GANGA CULTURAL DOCUMENTATION

BEGUSARAI DISTRICT

[Natural Heritage]

2022

National Mission for Clean Ganga

Indian National Trust for Art and Cultural Heritage

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1.0 Introduction

1.1 Begusarai distt. (25.42°N, 86.13°E) is one of the thirty-eight distt. of Bihar with an average elevation of 41 metres above msl. It comprises of 5 divisions, viz., Bakhari, Ballia, Begusarai, Manjhaul and Teghara which is further subdivided into 18 municipal blocks. It was the subdivision of the Munger distt., which was recognized as a separate district on 2nd October, 1972. (Distt. Profile Begusarai / Udyogmitra)

1.2 Covering a total area of 1918 sq.km., the distt. is bound by the Samastipur distt. on the north, on the south by the river Ganga and the distt. of Lakhisarai, Khagaria and Munger distt.s. on the east and on the west by Samastipur and Patna distt.s [Refer Map No. 1]. The rivers flowing through Begusarai distt. are Ganga, Balan, Bainty, Baya, Burhi Gandak, Kiul and Chandrabhaga. Ganga river enters the south-west part of the distt., and its boundary in the southern part is determined by floodplains, *Tals* (lake) and *Chaurs* (wetland) (Distt. survey report of Begusarai, 2019).

1.3 The climate of Begusarai distt. is warm and temperate with an average temperature ranging between 23°C to 8°C. The average annual rainfall in the distt. varies between 464.2 and 1,612.2 mm (Climate-data.org). It receives maximum precipitation between June to September. (Distt. Census handbook, Begusarai, 2011)

1.4 The distt. lies in the middle of the Northern Ganga plain and has a low-lying terrain, having a southerly to south-easterly slope. On the basis of geographical factors, the river Burhi Gandak forms the dividing line between the two sub-micro regions:

(a) **Ganga-Burhi Gandak floodplain:** forms the southern part of the distt. and comprises of the entire Bachhwara, Teghra, Barauni, Begusarai, Matihani, Sahebpur Kamal and major portion of Balia community development C.D. blocks.

(b) **Burhi Gandak-Kareha flood plain:** covers the northern part of the distt. and comprises of the entire Khudabandpur, Cheria, Bariarpur, Bakhri C.D. blocks and some parts of Balia C.D. blocks. (CGWB, 2013)

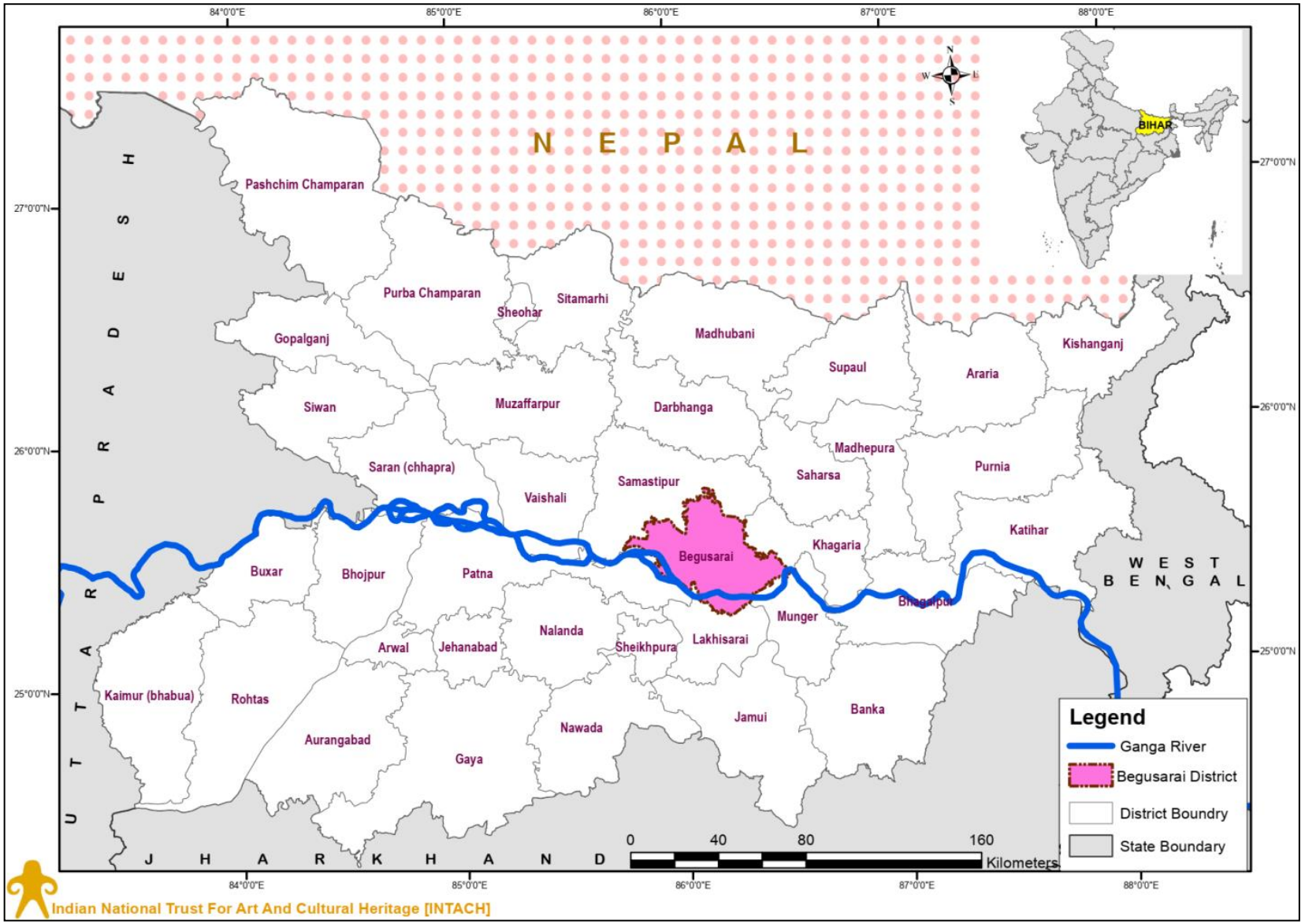
1.5 The distt. had a network of embankments from its very early days. The Munger Bundh (embankment), one of the two oldest embankments, runs along the left bank of the Baya river and protects a large part of Teghra and Bachhwara blocks from inundation. To the south of Begusarai lies the famous Gupta Bund, an old zamindari-era embankment. After the severe flood of 1934-35 a retired bundh (embankment) in the shape of ring from Kaithma village to Lakho village was constructed mainly to protect

