# Ganga Cultural Documentation
# 2022

# *BHAGALPUR DISTRICT*

NAMAMI GANGE

**National Mission for Clean Ganga**

Indian National Trust for Art and Cultural Heritage
INTACH

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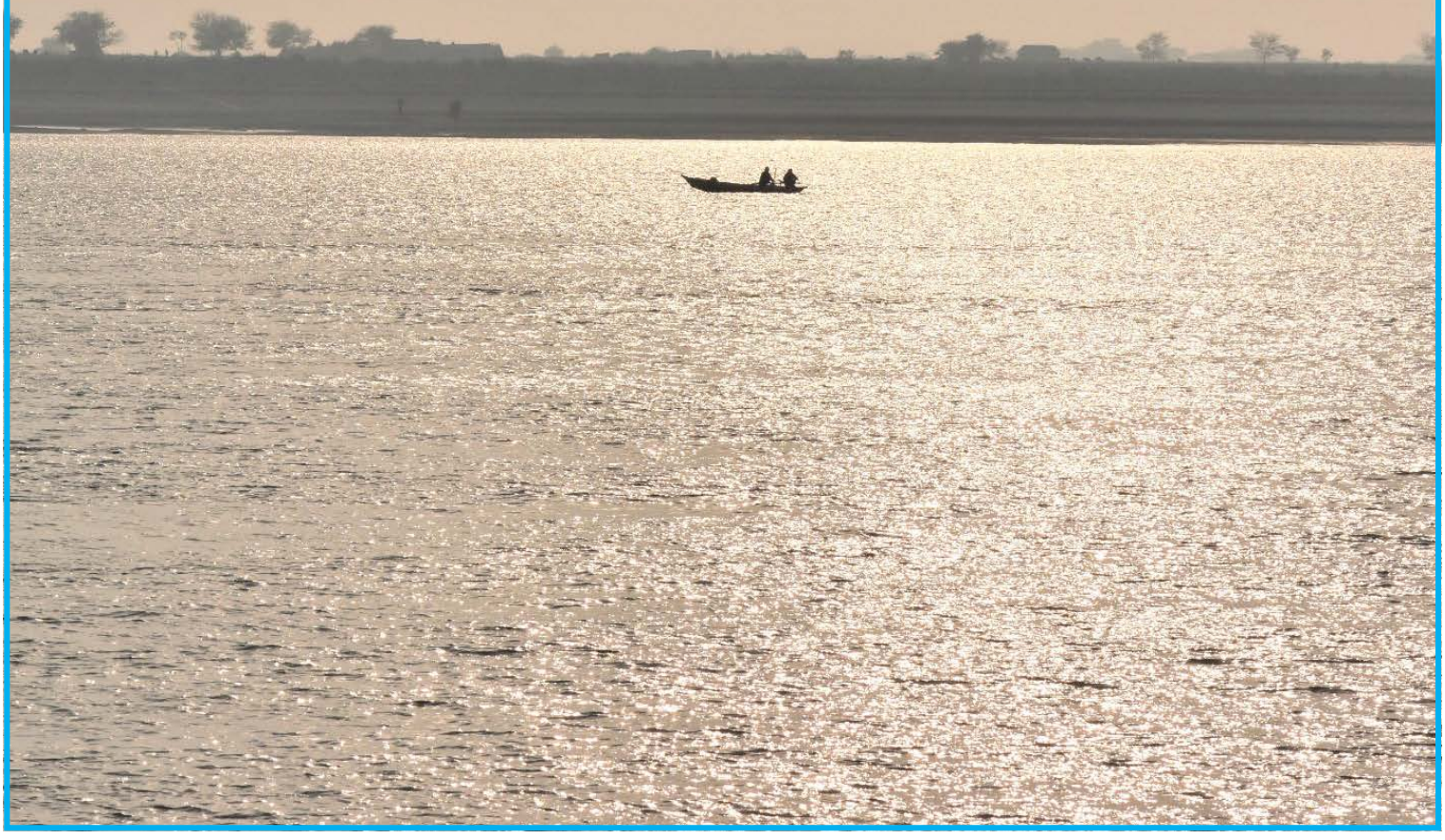
*Front Cover : Ganga River as seen near Vikramshila Setu*

*Background : Ganga River as seen near Titanga Diara*

*Back Cover : Ajgaivinath temple in Sultanganj*

*Formatting and Design by : Sumesh Dudani*



# GANGA CULTURAL DOCUMENTATION

## BHAGALPUR DISTRICT

JANUARY, 2022

Sponsored by :

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**Acknowledgement:** The authors wish to express their thanks and gratitude to Dr. K.D. Prabhat (Convener), Dr. Wibhu Kumar Roy (Addl. Co-Convener) and Mr. Kanhaiya (Member) of the INTACH Bhagalpur Chapter for rendering their guidance, help and support throughout the field visit for Ganga natural heritage documentation in Bhagalpur District. Their earlier data compilation and field information is also duly acknowledged through this report. Thanks are also accorded to the Bhagalpur Forest Division for assisting in boat hiring and survey in the Vikramshila Gangetic Dolphin Sanctuary. The local assistance and field support of Mr. Ajay Kumar Bhattacharya is also duly acknowledged in this report.

# 1.0 Introduction

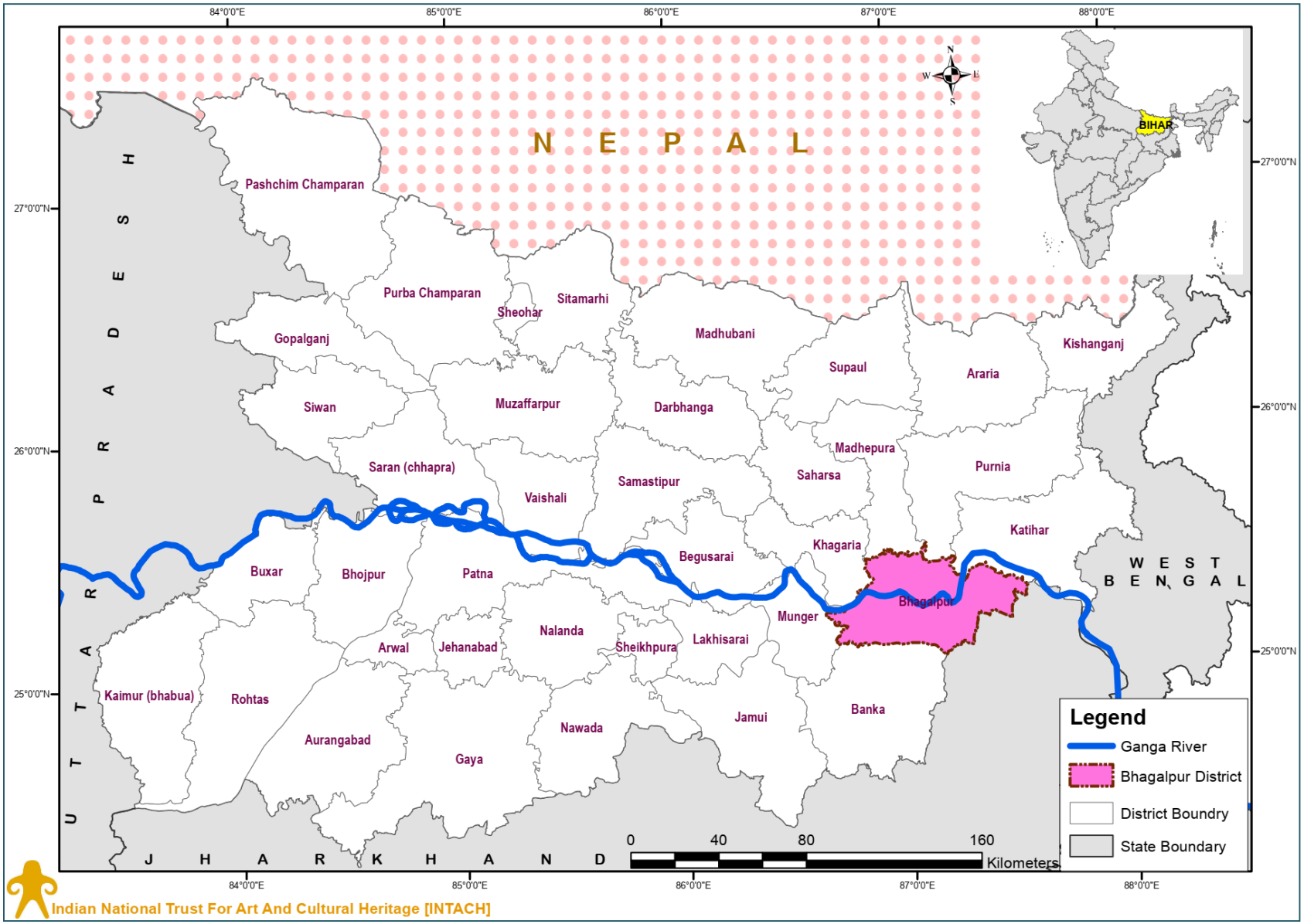
1.1 Bhagalpur Distt. (25.3478° N, 86.9824° E) is situated in the southern region of Bihar state occupying an area of about 2,569 sq. km. The Distt. has three sub-divisions viz., Bhagalpur Sadar, Kahalgaon and Naugachia which are further divided into sixteen development blocks. The Distt. is bounded by the Distt.s of Munger in the southwest, Katihar in the northeast, Madhepura and Purnea in the north, Khagaria in the west and the distt. of Banka in the south [Map 01]. The Sahibganj Distt. of Jharkhand lies on the east.

1.2 The Distt. is principally drained by the river Ganga and its tributaries Badua and Koa. Apart from these, a number of seasonal streams such as Gahra, Chanan, Kadwa, Gerua and Bhena from Chota Nagpur plateau join the mighty Ganga. Geomorphologically, Bhagalpur Distt forms a part of the Mid-Ganga Foreland Basin having soils mainly derived from the older and newer alluvium. The older alluvial soils are chiefly loamy in character with moderate to heavy texture and well-drained. The sandy soil derived from the younger alluvium is light-textured, well-drained and are moderate to highly fertile calcareous soils found along the banks of the river Ganga (CGWB, 2013). The climate in Bhagalpur is warm and temperate with an average annual temperature in of 25.8 °C and about 1,111 mm of average precipitation annually.

1.3 Bhagalpur town is the administrative headquarter of the Distt. and is also a city of historical importance on the southern banks of river Ganga. The area was a part of the kingdom of Magadh upon whom several dynasties have ruled of which the Haryanka, Mauryas, Guptas and the Pushyabhutis are most known. The area of Bhagalpur used to be a part of the Subah of Bihar during Mughal rule. After the Diwani of Bengal and Orissa, Bihar was also given to the East India Company under the Treaty of Allahabad in 1765. Munger was separated in the year 1832, the Santhal province in 1855-56, Saharsa in 1954 and Banka in 1991 (Roy Chaudhary, 1962).

- *Bhagalpur was considered a relatively important trade centre in eastern India by the 7th-century Chinese travelers Hieun-Tsang and Fa-Hien. It once had a large harbour on the river Ganga at a place called Champanala, which flows by the present-day western boundary of the city near Nathnagar.*
- *Shri Champapur Digamber Jain Siddha Kshetra is a Siddha Kshetra (Place of Salvation) for the Jains. It is located at village Nathnagar, Bhagalpur.*
- *Mandar Hill: King Harsha crowned Madhav Gupta as the king of Magadh, whose son Adityasena left an inscription at the Narsingh temple built by him.*
- *Ruins of Vikramshila: One of the two most important centres along with Nalanda was Vikramshila. Built under the patronage of the Pala king Dharampalaq in response to the decline in the quality of education at Nalanda. (Bhagalpur.nic.in; Gazeetter of Bhagalpur ,1962)*

Image 1 : Vikramshila Setu Bridge Over Ganga River In Bhagalpur

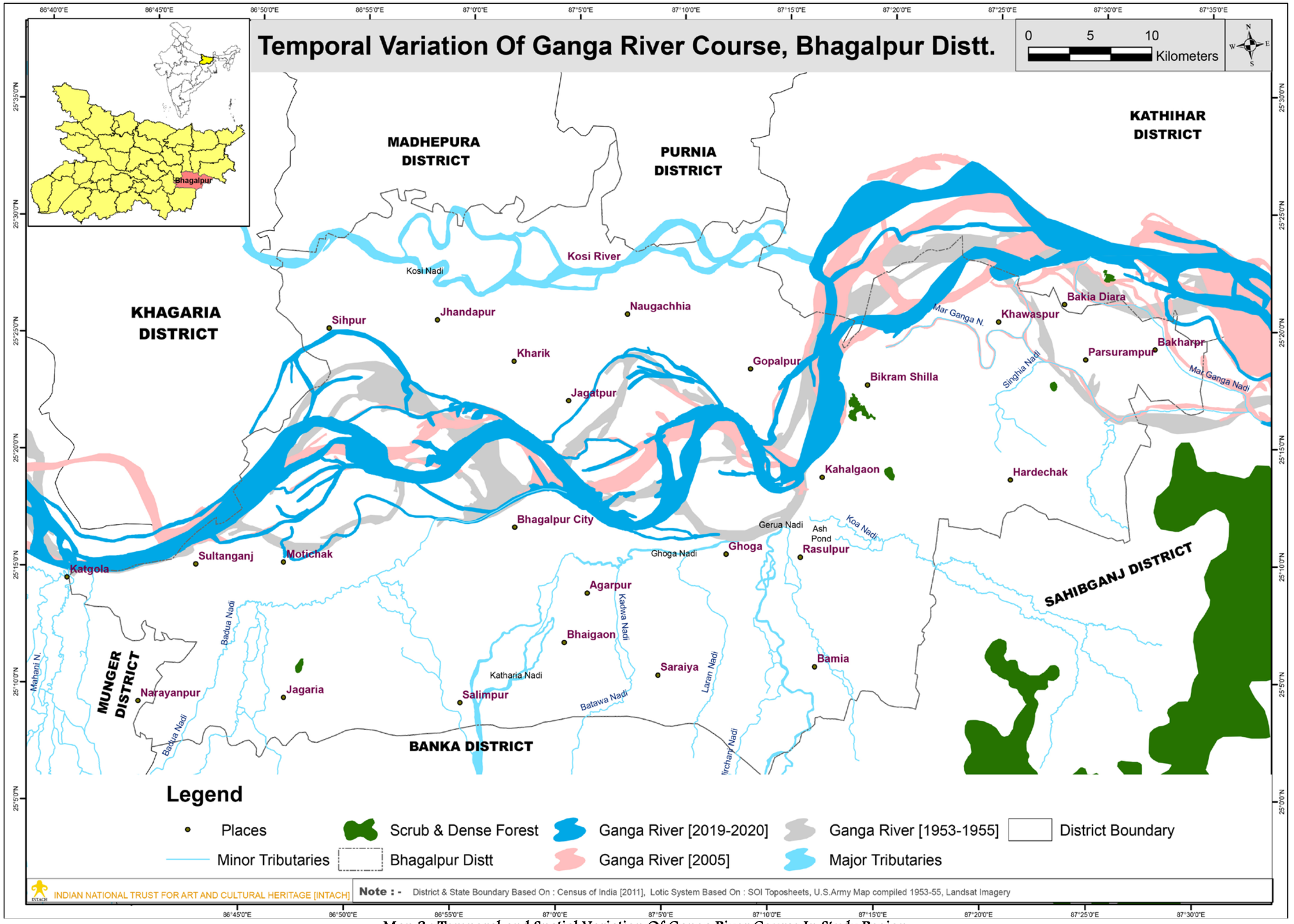



Map 1 : Location Of Bhagalpur

## 2.0 Ganga River In Bhagalpur

2.1 Ganga River enters Bhagalpur near west of Sultanganj at Jahanvi Chowk and covers a distance of about 50 kms dividing the Distt. into two unequal parts. During its course in the Distt. the river forms two bends – one towards northern part of Bhagalpur town and the other towards northern part of Ghogha. After the second bend, the river then flows northwardly towards Katria where it meets with the water of Koshi river. According to the District Gazetteer (Roy Chaudhary, 1962), the entire course of Ganga River was navigable during major portion of the year both for local boats and steamers of large capacity. The width of Ganga River in the area ranges between 2-5 kms, a major portion of which dries up during the summer season with only sand left in the river bed. In recent years, Ganga River has been shifting its course especially towards right bank in the downstream of Vikramshila Setu (Tiwari & Sharma, 2014). The course of Ganga River in Bhagalpur Distt. has undergone some changes during the last couple of years which is depicted in Map 02. Image 2 depicts a stretch of Ganga River as observed near Titanga Ferry Ghat in the study region.

Image 2 : Ganga River As Observed Near Titanga Ferry Ghat On 9th January, 2022

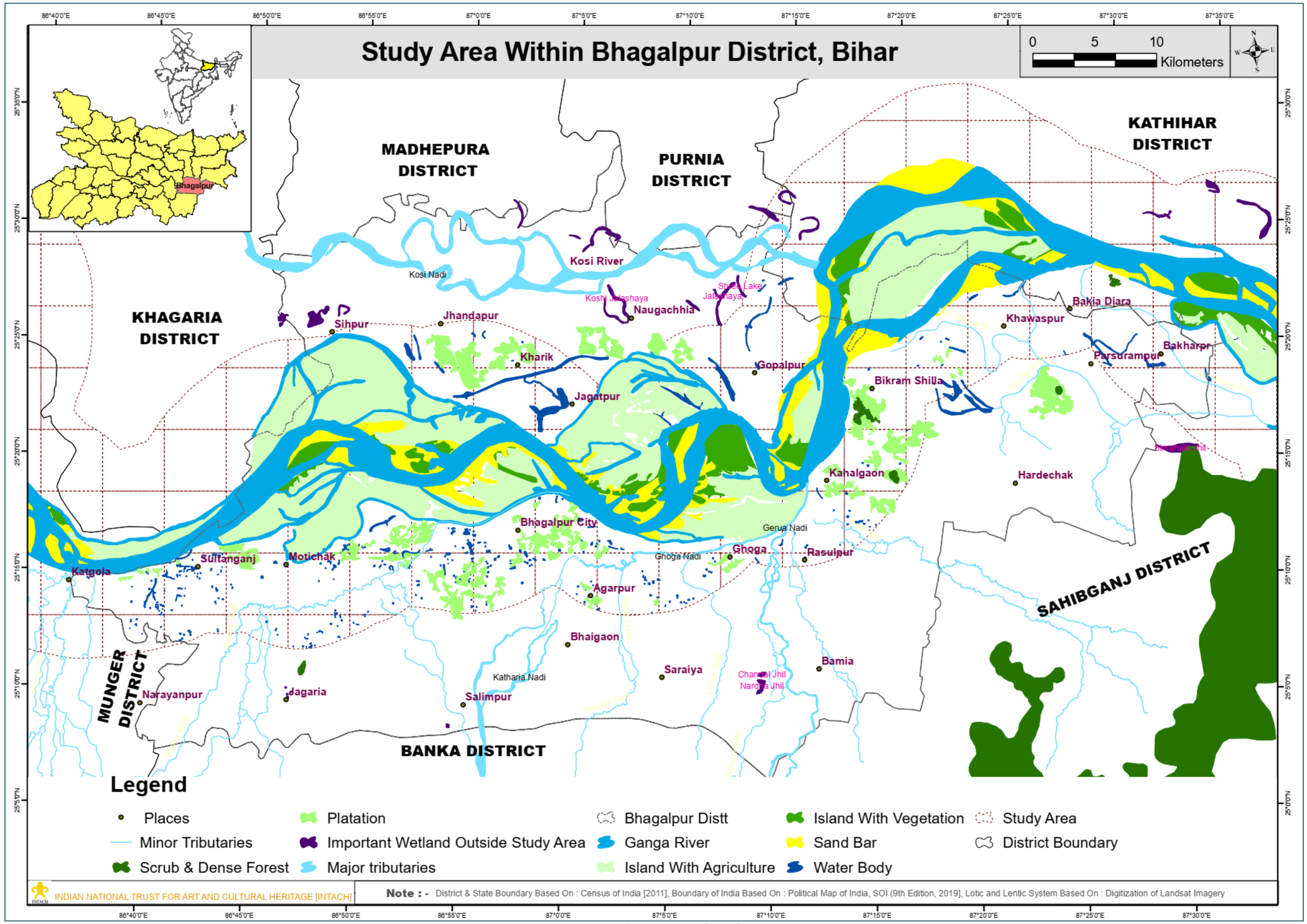



Map 2 : Temporal and Spatial Variation Of Ganga River Course In Study Region

# 3.0 Methodology

3.1 Ganga River flows in Bhagalpur for approximately 50 km adjoining it almost both on right and left banks. Hence for carrying out the ground survey, a 7 km of buffer zone was selected on the both the banks of Ganga River [Refer Map 3]. Based on the secondary information analyzed and the features noted from Google Earth satellite imagery, plan for the fieldwork was constituted to cover different elements of natural heritage in these grids. Special focus was laid on denoting the sites important for riparian biodiversity, riverine fishing, boat making communities, river and stream confluences, important water bodies and oxbow lakes. Furthermore, contacts were developed with various stakeholders including riparian and *Diara* communities in the area for carrying out relevant interactions.

