhoi district covers small portion of wetland area. The graphical distribution of district-wise wetland area is shown in Figure 25.

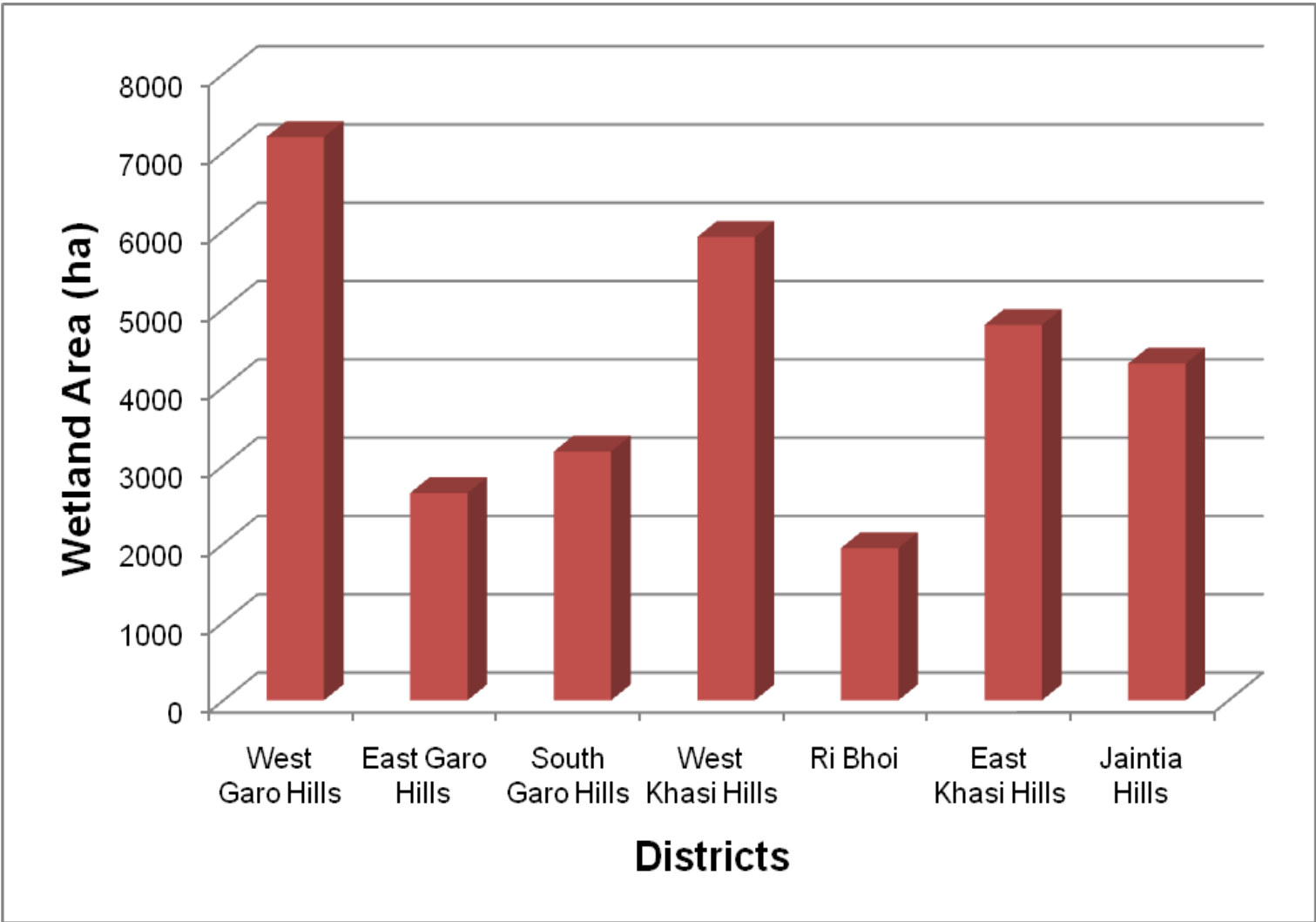
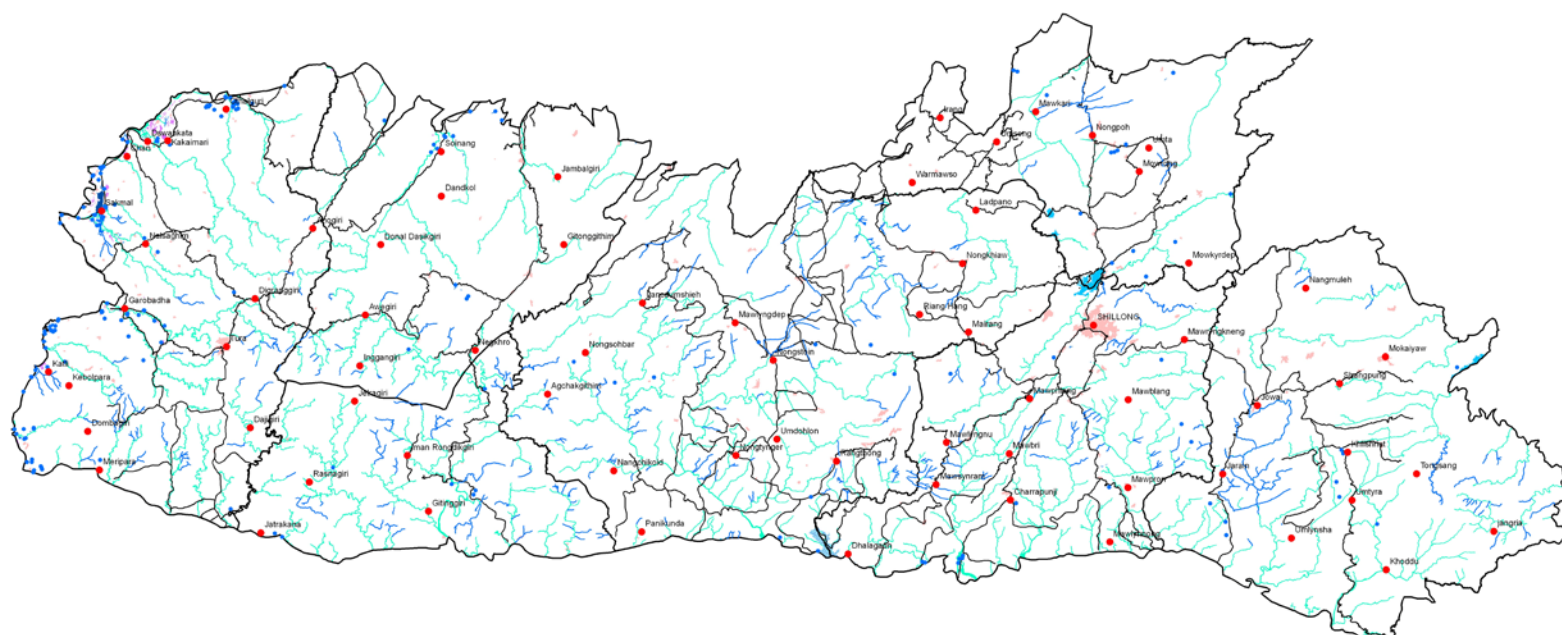


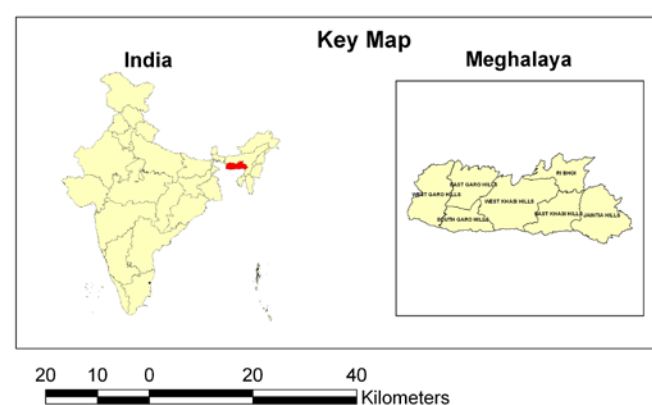
Figure 25: District-wise wetland distribution in Meghalaya



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

Legend

- Wetlands (<2.25ha)
- Drainage (line)
- Major Roads
- Settlements
- District Boundary
- Towns/Settlements



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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
North Eastern Space Applications Centre (NESAC)
Dept. of Space, Umiam, Meghalaya

Sponsored By:
Ministry of Environment and Forests
Government of India

7.7.1 West Garo Hills

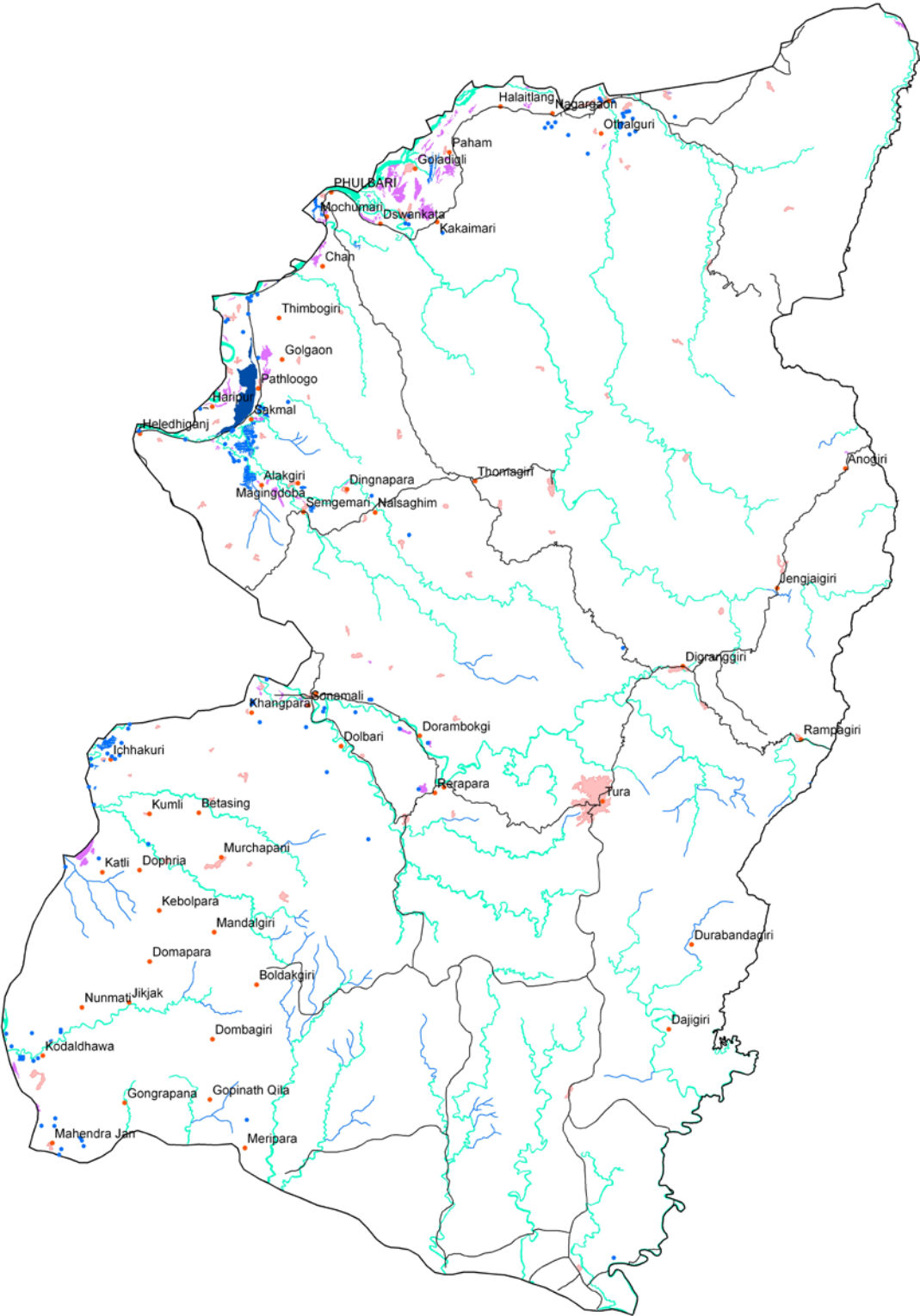
West Garo Hills is one of the largest districts of Meghalaya located in the western part of the State. The Garo Hills district was divided into two districts, viz. the West Garo Hills district and the East Garo Hills district in October 1976. The erstwhile West Garo Hills district was further divided into two administrative districts of West and South Garo Hills on June 1992. The district headquarters of West Garo Hills is Tura, which is the second largest town in the State after Shillong. The West Garo Hills district is bounded by the East Garo Hills district on the east, the South Garo Hills on the south-east, the Goalpara district of Assam on the north and north-west and Bangladesh on the south. The total geographic area of West Garo Hills district of Meghalaya is 343890 ha. The wetland area estimated is 7196 ha. Small wetlands, which are less than minimum mapable units (MMU), are 99 in the district. Details are given in Table 69. The major wetland types are River/Stream, waterlogged areas, Lakes/Ponds and Ox-bow lakes.

Table 69: Area estimates of wetlands in West Garo Hills

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	15	501	6.96	337	175
2	1102	Ox-bow lakes/ Cut-off meanders	1	461	6.41	316	107
3	1105	Waterlogged	74	1010	14.04	665	268
4	1106	River/Stream	61	5083	70.64	5149	5087
	1200	Inland Wetlands -Man-made					
5	1202	Tanks/Ponds	5	37	0.51	26	32
6	1203	Waterlogged	1	5	0.07	3	3
		Sub-Total	157	7097	98.62	6496	5672
		Wetlands (<2.25 ha), mainly Tanks	99	99	1.38	-	-
		Total	256	7196	100.00	6496	5672

Area under Aquatic Vegetation	630	778
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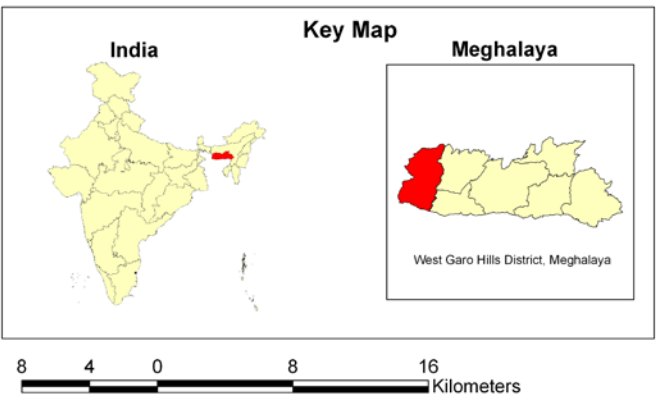
Area under turbidity levels		
Low	5664	5297
Moderate	716	302
High	114	70



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

Legend

- Wetlands (<2.25ha)
- Drainage (line)
- Major Roads
- Settlements
- District Boundary
- Towns/Settlements



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

Prepared By :
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Dept. of Space, Umiam, Meghalaya

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7.7.2 East Garo Hills

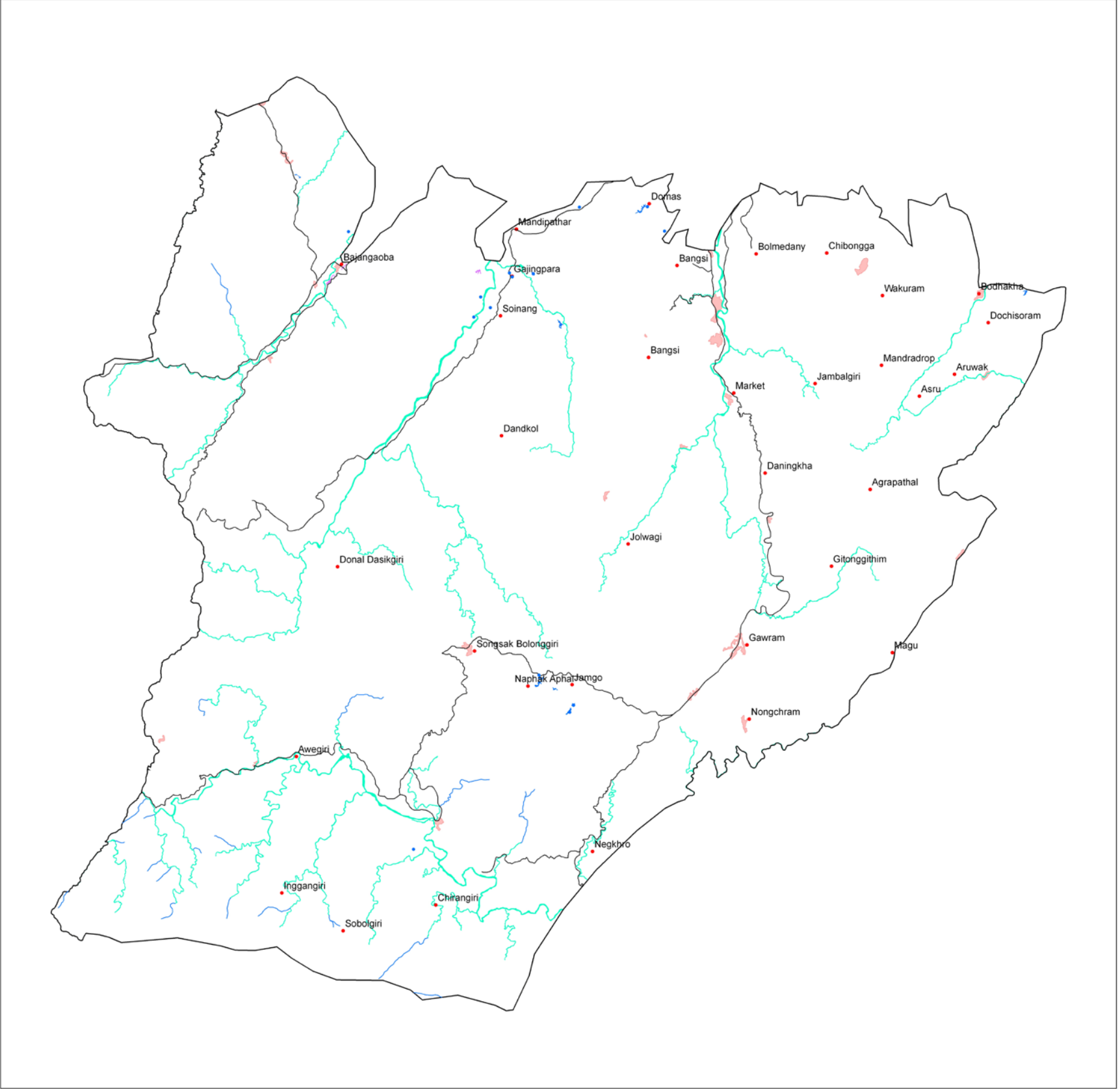
The East Garo Hills district was formed in 1976. The district was carved out from the Garo Hills District. The district headquarter is located at Williamnagar. As per 2001 census, the district is home to 2,50,582 people. Agriculture, horticulture, fisheries, textile, pottery, handicrafts, sericulture, cottage industries constitute the economic scenario of East Garo Hills. The topography of the district is undulating low hills, with altitude ranging from 150 to 600 metres above sea level. The total geographic area of East Khasi Hills district of Meghalaya is 286869 ha. The wetland area estimated is 2649 ha. Details are given in Table 70. Small wetlands, which are less than minimum mapable units (MMU), are 14 in the district. The major wetland types are River/Stream, tanks/ponds and areas under water logging. Other than the Simsang river which drains southeastwards, all other rivers run north or northwest towards the Brahmaputra.

Table 70: Area estimates of wetlands in East Garo Hills

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1105	Waterlogged	3	18	0.68	12	12
2	1106	River/Stream	19	2563	96.75	2563	2563
	1200	Inland Wetlands -Man-made					
3	1202	Tanks/Ponds	9	54	2.04	32	32
		Sub-Total	31	2635	99.47	2607	2607
		Wetlands (<2.25 ha), mainly Tanks	14	14	0.53	-	-
		Total	45	2649	100.00	2607	2607

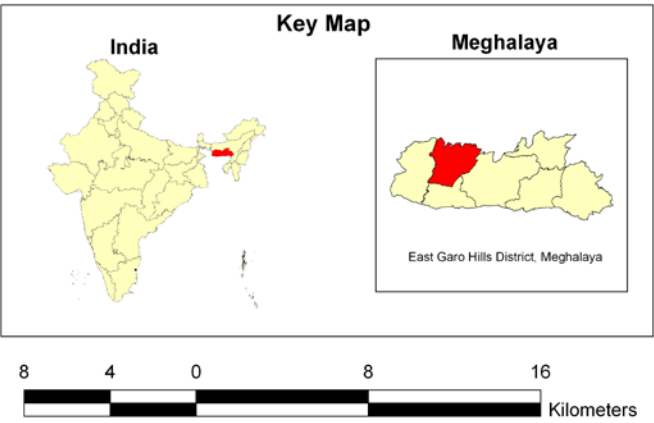
Area under Aquatic Vegetation	28	10
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Area under turbidity levels		
Low	2564	2565
Moderate	45	41
High	-	2



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

- Legend**
- Wetlands (<2.25ha)
 - Drainage (line)
 - Major Roads
 - Settlements
 - District Boundary
 - Towns/Settlements



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

Prepared By :
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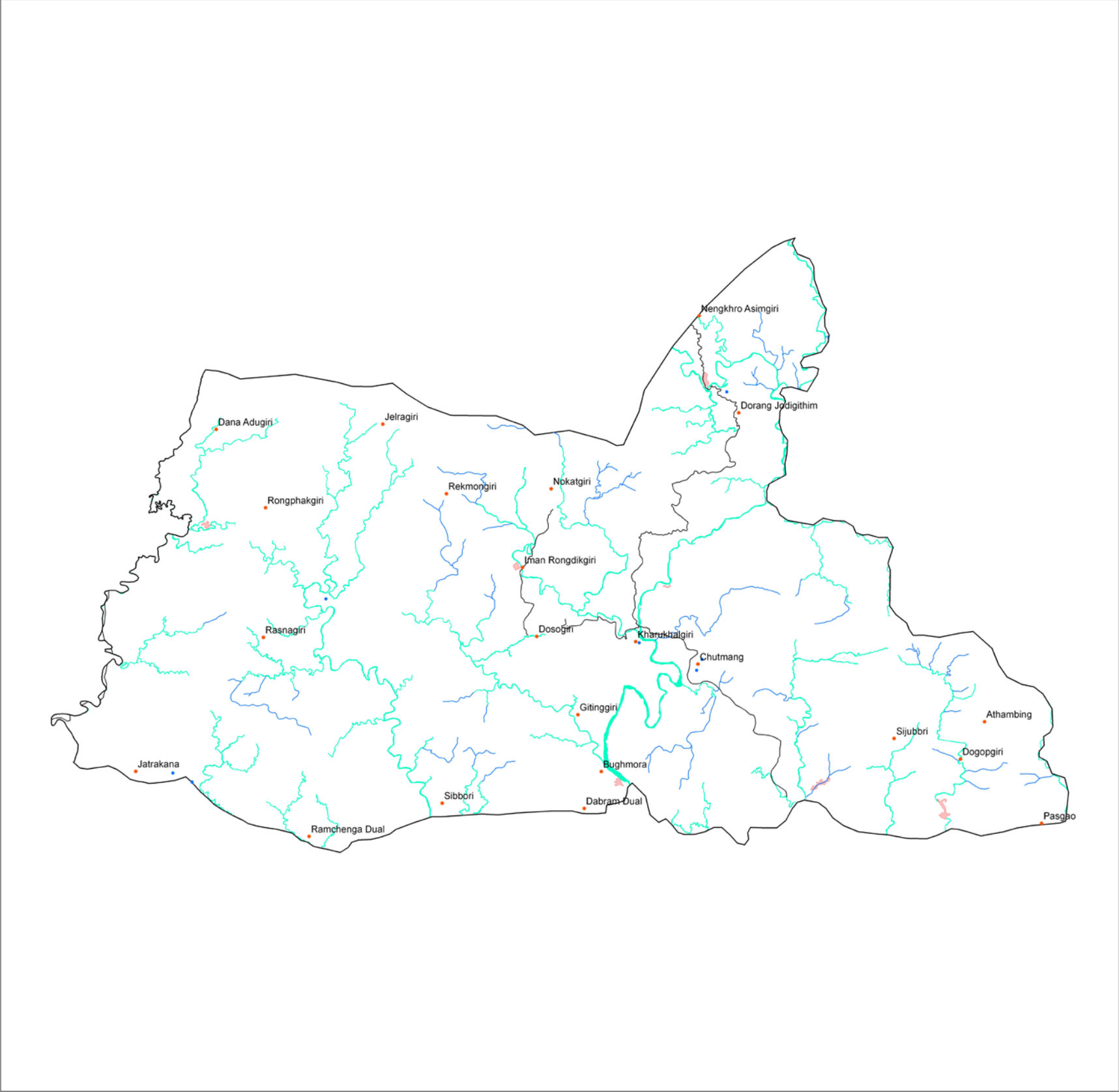
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7.6.2 South Garo Hills

The South Garo Hills district came into existence on 18th June 1992 after the division of the West Garo Hills district. The district headquarter is Baghmara. The district is located in the southern part of the state and bounded by West Garo Hills district in the west, East Garo Hills in the north, West Khasi Hills in the East and Bangladesh in the South. The district is hilly with difficult terrain. The total geographic area of South Garo Hills district of Meghalaya is 187083 ha. The wetland area estimated is 3179 ha. Small wetlands, which are less than minimum mapable units, are 7 in the district (Table 71).

Table 71: Area estimates of wetlands in South Garo Hills

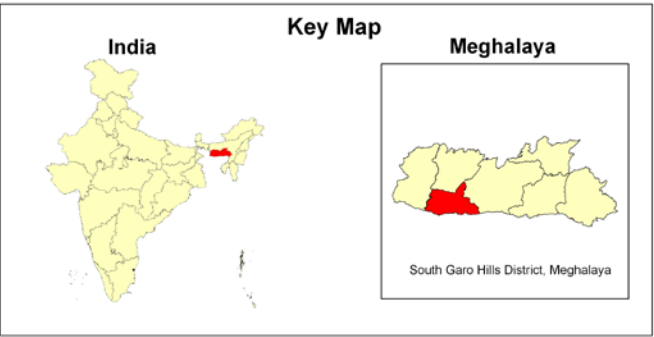
Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1106	River/Stream	127	3172	99.78	3168	3168
		Sub-Total	127	3172	99.78	3168	3168
		Wetlands (<2.25 ha), mainly Tanks	7	7	0.22	-	-
		Total	134	3179	100.00	3168	3168
Area under Aquatic Vegetation							-
Area under turbidity levels							
Low							3169
Moderate							-
High							-



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

Legend

- Wetlands (<2.25ha)
- Drainage (line)
- Major Roads
- Settlements
- District Boundary
- Towns/Settlements



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

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7.7.3 West Khasi Hills

The West Khasi Hills district is presently the largest district of Meghalaya. It was carved out from the Khasi Hills District on the 28th October, 1976. It is bounded on the north-west by Kamrup district of Assam, on the north-east by Ri-Bhoi district, on the east by East Khasi Hills district, on the south by Bangladesh, on the west by East Garo and South Garo Hills districts. Nongstoin, is the Headquarters of the District. Ranikor, Mawlangkhar, Mawthadraishan, Nongkhnum River Island, Thum Falls, Weinia Falls, Langshiang Falls, Jakrem Hot Spring, Kyllang rock are the major attractions of the region. The total geographic area of West Khasi Hills district of Meghalaya is 522543 ha. The wetland area estimated is 5920 ha. Small wetlands, which are less than minimum mapable units (MMU), are 10 in the district. Details are given in Table 72. The major wetland types are River/Stream and Riverine wetlands.




















Table 72: Area estimates of wetlands in West Khasi Hills

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	1104	Riverine wetlands	4	679	11.47	427	628
2	1106	River/Stream	135	5192	87.70	5067	5067
	1200	Inland Wetlands -Man-made					
3	1201	Reservoirs/Barrages	8	39	0.66	35	36
		Sub-Total	147	5910	99.83	5529	5731
		Wetlands (<2.25 ha), mainly Tanks	10	10	0.17	-	-
		Total	157	5920	100.00	5529	5731

Area under Aquatic Vegetation	60	4
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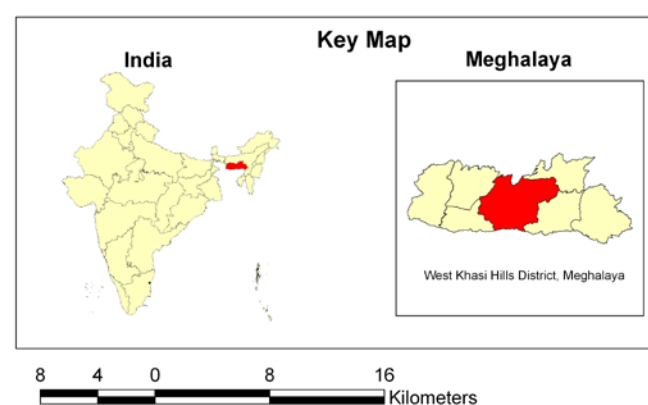
Area under turbidity levels		
Low	5074	5078
Moderate	29	25
High	423	628



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

Legend

- Wetlands (<2.25ha)
- Drainage (line)
- Major Roads
- Settlements
- District Boundary
- Towns/Settlements



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

Prepared By :
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7.7.6 Ri Bhoi

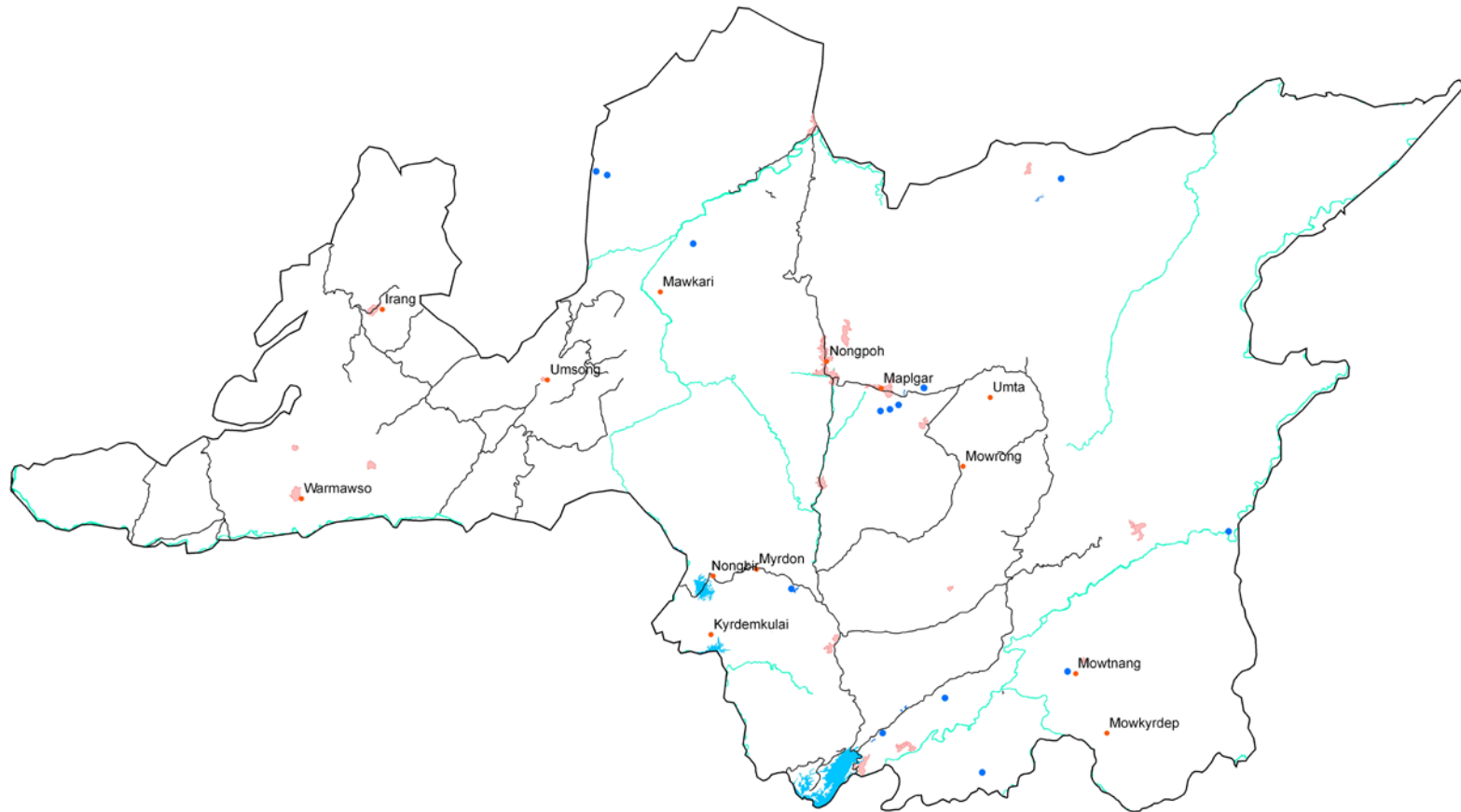
Ri Bhoi District was upgraded from Sub Divisional level to a full fledged district on 4th June, 1992. The new district, was carved out from the erstwhile East Khasi Hills. Its headquarter is at Nongpoh, which is about 53 Kms from the State Capital, Shillong. It is bounded on the north by Kamrup District and on the East by Jaintia Hills and Karbi Anglong District of Assam and on the West by West Khasi Hills district. This district is characterized by rugged and irregular land surface. It includes a series of hill ranges which gradually sloped towards the north and finally joins the Brahmaputra Valley. The important rivers flowing through this region includes the Umtrew, Umsiang, Umran and Umiam rivers. The total geographic area of Ri Bhoi district of Meghalaya is 237005ha. The wetland area estimated is 1945 ha. Small wetlands, which are less than minimum mapable units (MMU), are 13 in the district. Details are given in Table 73. The major wetland types are River/Stream and Reservoirs/Barrages.

Table 73: Area estimates of wetlands in Ri Bhoi

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1106	River/Stream	96	1156	59.43	1222	1222
	1200	Inland Wetlands -Man-made					
2	1201	Reservoirs/Barrages	10	754	38.77	731	705
3	1202	Tanks/Ponds	7	22	1.13	18	21
		Sub-Total	113	1932	99.33	1971	1948
		Wetlands (<2.25 ha), mainly Tanks	13	13	0.67	-	-
		Total	126	1945	100.00	1971	1948

Area under Aquatic Vegetation	8	30
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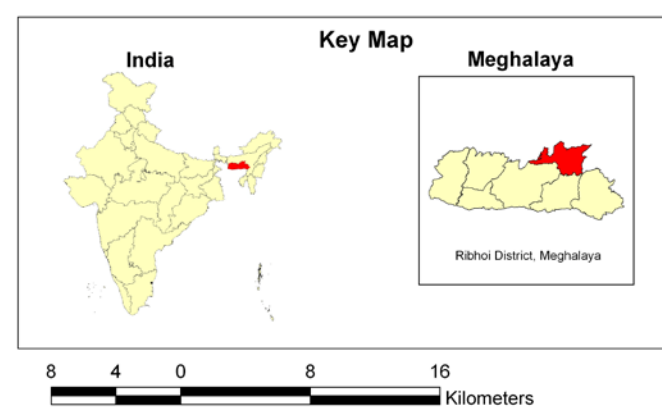
Area under turbidity levels		
Low	1401	1437
Moderate	512	347
High	58	164



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

Legend

- Wetlands (<2.25ha)
- Drainage (line)
- Major Roads
- Settlements
- District Boundary
- Towns/Settlements



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

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7.7.7 East Khasi Hills

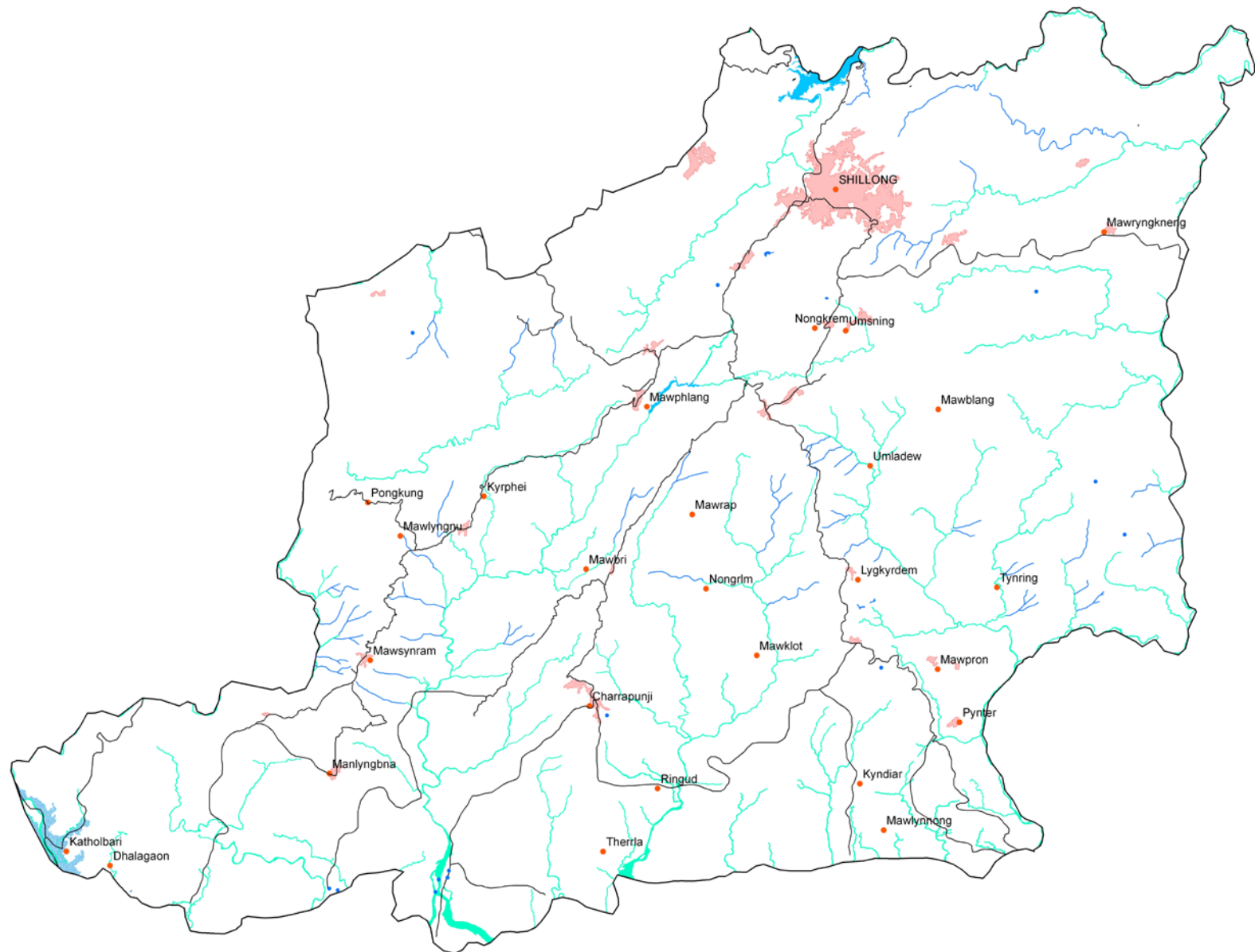
East Khasi Hills district forms central part of Meghalaya. The headquarter of the district is Shillong which is also the capital city of State. The district is bounded by Ri-Bhoi district in the north, Bangladesh in the south, Jaintia Hills district in the east and the West Khasi Hills district in the west. Agriculture, horticulture, fisheries, weaving, handicrafts, sericulture and cottage industries makes up the economic scenario of East Khasi Hills. The East Khasi Hills District is mostly hilly with deep gorges and ravines on the southern portion. The most important physiographic features of the district is the Shillong Plateau interspersed with river valley, then fall sharply in the southern portion forming deep gorges and ravine in Mawsynram and Shella-Bholaganj bordering Bangladesh. The total geographic area of East Khasi Hills district of Meghalaya is 285216 ha. The wetland area estimated is 4796 ha. Small wetlands, which are less than minimum mapable units (MMU), are 13 in the district. Details are given in Table 74. The major wetland types are River/Stream, riverine wetlands and Reservoirs/Barrages.

Table 74: Area estimates of wetlands in East Khasi Hills

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	1104	Riverine wetlands	6	593	12.36	409	643
2	1106	River/Stream	107	3656	76.23	3758	3758
	1200	Inland Wetlands -Man-made					
3	1201	Reservoirs/Barrages	5	509	10.61	493	474
4	1202	Tanks/Ponds	6	25	0.52	25	23
		Sub-Total	124	4783	99.73	4685	4898
		Wetlands (<2.25 ha), mainly Tanks	13	13	0.27	-	-
		Total	137	4796	100.00	4685	4898

Area under Aquatic Vegetation	93	30
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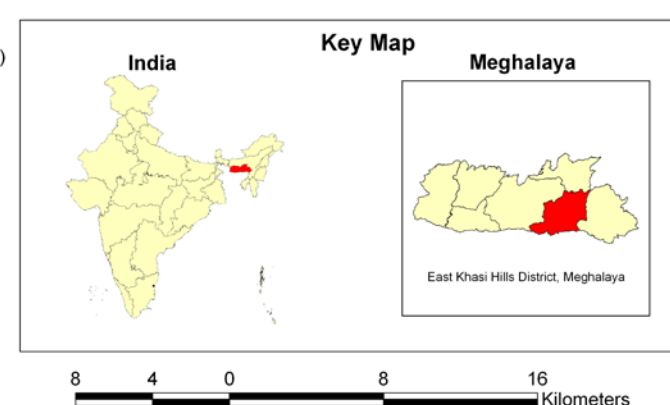
Area under turbidity levels		
Low	3862	3962
Moderate	392	241
High	432	696



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

Legend

- Wetlands (<2.25ha)
- Drainage (line)
- Major Roads
- Settlements
- District Boundary
- Towns/Settlements



Data Source :
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7.7.8 Jaintia Hills

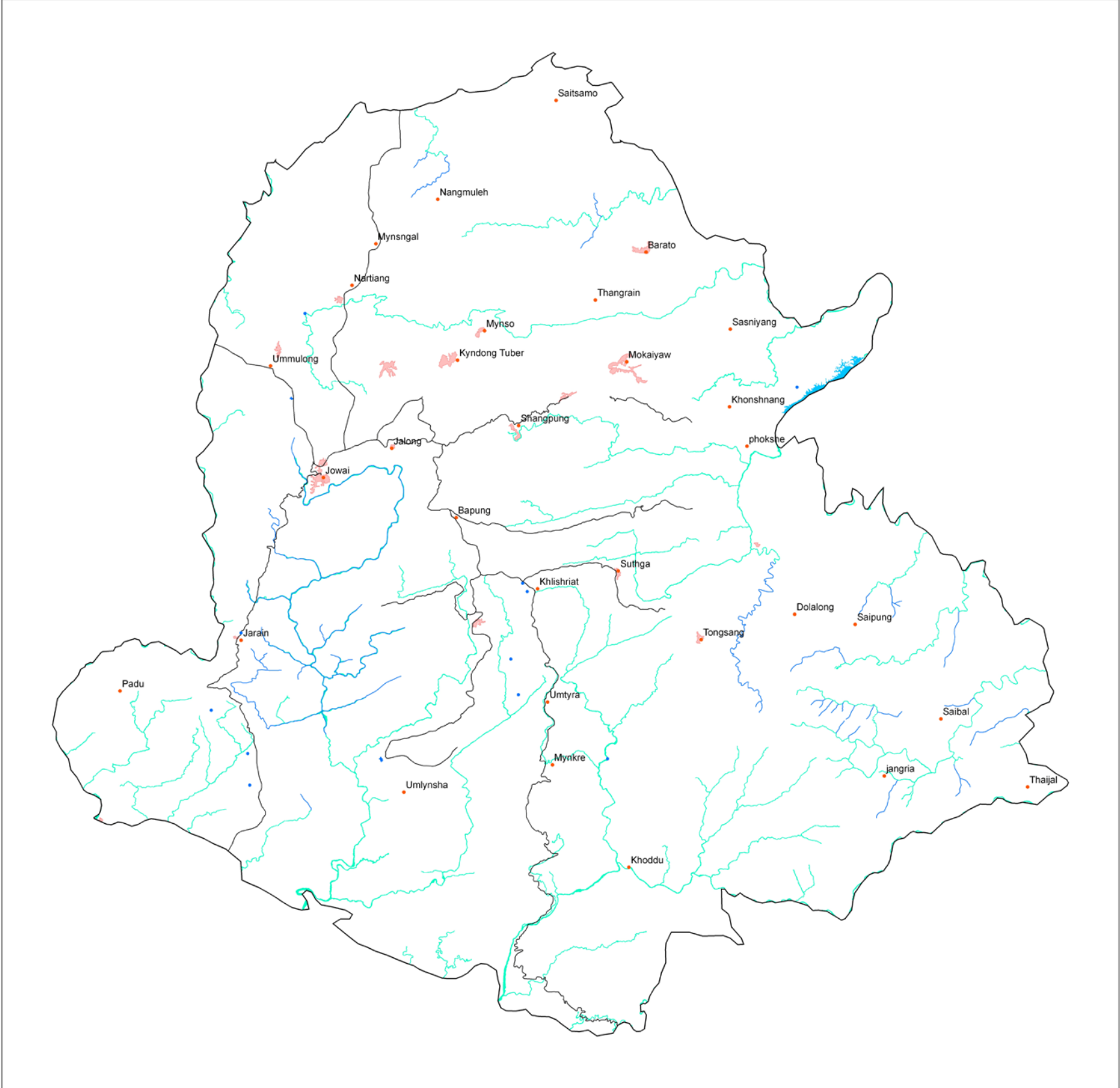
Jaintia Hills being a component of the Meghalaya Plateau has its physiographical features almost similar to that of Khasi Hills. The only difference is that Jaintia Hills has comparably more flat topography with a mild gradient. The Hills gently slope towards Brahmaputra valley of Assam in the North and meet up the gentle plains of Bangladesh in the South. The Marangsih peak on the Eastern plateau of Jaintia Hills stands majestically at the elevation of 1631 meters from the mean sea level of Karachi and is the highest peak in the entire district. The main elevation of the district ranges between 1050m to 1350m with Jowai which was established in the year 1972 as its Headquarter lies on the central plateau. In general, the whole district is full of rugged and undulating terrains with the exception of the deep gorges and narrow valleys carved out by the rivers. The Jaintia Hills is richly endowed with natural resources. Jaintia Hills have large deposits of coal and rich deposits of other mineral resources. Cement factory, coffee plantations, handloom, fisheries and by-products of fruit are other means of income for the people of Jaintia. The total geographic area of Jaintia Hills district of Meghalaya is 379347 ha. The wetland area estimated is 4302 ha. Small wetlands, which are less than minimum mapable units (MMU), are 11 in the district. Details are given in Table 75. The major wetland types are River/Stream and Reservoirs/Barrages.

Table 75: Area estimates of wetlands in Jaintia Hills

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1106	River/Stream	133	4019	93.42	3186	3185
	1200	Inland Wetlands -Man-made					
2	1201	Reservoirs/Barrages	1	260	6.04	259	199
3	1202	Tanks/Ponds	2	12	0.28	11	12
		Sub-Total	136	4291	99.74	3456	3396
		Wetlands (<2.25 ha), mainly Tanks	11	11	0.26	-	-
		Total	147	4302	100.00	3456	3396

Area under Aquatic Vegetation	-	-
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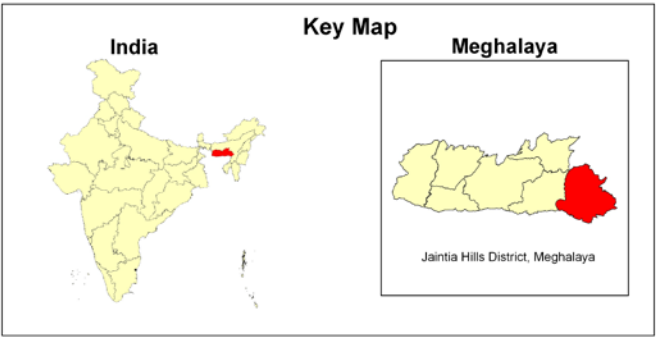
Area under turbidity levels		
Low	3185	3184
Moderate	234	212
High	38	-



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

Legend

- Wetlands (<2.25ha)
- Drainage (line)
- Major Roads
- Settlements
- District Boundary
- Towns/Settlements



8 4 0 8 16 Kilometers

Data Source :
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7.8 ASSAM

Area estimates of various wetland categories for Assam have been carried out using GIS layers of wetland boundary, water-spread, aquatic vegetation and turbidity. Total 5097 wetlands have been mapped at 1:50,000 scale in the state. In addition, 6081 small wetlands (< 2.25 ha) have also been identified. Total wetland area estimated is 764372 ha that is around 9.74 per cent of the geographic area (Table-76). Natural wetlands dominate the state. The major wetland types are River/Stream accounting for 84 percent of the wetlands (637164 ha), Lake/Ponds (51257 ha), waterlogged (47141 ha) and Ox-bow lakes (14173 ha). There are two Reservoir/Barrages mapped with 2833 ha area, which is the major man made wetland type. Graphical distribution of wetland type is shown in Figure 26.

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

Table-76: Area estimates of wetlands in Assam

						Area in ha	
Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	1175	51257	6.71	34408	14526
2	1102	Ox-bow lakes/ Cut-off meanders	873	14173	1.85	7721	5848
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	139	4258	0.56	1669	942
5	1105	Waterlogged	2461	47141	6.17	33660	12630
6	1106	River/Stream	213	637164	83.63	342197	353756
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	2	2833	0.37	2185	1346
8	1202	Tanks/Ponds	180	921	0.12	892	801
9	1203	Waterlogged	54	544	0.07	336	303
		Sub-Total	5097	758291	99.20	423068	390152
		Wetlands (<2.25 ha), mainly Tanks	6081	6081	0.80	-	-
		Total	11178	764372	100.00	423068	390152

Area under Aquatic Vegetation	36817	76036
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Area under turbidity levels		
Low	64137	22834
Moderate	358429	366654
High	502	664

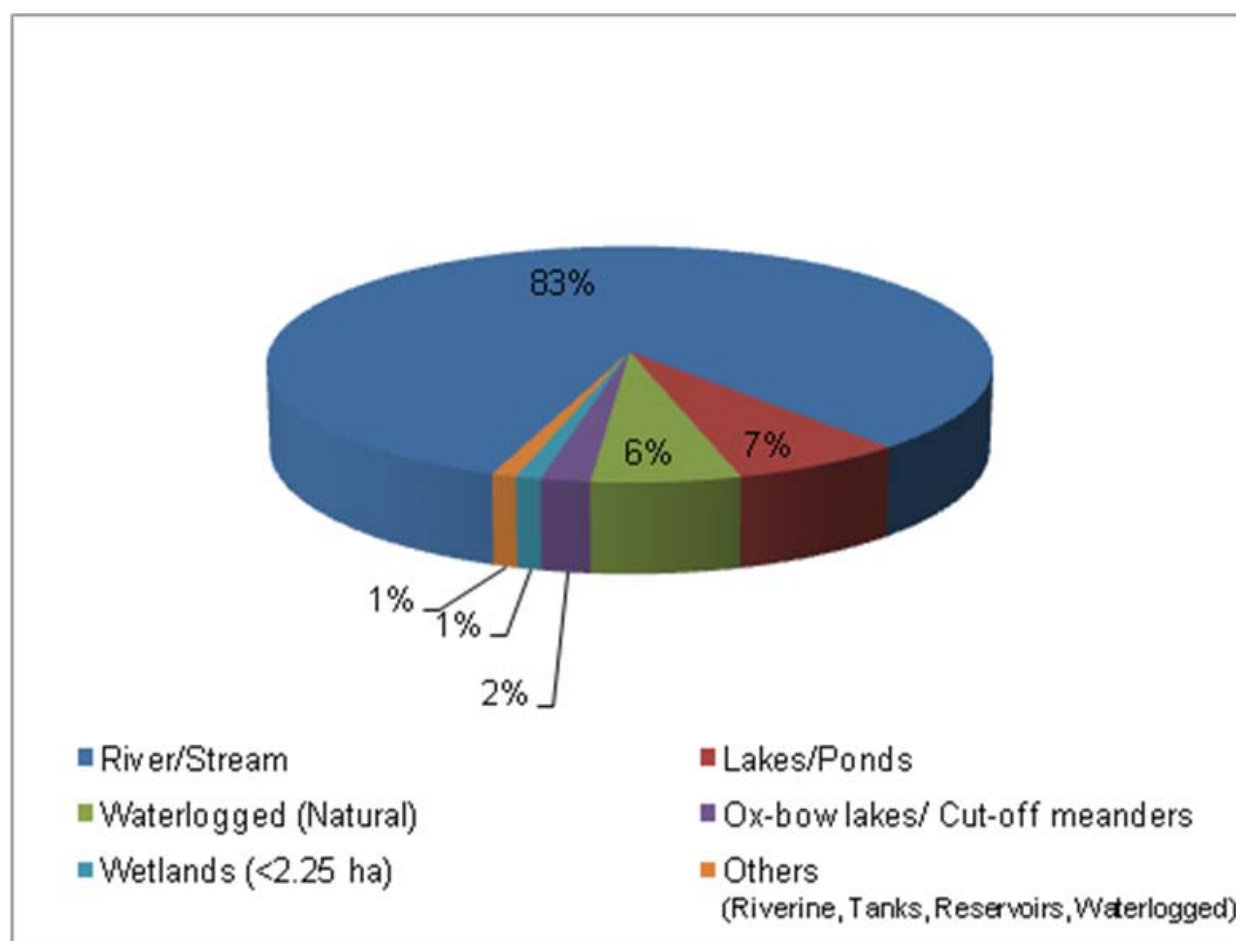


Figure 26: Type-wise wetland distribution in Assam

There are 23 administrative districts. The geographic area of the districts varies from 1317 sq.km (Hailakandi) to 10434 sq.km (Karbi Anglong) (Table- 5). The wetlands occupy as high as 21.43% of geographic area (Dibrugarh district), and as low as 1.35% (North Cachar Hills). In terms of total wetland area (% wetland area), Sonitpur is the leading district (83427 ha, 10.9%) and Hailakandi is the least (2600 ha, 0.34%).

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

District-wise wetland area estimates is given in Table-77. Figure 27 shows district-wise graphical distribution of wetlands. Wetland statistics followed by wetland map and corresponding satellite data for each district is given to have a fairly good idea about the distribution pattern and density of wetlands in the district.

Table-77: District-wise wetland distribution in Assam

District code	District	Geographic Area	Wetland Area	% of total wetland area	% of district geographic area	Open water		Aquatic Vegetation	
						Post-monsoon	Pre-monsoon	Post-monsoon	Pre-monsoon
		(sq. km.)	(ha)		(ha)	(ha)	(ha)	(ha)	(ha)
1	Kokrajhar	3129	24833	3.25	7.94	23266	22659	0	0
2	Dhubri	2838	56538	7.40	19.92	41072	37695	0	10
3	Goalpara	1824	33221	4.35	18.21	20348	20065	1901	2670
4	Bongaigaon	2510	22149	2.90	8.82	14933	14221	1571	2353
5	Barpeta	3245	59038	7.72	18.19	31162	29407	1187	2967
6	Kamrup	4345	43655	5.71	10.05	25106	18443	2992	9833
7	Nalbari	2257	20140	2.63	8.92	12049	10700	460	1811
8	Darrang	3481	48983	6.41	14.07	27631	26184	917	2288
9	Marigaon	1704	28737	3.76	16.86	17302	9875	2328	10118
10	Nagaon	3831	35695	4.67	9.32	28826	13580	5271	18235
11	Sonitpur	5324	83427	10.91	15.67	33705	30189	2203	2489
12	Lakhimpur	2277	27307	3.57	11.99	13739	13664	971	836
13	Dhemaji	3237	33468	4.38	10.34	12195	13118	2812	2724
14	Tinsukia	3790	40626	5.31	10.72	17712	22854	3570	2974
15	Dibrugarh	3381	72461	9.48	21.43	28240	36733	1769	1899
16	Sibsagar	2668	12582	1.65	4.72	7101	6773	2403	2458
17	Jorhat	2851	45979	6.02	16.13	18094	17287	3357	2586
18	Golaghat	3502	43635	5.71	12.46	21726	24363	1437	2304
19	Karbi Anglong	10434	5810	0.76	0.56	4802	4648	306	536
20	North Cachar Hills	4888	6619	0.87	1.35	6004	4385	634	1487
21	Cachar	3786	10419	1.36	2.75	10023	8286	137	1872
22	Karimganj	1809	6450	0.84	3.57	5548	2857	527	3206
23	Hailakandi	1327	2600	0.34	1.96	2484	2166	64	380
	Total	78438	764372	100.00	9.74	423068	390152	36817	76036

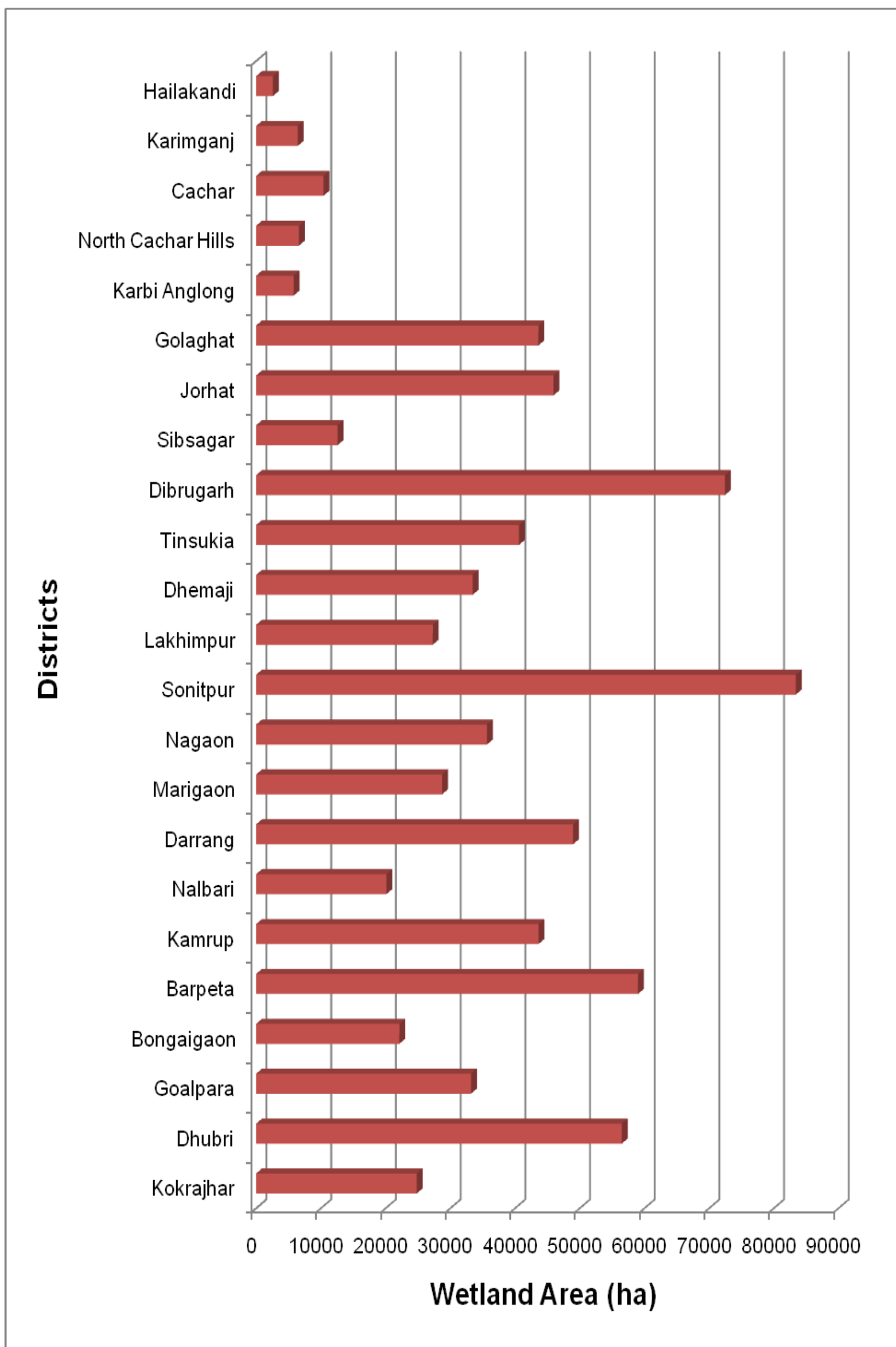
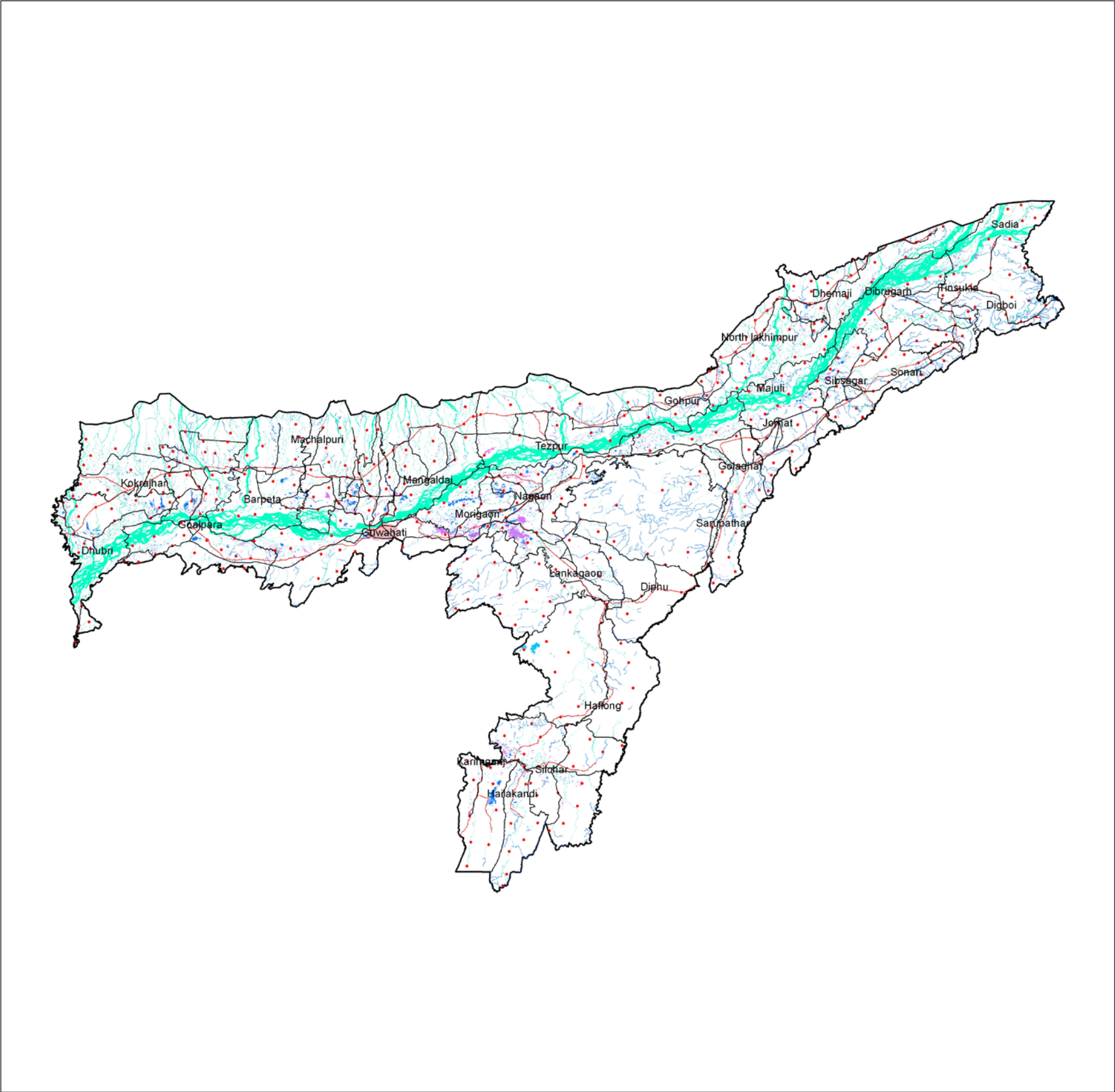
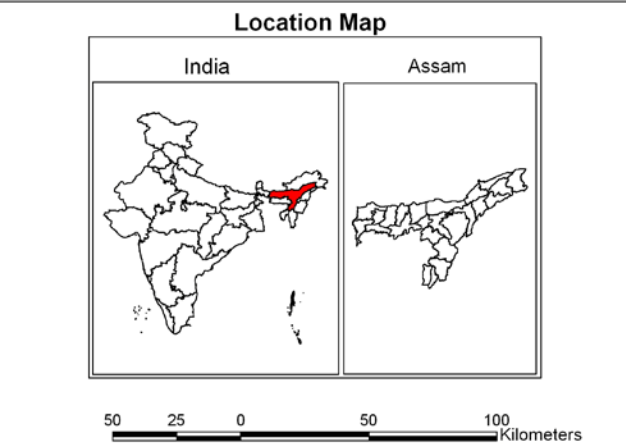


Figure 27: District-wise wetland distribution in Assam



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

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



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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

Sponsored By:
Ministry of Environment and Forests
Government of India

7.8.1 Kokrajhar

Kokrajhar district is situated in the lower Brahmaputra valley of Assam between 26° 20'N and 26° 45'N latitudes and 89° 45'E and 91° 00'E longitudes. It occupies 3,49,800 hectares of area. The district is bounded by the inter state boundary of West Bengal on the west and Bhutan in the north. The topography of the district is almost flat, with elevations ranging from 303 meter above m.s.l. in the north and 18 metre above m.s.l. in the south. The major rivers flowing through the district are Gaurang, Ai and Sankosh. All the rivers originate from Bhutan hills and flow into the Brahmaputra. The soil in the hillocks is old mountain valley alluvial and in the foot hills, it is mainly sandy to loamy textured soils. The soil pH ranges from 4.7 to 7.8 i.e. acidic in nature. During monsoon it receives an average rainfall of 248 mm, while in the post monsoon season 280 mm. The maximum and minimum temperatures in the district are 38°C and 10°C respectively. As per Census Report, 2001, the district has a total population of 9, 05,764.

Natural Inland wetlands dominated the district. Total area under wetland is 24833 ha, which includes 152 small wetland (<2.25 ha). River/stream occupies 91.3% of wetlands, followed by Lakes/pond (1.84%) and Waterlogged (1.28%). Under man made wetland type, only one Tank/pond is mapped with 33 ha area. Details of the wetland statistics of the district is given in Table-78.