the distt. from the ravages of the Ganga River. Constructed by Department of Waterways in the year 1950-51, the 'Musmara Prabhandha Mohanpur embankment' is an important system of embankment along the rivers Burhi, Gandak and Balan. (Distt. Gazeetter of Munghyr,1926)

1.6 The distt. has been mentioned in the Buddhist text Majjhim Nikaya as 'Anguttarapa' but the name Begusarai originates from "Begum" (queen) and "Sarai" (inn). The Begum of Bhagalpur used to visit "SimariaGhat" (consider as a holy place on the northern banks of the Ganga River), for a month of pilgrimage, which later took to the colloquial speech of Begusarai. (Distt. Profile Begusarai / Udyogmitra)

1.7 Kabar Tal, a 7,400 ha lake, which surrounds the famous Jaimangalgarh, is one of the most ecologically important wetlands in the Bihar State. It was declared as protected area in 1986 and is designated as Ramsar site in 2020. Situated on the north of Begusarai distt., Jaimangalgarh has an important religious centre where hundreds of people assemble to worship the goddess Jaimangala on every Tuesday and Saturday. (Ghosh, K.A., Bose, N. Department of Environment and Water Management), (Distt. Gazeetter of Munghyr,1926)

- *The history of Begusarai distt. is almost merged with the history of its parent distt. Monghyr. According to the Distt. Gazetteer of Monghyr, some rare images of the Pala period at Jaimangalgarh, and the Pala inscriptions at Nawlagarh reveal the existence of Pala rule in Begusarai distt. (Distt. Census handbook, Begusarai, 2011)*
- *During the Mauryan and Pala period, Jaimangalgarh and Nawlagarh in Begusarai distt. has been an important centre of administration, art and culture. Archaeological explorations have revealed that Jaimangalgarh was an important Buddhist center. (Distt. Census handbook, Begusarai, 2011)*
- *There is an industrial complex at Barauni situated on the bank of Ganga River. Barauni industrial town has the potential to become the industrial capital of Bihar. (Distt. Profile Begusarai / Udyogmitra)*



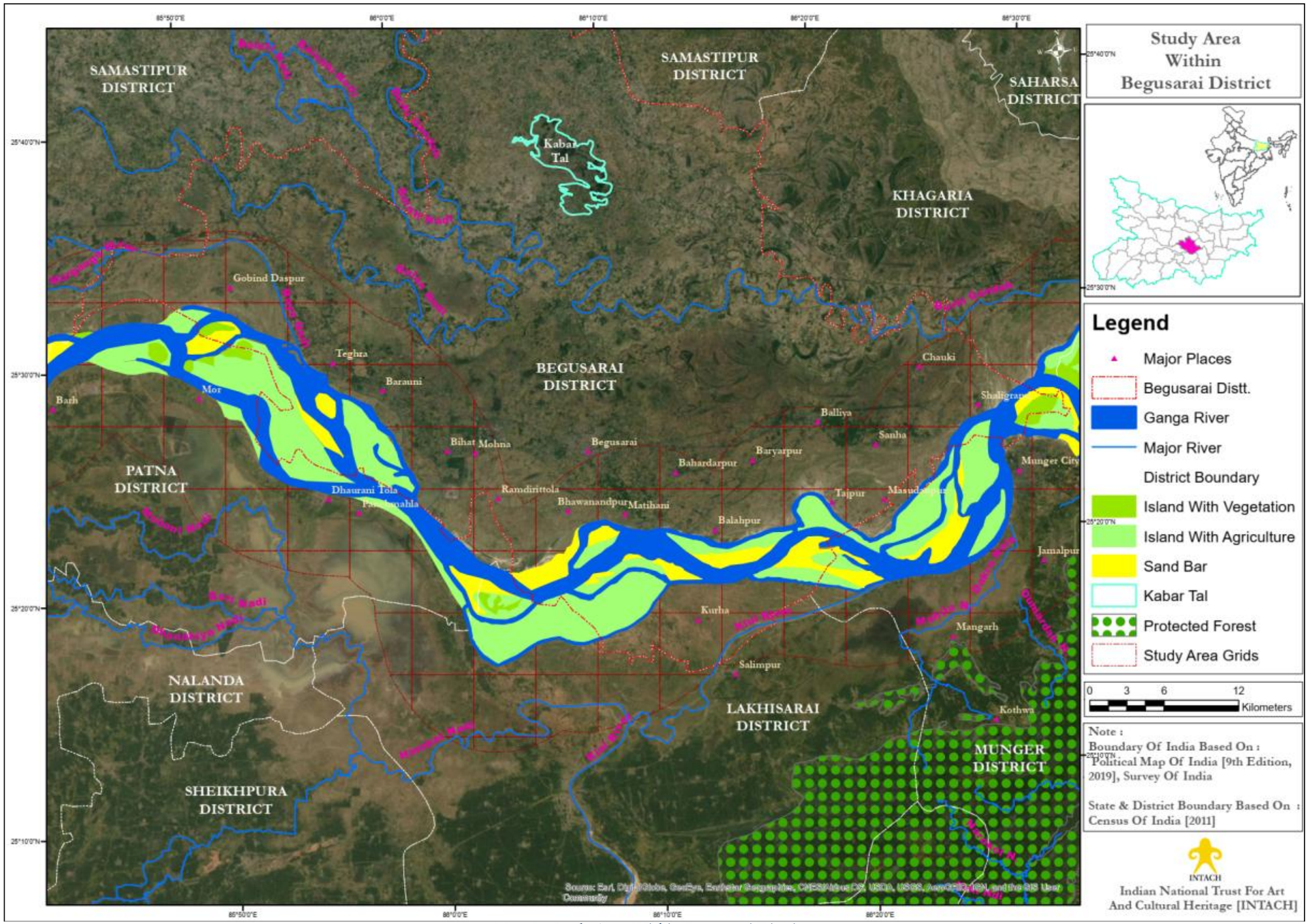
Map 1 : Location Map Of Begusarai Distt.