3.2 The field survey for Natural Heritage documentation in the study region of Bhagalpur Distt. was carried out from 05-10 January, 2022. The high-quality pictures related to the study were recorded using Nikon D3400 DSLR camera. The GPS locations were also recorded using Garmin hand-held GPS and videography at the study sites was carried out using Sony Handycam. The plants observed in the survey were identified based on available handbooks and online databases while the birds observed in the survey were identified using Grimmett *et al.* (2011). The information on current status of Ganga River and changes from the past was obtained from detailed interactions with different stakeholders such as agriculturists and dairy farmers, temple priests, village heads, fishermen, boatmen and general public.




Map 3 : Study Area In Bhagalpur

## 4.0 Tributaries Of Ganga River

4.1 **Kosi River :** Kosi is a trans-boundary river which flows through the regions of Tibet, Nepal and India for about 720 km and draining an area of about 74, 500 sq.km. Many studies have highlighted major shifts in the course of this river which have been random and oscillating. The unstable nature of this river is owing to the huge amount of silt that it carries during monsoon and its flooding events have extreme impacts in some parts of the study region. Hence, this river is often described as 'Sorrow of Bihar' as it leads to enormous losses of fertile agricultural fields along its both banks parts of which also fall in this study region. It is one of the important left bank tributaries having its confluence with Ganga River between Katri and Kursela villages falling in Katihar Distt. [Refer Map 4].

4.2 During the survey, this river was observed from the Kosi bridge connecting Katria towards Bhagalpur and Kursela towards Katihar Distt. [Image 3]. The floodplains of Kosi River along with Ganga River in the study region are an important habitat for Greater Adjutant Storks which are the most endangered among 20 other stork species in the world (IUCN, 2003; Choudhary, 2007). During the field survey a good population of these storks (about 10-15) were sighted in the wetlands/oxbow lakes formed in the Ganga-Kosi floodplain region [Image 4].

4.3 Kosi and Ganga rivers are also an important source of fishing for local residents in their floodplain villages. Fishing activities were observed during the survey in Kosi River as seen from its bridge. However, the interlocutors reiterated that owing to various factors such as decline in fish availability, insufficient catch and drying up of Kosi river bed in some parts, it is difficult to sustain entirely on the fish resource from this river. Many residents depend upon the wetlands/oxbow lakes created in these floodplain regions for fish resources while many have migrated from this region or looking for alternate source of livelihoods.

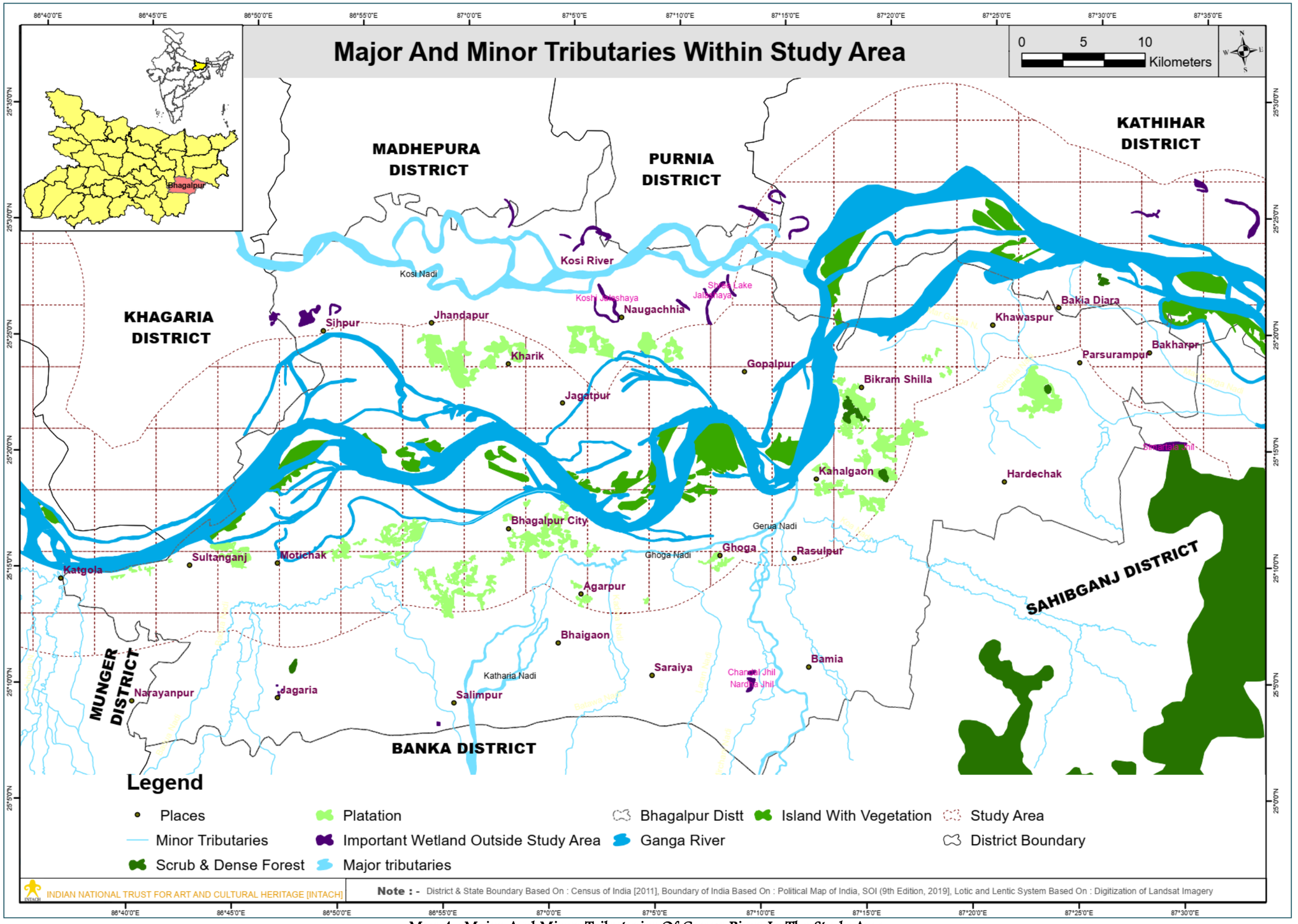
Image 3 : Kosi River As Observed From Kosi River Bridge On 6th January, 2022

Image 4 : A Population Of Greater Adjutants In A Kosi River Floodplain Wetland As Observed During Field Survey

4.4 **Kataria River:** It is a right bank tributary having its confluence with Ganga River near Kahalgaon town [Refer Map 4]. Approaching from southern direction, this river takes a turn eastwards close to Bhagalpur city and flows almost parallel to Ganga River converging with it just before Kahalgaon town. During the survey, floodplain region of this river was found to be infested with two major activities – agriculture and excessive brick kilns. Fishing was also an important activity in this river which was observed at various sites with the major fish caught being *rohu, sidhari, baam and gaichi*. Image 5 depicts this river as seen during the field survey.

**Image 5 : Kataria River With Silt Laden Water As Observed On 7th January, 2022**

4.5 Apart from these major tributaries, a number of ephemeral streams such as Gahra, Chanan, Kadwa, Gerua and Bhena from Chotnagpur plateau join the mighty Ganga (Sahu, 2013).



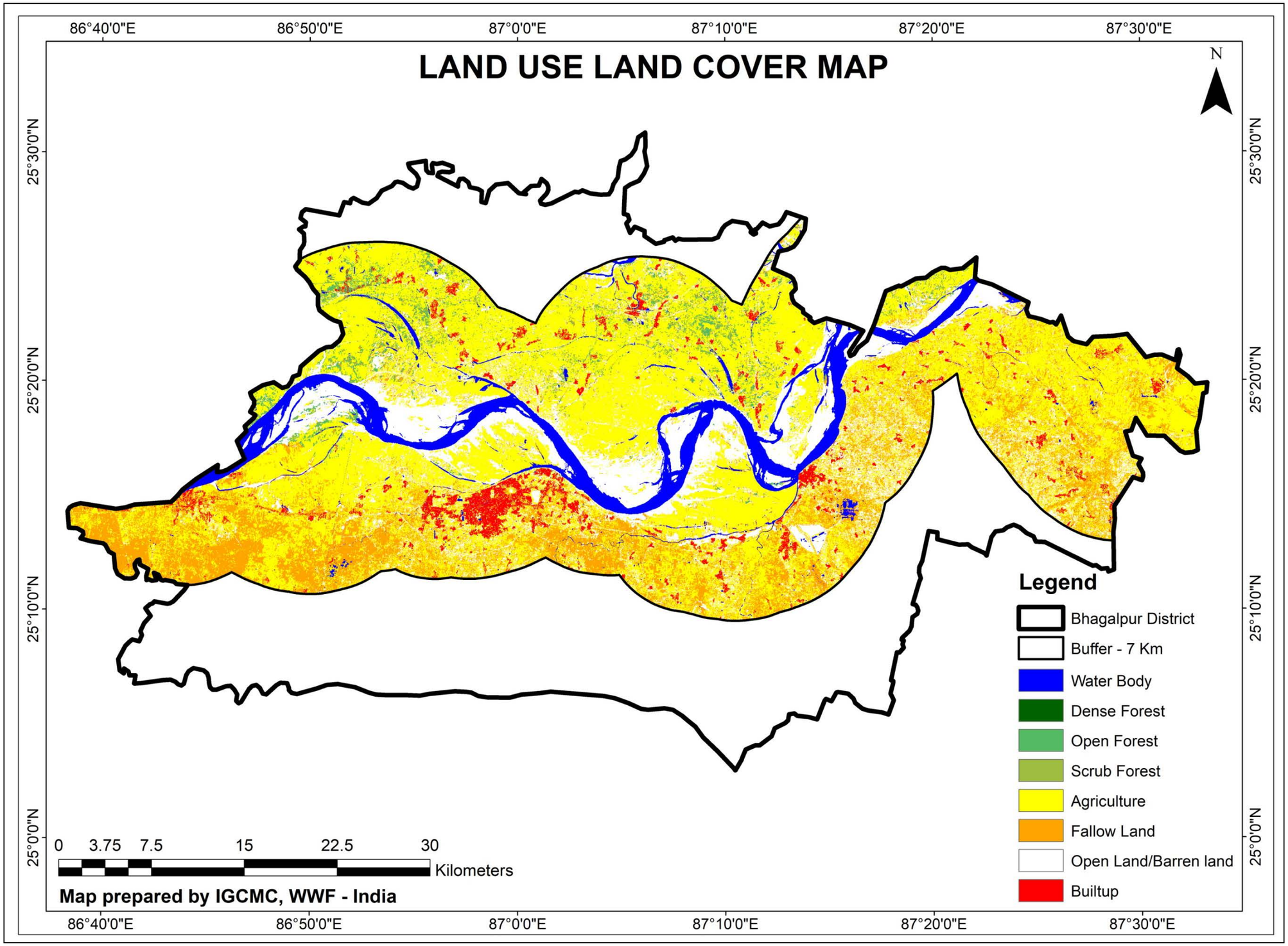

Map 4 : Major And Minor Tributaries Of Ganga River In The Study Area

## 5.0 Land Use/Land Cover

5.1 Land Use Land Cover (LULC) Map of the study corridor has been prepared from Landsat imagery. Using supervised classification system, 8 different classes were generated – water body, dense forest, open forest, scrub forest, agriculture land, fallow land, open/barren land and built up. Agriculture being a dominant source of income, occupies major part of the land use system in this area. The water body component covering 6.983% of the total geographical area of this Distt. chiefly includes Ganga river, its tributaries and other wetlands. The built up area includes Bhagalpur as the major city along with other towns and villages spread along in the study region. Table 1 provides the statistics while Map 5 depicts the various land use/land cover classes as analysed for the study region.

**Table 1 : Land Use And Land Cover Details Of Study Region**

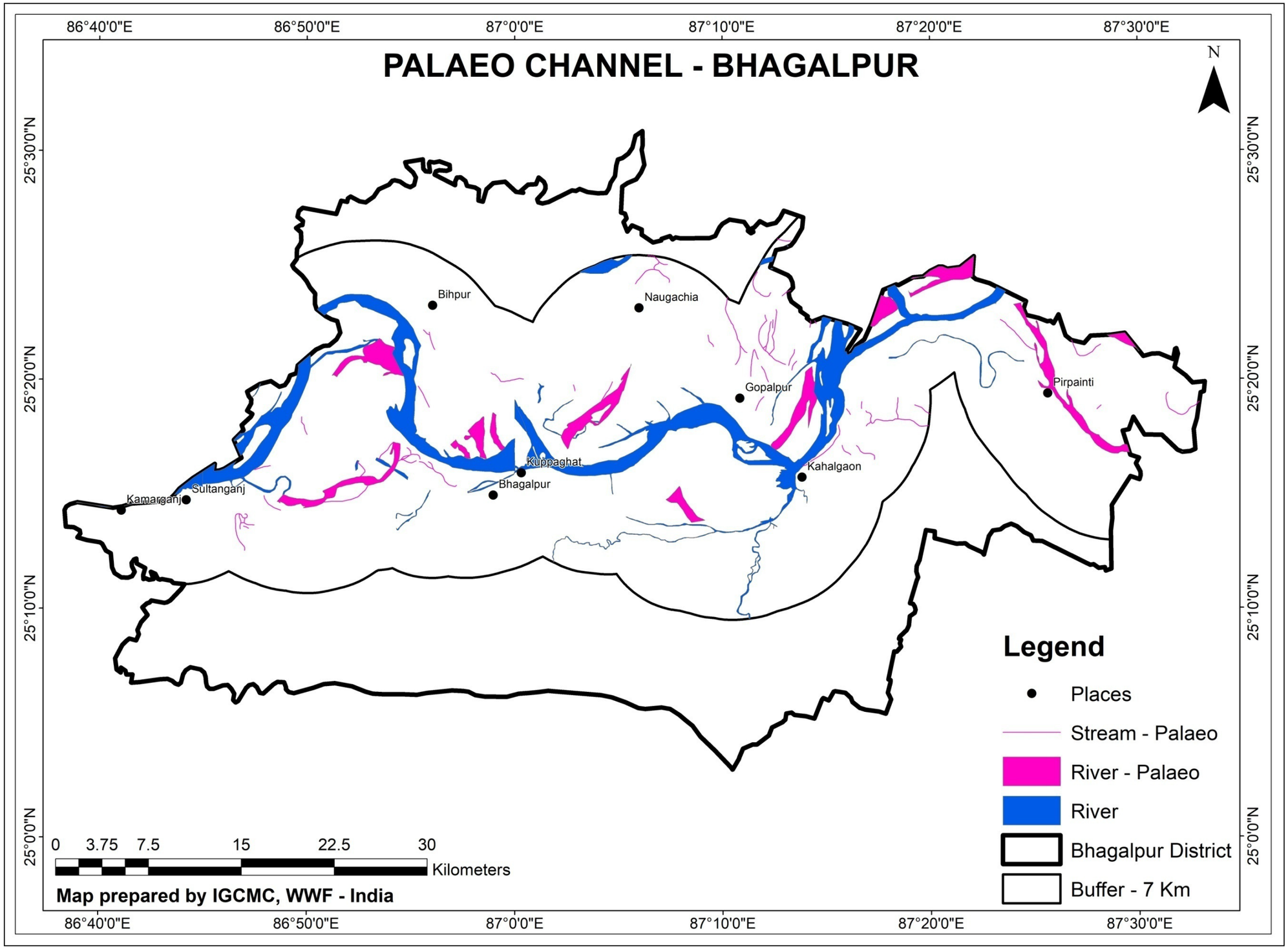
| BHAGALPUR | | | |
|---|---|---|---|
| **Class Name** | **Area (Ha)** | **Area (Sq. Km)** | **Area (%)** |
| Water Body | 11492.800 | 114.928 | 6.983 |
| Dense Forest | 1.260 | 0.013 | 0.001 |
| Open Forest | 3597.210 | 35.972 | 2.186 |
| Scrub Forest | 1180.530 | 11.805 | 0.717 |
| Agriculture Land | 81486.600 | 814.866 | 49.511 |
| Fallow Land | 29452.500 | 294.525 | 17.895 |
| Open Land/ Barren Land | 31849.000 | 318.490 | 19.351 |
| Built up | 5524.380 | 55.244 | 3.357 |
| **Total** | **164584.280** | **1645.843** | **100** |




Map 5 : Land Use/Land Cover Map Of Study Region In Bhagalpur

## 6.0 Palaeochannels Of Ganga River

6.1 Decline in natural flow of a River or stream decreases the sediment flushing ability of the Rivers. It may be a reason behind the disappearing of River channels in the Ganga River basin. Apart from that various other factors such as change in land use pattern, sand mining, agricultural practices and brick kilns may also lead to disappearance of streams and river channels in the region. These paleochannels do not carry water during most of the year but may flow during flood events. Such abandoned and silted paleochannels of the past can be mapped using the remote sensing techniques. Hence, based on the available satellite data and subsequent remote sensing analysis, Map 6 was prepared which depicts the various paleochannels in the study region of Bhagalpur




Map 6 : Paleochannels In The Study Region

## 7.0 Floodplain Of River Ganga In Bhagalpur

7.1 The active flood plain of a river is defined as an area on either side of the river channel with regular flooding on a periodic basis. Maintaining active flood plain of a river is critical for assuring equilibrium in ecosystem. The floodplains harbour rich biodiversity including riparian vegetation as well as many other groups of organisms which help in maintaining fertility of this region. Along with this, the floodplains have been of great cultural and economic importance with many early civilizations having risen in these fertile lands. As the rivers naturally meander through the landscape over a period of time, they deposit sand, silt and other soil forming materials in the floodplain region which make them ideal for agricultural production. Throughout history, people have learned to cultivate in the fertile floodplains and use their rich resources for sustaining livelihoods. Even today, in most of the riverine regions, especially in India, the floodplains have been occupied by local farmers for carrying out their agricultural activities especially in the non-monsoon season. Ganga River floodplain is one such important floodplain in India which has been extensively utilized in almost all the districts, where it passes through, for agricultural purposes.