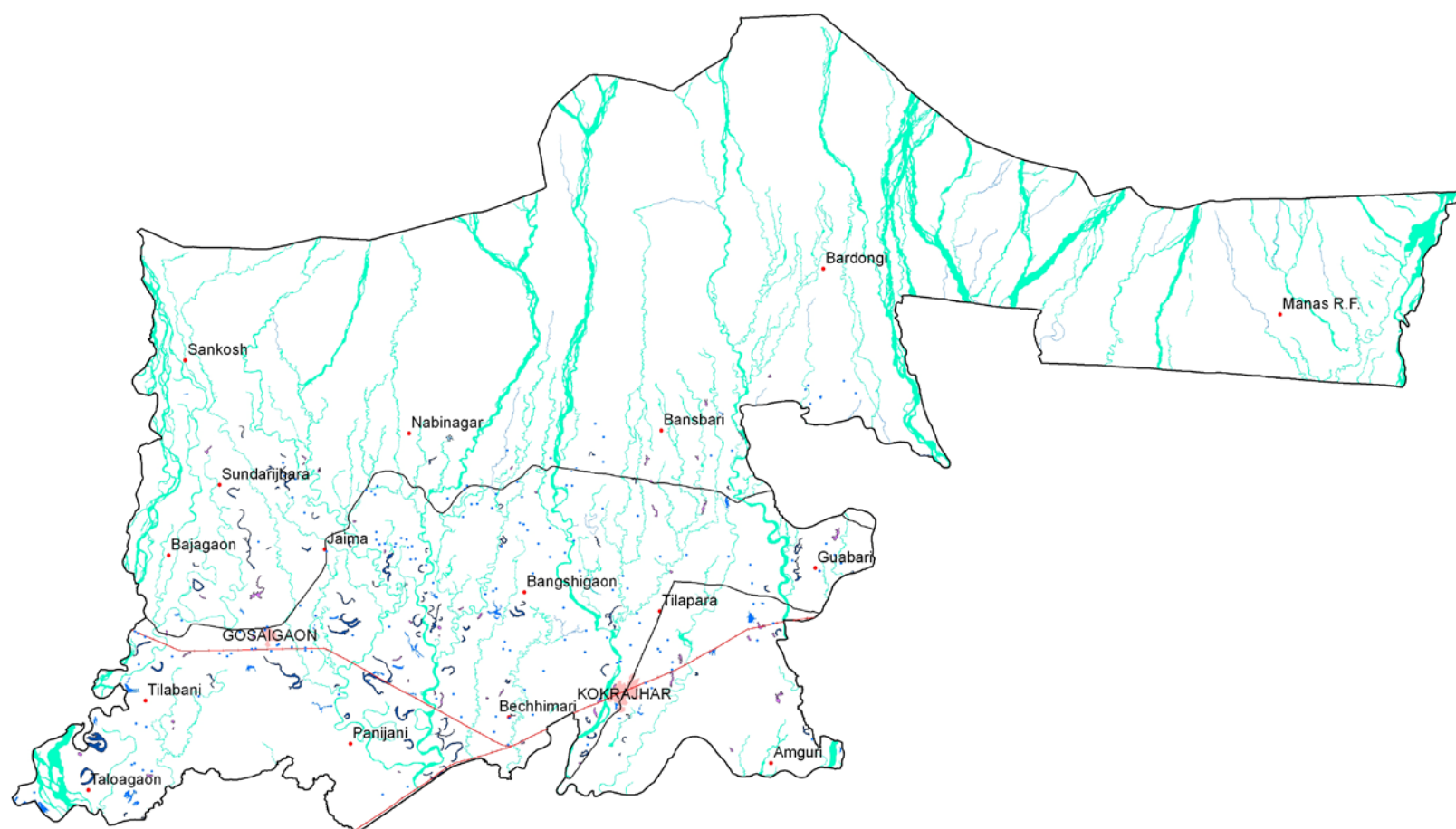
Aquatic vegetation is not observed in wetlands. Seasonal fluctuation of open water spread is negligible. Qualitative turbidity of water is moderate in both the seasons.

Table-78: Area estimates of wetlands in Kokrajhar

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	37	457	1.84	243	145
2	1102	Ox-bow lakes/ Cut-off meanders	76	1160	4.67	679	331
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	6	32	0.13	32	6
5	1105	Waterlogged	57	318	1.28	214	81
6	1106	River/Stream	105	22681	91.33	22067	22077
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	1	33	0.13	31	19
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	282	24681	99.39	23266	22659
		Wetlands (<2.25 ha), mainly Tanks	152	152	0.61	-	-
		Total	434	24833	100.00	23266	22659

Area under Aquatic Vegetation	-	-
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Area under turbidity levels		
Low	250	161
Moderate	23016	22489
High	-	9

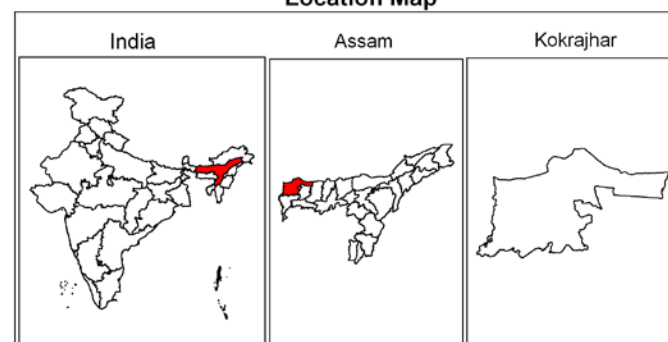


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



8 4 0 8 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
Assam Remote Sensing Applications Centre, Guwahati
Sponsored By:
Ministry of Environment and Forests
Government of India

7.8.2 Dhubri

The district is situated in the extreme south western part of the lower Brahmaputra valley of Assam between 25°30'N and 26°30'N latitude and 89°40'E and 90°30'E longitude, with an area of 2, 67,572 hectares. The district is characterised by almost flat topography but the eastern part has an undulating topography. The drainage system is dominated by the Brahmaputra river that flows through the district with a sharp south turn in the extreme west end of the district. The northern part is having a number of tributaries of the Brahmaputra namely Champamati, Gourang, Tipkai, Godadhar and Sonkosh which are perennial in nature, originate from Bhutan and flow into the Brahmaputra towards south. Among the southern tributaries, the Jinjiram originates from Urad beel of Goalpara district and flows parallel to the Brahmaputra for some distance before joining further downstream. The soil in the northern part of the district is composed of Recent Riverine Alluvial soils (Entiso1s), and that of the lowermost part of the district is formed by Old Riverine Alluvial soils (Inceptiso1s). The soil pH of the district varies from 4.5 to 7.5 i.e. acidic to neutral. The annual average rainfall of the district is 2647, mm. The maximum and minimum temperature of the district is 38°C and 7°C respectively. As per 2001 Census, the district has a total population of 16, 37,344.

Total wetland area in the district is 56464 ha that includes 74 small wetlands (<2.25 ha). River/stream occupies 84.5% of wetlands. The second major wetland type is Lake/pond. There are 178 Lake/pond with 5967 ha area (10.55%). The other wetland types are: Ox-bow lakes (2.8%) and Waterlogged-natural (1.8%). Details of wetland statistics is given in Table.79.

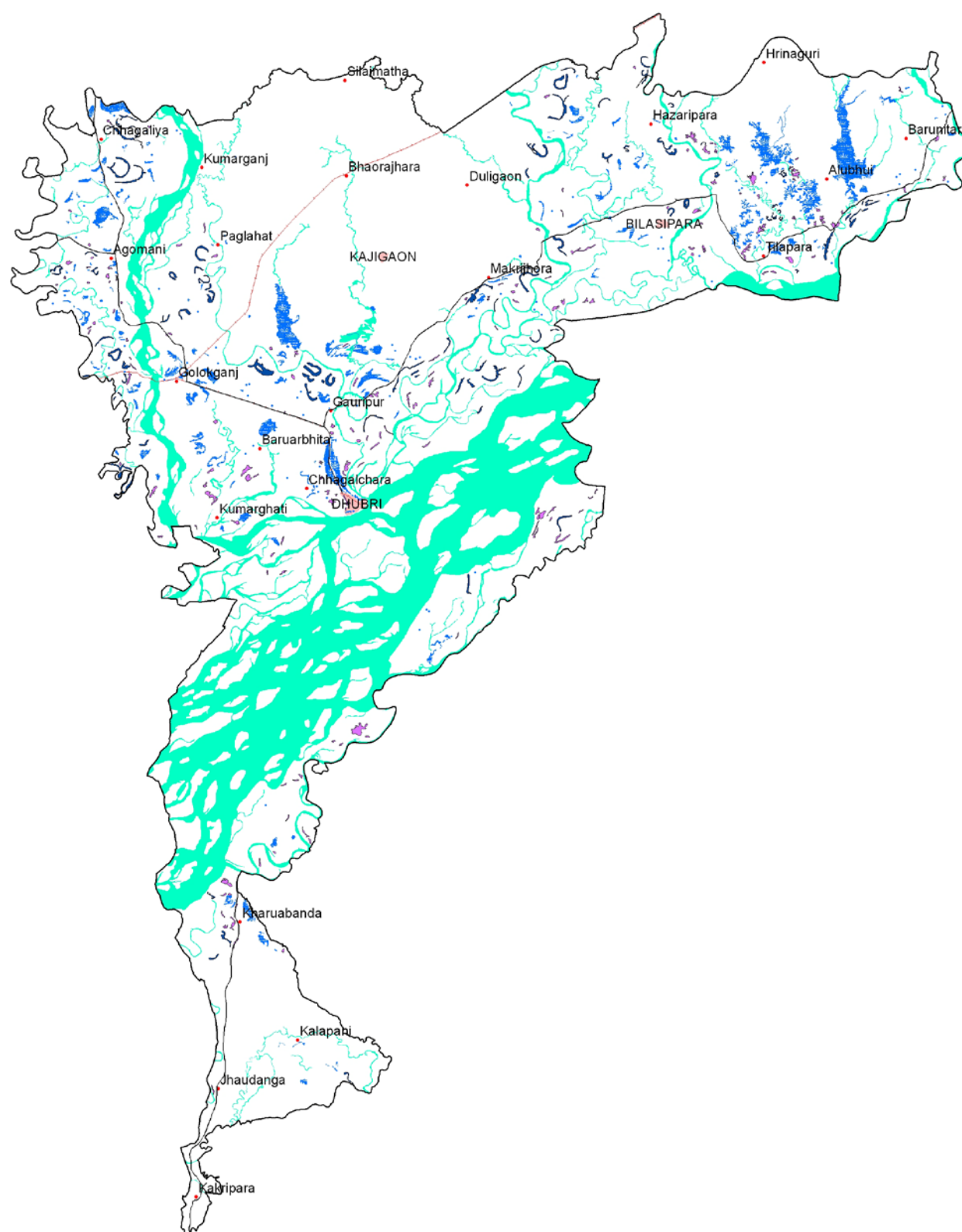
Aquatic vegetation is not observed in wetlands. The open water spread of River/stream is same in both the seasons. However, in case of Lake/pond wetland type, the open water is less (1690 ha) in pre monsoon compared to post monsoon (3703 ha). The turbidity of water is moderate in both the seasons.

Table-79: Area estimates of wetlands in Dhubri

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	178	5967	10.55	3703	1690
2	1102	Ox-bow lakes/ Cut-off meanders	94	1597	2.82	1040	376
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	172	1102	1.95	785	86
6	1106	River/Stream	60	47793	84.53	35541	35541
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	2	5	0.01	3	2
9	1203	Waterlogged	-	-	-	-	-
		Sub-Total	506	56464	99.87	41072	37695
		Wetlands (<2.25 ha), mainly Tanks	74	74	0.13	-	-
		Total	580	56538	100.00	41072	37695

Area under Aquatic Vegetation	-	10
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Area under turbidity levels		
Low	4259	1758
Moderate	36813	35937
High	-	-

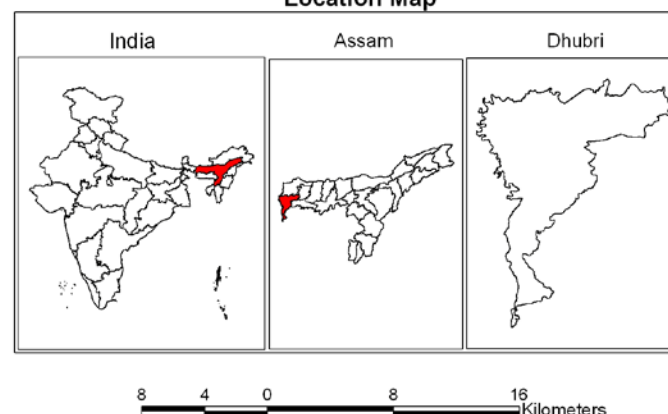


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
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Sponsored By:

Ministry of Environment and Forests
Government of India

7.8.3 Goalpara

Goalpara district is situated in the south western part of Assam between 25°53' N and 26° 30' N latitudes and 90°07' E and 91°05' E longitudes having 1,91,100 hectares of area. The Brahmaputra River is flowing along the northern boundary of the district in the east-west direction. The other two main rivers are Dudhnai and Jinjiram. Dhudnai and Krishnai rivers originating from hills of Meghalaya. The rivers are all perennial in nature. The topography of the district is characterised by an almost flat plain except for few hills with elevations ranging from 100 to 500 meters. The soils of the district consist of Newer Alluvium on the bank of the Brahmaputra and Older Alluvium near the hillocks and foot hills. The soil pH ranges from 5.5 to 6.8. The maximum temperature rises up to 33° C during July and August but the minimum temperature falls up to 7° C in January. The average annual rainfall in the district is 1614 mm. As per Census Report, 2001, the district has a total population of 8, 22,035 .A number of wetlands (locally called as Beels) viz. Urpad beel, Hasila beel and several artificial ponds exist in the district.

Total wetland area in the district is 33221 ha that includes 151 small wetlands (<2.25 ha). River/stream occupies 84.77% of wetlands. The other major wetland type is Waterlogged (7.1%) and Lake/pond (7.0%). There are 44 Lake/pond (locally called as Beels) with 2339 ha area. Ox-bow lakes occupied 195 ha area (0.59%). Details of wetland statistics is given in Table.80.

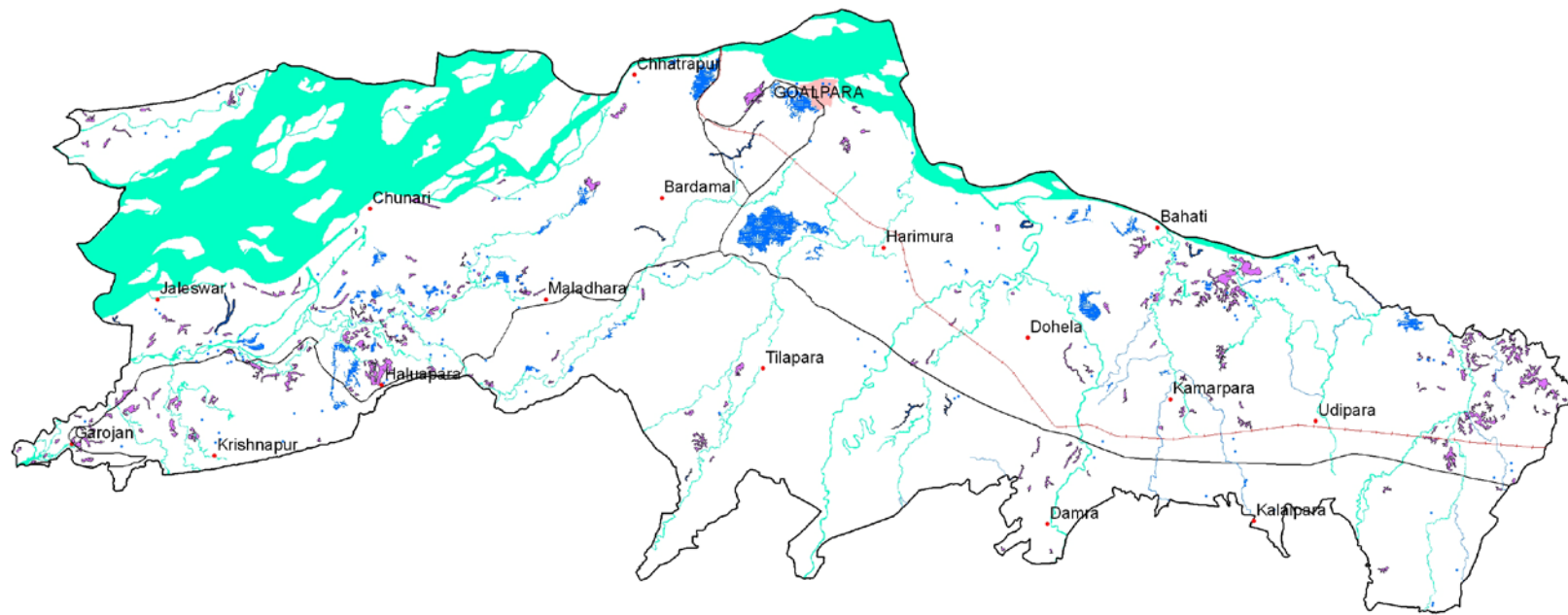
Aquatic vegetation is observed in Lake/pond, Waterlogged wetland types. The area under aquatic vegetation is slightly more in pre monsoon (2670 ha) than that of post monsoon (1901 ha). The open water spread of River/stream is same in both the seasons. However, in case of Lake/pond and Waterlogged wetland types, the open water is less in pre monsoon compared to post monsoon. The turbidity of water is mainly moderate in both the seasons.

Table-80: Area estimates of wetlands in Goalpara

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands – Natural					
1	1101	Lakes/Ponds	44	2339	7.04	1416	1173
2	1102	Ox-bow lakes/ Cut-off meanders	10	195	0.59	39	119
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	245	2374	7.15	1059	939
6	1106	River/Stream	41	28162	84.77	17834	17834
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
		Total - Inland	340	33070	99.55	20348	20065
		Sub-Total	340	33070	99.55	20348	20065
		Wetlands (<2.25 ha), mainly Tanks	151	151	0.45	-	-
		Total	491	33221	100.00	20348	20065

Area under Aquatic Vegetation	1901	2670
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Area under turbidity levels		
Low	1959	1887
Moderate	18389	18178
High	0	0

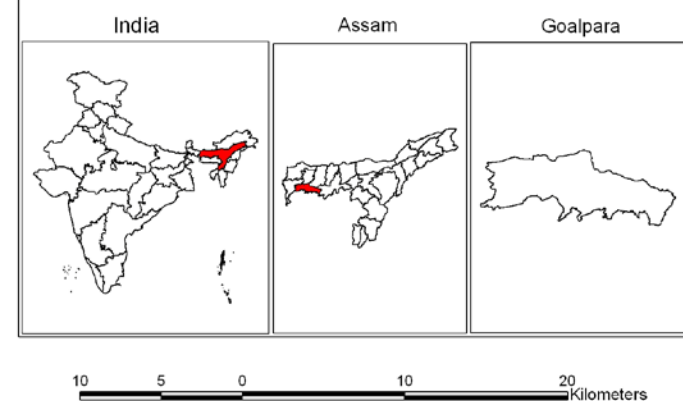


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



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

Prepared By :
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and
Assam Remote Sensing Applications Centre, Guwahati

Sponsored By:
Ministry of Environment and Forests
Government of India

7.8.4 Bongaigaon

The district is situated in the northwestern part of Assam between 26°10'N and 26°45'N latitudes and 90°50'E and 91°00'E longitudes. It occupies 2, 15,900 hectares of area. It is bounded on the east by Barpeta and on the west by Dhubri district. The topography of the district is n almost flat plain except for few hills with elevations ranging from 100 to 500 metres. The Brahmaputra River flows along the southern part of the district. The other two main rivers are Manas and Ai. Both the rivers rise on the hills of Bhutan, The Rivers are perennial in nature. There are considerable flood prone areas in the district, caused mainly due to inundation by overflowing rivers and congestion of rain water run off from the land side. A number of beels (natural lakes) exist in the district viz. Tamranga , Konara and Dalani. Several artificial ponds are also seen in the district. The soils of the district consist of Newer Alluvium on the bank of the Bramhaputra and Older Alluvium near the hillocks and foot hills. The soil pH ranges from 5.5 to 6.8. The average annual rainfall in the district is 1,614 mm. The maximum temperature rises up to 33° C during July and August but the minimum temperature falls up to 7° C in January. As per Census Report, 2001, the district has a total population of 9, 04,835.

Total wetland area in the district is 22149 ha that includes 71 small wetlands (<2.25 ha). River/stream occupies 84.25% of wetlands. The other major wetland type is Lake/pond (11.37%) and Waterlogged-natural (4.68%). There are 31 Lake/pond (locally called as Beels) with 2519 ha area. Ox-bow lakes occupied 519 ha area (2.34%). Details of wetland statistics is given in Table.81.

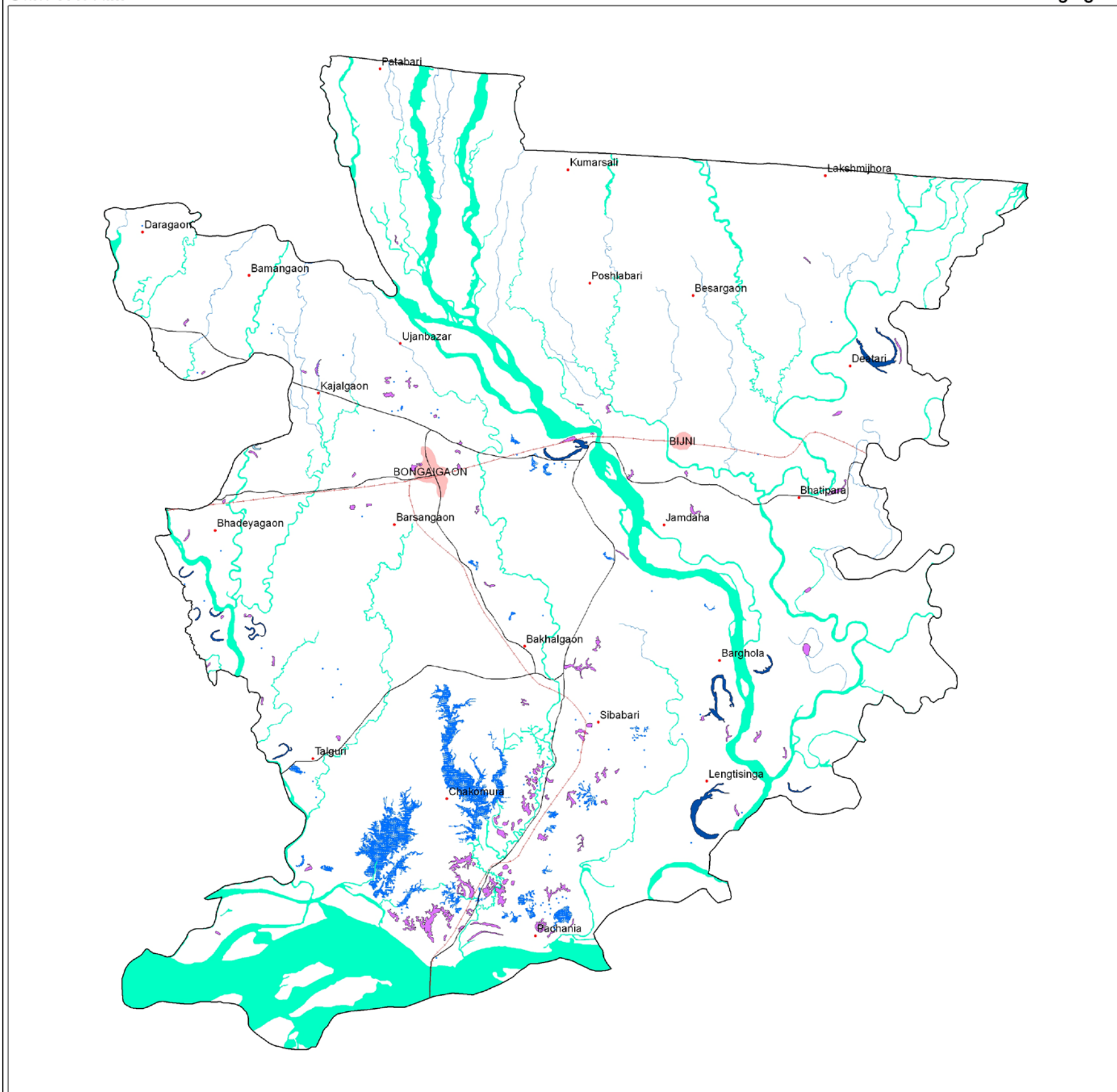
Aquatic vegetation is observed in Lake/pond, waterlogged wetland types. The area under aquatic vegetation is slightly more in pre monsoon (2353 ha) than that of post monsoon (1571 ha). The open water spread of River/stream is same in both the seasons. However, in case of Lake/pond and Waterlogged wetland types, the open water is less in pre monsoon compared to post monsoon. The turbidity of water is mainly moderate in both the seasons.

Table-81: Area estimates of wetlands in Bongaigoan

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	31	2519	11.37	1781	1224
2	1102	Ox-Bow Lakes/Cutt-Off Meanders	13	519	2.34	203	141
3	1103	High altitude Wetlands	-	-	-	-	-
4	1104	Riverine Wetlands	2	8	0.04	6	0
5	1105	Waterlogged	104	1036	4.68	449	362
6	1106	River/Stream	47	17996	81.25	12494	12494
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
		Sub-Total	197	22078	99.68	14933	14221
		Wetlands (<2.25 ha), mainly Tanks	71	71	0.32	-	-
		Total	268	22149	100.00	14933	14221

Area under Aquatic Vegetation	1571	2353
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Area under turbidity levels		
Low	1567	1583
Moderate	13366	12638
High	-	-

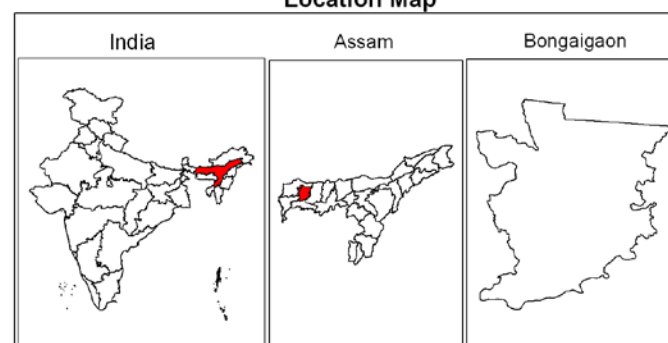


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



Data Source :

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

Prepared By :

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Sponsored By :

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7.8.5 Barpeta

The district is situated in the lower Brahmaputra valley of Assam between 26°5'N and 26°51 'N latitudes and 90°38'E and 91°20'E longitudes. It occupies 320704 hectares of area. It is bounded by Nalbari District on the east and its north boundary is marked by the kingdom of Bhutan. The district is characterised by almost plain topography with the highest elevation of 200 m above m.s.l. in north, while in the south it is below 18 m above m.s.l. The rivers flowing through the district are Tihu, Kaldia, Pahumara, Palla, Beki and Bhalukadoba which originate from Bhutan hills and are perennial in nature. The southern side of the district is very low lying and is frequently subjected to flood. Besides these, there are a number of small streams, abandoned channels and marshy lands. The major soil groups are Recent Riverine Alluvial Soil (Entisols), Old Riverine Alluvial soils (Inceptisols) and Old Mountain Valley Alluvial soils (Alfisols). The general pH value of the soils of the district varies from 4.5 to 7.3 i.e. acidic to neutral. The area receives an average rainfall of 1409 mm. The maximum and minimum temperatures recorded for the district are 35°C and 7°C respectively. As per Census Report, 2001, the district has a total population of 16, 47,201.

Total wetland area in the district is 59038 ha that includes 195 small wetlands (<2.25 ha). River/stream occupies 93.22% of wetlands. The other major wetland type is Lake/pond (4.48%) and Waterlogged (1.57%). There are 37 Lake/pond (locally called as Beels) with 2644 ha area. Ox-bow lakes occupied 235 ha area (0.4%). Details of wetland statistics is given in Table.82.

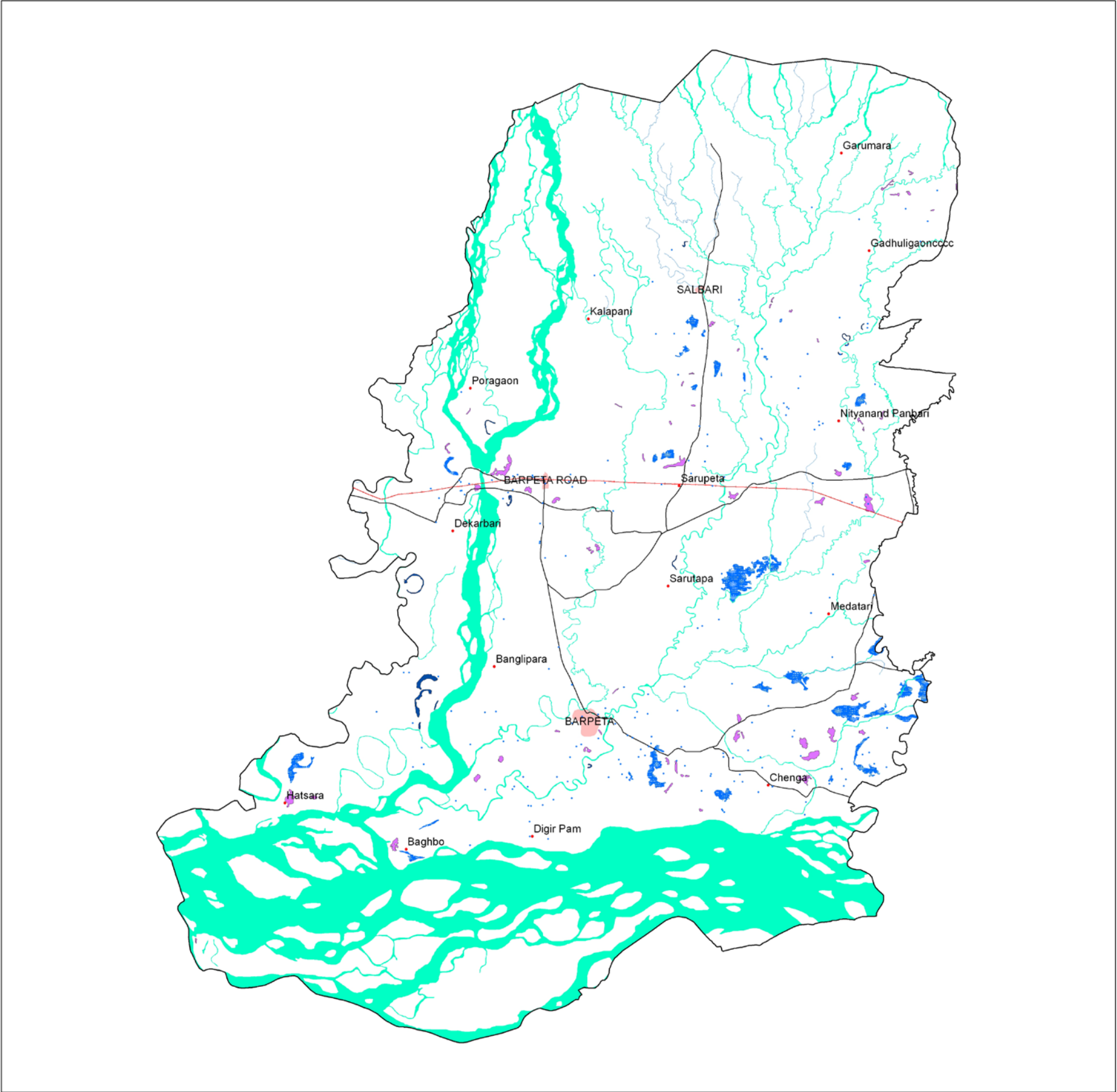
Aquatic vegetation is observed in Lake/pond, waterlogged wetland types. The area under aquatic vegetation is slightly more in pre monsoon (2967 ha) than that of post monsoon (1187 ha). The open water spread of River/stream is same in both the seasons. However, in case of Lake/pond and Waterlogged wetland types, the open water is less in pre monsoon compared to post monsoon. The turbidity of water is mainly moderate in both the seasons.

Table-82: Area estimates of wetlands in Barpeta

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	37	2644	4.48	1730	589
2	1102	Ox-bow lakes/ Cut-off meanders	14	235	0.40	214	67
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	62	927	1.57	676	209
6	1106	River/Stream	44	55037	93.22	28542	28542
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
		Sub-Total	157	58843	99.67	31162	29407
		Wetlands (<2.25 ha), mainly Tanks	195	195	0.33	-	-
		Total	352	59038	100.00	31162	29407

Area under Aquatic Vegetation	1187	2967
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Area under turbidity levels		
Low	2468	511
Moderate	28694	28896
High	-	-



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

Legend

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

Location Map

India

Assam

Barpeta

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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

Sponsored By:
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7.8.6 Kamrup

The district is situated in the lower Brahmaputra valley of Assam between 25°44' N and 26°51'N latitudes and 90°56'E and 92°10' E longitudes, with total area of 4,35,009 hectares. It is bounded by Darrang and Nagaon district on the east and the northern boundary is marked by the Kingdom of Bhutan and the Southern boundary is covered by Meghalaya State. The northern and southern parts of the district are characterised by hill ranges. The middle portion of the district, being a part of the Brahmaputra valley, is characterised by almost plain topography. The drainage system of the district is represented by the river Brahmaputra and its tributaries, namely Barnadi, Puthimari, Sessa Noi, Baralia and Nona. All these rivers originate from the Bhutan hills and subsequently flow into the Brahmaputra. Several rivers originating from the Khasi hills in the south, namely Digaru, Kulsi, Kukurmara, Boko and Singra also flow into the Brahmaputra. The general pH value of the soils of the district varies from 4.5 to 6.2. The average rainfall is 2124 mm. The maximum and minimum temperatures recorded in the district are 35°C and 6°C respectively. As per Census Report, 2001, the district has a total population of 25, 22,324.

Total wetland area in the district is 43655 ha that includes 228 small wetlands (<2.25 ha). River/stream occupies 68.29% of wetlands. The other major wetland type is Lake/pond (14.25%) and Waterlogged (15.51%). There are 74 Lake/pond (locally called as Beels) with 6220 ha area. The other wetland types are: Ox-bow lakes (0.62%) and Riverine (0.71%). Details of wetland statistics is given in Table.83.

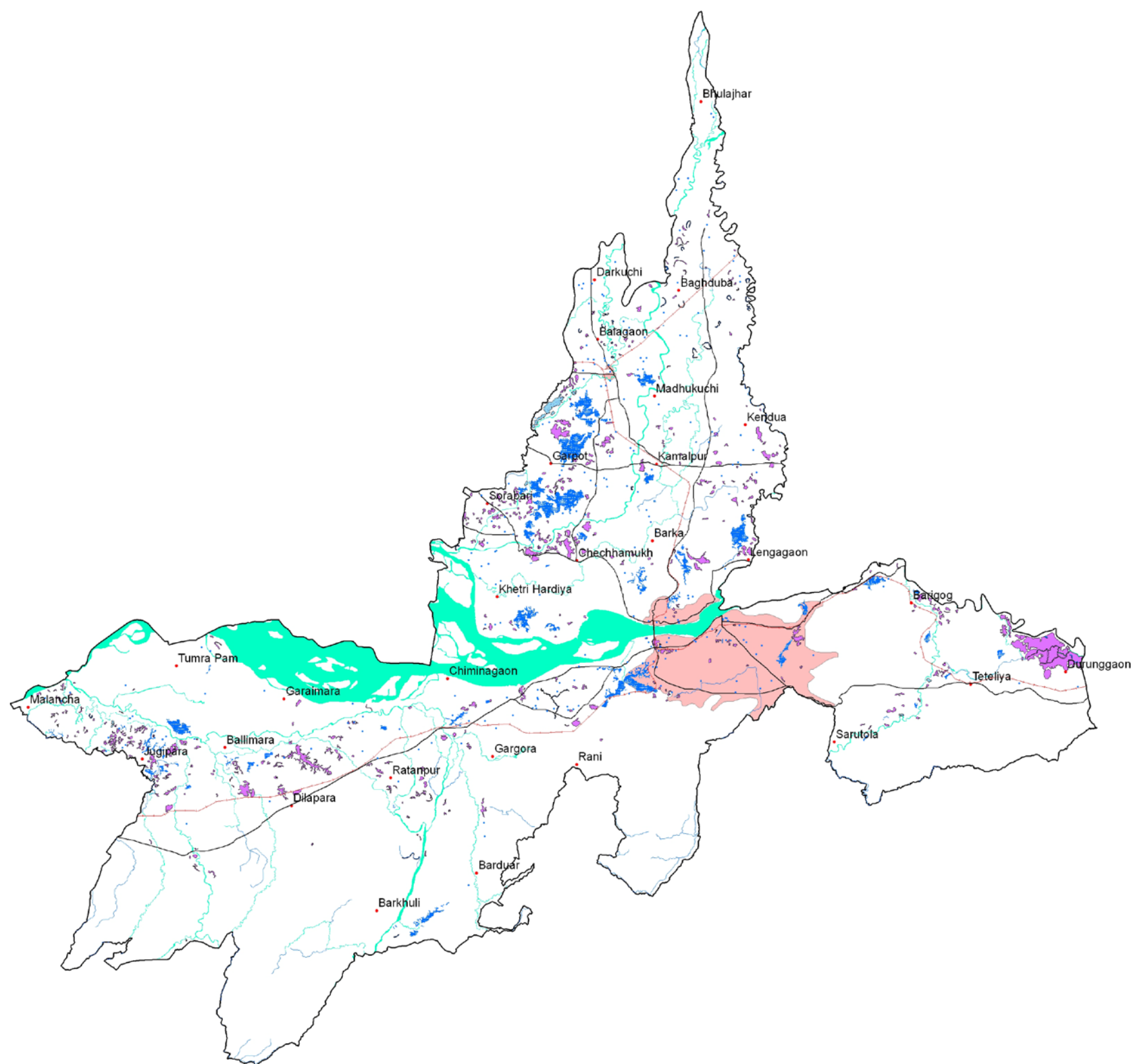
Aquatic vegetation is observed in Lake/pond, Waterlogged wetland types. The area under aquatic vegetation is significantly high in pre monsoon (9833 ha) than that of post monsoon (2992 ha). The open water spread of River/stream is same in both the seasons. However, in case of Lake/pond and Waterlogged wetland types, the open water is less in pre monsoon compared to post monsoon. The turbidity of water is moderate to low in both the seasons

Table-83: Area estimates of wetlands in Kamrup

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Pond	74	6220	14.25	4082	1369
2	1102	Ox-Bow Lakes/ Cut-Off Meanders	36	271	0.62	209	114
3	1103	High altitude Wetlands	-	-	-	-	-
4	1104	Riverine Wetlands	11	310	0.71	225	56
5	1105	Waterlogged	441	6769	15.51	6036	2361
6	1106	River/Stream	41	29813	68.29	14512	14512
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/ Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	11	44	0.10	42	31
9	1203	Waterlogged	-	-	-	-	-
		Sub-Total	614	43427	68.39	25106	18443
		Wetlands (<2.25 ha), mainly Tanks	228	228	0.52	-	-
		Total	842	43655	68.92	25106	18443

Area under Aquatic Vegetation	2992	9833
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Area under turbidity levels		
Low	10188	3148
Moderate	14918	15246
High	-	49

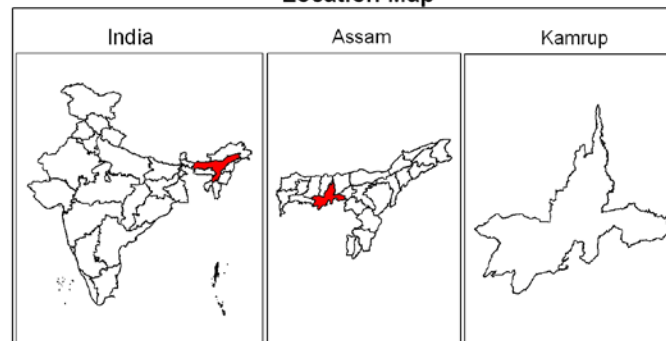


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
1101				Lakes/Ponds
1102				Ox-bow lakes/ Cut-off meanders
1103				High altitude wetlands
1104				Reverine wetlands
1105				Waterlogged
1106				River/Stream
			Man-made	
1201				Reservoirs/Barrages
1202				Tanks/Ponds
1203			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

Legend

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

Location Map



10 5 0 10 20 Kilometers

Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

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Ministry of Environment and Forests
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7.8.7 Nalbari

The district is situated in the lower Brahmaputra valley of Assam between 26°07'N and 26°51'N latitude and 91°13'E and 91°43'E longitude. It occupies 221844 hectares area. The district is characterised by almost plain topography with the highest elevation in the north is 219.6 m. above MSL and that in the south below 18 m. above m.s.l.. All the rivers are perennial in nature. The rivers flowing through the district are Pagladia, Nona, Baralia, Mara Pagladia and Buradia. All these rivers originate from Bhutan hills. There are some small streams, abandoned channels and marshy lands existing in the district. The soil texture of the north zone in the district is clay loam and that of south zone sandy loam. The soil pH varies from 4.5 to 7.0 i.e. acidic to neutral. The maximum and minimum temperatures are 35°C and 6°C respectively. The normal rainfall in the district is 2685.5 mm. As per Census Report, 2001, the district has a total population of 11,48,824.

Total wetland area in the district is 20140 ha that includes 239 small wetlands (<2.25 ha). River/stream occupies 87.92% of wetlands. The other major wetland type is Lake/pond (2.63%) and Waterlogged (6.92%). There are 15 Lake/pond (locally called as Beels) with 529 ha area. Details of wetland statistics is given in Table.84.

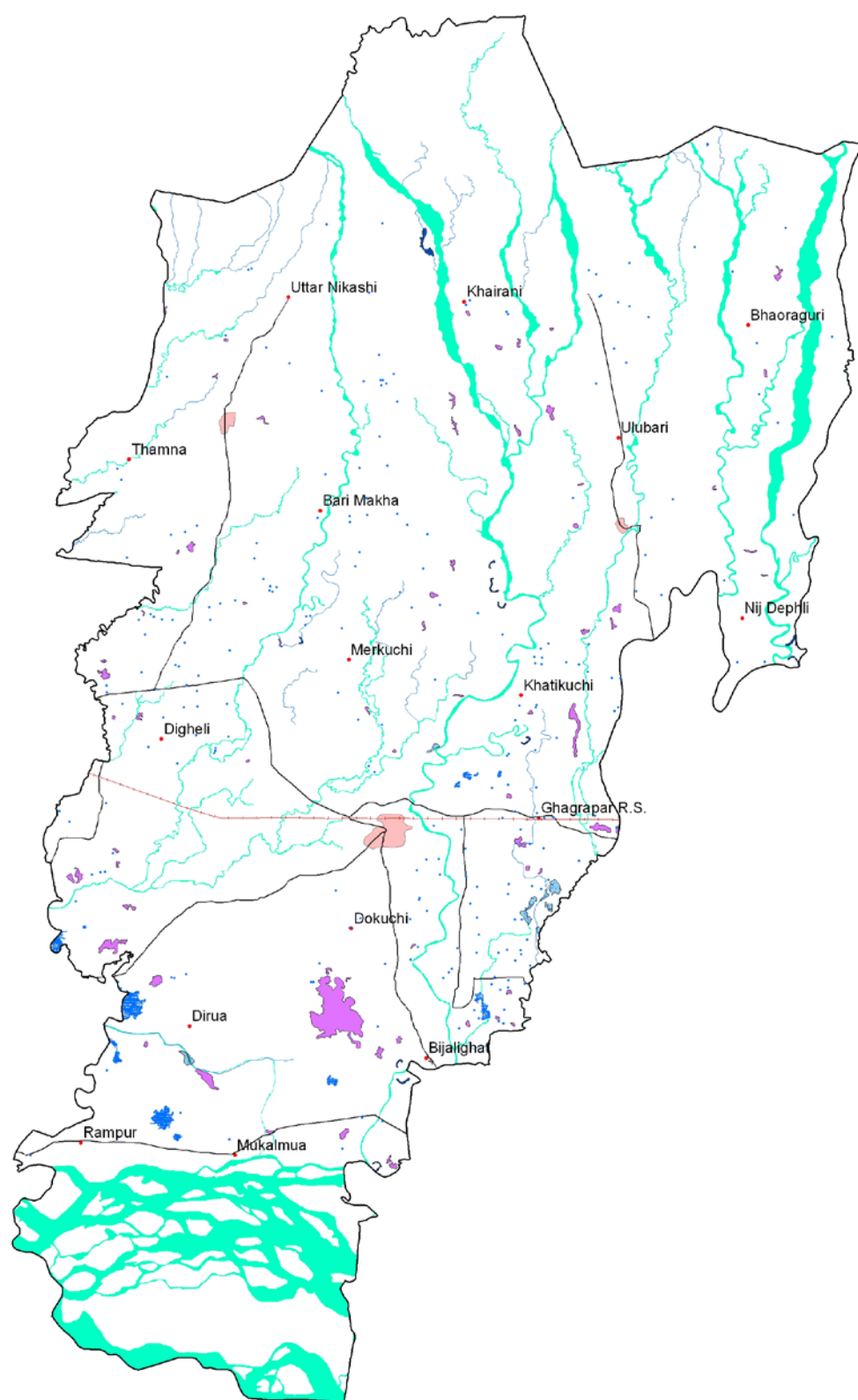
Aquatic vegetation is observed in Lake/pond, waterlogged wetland types. The area under aquatic vegetation is slightly more in pre monsoon (1811 ha) than that of post monsoon (460 ha). The open water spread of River/stream is same in both the seasons. However, in case of Lake/pond and Waterlogged wetland types, the open water is less in pre monsoon compared to post monsoon. The turbidity of water is mainly moderate in both the seasons

Table-84: Area estimates of wetlands in Nalbari

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	15	529	2.63	338	50
2	1102	Ox-Bow Lakes/ Cut-Off Meanders	12	104	0.52	94	76
3	1103	High altitude Wetlands	-	-	-	-	-
4	1104	Riverine Wetlands	8	160	0.79	82	16
5	1105	Waterlogged	75	1393	6.92	1212	237
6	1106	River/Stream	32	17707	87.92	10315	10315
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	3	8	0.04	8	6
9	1203	Waterlogged	-	-	-	-	-
		Sub-Total	145	19901	98.81	12049	10700
		Wetlands (<2.25 ha), mainly Tanks	239	239	1.19	-	-
		Total	384	20140	100.00	12049	10700

Area under Aquatic Vegetation	460	1811
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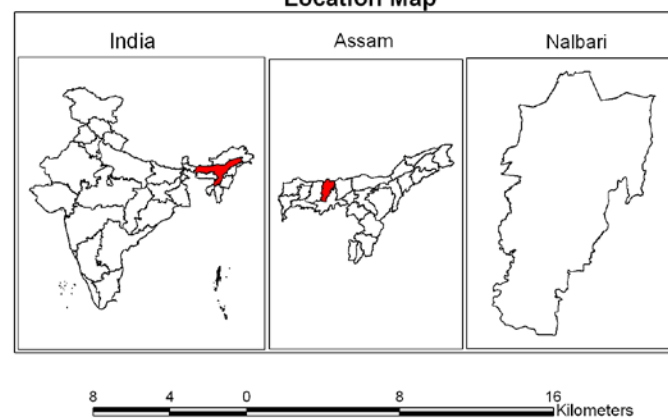
Area under turbidity levels		
Low	1725	163
Moderate	10324	10537
High	-	-



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

Legend

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

Location Map**Data Source :**

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

Sponsored By:

Ministry of Environment and Forests
Government of India

7.8.8 Darrang

The district is situated in the northern part of Assam State between 26°10'N and 26°58'N Latitudes and 91°43'E and 92°22'E longitudes. It occupies 341399 hectares of area. It is bounded on the east by Sonitpur district, on the north by Bhutan and Arunachal Pradesh and on the south by the river Brahmaputra. The topography of the district is almost flat Swampy areas and naturally depressed vast wetlands locally known as beels constitute a sizeable area. The major rivers that traverse through the district are Barnoi, Nanai, Noa-nai, Mangaldai nai, Mora Dhansiri and Dhansiri. The rivers are all perennial in nature. Both new Alluvium Soils (Entisols) and old Alluvium soils (Inceptisols) are found in the district. The average annual rainfall recorded is 1477.72 mm. The maximum temperature recorded is 35.6°C in the month of July-August and the minimum is 6°C in the months of December - January. As per Census Report, 2001, the district has a total population of 15, 04,320

Total wetland area in the district is 48983 ha that includes 450 small wetlands (<2.25 ha). River/stream occupies 93.44% of wetlands. The other major wetland type is Lake/pond (2.62%) and Waterlogged (1.95%). There are 14 Lake/pond (locally called as Beels) with 1282 ha area. Details of wetland statistics is given in Table.85.

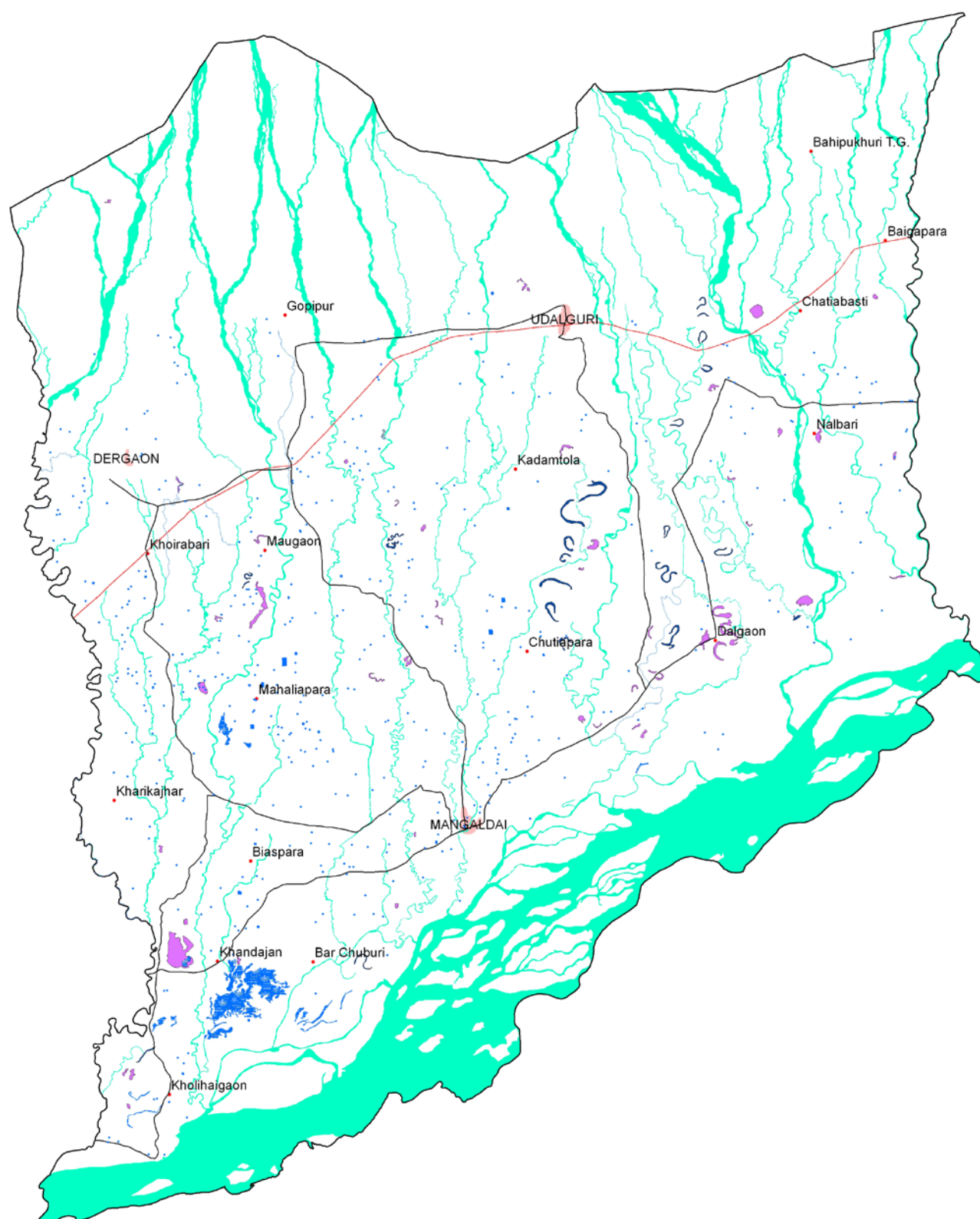
Aquatic vegetation is observed in Lake/pond, Waterlogged wetland types. The area under aquatic vegetation is slightly more in pre monsoon (2288 ha) than that of post monsoon (917 ha). The open water spread of River/stream is almost same in both the seasons. However, in case of Lake/pond and Waterlogged wetland types, the open water is less in pre monsoon compared to post monsoon. The turbidity of water is mainly moderate in both the seasons

Table-85: Area estimates of wetlands in Darrang

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	14	1282	2.62	810	77
2	1102	Ox-bow lakes/ Cut-off meanders	25	404	0.82	372	44
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	1	8	0.02	8	-
5	1105	Waterlogged	50	955	1.95	541	245
6	1106	River/Stream	40	45772	93.44	25788	25706
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	25	112	0.23	112	112
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	155	48533	99.08	27631	26184
		Wetlands (<2.25 ha), mainly Tanks	450	450	0.92	-	-
		Total	605	48983	100.00	27631	26184

Area under Aquatic Vegetation	917	2288
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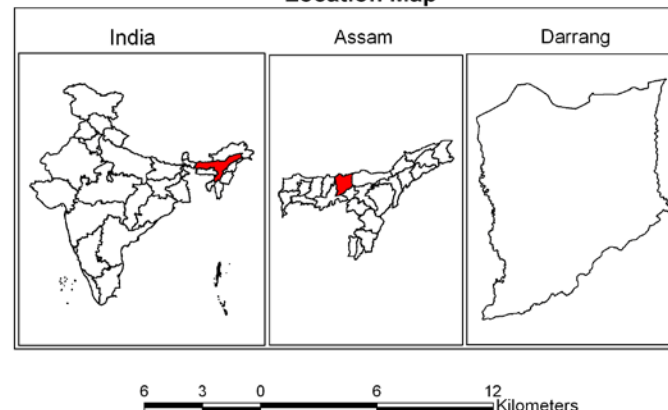
Area under turbidity levels		
Low	1844	308
Moderate	25787	25876
High	-	-



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

Legend

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

Location Map**Data Source :**

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

Sponsored By:

Ministry of Environment and Forests
Government of India

7.8.9 Marigaon

The district is situated in the Central Brahmaputra valley of Assam between 26° 00' N and 26° 40'N latitudes and 91° 59'E and 92° 35'E longitudes. It occupies 1, 91,100 hectares of area. It is bounded on the east by Nagaon district, on the west by Kamrup district, on the north by Darrang district and south by Karbi Anglong district. The topography of the district is almost flat plain. The Brahmaputra river flows on the northern side of the district. The flood plain along the river Brahmaputra and its tributaries suffer from regular floods during the rainy season. The other major rivers are Kapili, Kalang, Killing and Barapani. The rivers flowing through the district are all perennial in nature. A number of ox-bow lakes and ponds also exist in the district. Besides, there are many low lying areas and swamps. The soils of the district vary from sandy to clay loam and acidic to near neutral in nature. The normal rainfall in the district is 2000 mm. The average minimum and maximum temperatures are 8° C (in January) and 34.3° C (during July/Augus) respectively. As per Census Report, 2001, the district has a total population of 7, 76,256

Total wetland area in the district is 28737 ha that includes 158 small wetlands (<2.25 ha). River/stream occupies 57.65% of wetlands. The other major wetland type is Lake/pond (21.3%) and Waterlogged (17.08%). There are 96 Lake/pond (locally called as Beels) with 6121 ha area. Details of wetland statistics is given in Table-86.

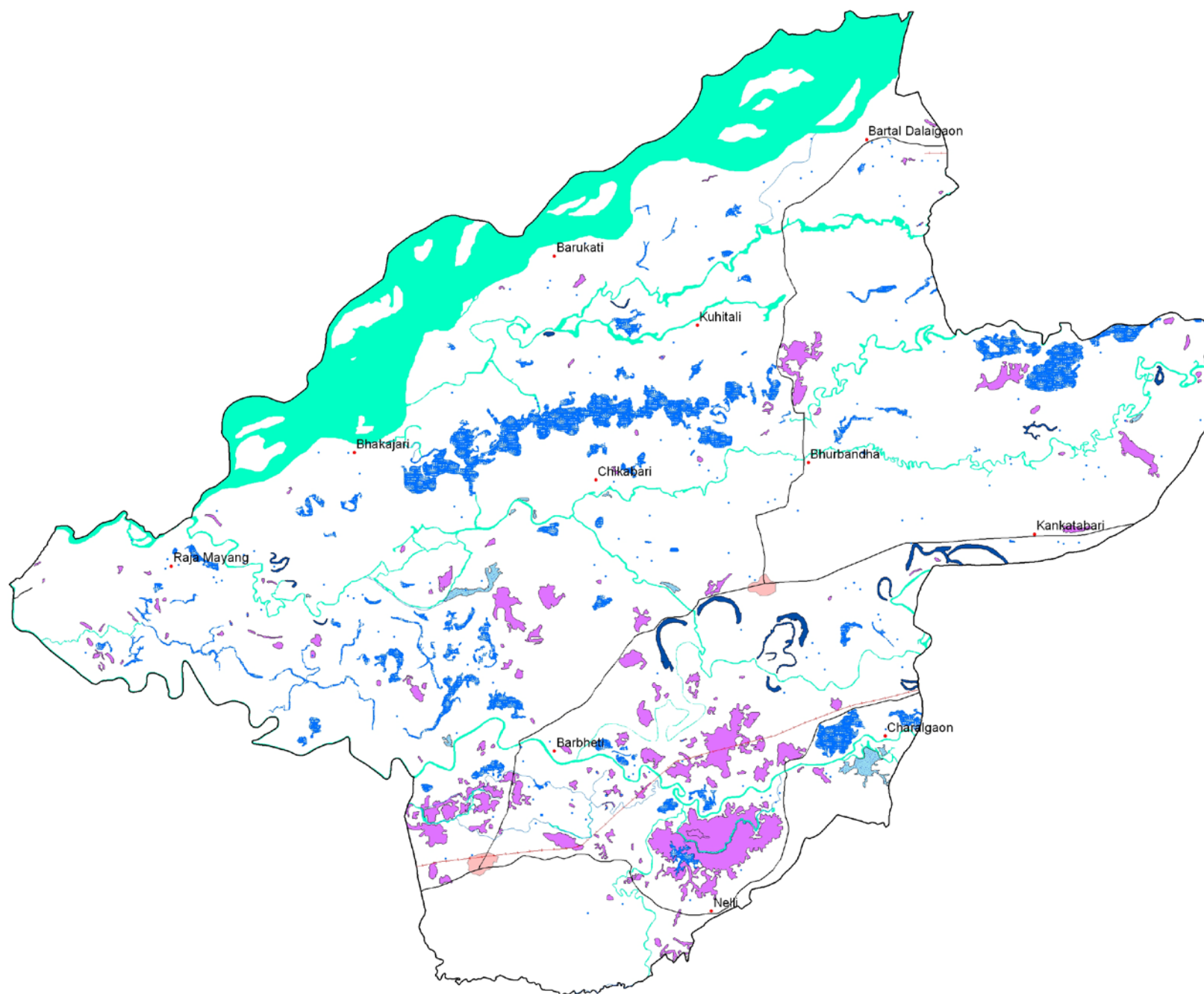
Aquatic vegetation is observed in Lake/pond, waterlogged wetland types. The area under aquatic vegetation is significantly more in pre monsoon (10118 ha) than that of post monsoon (2328 ha). The open water spread of River/stream show slight seasonal variation. However, in case of Lake/pond and Waterlogged wetland types, the open water is less in pre monsoon compared to post monsoon. The turbidity of water is low to moderate in post monsoon and mainly moderate in pre monsoon.

Table-86: Area estimates of wetlands in Marigaon

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	96	6121	21.30	4494	879
2	1102	Ox-Bow Lakes/ Cut-Off Meanders	16	613	2.13	375	271
3	1103	High altitude Wetlands	-	-	-	-	-
4	1104	Riverine Wetlands	12	357	1.24	305	10
5	1105	Waterlogged	159	4907	17.08	4292	693
6	1106	River/Stream	21	16567	57.65	7822	8013
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	3	14	0.05	14	9
9	1203	Waterlogged	-	-	-	-	-
		Sub-Total	307	28579	99.45	17302	9875
		Wetlands (<2.25 ha), mainly Tanks	158	158	0.55	-	-
		Total	465	28737	100.00	17302	9875

Area under Aquatic Vegetation	2328	10118
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Area under turbidity levels		
Low	9064	1781
Moderate	8238	8094
High	-	-

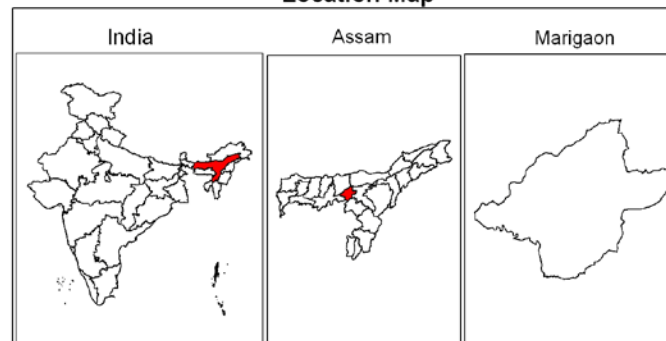


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

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7.8.10 Nagaon

The district is situated in the Central Brahmaputra valley of Assam between 25°35'N and 26°55'N latitudes and 92°15'E and 93°20'E longitudes. It occupies 397600 hectares of area. It is bounded on the east by Golaghat and Karbi Anglong districts, on the west by Marigoan district, on the north by Sonitpur district and south by N.C. Hills and Karbi Anglong district. The topography of the district is almost flat. The Brahmaputra River flows along the northern side of the district. A number of 'Char' area [sand bars] are observed along the Brahmaputra river bed. Kaziranga, Loakhowa wild life sanctuary exists in the valley close to the river Brahmaputra. The other major rivers are Kapili, Diju, Misa, Haria, Jamuna, Kalang and Barapani. A number of ox-bow lakes and ponds also exist in the district. Besides, there are many low lying areas and swamps. The soils of the district vary from sandy to clay loam. and generally acidic to near neutral in nature. The normal average rainfall in the district is 2000 mm. The average minimum and maximum temperatures is 8° C in January and about 34.3° C in July/August. As per Census Report, 2001, the district has a total population of 23, 14,629

Total wetland area in the district is 35659 ha that includes 233 small wetlands (<2.25 ha). River/stream occupies 34.48% of wetlands. The major wetland type is Waterlogged (35.53%). There are 178 Lake/pond with 8670 ha area (21.3%). Ox-bow lakes occupy 8670 ha area (3.36%). Details of wetland statistics is given in Table.87.

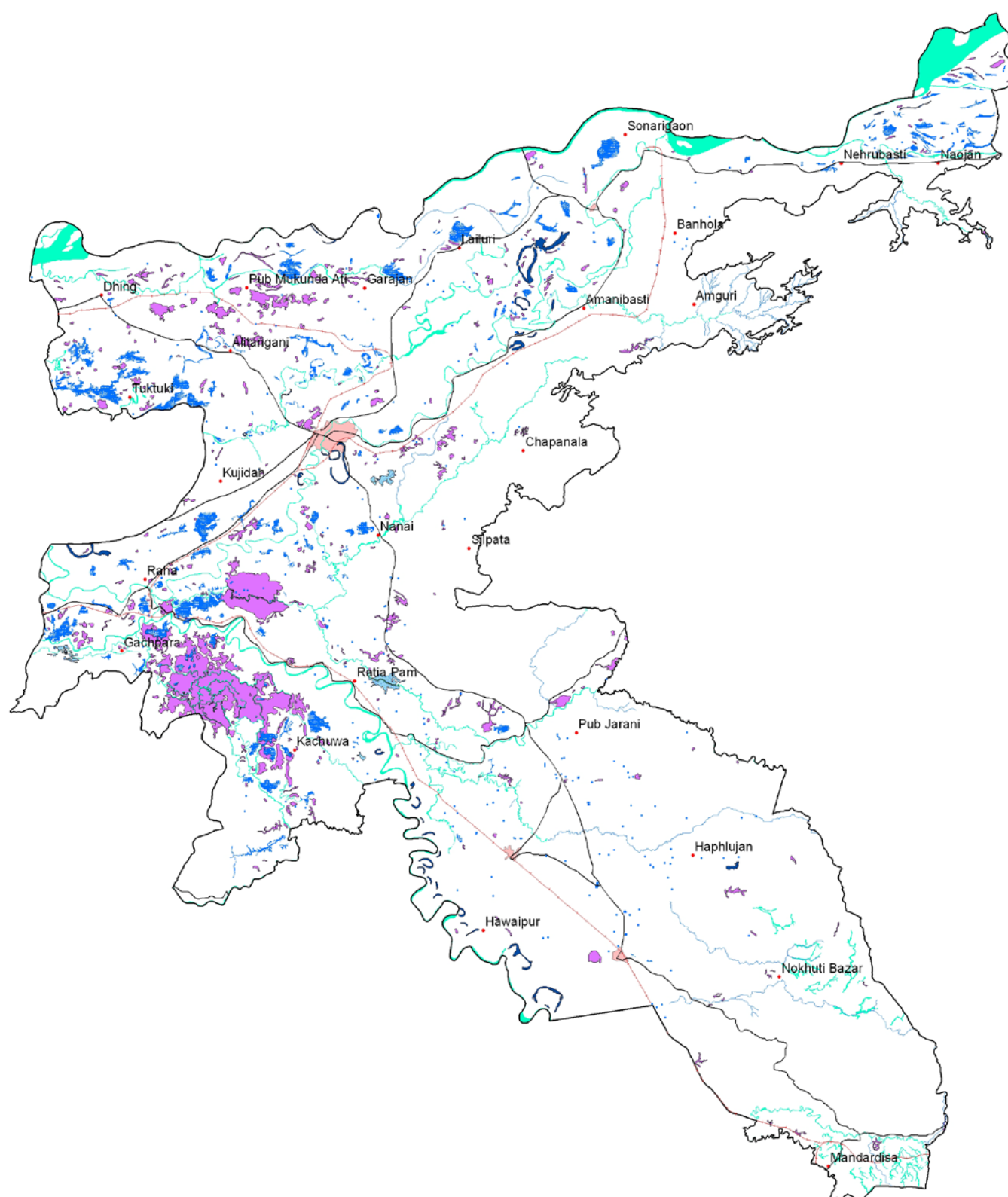
Aquatic vegetation is observed in Lake/pond, Waterlogged wetland types. The area under aquatic vegetation is significantly more in pre monsoon (18235 ha) than that of post monsoon (5271 ha). The open water spread of River/stream is almost same in both the seasons. However, in case of Lake/pond and waterlogged wetland types, the open water is significantly less in pre monsoon compared to post monsoon. The turbidity of water is low to moderate in post monsoon and mainly moderate in pre monsoon.

Table-87: Area estimates of wetlands in Nagaon

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	178	8670	24.29	6757	1446
2	1102	Ox-bow lakes/ Cut-off meanders	41	1198	3.36	639	470
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	15	490	1.37	385	3
5	1105	Waterlogged	410	12682	35.53	11631	2228
6	1106	River/Stream	66	12308	34.48	9300	9319
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	22	114	0.32	114	114
9	1203	Waterlogged	-	-	-	-	-
		Sub-Total	732	35462	99.35	28826	13580
		Wetlands (<2.25 ha), mainly Tanks	233	233	0.65	-	-
		Total	965	35695	100.00	28826	13580

Area under Aquatic Vegetation	5271	18235
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Area under turbidity levels		
Low	15427	2498
Moderate	13399	11082
High	-	-

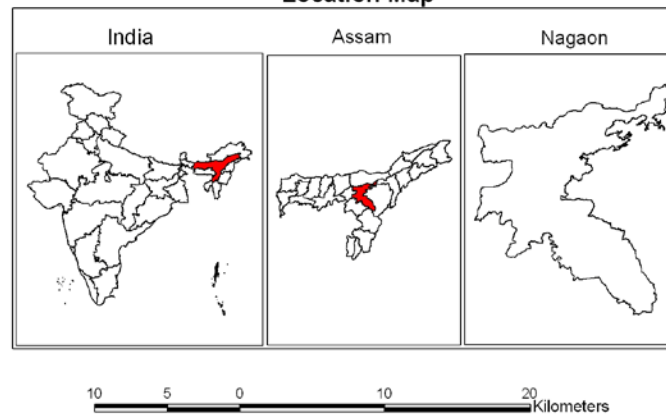


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

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Ministry of Environment and Forests
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7.8.11 Sonitpur

The district is situated in the northern part of Assam between 26°30'N and 27°02'N latitudes and 92°17'E and 93°47'E longitudes. It occupies an area of 492145 Hectares. It is bounded on the east by Lakhimpur district of Assam, on the west by Darrang district, on the north by Arunachal Pradesh and on the south by the river Brahmaputra. The topography of the district is almost flat. Along the river Brahmaputra and between the central belt and the Brahmaputra are chronically flood affected. Swamps are seen mainly in these areas which represent naturally depressed vast wetlands. The major rivers (tributaries of the Brahmaputra) that traverse this district are Pachnai, Belsiri Nai, Jia Gabharu, Jia Bhoroli, Bardikrai, Bargang and Burai. The rivers are all perennial in nature. Both New Alluvium Soils (Entisols) and Old Alluvium Soils (Inceptisols) are found in the district. Soils are sandy loam to clay loam in texture and are acidic with pH 4.5 to 6.5. The average annual rainfall is 1563 mm. The maximum temperature recorded is 35°C in the months of July-August and the minimum is 11°C in the months of December-January. As per Census Report, 2001, the district has a total population of 16, 81,513.