2.0 Ganga River In Begusarai Distt.

2.1 Ganga River enters Begusarai as a single channel a little before Jazira Raili [25°31'43.91"N, 85°44'12.72"E] on the opposite bank of Barh region in Patna distt. and flows south-eastwards forming the southern boundary of this distt. Throughout its course in the distt., the river is both wide and deep during most of the times in the year. The river exits Begusarai distt. near Ragunathpur Barari [25°24'47.05"N, 86°30'23.29"E] entering Khagaria distt. where it flows for a small distance before entering Munger distt. The total stretch of Ganga River in the distt. is approximately 68 kms while its width varies between 1.5 Km to 4.5 km [Refer Map No. 2].

2.2 Throughout its stretch, the river forms several *diaras*, which are mostly under cultivation for *Zaid* crops. The shifting tendency of the river has resulted in the formation of vast tract of floodplain [span over 5-7 kms]. The floodplain area is locally called *Kachhar*. The active floodplain of Ganga River is mainly under the cultivation excluding few patches of scrubland and plantation and brick kiln sites.

Image 1 : View of Ganga River In Begusarai Distt.



Map 2 : Study Area Within Begusarai District

3.0 Methodology

3.1 For carrying out surveys, a 7 km buffer [study area] of Ganga River in Begusarai Distt. was marked having a total area of 500.41 sq. km. covering left bank and right bank of River Ganga. The study area was divided into grids of 5 × 5 km for field survey. Before carrying out surveys, the study area was analysed with the help of secondary literature, mythological records, available maps [Google Earth historical satellite data, SOI old toposheets, SOI-OSM sheets]. Based on that, key features were marked in Google Earth Pro and Kml files were generated. The Kml files were further transported to mobile based QGIS field survey application. Key features were marked taking consideration of Natural Heritage documentation format.

3.2 The field survey in Begusarai Distt. was carried out in January, 2022. Various sites were visited within the study area wherein field data was collected along with interactions with stakeholders. The co-ordinates of all localities were taken by Garmin handheld GPS eTrex30 and the representative images of various parameters were taken with the help of Sony Digital Camera Cyber-shot DSC-HX300 with 50X optical zoom. Pre-marked Google Earth's Kml files and Google Maps were used for navigation. Scanned maps of the topographic map series of Army Map Services, U.S. Army [Map NG45-10], Survey of India [SOI] Open Series Maps [OSM] and Google Earth Historical Imagery were obtained and analysed for preparation of Maps.

3.3 Field guides were used for flora and fauna identification. The diversity of avian species was recorded using binoculars and identified using field guides [Salim Ali, 2012; Grimmett et al., 2016]. The conservation status of the species was listed by using IUCN Red Data List. Information regarding groundwater, agriculture, forest and wetland were obtained through informal/formal interviews and discussion with Govt. officials of Forest Department, and farmers, fishermen, boatmen and other stakeholders.

4.0 Tributaries Of Ganga River In Begusarai Distt.

4.1 Major tributaries within the district are - Burhi Gandak, Baghmati, Balan, Bainti, Baya and Kiul. Balan and Bainti are the tributaries of Burhi Gandak while Baghmati River is tributary of Kosi River. Baya and Kiul are only major rivers which flow through the study area. The small streams are not present in the study corridor. Detail of the major tributaries is discussed in this section and its spatial distribution is provided in Map No. 3.