7.2 Bhagalpur falls in the South Bihar Alluvial Plain agro-climatic zone (according to NARP) with the major soils being sandy soil, coarse sandy loam soil, fine sandy loam soil, clayey soil and saline/calcareous soil (NICRA-ICAR, 2013). Agriculture is one of the major sources of income for the residents in the area and is benefitted by the fertile alluvium brought by Ganga River and its tributaries. Vast floodplain lands along Ganga, Kosi and other smaller rivers were observed to be under extensive crop cultivation during the field survey in this region. Major crops grown in the study region included – wheat, rice, maize and mustard along with other crops such as various lentils and vegetables (such as onion, cauliflower, raddish, chillies and parwal). The details of some villages surveyed along with their floodplain agriculture produce are provided in Table 2 while Images 6-7 depict some floodplain agriculture fields as recorded during the survey.

7.3 A special variety of rice – **'Katarni rice'** is one of the most prevalent, ceremonial and finest quality scented rice in Bihar state. It is famous for its aromatic flavour, palatability, and Chura (beaten rice) making qualities. The geographical area of production of Katarni Rice includes districts of Zone IIIA of Bihar comprising of the south alluvial Gangetic plane of Munger, Banka and South Bhagalpur. The unique aroma in the Katarni grain is developed only when it is grown in few blocks namely Jagdishpur, Sanhaula, Sahkund and Sultanganj in Bhagalpur District; Tarapur and

Asharganj in Munger District and Amarpur, Shambhuganj, Rajaun, Barahat, Chanan and Katoria in Banka District (Kumar et al., 2018). Despite its popularity and uniqueness, the overall cultivation of this variety is declining in Bhagalpur and other areas chiefly due to reasons such as introduction of other high yield rice varieties, increasing irrigation costs, fluctuating demands and insufficient remuneration especially due to adulterated varieties of Katarni rice in the market.

**Table 2 : Some Floodplain Villages And Their Agriculture Produce As Noted During Field Survey In Bhagalpur**

| Sr. No. | Village Name | Agricultural Produce |
|---|---|---|
| 1. | Madhorampur | Wheat, Maize, Onion, Mustard |
| 2. | Umapur | Wheat, Mustard, Cauliflower, Mutter |
| 3. | Jagatpur | Wheat, Mustard, Mutter, Cabbage |
| 4. | Sultanganj | Wheat, Mustard, Sugarcane, Mutter |
| 5. | Sabour | Wheat, Mustard, Cauliflower, Chillies |
| 6. | Titanga *Diara* | Wheat, Mustard, Watermelon, Parwal |
| 7. | Gosaigaon | Wheat, Parwal, Lauki, Cauliflower |

Image 6 : Mustard And Wheat Cultivation In Ganga River Floodplain Fields Near Madhorampur Village In Study Region

Image 7 : Floodplain Wheat Fields Near Tilakpur Village In Study Region

7.3 **Floodplain Horticulture:** Besides agricultural crops, the Ganga river floodplain region is also known for its mango plantations, banana plantations and bamboo plantations [Images 8-10]. An important mango variety – **'Jardalu'** is unique to the study region of Bhagalpur. It is known for its light yellow skin, a distinct aroma, sweetness and nutritional properties which makes it a popular variety in Bihar state. This mango variety received the Geographical Indications (GI) certification in 2018. Another important horticultural crop is Banana which is grown principally in Naugacchia region of Bhagalpur Distt. along with some other areas. A study conducted in this region highlighted that banana variety **Robusta** was cultivated majorly in this region providing decent returns to both marginal and large scale farmers (Kumari et al., 2017). Another important plantation found extensively in the study region is **Indian Thorny Bamboo** (*Bambusa bambos*). The interlocutors from some study sites reiterated to have planted this variety as it is of immense use in fishing and construction of huts along with miscellaneous other purposes.

Image 8 : Mango Orchards As Seen Near Narkatiya Village In Study Region

Image 9 : Banana Plantation Near Jagatpur Village In Study Region

Image 10 : Bamboo Plantation Near Oriup Village In Study Region

7.4 **Floodplain Grasses:** The chief floodplain grasses growing throughout study region are – *S. spontaneum* (commonly known as *Kans*), *S. bengalense* (commonly known as *Munj/ Sarkanda*) and *Cynodon dactylon* (L.) Pers. (commonly known as Doob or Durva grass). Among these, the *Saccharum* grasses are dominant and luxuriant along the Ganga River banks and on the *diaras*. They are tall, perennial wild grasses growing upto 2-3 m height. They form extensive root networks that bind the soil/pebbles and form tall thick clumps with high biomass tufts. The dried *Saccharum* grasses are widely used throughout the area for roof thatching in villages [Image 11]. Along with this some local residents also use these grasses in construction of temporary huts to monitor their agricultural fields. The abundance of this grass and availability throughout the year makes it an excellent resource for the residents in this region.

Image 11 : Dried Saccharum Grasses Collected For Roof Thatching

# 8.0 Wetlands In Bhagalpur

8.1 Wetlands are one of the most productive and unique ecosystems. They help in maintaining the food web and provide habitat for the aquatic biodiversity. They also help in controlling floods, recharging groundwater, nutrient recycling, climate stabilization and carbon sequestration. According to the report prepared by Tare et al. (2012) about 605 wetlands are reported in Bhagalpur which include – lakes/ponds, oxbow lakes/cut-off meanders, riverine wetlands, waterlogged areas, rivers/streams, reservoirs/barrages, tanks/ponds and wetlands of smaller areas (<2.25 ha). However, during the current study [limited to the study area] about 357 different wetlands are recorded whose details are provided in Table 3. Map 7 shows the spatial distribution of these wetlands in the study region. Some notable wetlands as observed during the field survey are discussed in this section.

Table 3 : List Of Wetlands In The Study Region

| Sr. No. | Wetland number/name | Coordinates | | Area (Ha) |
|---|---|---|---|---|
| | | Latitude | Longitude | |
| 01 | 01 | 25°14'20.44"N | 86°39'10.13"E | 0.26 |
| 02 | 02 | 25°14'22.69"N | 86°39'8.73"E | 0.16 |
| 03 | 03 | 25°14'20.61"N | 86°39'13.83"E | 0.11 |
| 04 | 04 | 25°14'17.81"N | 86°39'12.75"E | 0.10 |
| 05 | 05 | 25°14'28.43"N | 86°39'15.25"E | 0.29 |
| 06 | 06 | 25°14'24.49"N | 86°39'52.51"E | 0.13 |
| 07 | 07 | 25°13'8.25"N | 86°41'8.00"E | 1.25 |
| 08 | 08 | 25°12'17.76"N | 86°41'1.20"E | 0.66 |
| 09 | 09 | 25°12'21.31"N | 86°41'2.11"E | 0.50 |
| 10 | 10 | 25°11'59.93"N | 86°40'56.16"E | 0.12 |
| 11 | 11 | 25°11'23.21"N | 86°41'1.18"E | 0.30 |
| 12 | 12 | 25°13'46.47"N | 86°41'12.66"E | 0.24 |
| 13 | 13 | 25°12'8.19"N | 86°41'15.44"E | 0.92 |
| 14 | 14 | 25°11'42.94"N | 86°41'29.95"E | 0.12 |
| 15 | 15 | 25°12'21.53"N | 86°41'18.36"E | 0.70 |

| | | | | |
|---|---|---|---|---|
| 16 | 16 | 25°12'50.98"N | 86°41'44.67"E | 0.50 |
| 17 | 17 | 25°13'36.23"N | 86°42'1.91"E | 1.30 |
| 18 | 18 | 25°13'57.16"N | 86°42'9.66"E | 0.56 |
| 19 | 19 | 25°14'17.26"N | 86°42'1.73"E | 0.24 |
| 20 | 20 | 25°14'19.66"N | 86°41'58.60"E | 0.27 |
| 21 | 21 | 25°14'22.55"N | 86°41'58.04"E | 0.21 |
| 22 | 22 | 25°12'47.79"N | 86°41'59.40"E | 0.85 |
| 23 | 23 | 25°12'49.40"N | 86°42'17.23"E | 1.82 |
| 24 | 24 | 25°12'44.79"N | 86°42'20.33"E | 1.10 |
| 25 | 25 | 25°12'52.35"N | 86°42'30.11"E | 0.85 |
| 26 | 26 | 25°12'54.82"N | 86°42'21.50"E | 0.24 |
| 27 | 27 | 25°13'0.56"N | 86°42'20.69"E | 0.67 |
| 28 | 28 | 25°12'49.79"N | 86°42'35.29"E | 1.29 |
| 29 | 29 | 25°14'39.30"N | 86°42'46.66"E | 0.30 |
| 30 | 30 | 25°11'17.87"N | 86°42'19.21"E | 0.14 |
| 31 | 31 | 25°11'56.54"N | 86°42'24.58"E | 0.45 |
| 32 | 32 | 25°12'38.33"N | 86°42'23.56"E | 0.41 |
| 33 | 33 | 25°12'28.31"N | 86°42'26.26"E | 0.50 |
| 34 | 34 | 25°12'27.27"N | 86°42'35.15"E | 0.33 |
| 35 | 35 | 25°12'33.41"N | 86°42'30.48"E | 0.44 |
| 36 | 36 | 25°12'41.69"N | 86°42'34.18"E | 0.29 |
| 37 | 37 | 25°13'27.89"N | 86°42'44.47"E | 0.20 |
| 38 | 38 | 25°14'40.50"N | 86°43'5.49"E | 0.66 |
| 39 | 39 | 25°14'39.60"N | 86°43'7.86"E | 0.35 |
| 40 | 40 | 25°12'36.45"N | 86°43'0.35"E | 0.89 |
| 41 | 41 | 25°11'15.84"N | 86°43'15.31"E | 1.79 |
| 42 | 42 | 25°11'33.81"N | 86°43'18.21"E | 1.26 |
| 43 | 43 | 25°11'21.31"N | 86°43'22.12"E | 0.86 |
| 44 | 44 | 25°11'30.58"N | 86°43'28.31"E | 0.81 |
| 45 | 45 | 25°12'46.59"N | 86°43'29.79"E | 0.50 |
| 46 | 46 | 25°13'13.23"N | 86°43'23.73"E | 4.17 |
| 47 | 47 | 25°13'31.31"N | 86°43'29.18"E | 2.0 |

| | | | | |
|---|---|---|---|---|
| 48 | 48 | 25°14'4.32"N | 86°43'23.59"E | 1.23 |
| 49 | 49 | 25°14'4.46"N | 86°43'31.73"E | 0.62 |
| 50 | 50 | 25°14'16.12"N | 86°43'35.74"E | 0.47 |
| 51 | 51 | 25°14'14.20"N | 86°43'30.92"E | 0.48 |
| 52 | 52 | 25°14'30.90"N | 86°43'29.55"E | 4.0 |
| 53 | 53 | 25°14'28.39"N | 86°43'37.02"E | 1.57 |
| 54 | 54 | 25°14'23.21"N | 86°43'47.71"E | 2.80 |
| 55 | 55 | 25°14'18.50"N | 86°43'44.75"E | 0.21 |
| 56 | 56 | 25°14'14.91"N | 86°43'53.57"E | 0.60 |
| 57 | 57 | 25°14'13.34"N | 86°43'44.27"E | 0.17 |
| 58 | 58 | 25°14'50.43"N | 86°43'51.33"E | 9.59 |
| 59 | 59 | 25°14'0.94"N | 86°43'49.38"E | 0.46 |
| 60 | 60 | 25°13'11.36"N | 86°43'38.86"E | 0.39 |
| 61 | 61 | 25°11'35.52"N | 86°43'46.60"E | 3.49 |
| 62 | 62 | 25°14'17.96"N | 86°44'12.78"E | 5.87 |
| 63 | 63 | 25°13'29.95"N | 86°43'43.22"E | 0.18 |
| 64 | 64 | 25°14'17.99"N | 86°44'0.42"E | 0.58 |
| 65 | 65 | 25°14'7.05"N | 86°44'14.54"E | 0.14 |
| 66 | 66 | 25°14'4.62"N | 86°44'22.21"E | 0.36 |
| 67 | 67 | 25°13'57.38"N | 86°44'20.20"E | 0.56 |
| 68 | 68 | 25°13'52.60"N | 86°44'25.95"E | 0.68 |
| 69 | 69 | 25°14'6.12"N | 86°44'29.81"E | 0.49 |
| 70 | 70 | 25°14'42.21"N | 86°44'11.16"E | 0.54 |
| 71 | 71 | 25°14'45.63"N | 86°44'44.10"E | 0.99 |
| 72 | 72 | 25°14'47.88"N | 86°45'0.40"E | 0.41 |
| 73 | 73 | 25°14'49.99"N | 86°45'13.19"E | 1.35 |
| 74 | 74 | 25°14'49.83"N | 86°45'20.44"E | 0.33 |
| 75 | 75 | 25°14'53.03"N | 86°45'28.71"E | 0.16 |
| 76 | 76 | 25°14'16.77"N | 86°45'33.51"E | 0.21 |
| 77 | 77 | 25°14'6.52"N | 86°45'29.61"E | 0.78 |
| 78 | 78 | 25°14'11.32"N | 86°45'0.80"E | 1.17 |
| 79 | 79 | 25°13'58.14"N | 86°45'19.88"E | 0.29 |

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| 80 | 80 | 25°13'27.04"N | 86°44'59.97"E | 1.16 |
| 81 | 81 | 25°13'18.02"N | 86°45'11.95"E | 2.74 |
| 82 | 82 | 25°12'47.96"N | 86°45'4.51"E | 0.53 |
| 83 | 83 | 25°12'44.02"N | 86°45'6.23"E | 0.20 |
| 84 | 84 | 25°12'57.21"N | 86°45'15.10"E | 0.66 |
| 85 | 85 | 25°11'31.99"N | 86°45'5.21"E | 1.28 |
| 86 | 86 | 25°14'45.61"N | 86°45'27.07"E | 1.19 |
| 87 | 87 | 25°14'50.34"N | 86°45'37.44"E | 0.57 |
| 88 | 88 | 25°13'29.77"N | 86°45'54.06"E | 0.65 |
| 89 | 89 | 25°13'20.88"N | 86°45'57.14"E | 0.82 |
| 90 | 90 | 25°12'53.62"N | 86°45'27.62"E | 1.12 |
| 91 | 91 | 25°13'41.18"N | 86°47'23.78"E | 3.19 |
| 92 | 92 | 25°11'45.28"N | 86°47'25.61"E | 1.47 |
| 93 | 93 | 25°11'24.89"N | 86°47'51.05"E | 0.76 |
| 94 | 94 | 25°11'9.29"N | 86°47'52.68"E | 0.49 |
| 95 | 95 | 25°14'15.83"N | 86°48'5.58"E | 3.54 |
| 96 | 96 | 25°10'35.28"N | 86°48'34.74"E | 0.36 |
| 97 | 97 | 25°10'33.25"N | 86°49'2.04"E | 0.84 |
| 98 | 98 | 25°10'30.31"N | 86°49'24.80"E | 2.67 |
| 99 | 99 | 25°10'31.27"N | 86°49'11.35"E | 0.39 |
| 100 | 100 | 25°10'39.47"N | 86°49'24.02"E | 0.71 |
| 101 | 101 | 25°10'33.39"N | 86°49'35.52"E | 0.24 |
| 102 | 102 | 25°11'3.00"N | 86°49'19.39"E | 0.66 |
| 103 | 103 | 25°10'56.70"N | 86°49'8.96"E | 0.21 |
| 104 | 104 | 25°10'53.96"N | 86°49'11.52"E | 0.23 |
| 105 | 105 | 25°10'52.35"N | 86°49'15.57"E | 0.39 |
| 106 | 106 | 25°10'52.23"N | 86°49'15.79"E | 0.20 |
| 107 | 107 | 25°17'25.99"N | 86°49'22.82"E | 3.69 |
| 108 | 108 | 25°14'49.11"N | 86°50'10.58"E | 12.3 |
| 109 | 109 | 25°14'42.65"N | 86°49'49.88"E | 1.38 |
| 110 | 110 | 25°14'3.35"N | 86°50'12.57"E | 0.69 |
| 111 | 111 | 25°13'17.96"N | 86°50'2.98"E | 0.62 |

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| 112 | 112 | 25°11'24.62"N | 86°50'27.03"E | 1.00 |
| 113 | 113 | 25°11'8.15"N | 86°49'56.20"E | 1.11 |
| 114 | 114 | 25°11'7.18"N | 86°49'50.26"E | 0.11 |
| 115 | 115 | 25°11'6.61"N | 86°49'45.64"E | 0.10 |
| 116 | 116 | 25°10'49.81"N | 86°50'45.97"E | 1.00 |
| 117 | 117 | 25°11'18.40"N | 86°50'45.82"E | 0.39 |
| 118 | 118 | 25°11'31.42"N | 86°50'57.74"E | 0.83 |
| 119 | 119 | 25°11'42.31"N | 86°50'40.48"E | 0.51 |
| 120 | 120 | 25°11'41.17"N | 86°50'55.31"E | 0.78 |
| 121 | 121 | 25°11'58.76"N | 86°50'42.07"E | 0.94 |
| 122 | 122 | 25°11'50.82"N | 86°50'42.29"E | 2.18 |
| 123 | 123 | 25°13'20.29"N | 86°50'45.78"E | 0.30 |
| 124 | 124 | 25°13'45.55"N | 86°50'45.73"E | 1.14 |
| 125 | 125 | 25°13'52.34"N | 86°50'55.08"E | 2.13 |
| 126 | 126 | 25°13'50.46"N | 86°50'50.04"E | 0.77 |
| 127 | 127 | 25°14'6.34"N | 86°50'36.70"E | 1.12 |
| 128 | 128 | 25°14'2.00"N | 86°50'41.42"E | 1.20 |
| 129 | 129 | 25°14'1.40"N | 86°51'5.08"E | 2.27 |
| 130 | 130 | 25°13'49.96"N | 86°50'26.04"E | 0.43 |
| 131 | 131 | 25°14'24.15"N | 86°50'34.19"E | 0.25 |
| 132 | 132 | 25°14'38.14"N | 86°51'28.54"E | 11.8 |
| 133 | 133 | 25°11'22.71"N | 86°51'31.25"E | 0.40 |
| 134 | 134 | 25°11'17.94"N | 86°51'42.76"E | 0.61 |
| 135 | 135 | 25°11'48.05"N | 86°52'14.52"E | 0.45 |
| 136 | 136 | 25°11'41.61"N | 86°52'3.94"E | 0.41 |
| 137 | 137 | 25°11'36.51"N | 86°52'4.86"E | 0.21 |
| 138 | 138 | 25°11'40.53"N | 86°51'59.37"E | 0.10 |
| 139 | 139 | 25°14'35.15"N | 86°52'22.79"E | 0.33 |
| 140 | 140 | 25°14'33.97"N | 86°52'17.03"E | 0.23 |
| 141 | 141 | 25°14'36.74"N | 86°52'14.16"E | 0.10 |
| 142 | 142 | 25°14'42.04"N | 86°52'6.25"E | 0.52 |
| 143 | 143 | 25°15'34.41"N | 86°53'25.02"E | 30.7 |