Total wetland area in the district is 83427 ha that includes 980 small wetlands (<2.25 ha). River/stream occupies 94.52% of wetlands. The other major wetland type is Waterlogged - natural (2.22%) and Ox-bow lakes (1.04%). There are 23 Tank/pond types with 84 ha. Details of wetland statistics is given in Table.88.

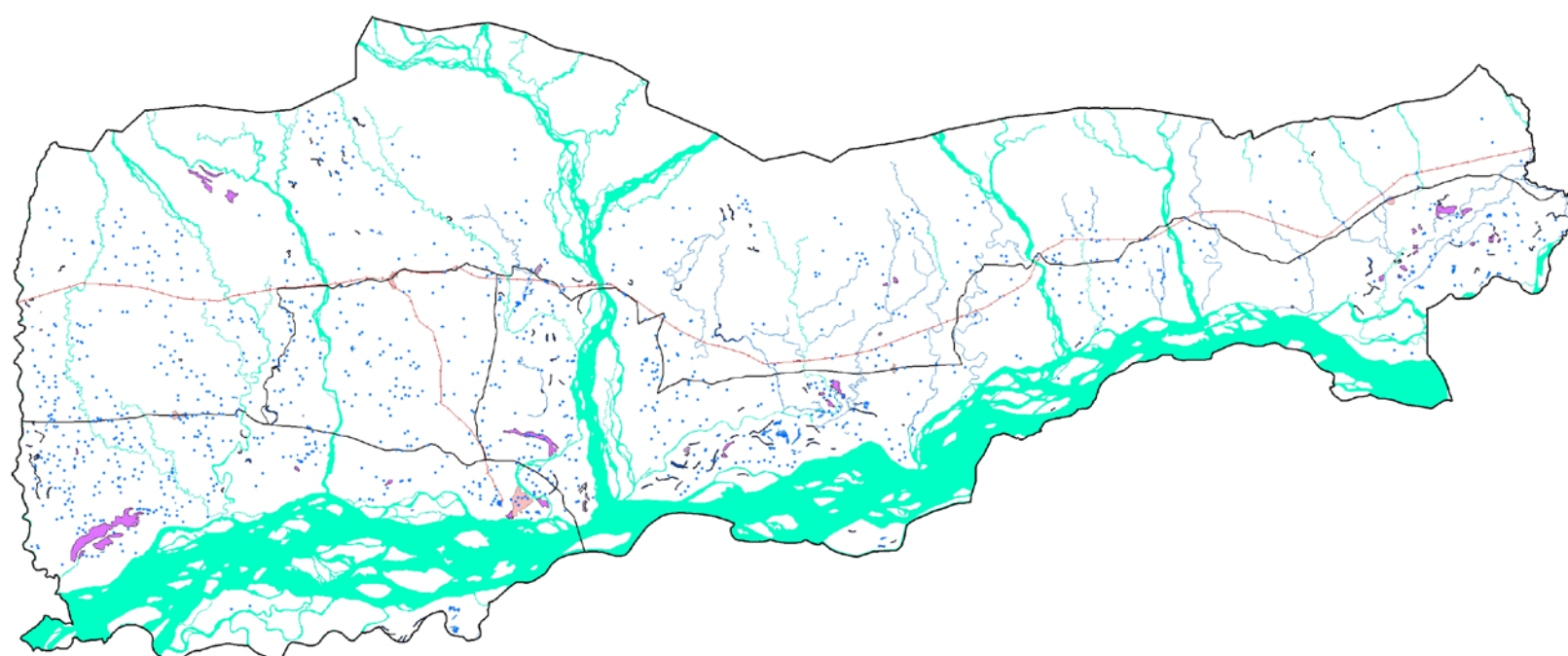
Aquatic vegetation is observed in Lake/pond, waterlogged wetland types. The area under aquatic vegetation is more or less same in both the seasons. Seasonal fluctuation of open water spread of wetlands is negligible. The turbidity of water is moderate in both the seasons.

Table-88: Area estimates of wetlands in Sonitpur

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	69	740	0.89	391	335
2	1102	Ox-bow lakes/ Cut-off meanders	96	864	1.04	555	427
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Reverine wetlands	-	-	-	-	-
5	1105	Waterlogged	32	1764	2.11	284	201
6	1106	River/Stream	12	78852	94.52	32301	29072
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	23	84	0.10	75	73
9	1203	Waterlogged	15	143	0.17	99	81
		Sub-Total	249	82447	98.65	33705	30189
		Wetlands (<2.25 ha), mainly Tanks	980	980	1.17	-	-
		Total	1229	83427	99.83	33705	30189

Area under Aquatic Vegetation	2203	2489
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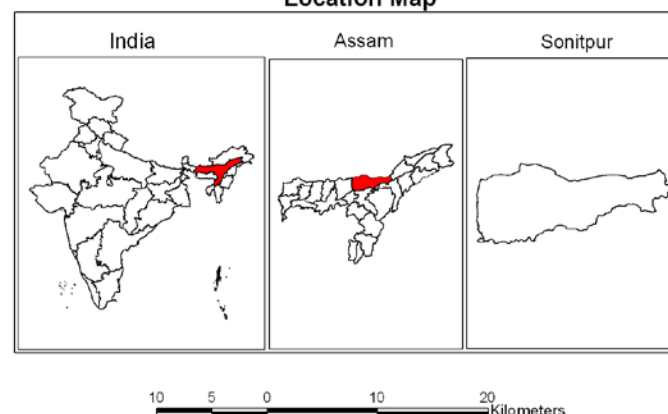
Area under turbidity levels		
Low	634	499
Moderate	32956	29615
High	115	75



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

Legend

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

Location Map**Data Source :**

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

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Ministry of Environment and Forests
Government of India

7.8.12 Lakhimpur

The district is situated in the north eastern part of Assam between 26° 45'N and 27° 35'N latitudes and 93° 40'E and 94° 53'E longitudes. It occupies 3, 00,800 hectares of area. It is bounded on the east by Dhemaji and Dibrugarh districts, on the west by Sonitpur district and part of Arunachal Pradesh, on the north by Arunachal Pradesh and Dhemaji district. The topography of the district varies from undulating uplands on the northern foothill belt to low lying plains on the south with elevation range of 35 metres (areas in riverine belt) to 140 metres (areas in the foothill belt) above the m. s.l. The mean altitude of the district is 102 metres above m.s.l. All the rivers in the district are perennial in nature. The river Brahmaputra flows on the southern side of the district. The other major rivers are Subansiri, Simen and Dikrai. The soils of the district are broadly fall into three major groups i.e. Older Alluvium along the foothill Older Alluvium on the flood plains and Newer Alluvium on the recent flood plains. The annual mean rainfall in the district is 300 cm. The maximum and minimum temperatures are 31°C and 7°C respectively, while the mean temperature is 19°C. As per Census Report, 2001, the district has a total population of 8, 89,010.

Total wetland area in the district is 27307 ha that includes 458 small wetlands (<2.25 ha). River/stream occupies 89.34% of wetlands. The other major wetland type is Ox-bow lakes (3.8%), Lake/pond (2.39%) and Waterlogged - natural (1.92%). Details of wetland statistics is given in Table.89.

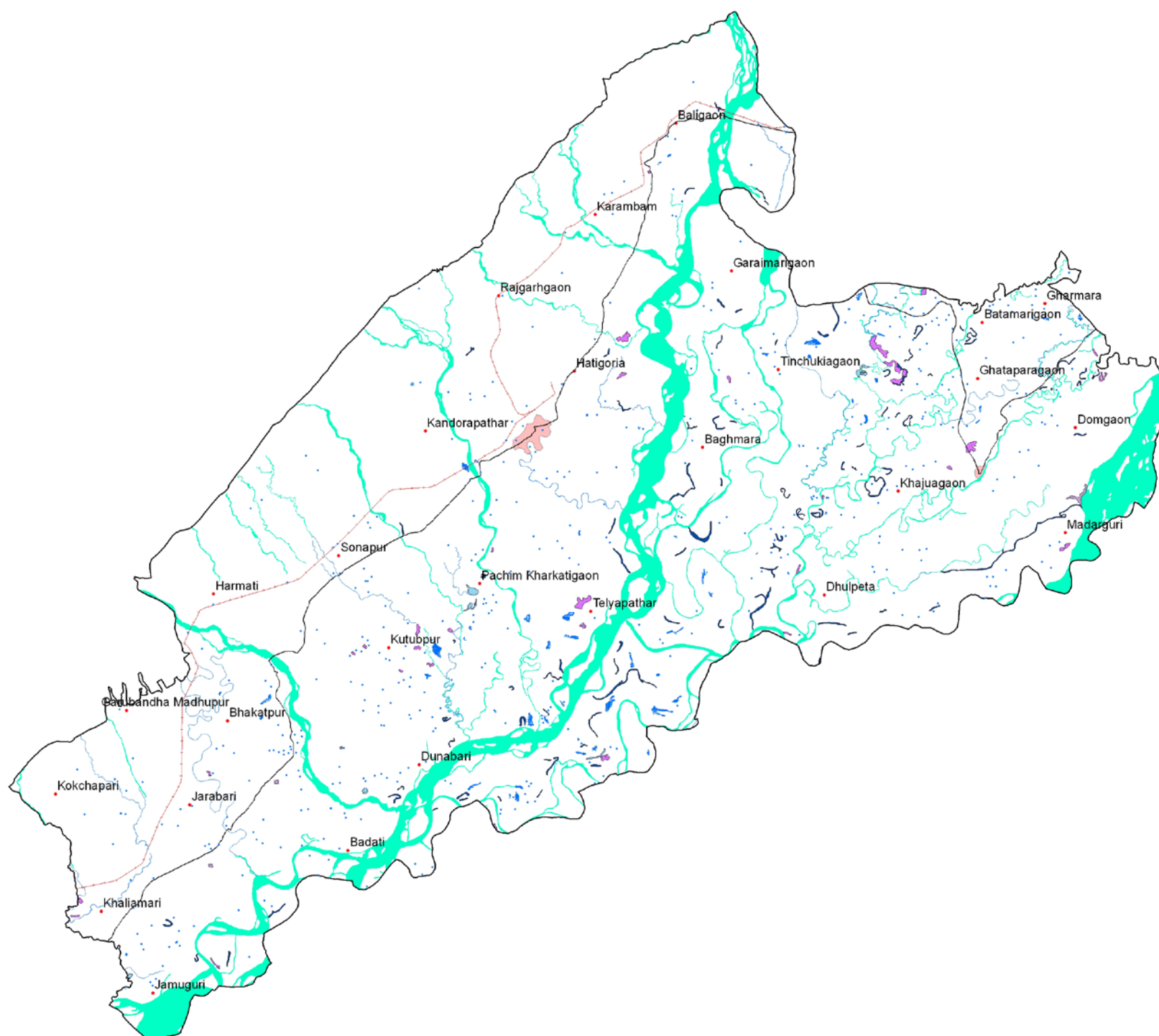
Aquatic vegetation is observed in Lake/pond, waterlogged wetland types. The area under aquatic vegetation is more or less in both the seasons. Seasonal fluctuation of open water spread of wetlands is negligible. The turbidity of water is moderate in both the seasons

Table 89: Area estimates of wetlands in Lakhimpur

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	53	652	2.39	388	458
2	1102	Ox-bow lakes/ Cut-off meanders	92	1038	3.80	807	706
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	7	134	0.49	53	66
5	1105	Waterlogged	34	524	1.92	174	322
6	1106	River/Stream	30	24397	89.34	12258	12048
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	14	41	0.15	33	38
9	1203	Waterlogged	4	63	0.23	26	26
		Sub-Total	234	26849	98.32	13739	13664
		Wetlands (<2.25 ha), mainly Tanks	458	458	1.68	-	-
		Total	692	27307	100.00	13739	13664

Area under Aquatic Vegetation	971	836
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Area under turbidity levels		
Low	152	240
Moderate	13495	13320
High	92	104

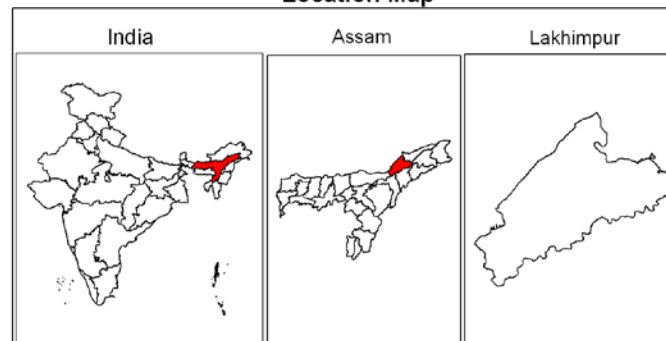


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



8 4 0 8 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
Assam Remote Sensing Applications Centre, Guwahati

Sponsored By:

Ministry of Environment and Forests
Government of India

7.8.13 Dhemaji

The district is situated in the north eastern part of Assam between 27° 15'N and 27° 55'N latitudes and 94° 10'E and 95° 30'E longitudes. It occupies 2, 63,701 hectares of area. It is bounded on the north by Arunachal Pradesh. The topography of the district varies from undulating uplands on the northern foothill belt to low lying plains on the south. The mean altitude of the district is 102 metres above m.s.l. The river Brahmaputra flows along the southern side of the district. The other major rivers are Subansiri, Jiadhal, Simen and Dikrai. All the rivers in the district are perennial in nature. These rivers flow through the high rainfall region at the foothill of the Assam Himalayas; so the district acts as a runoff zone for the excess water from Arunachal Pradesh. An extensive area of the district is, thus invariably subjected to 3 to 4 waves of flood during the monsoon period. The soils of the district broadly fall into Older Alluvium and New Aluvium. The annual mean rainfall in the district is 300 cm. The maximum and minimum temperatures are 31°C and 7°C respectively, while the mean temperature is 19°C. As per Census Report, 2001, the district has a total population of 5, 71,944.

Total wetland area in the district is 33468 ha that includes 314 small wetlands (<2.25 ha). River/stream occupies 87.53% of wetlands. The other major wetland types are waterlogged - natural (4.08%). Riverine wetland (2.78%), Lake/pond (2.32%) and Ox-bow lakes (1.77%). Details of wetland statistics is given in Table.90.

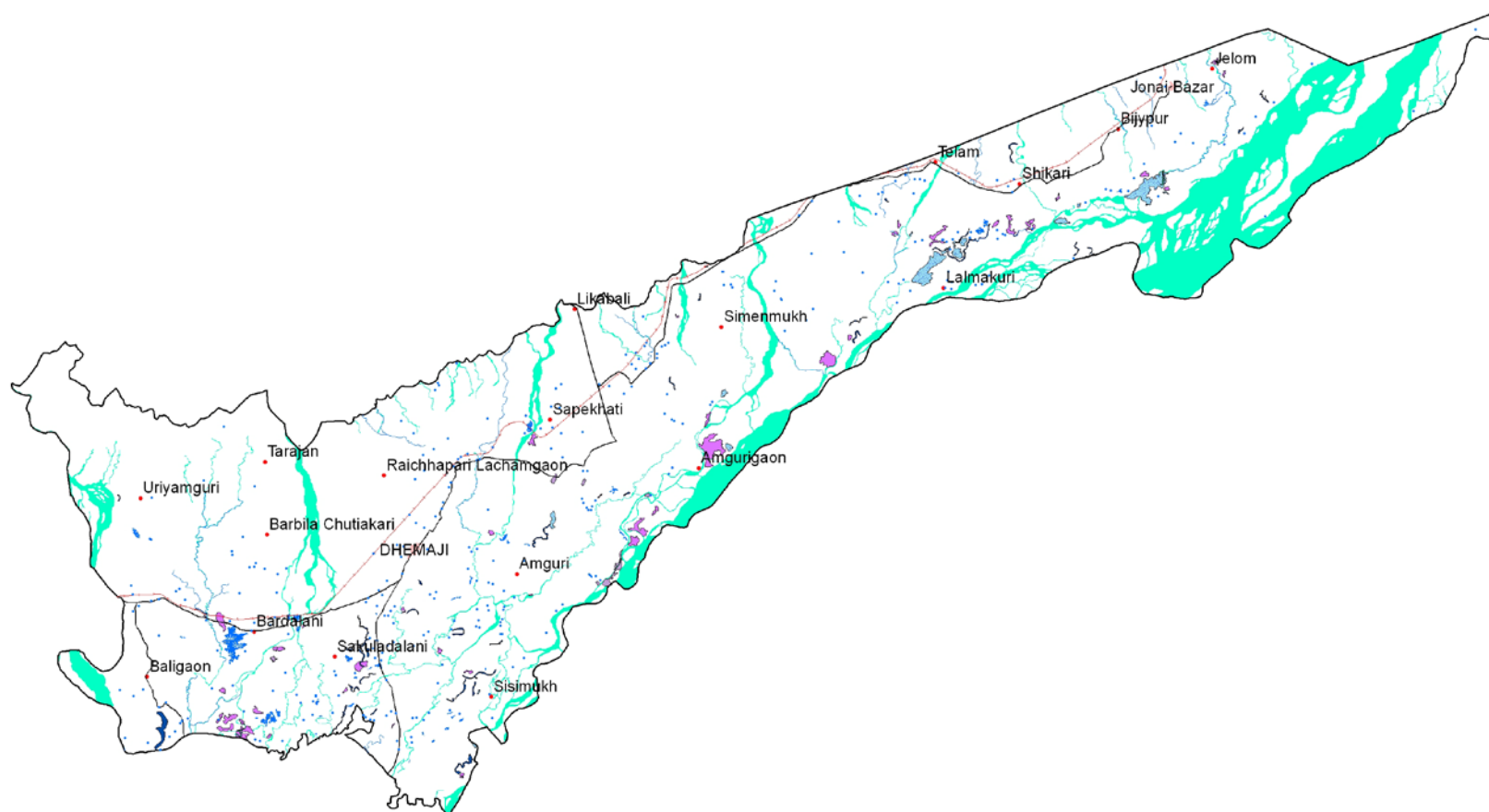
Aquatic vegetation is observed in Lake/pond, waterlogged wetland types. The area under aquatic vegetation is more or less in both the seasons. Seasonal fluctuation of open water spread of wetlands is negligible. The turbidity of water is moderate in both the seasons.

Table 90: Area estimates of wetlands in Dhemaji

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	36	776	2.32	172	145
2	1102	Ox-bow lakes/ Cut-off meanders	30	592	1.77	248	289
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	14	932	2.78	237	211
5	1105	Waterlogged	46	1365	4.08	277	388
6	1106	River/Stream	35	29293	87.53	11146	11980
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	8	23	0.07	20	23
9	1203	Waterlogged	12	173	0.52	95	82
		Sub-Total	181	33154	99.06	12195	13118
		Wetlands (<2.25 ha), mainly Tanks	314	314	0.94	-	-
		Total	495	33468	100.00	12195	13118

Area under Aquatic Vegetation	2812	2724
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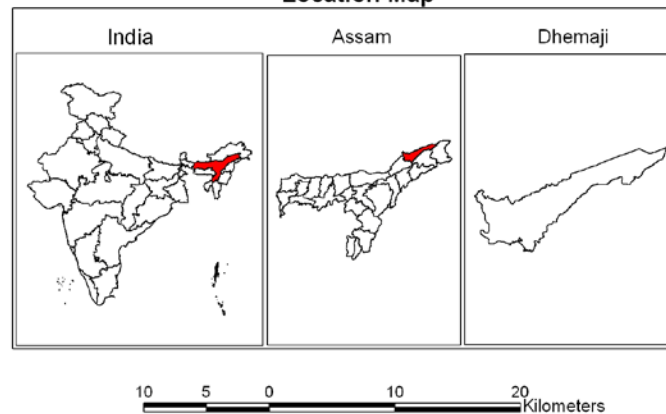
Area under turbidity levels		
Low	581	759
Moderate	11602	12347
High	12	12



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

Location Map**Data Source :**

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

Sponsored By:

Ministry of Environment and Forests
Government of India

7.8.14 Tinsukia

The district is situated in the north eastern part of Assam between 27° 15'N and 28° 00'N latitudes and 95° 15'E and 96° 00'E longitudes. It occupies 3,47,600 hectares of land.. It is bounded on the east by Arunachal Pradesh, on the west by Dibrugarh district, on the north by Lakhimpur district and south by the Dibrugarh district and part of Arunachal Pradesh. The district is characterised by a flat monotonous terrain from the Brahmaputra river southwards upto the upper Dihing R.F. where it starts rising slowly into the broken hills that comprise the foothills of the Tirap district of Arunachal Pradesh. The tract is drained by the Brahmaputra river and its main tributary Burhi Dihing. Soils of this district are divided into three distinct categories. viz. new alluvial soils in an area extending few kms to the south of the Brahmaputra river, old alluvial soils in the central part of the district and old mountain valley alluvial soil located on the foothills of Arunachal Pradesh. .The average annual rainfall ranges from a minimum of 2134 mm to a maximum of 3785 mm. The minimum and maximum temperatures recorded are 7°C and 37°C during winter and summer respectively. As per Census Report, 2001, the district has a total population of 11, 50,062.

Total wetland area in the district is 40626 ha that includes 478 small wetlands (<2.25 ha). River/stream occupies 87.81% of wetlands. The other major wetland types are Waterlogged - natural (4.08%). Riverine wetland (2.83%), Waterlogged-natural (4.15%) and Ox-bow lakes (3.44%). Details of wetland statistics is given in Table.91.

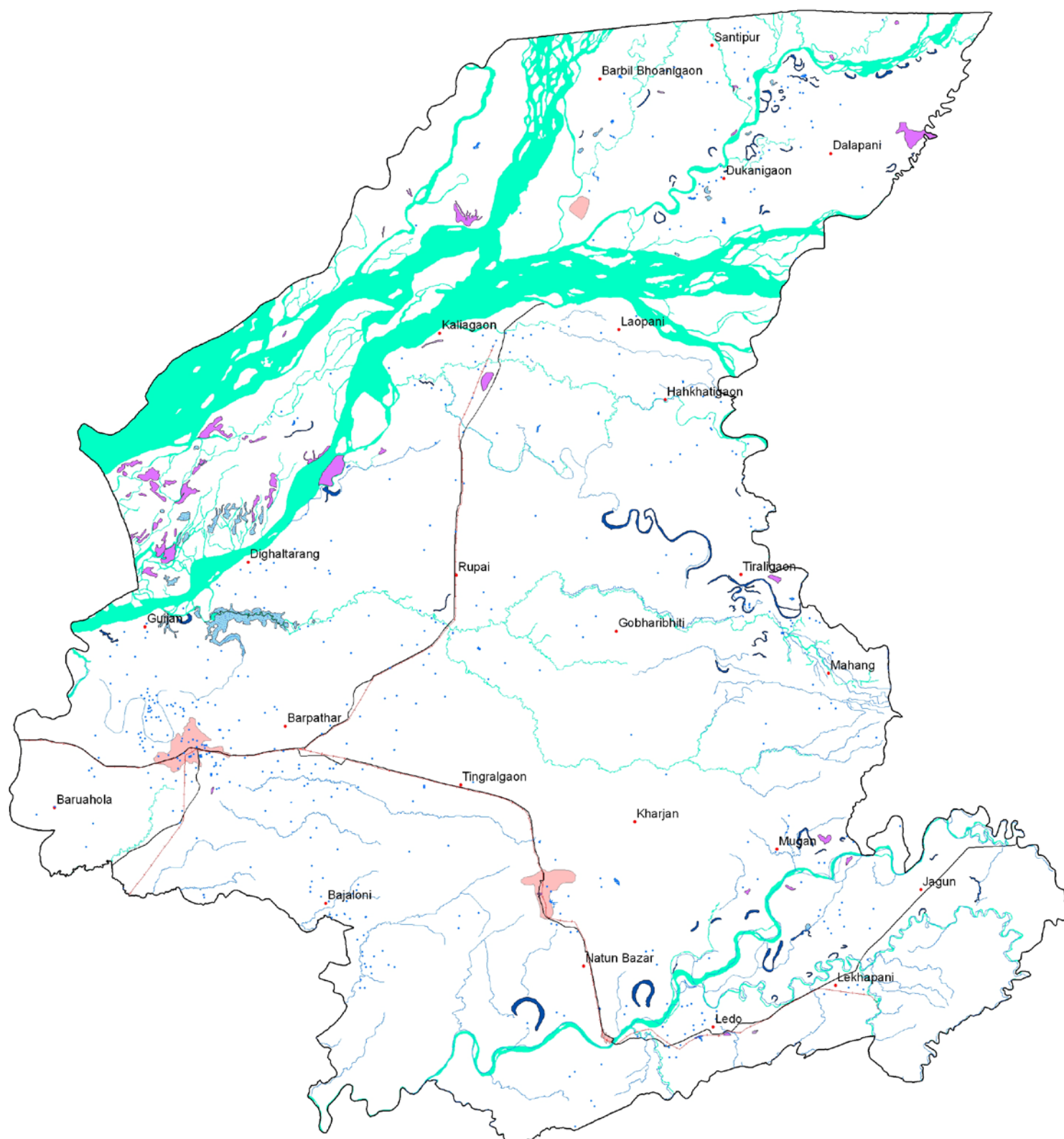
Aquatic vegetation is observed in Lake/pond, Riverine and Waterlogged wetland types. The area under aquatic vegetation is more during pre monsoon (2974 ha) than during post monsoon (3570 ha). Seasonal fluctuation of open water spread of wetlands show more spread during pre monsoon (22854 ha) than post monsoon (17712 ha). The turbidity of water is moderate in both the seasons.

Table 91: Area estimates of wetlands in Tinsukia

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	20	147	0.36	48	41
2	1102	Ox-bow lakes/ Cut-off meanders	59	1399	3.44	148	367
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	30	1151	2.83	290	483
5	1105	Waterlogged	43	1685	4.15	323	500
6	1106	River/Stream	5	35672	87.81	16825	21382
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	23	63	0.16	57	55
9	1203	Waterlogged	4	31	0.08	21	26
		Sub-Total	184	40148	98.75	17712	22854
		Wetlands (<2.25 ha), mainly Tanks	478	478	1.18	-	-
		Total	662	40626	99.92	17712	22854

Area under Aquatic Vegetation	3570	2974
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Area under turbidity levels		
Low	23	25
Moderate	17661	22722
High	28	107

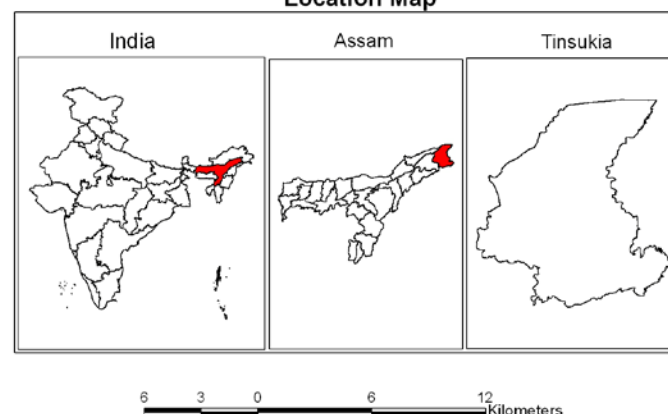


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

Sponsored By:

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7.8.15 Dibrugarh

The district is situated in the north eastern part of Assam between 27° 10'N and 27° 45'N latitudes and 94° 30'E and 95° 30'E longitudes. It occupies 3,54,500 hectares of area, which accounts for 4.52 per cent area of the state. It is bounded on the east by Tinsukia, on the west by part of Sibsagar and Lakhimpur districts, on the north by Lakhimpur district and south by the Sibsagar district and part of Arunachal Pradesh. The district is characterised by a flat monotonous terrain from the Brahmaputra river southwards upto the upper Dihing R.F. where it starts rising slowly into the broken hills that comprise the foothills of the Tirap district of Arunachal Pradesh. The tract is drained by the Brahmaputra river and its main tributary the Burhi Dihing and the Mai Jan river. Soils of this district are divided into three distinct categories. viz. new alluvial soils in an area extending few kms to the south of the Brahmaputra river, old alluvial soils in the central part of the district and old mountain valley alluvial soil located on the foothills of Arunachal Pradesh on the district. The average annual rainfall ranges from a minimum of 2134mm to a maximum of 3785mm. The minimum and maximum temperatures recorded are 7°C and 37°C respectively. As per Census Report, 2001, the district has a total population of 11, 85,072.

Total wetland area in the district is 72461 ha that includes 535 small wetlands (<2.25 ha). River/stream occupies 95.43% of wetlands. The other major wetland type is Ox-bow lakes (1.79%). There are 11 Lake/pond type mapped with 590 ha area. Details of wetland statistics is given in Table.92.

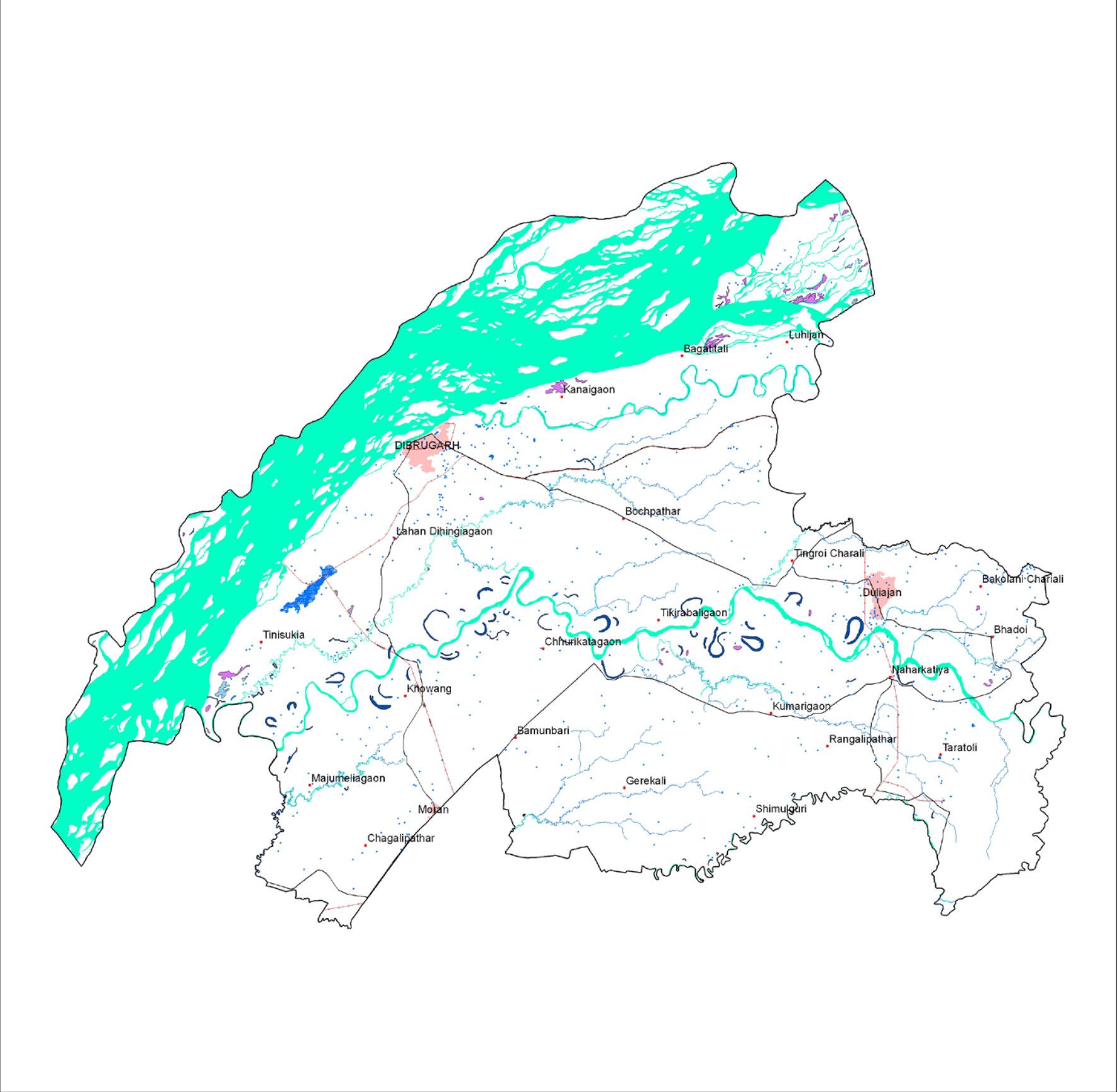
Aquatic vegetation is observed in Lake/pond, Ox-bow lake wetland types. The area under aquatic vegetation is slightly more during pre monsoon (1899 ha) than during post monsoon (1769 ha). Seasonal fluctuation of open water spread of wetlands show more spread during pre monsoon (36766 ha) than post monsoon (28280 ha). The turbidity of water is moderate in both the seasons.

Table 92: Area estimates of wetlands in Dibrugarh

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	11	590	0.81	115	45
2	1102	Ox-bow lakes/ Cut-off meanders	64	1295	1.79	700	456
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	11	146	0.20	0	42
5	1105	Waterlogged	31	656	0.91	103	248
6	1106	River/Stream	76	69149	95.43	27232	35856
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	14	45	0.06	45	41
9	1203	Waterlogged	9	45	0.06	45	45
		Sub-Total	216	71926	99.26	28240	36733
		Wetlands (<2.25 ha), mainly Tanks	535	535	0.74	-	-
		Total	751	72461	100.00	28240	36733

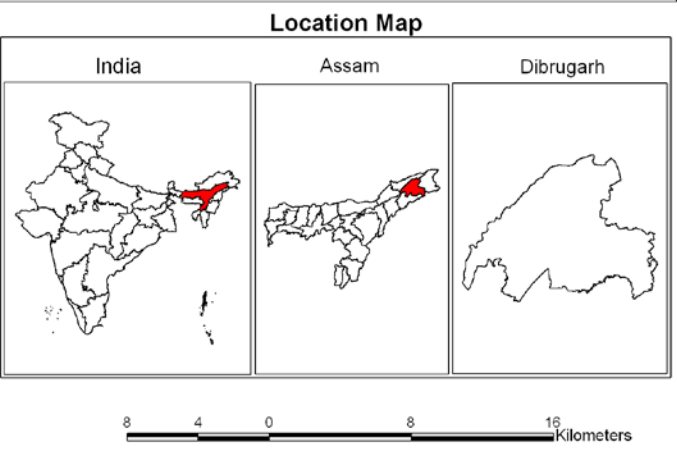
Area under Aquatic Vegetation	1769	1899
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Area under turbidity levels		
Low	187	124
Moderate	27938	36508
High	115	101



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

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



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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

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Government of India

7.8.16 Sibsagar

The district is situated in the north-eastern part of Assam between 26°42' and 27°15' north latitude and 94°24' and 95°23' east longitude. The district occupies an area of 64250 hectares. It is bounded on the east by Dibrugarh The district is situated in the north-eastern part of Assam between 26°42' and 27°15' north latitude and 94°24' and district of Assam and Tirap district of Arunachal Pradesh, on the west by Jorhat and Dibrugarh districts of Assam, on the north by Dibrugarh district and on the south by Jorhat district of Assam and Mokokchung district of Nagaland. The main rivers of the district are the Brahmaputra and its tributaries viz. Disang, Dikhow, Jhanzi and Burhidihing, which are perennial in nature. The soils of the district are divided into three main categories viz. New alluvial soil in an area of few kilometres on the south of Brahmaputra, old alluvial soil on the central part of the district and old mountain valley alluvial soils located along the foot hills of Nagaland. The district possesses the famous Panidihing wild life sanctuary. The normal annual rainfall in the district is 2244.5 mm. The minimum and maximum temperatures are 6.9°C and 37.2°C during winter and mid summer respectively. As per Census Report, 2001, the district has a total population of 10, 51,736.

Total wetland area in the district is 12582 ha that includes 530 small wetlands (<2.25 ha). River/stream occupies 69.13% of wetlands. The other major wetland types are Waterlogged-natural (10.57%), Lake/pond (8.28%), Ox-bow lakes (4.2%). There are 25 Tank/pond with 310 ha area (2.46%). Details of wetland statistics is given in Table.93.

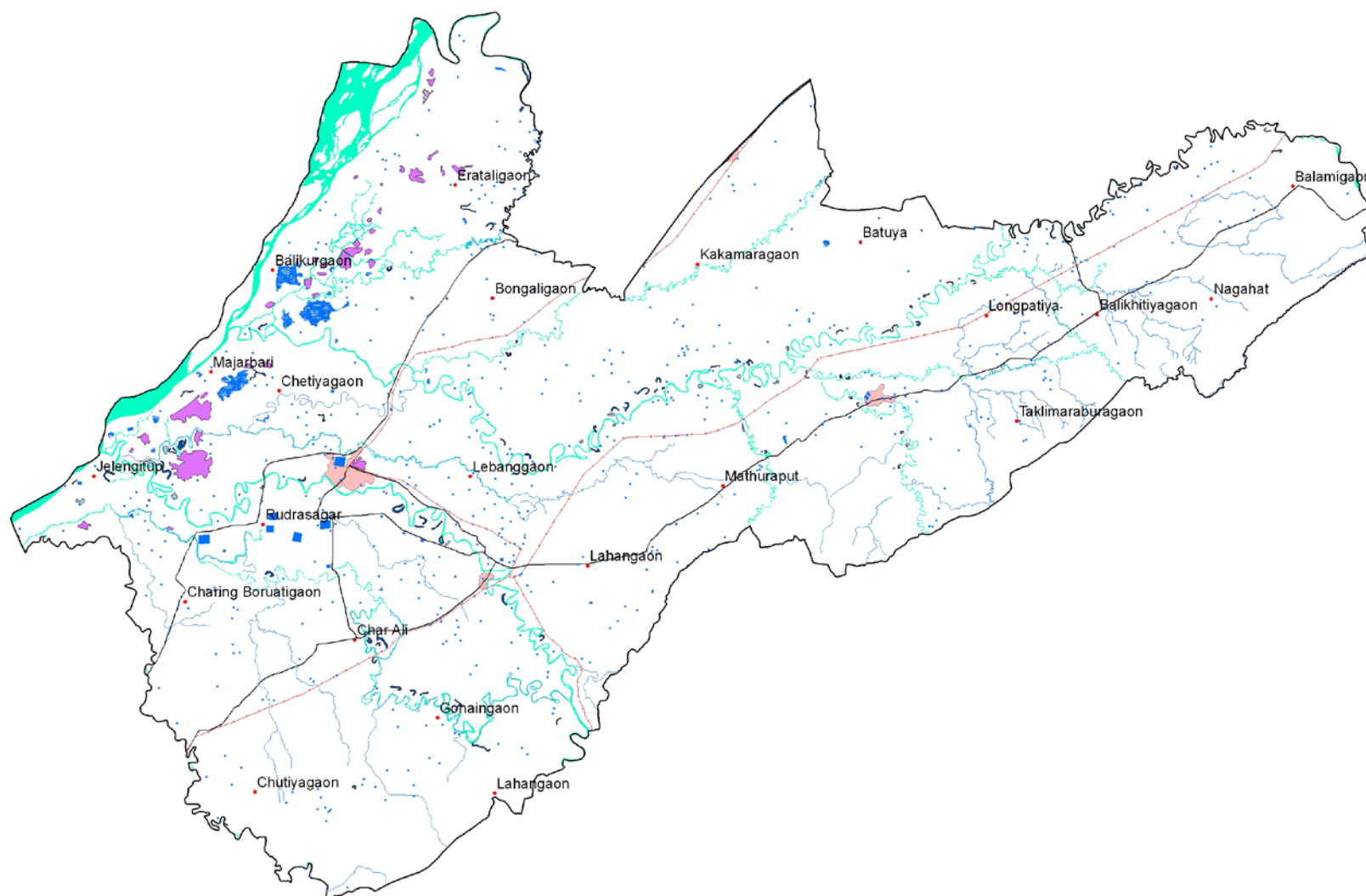
Aquatic vegetation is mainly observed in Lake/pond, waterlogged wetland types. The area under aquatic vegetation is more or less same in both the seasons. Seasonal fluctuation of open water spread of wetlands does not vary during both the seasons. The turbidity of water is moderate in both the seasons.

Table 93: Area estimates of wetlands in Sibsagar

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	30	1042	8.28	220	262
2	1102	Ox-bow lakes/ Cut-off meanders	75	529	4.20	317	333
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	16	113	0.90	40	36
5	1105	Waterlogged	34	1330	10.57	145	89
6	1106	River/Stream	74	8698	69.13	6045	5773
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	25	310	2.46	304	266
9	1203	Waterlogged	5	30	0.24	30	14
		Sub-Total	259	12052	95.79	7101	6773
		Wetlands (<2.25 ha), mainly Tanks	530	530	4.21	-	-
		Total	789	12582	100.00	7101	6773

Area under Aquatic Vegetation	2403	2458
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Area under turbidity levels		
Low	117	114
Moderate	6894	6591
High	90	68

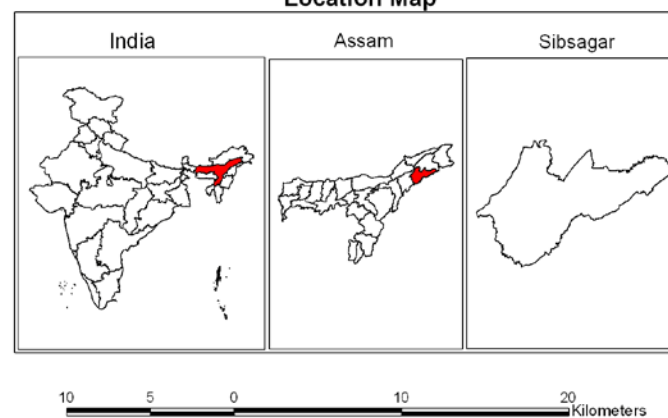


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

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Government of India

7.8.17 Jorhat

Jorhat district is situated in the eastern part of Assam state between 26°20'N and 27°11'N latitudes and 93°58'E and 94°33'E longitudes. It occupies 2,73,047.15 hectares area. It is bounded on the north by Lakhimpur district of Assam, and on the south by Wokha and Mokakchung districts of Nagaland. The river Brahmaputra flows along the northern side of the district separating Majuli sub-division from the main land. All rivers in the district are of perennial nature. The soils of the district vary from sandy loam to clay loam. The soil is mainly acidic in reaction with pH ranging from 4.5 to 6.5. Shifting cultivation areas are found in the Disai and Tiru hill region of the district. The mean annual rainfall in the district is 230 cm. The maximum and minimum temperatures recorded in the district are 32°C and 5°C during summer and winter respectively, while the mean temperature is recorded as 18°C. As per Census Report, 2001, the district has a total population of 9,99,221.

Total wetland area in the district is 45979 ha that includes 363 small wetlands (<2.25 ha). River/stream occupies 89.12% of wetlands. The other major wetland types are Waterlogged-natural (2.44%), Lake/pond (5.05%), Ox-bow lakes (1.52%). Details of wetland statistics is given in Table.94.

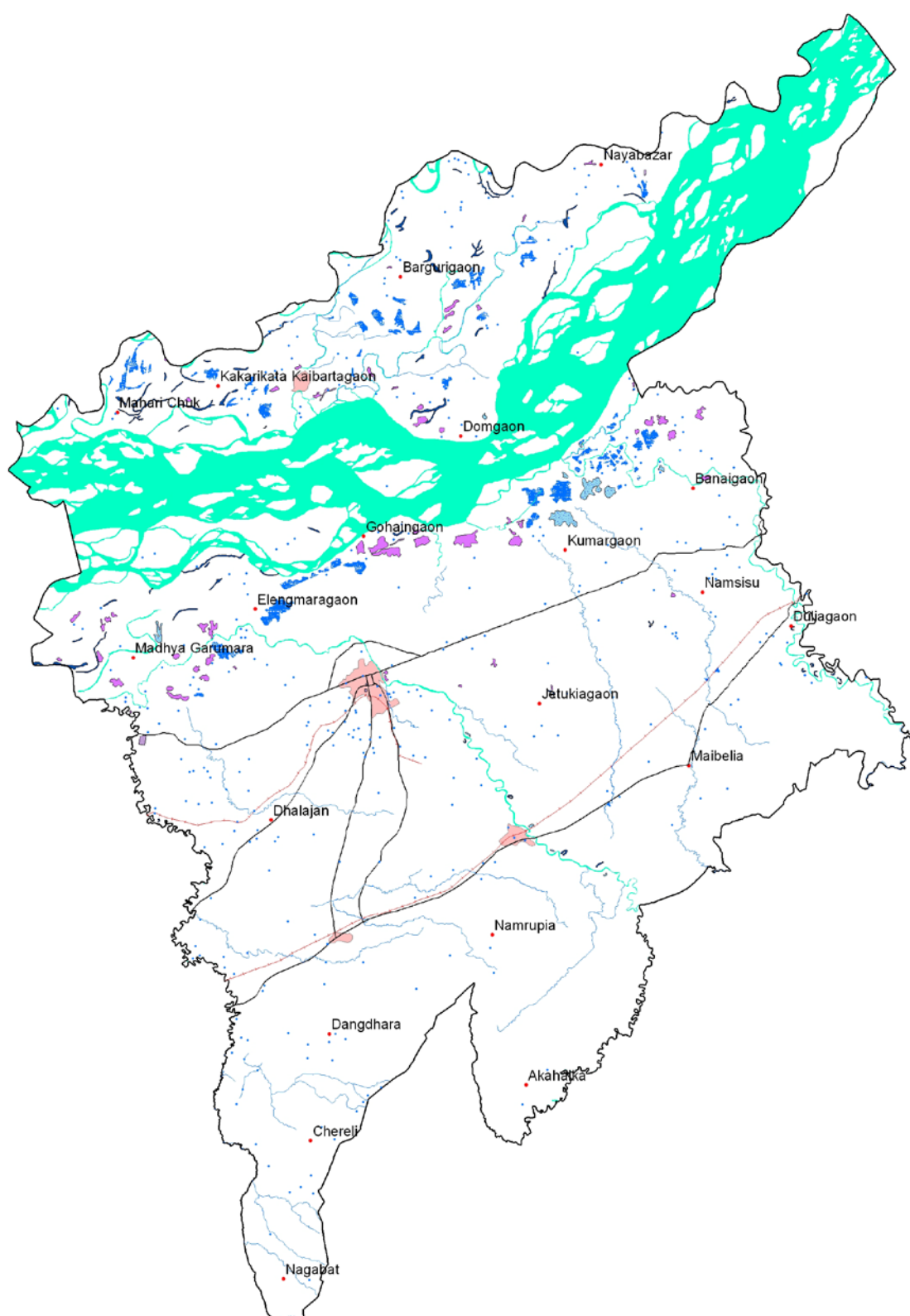
Aquatic vegetation is mainly observed in Lake/pond, waterlogged wetland types. The area under aquatic vegetation is slightly more during post monsoon (3357 ha) compared to pre monsoon (2586 ha). Seasonal fluctuation of open water spread of wetlands showed slightly more spread during post monsoon. The turbidity of water is moderate in both the seasons.

Table 94: Area estimates of wetlands in Jorhat

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	65	2322	5.05	809	1189
2	1102	Ox-bow lakes/ Cut-off meanders	57	698	1.52	391	556
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	12	417	0.91	6	13
5	1105	Waterlogged	58	1124	2.44	229	448
6	1106	River/Stream	23	40977	89.12	16623	15044
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	4	18	0.04	16	8
9	1203	Waterlogged	6	60	0.13	20	29
		Sub-Total	225	45616	99.21	18094	17287
		Wetlands (<2.25 ha), mainly Tanks	363	363	0.79	-	-
		Total	588	45979	100.00	18094	17287

Area under Aquatic Vegetation	3357	2586
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Area under turbidity levels		
Low	603	834
Moderate	17444	16317
High	47	136

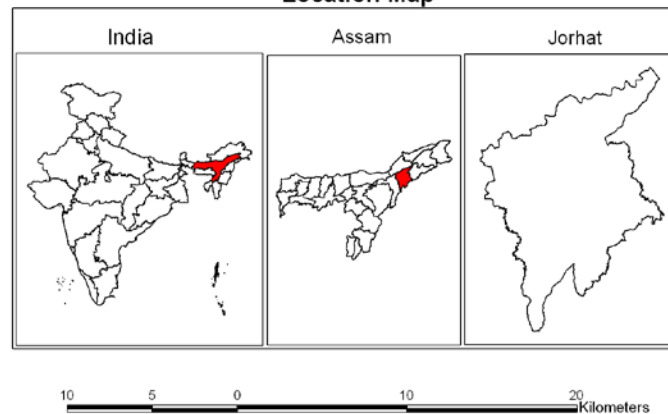


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

Sponsored By:

Ministry of Environment and Forests
Government of India

7.8.18 Golaghat

Golaghat district is situated in the south-east part of Assam state between 25°45'N to 26°40'N latitudes and 93°30'E to 94°29'E longitudes. It occupies 335879.83 hectares. It is bounded on the east by Jorhat district of Assam, on the west by Nowgong and Korbi Anglong districts of Assam, on the north by Sonitpur and Lakhimpur districts of Assam and on the south by Kohima and Wokha districts of Nagaland. The district is characterised by medium and low land topography. In the north-west is the famous Kaziranga National Park, the natural habitat of the one-horned Rhino. The river Brahmaputra flows through the northern side of the district. The other major tributary river is Dhansiri. The soil of the district varies from sandy loam to clay loam. It can be classified into three major soil groups i.e. Recent Riverine alluvial soils (Entisols), Old Riverine alluvial soils (Inceptisols) and Old Mountain valley alluvial soils (Altisols). The soil is acidic, pH ranging from 4.5 to 6.5. The mean annual rainfall in the district is 216 cm. The maximum and minimum temperatures recorded are 32°C and 6°C respectively while, the mean temperature is 19°C. As per Census Report, 2001, the district has a total population of 9, 46,279.

Total wetland area in the district is 43635 ha that includes 165 small wetlands (<2.25 ha). River/stream occupies 88.45% of wetlands. The other major wetland types are Lake/pond (5.16%), Waterlogged-natural (3.49%), and Ox-bow lakes (2.52%). Details of wetland statistics is given in Table.95.

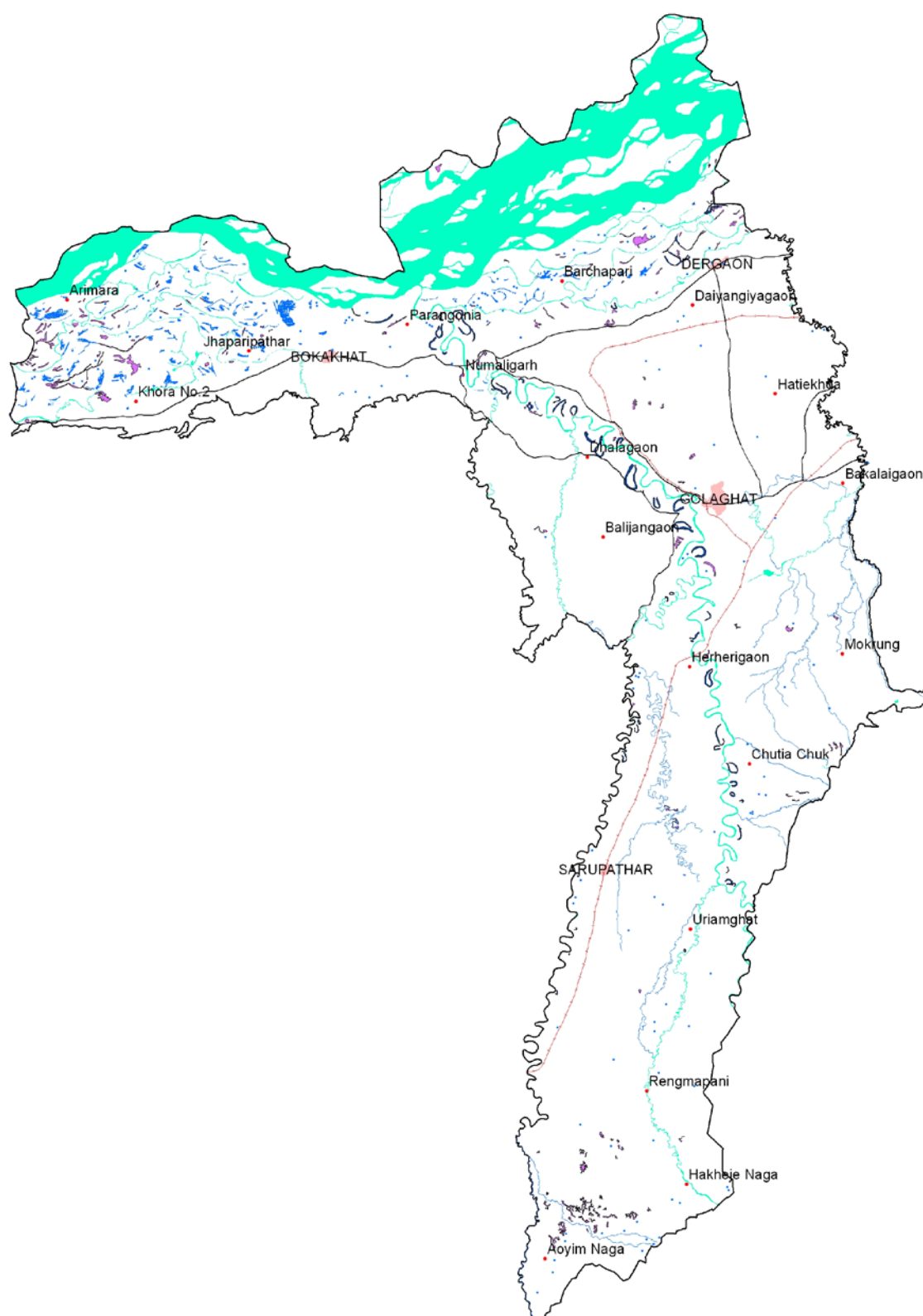
Aquatic vegetation is mainly observed in Lake/pond, waterlogged wetland types. The area under aquatic vegetation is slightly more during pre monsoon (2304 ha) compared to post monsoon (1437 ha). Seasonal fluctuation of open water spread of wetlands showed slightly more spread during pre monsoon. The turbidity of water is moderate in both the seasons.

Table 95: Area estimates of wetlands in Golaghat

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	120	2253	5.16	1456	976
2	1102	Ox-bow lakes/ Cut-off meanders	57	1099	2.52	518	510
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	172	1522	3.49	1026	675
6	1106	River/Stream	33	38593	88.45	18723	22199
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	1	3	0.01	3	3
9	1203	Waterlogged	-	-	-	-	-
		Sub-Total	383	43470	99.62	21726	24363
		Wetlands (<2.25 ha), mainly Tanks	165	165	0.38	-	-
		Total	548	43635	100.00	21726	24363

Area under Aquatic Vegetation	1437	2304
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Area under turbidity levels		
Low	2235	1259
Moderate	19491	23104
High	-	-

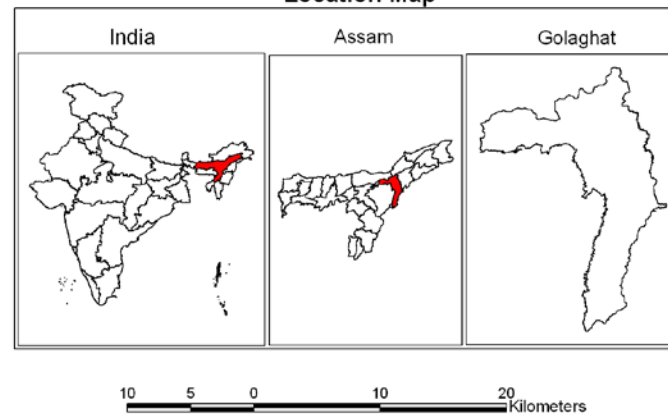


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

Sponsored By:

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Government of India

7.8.19 Karbi Anglong

Karbi Anglong district is situated in central part of Assam between 25°32'N to 26° 36'N latitudes and 92° 10' E to 93°50' E longitudes. It occupies an area of 1000257 hectares. It is bounded on the east by Golaghat district of Assam, on the west by East Khasi Hills of Meghalaya, and on the south by Kohima district of Nagaland, North Cachar hills district of Assam and Jaintia hills district of Meghalaya. The district can be broadly divided into two physiographic units viz., hills and plains. About 85 percent of the district is covered by hills. The highest peak in the district rises to a height of 1360 metres. The area located between the northern and southern hills in Diphu sub-division is characterised by undulating plains of subdued relief. The plain areas consist of valleys of the Jamuna, Kapili and Dhansiri rivers flowing through its eastern part. Other minor streams include Kaliani, Barpani, Patradisa and Digaru. The soils of the district are made up of laterised Red soils and non-laterised Red soils. The surface soils are generally pale red to reddish brown or bright red in colour. Shifting cultivation is a part of land use/cover. The mean annual rainfall in the district is 141 cm. The maximum and minimum temperatures recorded are 25°C and 4°C respectively while the mean temperature is 14.5°C. As per Census Report, 2001, the district has a total population of 8, 13,311.

Total wetland area in the district is **5810** ha that includes 89 small wetlands (<2.25 ha). River/stream occupies 85.13% of wetlands. The other major wetland types are Lake/pond (5.46%), Ox-bow lakes (5.71%) and Waterlogged-natural (2.12%). Details of wetland statistics is given in Table.96.

Aquatic vegetation is mainly observed in Lake/pond, waterlogged wetland types. The area under aquatic vegetation is slightly more during pre monsoon (536 ha) compared to post monsoon (306 ha). Seasonal fluctuation of open water spread of wetlands is more or less same in both the seasons. The turbidity of water is moderate in both the seasons.

Table 96: Area estimates of wetlands in Karbi Anglong

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	17	317	5.46	145	41
2	1102	Ox-bow lakes/ Cut-off meanders	31	332	5.71	142	164
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	23	123	2.12	101	41
6	1106	River/Stream	45	4946	85.13	4399	4399
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	1	3	0.05	15	3
9	1203	Waterlogged	-	-	-	-	-
		Sub-Total	117	5721	98.47	4802	4648
		Wetlands (<2.25 ha), mainly Tanks	89	89	1.53	-	-
		Total	206	5810	100.00	4802	4648

Area under Aquatic Vegetation	306	536
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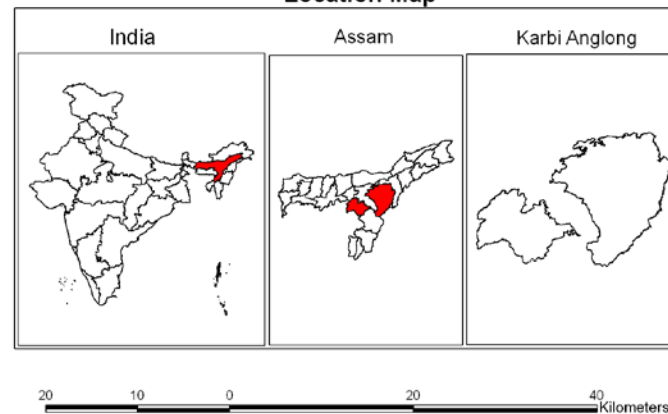
Area under turbidity levels		
Low	198	121
Moderate	4604	4527
High	-	-



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

Legend

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

Location Map**Data Source :**

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

Sponsored By:

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Government of India

7.8.20 North Cachar Hills

North Cachar Hills is situated in the south central part of Assam between 24°58' and 25°47' North latitudes and 92°32' and 93°28" East longitudes. The district occupies an area of 4,89,793 hectares. The only big town is Haflong which is the district head quarter also It is bounded on the east by the Jaintia hills of Meghalaya state, on the west by Tamenglong and Kohima districts of Nagaland, on the north by Karbi Anglong and Nagaon districts of Assam and on the south by Cachar district of Assam. The district consists mainly of hilly tracts and valleys with a negligible extent of plain area. The topography is rugged with elevations varying from 600 metres to 900 metres. The main rivers are Diyang, Kopili, Jiri and Dhansiri. The soils of the district vary from non-laterised red soil to laterised red soil ranging from sandy loam to clayey loam in texture. The non-laterised red soils occupy a relatively less area along a strip in the southern part of the district. The soil is acidic in reaction with pH varying from 4.10 to 6.20. The average annual rainfall varies from 2200 to 2300 mm. The maximum and minimum temperatures are 25.8°C and 5.3°C respectively. As per Census Report, 2001, the district has a total population of 1, 88,079.

Total wetland area in the district is 6619 ha that includes 44 small wetlands (<2.25 ha). River/stream occupies 56.43% of wetlands. The other major wetland type is Reservoir/Barrage. Two such wetland type are mapped with 2833 ha area and occupying 42.80%. Details of wetland statistics is given in Table.97.

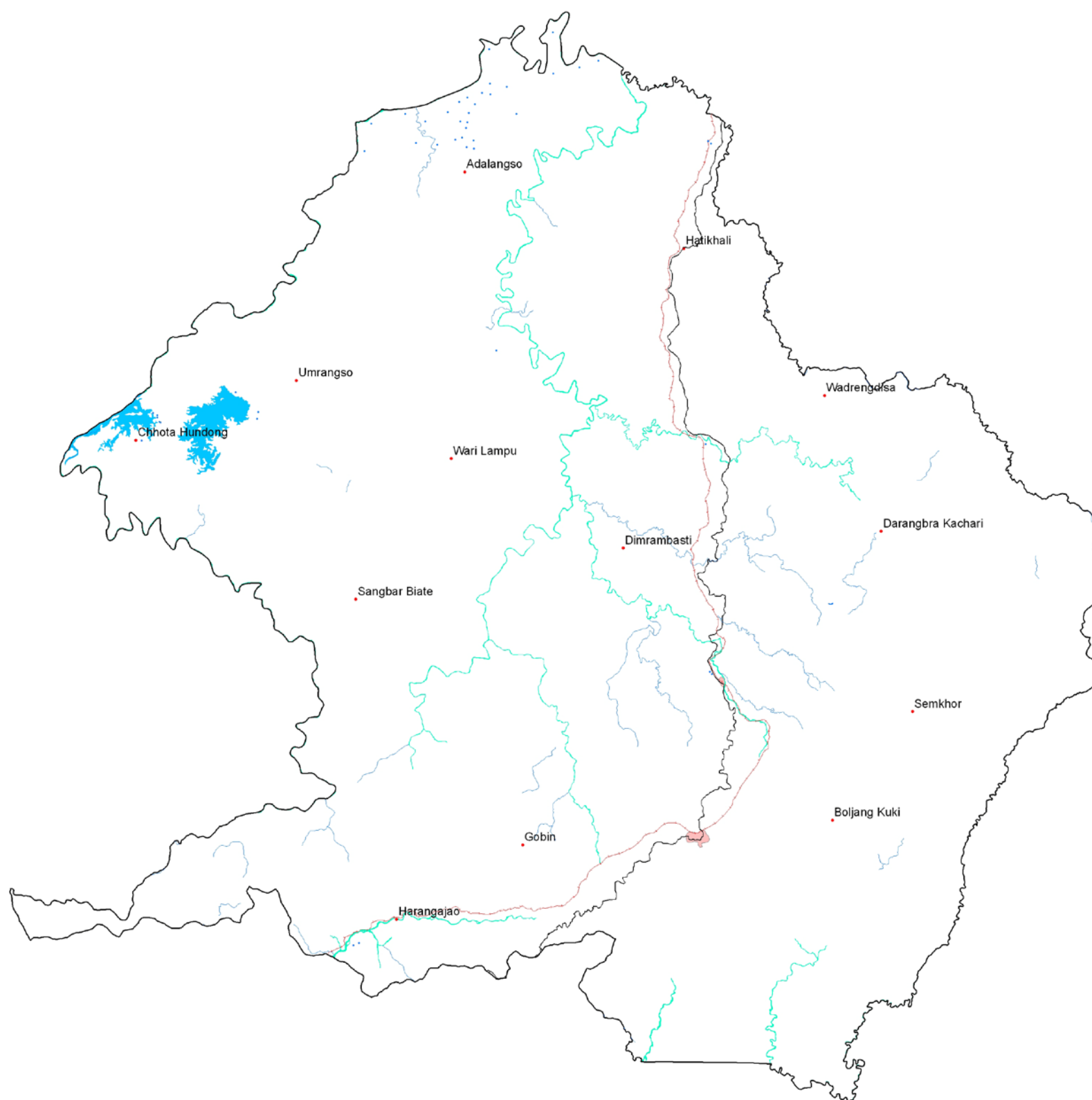
Aquatic vegetation is mainly observed in Reservoir/Barrage wetland types. The area under aquatic vegetation is significantly more during pre monsoon (1487 ha) compared to post monsoon (634 ha). Seasonal fluctuation of open water spread of wetlands is more during post monsoon (6004 ha) compared to pre monsoon (4385 ha). The turbidity of water is low to moderate in both the seasons.

Table 97: Area estimates of wetlands in North Cachar Hills

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	2	7	0.11	7	7
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	-	-	-	-	-
6	1106	River/Stream	11	3735	56.43	3812	3032
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	2	2833	42.80	2185	1346
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
		Sub-Total	15	6575	99.34	6004	4385
		Wetlands (<2.25 ha), mainly Tanks	44	44	0.66	-	-
		Total	59	6619	100.00	6004	4385

Area under Aquatic Vegetation	634	1487
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Area under turbidity levels		
Low	2190	1350
Moderate	3811	3032
High	3	3

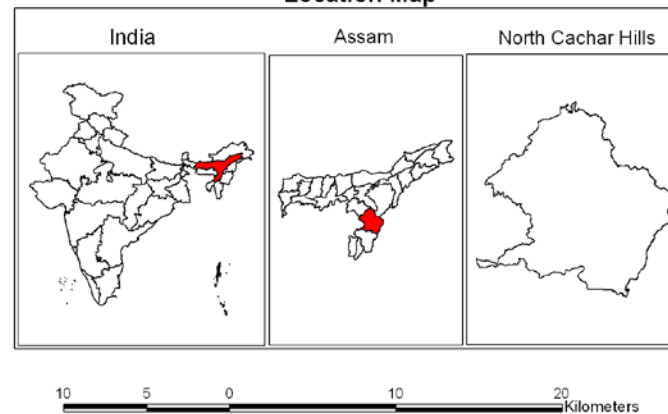


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

Sponsored By:

Ministry of Environment and Forests
Government of India

7.8.21 Cachar

Cachar district is situated in the lower Brahmaputra valley of Assam between 24°20'N and 25°10'N latitudes and 92°15'E and 93°15'E longitudes. It occupies 3, 77,600 hectares of area. The district is bounded by Manipur on the east, y Hailakandi district and Bangladesh in west, and Mizoram state on the south. Most of the areas in the district consist of hills and inselbergs leaving behind very little plain area. The main river flowing along the Central part of the district is the Barak and its tributaries viz., the Rukni and the Sonai. The Barak river flows along east-west direction. All the rivers are perennial in nature. The lowlying areas are usually characterised by the presence of natural lakes and swamps, locally known as 'haors'. The soils of the district vary from alluvial to lateritic, the major areas having a clayey loam to clayey texture. Loam to sandy loam soils are found in riverine tracts of the main river Barak and its tributaries. The average annual rainfall as recorded in the district is 2717mm. The maximum temperature recorded is 37.4°C and the minimum temperature is 9°C. As per Census Report, 2001, the district has a total population of 14, 44,921.

Total wetland area in the district is 10419 ha that includes 46 small wetlands (<2.25 ha). The wetlands belong to Inland- Natural type. River/stream occupies 55.22% of wetlands. The other major wetland types area Waterlogged –natural (29.66%) and Lake/pond (14.35%). Details of wetland statistics is given in Table.98.