4.2 **Burhi Gandak River:** This river originates from Chautarwa Chaur near Bisambharpur in the district of West Champaran in Bihar and is one of the important tributaries joining on the left bank of Ganga. Locally known as Sikrahana in its upper reaches, the river is then augmented by contribution from some rivers rising from the foothills of the Himalayas. Near Basantpur, River **Masan** joins this river on its left bank and after a distance of 56 km, it is joined by **Tilawe** and **Tiur** on its left bank. After its confluence with Tiur river near Gularia, this river is known as Burhi Gandak. From this point, the river takes south-easterly direction flowing through Muzaffarpur, Samastipur Begusarai, Khagaria and Munger Distt..

The river enters the Begusarai Distt. near Daulatpur Kothi [25°43'33.49"N, 86°1'47.27"E] and flows to a distance of approximately 109 Km and enters the Khagaria Distt. at Latitude 25°28'54.12"N and Longitude 86°25'22.76"E. In its journey, the river forms several oxbow lakes and huge floodplain. The river is joined by two important tributaries namely **Balan** and **Bainti** from its right bank. In Khagaria Distt., the River joins a channel of Ganga River Near *Tikarampur Diara* and finally empties to the main channel of Ganga River near Jhahwabahiyar. Tikarampur Diara or *Kachhar* formed due to the dual fluvial action of Ganga and Burhi Gandak River.

The confluence of the Ganga-Burhi Gandak was once located near Bishnupur or Bisunpur and Muradpur Village at latitude 25°19'22.19"N and longitude 86°38'7.86"E. The old confluence is located 7.8 Km eastward to the current confluence of Burhi Gandak-Ganga [Main Channel] confluence [Refer Image

No. 3 & 4]. The satellite imagery of the confluences [old and new] is presented in Image No. 3.

Image 2 : Burhi Gandak River As Seen From Begusarai-Rosera Road

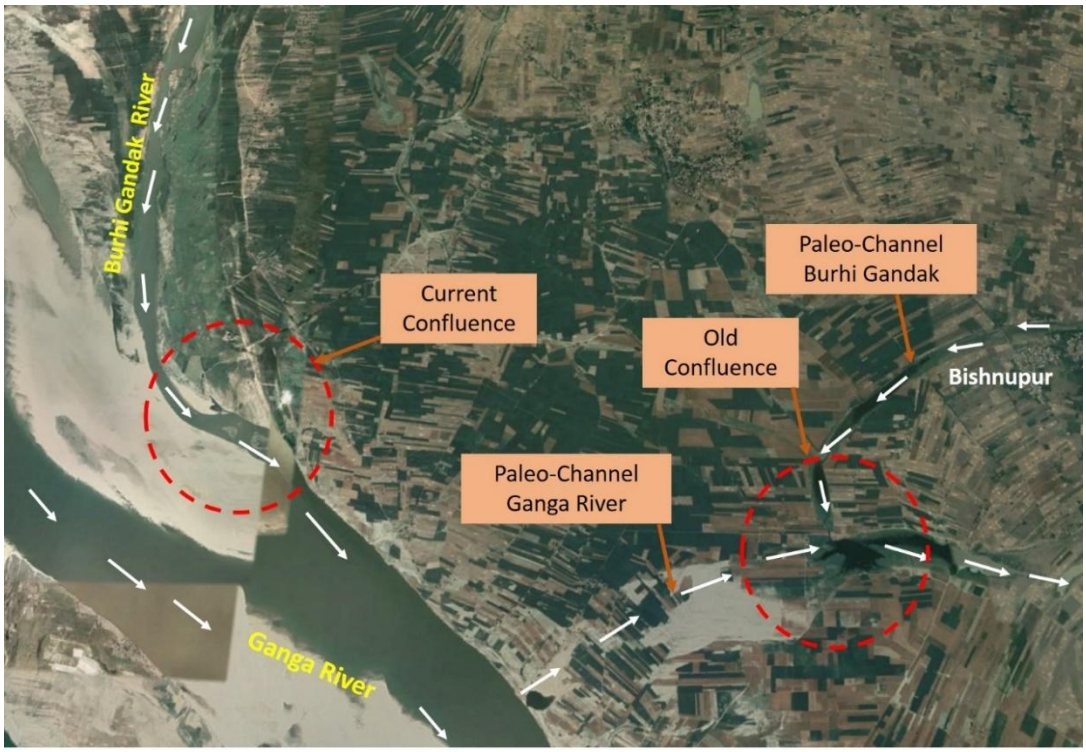


Image 3 : Old And Current Confluence Of Ganga-Burhi Gandak
[Source : Google Earth Imagery, January 2022]