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| 144 | 144 | 25°14'22.06"N | 86°53'21.13"E | 13.3 |
| 145 | 145 | 25°13'56.01"N | 86°53'8.27"E | 0.55 |
| 146 | 146 | 25°13'44.64"N | 86°52'43.94"E | 0.56 |
| 147 | 147 | 25°13'41.76"N | 86°53'0.61"E | 0.78 |
| 148 | 148 | 25°13'38.83"N | 86°53'34.99"E | 2.73 |
| 149 | 149 | 25°13'46.36"N | 86°53'14.61"E | 0.56 |
| 150 | 150 | 25°14'11.61"N | 86°53'48.68"E | 1.87 |
| 151 | 151 | 25°14'16.56"N | 86°53'45.01"E | 0.83 |
| 152 | 152 | 25°14'9.34"N | 86°54'26.19"E | 15.5 |
| 153 | 153 | 25°13'32.47"N | 86°54'22.26"E | 1.11 |
| 154 | 154 | 25°12'56.24"N | 86°54'40.72"E | 0.30 |
| 155 | 155 | 25°12'45.36"N | 86°54'44.38"E | 1.65 |
| 156 | 156 | 25°12'54.71"N | 86°54'46.67"E | 0.43 |
| 157 | 157 | 25°12'19.96"N | 86°54'34.41"E | 0.78 |
| 158 | 158 | 25°12'10.48"N | 86°54'49.40"E | 1.00 |
| 159 | 159 | 25°13'30.01"N | 86°55'51.86"E | 0.57 |
| 160 | 160 | 25°13'54.33"N | 86°55'26.53"E | 0.41 |
| 161 | 161 | 25°14'11.84"N | 86°55'23.88"E | 1.93 |
| 162 | 162 | 25°14'15.85"N | 86°55'27.25"E | 0.29 |
| 163 | 163 | 25°16'12.55"N | 86°55'29.85"E | 11.5 |
| 164 | 164 | 25°13'16.07"N | 86°56'0.79"E | 8.38 |
| 165 | 165 | 25°13'57.74"N | 86°56'16.26"E | 4.64 |
| 166 | 166 | 25°13'41.22"N | 86°56'26.50"E | 0.63 |
| 167 | 167 | 25°13'45.20"N | 86°56'13.82"E | 0.29 |
| 168 | 168 | 25°13'53.02"N | 86°56'7.58"E | 0.75 |
| 169 | 169 | 25°13'33.49"N | 86°56'13.51"E | 0.17 |
| 170 | 170 | 25°15'4.25"N | 86°56'24.10"E | 0.22 |
| 171 | 171 | 25°15'3.49"N | 86°56'36.60"E | 1.48 |
| 172 | 172 | 25°14'54.09"N | 86°56'36.29"E | 3.62 |
| 173 | 173 | 25°13'1.12"N | 86°56'27.06"E | 1.00 |
| 174 | 174 | 25°12'55.70"N | 86°56'32.77"E | 1.00 |
| 175 | 175 | 25°12'43.89"N | 86°56'30.70"E | 0.92 |

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| 176 | 176 | 25°12'48.86"N | 86°56'42.31"E | 1.69 |
| 177 | 177 | 25°13'9.15"N | 86°56'56.99"E | 0.61 |
| 178 | 178 | 25°14'16.89"N | 86°56'37.97"E | 0.27 |
| 179 | 179 | 25°14'10.43"N | 86°56'59.44"E | 0.88 |
| 180 | 180 | 25°11'25.98"N | 86°57'18.65"E | 0.32 |
| 181 | 181 | 25°11'35.92"N | 86°57'9.73"E | 1.46 |
| 182 | 182 | 25°11'34.27"N | 86°57'23.24"E | 0.30 |
| 183 | 183 | 25°11'54.65"N | 86°57'9.50"E | 0.52 |
| 184 | 184 | 25°12'29.86"N | 86°57'27.17"E | 0.52 |
| 185 | 185 | 25°12'39.69"N | 86°57'35.30"E | 0.43 |
| 186 | 186 | 25°12'46.29"N | 86°56'53.89"E | 0.39 |
| 187 | 187 | 25°12'42.15"N | 86°57'8.27"E | 0.65 |
| 188 | 188 | 25°12'47.55"N | 86°57'7.34"E | 0.15 |
| 189 | 189 | 25°12'49.43"N | 86°57'11.45"E | 0.16 |
| 190 | 190 | 25°13'0.09"N | 86°57'13.29"E | 0.75 |
| 191 | 191 | 25°13'18.82"N | 86°57'25.78"E | 0.75 |
| 192 | 192 | 25°13'11.39"N | 86°57'27.61"E | 1.11 |
| 193 | 193 | 25°13'39.40"N | 86°57'21.94"E | 1.00 |
| 194 | 194 | 25°13'33.43"N | 86°57'22.61"E | 0.50 |
| 195 | 195 | 25°13'56.77"N | 86°57'8.53"E | 1.30 |
| 196 | Shahjangi Pond | 25°13'57.30"N | 86°57'21.96"E | 7.13 |
| 197 | Mukhda Talab | 25°14'13.28"N | 86°57'20.13"E | 12.2 |
| 198 | 198 | 25°14'29.58"N | 86°57'15.67"E | 0.54 |
| 199 | 199 | 25°14'25.49"N | 86°57'17.17"E | 0.25 |
| 200 | 200 | 25°14'46.90"N | 86°57'14.41"E | 15.5 |
| 201 | 201 | 25°14'55.61"N | 86°57'23.56"E | 0.45 |
| 202 | 202 | 25°14'50.94"N | 86°57'34.21"E | 0.46 |
| 203 | 203 | 25°14'28.85"N | 86°57'32.85"E | 0.18 |
| 204 | 204 | 25°14'40.09"N | 86°57'35.26"E | 2.73 |
| 205 | 205 | 25°14'19.85"N | 86°57'45.50"E | 1.24 |
| 206 | 206 | 25°11'38.95"N | 86°57'52.03"E | 0.86 |
| 207 | 207 | 25°11'45.15"N | 86°57'52.02"E | 0.34 |

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| 208 | 208 | 25°12'27.14"N | 86°57'53.08"E | 0.75 |
| 209 | 209 | 25°12'50.62"N | 86°58'0.17"E | 0.80 |
| 210 | 210 | 25°13'2.06"N | 86°58'4.21"E | 1.37 |
| 211 | 211 | 25°13'14.38"N | 86°58'4.38"E | 0.91 |
| 212 | 212 | 25°13'24.17"N | 86°58'4.51"E | 0.58 |
| 213 | 213 | 25°13'16.47"N | 86°58'8.28"E | 0.18 |
| 214 | 214 | 25°13'29.71"N | 86°58'2.52"E | 0.41 |
| 215 | 215 | 25°13'18.52"N | 86°58'14.16"E | 0.87 |
| 216 | 216 | 25°13'56.30"N | 86°58'11.78"E | 4.16 |
| 217 | 217 | 25°14'8.79"N | 86°58'2.96"E | 0.55 |
| 218 | 218 | 25°14'18.96"N | 86°58'3.94"E | 0.66 |
| 219 | Mirza Talab | 25°13'33.71"N | 86°58'27.62"E | 1.99 |
| 220 | 220 | 25°13'39.13"N | 86°58'37.17"E | 1.60 |
| 221 | 221 | 25°13'58.63"N | 86°59'15.41"E | 4.10 |
| 222 | 222 | 25°13'26.45"N | 86°59'11.09"E | 0.56 |
| 223 | 223 | 25°13'19.24"N | 86°59'10.44"E | 0.40 |
| 224 | 224 | 25°13'18.94"N | 86°59'17.80"E | 0.37 |
| 225 | 225 | 25°13'7.59"N | 86°59'15.89"E | 4.97 |
| 226 | 226 | 25°12'26.05"N | 86°59'38.21"E | 1.55 |
| 227 | 227 | 25°13'16.83"N | 86°59'58.02"E | 2.19 |
| 228 | 228 | 25°13'9.08"N | 87° 0'3.64"E | 0.59 |
| 229 | 229 | 25°13'10.79"N | 87° 0'10.09"E | 0.49 |
| 230 | 230 | 25°13'23.85"N | 87° 0'5.37"E | 1.33 |
| 231 | 231 | 25°13'23.09"N | 87° 0'20.85"E | 1.63 |
| 232 | 232 | 25°13'49.13"N | 86°59'40.74"E | 2.14 |
| 233 | 233 | 25°13'38.44"N | 86°59'56.82"E | 6.22 |
| 234 | 234 | 25°13'37.00"N | 86°59'35.74"E | 0.35 |
| 235 | 235 | 25°13'22.02"N | 87° 0'45.85"E | 2.10 |
| 236 | 236 | 25°14'1.10"N | 87° 0'44.03"E | 2.10 |
| 237 | 237 | 25°16'0.42"N | 87° 0'49.64"E | 2.15 |
| 238 | 238 | 25°13'41.80"N | 87° 1'32.06"E | 2.38 |
| 239 | 239 | 25°14'40.41"N | 87° 1'26.12"E | 0.34 |

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| 240 | 240 | 25°14'37.58"N | 87° 1'42.38"E | 0.65 |
| 241 | 241 | 25°15'47.43"N | 87° 1'35.73"E | 3.54 |
| 242 | 242 | 25°15'52.72"N | 87° 1'53.72"E | 0.44 |
| 243 | 243 | 25°11'44.73"N | 87° 2'9.86"E | 0.40 |
| 244 | 244 | 25°12'4.30"N | 87° 2'15.04"E | 0.94 |
| 245 | 245 | 25°11'55.14"N | 87° 2'34.71"E | 0.48 |
| 246 | 246 | 25°14'1.91"N | 87° 2'36.36"E | 1.13 |
| 247 | 247 | 25°14'55.36"N | 87° 2'36.36"E | 6.72 |
| 248 | 248 | 25°14'34.24"N | 87° 3'9.05"E | 2.92 |
| 249 | 249 | 25°13'48.15"N | 87° 3'4.29"E | 2.00 |
| 250 | 250 | 25°13'43.34"N | 87° 3'16.51"E | 1.00 |
| 251 | 251 | 25°13'49.93"N | 87° 3'19.38"E | 0.71 |
| 252 | 252 | 25°13'30.45"N | 87° 2'38.76"E | 1.33 |
| 253 | 253 | 25°12'14.25"N | 87° 2'53.52"E | 0.54 |
| 254 | 254 | 25°11'54.80"N | 87° 2'35.52"E | 0.72 |
| 255 | 255 | 25°12'4.05"N | 87° 2'58.14"E | 0.40 |
| 256 | 256 | 25°11'35.86"N | 87° 2'41.15"E | 0.44 |
| 257 | 257 | 25°11'21.88"N | 87° 2'30.01"E | 1.39 |
| 258 | 258 | 25°11'14.91"N | 87° 2'58.60"E | 0.87 |
| 259 | 259 | 25°11'0.50"N | 87° 3'7.54"E | 1.67 |
| 260 | 260 | 25°13'56.62"N | 87° 3'27.13"E | 0.92 |
| 261 | 261 | 25°13'49.17"N | 87° 3'58.88"E | 4.89 |
| 262 | 262 | 25°13'35.97"N | 87° 4'2.90"E | 1.78 |
| 263 | 263 | 25°13'30.67"N | 87° 4'27.16"E | 1.16 |
| 264 | 264 | 25°12'28.95"N | 87° 5'21.41"E | 0.67 |
| 265 | 265 | 25°12'14.09"N | 87° 5'22.38"E | 0.67 |
| 266 | 266 | 25°12'8.03"N | 87° 5'26.83"E | 2.40 |
| 267 | 267 | 25°11'56.20"N | 87° 5'24.30"E | 0.40 |
| 268 | 268 | 25°12'3.26"N | 87° 5'30.56"E | 0.22 |
| 269 | 269 | 25°11'53.98"N | 87° 5'36.73"E | 2.20 |
| 270 | 270 | 25°11'24.86"N | 87° 5'38.08"E | 1.54 |
| 271 | 271 | 25°10'39.60"N | 87° 5'36.46"E | 0.26 |

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| 272 | 272 | 25°11'17.27"N | 87° 5'56.34"E | 0.69 |
| 273 | 273 | 25°11'56.76"N | 87° 5'48.81"E | 2.63 |
| 274 | 274 | 25°12'2.65"N | 87° 6'3.44"E | 1.91 |
| 275 | 275 | 25°11'2.32"N | 87° 6'30.89"E | 0.93 |
| 276 | 276 | 25°10'53.59"N | 87° 6'16.53"E | 0.64 |
| 277 | 277 | 25°11'17.05"N | 87° 6'52.91"E | 1.60 |
| 278 | 278 | 25°11'12.22"N | 87° 6'53.22"E | 0.54 |
| 279 | 279 | 25°10'59.42"N | 87° 7'2.70"E | 1.11 |
| 280 | 280 | 25°10'58.47"N | 87° 7'11.29"E | 0.32 |
| 281 | 281 | 25°10'56.51"N | 87° 7'15.09"E | 0.26 |
| 282 | 282 | 25°11'4.36"N | 87° 7'24.76"E | 1.25 |
| 283 | 283 | 25°11'6.36"N | 87° 7'38.61"E | 0.69 |
| 284 | 284 | 25°12'45.79"N | 87° 8'44.50"E | 1.19 |
| 285 | 285 | 25°12'35.60"N | 87° 8'49.00"E | 0.43 |
| 286 | 286 | 25°12'2.30"N | 87° 8'15.05"E | 2.42 |
| 287 | 287 | 25°12'17.66"N | 87° 8'23.32"E | 1.26 |
| 288 | 288 | 25°12'9.96"N | 87° 8'35.18"E | 0.97 |
| 289 | 289 | 25°12'11.88"N | 87° 8'29.54"E | 0.89 |
| 290 | 290 | 25°12'26.73"N | 87°10'49.88"E | 1.77 |
| 291 | 291 | 25°14'13.39"N | 87°12'7.50"E | 7.17 |
| 292 | 292 | 25°14'22.97"N | 87°12'9.33"E | 13.1 |
| 293 | 293 | 25°14'39.14"N | 87°12'22.52"E | 13.1 |
| 294 | 294 | 25°13'7.29"N | 87°12'2.22"E | 3.10 |
| 295 | 295 | 25°13'28.71"N | 87°12'40.72"E | 0.85 |
| 296 | 296 | 25°12'56.55"N | 87°13'13.36"E | 1.00 |
| 297 | 297 | 25°12'51.08"N | 87°13'9.02"E | 1.21 |
| 298 | 298 | 25°12'24.82"N | 87°13'5.29"E | 1.32 |
| 299 | 299 | 25°15'1.23"N | 87°14'3.12"E | 2.89 |
| 300 | 300 | 25°12'49.99"N | 87°14'46.54"E | 0.42 |
| 301 | 301 | 25°14'19.77"N | 87°14'38.09"E | 0.64 |
| 302 | 302 | 25°15'0.52"N | 87°15'18.33"E | 2.41 |
| 303 | 303 | 25°14'15.38"N | 87°15'22.48"E | 0.89 |