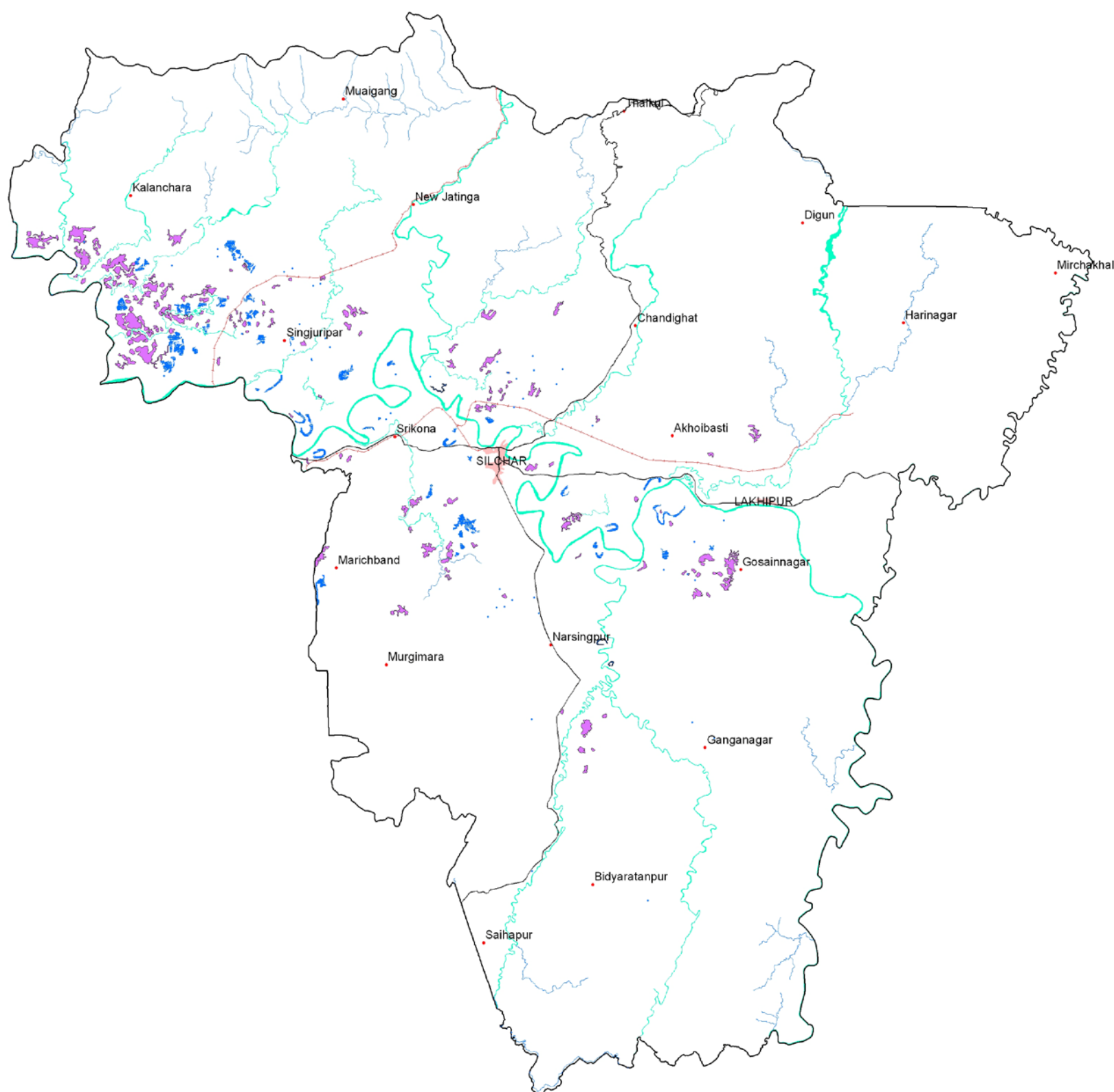
Aquatic vegetation is mainly observed in Waterlogged and Lake/pond wetland types. The area under aquatic vegetation is significantly more during pre monsoon (1872 ha) compared to post monsoon (137 ha). Seasonal fluctuation of open water spread of wetlands is more during post monsoon (10023 ha) compared to pre monsoon (8286 ha). The turbidity of water is low to moderate in both the seasons.

Table 98: Area estimates of wetlands in Cachar

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	49	1495	14.35	1458	1098
2	1102	Ox-bow lakes/ Cut-off meanders	3	31	0.30	31	31
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	142	3090	29.66	2968	1593
6	1106	River/Stream	17	5757	55.25	5566	5564
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
		Sub-Total	211	10373	99.56	10023	8286
		Wetlands (<2.25 ha), mainly Tanks	46	46	0.44	-	-
		Total	257	10419	100.00	10023	8286

Area under Aquatic Vegetation	137	1872
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Area under turbidity levels		
Low	3654	2023
Moderate	6369	6263
High	-	-

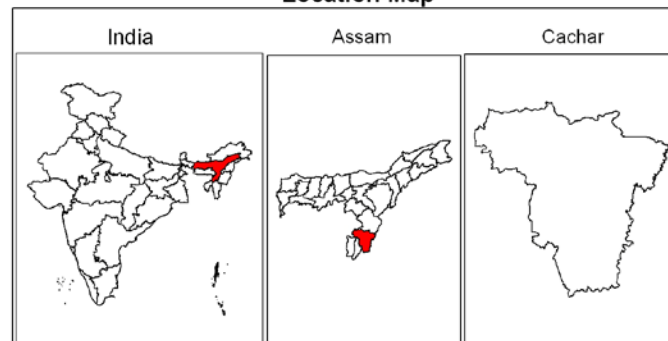


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



6 3 0 6 12 Kilometers

Data Source :

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

Prepared By :

Space Applications Centre (ISRO), Ahmedabad
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Assam Remote Sensing Applications Centre, Guwahati

Sponsored By:

Ministry of Environment and Forests
Government of India

7.8.22 Karimganj

Karimganj district is situated in the S-W part of Assam state between 24°14'N and 24°54'N latitudes and 92°16'E and 92°35'E longitudes. It occupies 1, 76,285 hectares of area. It is bounded on the east by the Cachar district of Assam and the state of Mizoram, on the west by the state of Tripura and Bangladesh, on the north by the Cachar district of Assam and Bangladesh and on the south by the state of Mizoram. The topography of the district is characterised by hills and valley fills. The Barak river flows on the northern part of the district and meet the river Surma near Bhanga from where it flows as river Kusiya along the northern boundary of the district. There are two other main rivers flowing from the south to the north and these are Longai and Singla rivers which join with the river Kusiya in the north. The average annual rainfall in the district is 3759.6 mm. The maximum temperature recorded during the month of June is about 36°C and minimum temperature is about 8°C during the month of December-January. The soils of the district are mostly made of older. Alluvium having a texture of clay loam to clayey. In some parts it is sandy loam in texture. The soil in the district is acidic to neutral in reaction with pH ranging from 4.5 to 6.0. As per Census Report, 2001, the district has a total population of 10, 07,976.

Total wetland area in the district is 6450 ha that includes 98 small wetlands (<2.25 ha). The major wetland type is Lake/pond. Total 8 Lake/pond are mapped with 3593 ha area (55.71%). The other major wetland types area River/stream (23.81%) and Waterlogged –natural (18.96%) Details of wetland statistics is given in Table.99.

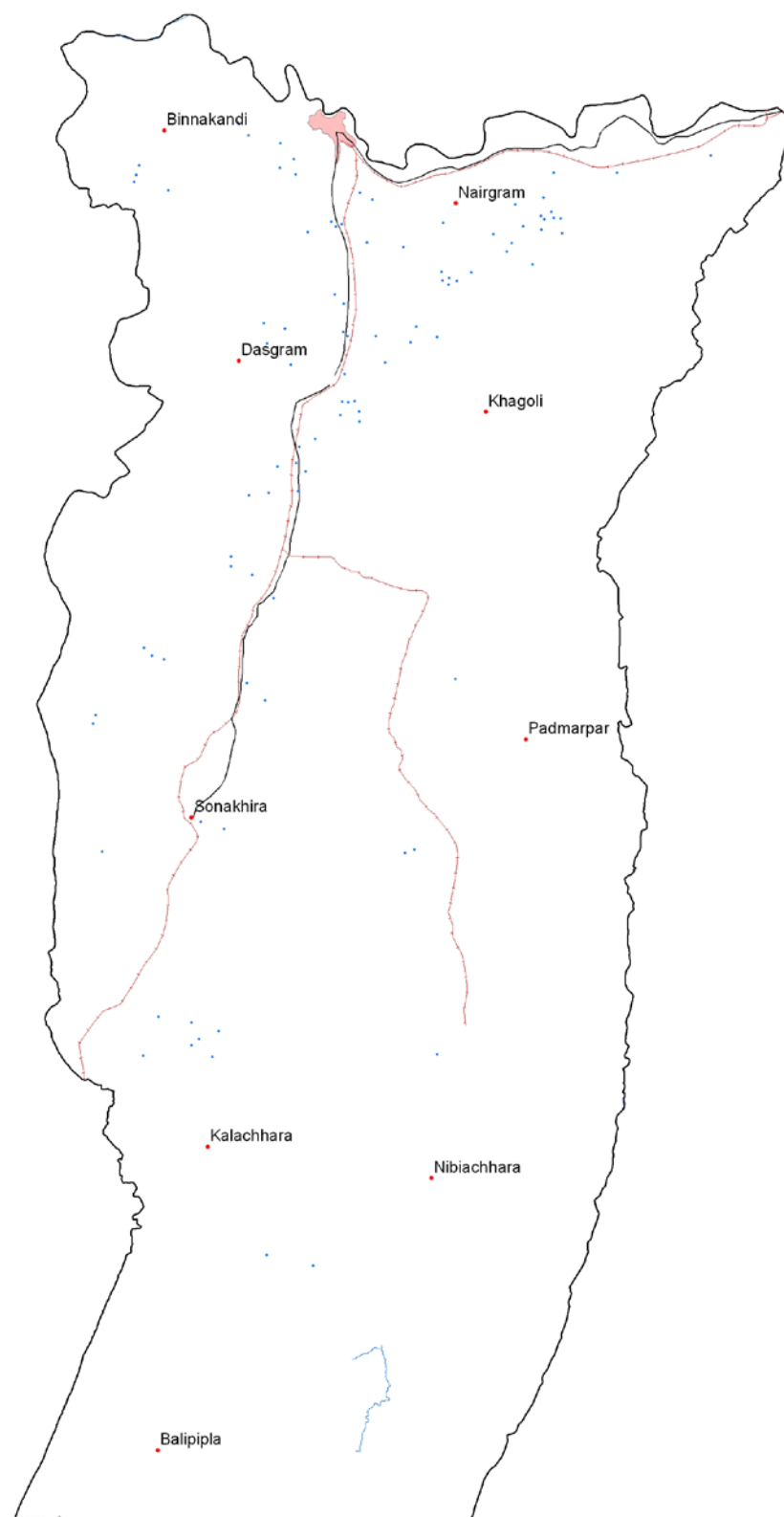
Aquatic vegetation is mainly observed in Waterlogged and Lake/pond wetland types. The area under aquatic vegetation is significantly more during pre monsoon (3206 ha) compared to post monsoon (527 ha). Seasonal fluctuation of open water spread of wetlands is more during post monsoon (5548 ha) compared to pre monsoon (2857 ha), mainly due to fluctuation of water in Lake/pond type. The turbidity of water is low to moderate in both the seasons.

Table 99: Area estimates of wetlands in Karimgani

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	8	3593	55.71	3305	976
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	82	1223	18.96	890	528
6	1106	River/Stream	5	1536	23.81	1353	1353
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	95	6352	98.48	5548	2857
		Wetlands (<2.25 ha), mainly Tanks	98	98	1.52	-	-
		Total	193	6450	100.00	5548	2857

Area under Aquatic Vegetation	527	3206
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Area under turbidity levels		
Low	4031	1321
Moderate	1517	1536
High	-	-

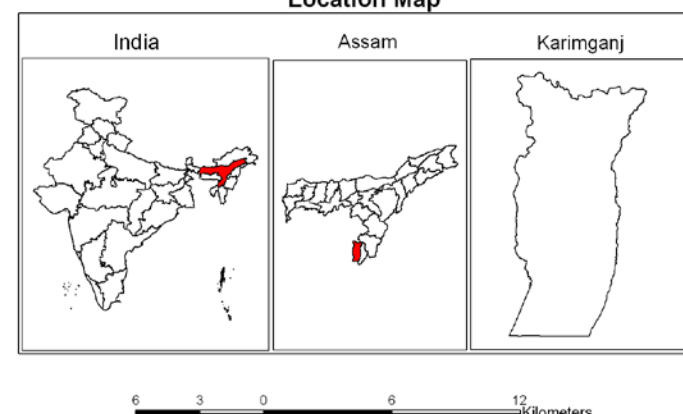


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

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

Location Map



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

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Government of India

7.8.23 Hailakandi

Hailakandi district is situated in the lower Brahmaputra valley of Assam between 24°10'N and 24°55'N latitudes and 92°25'E and 92°45'E longitudes. It occupies 1, 32,600 hectares of area. The district is bounded by the interstate boundary of Mizoram and Cachar district of Assam on the east, Karimganj district on the west. The north boundary is marked by parts of Cachar and Karimganj districts while Mizoram is on the south. The district shares the Son Beel wetland, largest in the state, along the western boundary with Karimganj district. Most of the areas in the district consist of hills and inselbergs leaving behind very little plain area. The low lying areas are usually characterised by the presence of natural lakes and beels, locally known as 'haors'. The main river flowing along the northern boundary of the district is the Barak and its tributaries viz., the Katakhal and the Dhaleswari. All the rivers flow northwards from the hills of Mizoram. The Barak river flows along east-west direction. The soils of the district mostly made of older alluvium having a texture of clay-loam to clayey. Beel soils (peat soils) are also found in some areas. The soil in the district is acidic to neutral in reaction with pH ranging from 4.5 to 6.0. As per Census Report, 2001, the district has a total population of 5, 42,872. The average annual rainfall is 2717mm. The maximum temperature recorded during summer is 37.4°C and the minimum temperature recorded during winter is 9°C.

Total wetland area in the district is 2600 ha that includes 30 small wetlands (<2.25 ha). The major wetland type is River/stream (66.27%). Total 19 Lake/pond are mapped with 575 ha area (22.12%). The other major wetland type is Waterlogged-natural (10.46%). Details of wetland statistics is given in Table.100.

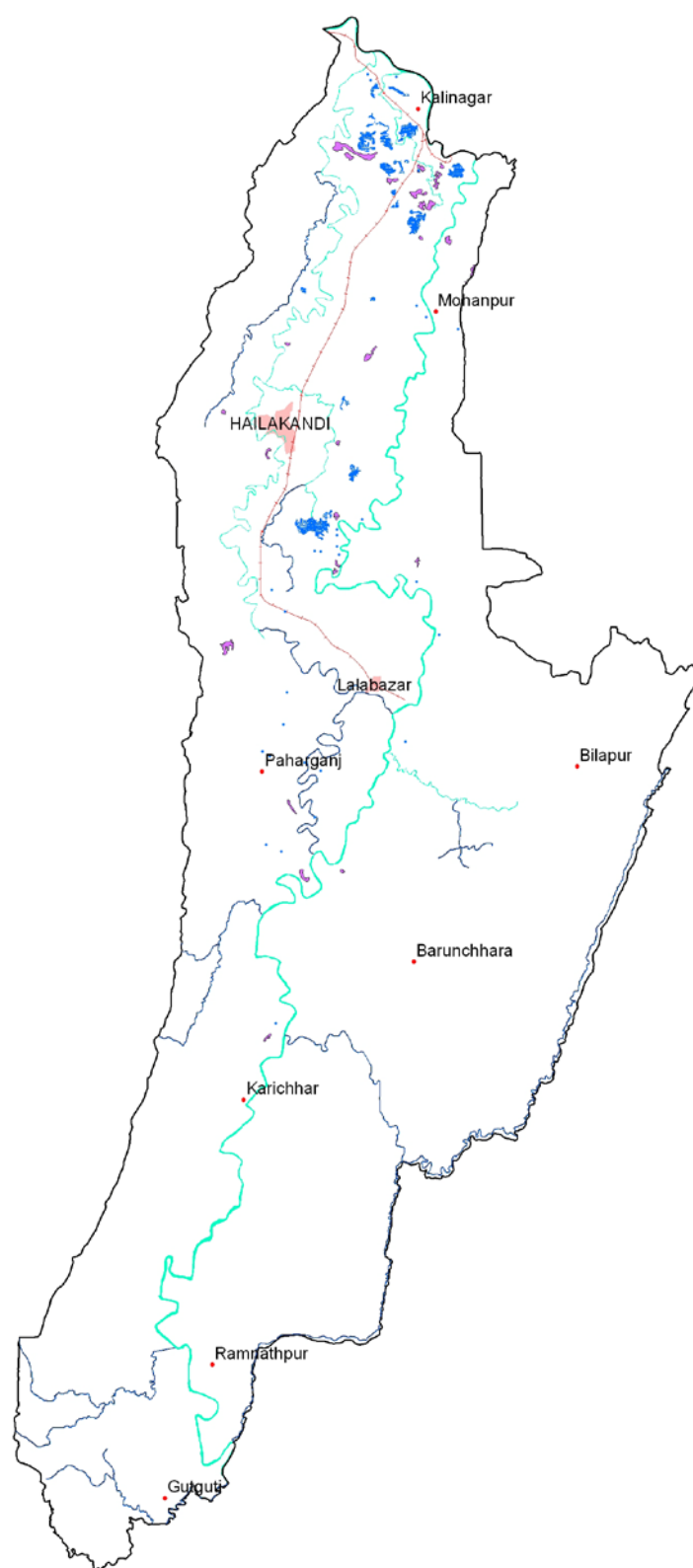
Aquatic vegetation is mainly observed in Waterlogged and Lake/pond wetland types. The area under aquatic vegetation is significantly more during pre monsoon (380 ha) compared to post monsoon (64 ha). Seasonal fluctuation of open water spread of wetlands is more or less same in both the seasons. The turbidity of water is low to moderate in both the seasons.

Table 100: Area estimates of wetlands in Hailakandi

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	19	575	22.12	540	311
2	1102	Ox-bow lakes/ Cut-off meanders	-	-	-	-	-
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	-	-	-	-	-
5	1105	Waterlogged	27	272	10.46	245	156
6	1106	River/Stream	6	1723	66.27	1699	1699
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	-	-	-	-	-
9	1203	Waterlogged	-	-	-	-	-
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	52	2570	98.85	2484	2166
		Wetlands (<2.25 ha), mainly Tanks	30	30	1.15	-	-
		Total	82	2600	100.00	2484	2166

Area under Aquatic Vegetation	64	380
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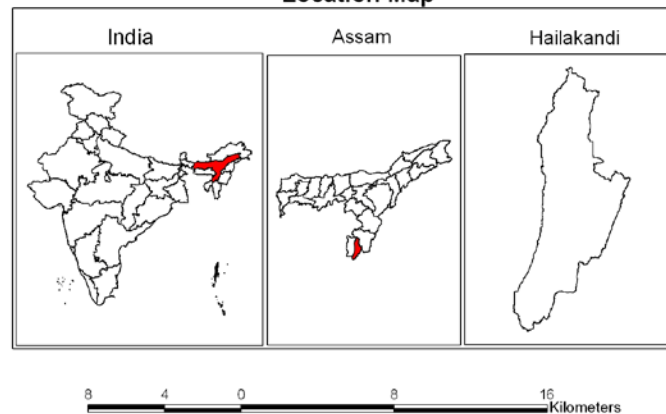
Area under turbidity levels		
Low	781	367
Moderate	1703	1799
High	-	-



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

Legend

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

Location Map**Data Source :**

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

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MAJOR WETLAND TYPES

8.0 MAJOR WETLAND TYPES OF NORTH EASTERN STATES

Major wetland types observed in North-Eastern States are rivers/streams, lakes/ponds, waterlogged, ox-bow lakes, high altitude lakes and reservoirs. The wetlands as seen in remote sensing image and derived indice images is shown in Plates 1a-1i. Field photographs of different wetland types are shown in Plates 2a-2j.

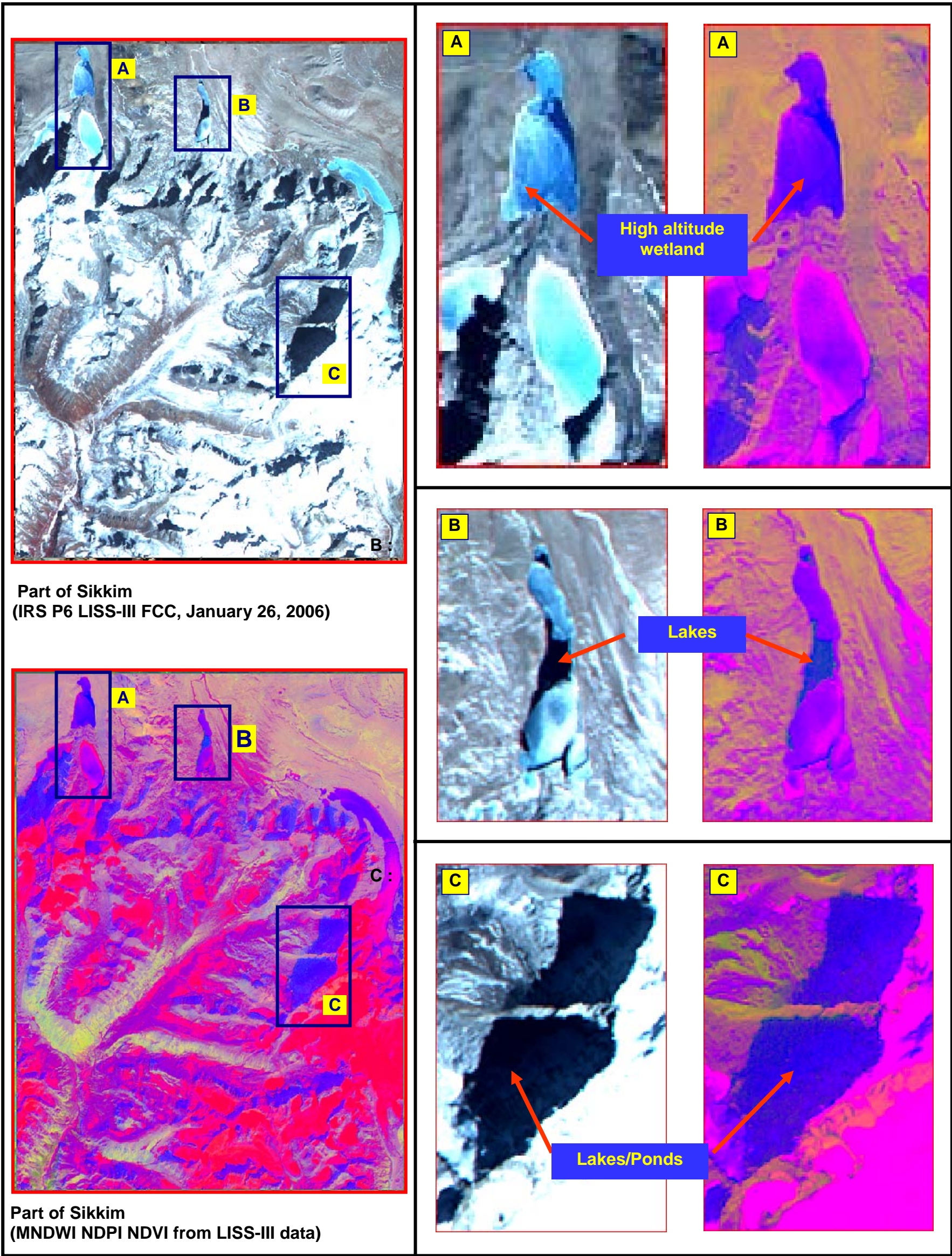
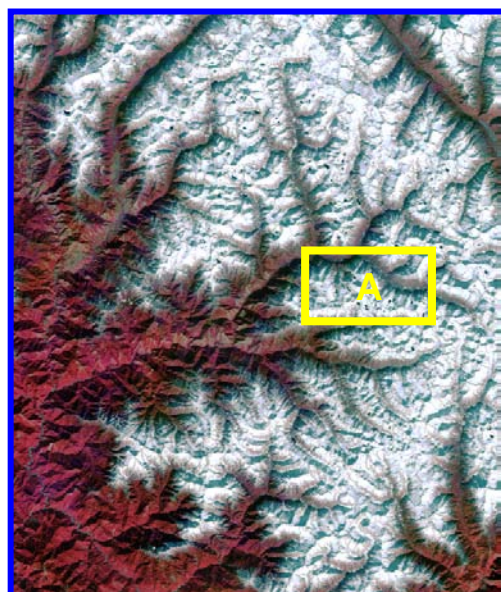
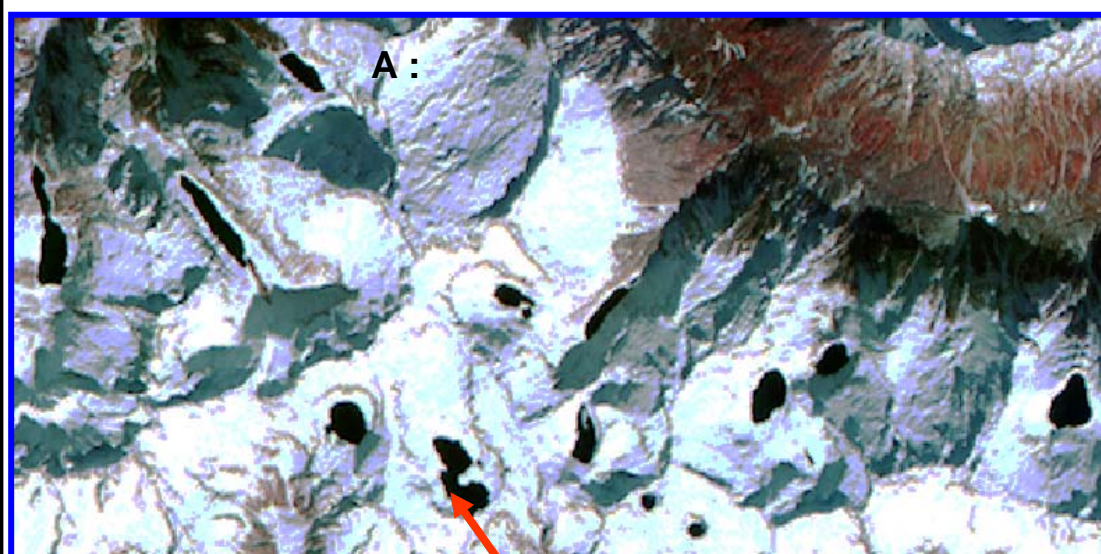


Plate - 1a: Major wetland types of Sikkim

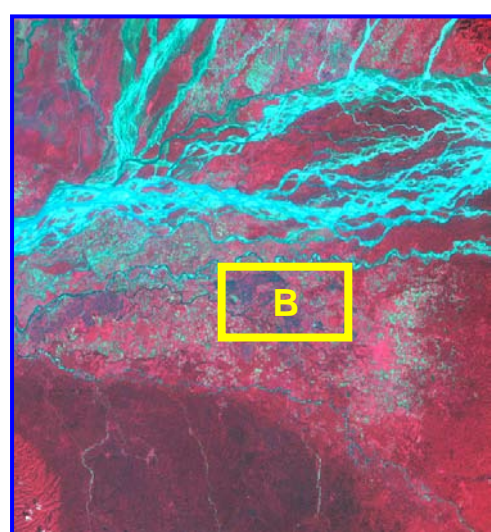
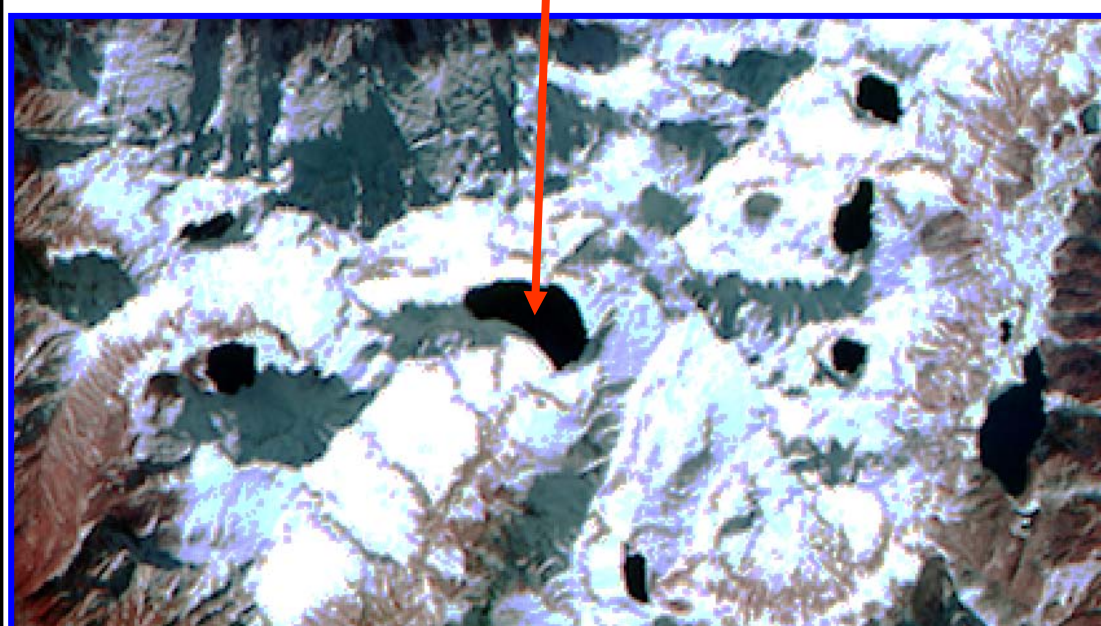


Part of Dibang Valley
(IRS P6 LISS-III data, 15 Dec. 06)

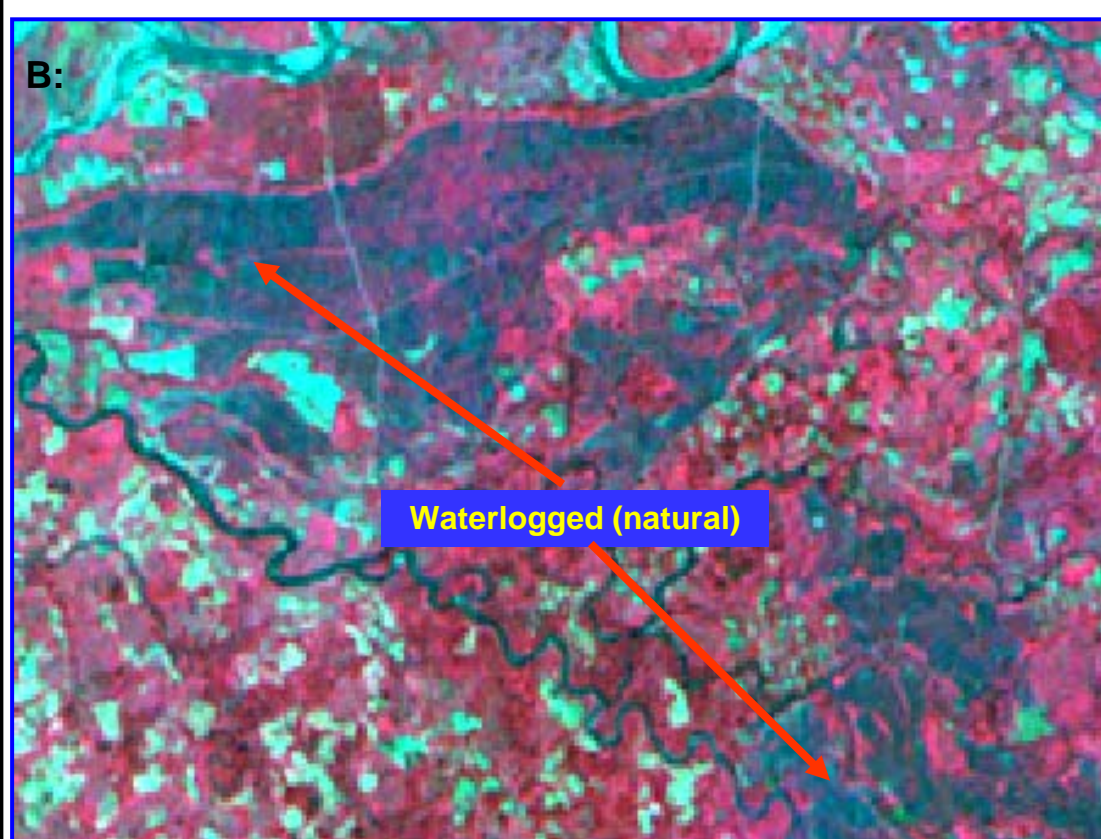


A:

High Altitude Wetlands

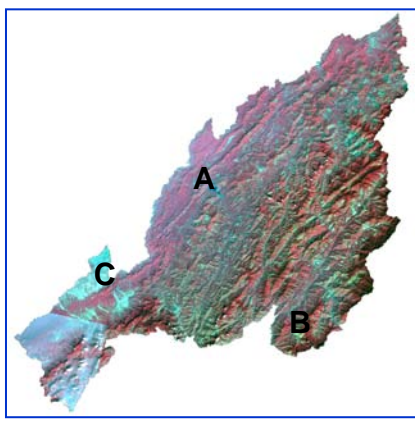


Part of Lohit District
(IRS P6 LISS-III data, 27 Jan. 07)



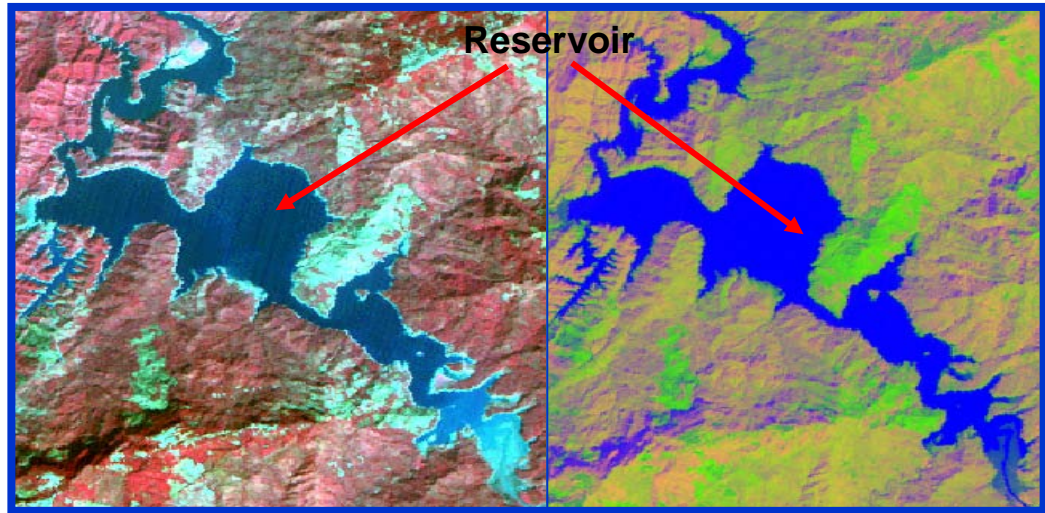
Waterlogged (natural)

Plate – 1b: Major wetland types of Arunachal Pradesh

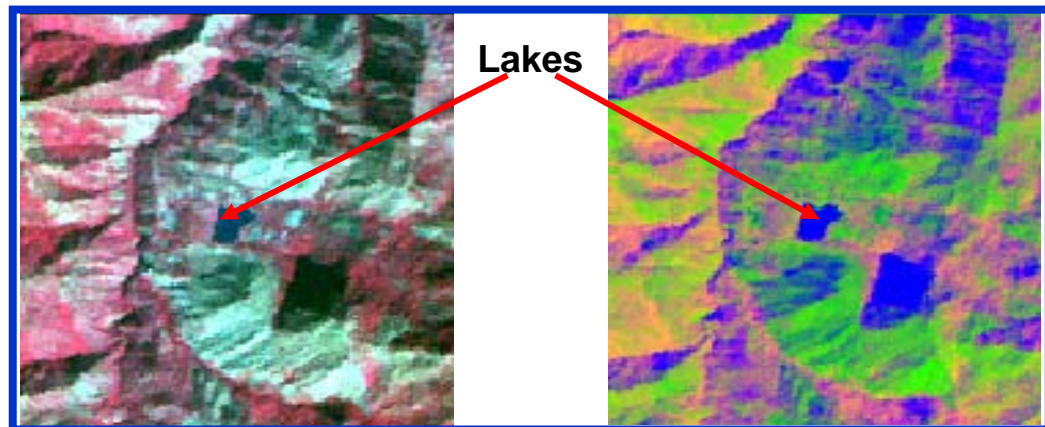


IRS P6 LISS-III FCC

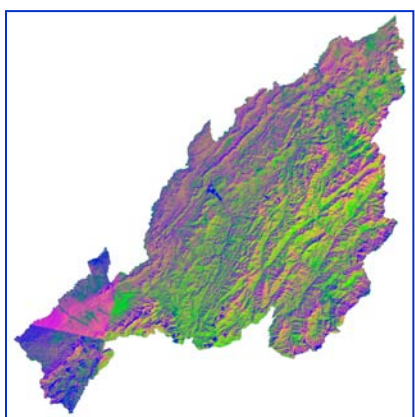
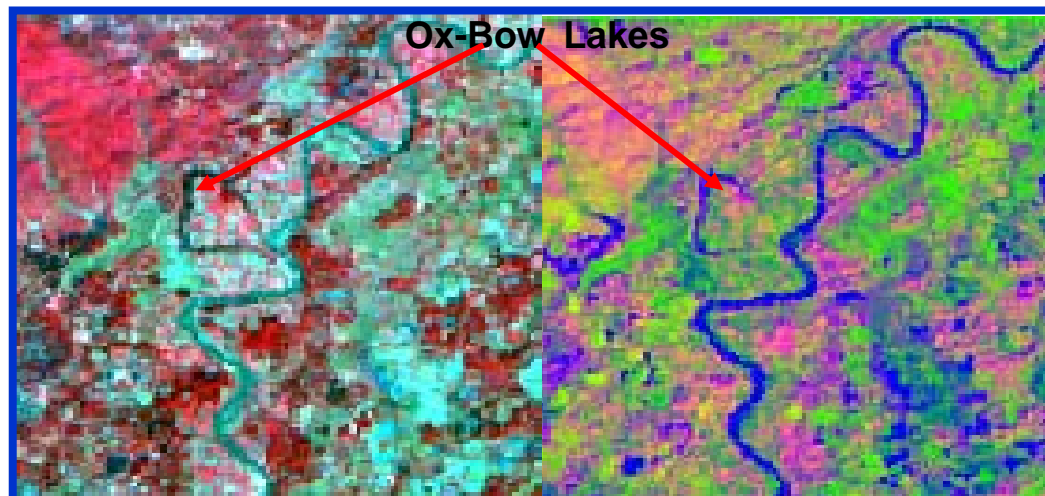
A.



B.



C.



MNDWI NDPI NDVI (Indices from LISS-III)

Plate – 1c: Major wetland types of Nagaland

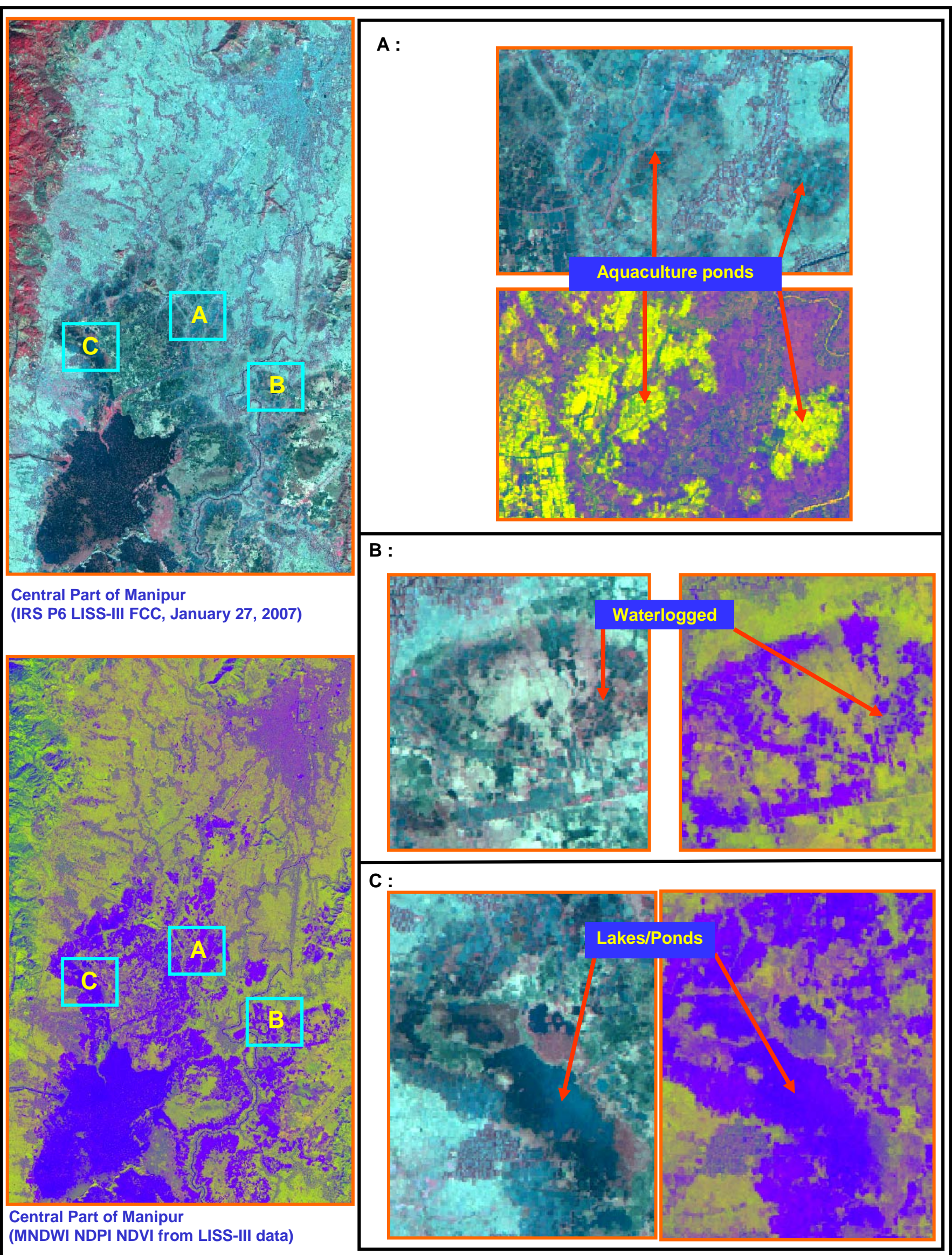


Plate – 1d: Major wetland types of Manipur

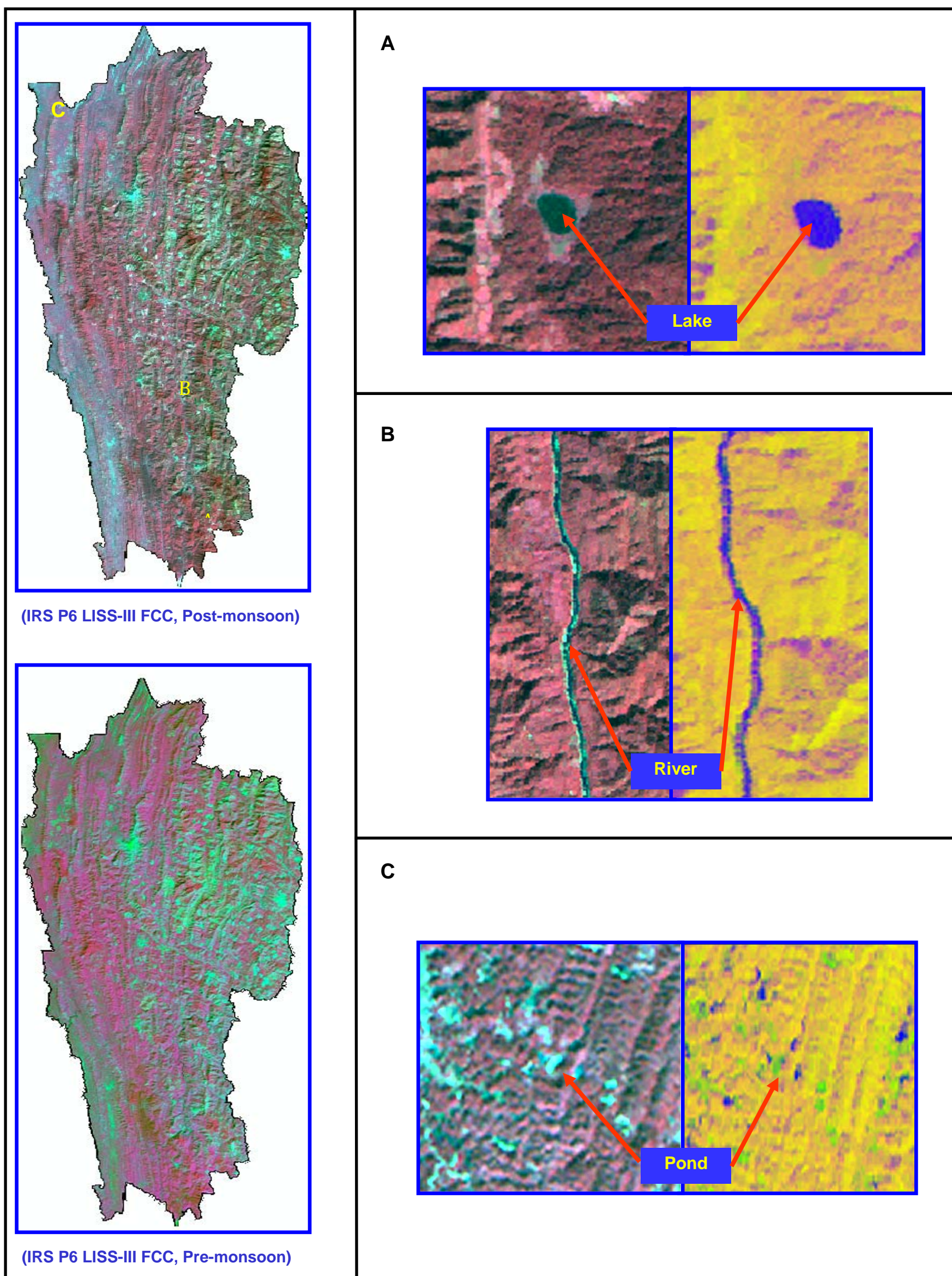


Plate – 1e: Major wetland types of Mizoram

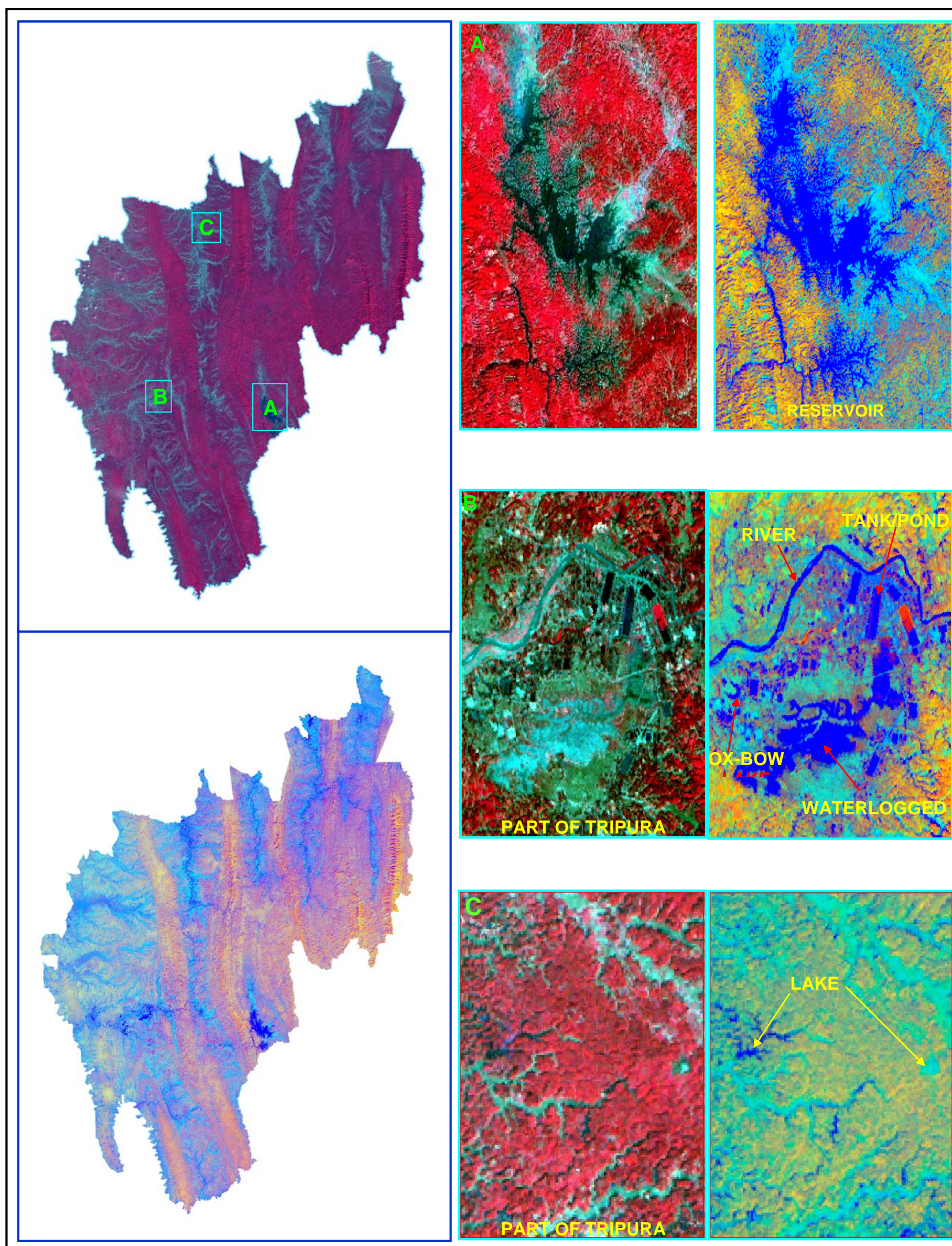


Plate – 1f: Major wetland types of Tripura

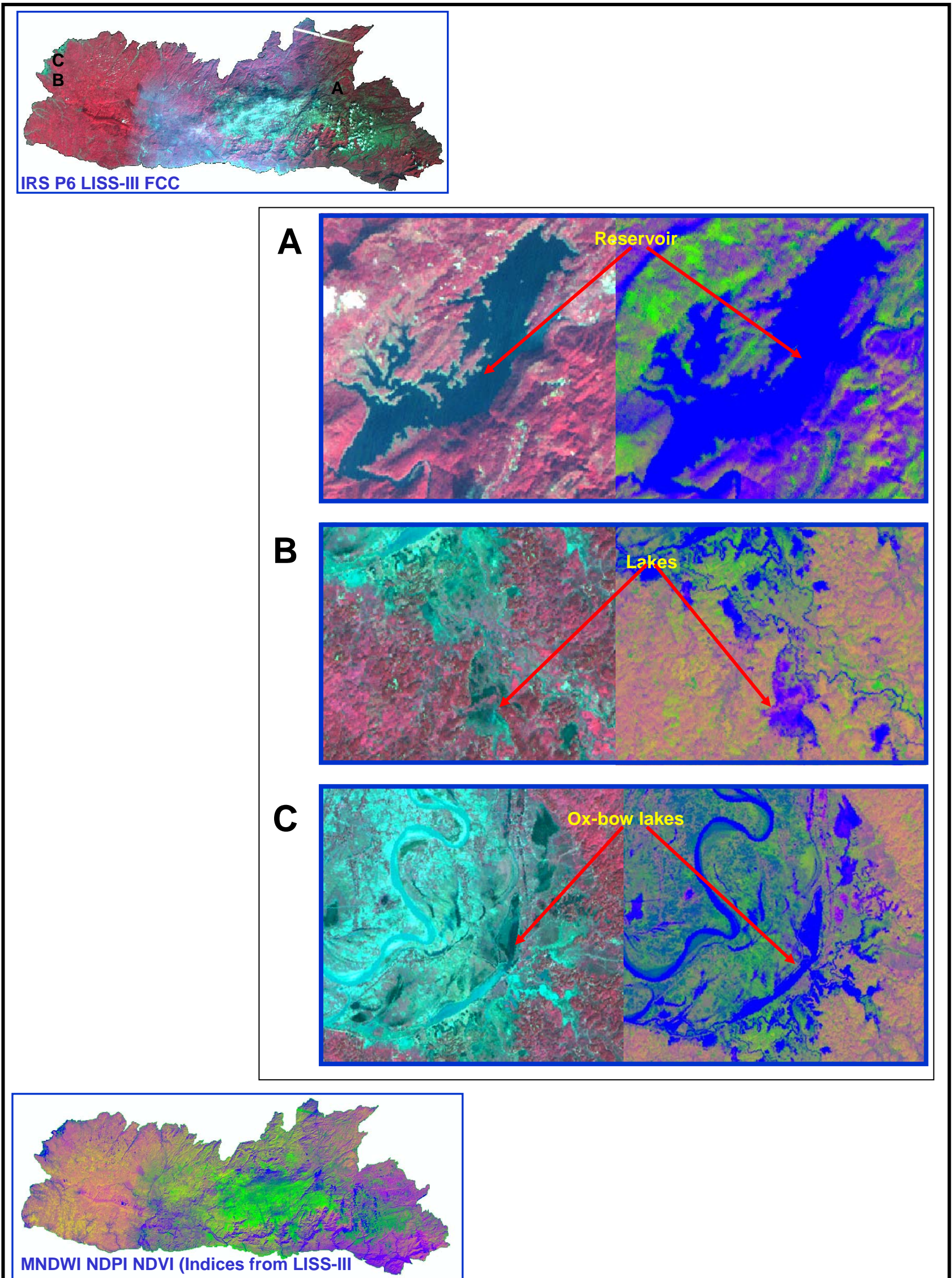


Plate – 1g: Major wetland types of Meghalaya

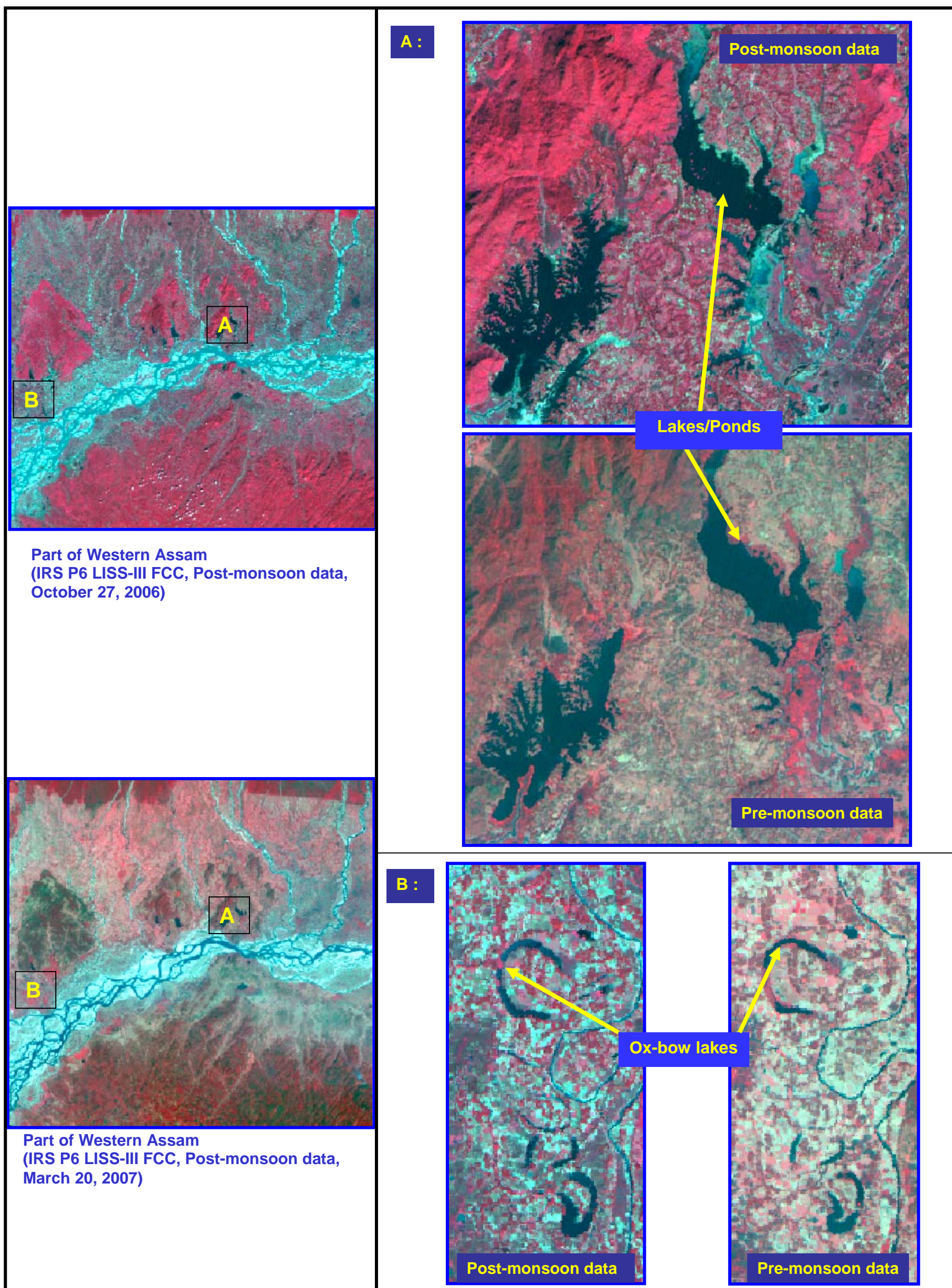
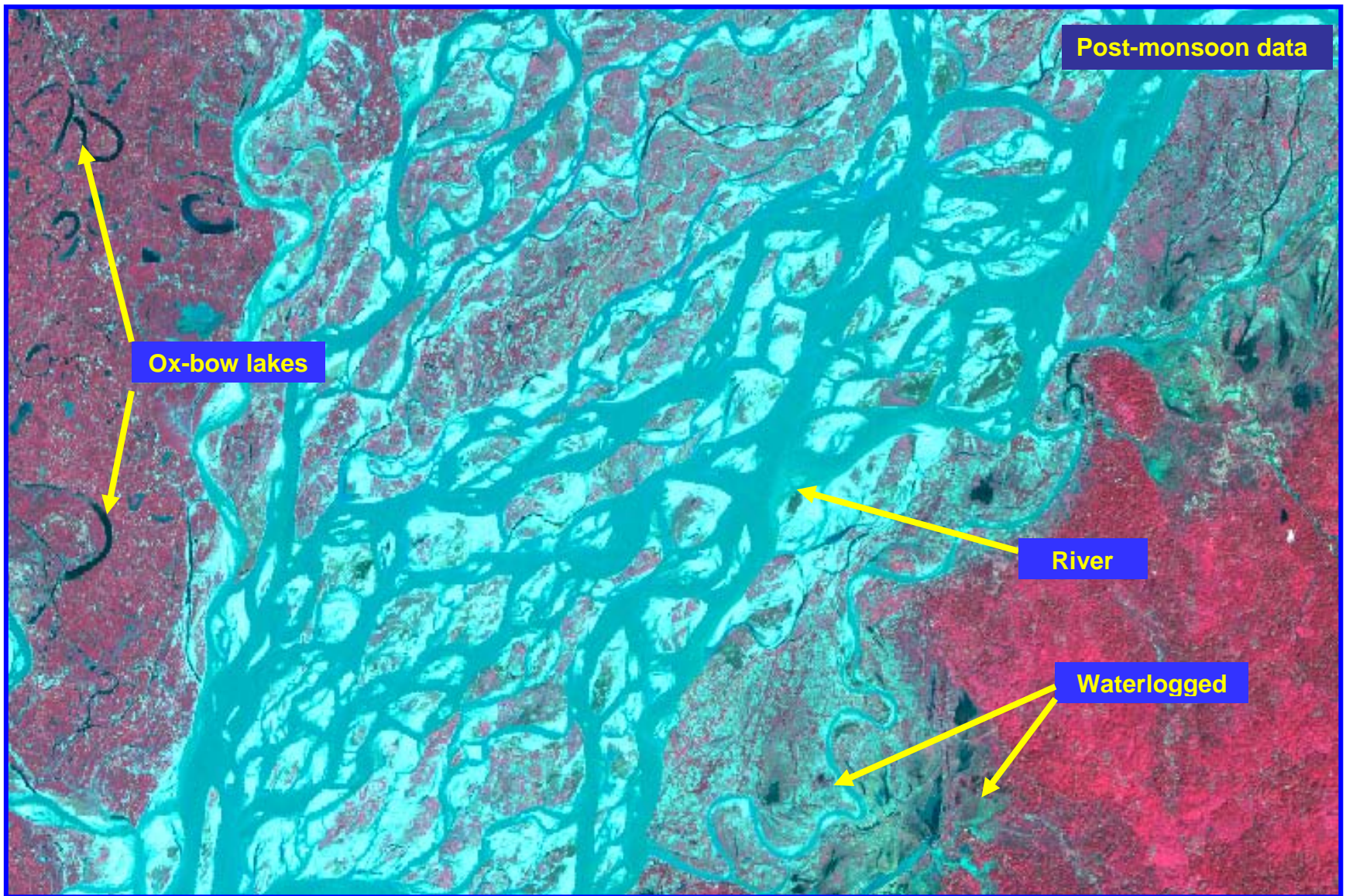


Plate – 1h: Major wetland types of Assam



Part of Western Assam

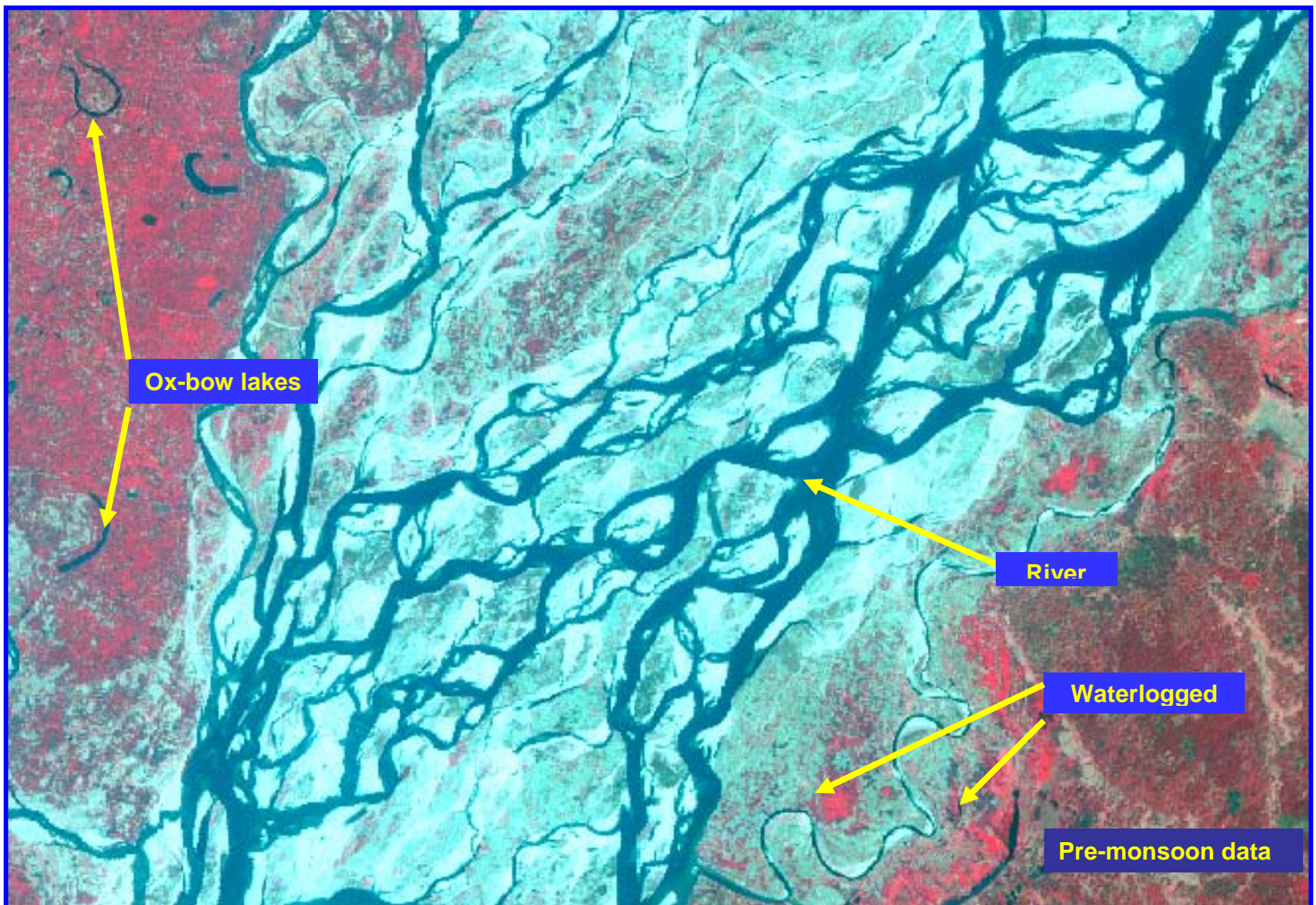


Plate – 1i: Major wetland types of Assam





Sr. No.	Description	Field photograph
1.	<p>Wetland Type: Natural Lake Name: Shilloi Lake</p> <p>Location : Longitude: 94 ° 47' 41.80"E Latitude : 25 ° 35' 42.55"N</p>	
2.	<p>Wetland Type : Reservoir Name: Likhimro</p> <p>Location : Longitude: 94 ° 52' 31.93"E Latitude : 25 ° 46' 39.84"N</p>	
3.	<p>Wetland Type : River Name: Tizü</p> <p>Location : Longitude: 94 ° 35' 06.94"E Latitude: 25 ° 38' 26.05"N</p> <p>Turbidity : Medium</p>	
4.	<p>Wetland Type : River Name: Züngki</p> <p>Location : Longitude: 94 ° 50' 47.68"E Latitude : 26 ° 02' 06.05"N</p> <p>Turbidity : High</p>	

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


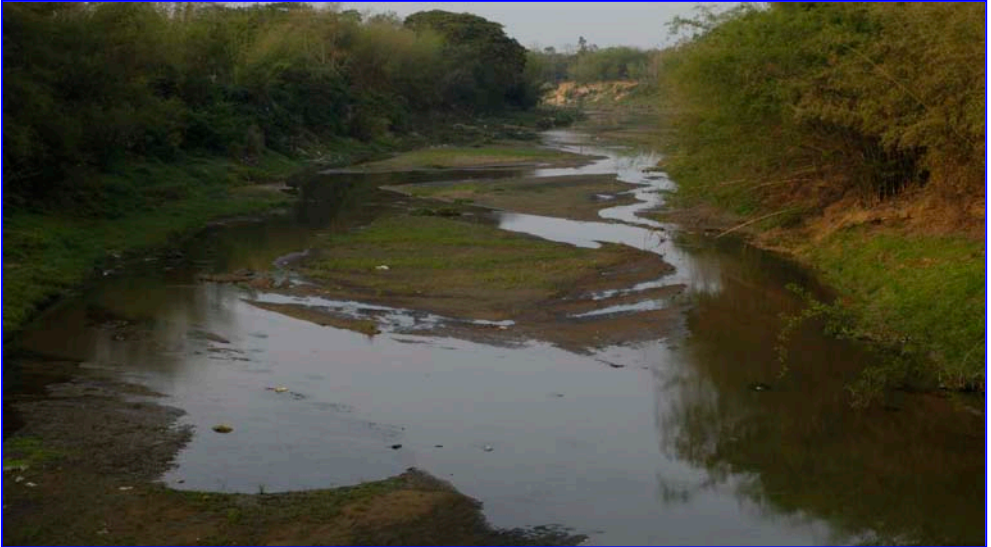


Sr. No.	Description	Field photograph
5.	Wetland Type: Reservoir Name: Chathe Location: Longitude: 93 ° 48' 26.84"E Latitude : 25 ° 45' 52.98"N	
6.	Wetland Type: River Name: Dhansiri Location: Longitude: 93 ° 44' 07.88"E Latitude : 25 ° 53' 11.57"N	
7.	Wetland Type: River Name: Dikhu Location: Longitude: 94 ° 35' 26.93"E Latitude: 26 ° 17' 55.96"N Turbidity: Medium	
8.	Wetland Type: Reservoir Name: Doyang Location : Longitude: 94 ° 17' 13.97"E Latitude : 26 ° 7' 32.68"N	

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





Sr. No.	Description	Field photograph
9	<p>Wetland Type: Lake/Pond (Northern part of Loktak lake)</p> <p>Location: longitude: 93° 48' 58" E latitude : 24° 36' 10" N</p> <p>Turbidity : High</p> <p>Aquatic Vegetation : Yes</p>	
10	<p>Wetland Type: Lake/Pond</p> <p>Location: longitude: 93° 48' 34" E latitude : 24° 35' 54" N</p> <p>Turbidity : Moderate</p> <p>Aquatic Vegetation : Yes</p>	
11	<p>Wetland Type: Lake/Pond (Western part of Loktak lake)</p> <p>Location: longitude: 93° 46' 21" E latitude : 24° 33' 38" N</p> <p>Turbidity : Moderate</p> <p>Aquatic Vegetation : Yes</p>	
12	<p>Wetland Type: Lake/Pond (Central part of Loktak lake)</p> <p>Location: longitude: 93° 48' 18" E latitude : 24° 33' 10" N</p> <p>Turbidity : Moderate</p> <p>Aquatic Vegetation : Yes</p>	

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





Sr. No.	Description	Field photograph
13	Wetland Type : Lake/Pond Location: Longitude: 93°48'32" E Latitude : 24°35'5" N Turbidity: Low Aquatic Vegetation: Yes	
14	Wetland Type : Lake/Pond Location: Longitude: 93°48'9" E Latitude : 24°38'31" N Turbidity: Low Aquatic Vegetation: Yes	
15	Wetland Type : Waterlogged (permanent) Location: Longitude: 93°55'32" E Latitude : 24°37'55" N Turbidity: Moderate Aquatic Vegetation: Yes	
16	Wetland Type : Waterlogged (permanent) Location: Longitude: 93°55'33" E Latitude : 24°37'55" N Turbidity: Moderate Aquatic Vegetation: Yes	

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




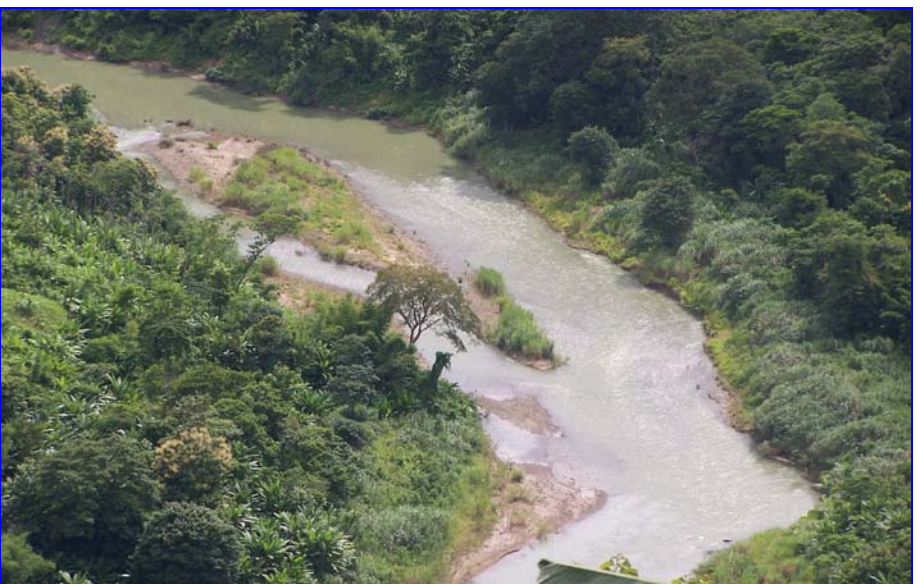
Sr. No	Description	Field Photographs
17	Wetland Type : Lake-Palak Location : Longitude : 92 ⁰ 53' E Latitude : 22 ⁰ 12' N	
18	Wetland Type : River-Chhimtuipui Location : Longitude : 92 ⁰ 57' E Latitude : 22 ⁰ 22' N	
19	Wetland Type :Lake-Rungdil Location : Longitude : 93 ⁰ 03' E Latitude : 23 ⁰ 59' N	
20	Wetland Type : River-Tut Location : Longitude : 92 ⁰ 31' E Latitude : 23 ⁰ 46' N	

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





Sr. No	Description	Field Photographs
21	Wetland Type : Lake Collage Tilla Lake Location : Longitude : 91 ⁰ 27' E Latitude : 23 ⁰ 49' N	
22	Wetland Type : Waterlogged Belabar Jolla Location : Longitude : 91 ⁰ 14' E Latitude : 23 ⁰ 48' N	
23	Wetland Type :Lake Khawra Bil Location : Longitude : 92 ⁰ 00' E Latitude : 24 ⁰ 22' N	
24	Wetland Type :Tank/Pond Lakhi Narayan (Bari Dighi) Location : Longitude : 91 ⁰ 17' E Latitude : 23 ⁰ 50' N	

Plate 2f: Field photographs and ground truth data of different wetland types in Tripura





Sr. No.	Description	Field photograph
25	<p>Wetland Type : Man-made Reservoir Name: Umiam/Barapani</p> <p>Location : longitude: 91⁰ 51' E latitude : 25⁰ 37' N</p> <p>Aquatic Vegetation : Absent</p> <p>Turbidity : Low</p>	
26	<p>Wetland Type : River Name: River Island – Nongkhnum</p> <p>Location: longitude: 91⁰ 14' E latitude : 25⁰ 25' N</p> <p>Turbidity : Moderate</p>	
27	<p>Wetland Type: River Name: Ranikor</p> <p>Location: longitude: 91⁰ 14' E latitude : 25⁰ 13' N</p> <p>Turbidity : Low</p>	
28	<p>Wetland Type: River Santuksiar</p> <p>Location : Longitude: 92⁰ 12' E Latitude : 25⁰ 26' N</p> <p>Turbidity : Low</p>	

Plate 2g: Field photographs and ground truth data of different wetland types in Meghalaya





Sr. No.	Description	Field photograph
29	<p>Wetland Type: River/stream</p> <p>Wetland Name: Brahmaputra River</p> <p>Location: Longitude: 92°14'10.2"E Latitude : 26°24'29.2" N</p> <p>Turbidity: low</p>	
30	<p>Wetland Type: Lake</p> <p>Wetland Name: Deepor Beel</p> <p>Location: Longitude: 91°39'30.9" E Latitude : 26°06'46" N</p> <p>Turbidity: High</p>	
31	<p>Wetland Type: Waterlogged (natural)</p> <p>Location: Longitude : 92°15'30.5"E Latitude : 26°19'29.3"N</p> <p>Turbidity: Moderate</p>	
32	<p>Wetland Type: Tank / Pond</p> <p>Wetland Name: Anua Beel</p> <p>Location: Longitude: 90°21.02'E Latitude : 26°32.94" N</p> <p>Turbidity: Moderate</p>	

Plate 2h: Field observations of different wetland types in Assam





Sr. No.	Description	Field photograph
33.	<p>Wetland Type: River/stream</p> <p>Wetland Name: Beki River</p> <p>Location: Longitude: 90°55'02.6"E Latitude : 26°31'01.5"N</p> <p>Turbidity: Moderate</p>	
34.	<p>Wetland Type: Ox-bow lake</p> <p>Wetland Name: Saren Beel</p> <p>Location: Longitude: 91°46'42.5"E Latitude : 26°06'46" N</p> <p>Turbidity: Moderate</p>	
35.	<p>Wetland Type: Waterlogged (natura)</p> <p>Wetland Name: Naitara Beel</p> <p>Location: Longitude : 90°59.07"E Latitude : 26°03.16'N</p> <p>Turbidity: Moderate</p>	
36.	<p>Wetland Type: Tank / Pond</p> <p>Wetland Name: Hajo Pukhuri</p> <p>Location: Longitude: 91°31'54"E Latitude : 26°14'36"N</p> <p>Turbidity : Low</p>	

Plate 2i: Field observations of different wetland types in Assam





Sr. No.	Description	Field photograph
37	<p>Wetland Type: High altitude lake (Khechodpalri Lake)</p> <p>Location: latitude: 27° 21' 10.13" longitude: 88° 11' 25.23" Altitude: 1820 m Turbidity: moderate Aquatic Vegetation on the periphery</p>	
38	<p>Wetland Type: High altitude lake (Gunudogmar Lake)</p> <p>Location: latitude: 28° 02' 07.88" longitude: 88° 42' 44.36" Altitude: 5,134 m Turbidity: Low Aquatic Vegetation: NIL</p>	
39	<p>Wetland Type: High altitude lake (Tsomgo Lake)</p> <p>Location: latitude: 27° 21' 28.36" longitude: 88° 46' 00.40" Altitude: 3,759 m Turbidity: Moderate Aquatic Vegetation: No</p>	
40	<p>Wetland Type: River (River Tista)</p> <p>Turbidity: Moderate</p>	

Plate 2j: Field observations of different wetland types in Sikkim

IMPORTANT WETLANDS OF N-E STATES

9.0 IMPORTANT WETLANDS OF NORTH-EASTERN STATES

The N-E states have large number of lakes/ponds, rivers, ox-bow lakes, high altitude lakes and waterlogged area. Sikkim has many lakes even though they are not very big in volume. The Lakes are spring fed as well as river fed and most of the lakes in sikkim are considered sacred and are revered by the people. The North Sikkim plateau adjoining Tibet has a number of mountain lakes of which Gurudongmar and Chho lamo are the most famous. Chho lamo is the source of the Teesta river. The Tsomgo Lake in east Sikkim is the most popular with tourists while Khecheopalri in West Sikkim is one of the most beautiful and sacred. On the Gangtok and Nathula highway, 34 kms from Gangtok lies the serene Tsomgo (Changu) lake at an altitude of about 11,000 feet. Khecheopalri lake is another well known lake that lies on a bifurcation of the route between Gyalshing and yuksom. Menmecho lake, green lake and Samiti lake are some other beautiful lakes. Lakshmi Pokhari and Bidan Chu Lake are the graceful lakes of Sikkim.