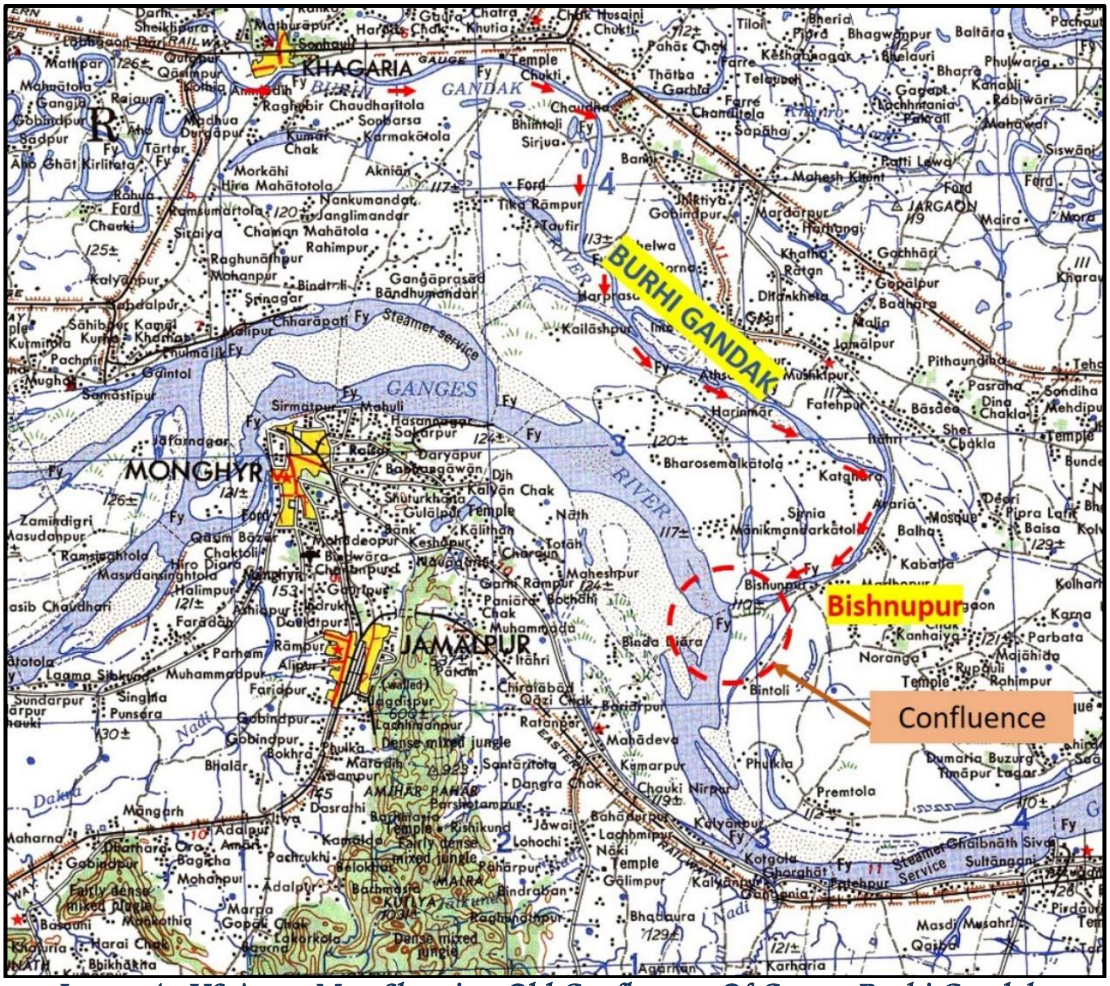


Image 4 : US Army Map Showing Old Confluence Of Ganga-Burhi Gandak

*Source: Topographic Map series of Army Map Services, U.S. Army [Map NG45-10 Compiled 1955, Based On SOI 1936-1937], Scale – 1:2,50,000.

The District gazetteer of Monghyr [Munger][1] describes the Burhi Gandak and its tributaries as :

Burh Gandak used to be navigable throughout the year for large boats during rains and small boats during other times.

"The main tributary of Burh Gandak is the Balan, which flows from the Darbhanga district and then takes a south-easterly course, joining the Burh Gandak at Umedpur near the Chiria Bariarpur police outpost. It has one small tributary, the Bainti, a stream debouching from Darbhanga, which falls into it near its junction with the

[1] O'Malley L.S.S. and James J.F.W. (1926), Bihar and Orissa District Gazetteers Monghyr. Government Printing, Bihar and Orissa, Gulzarbagh P.O.

Burh Gandak. The Balan has a considerable volume in the rains, and is navigable by small boats throughout the year."

4.3 **Baya Nadi :** Baya river enters Begusarai distt. near Barakahat village at Latitude 25°35'8.99"N and Longitude 85°46'30.86"E. After Barakahat village, two small channels named **Marganga** and **Chhoti Marganga** join the Baya from its right bank. Flowing downwards for 17 Km.s Baya joins Ganga River near Bhagwanpur Village at Latitude 25°30'15.03"N and Longitude 85°54'46.74"E. The confluence of the Ganga-Baya was once located near Simaria Ghat at latitude 25°25'17.78"N and longitude 85°59'5.71"E. The old confluence is located 12.7 Km eastward to the current confluence of Ganga-Baya confluence. The paleo-channel of the Baya river is still present in the district [Refer Image No. 7]. **The confluence has shifted because of the phenomenon of river capture.** The satellite imagery of the confluences [old and new/ existing] is presented in Image No. 5 & 6.