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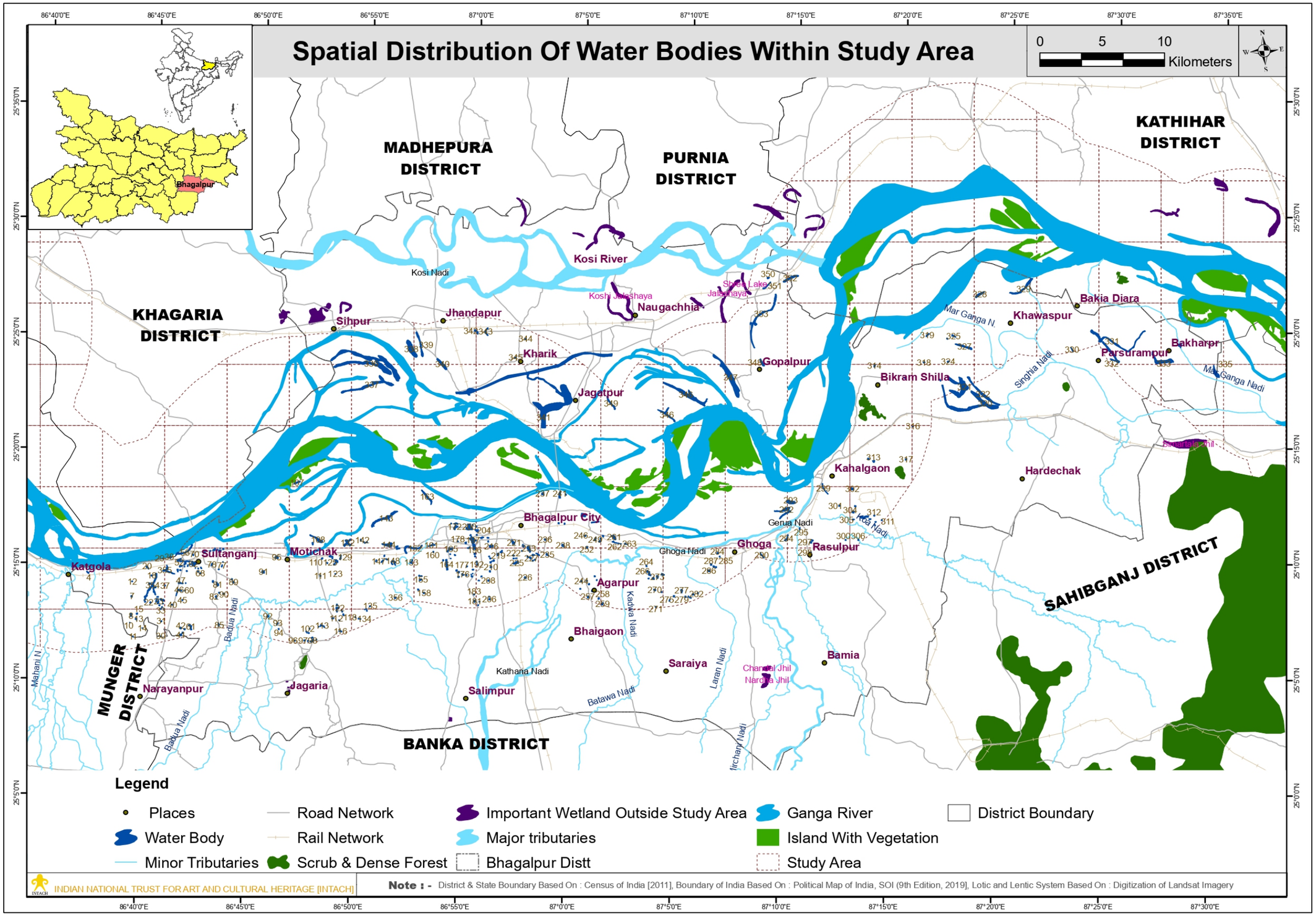
| 304 | 304 | 25°13'59.87"N | 87°15'15.36"E | 1.97 |
| 305 | 305 | 25°13'40.61"N | 87°15'12.95"E | 1.10 |
| 306 | 306 | 25°12'47.11"N | 87°15'21.99"E | 0.64 |
| 307 | 307 | 25°13'43.49"N | 87°15'41.65"E | 6.70 |
| 308 | 308 | 25°13'37.97"N | 87°15'59.51"E | 0.82 |
| 309 | 309 | 25°13'29.29"N | 87°16'15.63"E | 0.51 |
| 310 | 310 | 25°13'20.64"N | 87°16'12.91"E | 0.28 |
| 311 | 311 | 25°13'32.32"N | 87°16'33.44"E | 0.61 |
| 312 | 312 | 25°13'46.01"N | 87°16'12.98"E | 0.64 |
| 313 | 313 | 25°16'6.98"Nc | 87°16'26.07"E | 1.47 |
| 314 | 314 | 25°20'12.38"N | 87°16'53.96"E | 1.22 |
| 315 | 315 | 25°19'36.77"N | 87°18'14.56"E | 0.55 |
| 316 | 316 | 25°17'28.72"N | 87°18'25.52"E | 0.55 |
| 317 | 317 | 25°16'4.82"N | 87°17'57.32"E | 0.99 |
| 318 | 318 | 25°20'12.42"N | 87°19'14.59"E | 1.00 |
| 319 | 319 | 25°21'21.60"N | 87°19'30.07"E | 1.50 |
| 320 | 320 | 25°18'4.48"N | 87°22'0.58"E | 125 |
| 321 | 321 | 25°19'0.90"N | 87°20'55.90"E | 89.2 |
| 322 | 322 | 25°19'8.42"N | 87°21'19.92"E | 37.6 |
| 323 | 323 | 25°19'21.88"N | 87°19'54.65"E | 0.40 |
| 324 | 324 | 25°20'8.09"N | 87°20'22.33"E | 1.35 |
| 325 | 325 | 25°21'12.74"N | 87°20'44.14"E | 2.38 |
| 326 | 326 | 25°21'7.94"N | 87°20'25.24"E | 0.56 |
| 327 | 327 | 25°20'41.87"N | 87°21'13.51"E | 13.4 |
| 328 | 328 | 25°22'54.79"N | 87°22'8.83"E | 10.1 |
| 329 | 329 | 25°22'51.94"N | 87°24'5.07"E | 22.5 |
| 330 | 330 | 25°20'8.05"N | 87°26'12.71"E | 1.13 |
| 331 | 331 | 25°20'29.75"N | 87°27'34.68"E | 44.8 |
| 332 | 332 | 25°19'42.04"N | 87°28'9.42"E | 23.5 |
| 333 | 333 | 25°19'15.44"N | 87°30'42.57"E | 37.4 |
| 334 | 334 | 25°19'53.77"N | 87°31'17.07"E | 4.92 |
| 335 | 335 | 25°18'30.19"N | 87°32'50.73"E | 16.6 |

| | | | | |
|---|---|---|---|---|
| 336 | 336 | 25°22'2.71"N | 86°53'51.61"E | 240 |
| 337 | 337 | 25°21'24.18"N | 86°53'24.95"E | 62.4 |
| 338 | 338 | 25°22'40.68"N | 86°55'18.58"E | 45.3 |
| 339 | 339 | 25°22'52.16"N | 86°55'44.61"E | 17.7 |
| 340 | 340 | 25°21'55.68"N | 86°56'44.03"E | 15.9 |
| 341 | Jagatpur Lake | 25°19'56.29"N | 87° 2'25.00"E | 487 |
| 342 | 342 | 25°23'15.34"N | 86°58'27.35"E | 3.24 |
| 343 | 343 | 25°23'14.80"N | 86°58'50.45"E | 3.50 |
| 344 | 344 | 25°22'46.60"N | 87° 0'40.84"E | 0.86 |
| 345 | 345 | 25°22'0.51"N | 87° 0'7.34"E | 0.40 |
| 346 | 346A | 25°18'53.02"N | 87° 7'2.08"E | 15.5 |
| 347 | 346B | 25°19'26.12"N | 87° 8'26.38"E | 73.0 |
| 348 | 347 | 25°20'7.90"N | 87°10'10.52"E | 105 |
| 349 | 348 | 25°20'47.45"N | 87°11'38.80"E | 6.53 |
| 350 | 349 | 25°19'31.19"N | 87° 4'30.14"E | 7.86 |
| 351 | 350 | 25°24'28.21"N | 87°12'19.18"E | 1.14 |
| 352 | 351 | 25°24'5.89"N | 87°12'10.85"E | 3.70 |
| 353 | Kalwaliya oxbow lake | 25°24'23.13"N | 87°13'22.17"E | 15.5 |
| 354 | 353 | 25°22'35.13"N | 87°11'27.46"E | 43.4 |
| 355 | 354 | 25°13'31.64"N | 86°42'9.86"E | 23.8 |
| 356 | 355 | 25°14'6.10"N | 86°42'50.75"E | 8.76 |
| 357 | 356 | 25°12'4.81"N | 86°53'27.75"E | 1.16 |
| **Total area (Hectares)** | | | | **2117.87** |




Map 6 : Spatial Distribution Of Water Bodies Within Study Area

8.2 **Jagatpur Lake :** This is one of the biggest and important wetlands in the study region situated about 12 km northeast of Bhagalpur city [Image 12]. It is a perennial freshwater floodplain type of wetland covering an area of about 487 ha in the middle Ganga plain. The wetland is mainly rain-fed, but underground seepage also contributes to its volume of water. The area under this wetland includes both government and private holdings. In an earlier study, 34 different bird species belonging to 12 families and 8 orders have been reported from Jagatpur Lake among which 79% of the avifauna was wetland dependent (Kumar & Choudhary, 2010). During the current survey, a large part of this lake was covered by water hyacinth (*Eicchornia crassipes*) which is the dominant free-floating species in this wetland [Image 13]. Several bird species such as Black-necked Stork [Image 14], Red crested Pochard, Common Pochard, Ferruginous Duck, Fulvous Whistling Duck and Greenish Warbler were observed to be present in this lake. The surroundings of this wetland comprised of trees such as Babool (*Acacia nilotica*), Peepal (*Ficus religiosa*), Mango (*Mangifera indica*), Taad (*Borassus flabellifer*) and Neem (*Azadirachta indica*). Agriculture was found to be a prominent activity in the villages surrounding this lake with crops such as banana, mustard and wheat being grown. Upon interaction with some native interlocutors in this region, they reiterated the importance of this wetland as an important bird habitat in the region and that many visitors including govt. authorities, researchers and nature enthusiasts visit this site for bird watching and surveys. The local forest department has taken up initiatives for converting this into a protected site and ensuring appropriate conservation measures for bird population dependent on this lake.


**Image 12 : Location Of Jagatpur Lake**

Image 13 : Jagatpur Lake As Observed On 7th January, 2022

Image 14 : A Pair Of Black-Necked Stork Observed In Jagatpur Lake

8.3 **Oxbow Lake Near Sadhua Village:** An oxbow lake measuring about 5 km long, 0.1-0.3 km wide and spread in an area of about 15.5 ha was observed near Sadhua village in Bhagalpur Distt. [Image 15]. This is also a floodplain type of wetland located close to Kosi-Ganga confluence. It is referred to as 'Kalwaliya talab' by the native residents in this region. Upon interaction, the interlocutors reiterated that this wetland receives water mainly from the floods of Kosi & Ganga Rivers. Surrounded by extensive agricultural fields, this wetland serves as an important source of irrigation for the crops. Fishing was also observed in this wetland [Image 16] which is a crucial activity for food and small scale livelihood. Major fish caught from this wetland included rohu, katla, buari, sidhari and gaichi.

Image 15 : Location Of Kalwaliya Oxbow Lake

**Image 16 : Fishing In Kalwaliya Oxbow Lake As Seen On 7th January, 2022**

8.4 **Shahjangi Wetland:** This pond is located between Shahjangi Peer Mosque and Shahjangi Peer Dargah in Bhagalpur city about 2 km from Bhagalpur railway station covering an area of about 7.13 ha [Image 17]. According to the interlocutors, this is a historic pond believed to be hundreds of years old and an important source of water in this part of the city [Image 18]. A committee comprising of members from the mosque and dargah are tasked at looking after this wetland. Despite several assurances from govt. authorities, this wetland has not been developed into a tourist spot as has been demanded since long. Moreover, the water from this pond which was once used for drinking is now polluted due to solid and liquid waste being dumped into this (Shashiraman, 2019).


Image 17 : Location Of Pahar Kha Ka Pokhara [25°34'50.09"N 83°34'26.16"E]

Image 18 : Shahjangi Wetland As Observed On 7th January, 2022

8.5 **Mukhda Talab:** An irregularly shaped wetland known locally as 'Mukhda talab' was located close to Shahjangi talab [Image 19]. The interlocutors reiterated fishing to be an important activity here with the major fish caught being rohu, tilapia and pothia. Apart from this, a part of this wetland served as an important site for washing clothes by the residents apart from other activities such as cleaning utensils and bathing reared animals. Two small islands were present in the middle of this wetland [Image 20] mainly dominant with Khajur trees (*Phoenix dactylifera*), Neem tree and Bamboo along with other vegetation. They were found to be important habitats and nesting sites for birds such as cormorants.


Image 19 : Location Of Mukhda Talab

Image 20 : Mukhda Talab As Observed On 7th January, 2022

# 9.0 Riparian Flora Along Ganga River In Bhagalpur

9.1 The riparian areas, lying between the aquatic and the terrestrial habitats, serve as functional interfaces within the landscapes, mediating energy and matter between these two ecosystems. With dynamic environmental conditions and ecological processes, these areas tend to harbor rich biodiversity. A major component of this biodiversity is the plant communities growing along the river bank which are interacting with both terrestrial and aquatic ecosystems. The riparian vegetation is significant in the overall ecology and environmental aspects of the region owing to its important roles in soil conservation, harboring faunal diversity and providing livelihood resources [Groffman *et al.*, 1990; Castelle *et al.,* 1994].

9.2 Till some time ago, no proper systematic sampling had been undertaken or record had been maintained for the riparian plant diversity all along Ganga River. There are however, some scattered but significant works of Pallis [1934], Auden [1941], Sahai [1953], Gupta [1960], Bhattacharyya and Goel [1982], Groffman *et al.* [1990], Krishanmurti [1991], Castelle *et al.* [1994], Shyam [2008], Gangwar and Joshi [2006] and Gangwar and Gangwar [2011] which have explored the biodiversity of Ganga river basin. Also, a detailed study published in the form of a book titled – "The Ganga – A Scientific Study" edited by Krishnamurti [1991] documents 475 riparian plant species from Rishikesh to Chinasura. Earlier workers have reported from Buxar to Barh, the presence of 7 shrubs, 41 herbs, 6 grasses and 2 sedges, besides these a number of tree species along the banks of river during 1987-88 (Kumar, 2001).

9.3 Kumar & Kishor (2016) studied the riparian floral diversity along Ganga river in Bhagalpur and recorded 37 different plant species. Overall, the riparian flora in the region showed considerably lower proportion of trees and shrubs as compared to herbs. Similar observations were made during the field survey where the riparian vegetation was found to be mostly sparse in distribution throughout the study region. This could be attributed to the exponential growth of human habitation and expansive agriculture in the study region. The floodplain grass – *Saccharum* sps. was a major component of riparian vegetation throughout with its luxuriance dominating the other flora at some sites. Other commonly occurring species included – *Croton bonplandianus, Polygonum sp* and *Lantana sp.* Some notable riparian flora are presented in Table 3 while Images 21-22 depict some common species observed.

Table 4 : Riparian Plant Species Recorded In The Study Area

| Sr. No. | Botanical Name | Family | Habit | Common Name |
|---|---|---|---|---|
| 1. | *Acacia nilotic*a (L.) Delile | Fabaceae | Tree | Babool |
| 2. | *Aegle marmelos* (L.) Correa | Rutaceae | Tree | Bel Patra |
| 3. | *Azadirachta indica* A.Juss. | Meliaceae | Tree | Neem |
| 4. | *Borassus flabellifer* L. | Arecaceae | Tree | Taad |
| 5. | *Dalbergia sissoo* Roxb. ex DC. | Fabaceae | Tree | Shisham |
| 6. | *Ficus benghalensis* L. | Moraceae | Tree | Banyan |
| 7. | *Ficus religiosa* L. | Moraceae | Tree | Peepal |
| 8. | *Mangifera indica* L. | Anacardiaceae | Tree | Mango |
| 9. | *Calotropis gigantea* (L.) Dryand. | Apocynaceae | Shrub | Safed Aak |
| 10. | *Calotropis procera* (Aiton) Dryand. | Apocynaceae | Shrub | Aak |
| 11. | *Lippia alba* (Mill.) N.E. Br. ex Britton & P. Wilson | Verbenaceae | Shrub | Bushy Lippia |
| 12. | *Polygonum sp.* | Polygonaceae | Shrub | |
| 13. | *Ricinus communis* L. | Euphorbiaceae | Shrub | Wild Castor |
| 14. | *Zizyphus* sp. | Rhamnaceae | Shrub | Wild Ber |
| 15. | *Achyranthes aspera* L. | Amaranthaceae | Herb | Chirchira |
| 16. | *Amaranthus spinosus* L. | Amaranthaceae | Herb | Prickly Amaranth |
| 17. | *Croton bonplandianus* Baill. | Euphorbiaceae | Herb | Ban Tulsi |
| 18. | *Rumex dentatus* L. | Polygonaceae | Herb | |
| 19. | *Parthenium hysterophorus* L. | Asteraceae | Herb | Congress Grass |
| 20. | *Xanthium strumarium* L. | Asteraceae | Herb | Chhotav dhatura |
| 21. | *Saccharum munja* Roxb. | Poaceae | Grass | Munj |
| 22. | *Cyperus* sp. | Cyperaceae | Grass | |
| 23. | *Cynodon dactylon* (L.) Pers. | Poaceae | Grass | Doob/Durva |
| 24. | *Saccharum spontaneum* L. | Poaceae | Grass | Kans/Katha |
| 25. | *Saccharum bengalense* Retz. | Poaceae | Grass | Munj |

Image 21 : *Polygonum* sp.

Image 22 : *Croton bonplandianus*

# 10.0 Faunal Diversity In Bhagalpur

10.1 **Gangetic Dolphins :** The Gangetic River Dolphin is exclusively aquatic and piscivorus, occasionally found in small groups. The Ganges River Dolphin is one of the three freshwater dolphin species in the world and is distributed in the Ganges–Brahmaputra–Meghna and Sangu–Karnaphuli River systems in India, Nepal, and Bangladesh (Sinha & Kannan, 2014). It has been declared as the National Aquatic Animal by Govt. of India (Sinha & Kannan, 2014) and is classified as 'Endangered' in the IUCN Red List owing to the decrease in its population in the last 3-4 decades. During the survey, major sightings of dolphins occurred in different parts of Vikramshila Gangetic Dolphin Sanctuary (VGDS). Other sightings occurred at sites such as Sultanganj near Ajgaivinath temple and near Batteshwar Sthan temple. The dolphin sightings during survey were not to the extent as expected from the region owing to various factors such decrease in dolphin population, decrease in fish resources and increasing anthropogenic pressures.

**Vikaramshila Gangetic Sanctuary**

In order to protect and conserve this endangered species, the Govt. of Bihar designated about a 60 km of Ganga river segment between Sultanganj to Kahalgaon in Bhagalpur Distt. as Vikramshila Gangetic Dolphin Sanctuary (VGDS) in August, 1991 under the provisions of Wildlife Protection Act, 1972. This is the only protected area established for these dolphins and the conservation cum monitoring in this area is mainly carried out by Vikramshila Biodiversity Research and Education Centre (VBREC). A survey conducted by VBREC and other partner organizations in 2017 found that the number of dolphins in the sanctuary had declined from 204 in earlier years to 157 in 2015 (Khan, 2018). They considered the movement of big cargo vessels and dredging activities in Ganga River to be the main reasons for this decline along with some other factors.

10.2 **Crocodiles :** Two species of crocodiles – *Gavialis gangeticus* (Gharial) and *Crocodylus palustris* (Mugger) have been reported occurring sporadically in Ganga River stretch of Bhagalpur. Amongst these, the gharials are an ancient group of river-dwelling crocodilians, most of which are extinct and hence, this species is considered to be a living fossil (Vasudevan & Sondhi, 2010). The Gharial is endemic to Indian subcontinent occurring and listed as Critically Endangered by the IUCN Red List (Sarkar et al., 2018; Chodhury et al., 2007). In an earlier record, Nawab et al. (2016), had sighted gharial presence in the Ganga river stretch between Bhagalpur and Sultanganj. A recent sighting by members of INTACH Bhagalpur chapter in the region was of one sub-adult gharial which was basking on a small sand bar, nearly 10.5 km downstream of Sultanganj [Image 23]. The length of this particular reptile individual was between 2-3 meters and it seemed to be wild one as no clipped scutes on its tail were observed by the team. This reptile might have come from the Gandak River which is the nearest tributary that sustains a viable population of gharials. This is the largest size for a gharial recorded by Bhagalpur researchers in the last 20 years.

**Image 23 : Gharial Spotted In Sultanganj Area Of Study Region By Members Of INTACH Bhagalpur Chapter**

10.3 **Turtles :** Turtles form an important component of Ganga riverine biodiversity and play a critical ecological role by controlling aquatic vegetation, serve as scavengers and help maintain rivers (WII-GACMC, 2017). A total of six species of turtles have been recorded in Bhagalpur Distt. with most of the sightings occurring in VGDS, as confirmed by the Bhagalpur Forest Department. Out of six species recorded in the District, three fall under "**Endangered**" category **(Indian Softshell Turtle, Indian Peacock Softshell Turtle** and **Indian Narrow-headed Softshell Turtle)** whereas two have "**Vulnerable**" status **(Indian Roofed Turtle** and **Indian Flapshell Turtle)** in IUCN's Red List of Threatened Species. However Indian Softshell Turtle and Indian Roofed Turtle are most frequently sighted species as reiterated by the local fishing community. The list of species recorded and their conservational status have been listed below:

**Table 5 : List Of Turtles In The Study Region**

| Sr. No. | Common Name | Scientific Name | Conservational Status as per IUCN List. |
|---|---|---|---|
| 1 | Indian Softshell Turtle | *Nilssonia gangetica* | **Endangered** |
| 2 | Indian Peacock Softshell Turtle | *Nilssonia hurum*, | **Endangered** |
| 3 | Indian Roofed Turtle | *Pungshura tecta* | **Vulnerable** |
| 4 | Indian Tent Turtle | *Pungshura tentoria* | Least Concern |
| 5 | Indian Flapshell Turtle | *Lissemys punctata* | **Vulnerable** |
| 6 | Indian Narrow-headed Softshell Turtle | *Chitra indica* | **Endangered** |

10.4 **Nilgai :** The Nilgai antelope – *Boselaphus tragocamelus* is widely distributed throughout the country. However, due to prolonged breeding activity and lack of potential predators, the numbers of Nilgai have increased considerably and become locally overabundant in states of Gujarat, Bihar, Uttar Pradesh, Haryana, Punjab, Rajasthan, Madhya Pradesh and Delhi (Meena, 2017). In the due course of time, this species has been successful in adjusting to the human-altered landscapes and in many places have become serious pests of agricultural crops. The presence of Nilgai was recorded in areas such as Naugachia, Khasri, Bateshwar sthan, Sultanganj and Kahalgaon. The farmers in this region often complained about the large-scale damage to agricultural produce caused by nilgai but despite this they never retaliated violently towards it. The villagers often enclosed their fields with mesh nets or wires or thorny plants to prevent intrusion of nilgai and used to drive them away with the help of sticks and stones.