The Brahmaputra and Barak are two important rivers of Assam. Deepor beel, Dhir beel, Sareswar beel, Sone beel, Tamaranga beel and Sonai beel are some of the important wetland sites of Assam .

Wetlands of the Manipur state comprise of a large as well as small lakes in the southern portion of the Manipur valley. There are also a number of freshwater swamps and marshes which are found in the vicinity of Loktak Lake. The lakes besides the rivers constitute the major part of the wetlands of the state. Loktak lake (including Keibul Lamjao, Sana pat, Laphu pat & Thaunamcha pat) is most important wetland areas of Manipur state. Southern part of Loktak lake is declared as Keibul Lamjao National Park (KLNP). This is also known as the only floating lake in the world due to the floating mats (heterogeneous mass of vegetation, soil, and organic matters at various stages of decomposition) on it. The floating mats, formed by collection of decaying vegetable matter, locally called '*phumdi*' play a significant role in the socio-cultural life of the people and are characteristic of the lake. These *phumdis* are most prominent features and well distributed covering almost entire lake. The area of the lake is 246.72 km², comprising large pockets of open water and marshy land formed at the southern part of the Imphal valley up to the confluence of Manipur River and Khuga River in the district of Imphal West. Within the lake and on its periphery, there are 14 hills of varying size and elevation; the islands in the southern part of the lake are called the Sendra, Ithing and Thanga islands. Towards the east and the southeast of Loktak lake, three smaller lakes namely the Ipok Pat, the Kharung Pat and the Pumlen Pat and Aongbikhong Pat complete the wetland ecosystem of the Manipur valley. Wetland habitats include the Miao River, its tributaries, and associated marshes.

Doyang Lake, Chathe Reservoir, Shilloi Lake and part of Tizu River are some of the important wetlands of Nagaland.

Umiam Lake, Nongkhnum Island and Ranikor riverine area are important wetland sites of Meghalaya.

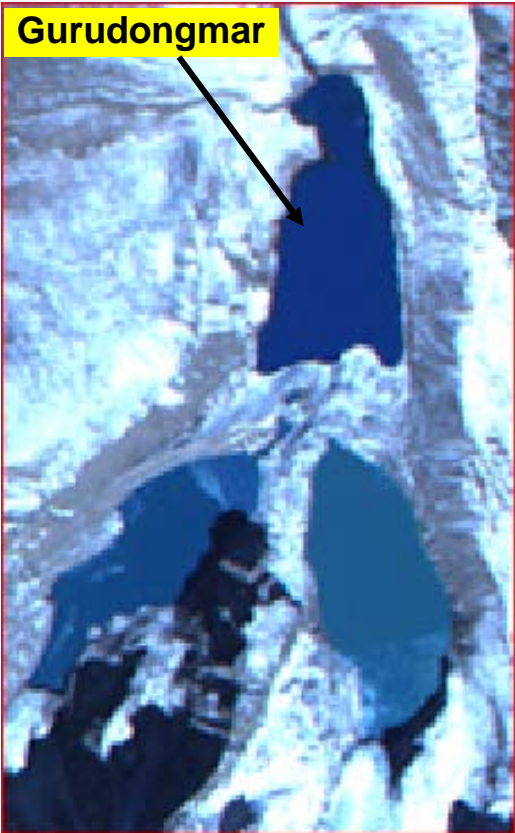
Palak Lake, Tlawng River and Tamdil lake are the important wetlands of Mizoram.

Tripura has seven wetlands important in the context of state. These are Rudra Sagar, Gomti Reservoir (Dumbur Lake), Sipahijala Reservoir, Trishna, Sattar Mia's Hoar, Batapura Lake and College Tilla Lake.

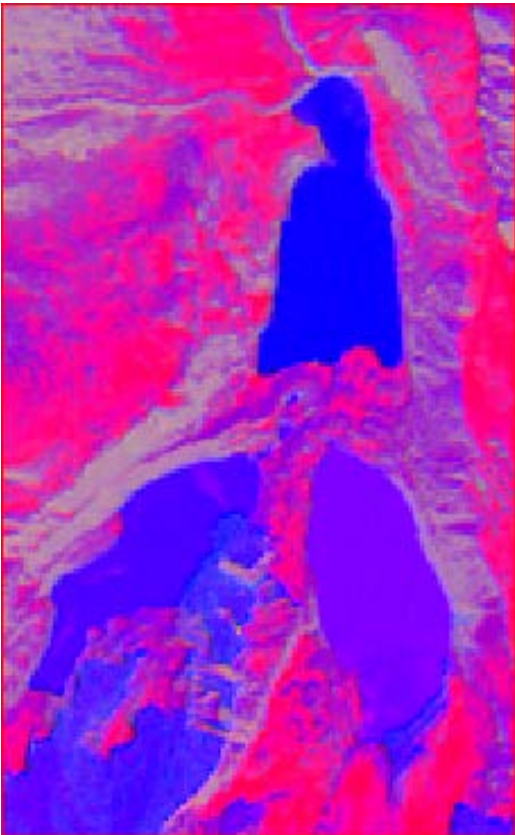
Extensive field work was carried out for these wetland areas. Wetland maps have been prepared covering 5km buffer area of each wetland sites. Details of the some of the selected wetlands and wetland maps of 5 km buffer area are shown in plates 3 to 26.

9.1 Gurudongmar lake

Name	Gurudongmar Lake
Location	Upper left: 28° 02' 07.05" N, 88° 42' 18.15" E Lower right: 28° 01' 04.61" N, 88° 42' 52.62" E
Area	118 ha
Altitude	5,148 M
	The lake is encircled all around by snow-covered mountains and freezes during the winter except one spot believed of having curative properties.
Climate	Average annual rainfall : 1183 mm Temperature : 0° to 35° C.
Morphometric features	Maximum length : 1954m Maximum breadth : 963m Maximum depth : 4.58 m Average depth : 2.07 m
Turbidity	Low
Vegetation	Sparse alpine vegetation around the lake.
Fauna	Few or no fauna is associated with the lake.
	The lake is situated at very high elevation and rests on the northern side of the Khangchengyao Range, close to the Indo-China Border in the province of North Sikkim, in a high plateau area next to the Tibetan Plateau. The lake is highly revered by both Buddhists and Hindus as a sacred lake.



IRS P6 LISSIII, 15 November 2005



MNDWI NDPI NDVI from LISS-III data

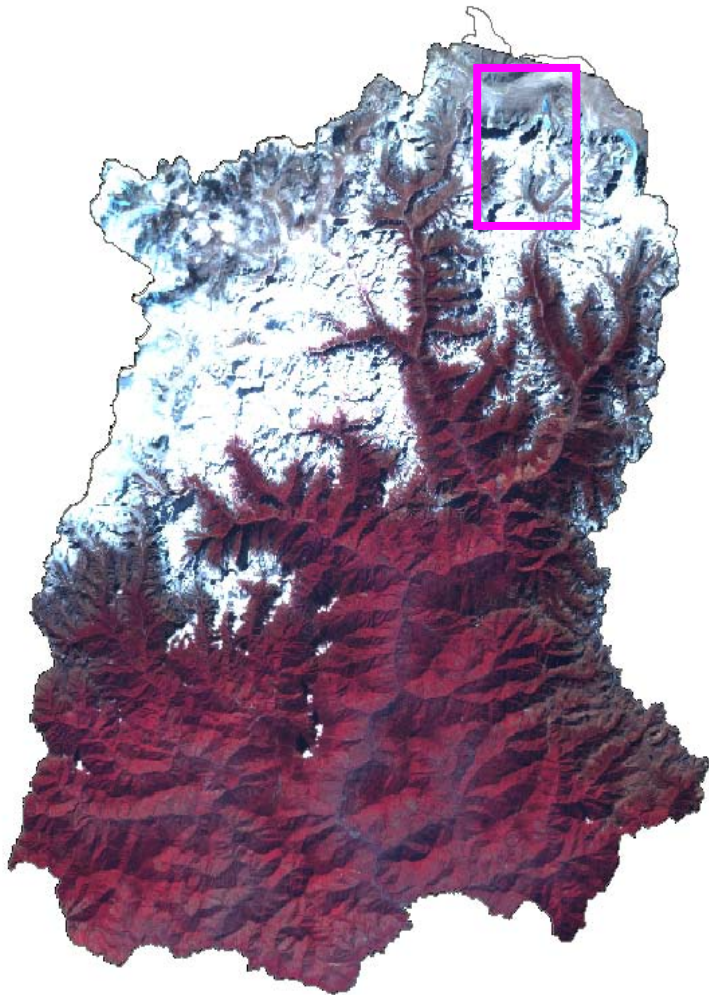


Plate 3: Gurudogmar Lake

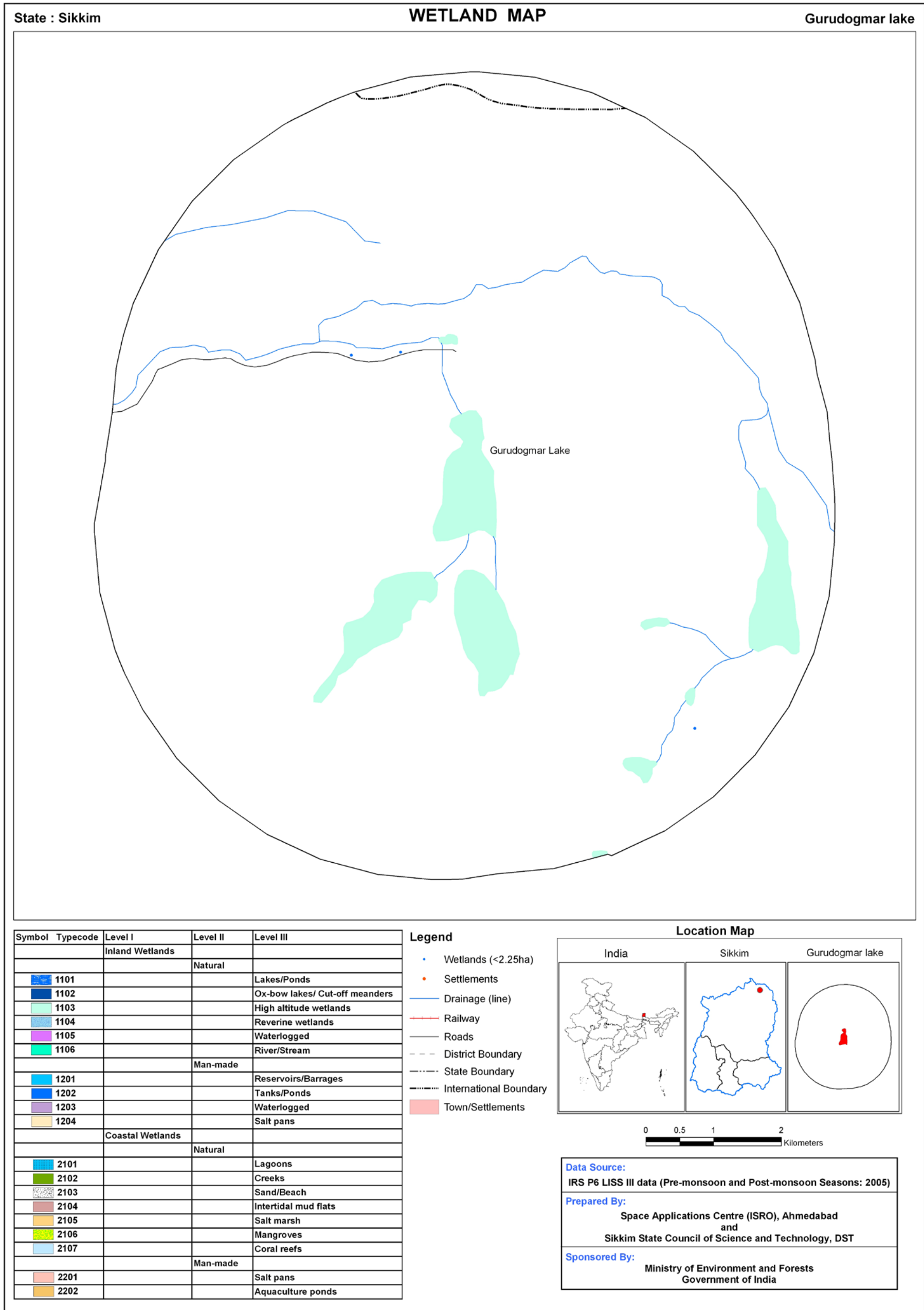
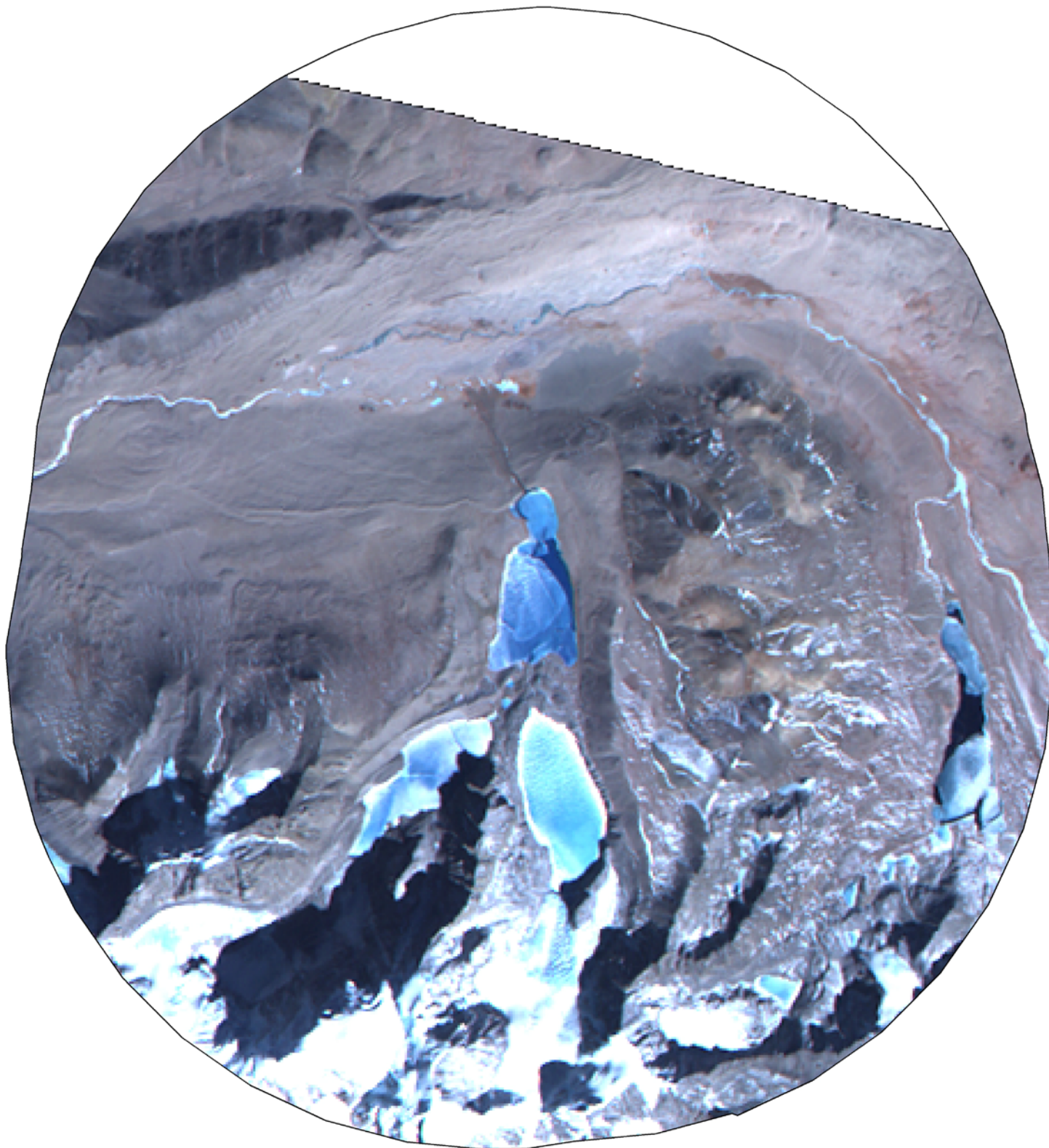


Plate 4: Wetland map - 5 km buffer area of Gurudogmar Lake



IRS P6 LISS-III post-monsoon data (2005)

Plate 5: Gurudogmar Lake as seen on IRS P6 LISS-III image with 5 km buffer area

9.2. Loktak Lake (Ramsar site)

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

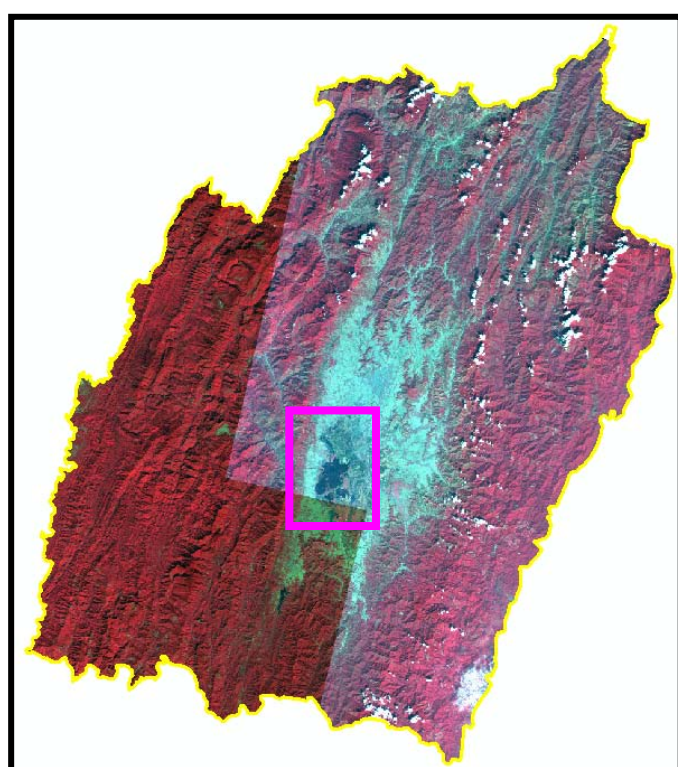
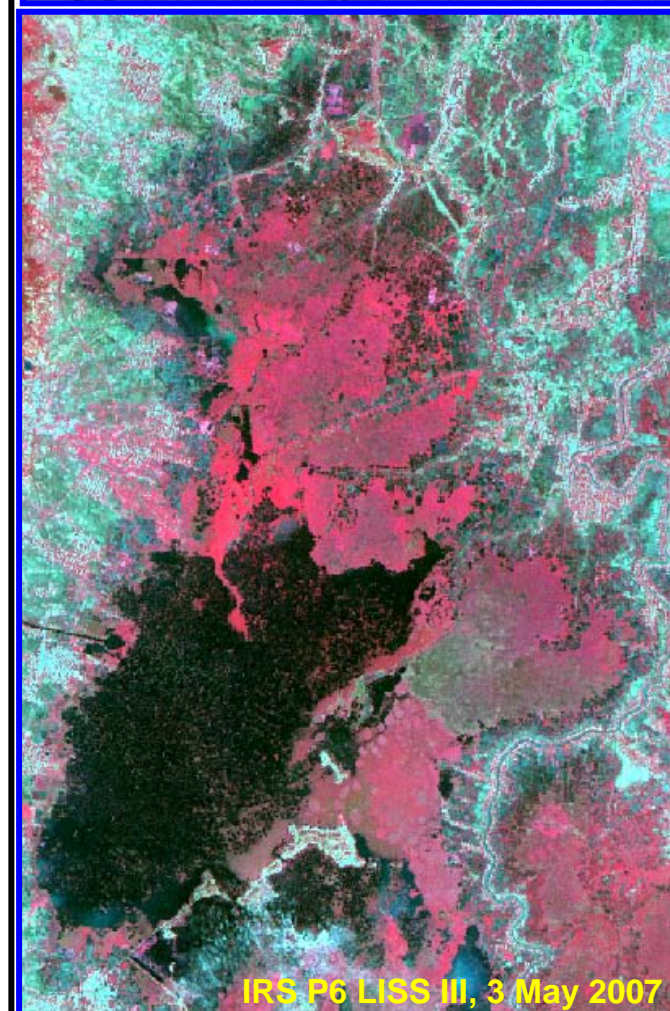
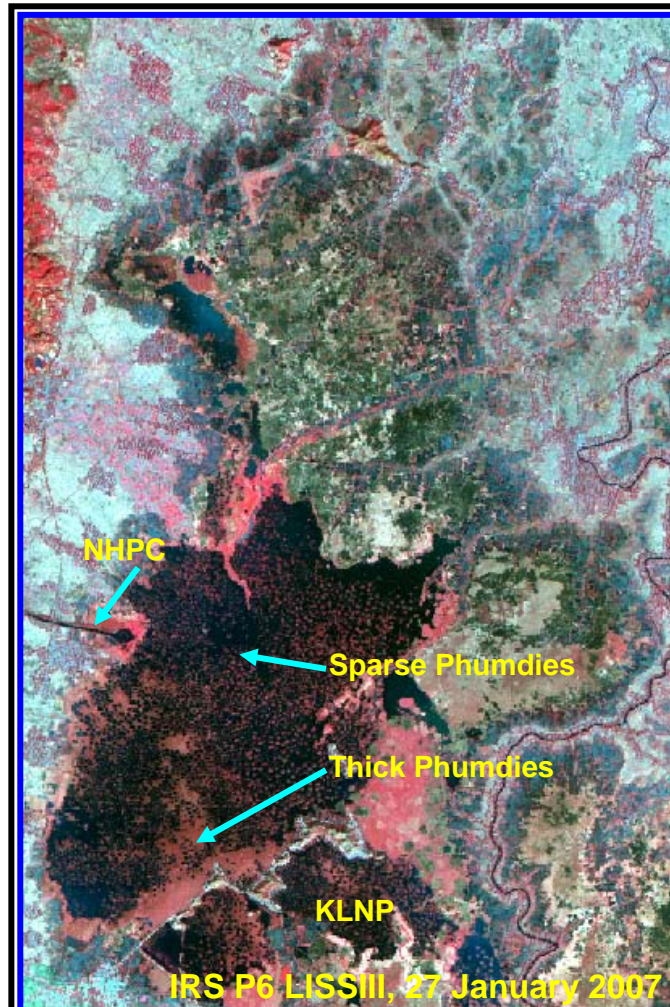
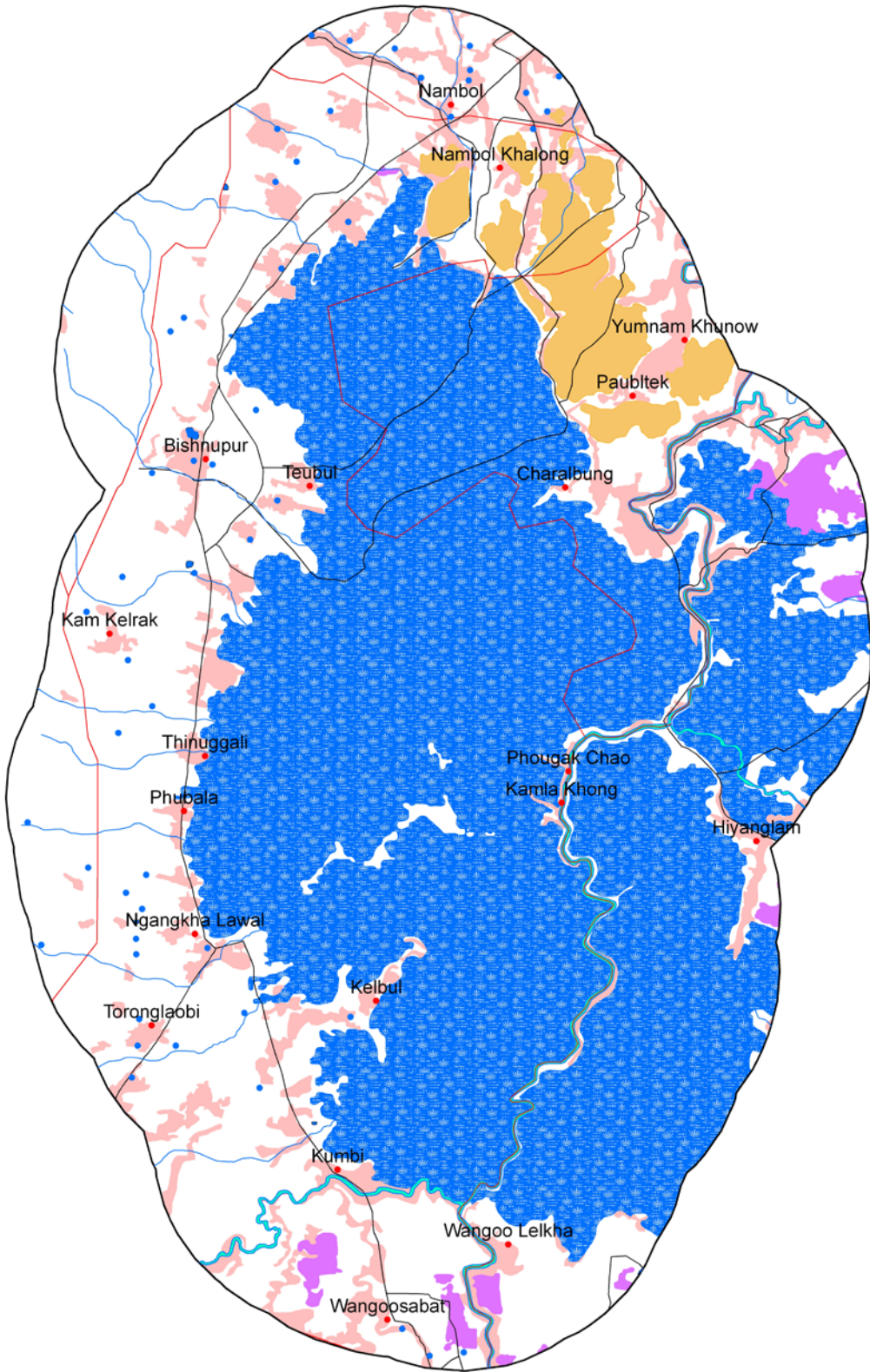


Plate 6: Loktak Lake

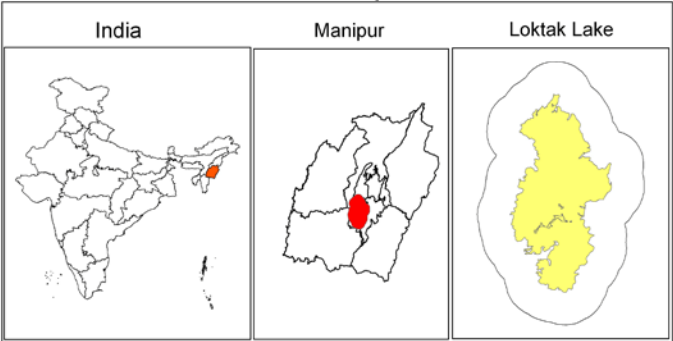


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

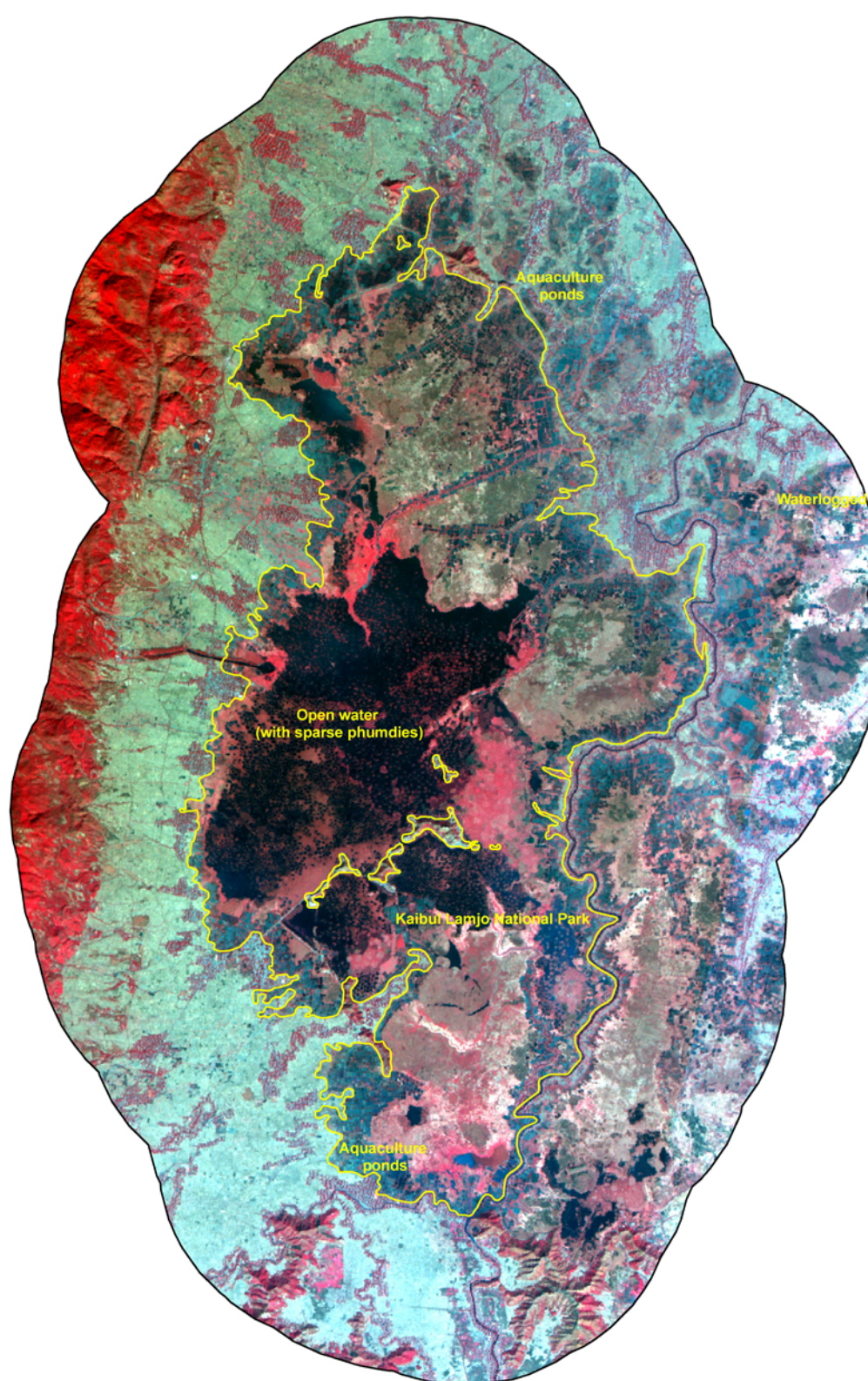
- Wetlands (<2.25ha)
- Roads
- Drainage (line)
- Settlements
- Town/Settlements
- District Boundary

Location Map



Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
Sponsored By:
Ministry of Environment and Forests
Government of India

Plate 7: Wetland map - 5 km buffer area of Loktak lake



IRS P6 LISS-III post monsoon data (2006)

Plate 8: IRS LISS III FCC - 5 km buffer area of Loktak lake

9.3 Doyang Lake

Doyang Lake is located at a distance of 30 Kms from Wokha town and around 110 kms away from Kohima. The place is formed by damming the Doyang river under the NEEPCO-Hydro-Electric project.

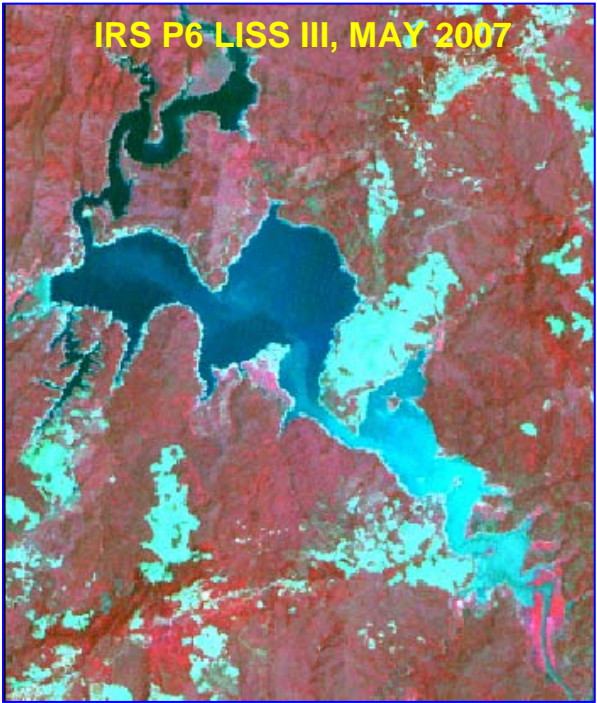


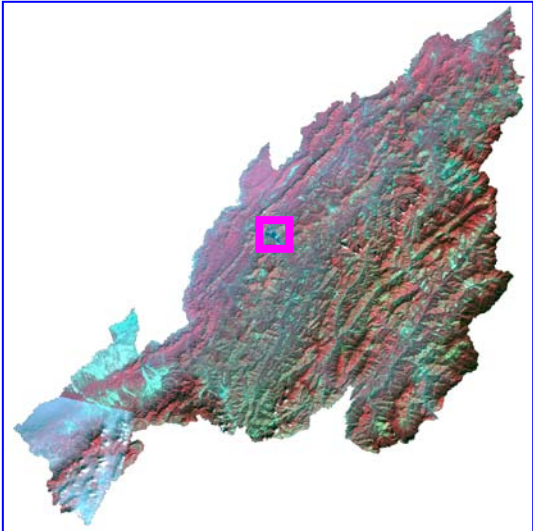
	Name : Doyang Lake	<div></div> <div></div> <div></div>
1.	Location: 94 °15' 43.79"E to 94 ° 20'11.65"E 26 ° 6' 05.53"N to 26 °10' 53.30"N	
2.	Area: 15.32 Sq Km	
3.	Wetland type: Man- Made - Reservoir	
4.	Observation: Doyang wetland shows significant change in the water spread in pre-monsoon and post monsoon season. Marked shrinkage of water spread in May image and shallow ness of water is observed compared to the post monsoon image (December). Aquatic vegetation growth in the lower part of the wetland in pre monsoon is prominent. .	
5.	<p>Doyang Lake is a spot where a massive hydro-electric dam has been constructed across the Doyang River. The Lake is popular for fishing. Some of the important introduced fish species in Doyang reservoir are <i>Cirrhhinnus mrigala</i>, <i>Labeo rohita</i>, <i>Catla catla</i>, <i>Cyprinus carpio</i> and important fish fauna found in the river doyang are <i>Barilius bendelisis</i>, <i>Barilius tileo</i>, <i>Crrihinus reba</i>, <i>Crossocheilus latius</i>, <i>Crossocheilus burmanicus</i>, <i>Danio aequipinnatus</i> <i>Labeo dyocheilus</i>, <i>Neolissocheilus hexagonolepsis</i>, <i>Osteobrama coteo</i>, <i>Puntius shalynius</i>, <i>Rasbora rasbora</i>, <i>Salmostoma bacaila</i>, <i>Salmostoma acinaces</i>, <i>Tor putitora</i>, <i>Tor tor</i>, <i>Garra rupecula</i>, <i>Nemacheilus botia</i>, <i>Nemacheilus arunachalensis</i>, <i>Silurus afghan</i>, <i>Glyptothorex telchitta</i>, <i>Glyptothorex trilineatus</i>, <i>Channa orientalis</i>, <i>Mastacembelus armatus</i> etc).</p> <p>The climate of the area is sub-tropical montane characterized by mild summer and cold winters. The annual rainfall in the area is about 2878 mm. currently, ferry service is available. The lake can be made as a tourist destination by developing facilities like Water Sport and adventure. Kavakina.</p>	
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Plate 9: Doyang Lake

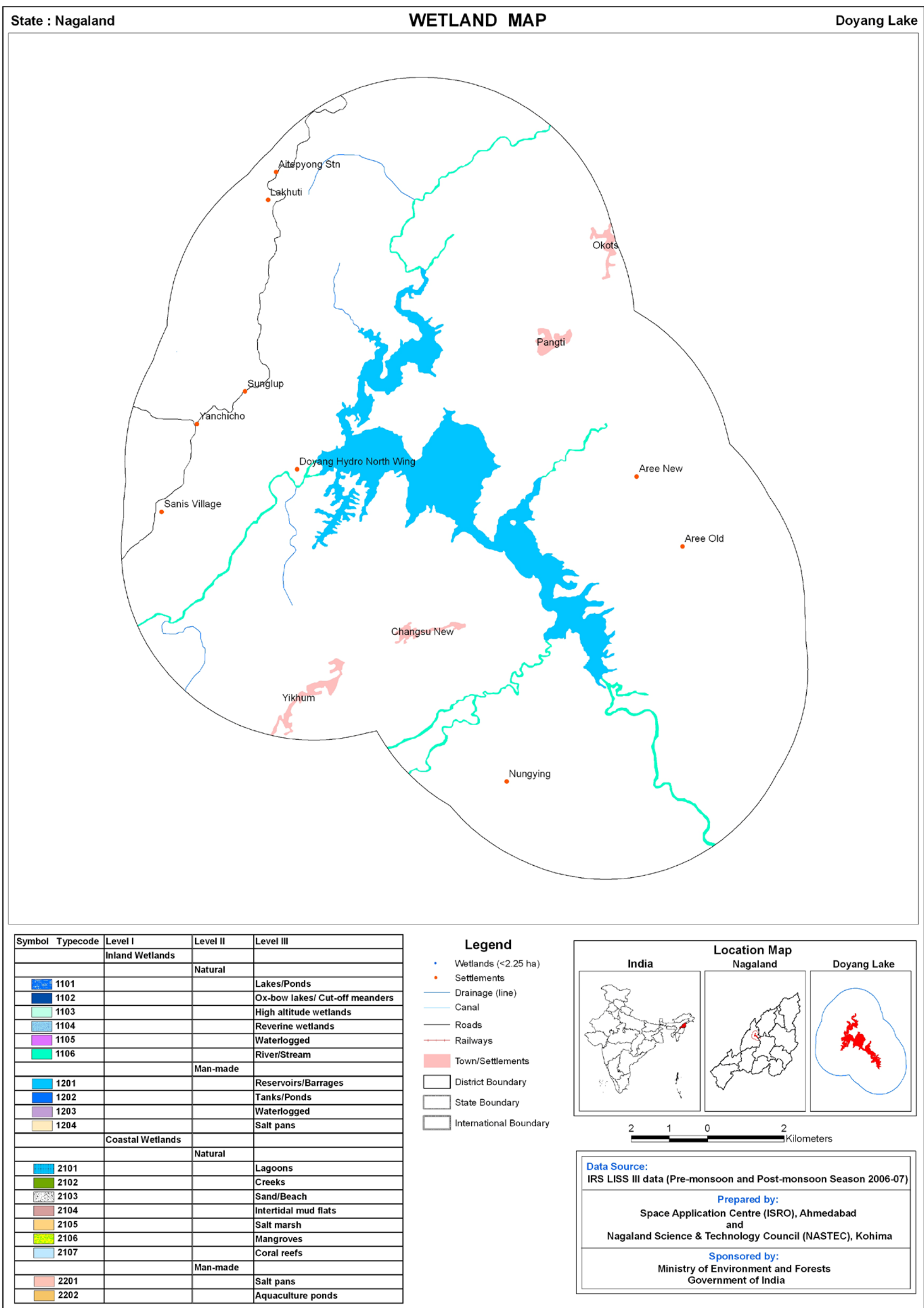
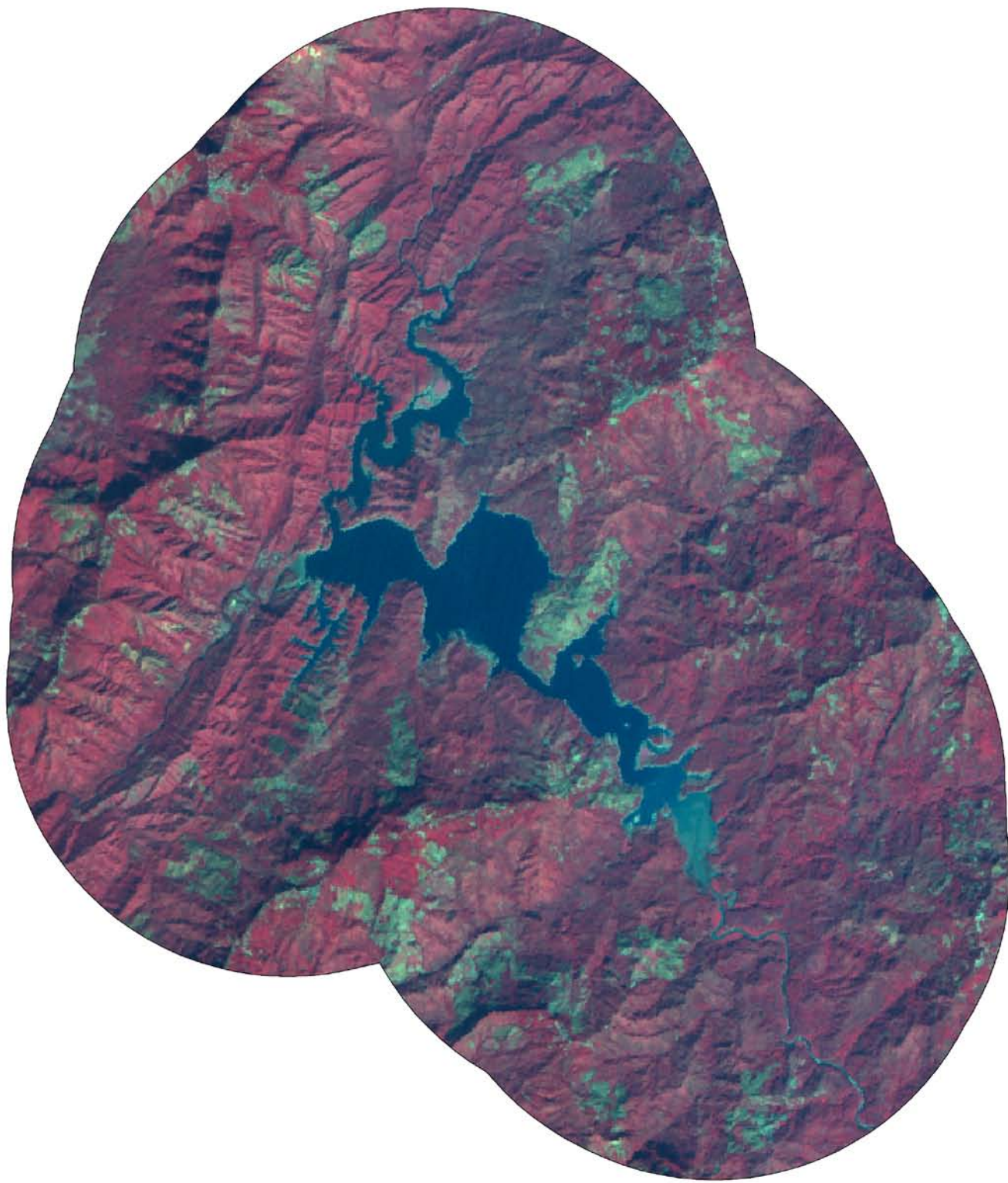


Plate 10: Wetland map - 5 km buffer area of Doyang Lake



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

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

9.4 Rudrasagar Lake (Ramsar site)



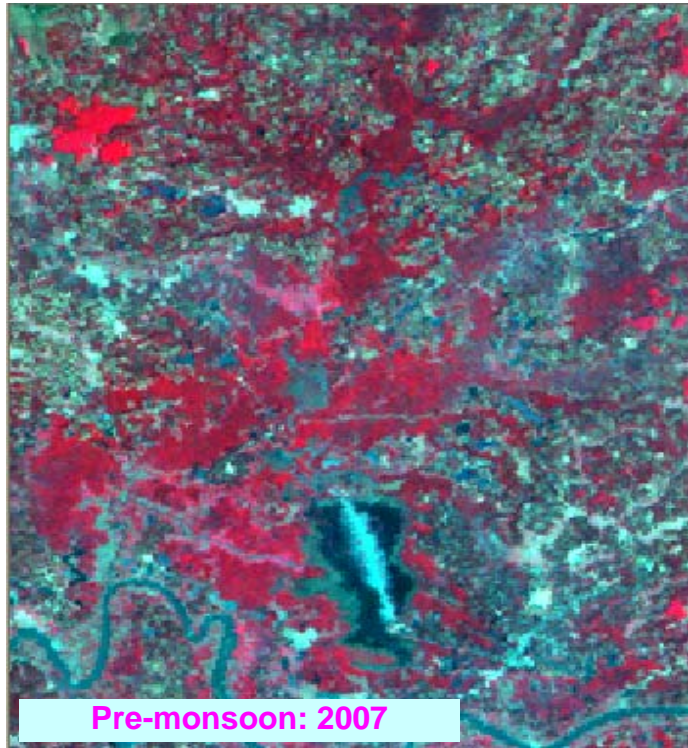
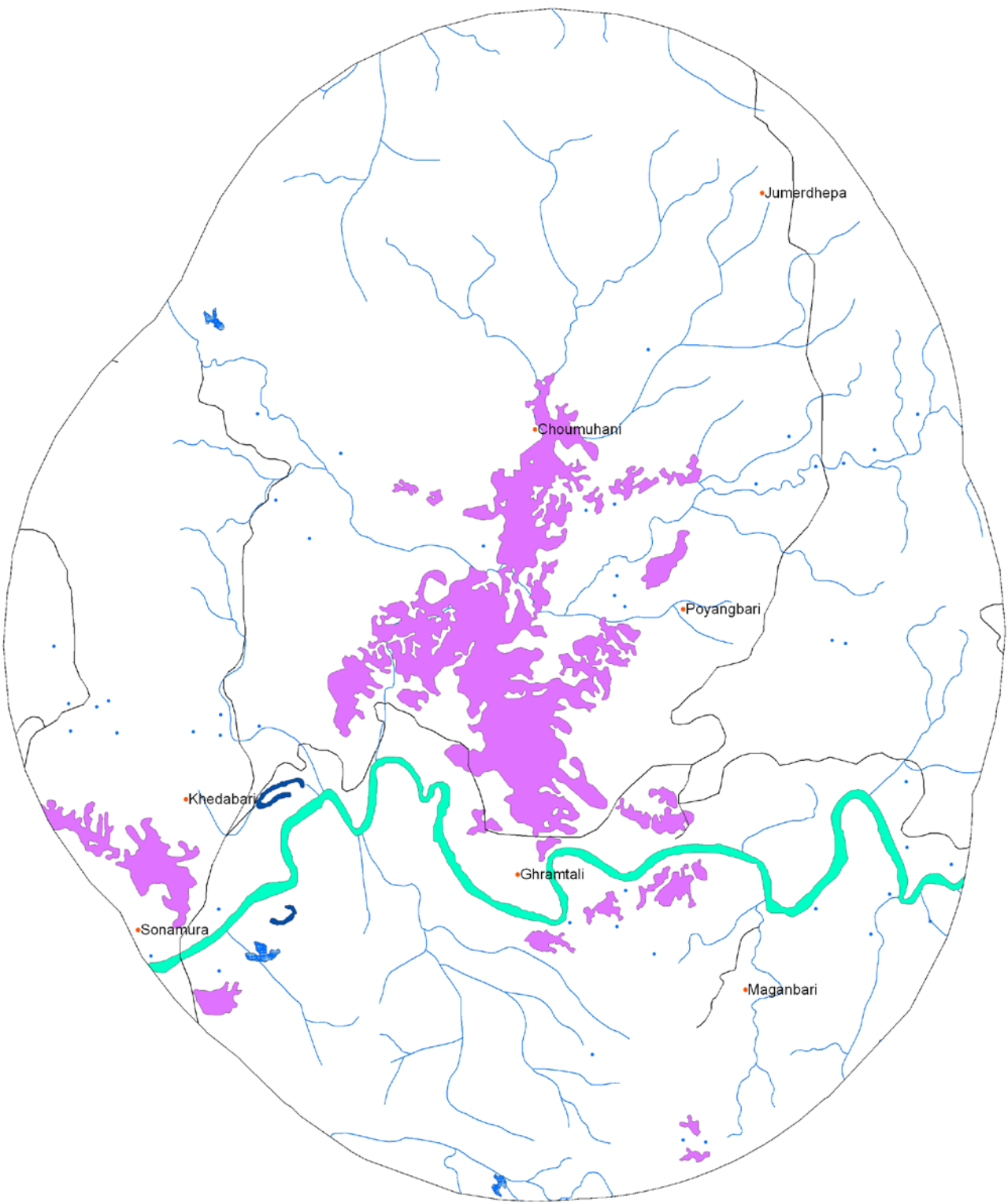
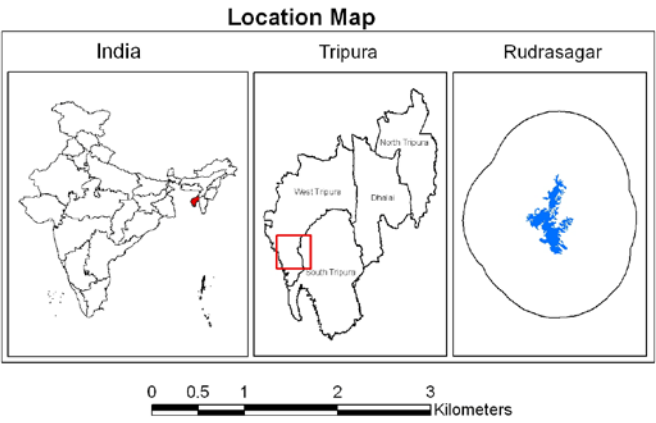
<p>Wetland Type: Reservoir</p> <p>Name: Rudrasagar</p> <p>Village-District: Melagarh-West Tripura</p> <p>Location: 23° 29' 00" N and 90° 01' 00" E</p> <p>Annual rainfall: 2500 mm (June to September with 4-5 peak floods)</p> <p>Depth: 2 to 9 m</p> <p>Area: 688 ha</p> <p>General Turbidity: 7.1 NTU (low)</p> <p>pH: 6.75</p> <p>Geologically the area has been formed by silt deposition on seabed and soil in the catchment. The lake is a natural sedimentation reservoir, which receives flow from three perennial streams namely, Oacherra, Durlanaraya cherra and Kemtalicerra. After settling the sediment from the received flow, clear water discharges into the river Gomti through a connective channel namely Kachigang.</p> <p>Macrophytes: <i>Azolla pinnata</i>, <i>Eichhornia crassipes</i>, <i>Hydrilla verticillata</i>, <i>Ipomea aquatica</i>, <i>Lemna minor</i>, <i>Najas graminea</i>, <i>Pistia stratiotes</i>, <i>Salvinia natans</i>, <i>Trapa natans</i>, <i>Typha angustifolia</i>, <i>Utricularia striatula</i> and <i>vallisneria spiralis</i></p> <p>Fish: Six rare species namely <i>Botia</i> sp., <i>Cyclinia</i> sp., <i>Kachuga</i> sp., <i>Macrobrachium</i> sp., <i>Notopterus chitala</i>, <i>Oxygustus</i> sp. and nine species of endangered species namely <i>Channa marulius</i>, <i>Cirrhinus reba</i>, <i>Labeo bata</i>, <i>Macrobrachium rosenbergii</i>, <i>M. rude</i>, <i>Mystus aor</i>, <i>M. gulio</i>, <i>Notopterus chitala</i> and <i>Ompak paba</i>. The lake has perennial connection with one of the major rivers facilitating the natural breeding ground for fish and freshwater turtle and tortoise.</p> <p>The wetland supports IUCN Red listed endangered Three-striped Roof turtle (<i>Kachuga dhongka</i>).</p>	  
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Plate-12: Rudrasagar Lake



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

- Legend**
- Wetlands (<2.25 ha)
 - Settlements
 - Roads
 - Railways
 - Drainage
 - District Boundary
 - State Boundary
 - Town/Settlements

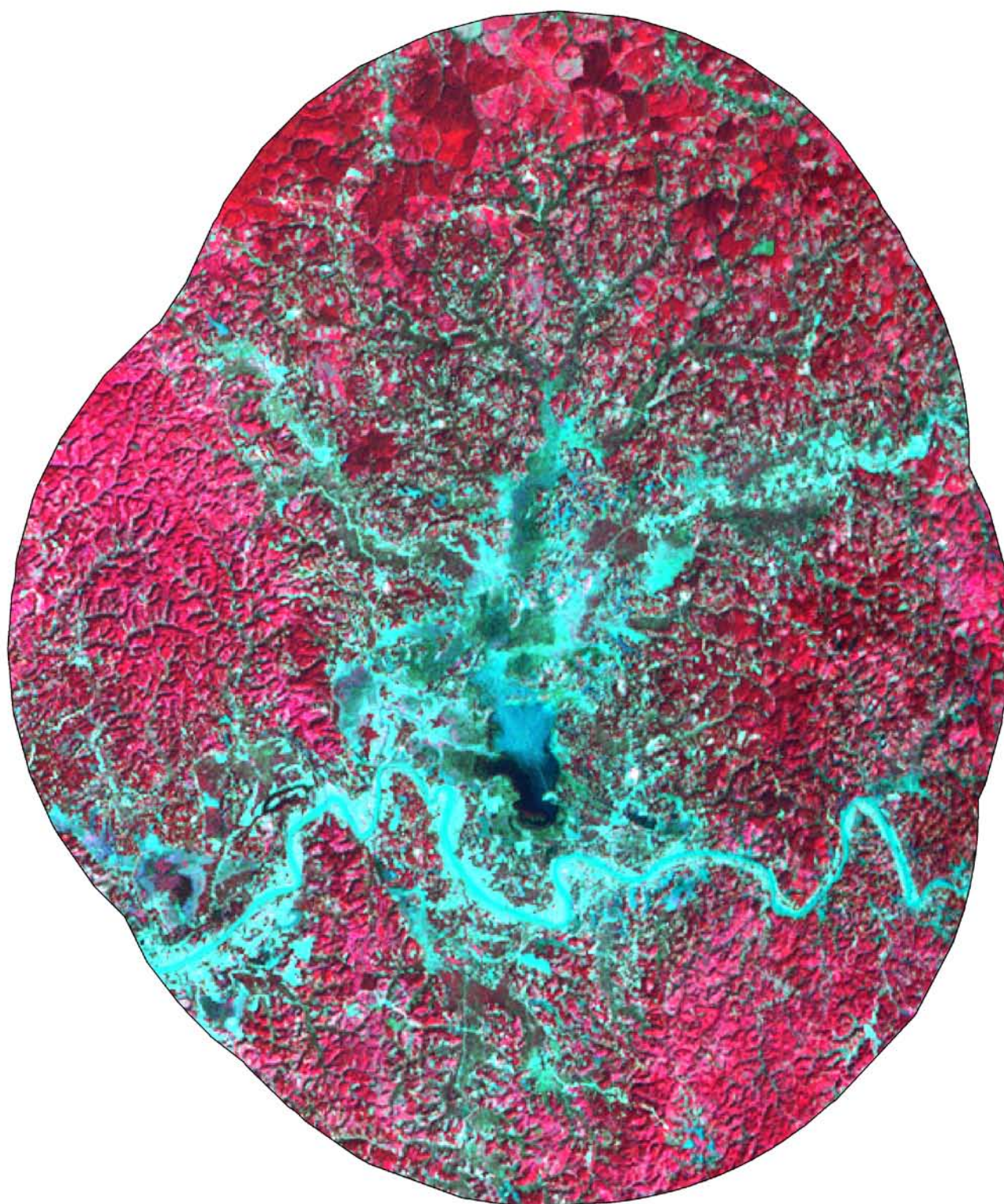


Data Source:
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

Sponsored By :
Ministry of Environment and Forests
Government of India

Plate 13: Wetland map - 5 km buffer area of Rudrasagar lake





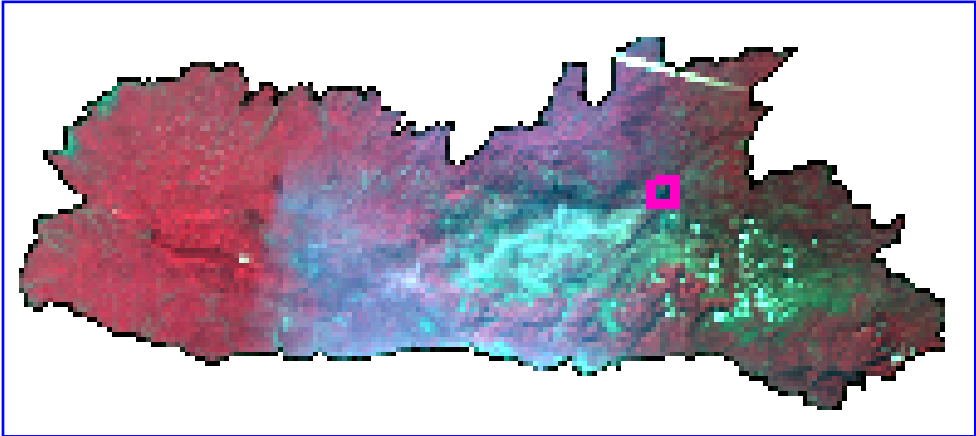
IRS-P6 LISS-III Post-monsoon data(2006)

Plate 14: IRS P6 LISS-III FCC of 5 km buffer area of Rudrasagar Lake

9.5 Umiam Lake

Umiam Lake, also known as Barapani is located at a distance of 14 Kms from Shillong town on the Shillong-Guwahati road. The place is formed by damming of the Umiam River under the Umiam-Hydro-Electric project. It is one of the places of major tourist attraction in Meghalaya.

	Name : Umiam/Barapani Reservoir	
1.	Location: 91° 51' to 91° 54' 25° 37' to 25° 40'	
2.	Area: 10.24 Sq Km	
3.	Wetland type: Man-made - Reservoir	
4.	Umiam reservoir shows change in the wetland waterspread in premonsoon and post monsoon boundary. Pre-monsoon image shows marked shrinkage of wetland boundary in parts of the lake boundary. No significant growth of aquatic vegetation seen in the waterbody. The lake shows low turbidity level.	
5.	Umiam Lake, also known as Barapani is a spot around 15 Km from Shillong where a massive hydro-electric dam has been constructed across the Umiam river stream. The Lake is popular for the Water Sport and adventure facilities that it offers. Kayaking, Water cycling/scooting and boating are a few of the facilities available at the Umiam Lake. The Lake has been developed as a tourist spot by the State authorities and the Meghalaya Tourism Department. The water spread of the reservoir is about 10.24 Sq.km. The climate of the area is sub-tropical montane characterized by mild summer and cold winters. The annual rainfall in the area is about 2400mm. The amount of rainfall increases in the southern parts, coming Under the Mawsynram- Cherrapunji rain belt.	