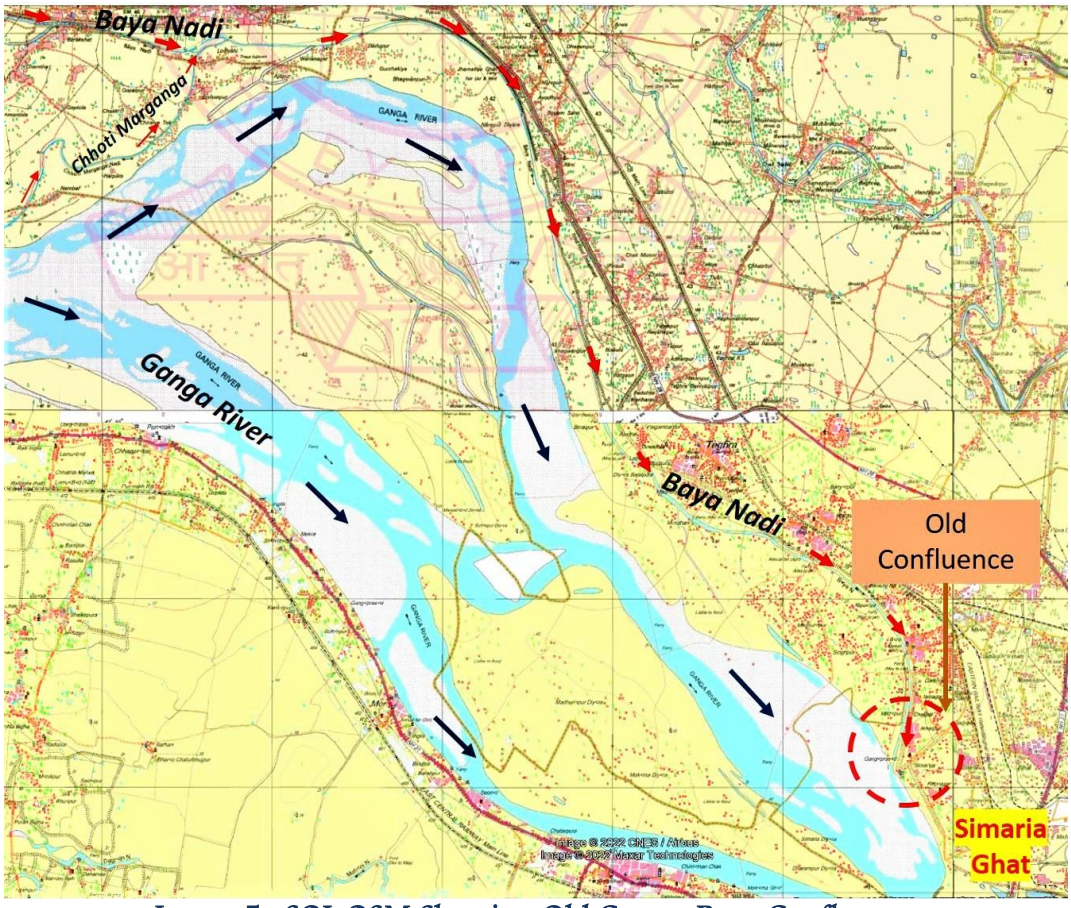


Image 5 : SOI-OSM Showing Old Ganga-Baya Confluence
[Source : SOI-OSM (G45N14 & G45N15), Based on Survey 1973-1974 and Updated for Major Details 2008-2009, Scale – 1: 50,000]

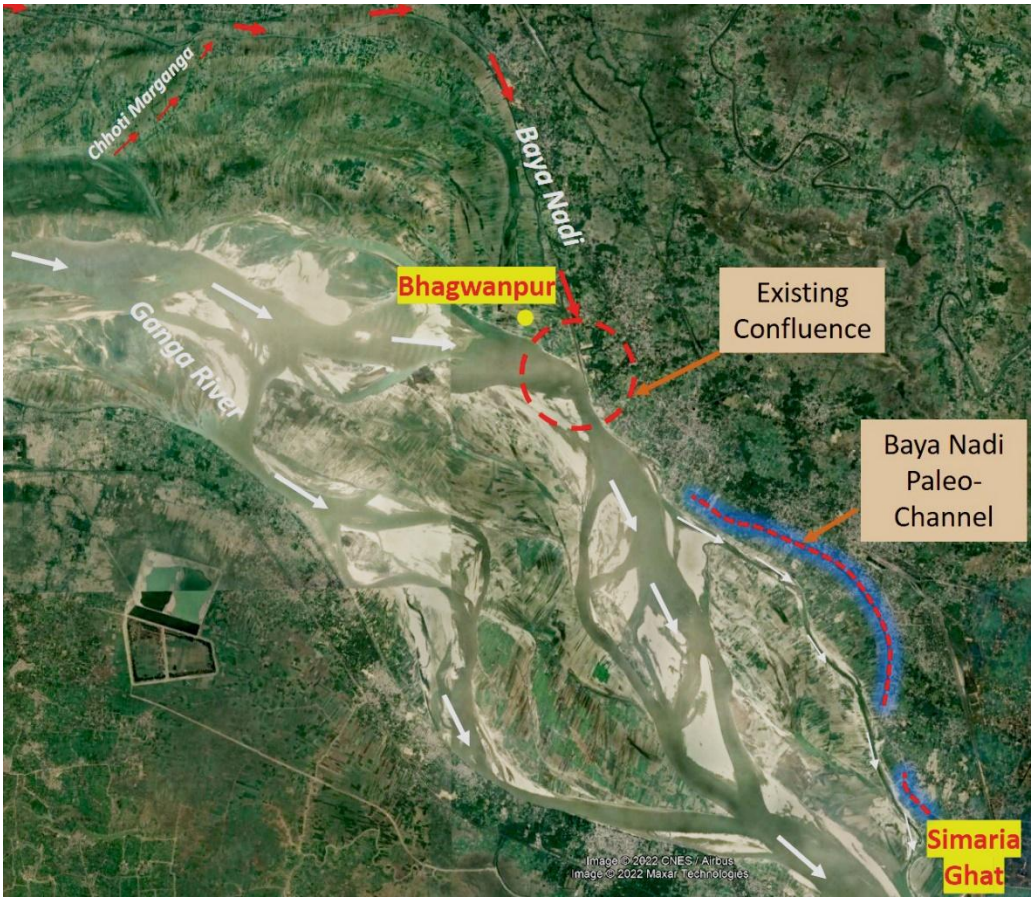


Image 6 : Current/ Existing Confluence Of Ganga-Baya Nadi
[Source : Google Earth Imagery, January 2022]