10.5 **Wild Boar :** The Indian wild boar (*Sus scrofa* L.) also known as the wild pig is one of the widespread animals throughout the world. In recent times, wild boar has become a regular menace for farmers as it generally causes damage right from planting till the maturity of the crop (Vasudeva Rao et al., 2015).The farmers in areas such as Shankerpur *diara*, Tilakpur *diara*, Mahadevpur Ghat, Naugachia, Khasri and Sultanganj reiterated regular sightings of wild boars which attacked crops such as potato and other vegetables grown in these regions. **They claimed that the boars destroyed entire fields sometimes resulting in huge losses and even attacked small children or some local residents who tried to drive them away.**

10.6 **Smooth Coated Otters :** Smooth-coated Otter is an endangered species that is listed in Schedule I of the Indian Wildlife (Protection) Act 1972 and included as 'Vulnerable' in the IUCN Red list of threatened animals. They occur in considerable abundance almost throughout VGDS making this region a crucial conservation zone for this species. Otters are apex predators of the riverine ecosystem, hunting large fish by working together in packs. Otter nesting and foraging areas are more or less known, and together might cover roughly 65-70% of the total floodplain area of the VGDS river stretch. During the survey, an otter's nesting site was recorded at a part of Shankerpur *diara* [Image 24] near Vikramshila Setu and the pugmark of this mammal around the burrow was also captured confirming its presence in this region.

**Image 24 : Nesting Site Of Smooth Coated Otter Recorded During The Survey**

10.7 **Other important fauna :** The presence of wild fauna such as Golden Jackal, Indian Grey Mongoose, Bengal Monitor Lizard, Indian Fox, Jungle Cat and bat species have also been recorded in various riparian habitats based on visual observations and information from resident interlocutors. The lists of such species recorded is present in Table 6:

**Table 6 : Other Important Fauna Recorded In The Study Region**

| Sr. No. | Common Name | Scientific Name | Conservation Status |
|---|---|---|---|
| 1. | Golden Jackal | *Canis aureus* | Least Concern |
| 2. | Indian Grey Mongoose | *Herpestes edwardsii* | Least Concern |
| 3. | **Bengal Monitor** | ***Varanus bengalensis*** | **Near Threatened** |
| 4. | Indian Fox | *Vulpes bengalensis* | Least Concern |
| 5. | Spotted Deer/Chital | *Axis axis* | Least Concern |

| | | | |
|---|---|---|---|
| **6.** | Jungle Cat | *Felis chaus* | Least Concern |
| **7.** | Indian Flying Fox | *Pteropus giganteus* | Least Concern |
| **8.** | Danaid Eggfly (Butterfly) | *Hypolimnas misippus* | Least Concern |
| **9.** | Peacock Pansy (Butterfly) | *Junonia almana* | Least Concern |
| **10.** | Blue Jay (Butterfly) | *Graphium doson* | Least Concern |
| **11.** | Common Mime (Butterfly) | *Papilio clytia* | Least Concern |
| **12.** | Common Grass Yellow (Butterfly) | *Eurema brigitta* | Least Concern |

10.8 **Avifauna Diversity:** Ganga River, with its mosaic of habitats, supports a rich diversity of avifauna which include both resident and migratory species. The study area of Bhagalpur harbors highly diverse avifauna and serves as an important staging point for winter migrants. This is also fortified from the fact that Vikramshila Gangetic Dolphin Sanctuary has been selected as Important Bird & Biodiversity Area (IBA) owing to the presence of hundreds of significant birds apart from other faunal groups. A study by Dey et al. (2014) has recorded the presence of 198 different bird species which include passerine and non-passerine species. During the current study, about 114 different bird species were recorded from the study region in Bhagalpur based on visual observations using binoculars along with detailed discussions with local forest department and resident villagers. Among these, 50 species of birds were of wetland ecosystem while remaining 64 species were of forest and grassland ecosystem including 6 species of raptors. Among the rare and significant sightings, birds such as Black-necked Stork, River Lapwing and Alexandrine Parakeet fall under 'Near Threatened Category'; birds such as Lesser Adjutant, River Tern and Common Pochard fall under 'Vulnerable' category; and birds such as Palas's Fish Eagle and Greater Adjutant fall under 'Endangered' category of IUCN Red List of Threatened Species. **Among these significant birds, special mention is to be made of Greater Adjutant (*Leptoptilos dubius*) whose number of individuals in the wild are between 800-1200 only. A total of 15 individuals of this species were sighted in the study region during this survey**. The other frequently sighted bird species during this survey include – Little Egret, Great Egret, Indian Pond Heron, Asian Pied Starling, Common Moorhen, Little Cormorant,

Red-wattled Lapwing and Eurasian Collared Dove. The list of all the bird species recorded during the survey is presented in Table 7 while Images 25-27 depict some significant among these.

**Table 7 : List Of Birds Recorded In The Study Region**

| Sr. No. | Common Name | Scientific Name | Conservation status |
|---|---|---|---|
| 1. | White throated Kingfisher | *Halcyon smyrnensis* | Least Concern |
| 2. | Common Kingfisher | *Alcedo atthis* | Least Concern |
| 3. | Pied Kingfisher | *Ceryle rudis* | Least Concern |
| 4. | Cattle Egret | *Bubulcus ibis* | Least Concern |
| 5. | Little Egret | *Egretta garzetta* | Least Concern |
| 6. | Intermediate Egret | *Ardea intermedia* | Least Concern |
| 7. | Great Egret | *Ardea alba* | Least Concern |
| 8. | Indian Pond Heron | *Ardeola grayii* | Least Concern |
| 9. | Grey Heron | *Ardea cinerea* | Least Concern |
| 10. | Purple Heron | *Ardea purpurea* | Least Concern |
| 11. | Cinnamon Bittern | *Loxbrychus cinnamoeus* | Least Concern |
| 12. | Common Sandpiper | *Actitishypoleucos* | Least Concern |
| 13. | Green Sandpiper | *Tringa ochropus* | Least Concern |
| 14. | Asian Openbill | *Anastomus oscitans* | Least Concern |
| 15. | **Black-necked Stork** | ***Ephippiorhynchus asiaticus*** | **Near Threatened** |
| 16. | **Lesser Adjutant** | ***Leptoptilos javanicus*** | **Vulnerable** |
| 17. | **Greater Adjutant** | ***Leptoptilos dubius*** | **Endangered** |
| 18. | Little Stint | *Caldris minuta* | Least Concern |
| 19. | **Woolly-necked Stork** | ***Ciconia episcopus*** | **Near Threatened** |
| 20. | Little Cormorant | *Microcarbo niger* | Least Concern |
| 21. | Indian Cormorant | *Phalacrocorax fuscicollis* | Least Concern |
| 22. | Great Cormorant | *Phalacrocorax carbo* | Least Concern |
| 23. | **Oriental Darter** | ***Anhinga melanogaster*** | **Near Threatened** |
| 24. | Red-naped Ibis | *Pseudibis papillosa* | Least Concern |
| 25. | Glossy Ibis | *Plegadis falcinellus* | Least Concern |
| 26. | **Black-headed Ibis** | ***Threskiornis melancephalus*** | **Near Threatened** |
| 27. | White breasted -Waterhen | *Amaurornis phoenicurus* | Least Concern |
| 28. | Common Moorhen | *Gallinula chloropus* | Least Concern |
| 29. | Little Grebe | *Tachybaptus ruficollis* | Least Concern |
| 30. | Common Teal | *Anas crecca* | Least Concern |

| | | | |
|---|---|---|---|
| 31. | Gadwall | *Mareca strepera* | Least Concern |
| 32. | Fulvous Whistling-duck | *Dendrocygna bicolor* | Least Concern |
| 33. | Lesser Whistling-duck | *Dendrocygna javanica* | Least Concern |
| 34. | Cotton Pygmy-goose | *Nettapus coromandelianus* | Least Concern |
| 35. | Bar-headed Goose | *Anser indicus* | Least Concern |
| 36. | Tufted Duck | *Aythya fuligula* | Least Concern |
| 37. | **Ferruginous Duck** | ***Aythya nyroca*** | **Near Threatened** |
| 38. | **Common Pochard** | ***Aythya ferina*** | **Vulnerable** |
| 39. | Red-creasted Pochard | *Netta rufina* | Least Concern |
| 40. | Ruddy Shelduck | *Tadorna ferruginea* | Least Concern |
| 41. | Northern Pintail | *Anas Acuta* | Least Concern |
| 42. | Brown-headed Gull | *Larus brunnicephalus* | Least Concern |
| 43. | Purple Swamphen | *Porphyrio porphyrio* | Least Concern |
| 44. | **River Tern** | ***Sterna aurantia*** | **Vulnerable** |
| 45. | Eurasian Coot | *Fulica atra* | Least Concern |
| 46. | Common Greenshank | *Tringa nebularia* | Least Concern |
| 47. | Common Redshank | *Tringa totanus* | Least Concern |
| 48. | Black-winged Stilt | *Himantopus himantopus* | Least Concern |
| 49. | Bronze-winged Jacana | *Metopidius indicus* | Least Concern |
| 50. | Pheasant-tailed Jacana | *Hydrophasiansus chirurgus* | Least Concern |
| 51. | **River Lapwing** | ***Vanellus duvaucelii*** | **Near Threatened** |
| 52. | Red-wattled Lapwing | *Vanellus indicus* | Least Concern |
| 53. | Black Drongo | *Dicrurus macrocercus* | Least Concern |
| 54. | Common Myna | *Acridotheres tristis* | Least Concern |
| 55. | Bank Myna | *Acridotheres ginginianus* | Least Concern |
| 56. | Asian Pied Starling | *Gracupica contra* | Least Concern |
| 57. | Brahminy Starling | *Sturnia Pagodarum* | Least Concern |
| 58. | Common Stonechat | *Saxicola torquatus* | Least Concern |
| 59. | Pied Bushchat | *Saxicola caprata* | Least Concern |
| 60. | Indian Bushlark | *Mirafra erythroptera* | Least Concern |
| 61. | Paddyfield Pipit | *Anthus rufulus* | Least Concern |
| 62. | Common Babbler | *Argya caudata* | Least Concern |
| 63. | Jungle Babbler | *Argya striata* | Least Concern |
| 64. | Large Grey Babbler | *Argya malcolmi* | Least Concern |
| 65. | Black-hooded Oriole | *Oriolus xanthornus* | Least Concern |
| 66. | Indian Golden Oriole | *Oriolus Kundoo* | Least Concern |
| 67. | White Wagtail | *Motacilla alba* | Least Concern |

| | | | |
|---|---|---|---|
| 68. | Grey Wagtail | *Motacilla cinerea* | Least Concern |
| 69. | White-browed Wagtail | *Motacilla maderaspatensis* | Least Concern |
| 70. | Indian Silverbill | *Euodice malabarica* | Least Concern |
| 71. | Common Tailorbird | *Orthotomus sutorius* | Least Concern |
| 72. | **Alexandrine Parakeet** | ***Palaeornis eupatria*** | **Near Threatened** |
| 73. | Rose-ringed Parakeet | *Psittacula krameri* | Least Concern |
| 74. | House Sparrow | *Passer domesticus* | Least Concern |
| 75. | Indian Jungle Crow | *Corvus culminatus* | Least Concern |
| 76. | House Crow | *Corvus splendens* | Least Concern |
| 77. | Oriental Magpie Robin | *Copsychus saularis* | Least Concern |
| 78. | Streak throated Swallow | *Petrochelidon fluvicola* | Least Concern |
| 79. | Barn Swallow | *Hurindo rustica* | Least Concern |
| 80. | Asian Plain Martin | *Riparia chinensis* | Least Concern |
| 81. | Brown-headed Barbet | *Psilopogon zeylanicus* | Least Concern |
| 82. | Blue-throated Barbet | *Psilopogon asiaticus* | Least Concern |
| 83. | Ashy Prina | *Prinia socialis* | Least Concern |
| 84. | Plain Prinia | *Prinia innornata* | Least Concern |
| 85. | Greater Coucal | *Centropus sinensis* | Least Concern |
| 86. | Red-whiskered Bulbul | *Pycnonotus jocosus* | Least Concern |
| 87. | Red-vented Bulul | *Pycnonotus cafer* | Least Concern |
| 88. | Common Kaestral | *Falco tinnunculus* | Least Concern |
| 89. | Black-winged kite | *Elanus caeruleus* | Least Concern |
| 90. | Shikra | *Accipiter badius* | Least Concern |
| 91. | Osprey | *Pandion haliatus* | Least Concern |
| 92. | White-eyed Buzzard | *Bustastur teesa* | Least Concern |
| 93. | **Pallas's Fish Eagle** | ***Haliaeetus leucoryphus*** | **Endangered** |
| 94. | Green Bee-eater | *Merops orientalis* | Least Concern |
| 95. | Scaly-breasted Munia | *Lonchura punctulata* | Least Concern |
| 96. | Indian Peafowl | *Pavo cristatus* | Least Concern |
| 97. | Spotted Owlet | *Athene brama* | Least Concern |
| 98. | Jungle Owlet | *Glaucidium radiatum* | Least Concern |
| 99. | Common Pigeon | *Columba livia* | Least Concern |
| 100. | Spotted Dove | *Spilopelia* chinesis | Least Concern |
| 101. | Eurasian Collared Dove | *Streptopelia decaocto* | Least Concern |
| 102. | Laughing Dove | *Spilopelia senegalensis* | Least concern |
| 103. | Yellow-footed Green-pigeon | *Treron phoenicopterus* | Least concern |

| | | | |
|---|---|---|---|
| 104. | Rufous Treepie | *Dendrocitta vagabunda* | Least concern |
| 105. | Purple Sunbird | *Cinnyris asiaticus* | Least concern |
| 106. | Indian Roller | *Coracias benghalensis* | Least concern |
| 107. | Indian Grey Hornbill | *Ocyceros birostris* | Least Concern |
| 108. | Common Chiffchaff | *Phylloscopus collybita* | Least Concern |
| 109. | Greenish Warbler | *Phylloscopus trochiloides* | Least Concern |
| 110. | Blyth's Reed Warbler | *Acrocephalus dumetorum* | Least Concern |
| 111. | Common Iora | *Aegithinia tiphia* | Least Concern |
| 112. | Black Redstart | *Phoenicurus ochorus* | Least Concern |
| 113. | Brown Rockchat | *Oenanthe fusca* | Least Concern |
| 114. | White-throated Fantail | *Rhipidura albicollis* | Least Concern |

Image 25 : Greater Adjutant

Image 26 : Bar-headed Geese

Image 27 : A Flock Of Black-headed Ibis Along With Great Egret

10.9 **Migratory Birds :** A total of 23 migratory and 8 local migratory birds were identified among the recorded avian species. These migratory species (excluding local migrants) are winter visitors to Indian Subcontinent and can be observed from October to March months. Table 9 provides the details of migratory birds as recorded during the survey:

**Table 8 : Details Of Migratory Birds In The Study Region**

| Sr. No | Common Name | Scientific Name | Conservation Status | M (Migrant) / LM (Local Migrant) |
|---|---|---|---|---|
| 1. | Common Sandpiper | *Actitish ypoleucos* | Least Concern | M |
| 2. | Green Sandpiper | *Tringa ochropus* | Least Concern | M |
| 3. | Common Teal | *Anas crecca* | Least Concern | M |
| 4. | Gadwall | *Mareca strepera* | Least Concern | M |
| 5. | Ferruginous Duck | *Aythya nyroca* | Near Threatened | M |
| 6. | Common Pochard | *Aythya farina* | Vulnerable | M |
| 7. | Red-creasted Pochard | *Netta rufina* | Least Concern | M |
| 8. | Ruddy Shelduck | *Tadorna ferruginea* | Least Concern | M |
| 9. | Northern Pintail | *Anas Acuta* | Least Concern | M |
| 10. | Fulvous Whistling-duck | *Dendrocygna bicolor* | Least Concern | M |
| 11. | Brown-headed Gull | *Larus brunnicephalus* | Least Concern | M |
| 12. | Bar-headed Goose | *Anser indicus* | Least Concern | M |
| 13. | Tufted Duck | *Aythya fuligula* | Least Concern | M |
| 14. | Common Greenshank | *Tringa nebularia* | Least Concern | M |
| 15. | Common Redshank | *Tringa totanus* | Least Concern | M |
| 16. | Common Stonechat | *Saxicola torquatus* | Least Concern | M |
| 17. | White Wagtail | *Motacilla alba* | Least Concern | M |
| 18. | Grey Wagtail | *Motacilla cinerea* | Least Concern | M |
| 19. | Little Stint | *Caldris minuta* | Least Concern | M |
| 20. | Osprey | *Pandion haliatus* | Least Concern | M |
| 21. | Common Chiffchaff | *Phylloscopus collybita* | Least Concern | M |
| 22. | Blyth's Reed Warbler | *Acrocephalus dumetorum* | Least Concern | M |
| 23. | Black Redstart | *Phoenicurus ochorus* | Least Concern | M |

| | | | | |
|---|---|---|---|---|
| 24. | Indian Cormorant | *Phalacrocorax fuscicollis* | Least Concern | LM |
| 25. | Great Cormorant | *Phalacrocorax carbo* | Least Concern | LM |
| 26. | Black-winged Stilt | *Himantopus himantopus* | Least Concern | LM |
| 27. | Common Kaestral | *Falco tinnunculus* | Least Concern | LM |
| 28. | Glossy Ibis | *Plegadis falcinellus* | Least Concern | LM |
| 29. | Indian Golden Oriole | *Oriolus Kundoo* | Least Concern | LM |
| 30. | Barn Swallow | *Hurindo rustica* | Least Concern | LM |
| 31. | Greenish Warbler | *Phylloscopus trochiloides* | Least Concern | LM |

## 11.0 Ganga Riverine Islands/*Diaras* In Bhagalpur

11.1 The riverine fluvial islands are present in many major rivers and are defined as 'land masses within a river channel that are separated from the floodplain by water on all sides and exhibiting some kind of stability' [Osterkamp, 1998]. Such islands may not be permanent on the geologic time scale owing to the river meandering, climate change, etc. but can remain in place over decadal or century time scales and hence exhibit stability [Wyrick & Klingeman, 2011]. Many irregularly shaped riverine islands are present in the Ganga river stretch of study region.