Plate 15: Umiam lake

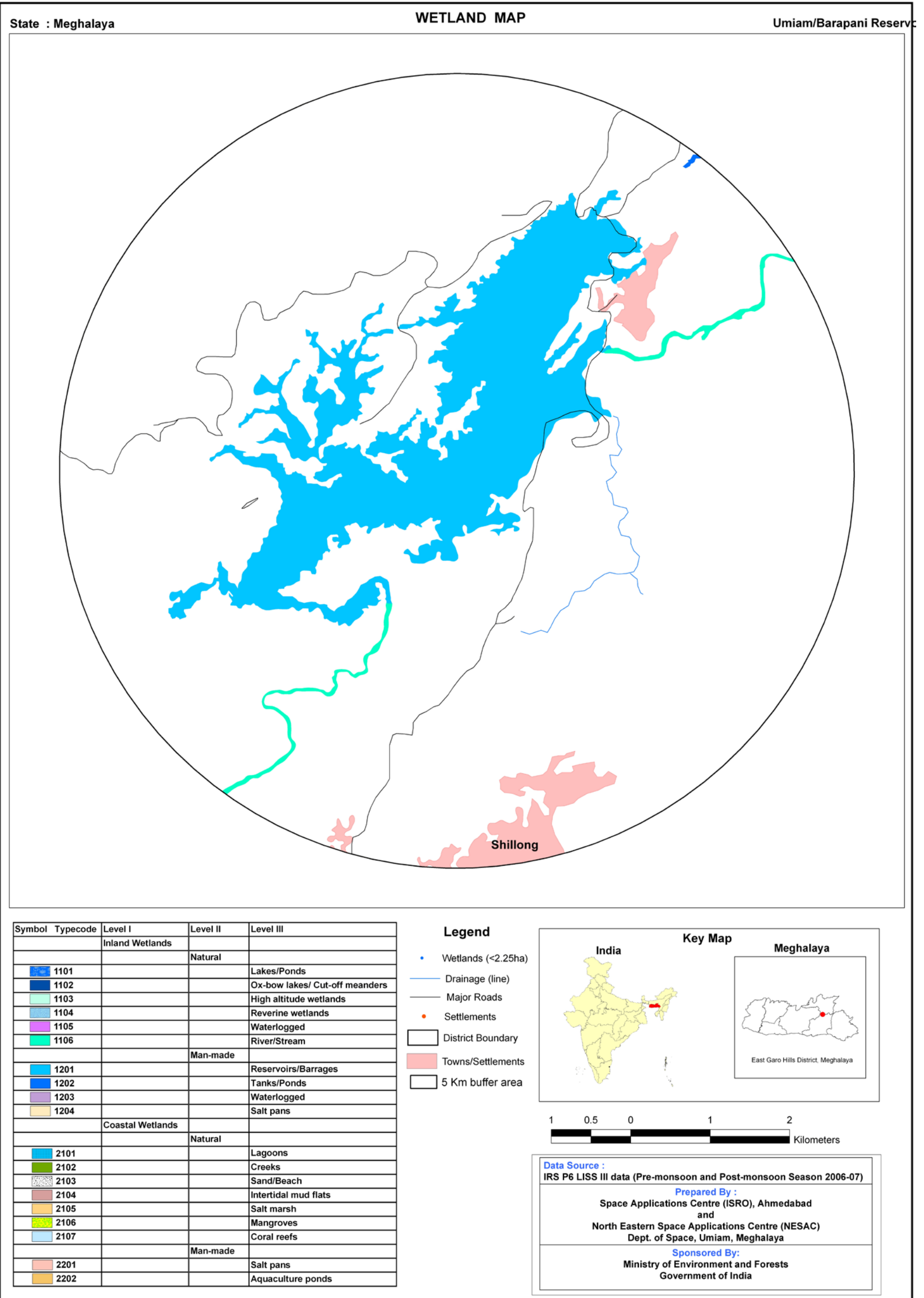


Plate 16: Wetland map - 5 km buffer area of Uiam Lake

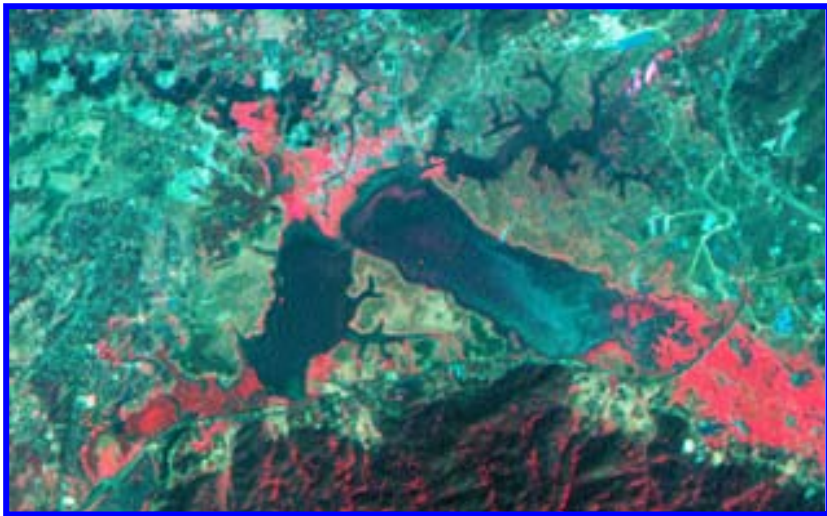


IRS P6 LISS III post-monsoon data 2006

Plate 17: IRS P6 LISS-III FCC of 5 km buffer area of Umiam Lake

9.6 Deepor Beel (Ramsar Site)

Name	Deepor Beel
Location	26° 07' 30" N, 91° 38' 35" E District: Kamrup Ownership: State, Fishery Department
Area	589 ha
Altitude	53 m
Wetland Type	Freshwater Swamp, Lake
Climate	Rainfall : >2000 mm Temperature: 7 °C to 37 °C
Status	Wildlife Sanctuary, established in January 1989. Presently it is a Ramsar Site (designated in November 2002).
Description	This is a fresh water lake, on the southern bank of the Brahmaputra River, covering an area of about 900 ha. The main source of water of this lake is from rainfall runoff and from the Basistha and Kalamoni rivers. The <i>Beel</i> drains into the Brahmaputra River, located about 5 km away through a small rivulet called Khanajan. The southern side of the lake is contiguous with Rani Reserve Forest. About half of the <i>Beel</i> dries out during the winter and the exposed shores are converted into paddy fields. At maximum flooding, it is c. 4 m deep, while during the dry season, the depth drops to about 1.0 m..
Bio-diversity	<p>A large variety of aquatic flora of tropical wetland is found in Deepor <i>Beel</i> and its adjoining areas. The dominant aquatic plants include <i>Azolla pinnata</i>, <i>Nymphaea rubra</i>, <i>Ottelia alismoides</i>, <i>Eleocharis plantaginea</i>, <i>Pistia stratiotes</i>, <i>Hydrilla verticillata</i>, <i>Potamogeton crispus</i>, <i>Ipomoea reptans</i>, <i>Sagittaria sagittifolia</i>, <i>Nymphaea alba</i>, <i>Vallisneria spiralis</i>. The giant water lily (<i>Euryale ferox</i>) also grows here. <i>Eichhornia crassipes</i> is the dominate weed.</p> <p>The diversity and concentration of indigenous fresh water fish species in this lake is very high (around 50 species under 19 families). It harbors many species of migratory birds in winter as well as resident birds. Around 150 species of birds have been recorded so far in and around the Sanctuary, including nine threatened species. The wetland is used for fishery, domestic water supply, collection of natural products, fodder and food supply, transport, and recreation.</p>
Current Status	Current status: Heavy siltation, pollution from city/industry effluents, poaching and unregulated fishing, encroachment.
	As observed in the image, the beel is fragmented, surrounded with waterlogged areas in the 5 km buffer zone. The intensive growth of the weed water hyacinth is very prominent. The field photograph shows the shallowness of water, growth of vegetation in and around the lake.



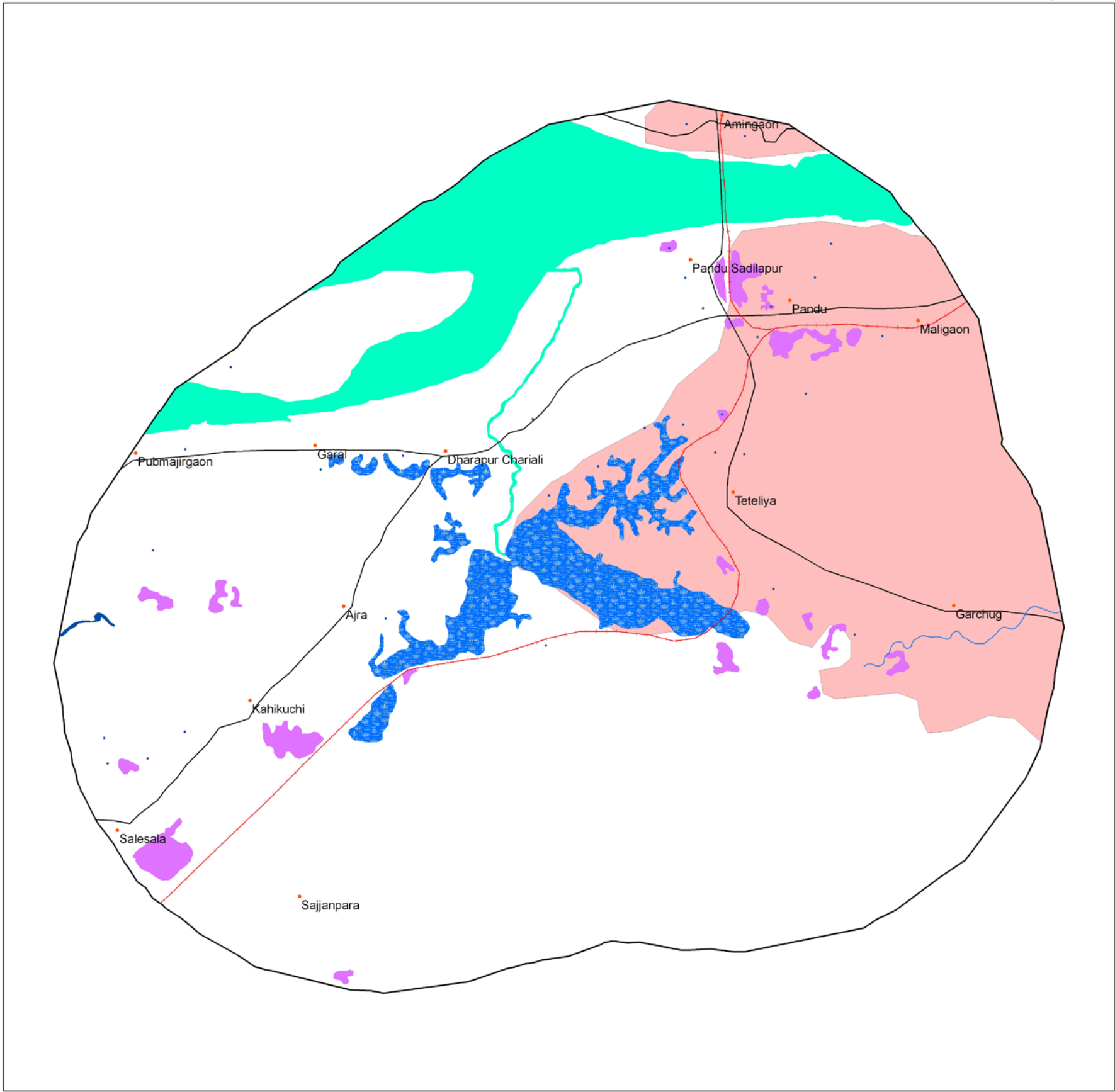
IRS LISS-III Post monsoon data (November 1, 2006)



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

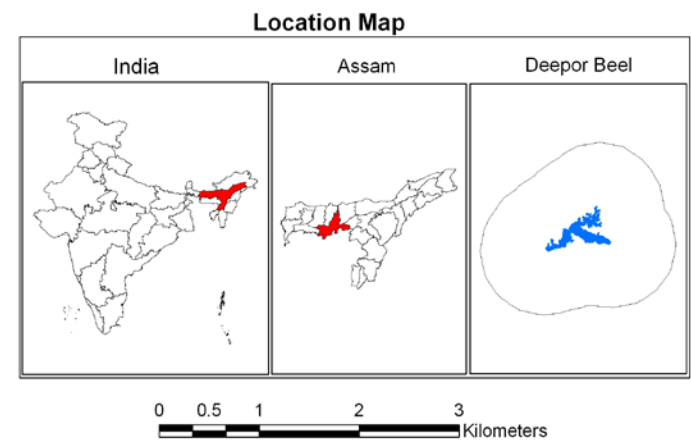


Plate 18: Deepor Beel



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

- Legend**
- Wetlands (<2.25 ha)
 - Settlements
 - Canal
 - Drainage(line)
 - Railway
 - Roads
 - District Boundary
 - Towns/Settlements

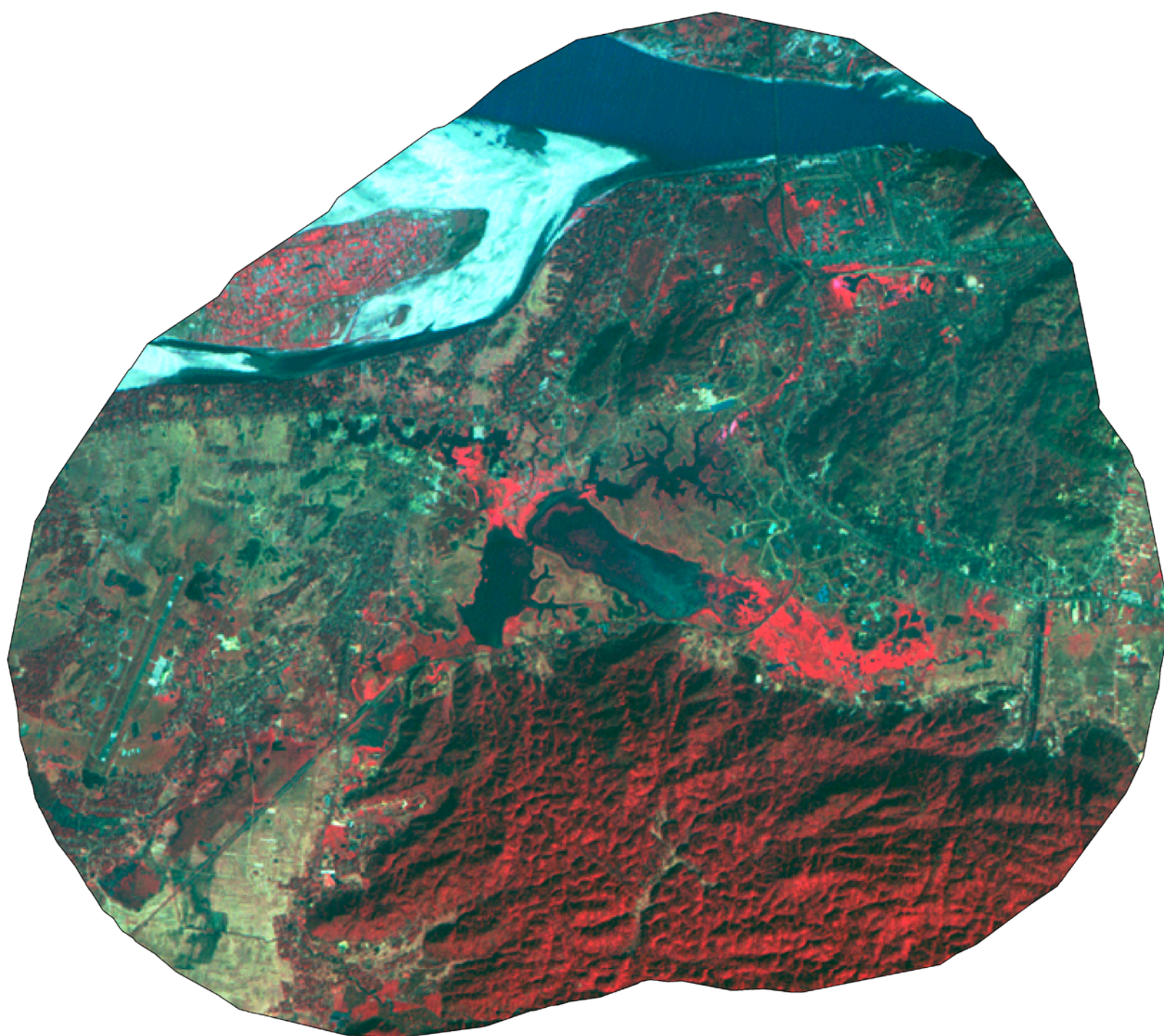


Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
and
Assam Remote Sensing Applications Centre, Guwahati

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Plate 19: Wetland map - 5 km buffer area of Deepor Beel



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

Plate 20: IRS LISS III FCC - 5 km buffer area of Deepor Beel

9.7 Dhir Beel

Name	Dhir Beel
Location	26° 16' 55" N, 90°21' 10"E District : Dhubri Ownership : State (Fisheries Department)
Area	1003 ha
Wetland Type	Lakes/ponds
Description	<p>Dhir <i>beel</i> is situated 30 km from Kokrajhar town at the base of Chakrashila Wildlife Sanctuary. During the rainy season, this wetland gets connected with the Brahmaputra river through a small river called Dhir River. The wetland is rich in aquatic flora and fauna and is a breeding ground for fish.</p> <p>Adjacent to Dhir, there is another Lake- Diplai. These twin lakes attract a lot migratory birds in winter including Near Threatened Ferruginous Duck and the Vulnerable Baer's Pochard <i>Aythya baeri</i>. Swamp Francolin <i>Francolinus gularis</i> (Lahkar 2003) was common in the area till the late eighties, but due to destruction of habitat in the form of agriculture, settlements, and over hunting it has been wiped out gradually</p>
Current Status	Unregulated fishing and poaching are the major threats.
	One can observe the shallowness and drying status of the lake even in post monsoon. Aquatic weed like water hyacinth is not observed. However, encroachment for agriculture is observed.



IRS LISS-III Post monsoon data (October 27, 2006)



IRS LISS-III Pre-monsoon data (March 20, 2007)



Plate 21: Dhir Beel

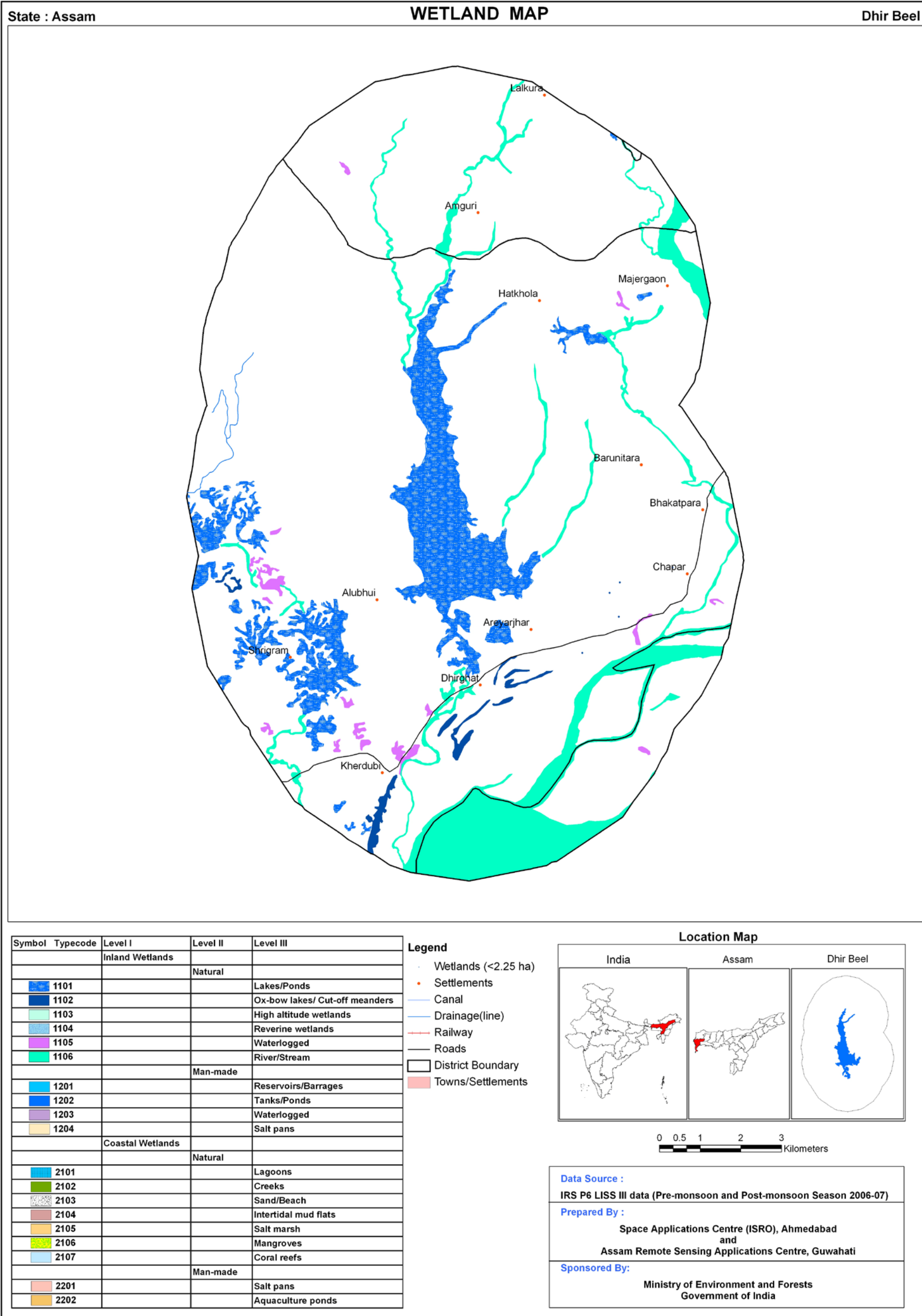


Plate 22: Wetland map - 5 km buffer area of Dhir Beel



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

Plate 23: IRS LISS III FCC - 5 km buffer area of Dhir Beel

9.8 Tamaranga Beel

Name	Tamaranga Beel
Location	Coordinates : 26° 19' 8" N, 90° 34' 19" E District : Bongaigaon Ownership : State
Area	627 ha
Wetland Type	Inland – Natural - Lakes/ponds
Climate	Rainfall : >3,000 mm Temperature : 7 °C to 36 °C
Description	Tamaranga beel is actually a complex of wetlands known as Tamaranga -Dalani-Bhairab Complex which includes the wetlands of Tamaranga, Konora, Paropota and Dalani in western Assam. The Tamaranga beel wetland is situated only 30 km south from Bongaigaon town, the district headquarters of Bongaigaon district of Assam. This is an important freshwater lake (<i>beel</i>) and has been listed as a Site of Global Importance in the Directory of Asian Wetlands as it plays hosts to a large number of avifauna. The nearby Bhairab Reserve Forest is rocky hillock, part of an Archaean plateau, covered with degraded Tropical Moist Deciduous Forest dominated by <i>Sal Shorea robusta</i> and Bamboo brakes.
Bio-diversity	<p>The <i>beel</i> attracts many migratory birds and is a good breeding ground for resident water birds. More than 150 bird species are known to occur in this Complex. More than 20,000 waterfowl are reported regularly in winter. The nearby Bhairab Pahar harbours an important population of the Golden Langur and Gaur. The adjacent area is used for agriculture.</p> <p>Water Hyacinth <i>Eichhorniacrassipes</i> is the major weed. Wherever this pernicious weed is not found, submerged and emergent plants are observed. The wetland is being overexploited for fishing. The spread of Water Hyacinth also is the major problems for birds.</p>

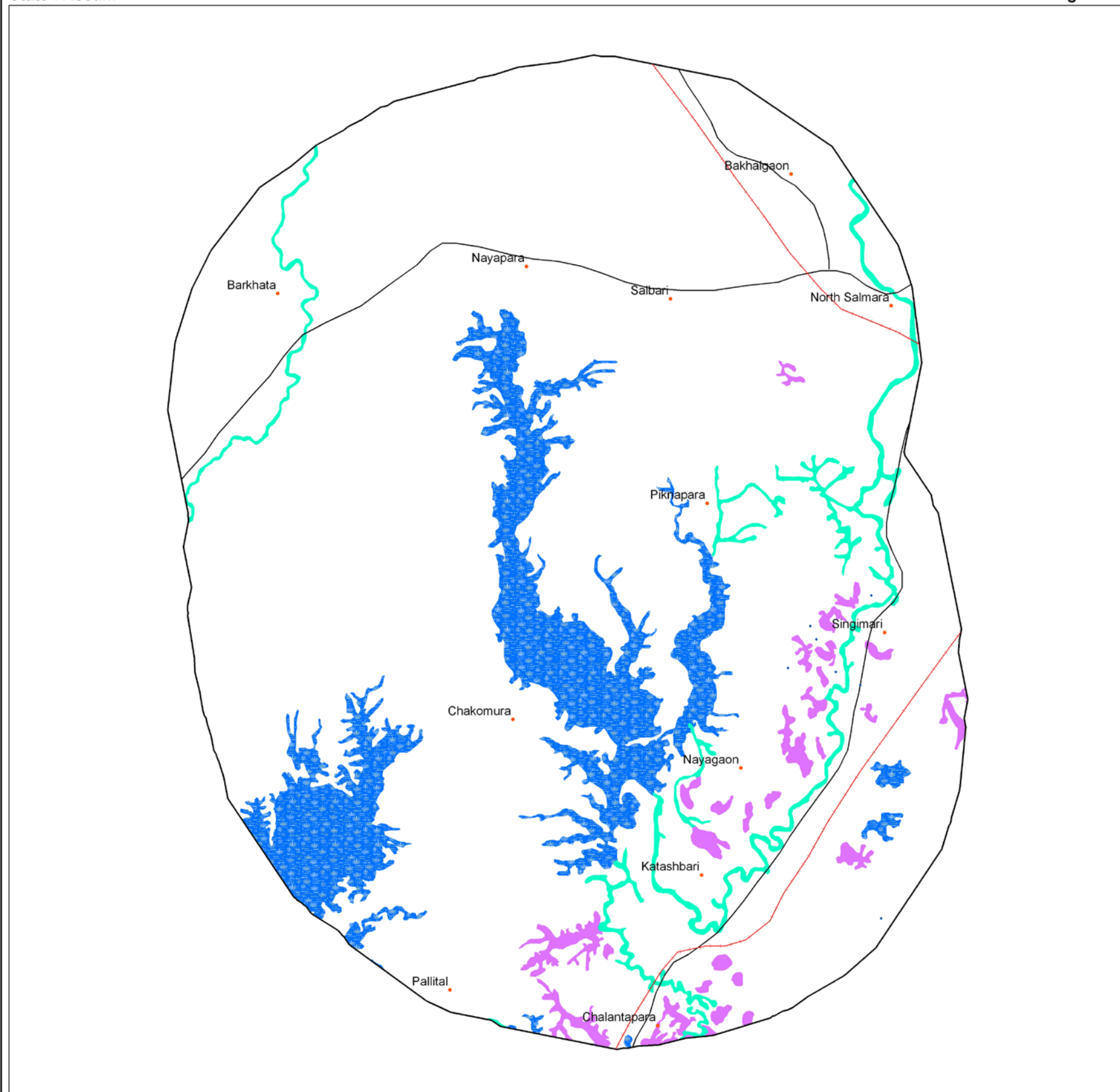


IRS LISS-III Post monsoon data (October 27, 2006)



IRS LISS-III Pre-monsoon data (March 20, 2007)

Plate 24: Tamaranga Beel

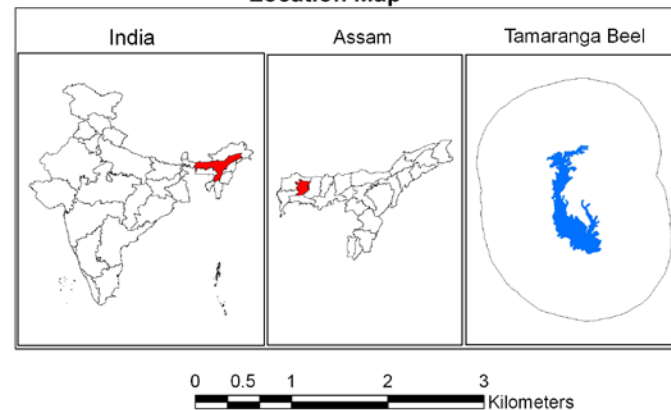


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203		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

Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map

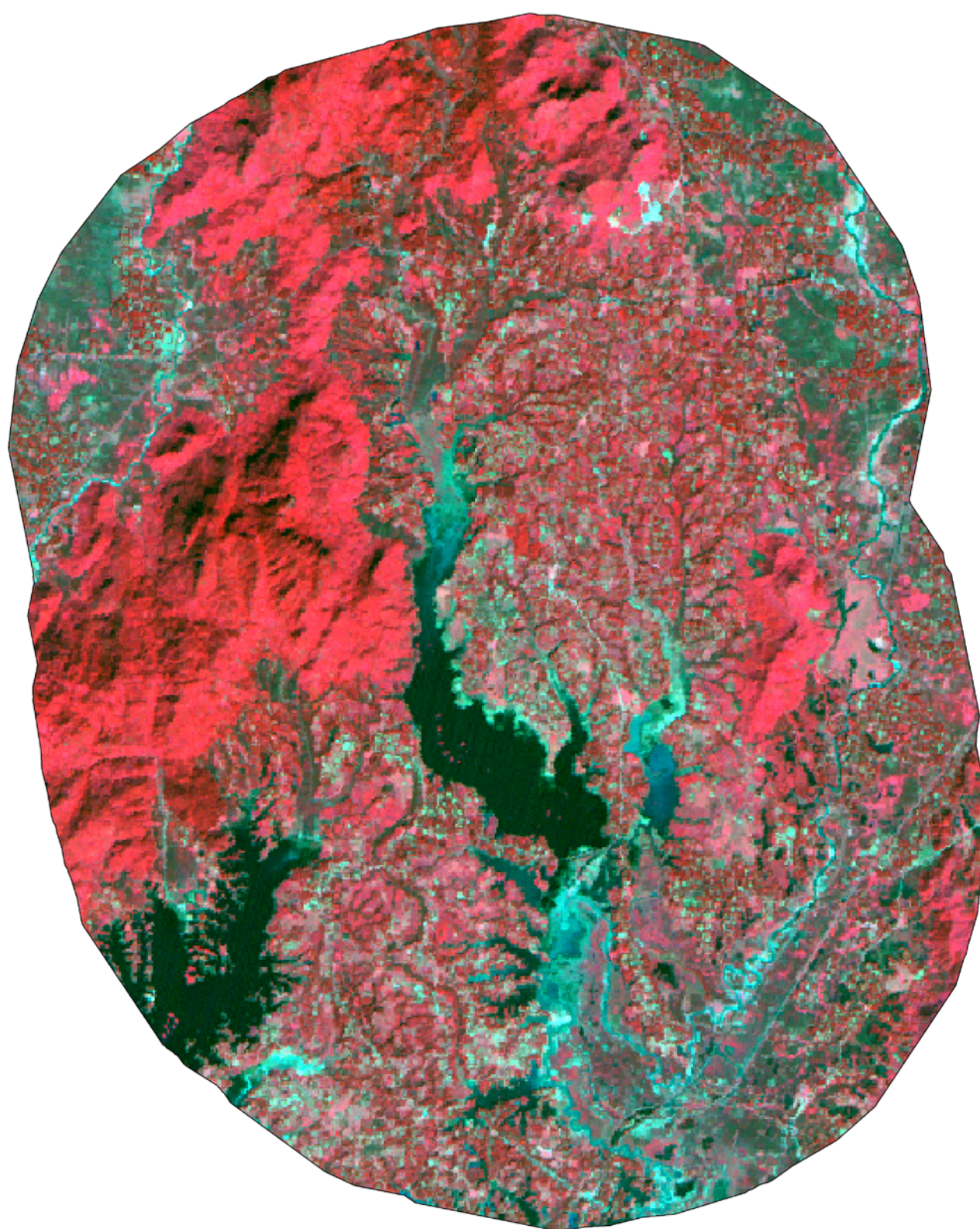


Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :
Space Applications Centre (ISRO), Ahmedabad
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Assam Remote Sensing Applications Centre, Guwahati

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Government of India

Plate 25: Wetland map - 5 km buffer area of Tamaranga Beel

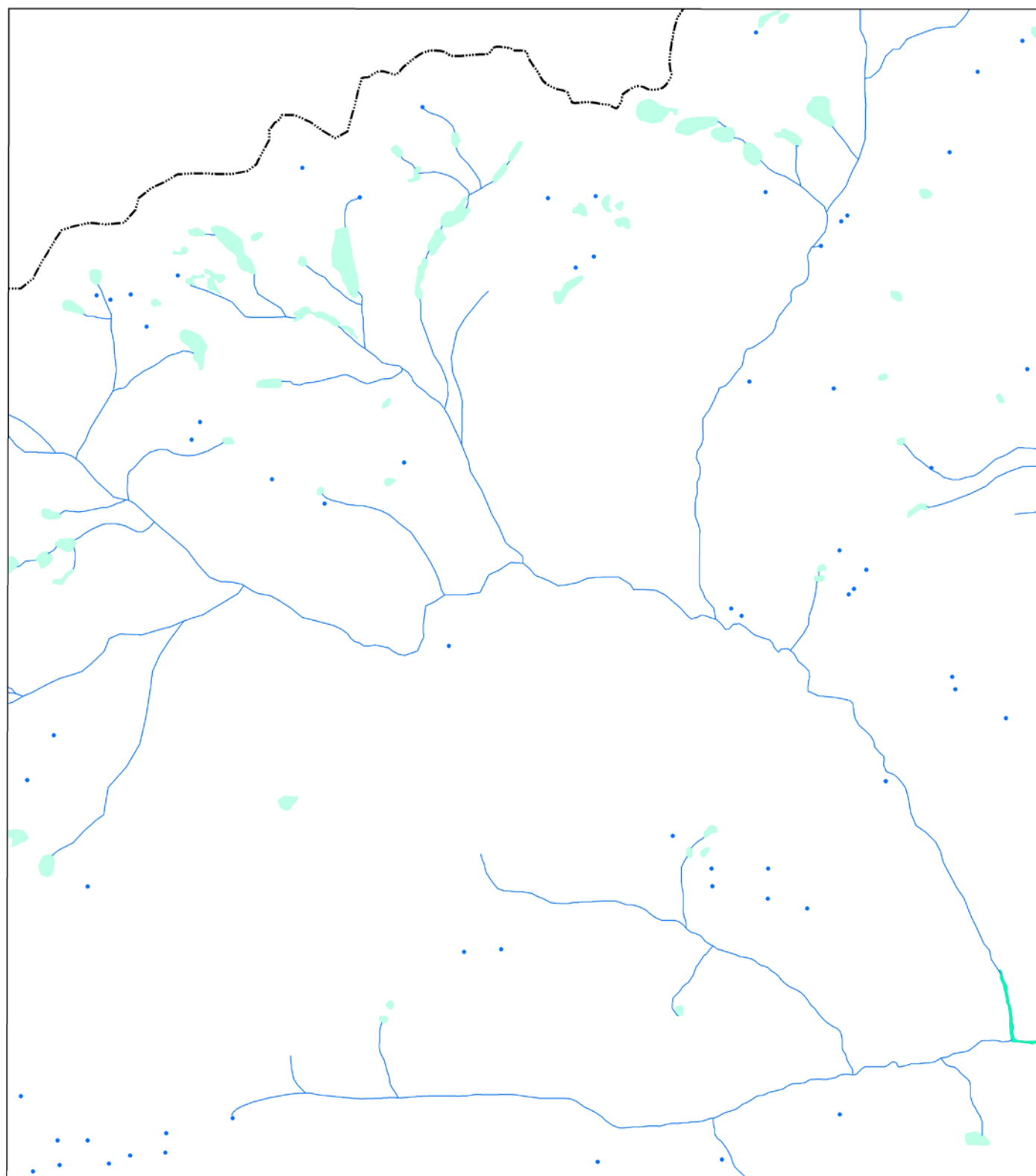


IRS P6 LISS-III post-monsoon data (2006)

Plate 26: IRS LISS III FCC - 5 km buffer area of Tamaragna Beel

SOI MAP-SHEET WISE WETLAND MAPS

(Selected)

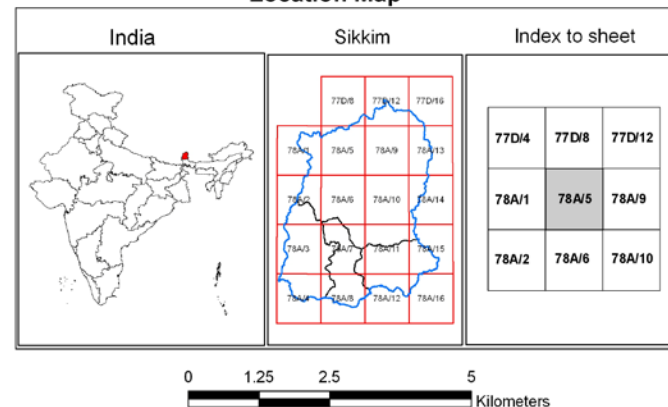


Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
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	1105			Waterlogged
	1106			River/Stream
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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

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

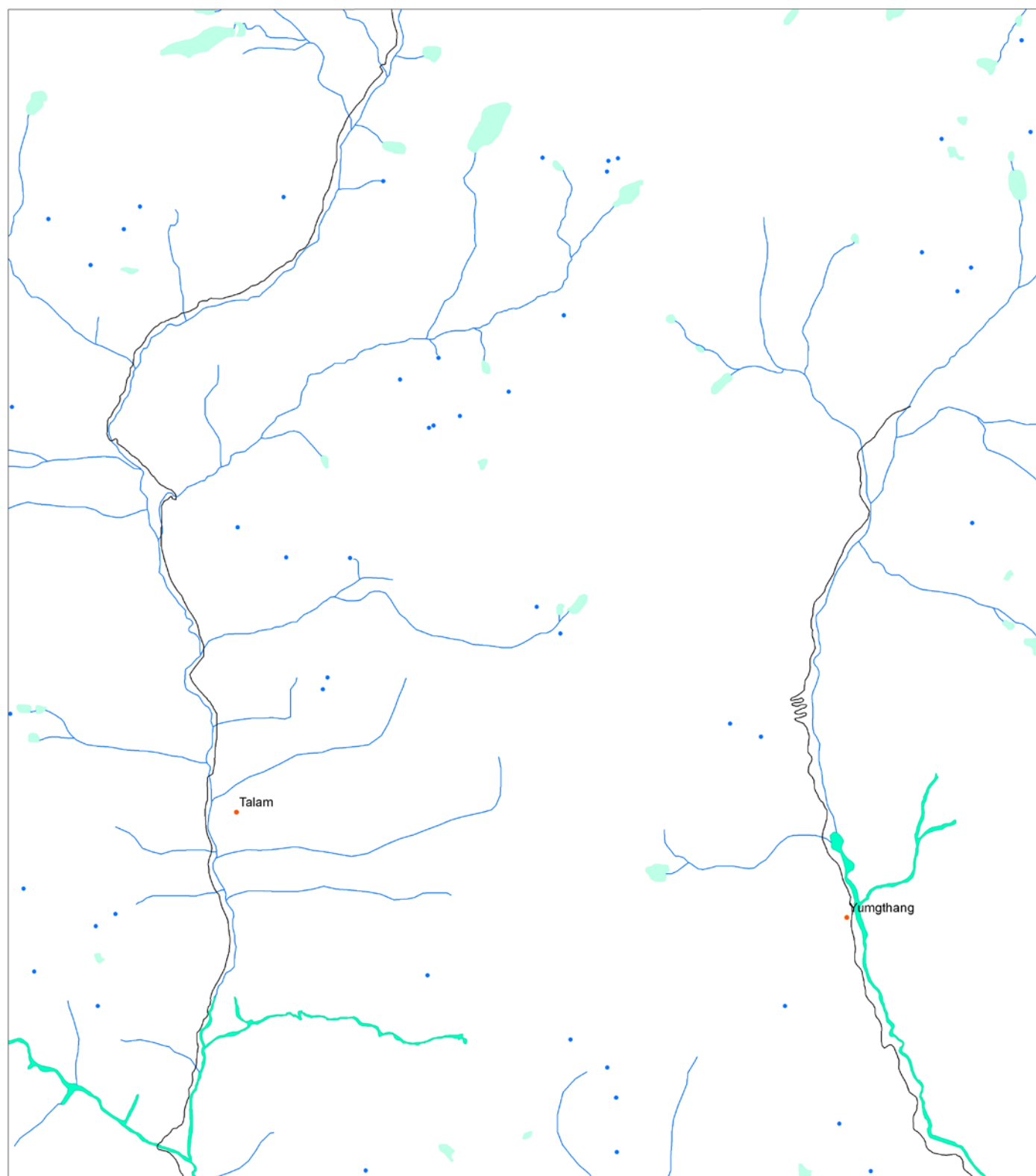
Location Map



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

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

Sponsored By:
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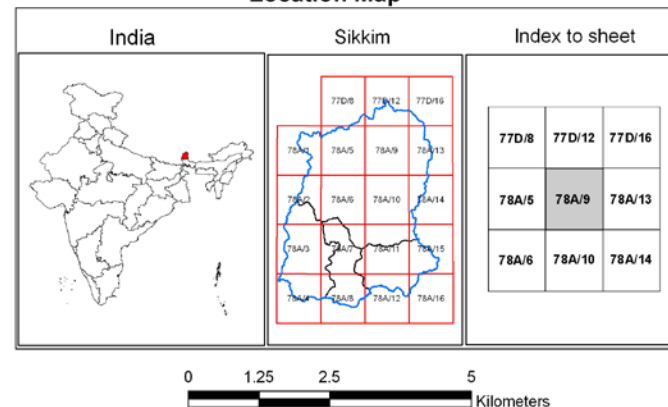


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Legend

- Wetlands (<2.25ha)
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- District Boundary
- State Boundary
- International Boundary
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Location Map



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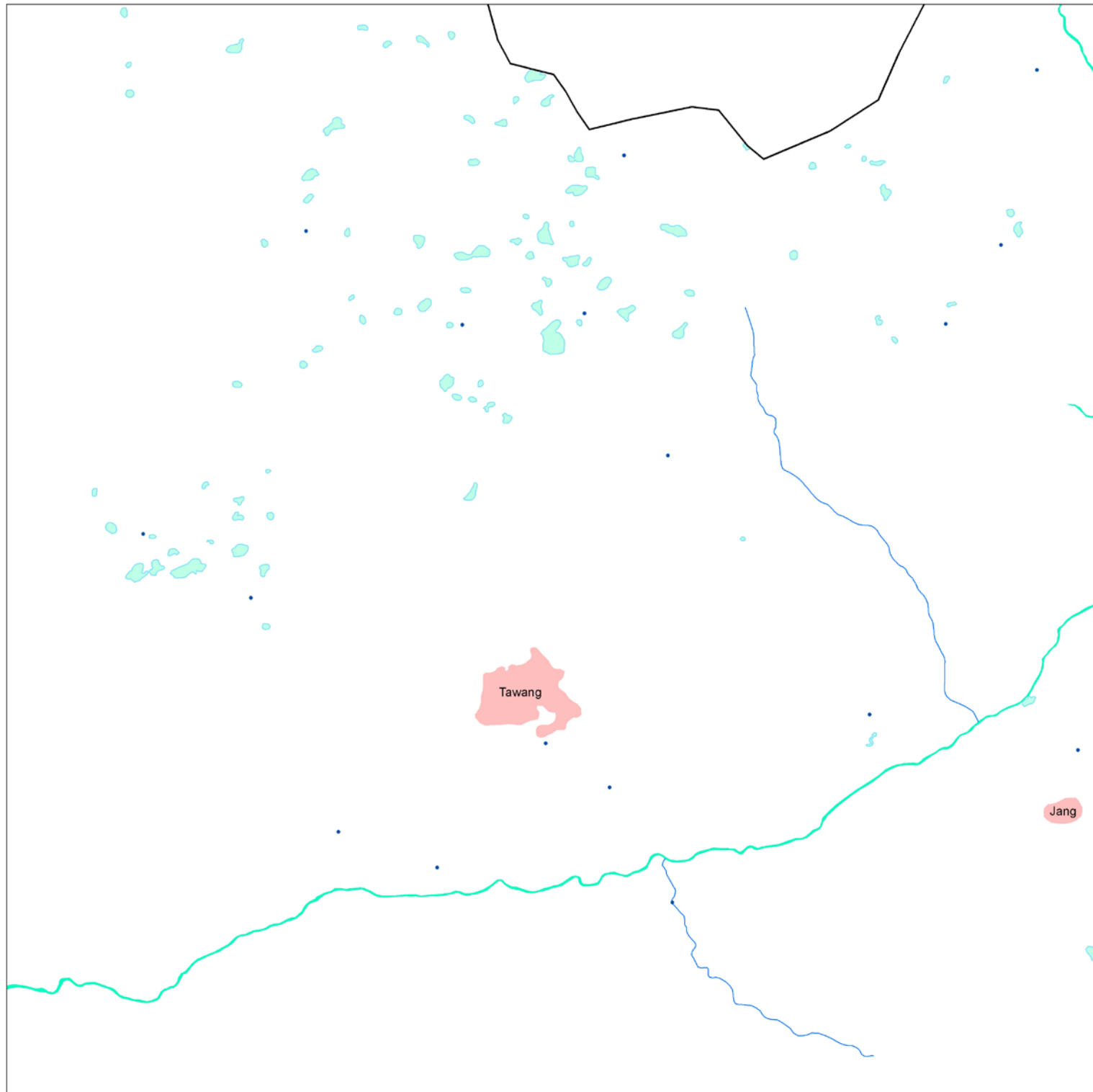
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Seasons: 2005)

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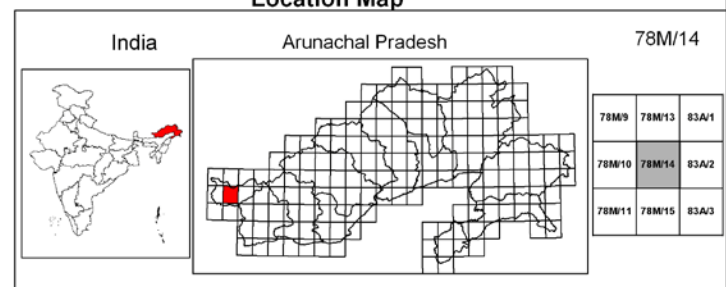


Symbol	Typecode	Level I	Level II	Level III
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Location Map



Data Source :

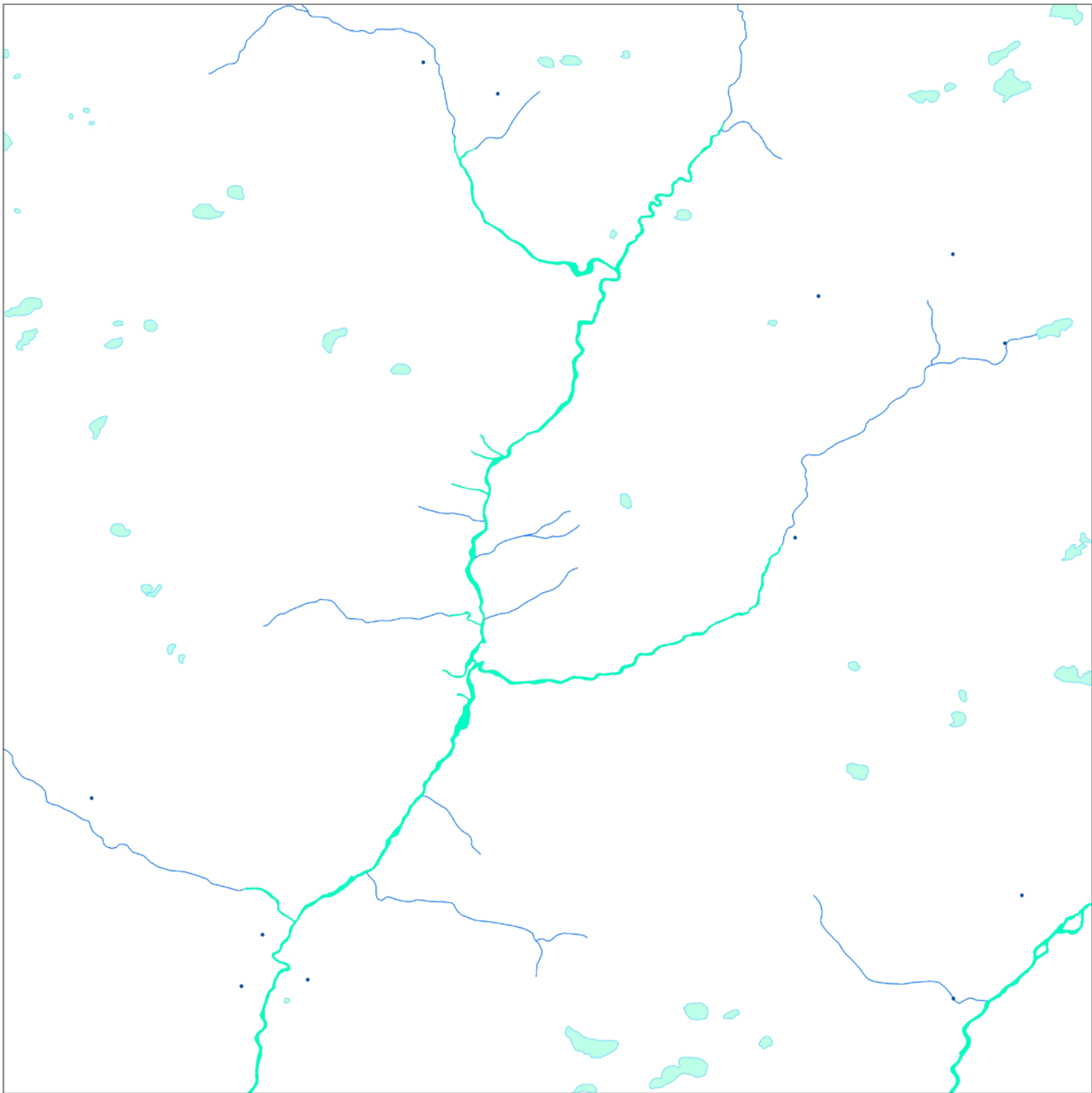
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

Prepared By :

Space Applications Centre (ISRO), Ahmedabad

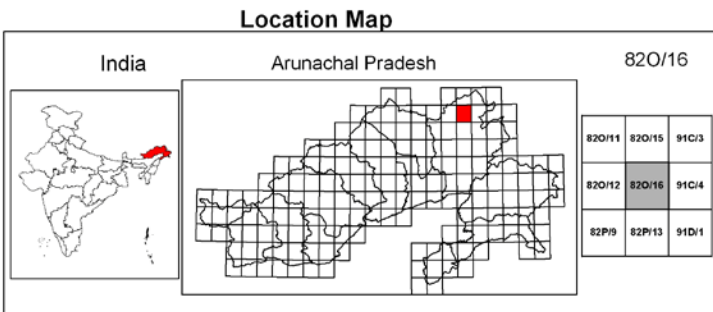
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			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

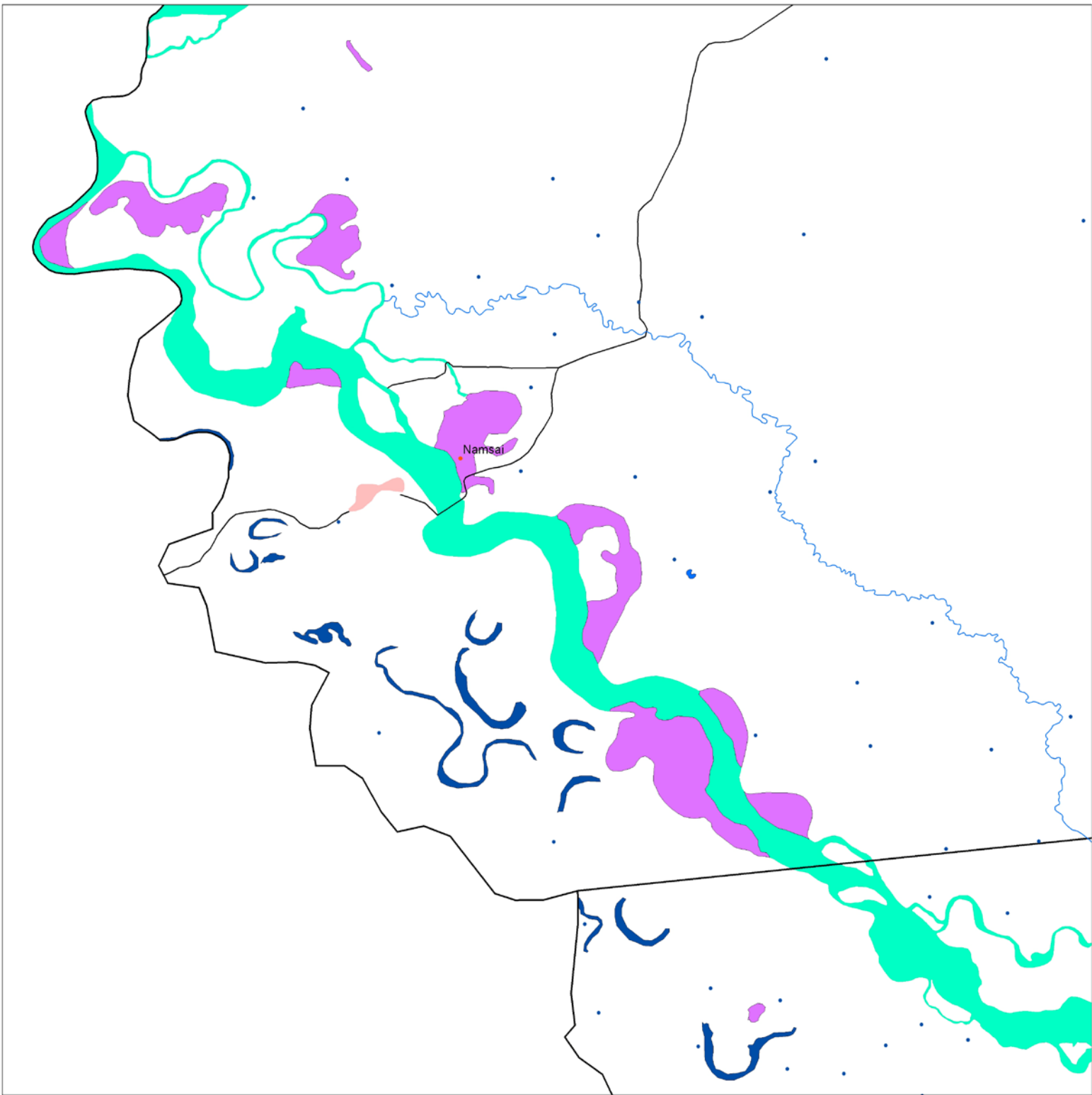
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 - Drainage(line)
 - Railway
 - Roads
 - District Boundary
 - Towns/Settlements



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

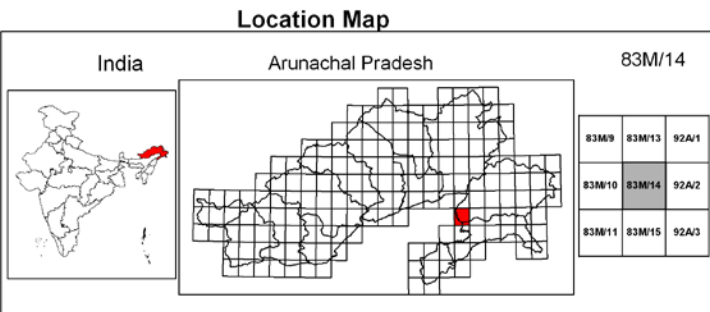
Prepared By :
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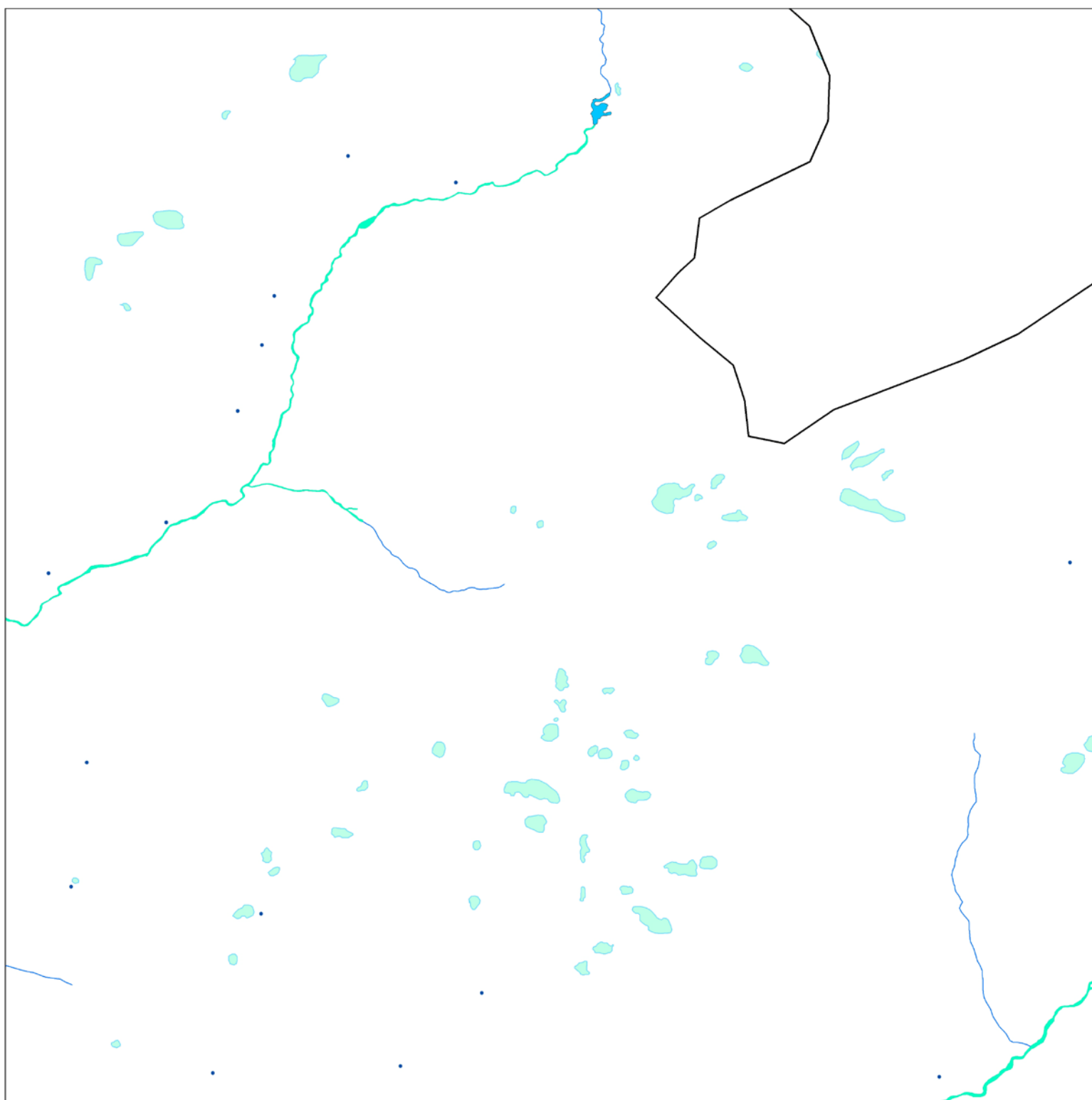
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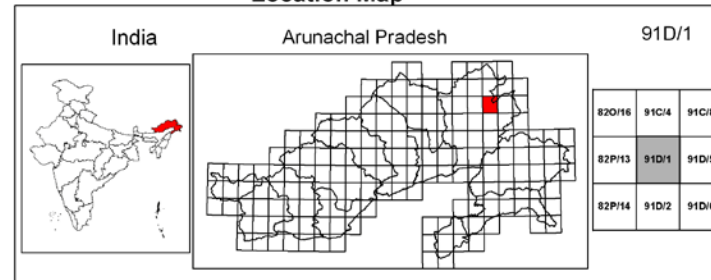


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	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

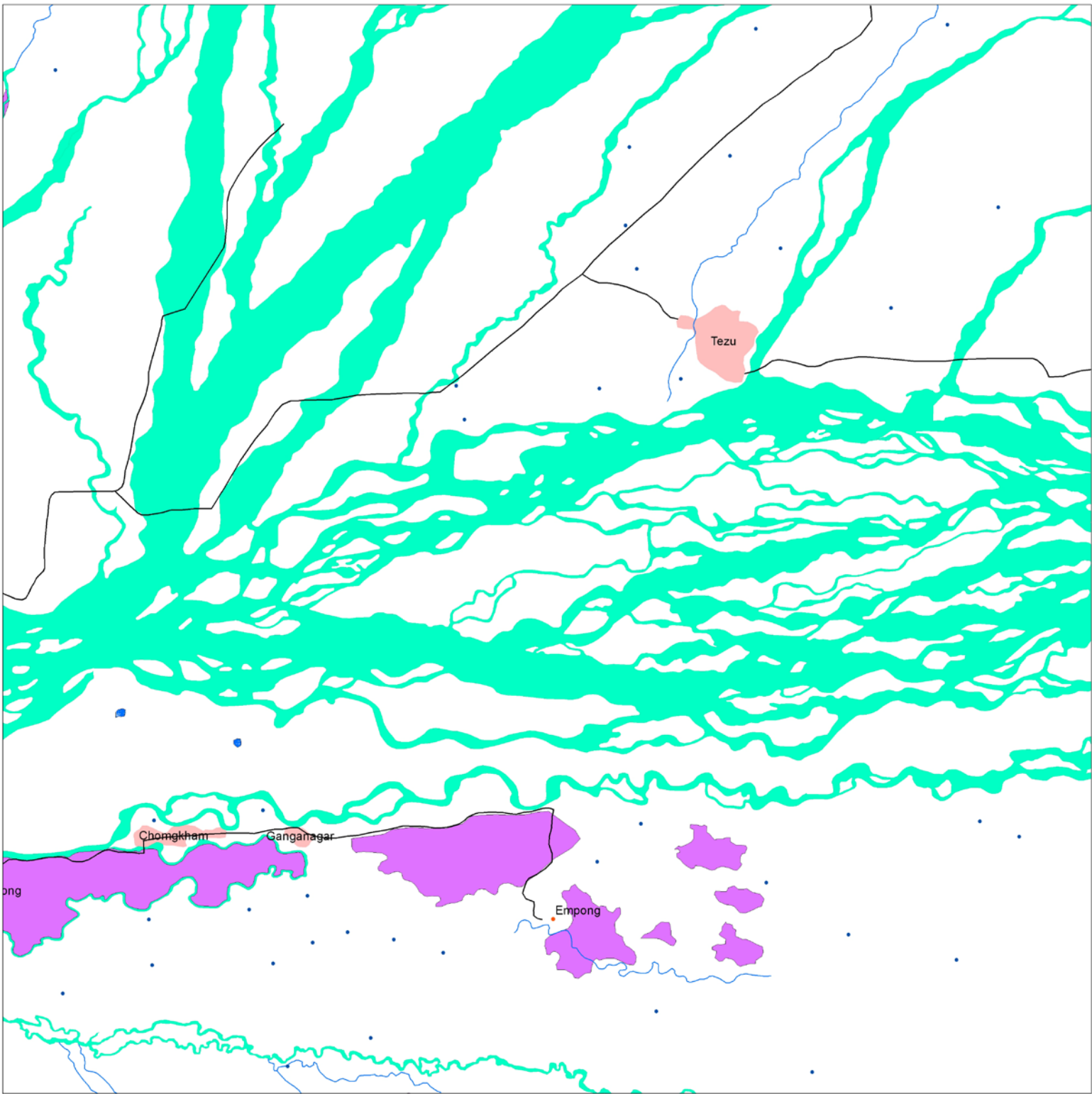
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- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

Location Map



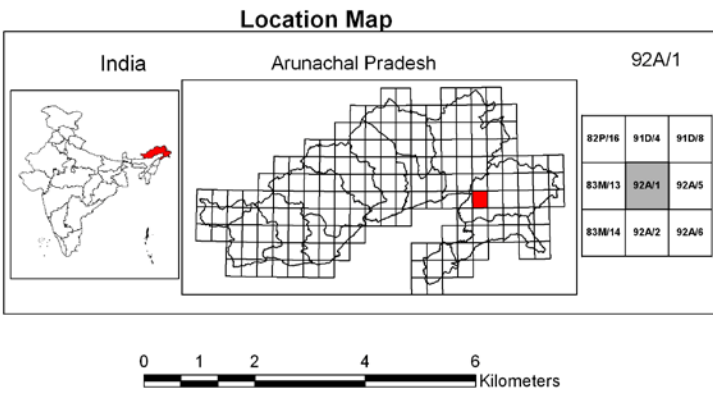
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Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)
Prepared By :
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		Coastal Wetlands		
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			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

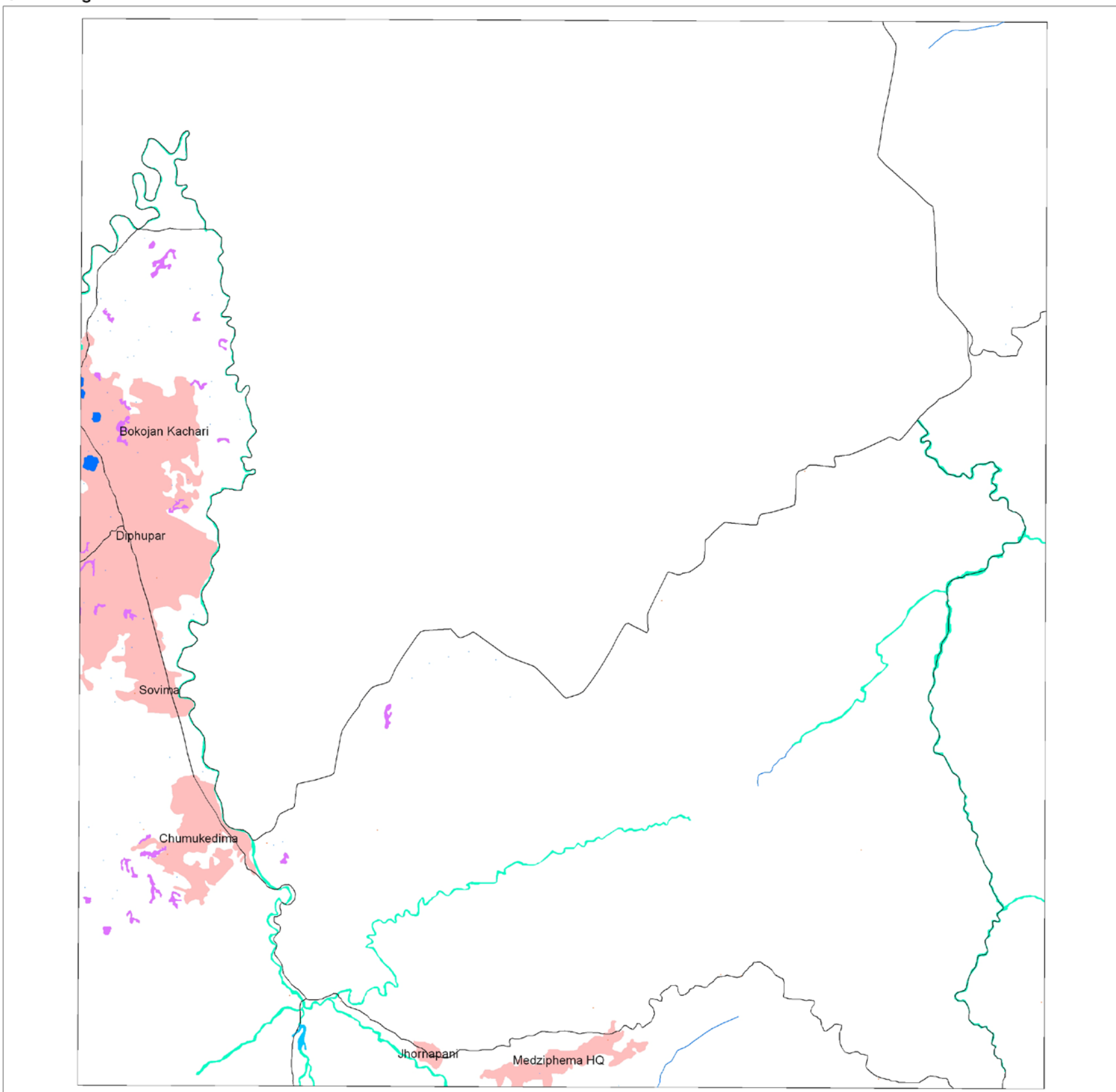
- Legend**
- Wetlands (<2.25 ha)
 - Settlements
 - Canal
 - Drainage(line)
 - Railway
 - Roads
 - District Boundary
 - Towns/Settlements