Image 7 : A Paleo-Channel Of Baya Nadi Near Amarpur

4.4 **Baghmati River:** It is a perennial river originating from 'Baghdwar' (also known as 'Tiger Gate') above the southern edge of Shivpuri hills in Nepal. After flowing through a major part of Nepal, this river enters Indian territory in Bihar in the village Shorwatia in Sitamarhi district, nearly 2.5 Km north of Dheng railway station [http://fmis.bih.nic.in/]. It then flows through various districts of Bihar such as Darbhanga, Sitamarhi, Sheohar, Muzaffarpur and Khagaria during which it is full of silt load with continuously changing course and braiding into many branches. One such branch of Baghmati river joins the Burhi Gandak River near Begusarai and then this single channel drains into Ganga River.

4.5 **Kiul River:** Originating from the hills of Giridih district in Jharkhand state, this is one of the most important rivers of south Bihar. After its origination, it enters Jamui Distt. where it is joined by **Barnar**, **Alai** (a mountain stream) and **Anjan river** near Jamui railway station. It then flows north-east into Lakhisarai Distt. where it is joined by **Harohar** or Halahar river near Rohua village at latitude 25°13'56.11"N and longitude 86° 7'29.41"E [Refer Image No. 12].

In recent years, the confluence of Kiul-Harohar has shifted from Rohua Village to Surji Chak [Refer Image No. 7 & 8]. This is because of the breaking of narrow meander neck during monsoon. After Kiul-Harohar confluence the Kiul River enters Begusarai Distt. and flows few kilometres [Right Bank]. The river enters in Munger Distt. before meeting River Ganga at latitude 25°18'10.68"N and longitude 86°21'43.06"E. A small stream named **Garkhe Nadi** originates near Bherha Village in Munger Distt. joins Kiul river near Nista Village just before its confluence with Ganga River.

The District gazetteer of Monghyr [Munger][2] describes the Kiul and its tributaries as:

"The Kiul has a broad sandy bed, and in some places is as much as half a mile wide, though it contains very little water in the hot weather. It is spanned by a large railway bridge between Kiul and Lakhisarai"

"The Anjan rises in the Anjan Hill to the north of the Anjan village of Barhat in the Mallepur taluk, and after passing through that taluk falls into the Kiul near Bariarpur. It has been dammed up in Barhat, and its water is diverted into an irrigation channel known as the Belia Nali, which irrigates several villages. The river receives several tributary streams viz. the Jamkhar, the Bajan, and the Chhuria, which has a sub-tributary, the Kairwar".

Image 8 : Kiul River As Seen From Bridge Near Garhi Bishanpur Village [Before Kiul-Harohar Confluence]

[A small water fall has been developed due to river bed mining. Illegal sand mining is a major issue throughout the stretch of the river.]

[2] O'Malley L.S.S. and James J.F.W. (1926), Bihar and Orissa District Gazetteers Monghyr. Government Printing, Bihar and Orissa, Gulzarbagh P.O.

Image 9 : Satellite Imagery of 2007 Showing The Kiul Harohar Confluence, Lakhisarai Distt.

[Source : Google Earth Imagery, January 2007]