11.2 One of the biggest and most significant riverine island (*diara*) in the study region is **Shankerpur *diara*** located close to Bhagalpur city which roughly lens shaped measuring about 10 km long and 2-4 km wide [Image 28]. This *diara* is under extensive agriculture [Image 29] with crops such as mustard, parwal, tarbuj and wheat being grown there in different seasons. This *diara* is accessed by boats mainly from Barari Ghat in Bhgalpur city and Mahadeopur Ghat on the opposite bank. The interlocutors claimed that they had obtained necessary permissions and got designated lands on the *diara* from local authorities for undertaking agricultural activities. On some fringe parts of this *diara*, natural vegetation dominated by *Saccharum* sps. grasses was also present which was an important bio resource for construction of huts, thatching roofs of houses and making boundaries for agricultural fields on this *diara*.


Image 28 : Location Of Shankerpur *Diara*

**Image 29 : Part Of This Shankerpur *Diara* Under Agriculture As Seen on 13th January, 2022**

11.3 The other major riverine island in study region is and elongated and roughly spear head shaped island measuring about 11-12 km long and 1-3 km wide [Image 30]. This *diara* was observed near Tilakpur village where the locals referred to as **'Tilakpur *diara'***. Residents of this entire village along with other neighboring villages were involved in agriculture and cattle rearing activities on this *diara*. Upon further interacting, they claimed to possess papers issued by local authorities pertaining to their share of land on this island. The smaller part of Ganga which gets braided from the main channel due to this island is referred by the residents as 'Chutki Ganga'. This stem of the river swells up during monsoon and dries up as summer approaches thereby giving an easy access to the *diara* as observed during the survey [Image 31].


Image 30 : Location Of Tilakpur *Diara*

Image 31 : Part Of Tilakpur *Diara* As Observed On 10th January, 2022

11.4 Another significant semi-circular shaped *diara* was observed in the study region [Image 32] which measures about 10-12 km long and 2-6 km wide. This *diara* was observed near Balaha Ganga Ghat [Image 33] where the interlocutors address this as '**Chakrama *diara***'. Extensive agriculture is practiced on this island with major crops being mustard, wheat, mutter and parwal. Small boats are employed by the local residents to access this *diara* during monsoon and post monsoon period. However, this small channel of Ganga River almost dries up during summer season giving easy access to this *diara*.

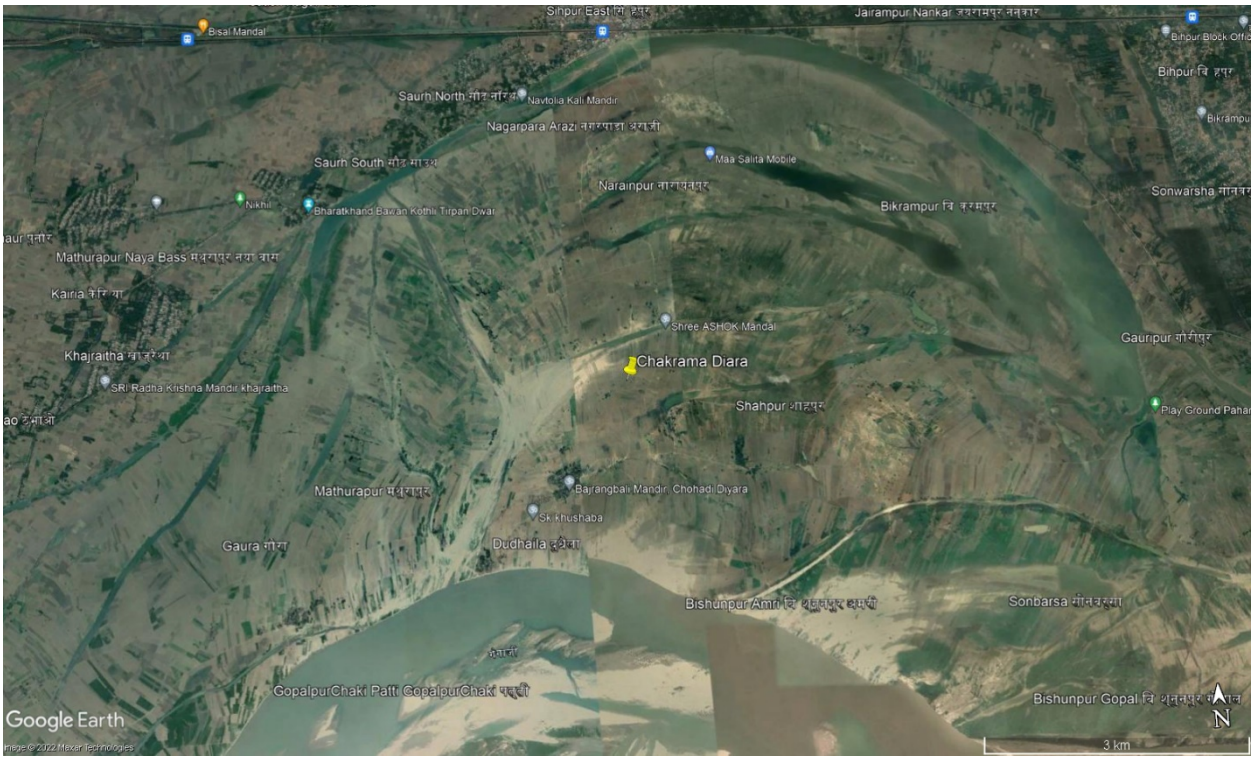



**Image 32 : Location Of Chakrama *Diara***

**Image 33 : Part Of Chakrama *Diara* As Observed From Balaha Ganga Ghat On 14th January, 2022**

11.5 A roughly fish shaped *diara* [Image 34] known locally as **Titanga *Diara*** was observed in the eastern part of Bhagalpur It is an important *diara* in this region measuring about 8-9 km long and 0.5-2.5 km wide. Residents from different villages on both the banks of Ganga River in this region access this *diara* throughout the year by boats mainly for agricultural purposes. Scattered settlements are also present on this *diara* while vegetation mainly comprising of Babool trees and *Saccharum* grasses can be observed on the fringe parts of this *diara*.


Image 34 : Location Of Titanga *Diara*

Image 35 : Part Of Titanga *Diara* As Observed Near Bateshwar Sthan Temple On 8th January, 2022

## 12.0 Fishing In Bhagalpur

12.1 Fish resources of Ganga River have been an important source of livelihood and food security for millions of people residing along its banks. Ganga river supports a diverse fish fauna with about 260 species reported for Indian waters (Sinha and Khan, 2001) among which about 35 species have been identified as having highest commercial value including carps (Cyprinidae), snakeheads (Channidae) and catfish (Siluriformes) (Islam *et al.*, 2006). However, today these rich fish resources are threatened by various anthropogenic activities and resulting water pollution, accumulation of heavy metals, eutrophication, damming, alteration of hydrology and introduction of exotic species (Tripathi *et al.*, 2017).

12.2 Fishing from Ganga River and its tributaries (Kosi, Kataria and other streams) is an important source of livelihood and food for local residents which is carried out almost throughout the year. However, the catch of fish was found to be higher in summer and monsoon seasons as compared to winters. Similar observation has been made by Choudhary et al. (2006) which has reported highest fishing intensity during the peak of the dry season in a stretch of the middle River Ganges in Bihar, India. The common fishing techniques in the study region involve cast nets, drag nets, fine meshed plastic nets and locally made fishing rods. The fine-meshed fishing nets are chiefly employed for catching smaller fish while nets having slightly bigger mesh sizes are employed for catching bigger fish species. Some fishermen purchased nylon based nets which are known locally as 'Bisara jaal' [Image 36] costing around Rs. 350 per kg. Most of the fishing nets that were set up in the river systems of study region were done so with the help of bamboo sticks [Image 37].

12.4 The boats used for fishing are small sized and hand-rowed made chiefly from 'Sakhua/Sal' wood (*Shorea robusta*) which is available from the market. However, in many cases, the interlocutors reiterated use of other wood such as Jamun, Mango and Babool for constructing these boats due to unavailability of Sakhua. Mostly members of Mallah community residing in villages along Ganga River are involved in construction of these boats with the help of Mistry (carpenter). The cost of constructing these boats can range from Rs. 50,000/- to Rs.1,00,000/- depending upon various factors.

Image 36 : Nylon Based Bisara Jaal Used By Fishermen In Study Region

Image 37 : Bamboo Used For Setting Up Fishing Nets In Ganga River

12.4 According to a study carried out by Montana et al., (2011), seventy-six different fish species were recorded from the Ganga river stretch of Bhagalpur amongst which Wallago attu (Buari) was found to be dominant in the catch along with other major carps such as Rohu, Catla, Naini and Kalbasu. During the current survey, major fish caught from these rivers as per the interlocutors included – Rohu (*Labeo rohita*), Catla (*Labeo catla*), Tengara (M*ystus tengara*), Buari/Barari (*Wallago attu*) and Sidhari (*Puntius* sp.). These fish, especially Rohu and Catla, are found in plenty during monsoons while Tengara is found more during the summer months. Some of the important fish species caught from the region are represented in Table 7. The fish caught are generally sold in Bhagalpur city or local markets of nearby villages. The interlocutors highlighted that fish availability from a particular stretch of Ganga River was deciphered from the presence of dolphin population as fish was its main food source. According to them, the more the dolphin sightings, the more chances of getting good fish catch from that area. The demand for fish consumption in this region is very high thereby leading to prices ranging from Rs. 150/-to Rs. 200/- per kg for small fish and Rs. 300/- to Rs.400/- per kg for big fish in the market.

12.5 The fishermen in this region unanimously reiterated their concerns over decreasing fish catch and yield during the last few decades. Various important factors such as overexploitation of fisheries, water pollution, and variations in river flow and depth along with changes in climatic conditions such as uncertain monsoons and higher temperatures during summers were believed to be chief reasons for this decrease. Besides this, the increase in population of exotic carps also proved to be a tough competition for survival of Indian major carps in Ganga River. The interlocutors also informed use of destructive fishing techniques such as poison and use of electricity based fishing nets in the study region by some hoodlums. This had significantly impacted the livelihoods of fishermen in the region who are forced to look for alternate modes of earning income for family. **The respondents also reiterated that Hilsa fish, which was once available in the Ganga river stretch of Bhagalpur Distt. was no longer seen since the last few decades. Similarly Ganga River Prawns have also decreased considerably in the study region and are almost negligible in the fish catch from this river stretch.**

Table 9 : Major Fish Caught In The Study Region Based On Information From Fishermen During The Survey

| Sr. No. | Scientific Name | Common Name |
|---|---|---|
| 1. | *Labeo rohita* | Rohu |
| 2. | *Labeo catla* | Catla/Bhakur |
| 3. | *Wallago attu* | Buari/Barari |
| 4. | *Mystus tengara* | Tengara |
| 5. | *Puntius sp.* | Sidhari |
| 6. | *Cyprinus carpio* | Common/Chinese carp |
| 7. | *Channa punctata* | Garai |
| 8. | *Eutropiichthys vacha* | Bachwa |
| 9. | *Anguilla bengalensis* | Baam |
| 10. | *Cirrhinus mrigala* | Naini |
| 11. | *Mastacembelus armatus* | Gaichi |
| 12. | *Cabdio morar* | Chepua |
| 13. | *Oreochromis* sp. | Tilapia |
| 14. | *Labeo calbasu* | Kalbasu |

# 13.0 Groundwater In Bhagalpur

13.1 Ground water characteristics of a particular area are subject to several natural factors like precipitation, drainage, topography, lithology and hydrogeological conditions of the region. Bhagalpur is principally drained by Ganga River while the northern boundary of this is marked by Kosi River which is known to be heavily laden with silt and sand. Geomorphologically, this forms a part of the Mid-Ganga Foreland Basin. The north and central Bhagalpur towards the north and south of Ganga respectively forms a flat Indo-Gangetic alluvium tract (parts of the North Bihar Plains and Central Bihar Plains respectively). The southern part of this forms a marginal alluvial tract. The general elevation of the alluvium tract remains within 45 m above mean sea level. There are some detached hard rock bodies of pre-Cambrian age, which stand out as prominent peaks (inliers) within the alluvial plains. The alluvial plain soils in this Distt. are light grey to dark grey in colour, rather heavy and texturally fine in nature (Sahu, 2013).

13.2 The sand layers in the Quaternary Alluvium (both newer and older) of this Distt. forms the main source of ground water. Based on the strata logs and hydrogeological properties, the aquifer system in the Distt. can be divided into two categories – (1) the shallow aquifers within 50 m depth and (2) the deep aquifers within 50 – 200 m depth. In shallow aquifers, the ground water occurs under unconfined condition and in deeper aquifers under semi-confined to confined conditions. The shallow aquifers consisting of fine to medium sand with clay, silt and kankars are the main sources of ground water in the marginal alluvial tract in the south Bhagalpur. In general the thickness of these aquifers varies from 13 to 18 m, being more at central parts than the eastern and western parts of the marginal alluvium. The thickness of the aquifer is controlled by the geometry of the underlying basement rock. The deeper aquifers mainly consist of sand, gravel and calcareous nodules with alternating layers of clay. The exploration data reveals the presence of four to five major aquifers with cumulative thickness 20 to 85 m. These aquifers thin out towards Sultanganj in the western part since clay dominancy increase (Sahu, 2013).

13.3 During the field survey, ground water levels in different parts of study region was recorded based on information provided by the interlocutors. This information is provided in Table 10. The groundwater in the study region ranged from 20 – 55 feet (approximately 6-16 m) with a general trend of increasing depth as the distance from Ganga River increased.

Table 10 : Groundwater Levels Recorded From Different Villages In Study Region

| Sr. No. | Village Name | Latitude | Longitude | Groundwater depth (ft) |
|---|---|---|---|---|
| 1. | Kabipur, Bhagalpur town | 25°13'57.91"N | 86°57'26.65"E | 20 ft. |
| 2. | Bhagalpur Bus Stand | 25°14'33.68"N | 86°58'39.55"E | 25 ft. |
| 3. | Naugachiya | 25°23'35.01"N | 87° 5'57.49"E | 20 ft. |
| 4. | Sultanganj | 25°14'26.09"N | 86°44'22.18"E | 40 ft. |
| 5. | Ajgaivinath, Sultanganj | 25°15'8.51"N | 86°44'5.42"E | 30 ft. |
| 6. | Tilakpur *Diara* | 25°14'54.70"N | 86°47'4.42"E | 40 ft. |
| 7. | Farka | 25°13'37.87"N | 87° 5'20.34"E | 30 ft. |
| 8. | Mahadevpur Ghat | 25°17'53.99"N | 87° 1'51.46"E | 55 ft. |
| 9. | Barari | 25°15'30.35"N | 87° 1'21.05"E | 30 ft. |
| 10. | Kahalgaon | 25°15'44.69"N | 87°14'1.36"E | 50 ft. |
| 11. | Bihpur | 25°23'10.91"N | 86°56'2.94"E | 30 ft. |
| 12. | Ghogha | 25°12'54.97"N | 87°10'17.83"E | 35 ft. |

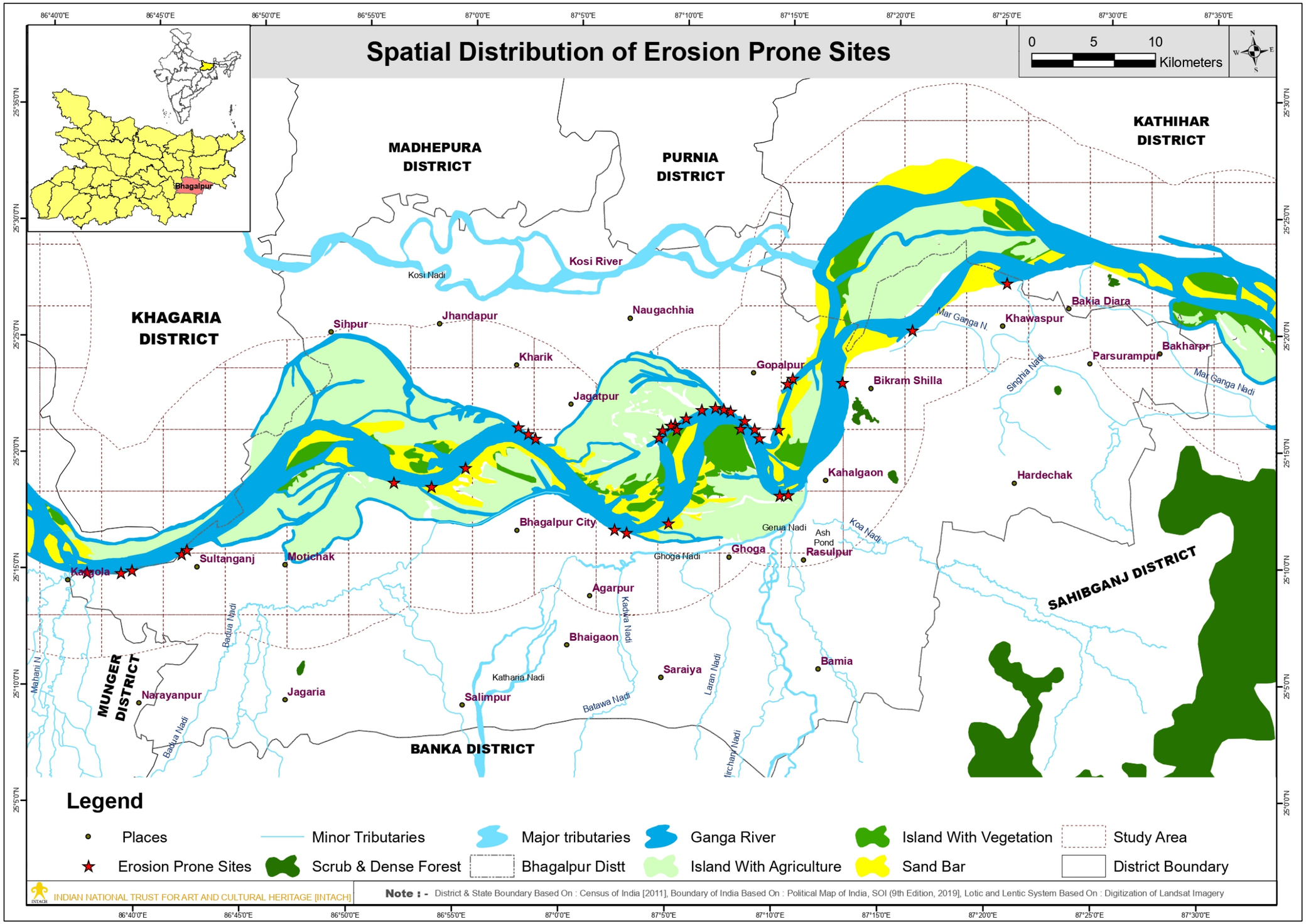
## 14.0 Ganga River Bank Erosion In Bhagalpur

14.1 Weathering of soils by natural forces is both constructive and destructive. Erosion is the chief agent responsible for the natural topographic cycles as it wears down higher elevations, banks (lateral erosion) and deposits sediments in the plains. However, erosion gets aggravated due to human interventions through change in land use, excessive grazing, extensive farming, cultivation without taking proper conservation measures, destruction of forest and riparian vegetation. It is well known that exposed soil may erode rapidly. During the field survey lateral erosion was observed along Ganga river bank at different sites such as close to Titanga *diara*, Mahadevpur Ghat, near Tilakpur *diara* and from Sabour to Farka. Among these, the most severe erosion effects were observed between Sabour to Farka bank of Ganga River which can be observed in Images 38-40. The interlocutors reiterated the need for urgent interventions to control these erosion effects in the study region.