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

Prepared By :
Space Applications Centre (ISRO), Ahmedabad

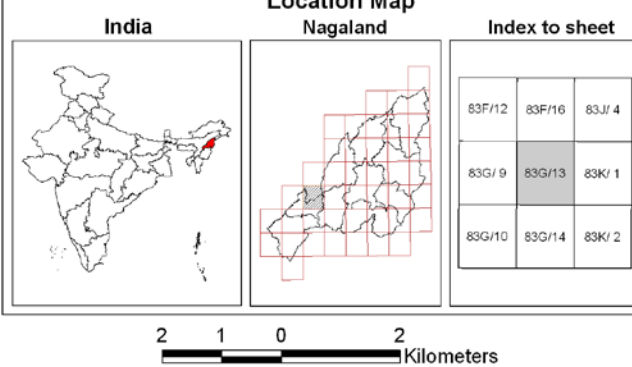
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Government of India



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

Legend

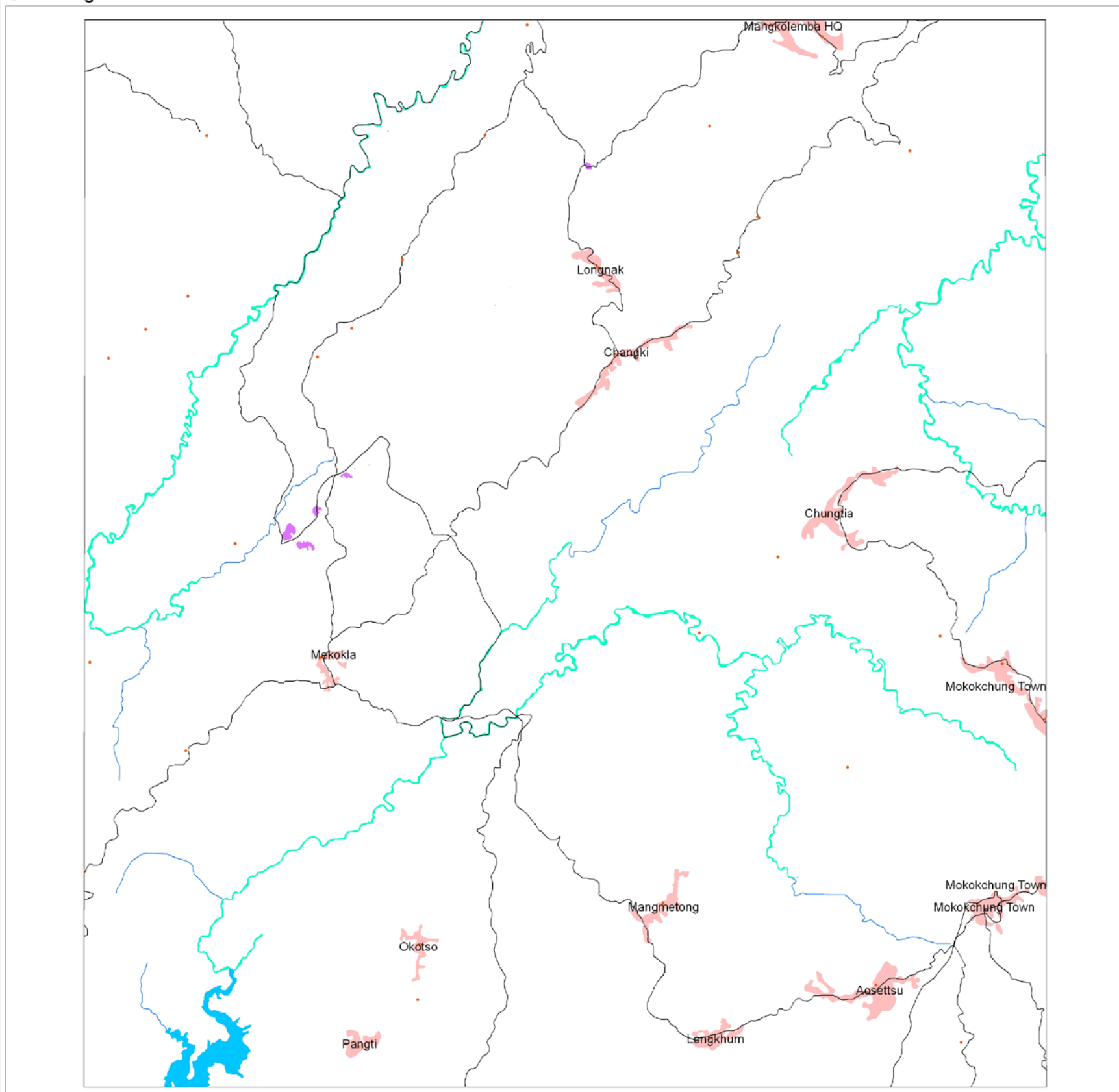
- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary

Location Map

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

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

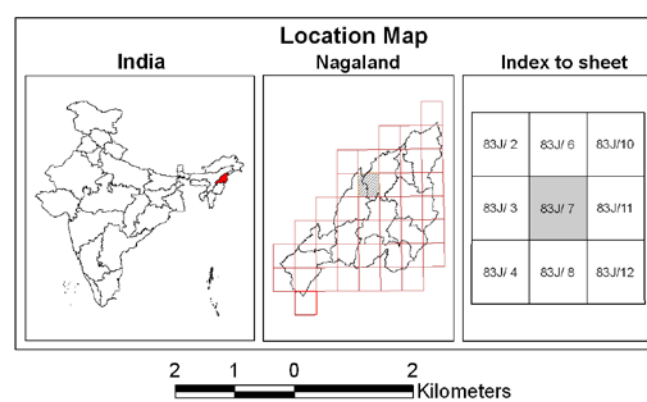
Sponsored by:
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Symbol	Typecode	Level I	Level II	Level III
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	1101			Lakes/Ponds
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			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds

Legend

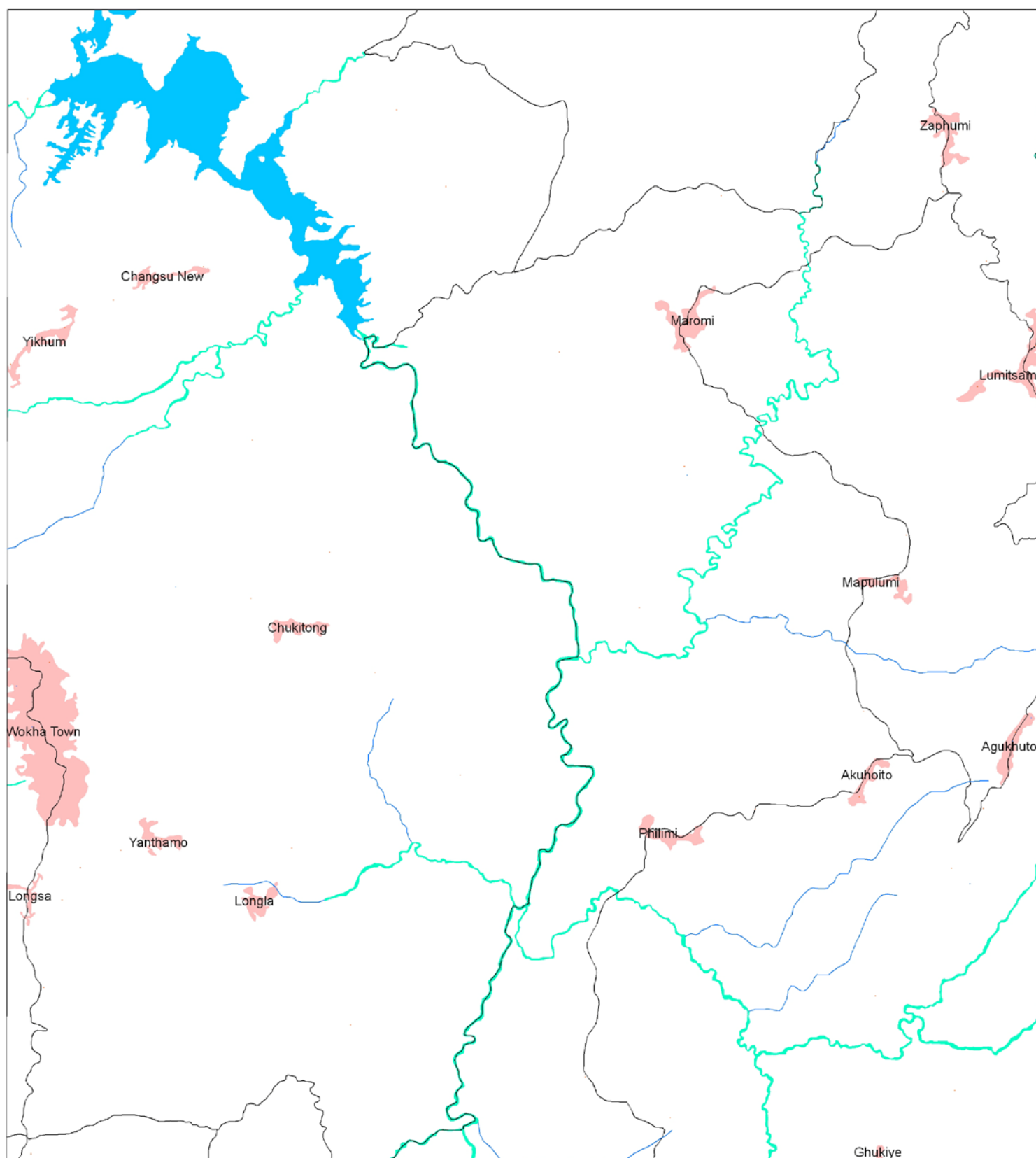
- Wetlands (<2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary



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

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

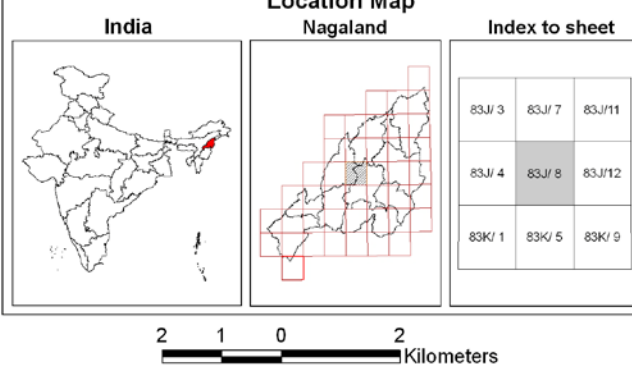
Sponsored by:
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Government of India



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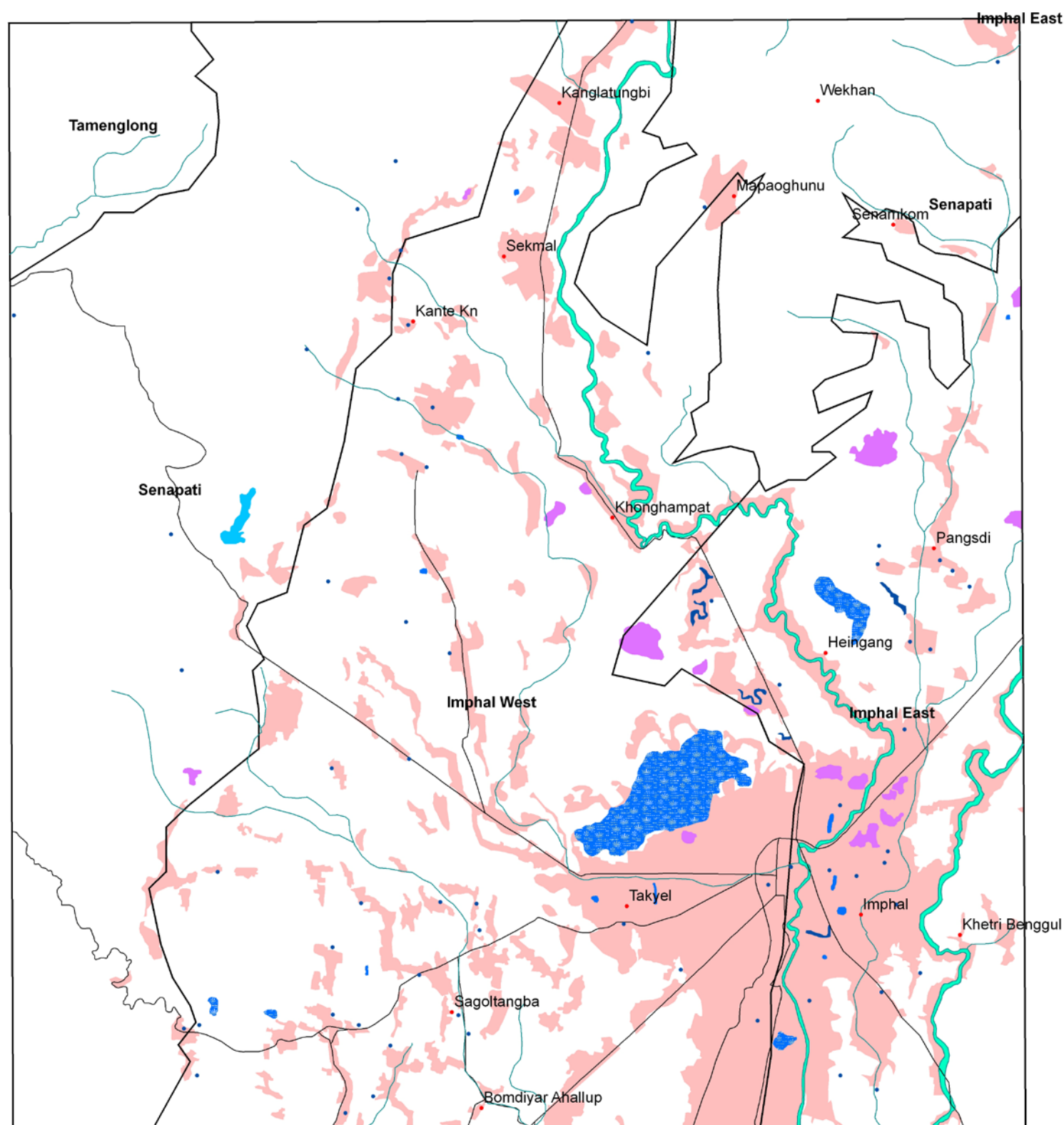
Location Map

2 1 0 2 Kilometers

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

Prepared by:
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Sponsored by:
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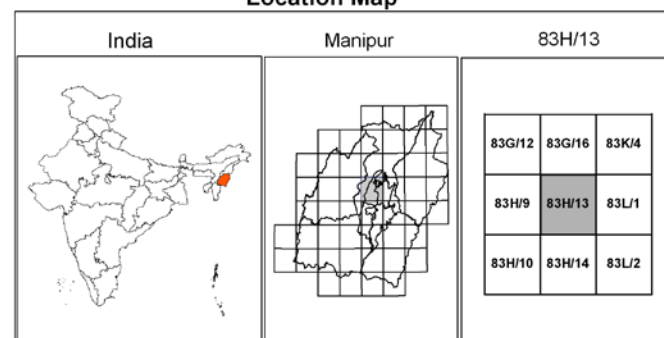


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Legend

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

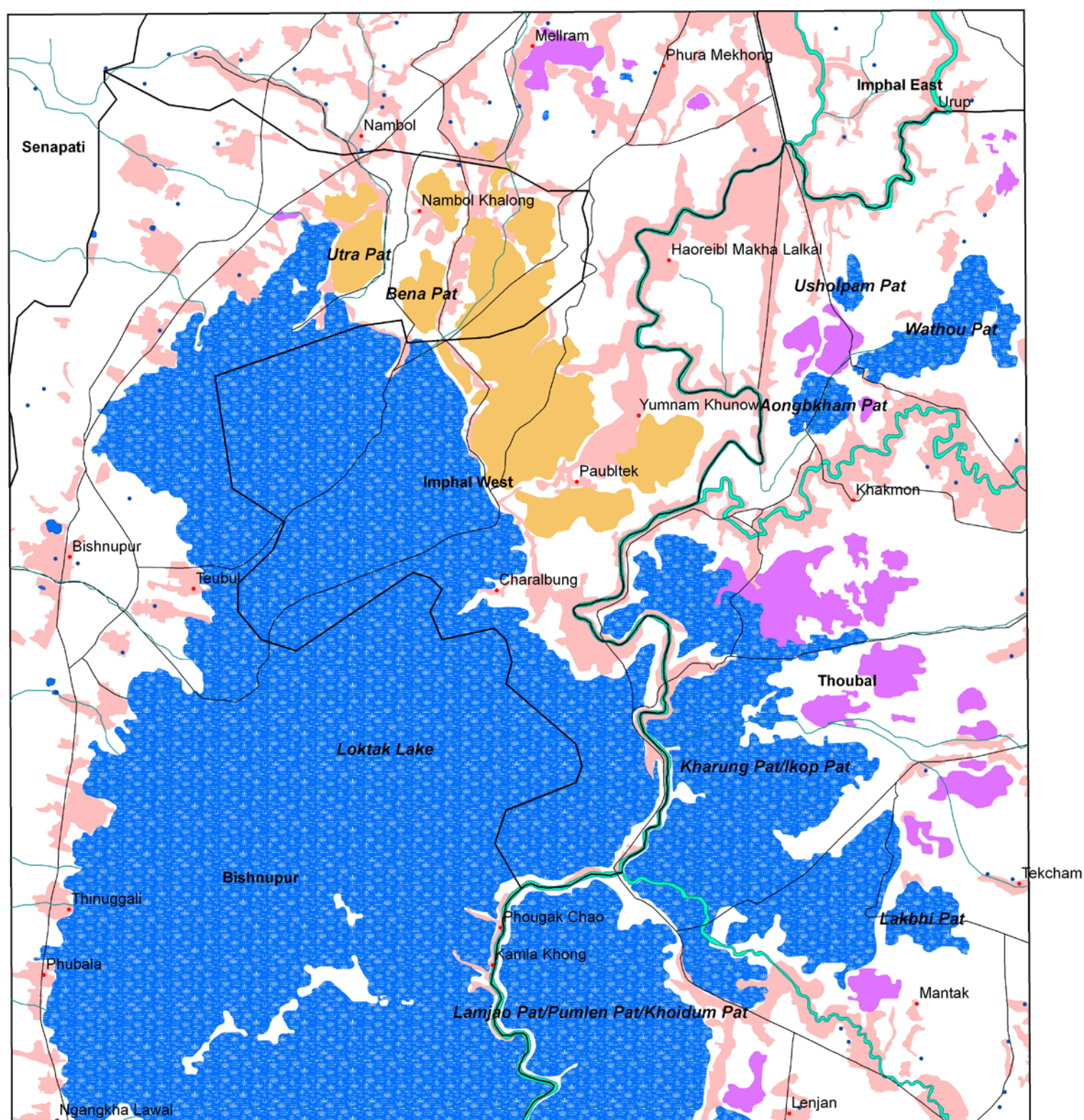
Location Map



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Sponsored By:
Ministry of Environment and Forests
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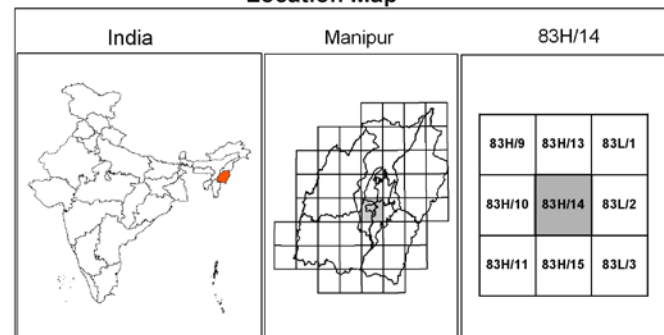


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Legend

- Wetlands (<2.25ha)
- Roads
- Drainage (line)
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Location Map

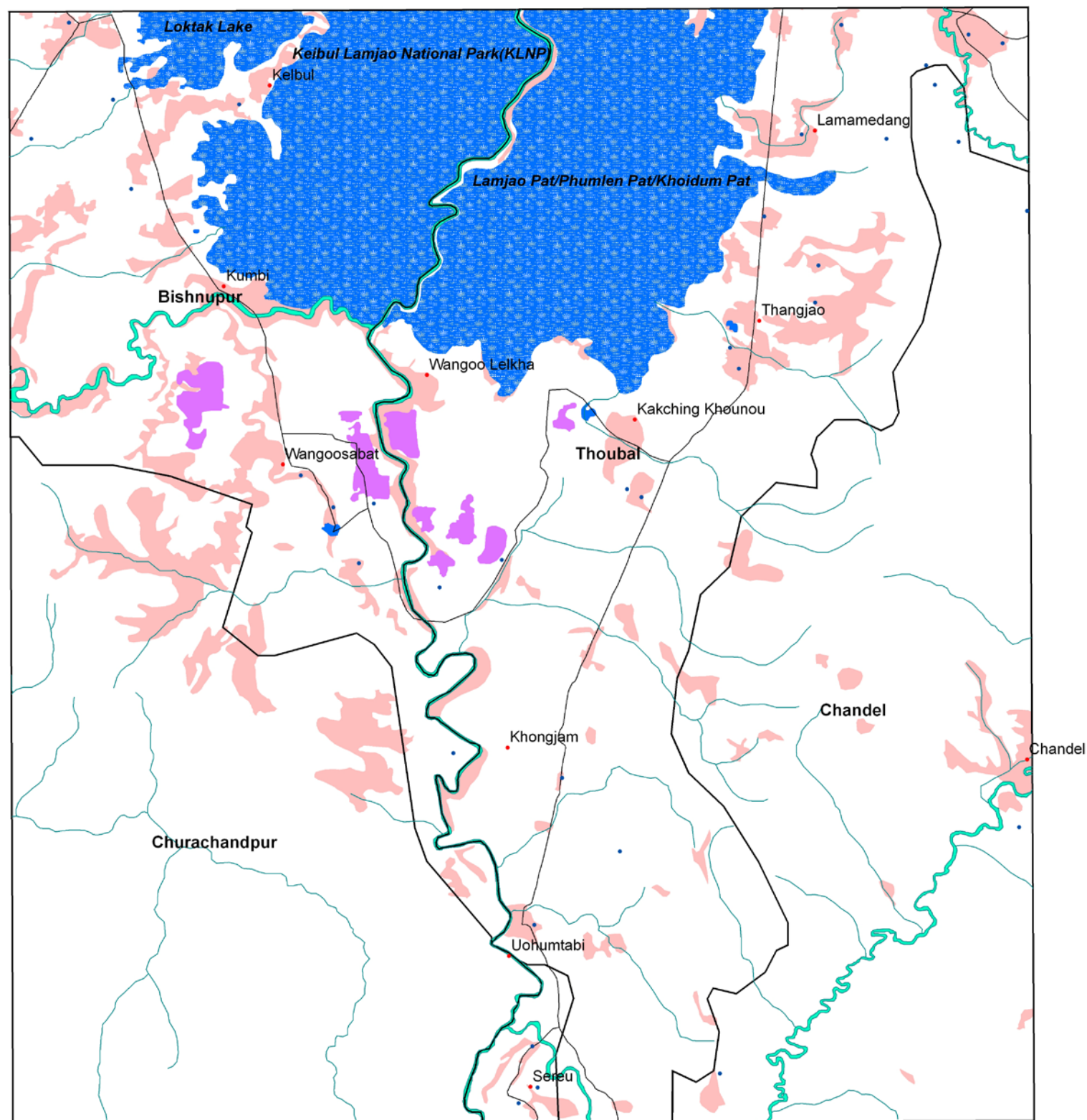


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Kilometers

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

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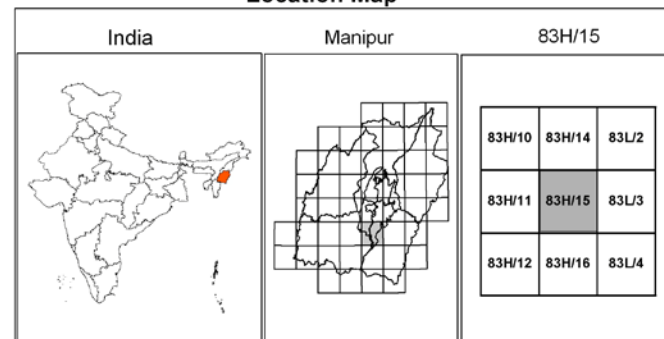


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Legend

- Wetlands (<2.25ha)
- Roads
- Drainage (line)
- Settlements
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Location Map

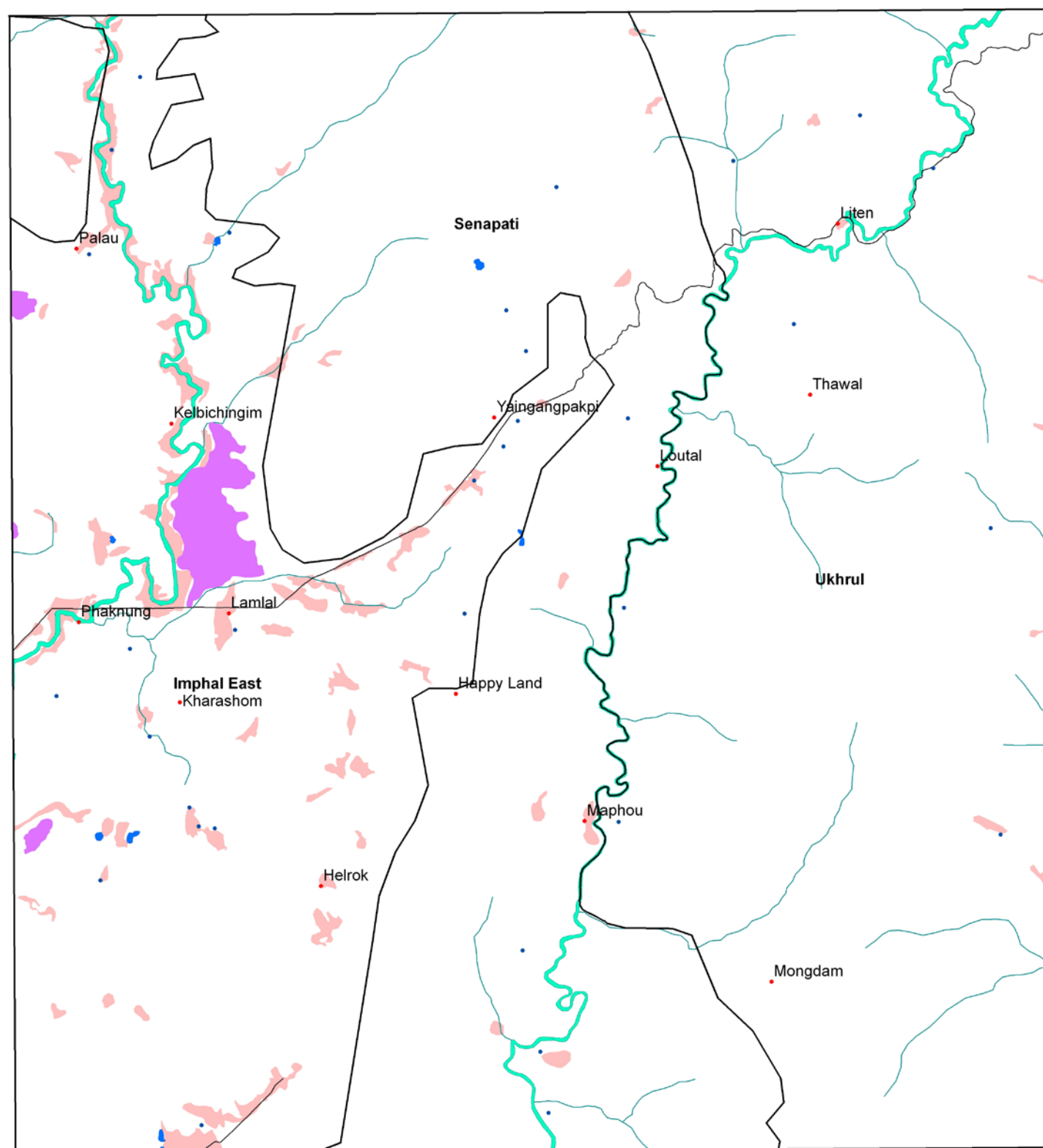


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Kilometers

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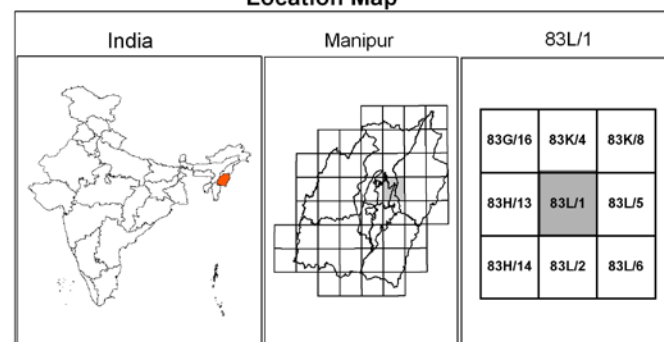


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Legend

- Wetlands (<2.25ha)
- Roads
- Drainage (line)
- Settlements
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Location Map

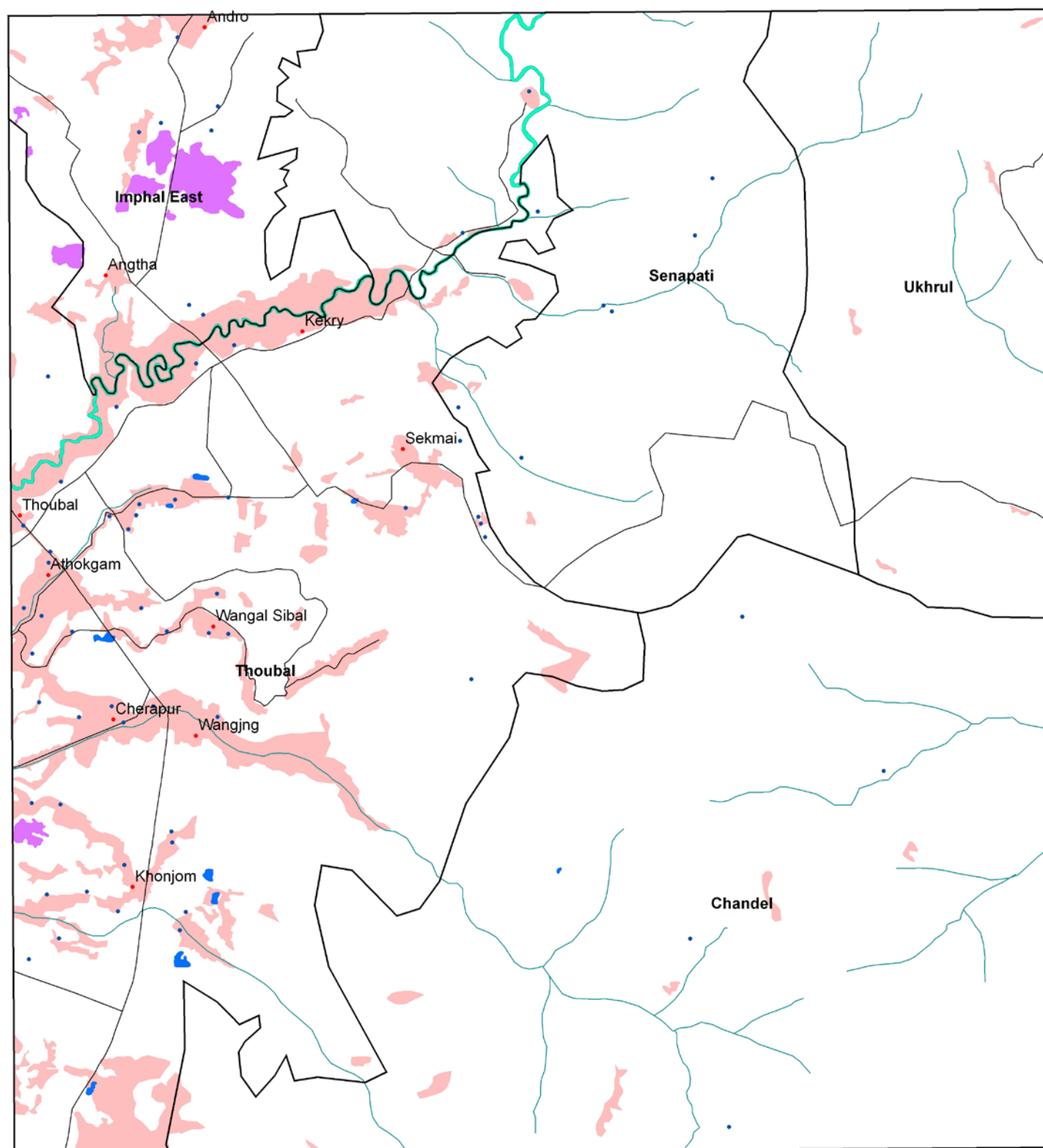


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Kilometers

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

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Ministry of Environment and Forests
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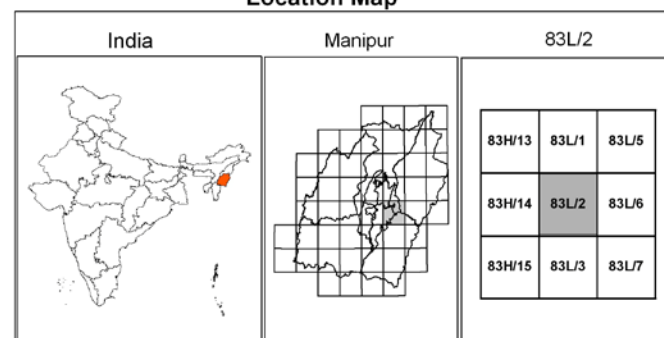


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Legend

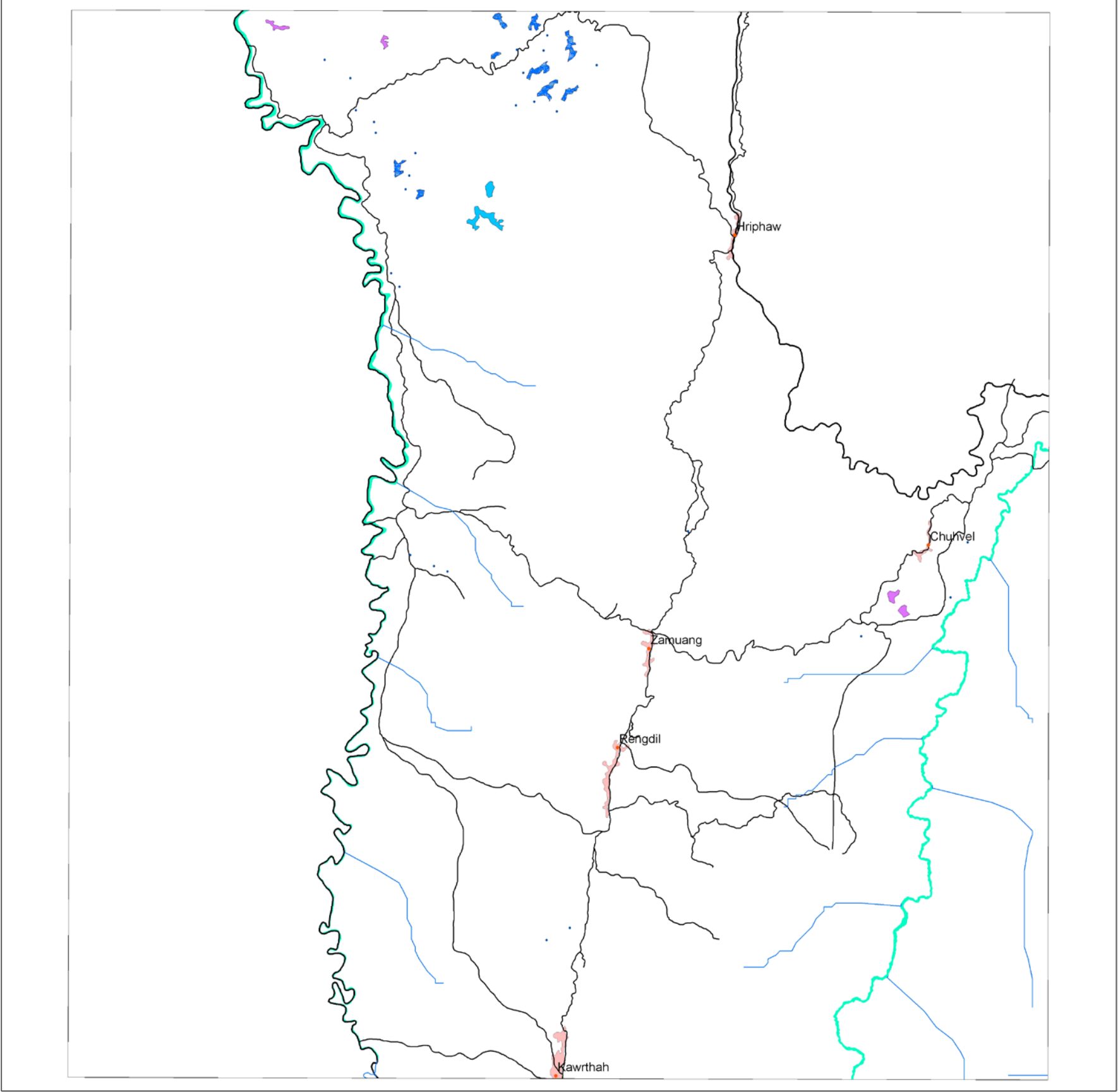
- Wetlands (<2.25ha)
- Roads
- Drainage (line)
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- Town/Settlements
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Location Map



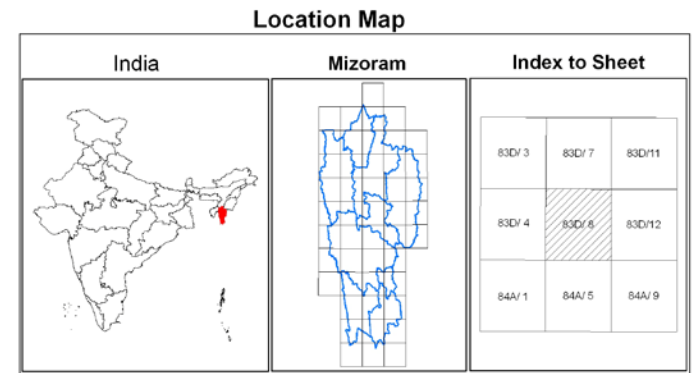
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Kilometers

Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)
Prepared By :
Space Applications Centre (ISRO), Ahmedabad
Sponsored By:
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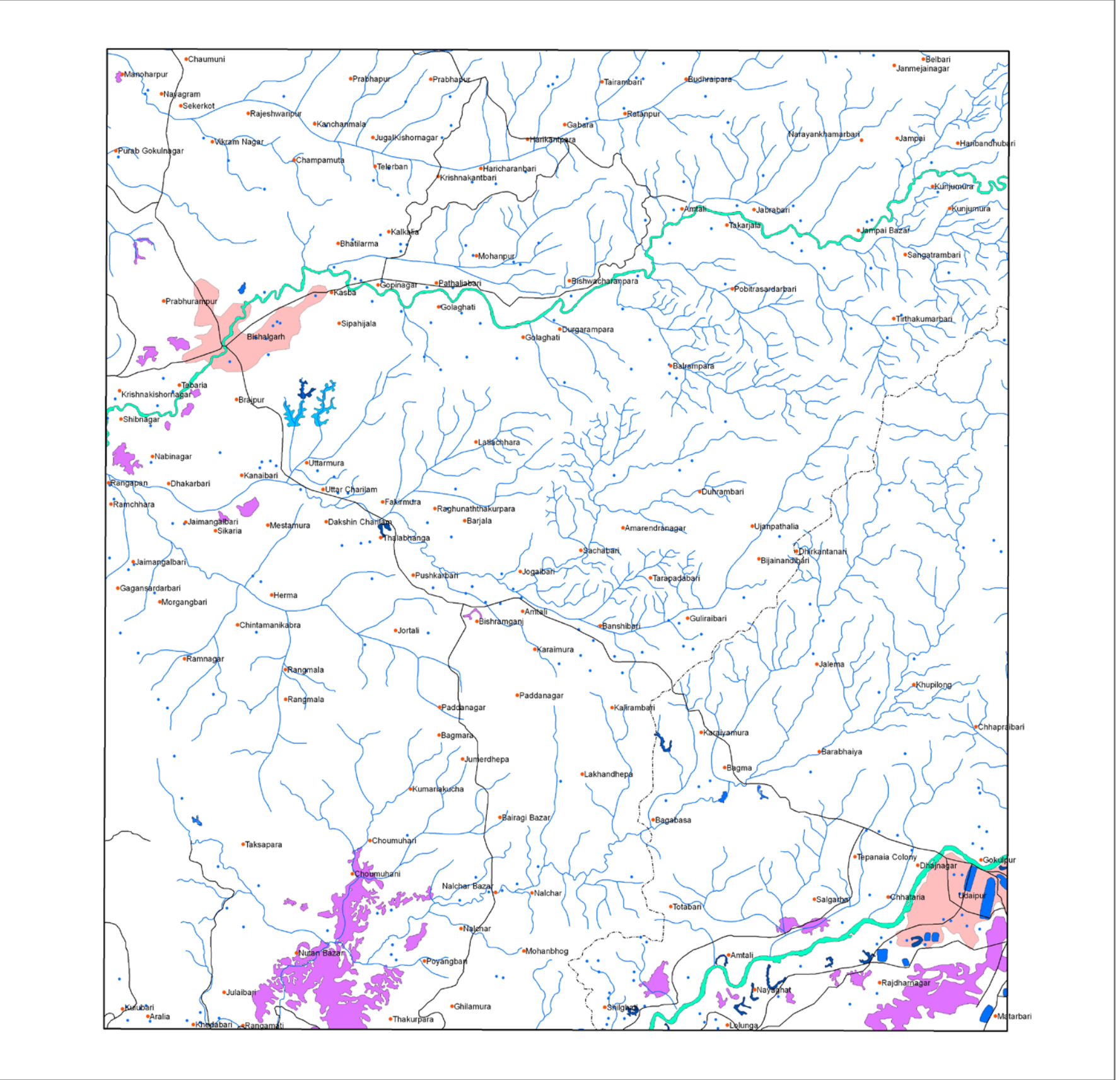


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- Legend**
- Wetlands (<2.25 ha)
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 - Drainage(line)
 - Railway
 - Roads
 - District Boundary
 - Towns/Settlements

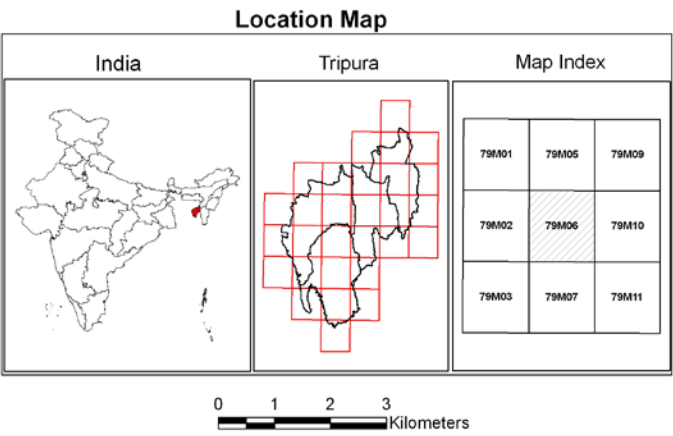


Data Source:
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)
Prepared By:
Space Applications Centre (ISRO), Ahmedabad and Mizoram Remote Sensing Application Centre (MIRSAC)
Sponsored By:
Ministry of Environment and Forests Government of India



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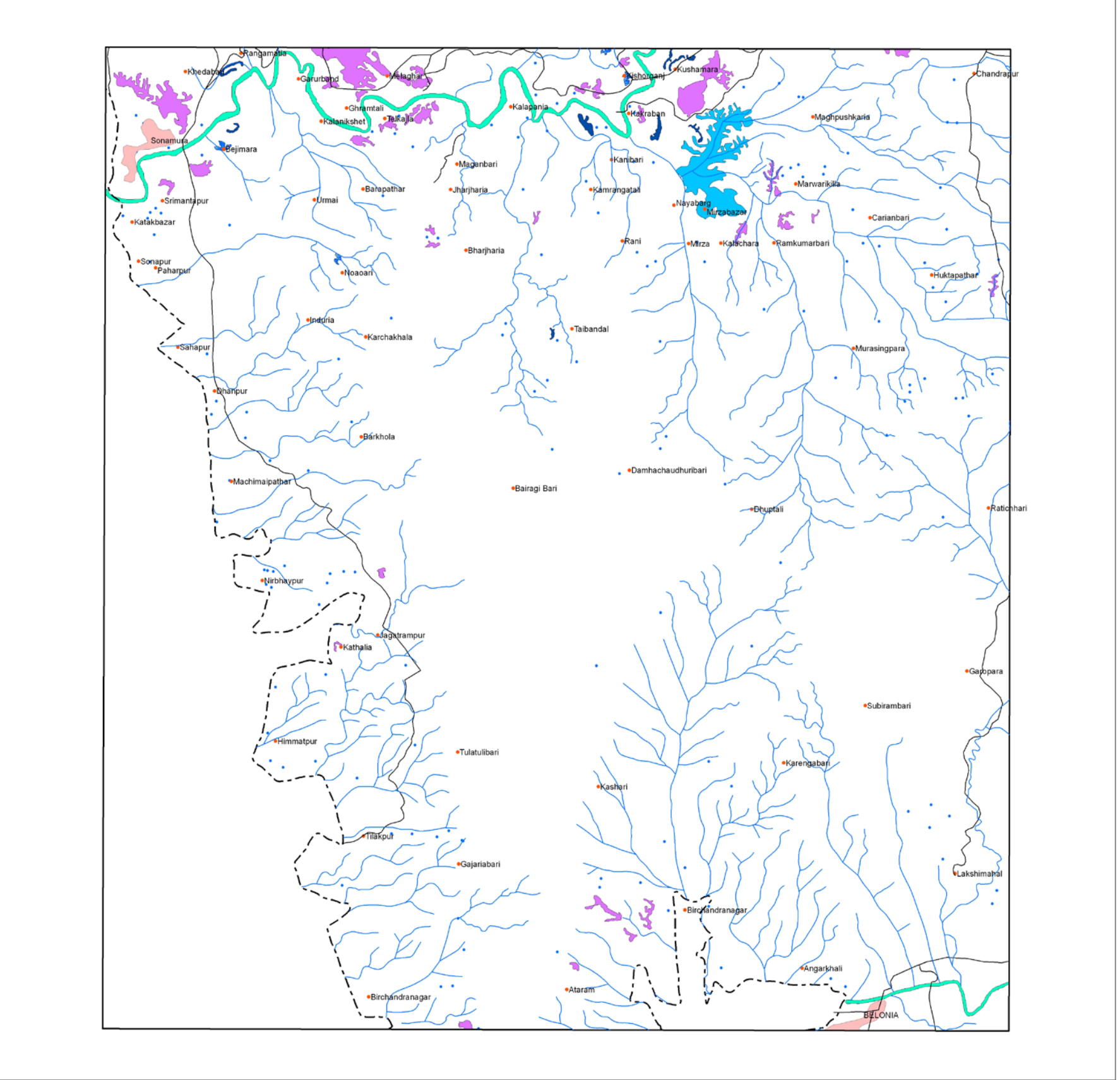
- Legend
- Wetlands (<2.25 ha)
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Data Source:
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

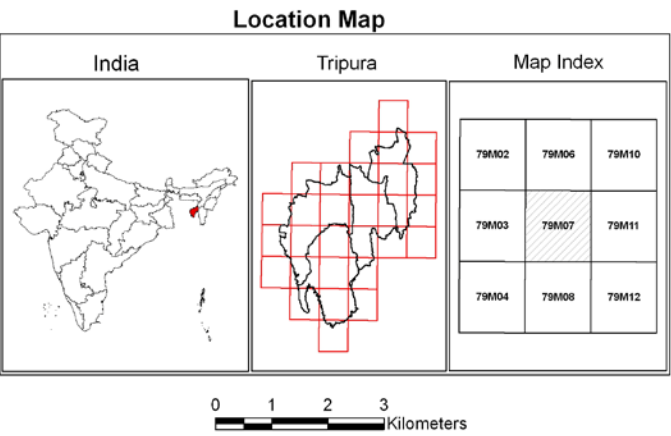
Prepared By :
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Sponsored By :
Ministry of Environment and Forests
Government of India



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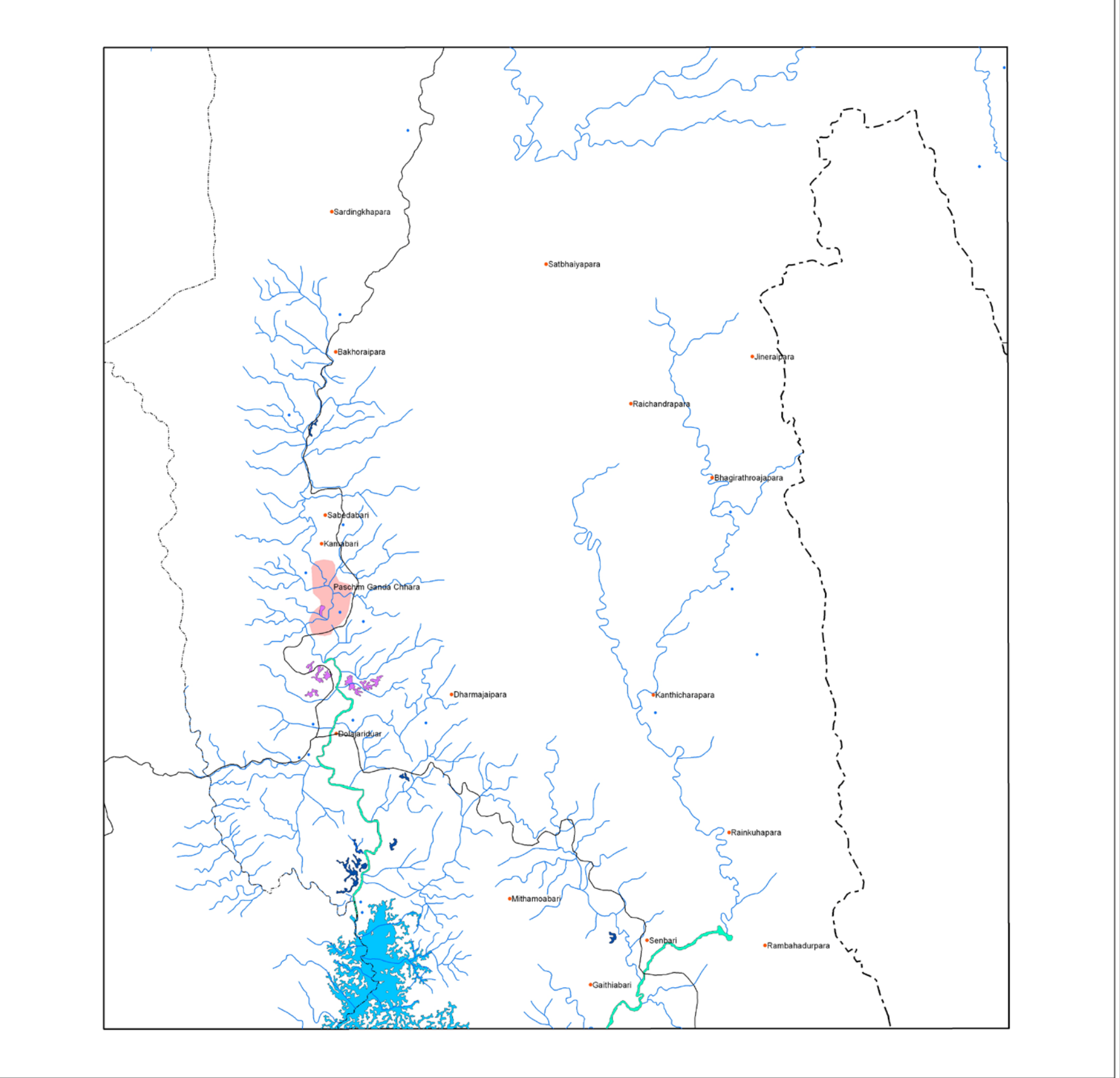
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Data Source:
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

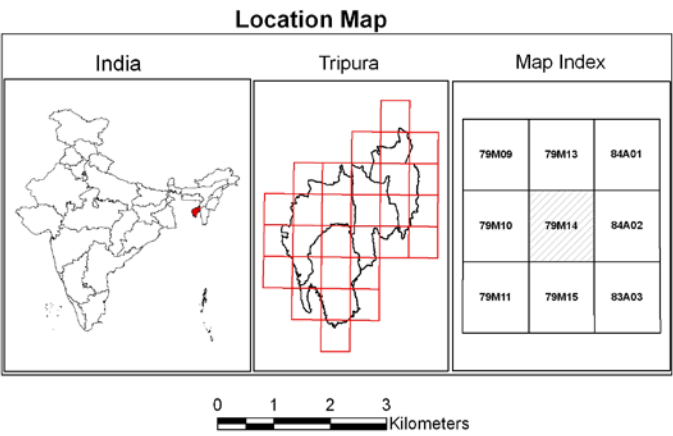
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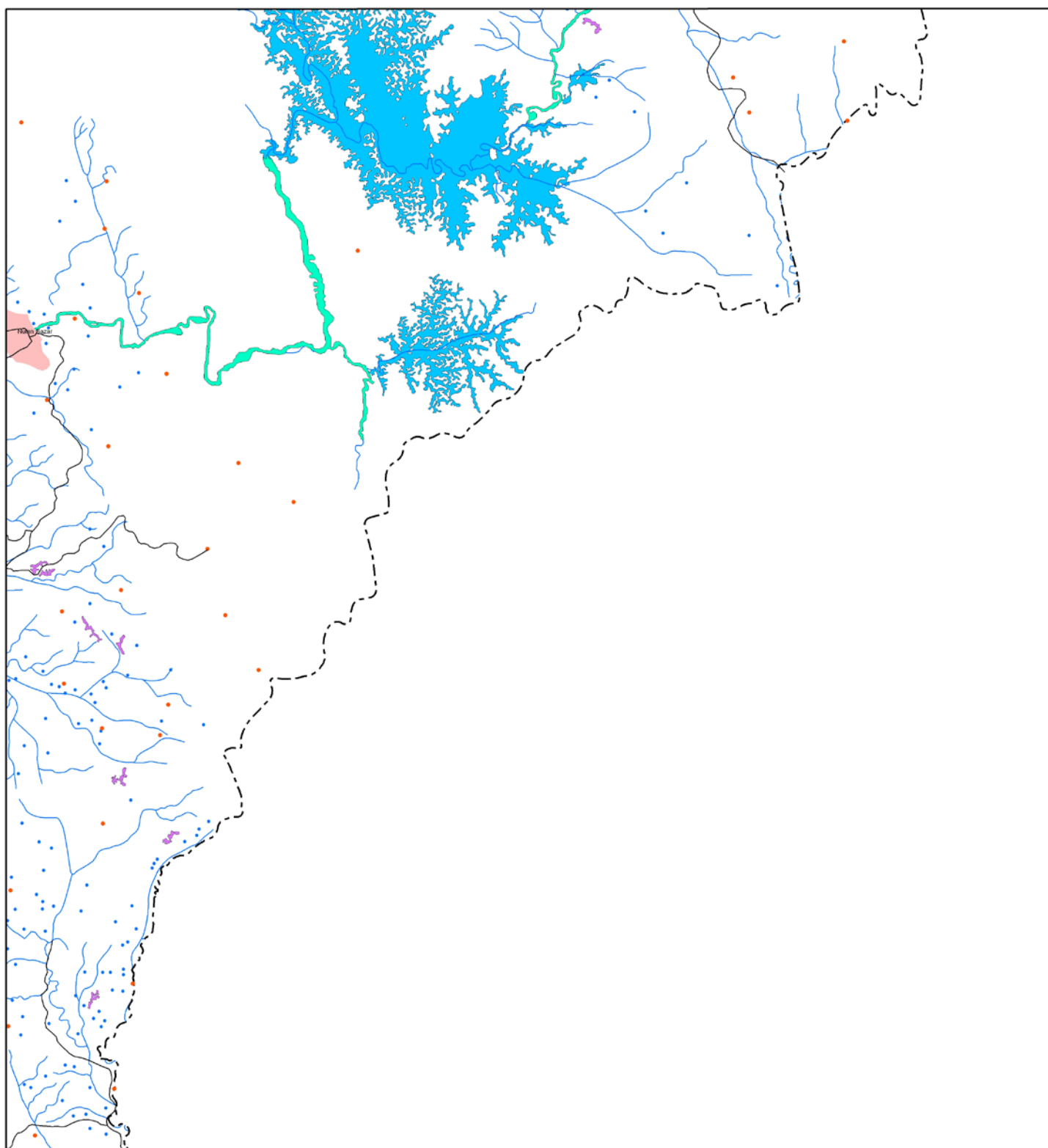
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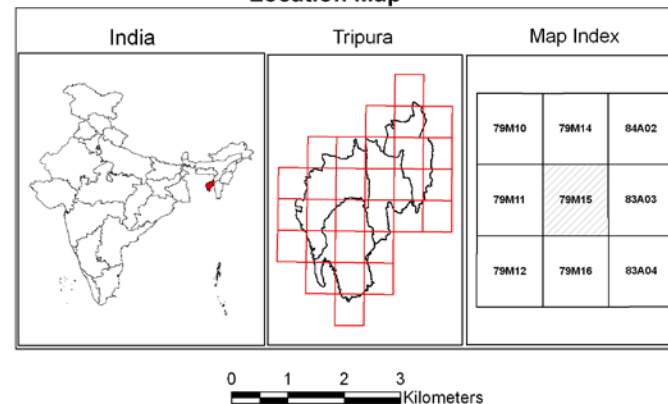
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Legend

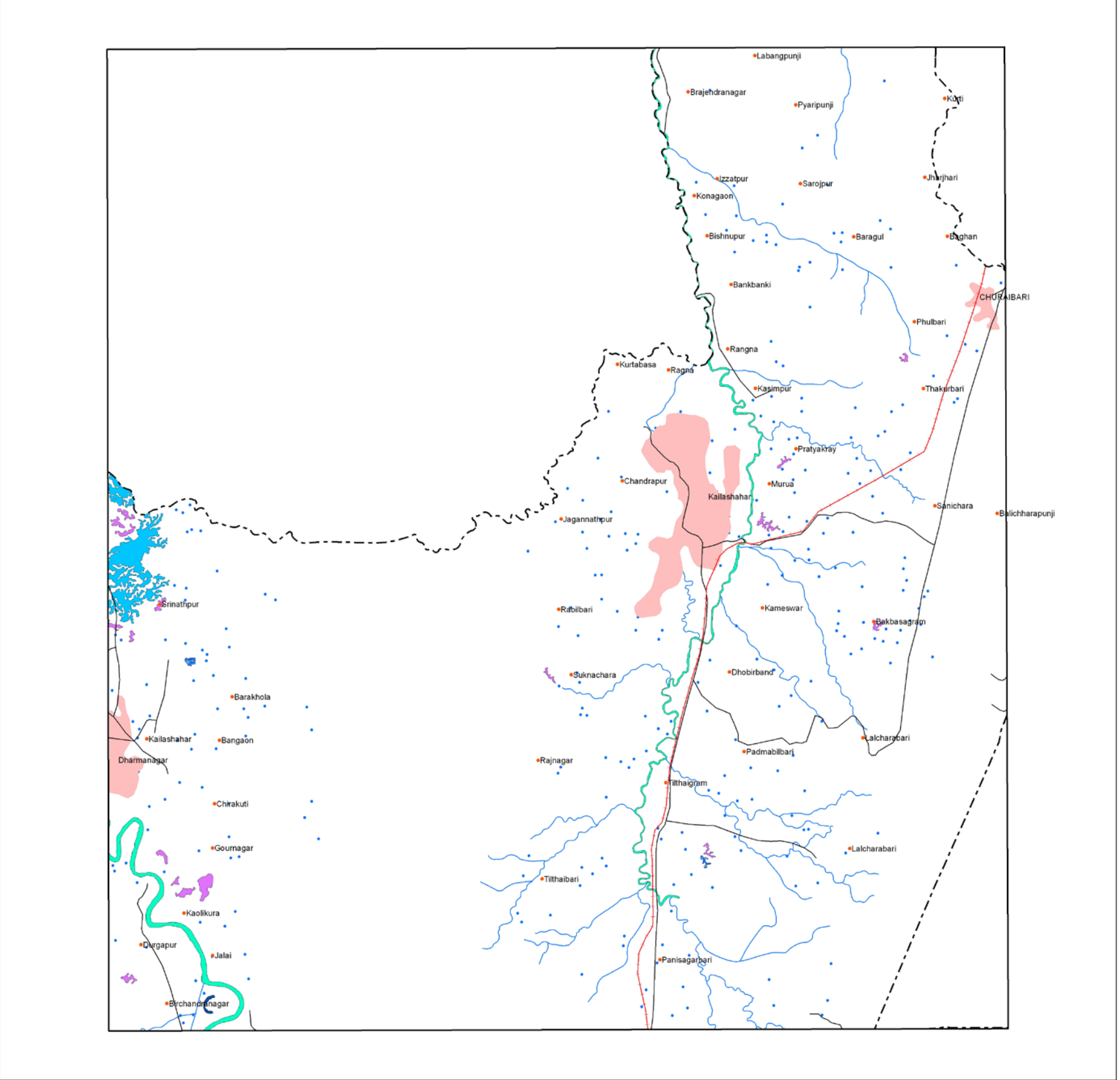
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Location Map

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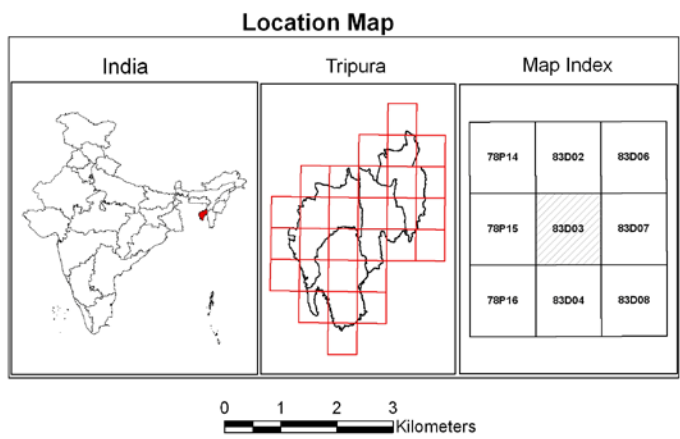
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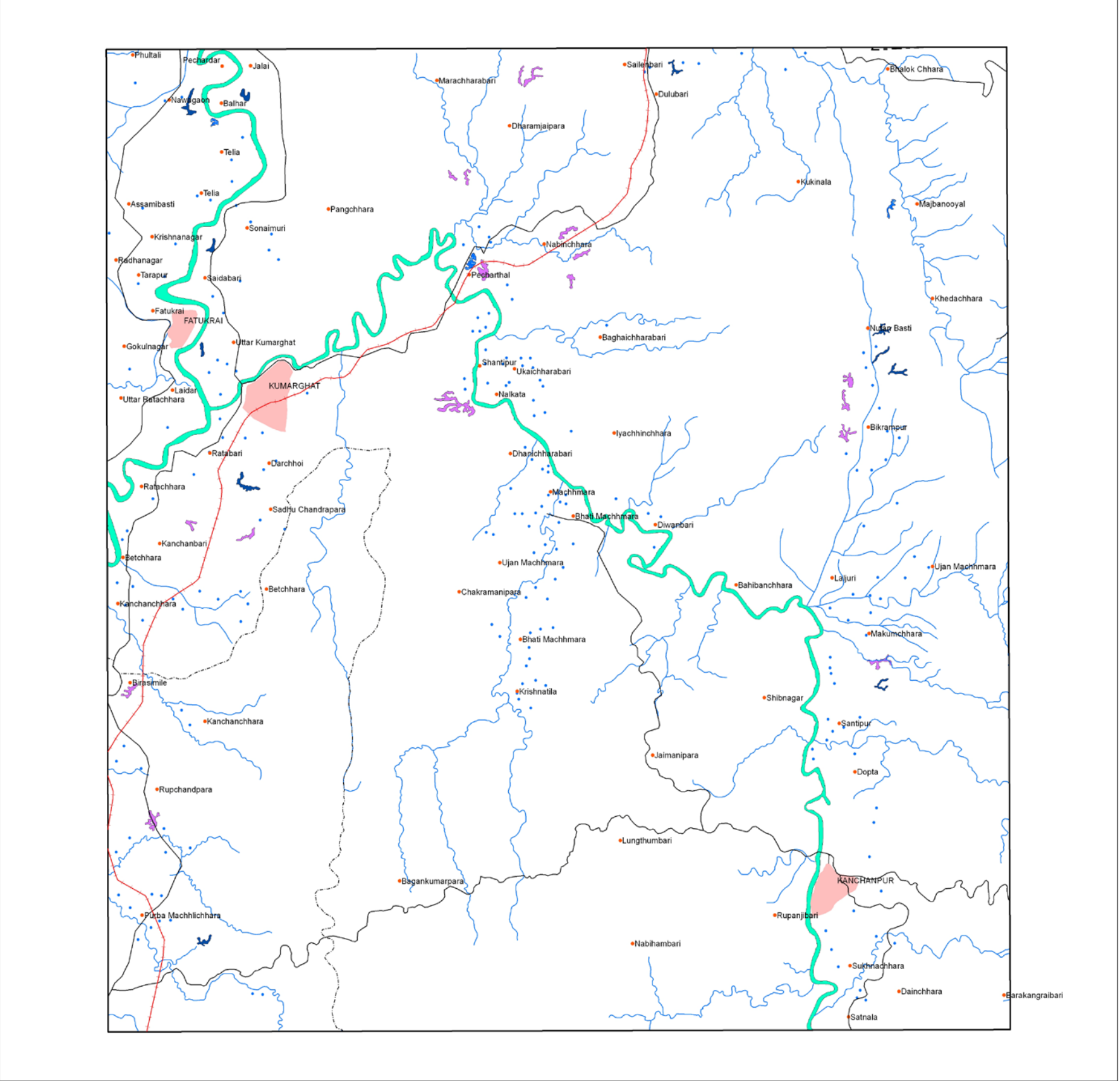
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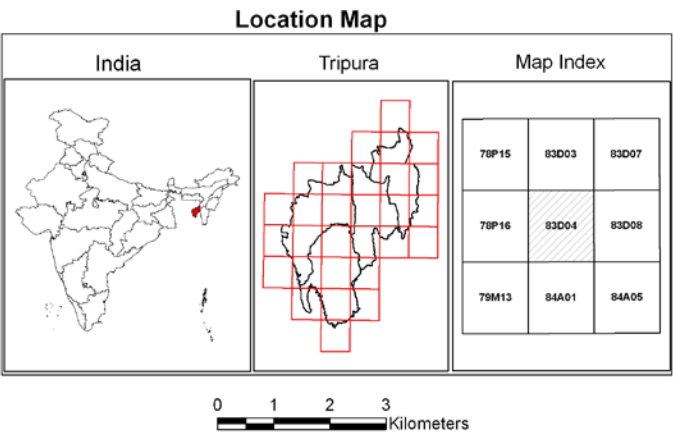
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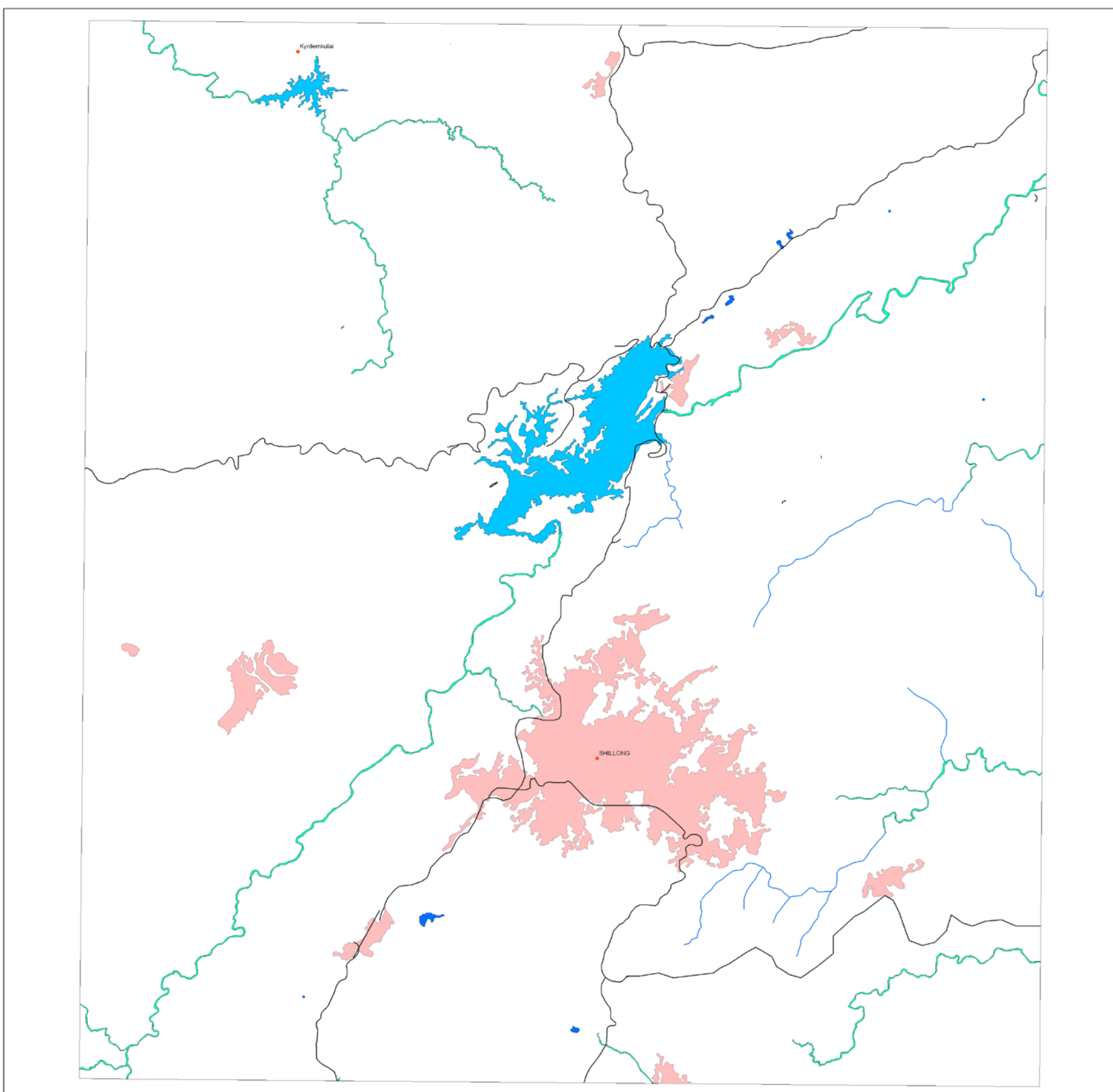
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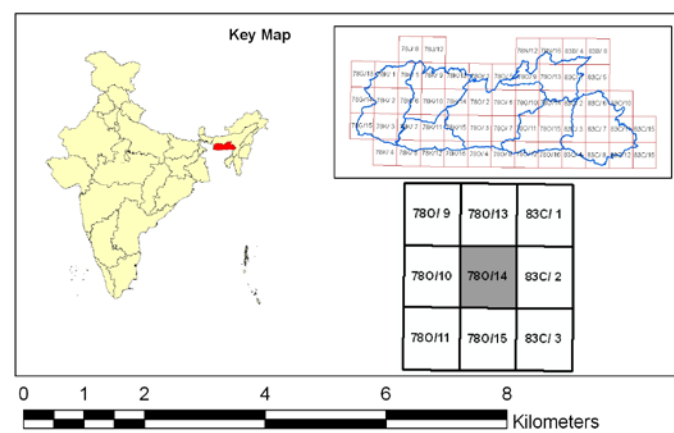
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			Man-made	
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	2202			Aquaculture ponds

Legend

- wetpoint point
- drain/arc
- settlep point
- settlea polygon

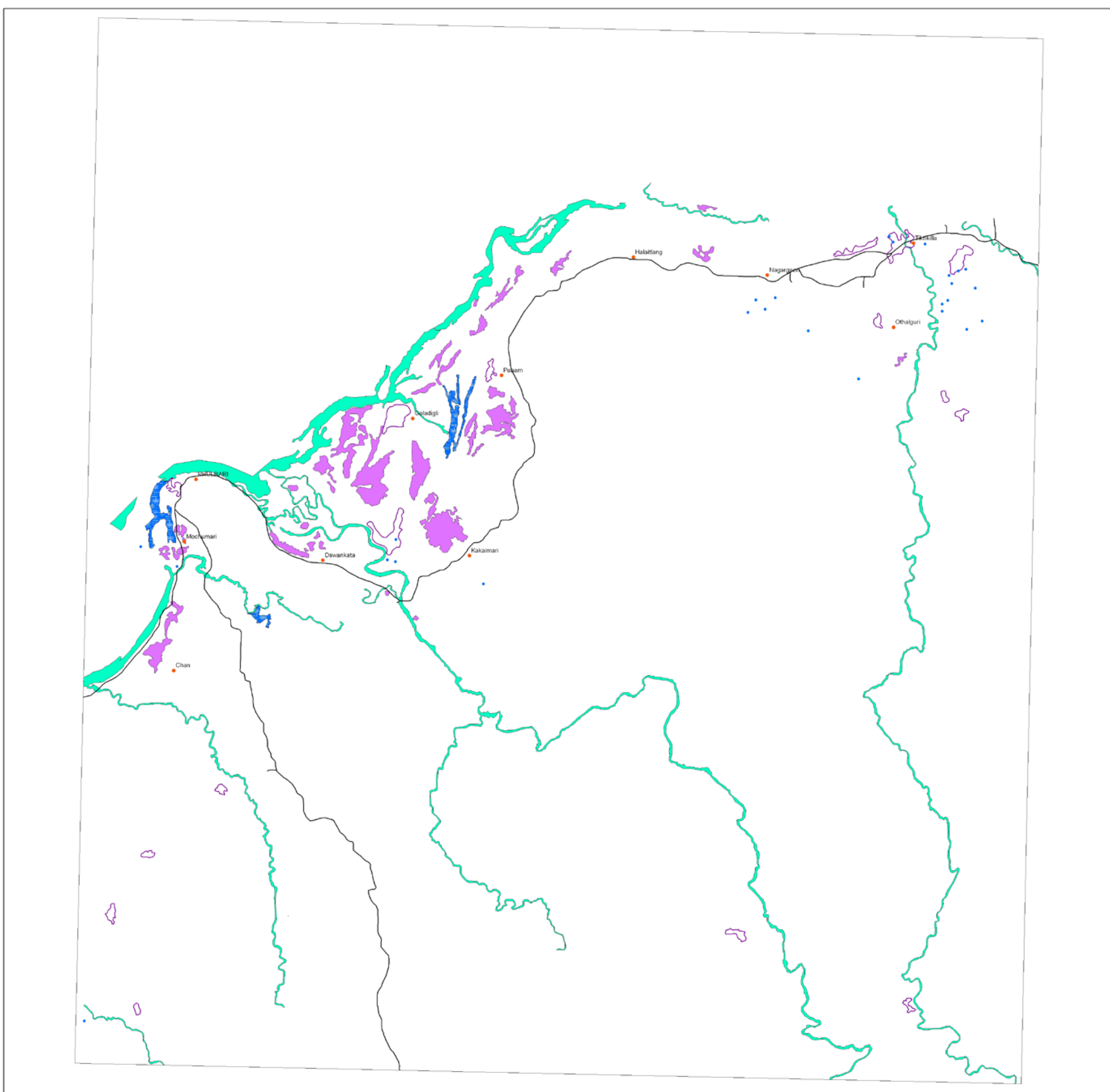


0 1 2 4 6 8 Kilometers

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

Prepared By :
North Eastern Space Applications Centre, Meghalaya

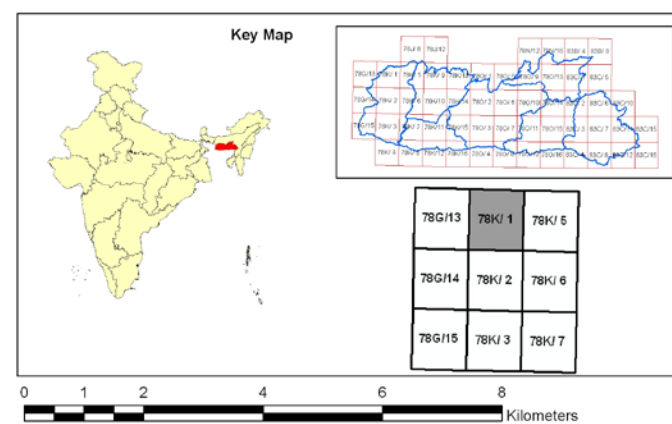
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Government of India



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

- wetland point
- drain arc
- settle point
- settle polygon



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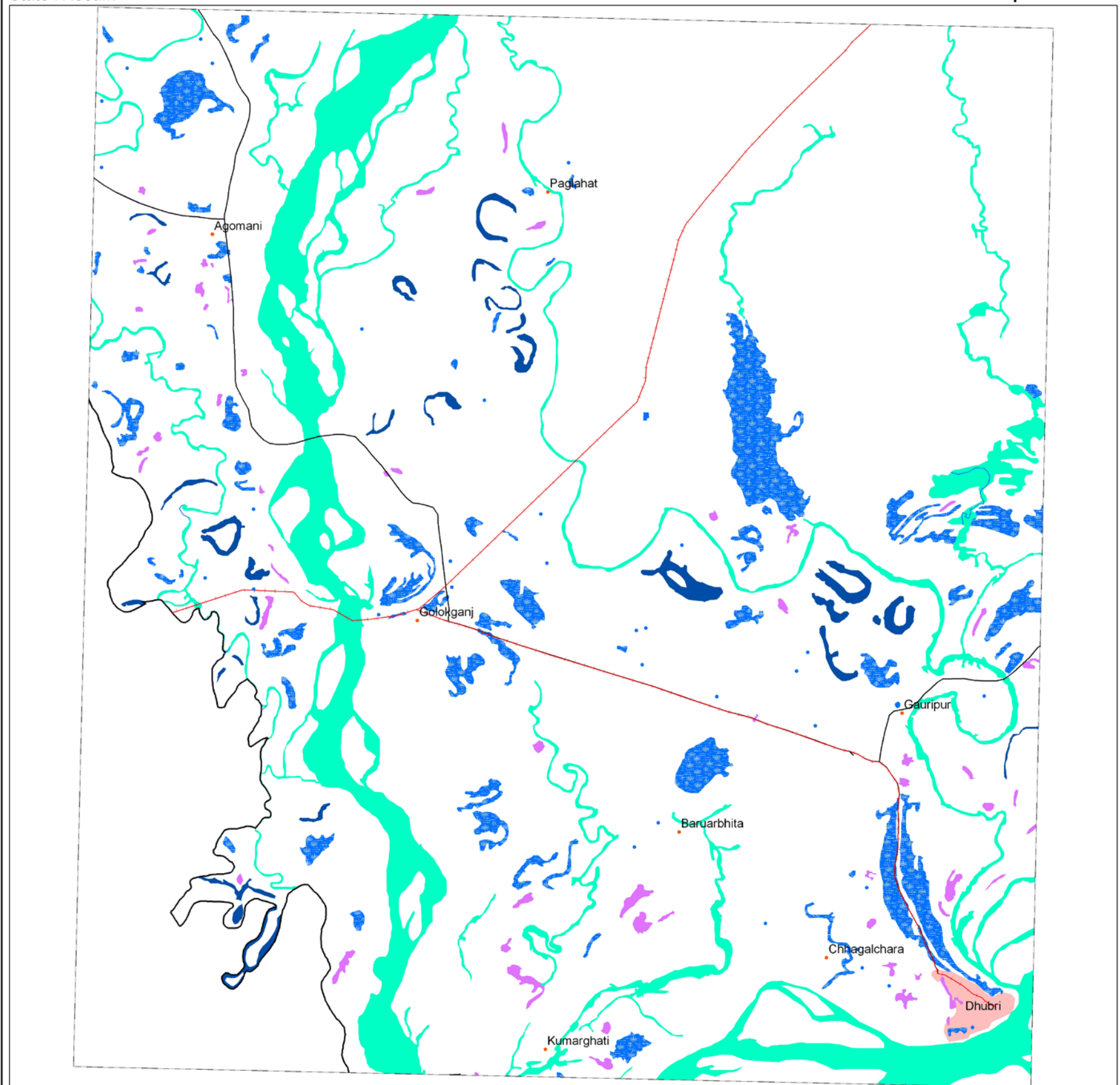
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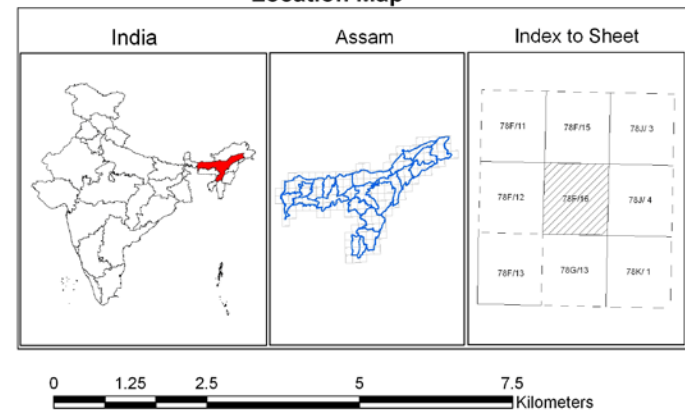


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Legend

- Wetlands (<2.25 ha)
- Settlements
- Canal
- Drainage(line)
- Railway
- Roads
- District Boundary
- Towns/Settlements

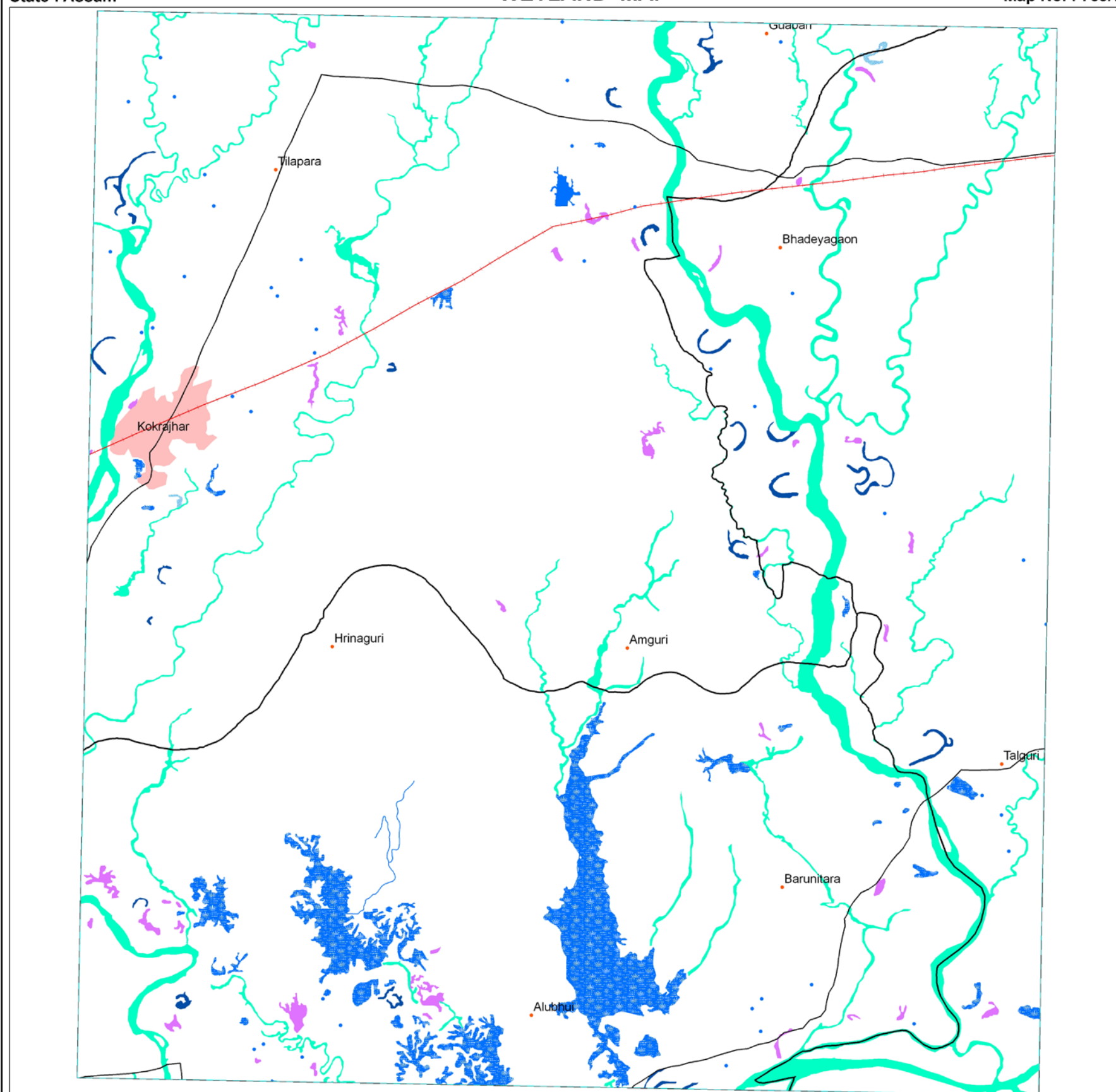
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Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)

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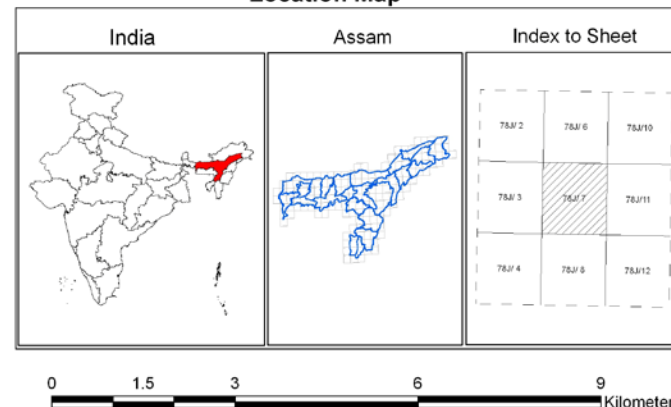
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Legend

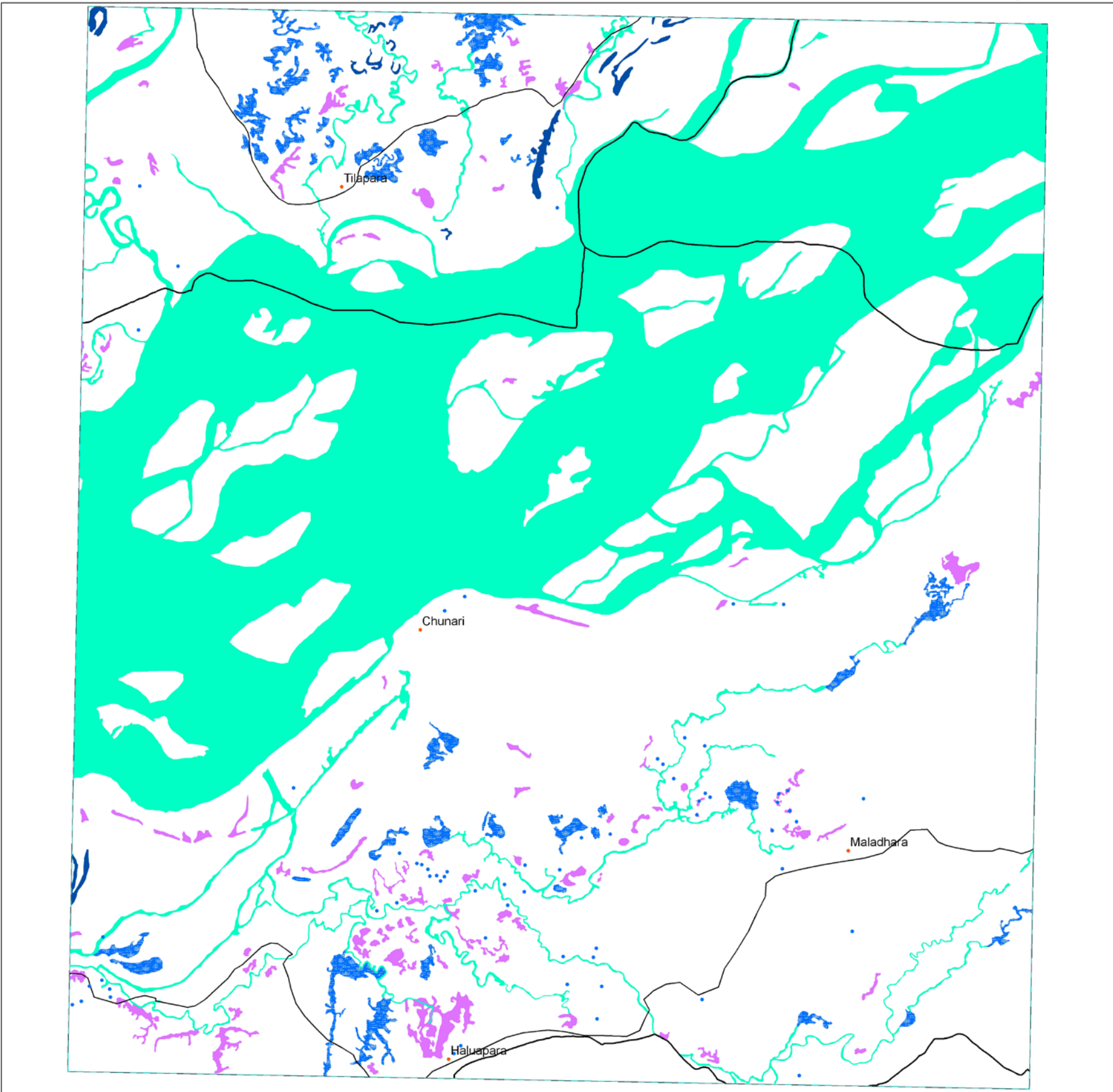
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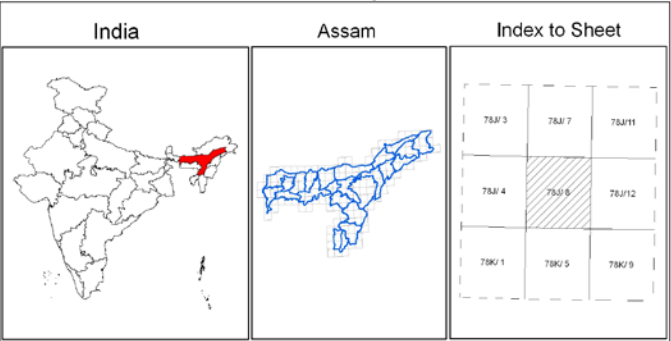
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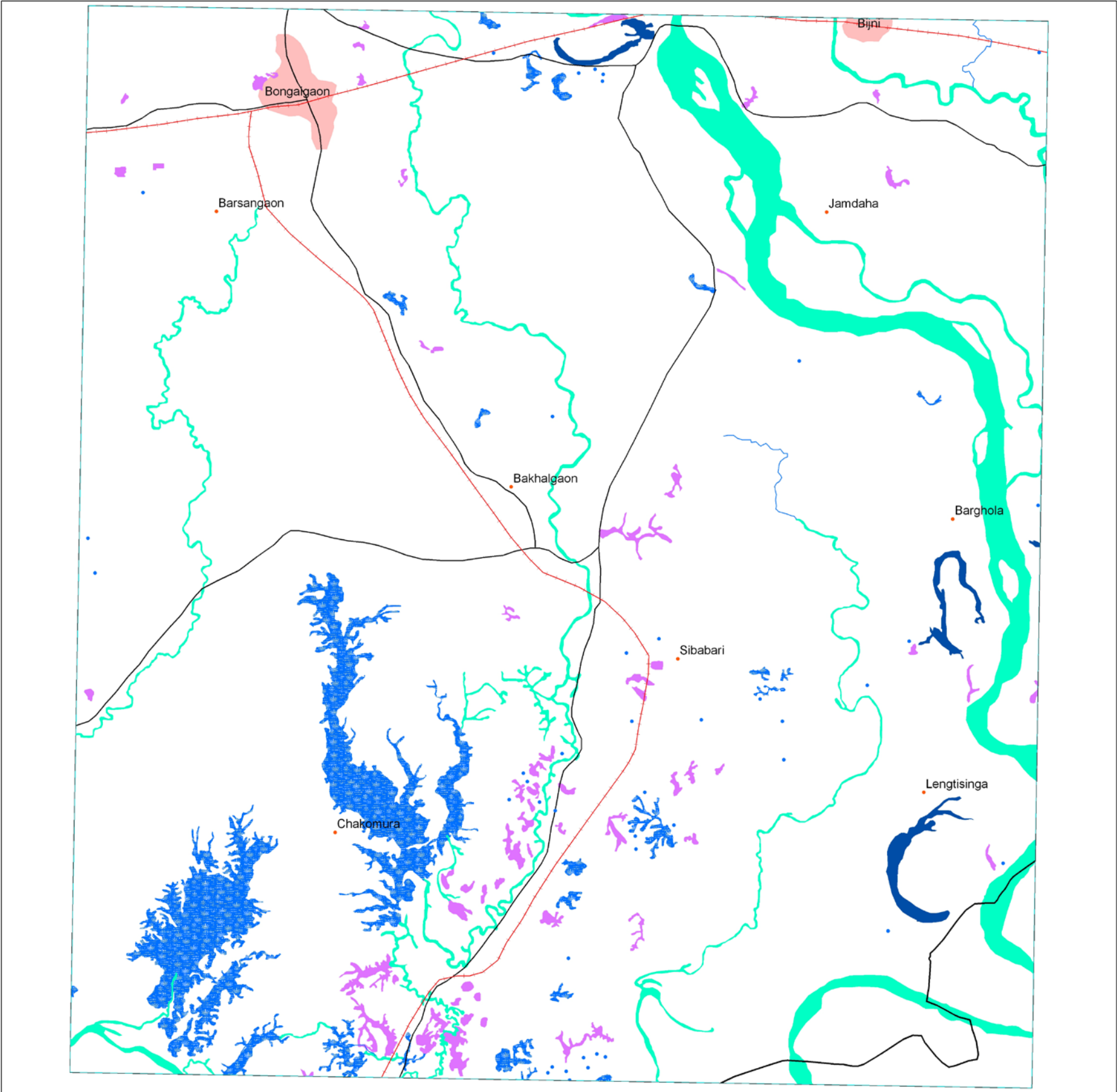
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Location Map



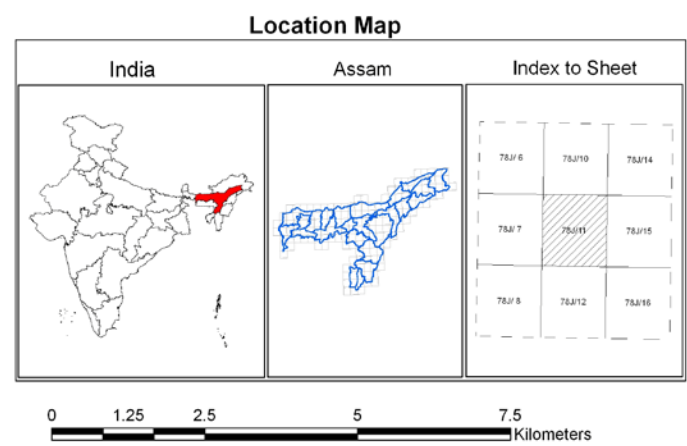
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Data Source :
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)
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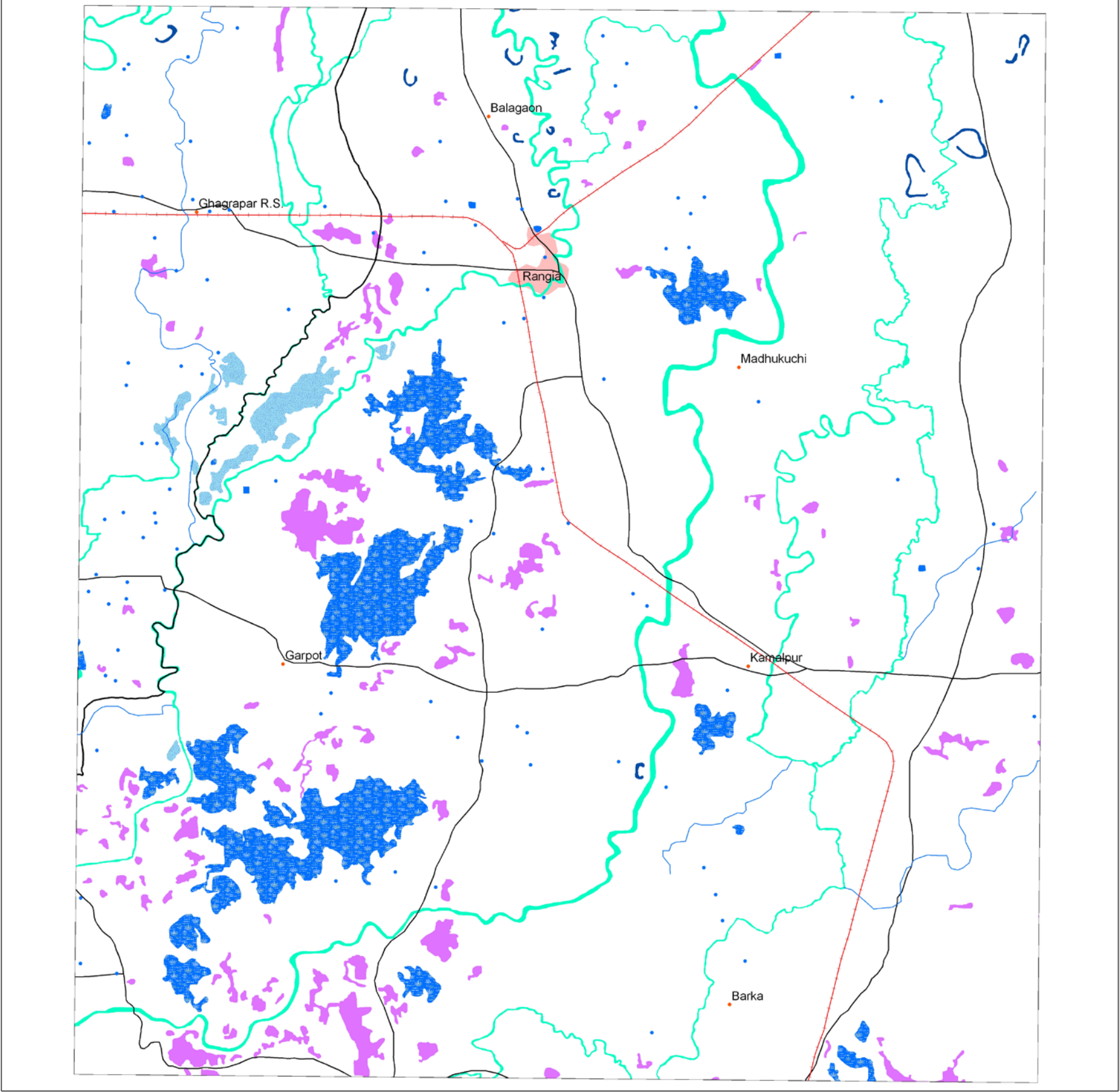
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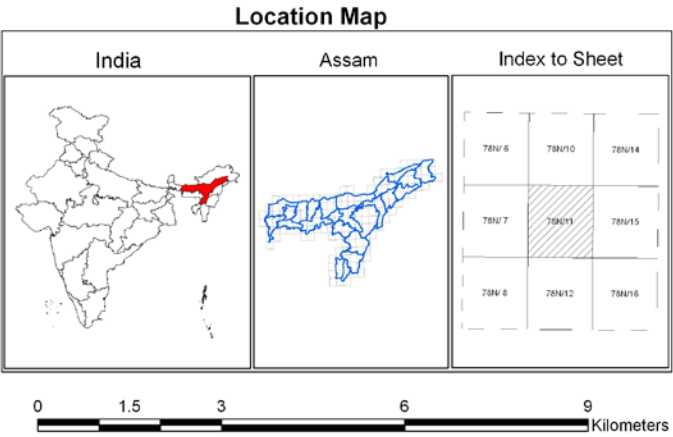
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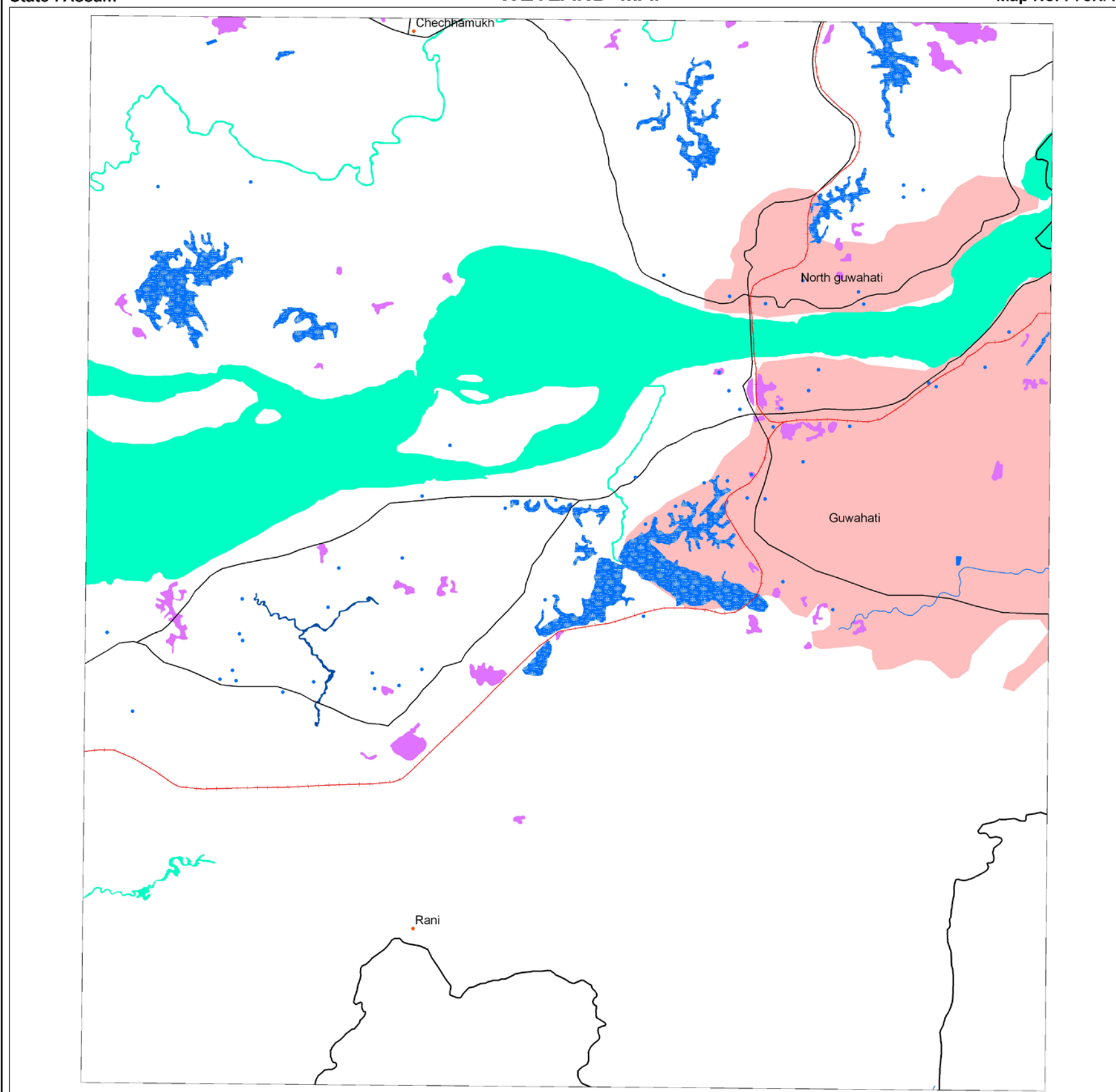
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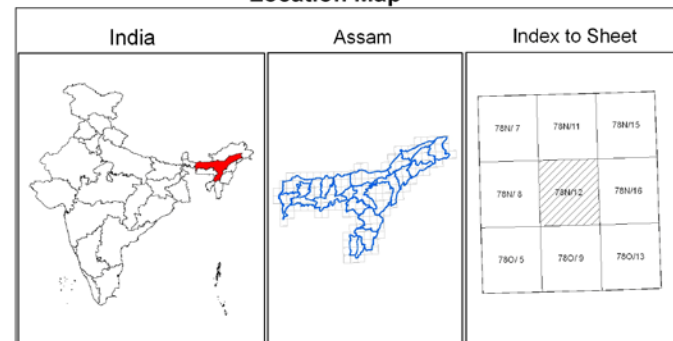


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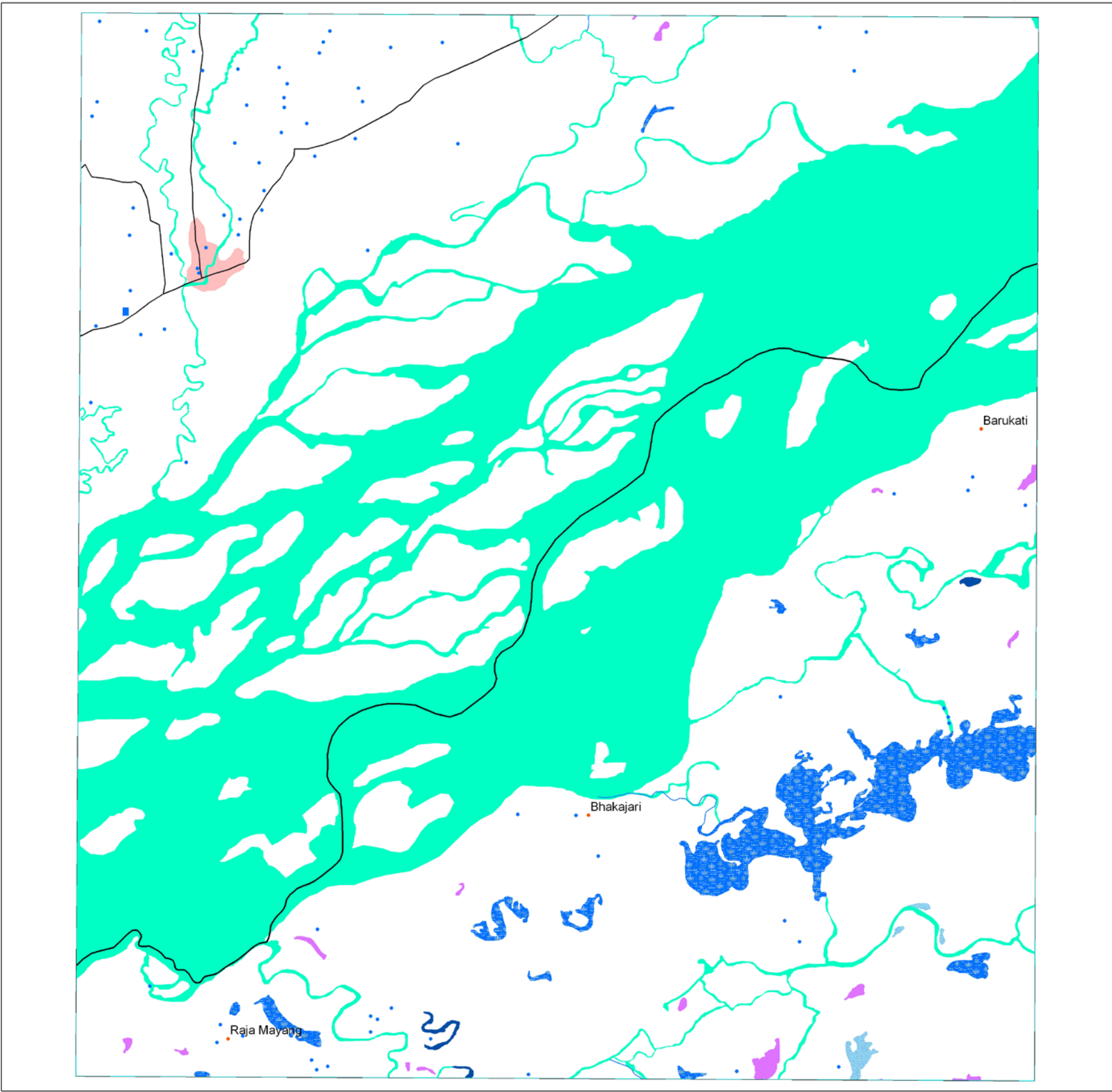


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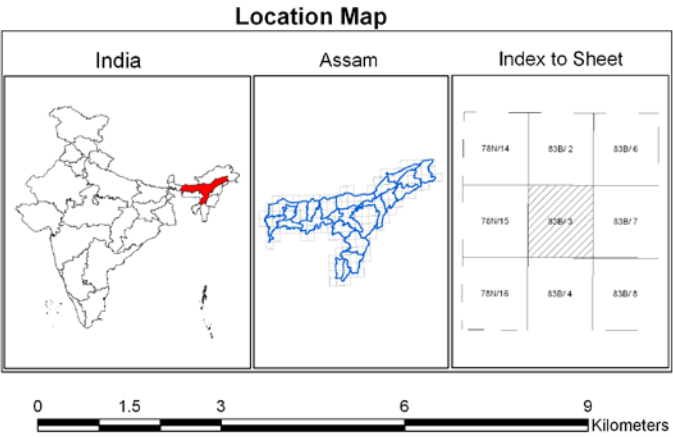
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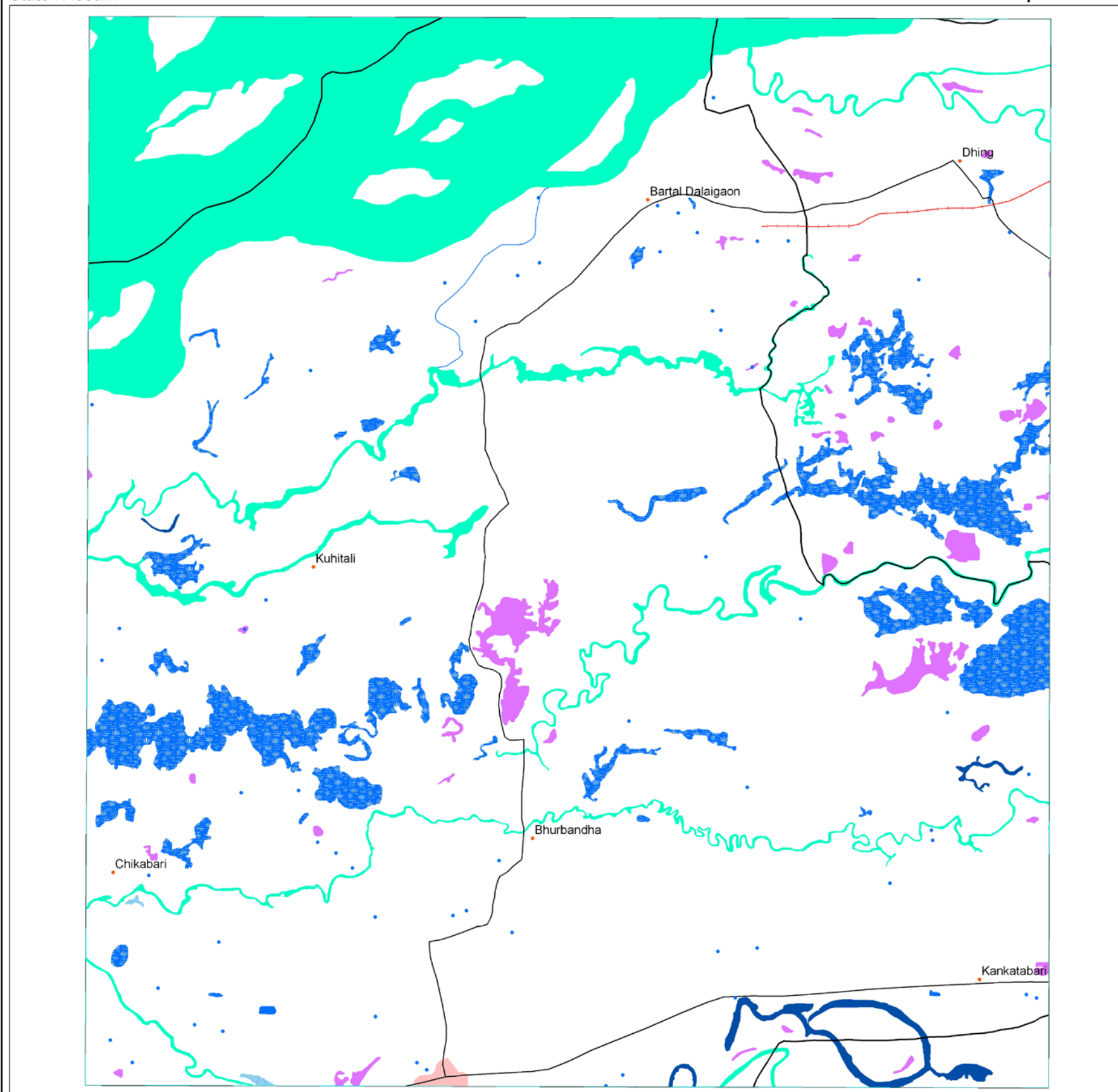
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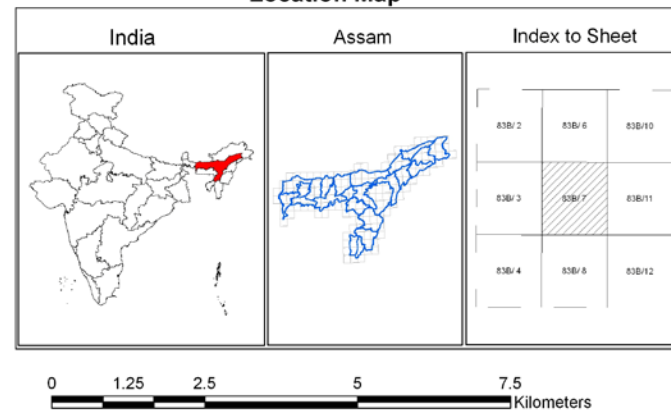


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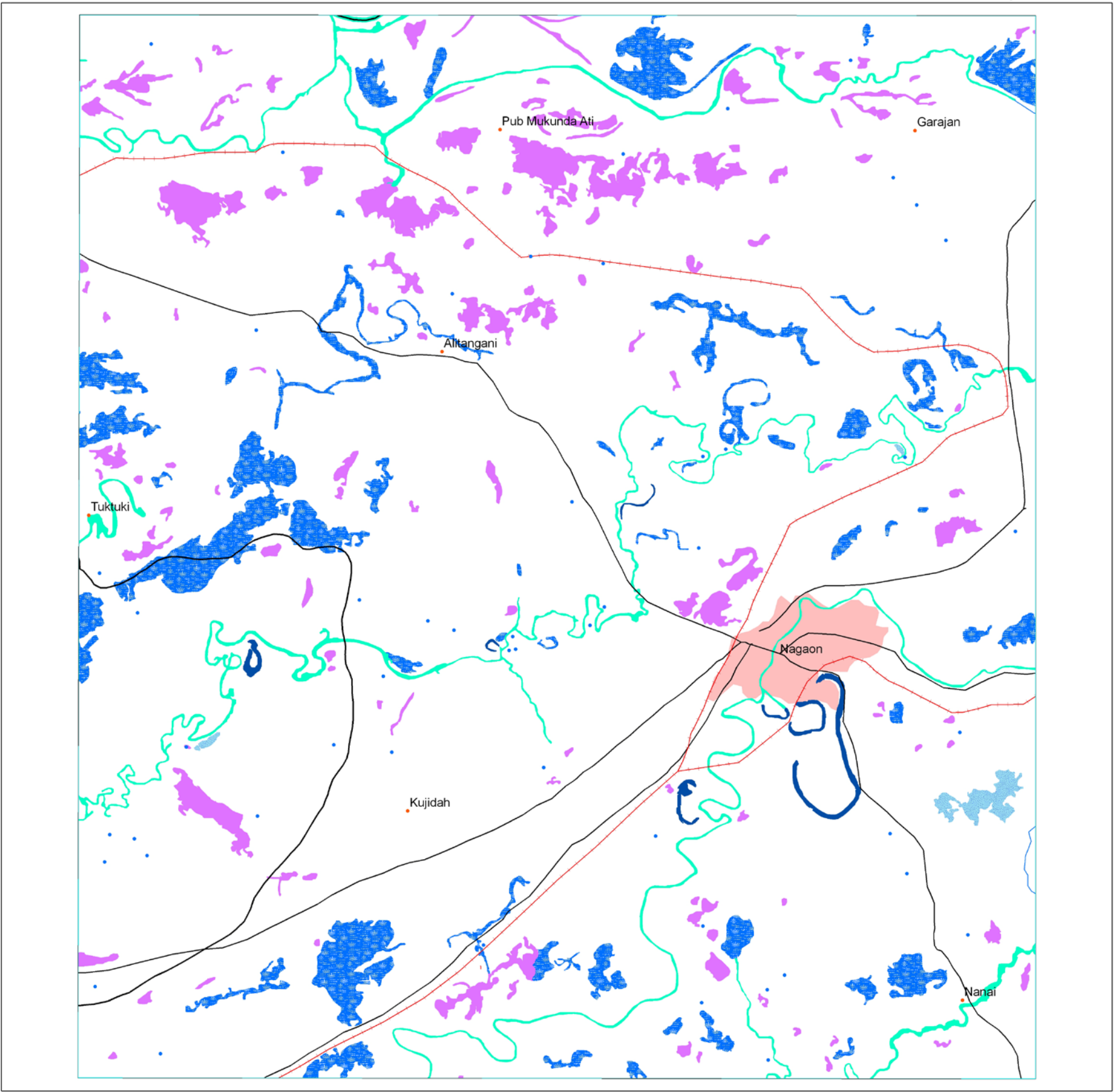
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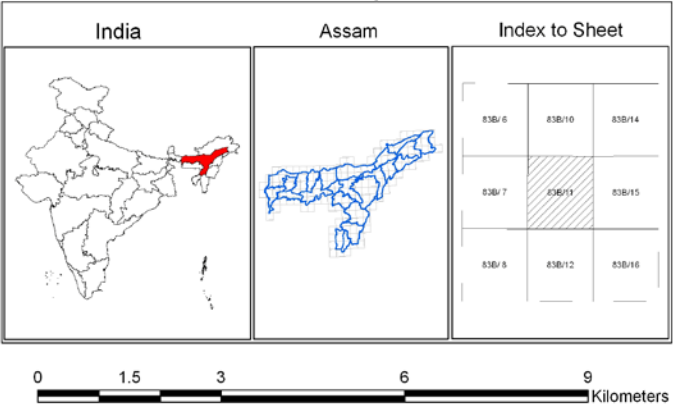
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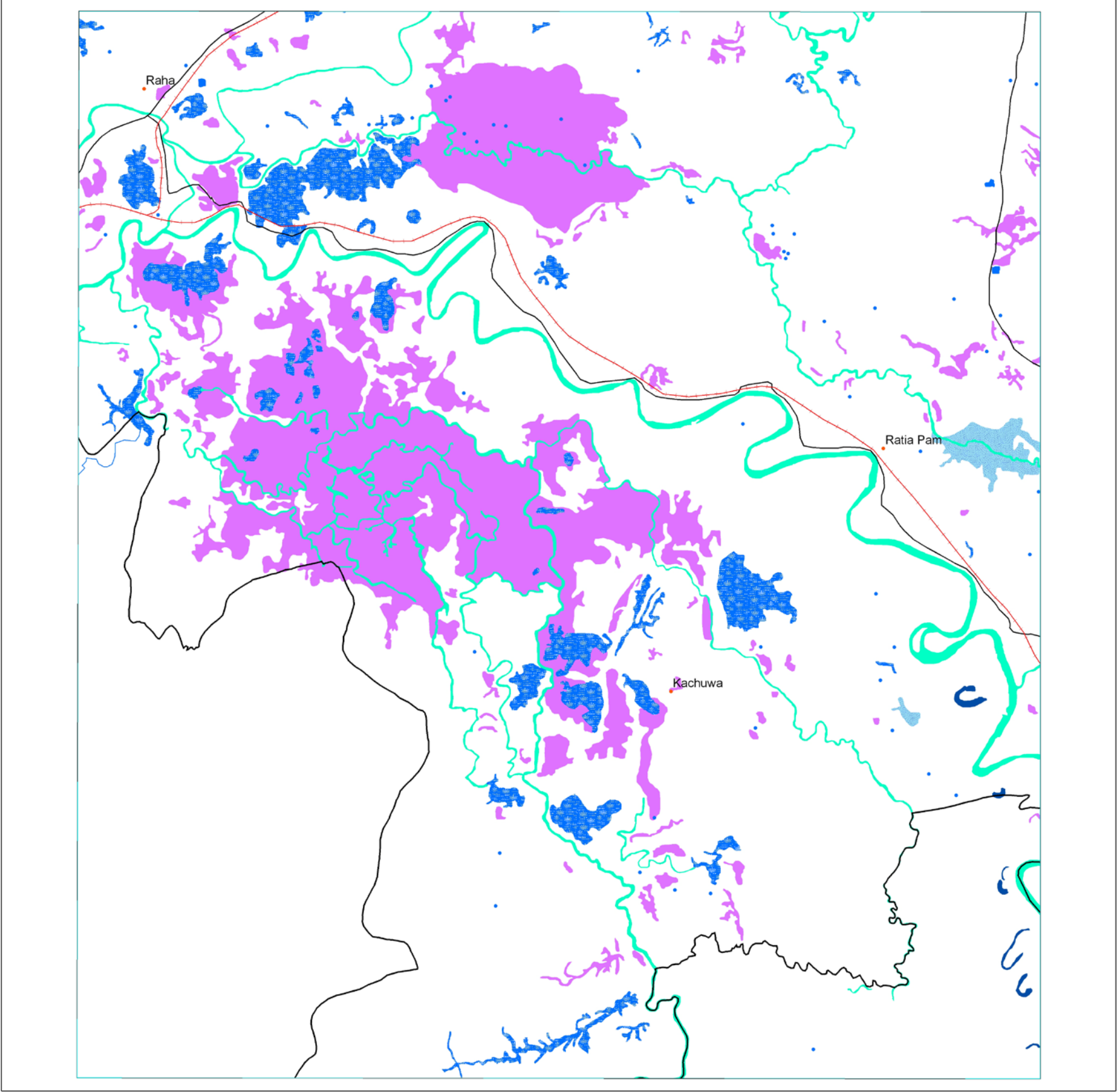
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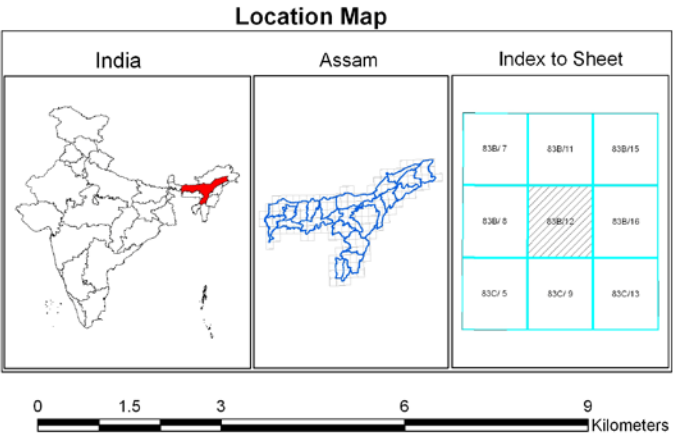
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REFERENCES

1. Anon. 2006. India 2006 - A reference Annual. Publications Division, Ministry of Information and Broadcasting, Government of India, New Delhi. 1197 P.
2. Anon. 2005a. NNRMS Standards, A National Standard for EO images, thematic & cartographic maps, GIS databases and spatial outputs. ISRO: NNRMS: TR: 112:2205. A Committee Report: National Natural Resources Management System, Bangalore.
3. Anon., 1993. Directory of Indian wetlands, 1993. WWF INDIA, New Delhi and AWB, Kuala Lumpur, xvi +264pp., 32 maps.
4. Clark, John R. (1977). Coastal Ecosystem Management, A Wiley Interscience Publication, John Wiley & Sons, New York.
5. 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.
6. Encyclopedic Directory of Environment (1988). (Ed. By G.R. Chatwal, D.K. Pandey, and K.K. Nanda). Vol. I-IV, Anmol Publications, New Delhi.
7. 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,
8. Garg J.K. and Patel J. G. 2007. National Wetland Inventory and Assessment, Technical Guidelines and Procedure Manual. SAC/EOAM/AFEG/NWIA/TR/01/2007. A Technical Report: Space Applications Centre, Ahmedabad.
9. Glossary of Geology (1974). (Ed. By Margarate G., Robbert, M. Jr. and Wolf, C.L), American Geological Institute, Washington, D.C.
10. Jensen, J.R. (1986). *Introductory Digital Image Processing: A Remote Sensing Perspective*, Prentice Hall, Englewoods Cliff, NJ.
11. Khan, I. H. 1983. Wildlife. Centenary Souvenir, A & N Forest Department.
12. 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.
13. Lillesand, T.M. and Keifer, R.W. 1987. Remote Sensing and Image Interpretation. John Wiley and Sons, New York.
14. Manorama Yearbook 2007
15. McGraw - Hill Encyclopedia of Environmental Science (1974). (Ed. Sybil P. Parker), McGraw-Hill Book Company, New York.
16. 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.
17. Millennium Ecosystem Assessment. 2005, Ecosystems and Human Well-being: A Framework for Assessment, <http://www.MAweb.org>
18. Mitsch, William J. and Gosselink, James G. (1986). *Wetlands*, Van Nostrand Reinhold Company, New York.
19. 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.
20. Negi, S.S. 1995. Handbook of National Parks, Sanctuaries and Biosphere Reserves in India. Indus Publishing Company, New Delhi. 270pp.
21. Patel J.G., Singh T.S., Garg J.K. 2003. Wetland Information System, West Bengal, SAC/RSAM/RESA/FLPG/WIS/01/2003. A Technical Report: Space Applications Centre, Ahmedabad.
22. Ramsar Convention (2007). www.ramsar.org
23. Reid, George K and Wood, Richard D. (1976). *Ecology of Inland Waters and Estuaries*. D. Van Nostrand Company, New York.
24. 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,
25. Singh T.S., Patel J.G., Garg J.K. 2003. Loktak Lake Resources Information System (LRIS), SAC/RSAM/RESIPA/FLPG/WIS/ 02/ 2003. A Technical Report: Space Applications Centre, Ahmedabad.
26. 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.
27. Tucker, C.J. and Sellers, P.J. 1986. Satellite remote sensing of primary productivity. *International Journal of Remote Sensing*, 7, pp. 1395-1416.
28. Xu Hanqiu, 2006. Modification of normalised difference water index (NDWI) to enhance open water features in remotely sensed imagery. *International Journal of Remote Sensing*, 27, pp. 3025-3033.

29. Whitaker, R. 1985. Managing Tropical Forests. Endangered Andamans. A joint Publication Environmental Services Group, WWF INDIA and MAP India, Department.
30. Whitaker, R. and Zai (1979). Preliminary crocodile survey in the Andaman Islands. Journal of Bombay Natural History Society. 75 (1).
31. National Wetland Atlas: Meghalaya, SAC/RESA/AFEG/NWIA/ATLAS/02/2009, Space Applications Centre(ISRO), Ahmedabad, India, 88p.
32. National Wetland Atlas: Manipur, SAC/RESA/AFEG/NWIA/ATLAS/03/2009, Space Applications Centre(ISRO), Ahmedabad, India, 96p.
33. National Wetland Atlas: Arunachal Pradesh, SAC/RESA/AFEG/NWIA/ATLAS/06/2009, Space Applications Centre (ISRO), Ahmedabad, India, 98p.
34. National Wetland Atlas: Mizoram, SAC/RESA/AFEG/NWIA/ATLAS/10/2010, Space Applications Centre(ISRO), Ahmedabad, India, 94p.
35. National Wetland Atlas: Tripura, SAC/RESA/AFEG/NWIA/ATLAS/17/2010, Space Applications Centre(ISRO), Ahmedabad, India, 88p.
36. National Wetland Atlas: Assam, SAC/RESA/AFEG/NWIA/ATLAS/18/2010, Space Applications Centre(ISRO), Ahmedabad, India, 174p.
37. National Wetland Atlas: Nagaland, SAC/RESA/AFEG/NWIA/ATLAS/20/2010, Space Applications Centre (ISRO), Ahmedabad, India, 116p.
38. National Wetland Atlas: Sikkim, SAC/RESA/AFEG/NWIA/ATLAS/13/2010, Space Applications Centre (ISRO), Ahmedabad, India, 88p.

Annexure I
Definitions of wetland categories used in the project

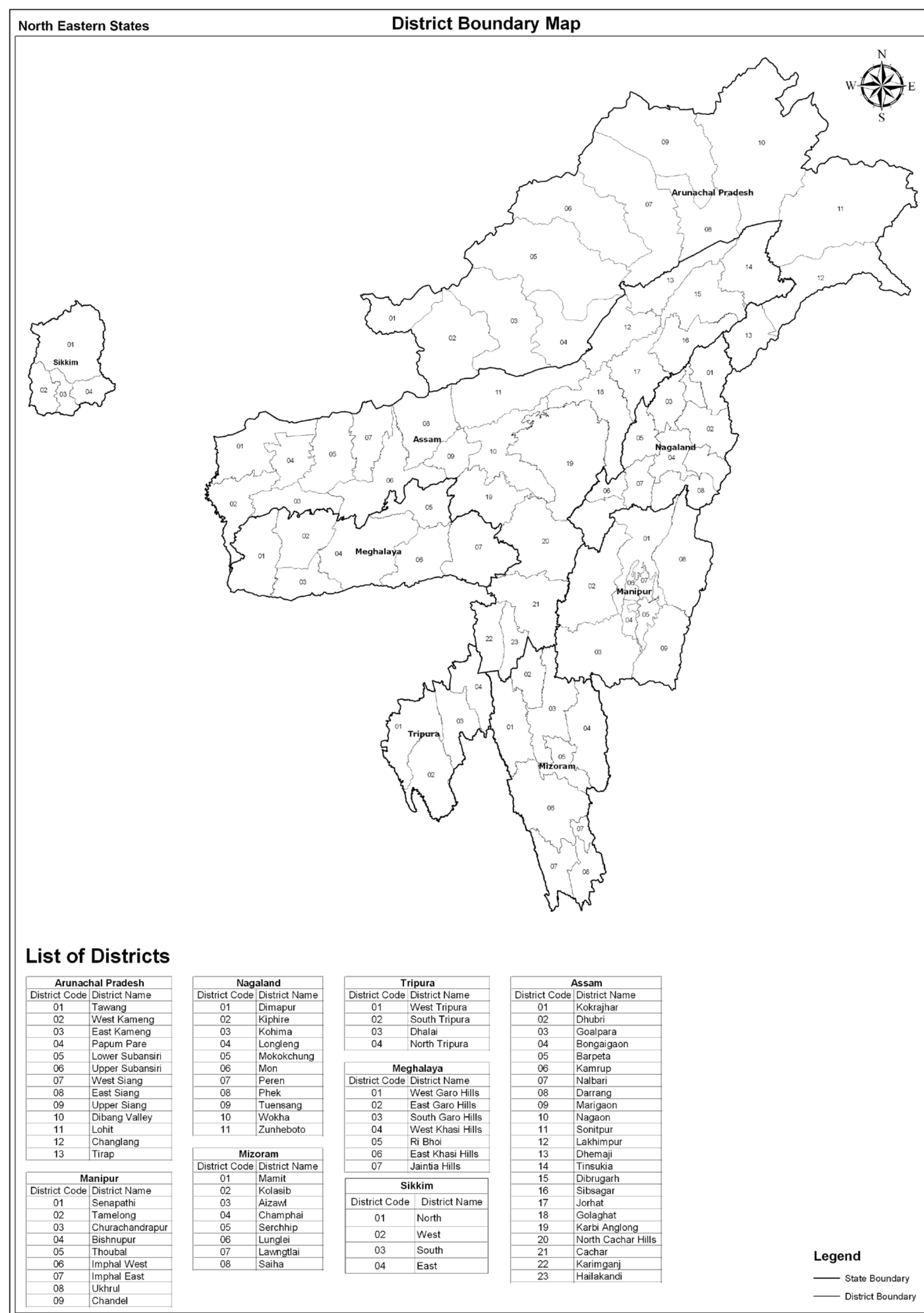
For ease of understanding, definitions of wetland categories and their typical appearance on satellite imagery is given below:

Wetland type code	Definition and description
1000	Inland Wetlands
1100	Natural
1101	Lakes: Larger bodies of standing water occupying distinct basins (Reid <i>et al</i> , 1976). These wetlands occur in natural depressions and normally fed by streams/rivers. On satellite images lakes appear in different hues of blue interspersed with pink (aquatic vegetation), islands (white if non-vegetated, 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 <i>et al</i> , 1976). On the satellite image Ox-bow lakes occur near the rivers in plain areas. Some part of the lake normally has aquatic vegetation (red/pink in colour) during pre-monsoon season.
1103	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 <i>Sphagnum</i>) 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 (Glossary of Geology, 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 Caverry 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 (Glossary of Geology, 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	<p>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 (Glossary of Geology, 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 <i>et al</i>, 1976). Tanks appear in light blue colour showing bottom reflectance.</p> <p>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 Encyclopedia of Environmental Sciences, 1974), Ash pond/Cooling pond The water body created for discharging effluents in industry, especially in thermal power plants (Encyclopedic Directory of Environment, 1988) and Cooling pond: An artificial lake used for the natural cooling of condenser-cooling water serving a conventional power station (Encyclopedic Directory of Environment, 1988). These ponds can be of any shape and size. Texture is rough and tonal appearance light (quarry) to blue shade (cooling pond).</p>
1203	<p>Waterlogged: Man-made activities like canals cause water-logging in adjacent areas due to seepage especially when canals are unlined. Such areas can be identified on the images along canal network. Tonal appearance is in various hues of blue. Sometimes, such waterlogged areas dry up and leave white scars on the land. Texture is smooth.</p>
1204	<p>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.</p>
2000	Coastal Wetlands
2100	Natural
2101	<p>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 <i>et al</i>, 1976).</p> <p>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 (Glossary of Geology, 1974).</p>
2102	<p>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.</p>
2103	<p>Sand/Beach: Beach is an non-vegetated part of the shoreline formed of loose material, usually sand that extends from the upper berm (a ridge or ridges on the backshore of the beach, formed by the deposit of material by wave action, that marks the upper limit of ordinary high tides and wave wash to low water mark (Clark, 1977). Beach comprising rocky material is called rocky beach.</p>
2104	<p>Intertidal mudflats: Most non-vegetated areas that are alternately exposed and inundated by the falling and rising of the tide. They may be mudflats or sand flats depending on the coarseness of the material of which they are made (Clark, 1977).</p>
2105	<p>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.</p>
2106	<p>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.</p>
2107	<p>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 foraminifera. Present reefs are living associations growing on this accumulation of past (Clark, 1977). Reefs appear in light blue shade.</p>
2200	Man-made
2201	<p>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 (Glossary of Geology, 1974). Salt pans are square or rectangular in shape. When water is there appearance is blue while salt is formed tone is white.</p>
2202	<p>Aquaculture ponds: Aquaculture is defined as "The breeding and rearing of fresh-water or marine fish in captivity. Fish farming or ranching". The water bodies used for the above are called aquaculture ponds (Encyclopedic Directory of Environment, 1988). Aquaculture ponds are geometrical in shape usually square or rectangular. Tone is blue.</p>

Annexure – II

Details of District information followed in the atlas



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

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