Image 38 : Part Of A School Complex Damaged Near Farka Facing Toe Erosion

Image 39 : Destruction Caused By Erosion Between Sabour And Farka

Image 40 : Erosion Control With Geotubes Along Ganga River Bank Near Sabour – Could be Durably and Economically Controlled by Riparian Grasses




Map 7 : Spatial Distribution Of Erosion Prone Sites In Bhagalpur

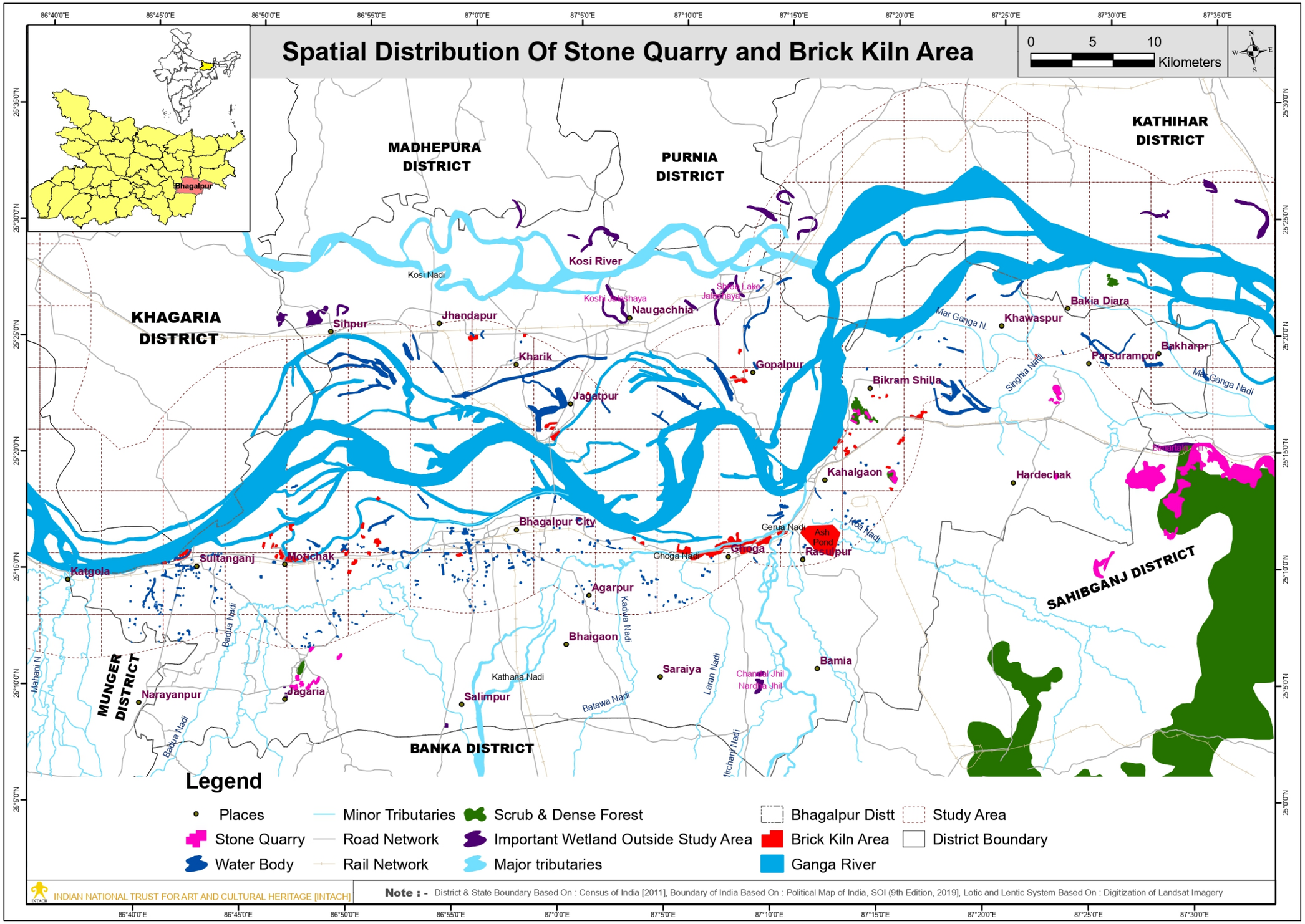
## 15.0 Mining And Brick Kilns In Bhagalpur

15.1 Illegal sand mining from Ganga River was observed during the field survey as well as reiterated by interlocutors in different parts of the study region. Image 41 provides a glimpse of illegal sand collection from a sand bar in Ganga River which falls under the protected zone of VGDS. Sand is an important mineral obtained from Ganga river stretch of this Distt. and often remains in huge demand mainly for constructions purposes.

**Image 41 : Illegally Mined Sand From A Sandbar In VGDS Protected Area Being Transported by Barge**

15.2 **Brick Kilns:** An important economic activity in the Distt. is production of bricks in the brick kilns. With rapid urbanization, bricks have become an important building material for construction activities. Brick kilns in the study area provide livelihood opportunity to the local community. However, this industry has posed current and potential future threats to the soil, air, biota and water system of the region. During the survey, brick making was found to be an important activity in the study region with hundreds of brick kilns spread along Ganga River as well as in other parts of the region. The study region stretch between Sabour and Kahalgaon was found to be most dense in terms of several brick kilns located close to each other in close proximity of Ganga River and its tributaries such as Kataria River. Image 42 depicts the brick kilns as seen during the survey.

Image 42 : Brick Kilns As Seen Near Kahalgaon In The Study Region




Map 8 : Spatial Distribution Of Brick Kilns In The Study Region

## 16.0 Boatmaking And Inland Navigation In Bhagalpur

16.1 Boats play a crucial role in the livelihood and day-to-day activities of riparian communities in the study region. Boats of varying sizes were found to be plying in Ganga River and its tributaries in the study region. The majority chunk of these were small wooden boats which are hand rowed and principally used for fishing activities [Images 43-44]. These boats were constructed by the local fishermen communities often with the help of a 'Mistry' from Bhagalpur city. While Sakhua/Sal (Shorea robusta) was the main choice for this construction, other woods such as Babool, Mango and Shisham were also employed due to high prices and unavailability of sufficient Sakhua wood from the market. The interlocutors further reiterated that the cost of constructing these boats ranged from Rs. 50,000 to Rs. 1,00,000/- depending upon various factors.

Image 43 : Smaller Hand-Rowed Wooden Fishing Boats With The Fishing Gear Near Sultanganj

**Image 44 : Small Hand Rowed Wooden Boats With Fishing Gear Near Bateshwar Sthan Temple**

16.2 The other major boat type in the study region included larger sized wooden boats also incorporating metallic components which were motorized and principally employed for transportation of passengers and their goods from one place to the other on opposite banks of Ganga River. These boats were also constructed using Sakhua and/or other wood types with the costs ranging between Rs. 1.5 to Rs. 2 lakhs depending upon various factors. Examples of such boats for inland navigation purposes were observed at various sites such as Barari Ghat in Bhagalpur city, Near Ajgaivinath temple in Sultanganj and near Bateshwar Sthan temple in Oriup [Image 45]. Another important example of inland navigation was observed from Titanga ferry Ghat to Kahalgaon which was operated by the Govt. authorities. They charged Rs. 50/- per passenger on this route [Image 46].

Image 45 : Inland Navigation Using Motorized Boats Near Bateshwar Sthan Temple


Image 46 : Government Operated Ferry Service Between Titanga And Kahalgaon

## 17.0 Sacred Sites & Sacred Trees In Bhagalpur

17.1 **Agjaivinath Temple**: It is an ancient temple dedicated to Lord Shiva built solidly on rocks [Image 47] which are emerging out of Ganga River in Sultanganj area of Bhagalpur The temple premises also contain a series of marvelous rock sculptures and some inscriptions. This is an important and most revered spot in this Distt. which is thronged upon by thousands of pilgrims and tourists from different parts of the country especially on auspicious occasions. It is well known that these rocks remained surrounded by Ganga River on both sides and could be accessed only by boats or a bridge which was constructed to connect it with the mainland. However, the interlocutors reiterated that the river had shifted course during last two decades and hence, barring monsoon season, it flows only on one side of this temple. The other part of river between this temple and the mainland remains dry and is used for agriculture along with other activities as observed during the field survey.

Image 47 : Ajgaivinath Temple As Observed During Field Survey On 9th January, 2022

17.2 **Sri Bateshwar Sthan temple:** This is another important sacred site along Ganga River in the study region of Bhagalpur It is located near Oriup village close to Kahalgaon which is an important town in this region. Kahalgaon is believed to have been named after Rishi Kohal who did penance here along with some other popular sages such as Guru Vashishtha and Rishi Durvasa. Furthermore, it is believed that Guru Vashishtha worshipped Lord Shiva and established this temple here which was earlier known as Vashisheshwar Nath and over the period of time came to be known as Bateshwar Nath temple [Image 48]. There is another temple dedicated to Goddess Kali here which is a rare occurrence of these two temples being at one place. This site has for long been known to be an important area for learning 'Tantra Vidya'. Its importance also arises from the fact that Vikramshila University was established about 3 km close to this temple was well known for dispensing knowledge on 'Tantra Vidya' (Jha, 2021). During the survey an ancient Bargad tree (*Ficus benghalensis*) believed to be hundreds of years old was also sighted associated with this temple [Image 49].

**Image 48 : Bateshwar Nath Temple**

**Image 49 : Old And Sacred Banyan Tree Near Bateshwar Nath Temple**

17.3 **Sacred Trees:** Various sacred trees were also observed during the field survey in study region. Peepal (*Ficus religiosa*) is the major tree species often found associated with temples and other religious sites throughout. The worship of this tree is usually done by the female residents in that region by tying threads around it and offering water along with sindoor, coconuts or incense sticks. Another tree species that is also found commonly associated with sacred sites is *Ficus benghalensis* (Banyan tree). Owing to their protection these sacred trees often develop trunks with huge girths and a luxuriant canopy. Some such examples of sacred trees as observed during field survey are depicted in Images 50-53.

Image 50 : An Old And Sacred Peepal Tree Near Bateshwar Sthan Temple

Image 51 : An Old And Sacred Tree Near Balaha Ganga Ghat

Image 52 : An Old Banyan Tree Near T.M.B. University, Bhagalpur

Image 53 : A Banyan Tree Approx. 250 Years Old At Idgah Maidan, Barahpura, Bhagalpur

## 18.0 Key Observations and Recommendations

18.1 One important Hindu ritual associated with Ganga river throughout India is cremation of dead bodies as it is widely believed that by immersing your burnt remains in the holy Ganga water, the person will attain 'Moksha'. The remains of these rites along with other substances such as pots, flowers, clothes, threads and so on are often dumped directly into the river thereby impacting the riparian and in stream biodiversity. Some such cremation sites were observed during the survey along Ganga River in this study region [Image 54]. Hence, it is strongly suggested through this study to take cognizance of this matter and develop suitable cremation facilities while ensuring that water pollution and ecosystem damage is prevented in this region

**Image 54 : Cremation Activities As Recorded Along Ganga River Near Barari Ghat**

18.2 One important concern often raised during the survey was crop destruction caused by nilgai and wild boar especially in the floodplain agricultural fields. Though the farmers never retaliated violently towards the nilgai, they did admit to killing wild boars as they are equally dangerous to local residents in this region. Nonetheless, both these animals are known to cause huge losses to the farmers who claimed to receive no compensation or help of any kind from the authorities. Hence, this important issue in the study region needs to be mitigated by creating awareness among the local people, ensuring sufficient

compensation for their losses and incorporating non-violent techniques to keep these animals away from the fields.

18.3 Many settlements along Ganga River often lead to escalated solid and liquid waste dumping directly into the water which turns out extremely hazardous by degrading the water quality and negatively impacting the aquatic biodiversity. Such examples were observed in the study region during the field survey which need to be brought to immediate attention. Hence, it is suggested in this study to develop appropriate waste management strategies for the local communities directly linked to Ganga River.

**Image 55 : Waste Strewn Along Ganga River Bank In Sultanganj**

18.4 In some places, the interlocutors also reiterated dumping of dead animals such as cows and buffaloes directly into the Ganga River. Once dumped, these carcasses move along with the water current and get stuck at some sites along the banks due to low depth thereby creating foul smell and high chances of infections. Stricter check on such practices and sensitization of people dependent upon the river should be undertaken.

18.5 Evidences of severe bank erosion can be observed on the map throughout the study region which usually results in losses of human settlements and agricultural fields. Hence, it is recommended to carry out detailed studies in the to identify erosion prone and impacted sites along with developing suitable remedies for its control such as extensive plantation of trees, shrubs and grasses having strong root system to bind the soil.

18.6 The wetlands observed in the study serve as crucial resources for livelihoods and day to day needs of local residents associated with them. However, no effort has been made to ensure conservation and maintenance of these resources which has resulted in issues like sewage influx and dominance of invasive species. These wetlands if conserved properly have the potential to not only provide good fish resources, but also harbor other flora and fauna diversity, provide aesthetic benefits and clean water for various uses. Hence, it is strongly recommended to pay immediate attention for maintenance of these water bodies especially in conjunction with local stakeholders.

18.7 The fishermen in study region strongly reiterated their concerns regarding sharp decline in the fish availability, catch and yield which could be attributed to reasons such as changes in river flow and depth, climatic alterations and dominance of invasive exotic species such as Chinese/Common carps. Along with this the influx of pollution in Ganga River from various sources was also to blame for the changes in fisheries. Hence, it is imperative to carry out awareness cum survey programs involving fishermen in the region to understand these changes and address the necessary issues. Along with that alternate livelihoods could to be developed for fishermen communities such as promoting them for building different boats and involving in eco-tourism activities.

18.8 The Ganga river stretch of Bhagalpur is also an important habitat for IUCN Red Listed and Schedule-I (Wildlife Protection Act, 1972) species – Gangetic dolphin. The VGDS harboring hundreds of dolphins is under continuous anthropogenic factors such as rampant & unchecked fishing, sand mining, dumping of wastes and so on. Urgent intervention is required by appropriate authorities to ensure appropriate habitat availability for the already endangered dolphins in this region.

18.9 The riparian ecosystems are of high conservation priority owing to the rich biodiversity they support and the large-scale ecosystem services they provide. However, intensive agricultural practices including expansion of fields up to the current flow of Ganga River in many parts of this [Image 55] has already negatively impacted the riparian vegetation communities which is evident from the sparse growth and low species

diversity of riparian plants recorded during this survey. This in turn impacts the associated faunal diversity as well as bank stability often leading to severe erosion during flood situation. Hence, it is recommended through this study to take up measures for checking the limit of agriculture in riparian areas of Ganga River in order to allow the natural biota to flourish.

**Image 56 : Intensive Agriculture Along Ganga River In The Study Region Leaving Bald Banks Vulnerable to Erosion**

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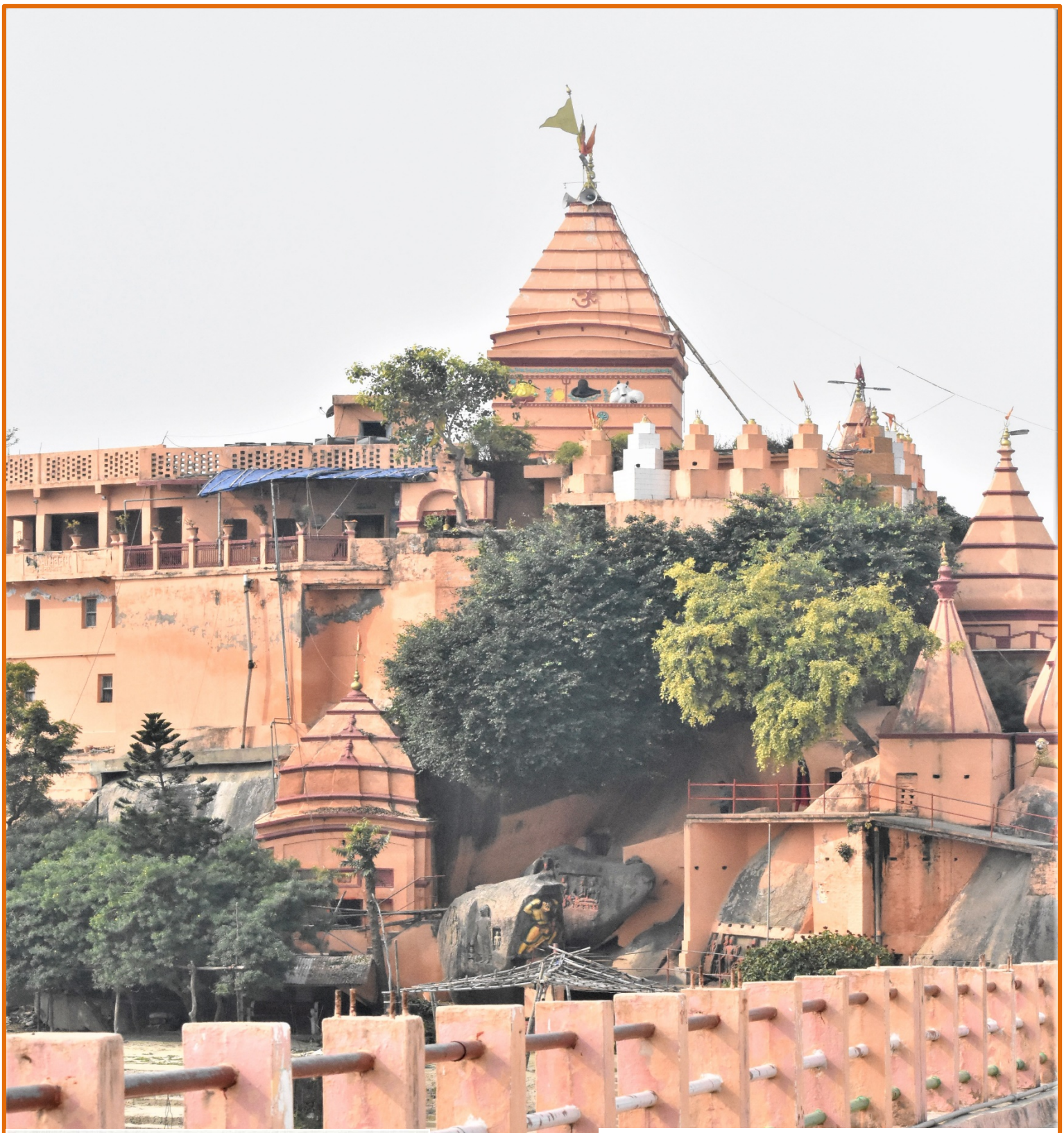

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