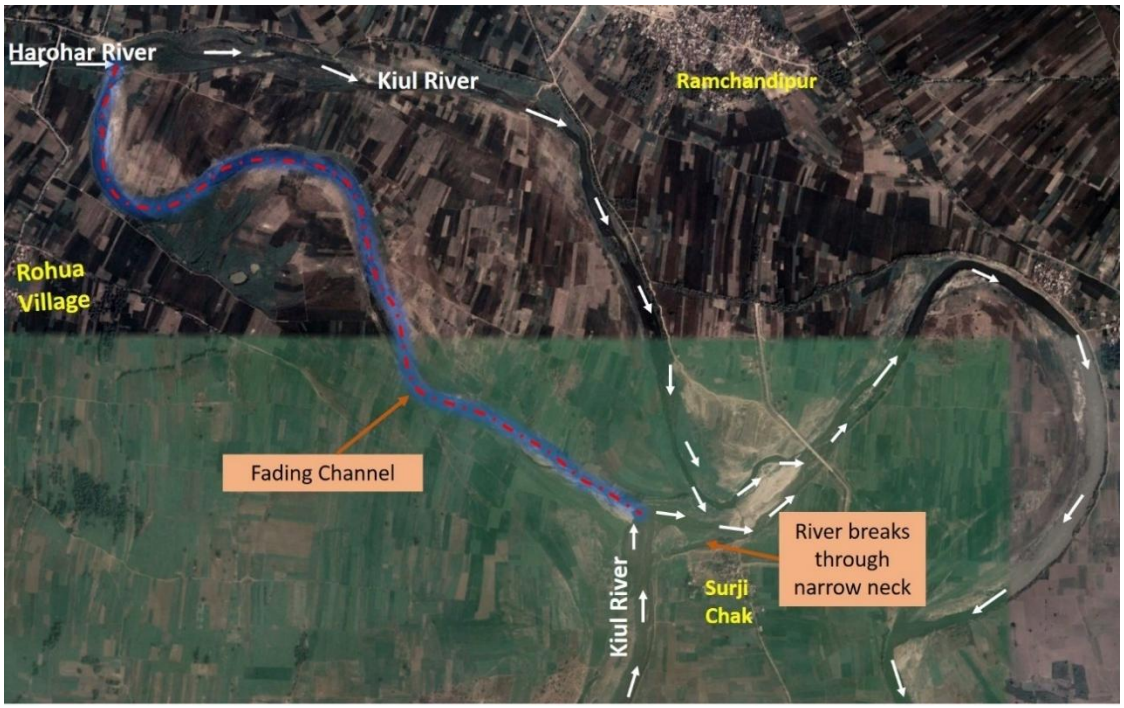
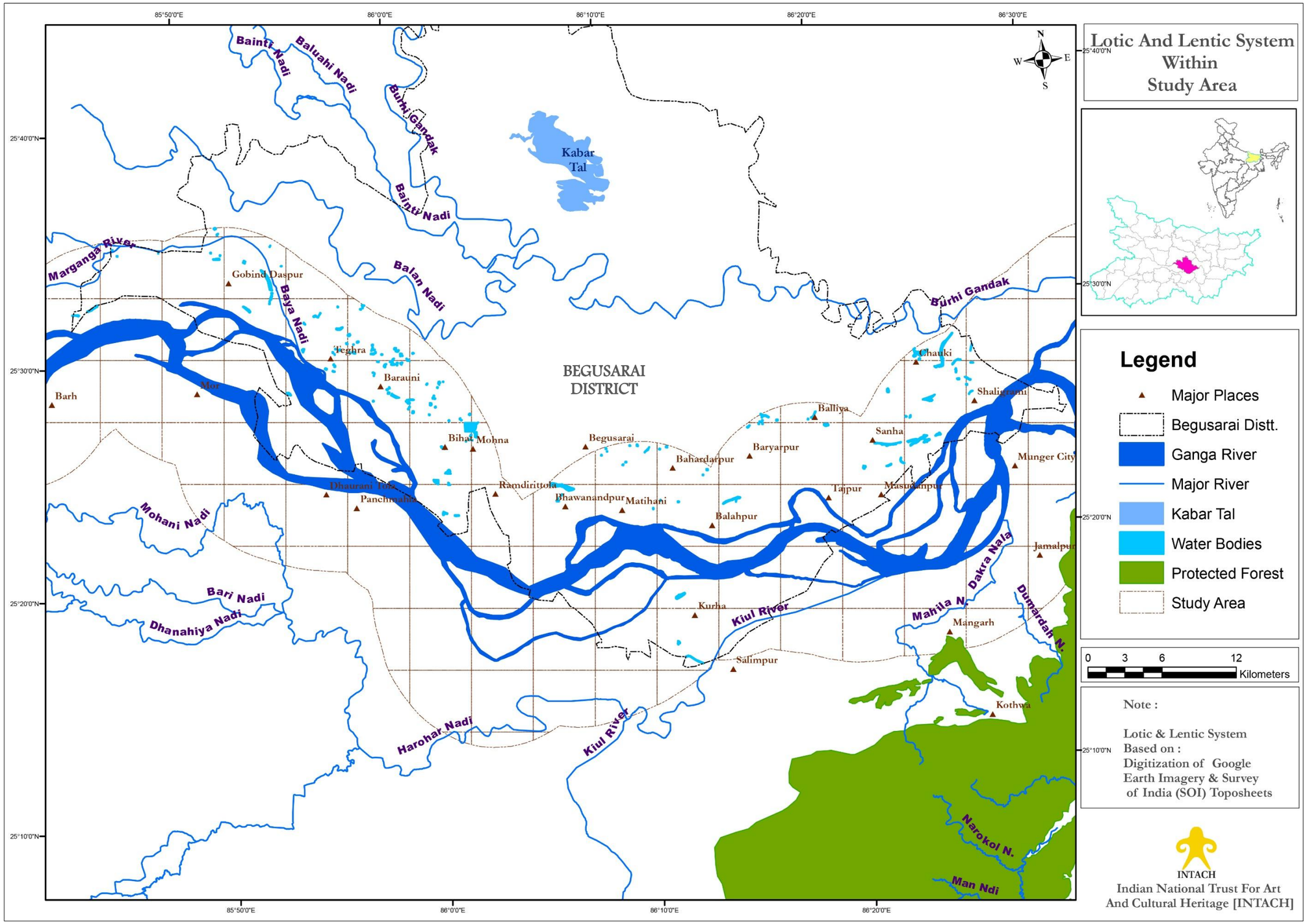


Image 10 : Satellite Imagery of 2021 Showing The Kiul Harohar Confluence, Lakhisarai Distt.

[Source : Google Earth Imagery, December 2021]

Image 11 : Satellite Imagery Showing River Bed Mining In Lakhisarai Distt.
[Source : Google Earth Imagery, April 2018]

Image 12 : Harohar River As Seen Near Bahadur Village
[At 25°12'48.81"N, 86° 4'12.43"E]



Map 3 : Lotic And Lentic System Within Study Area

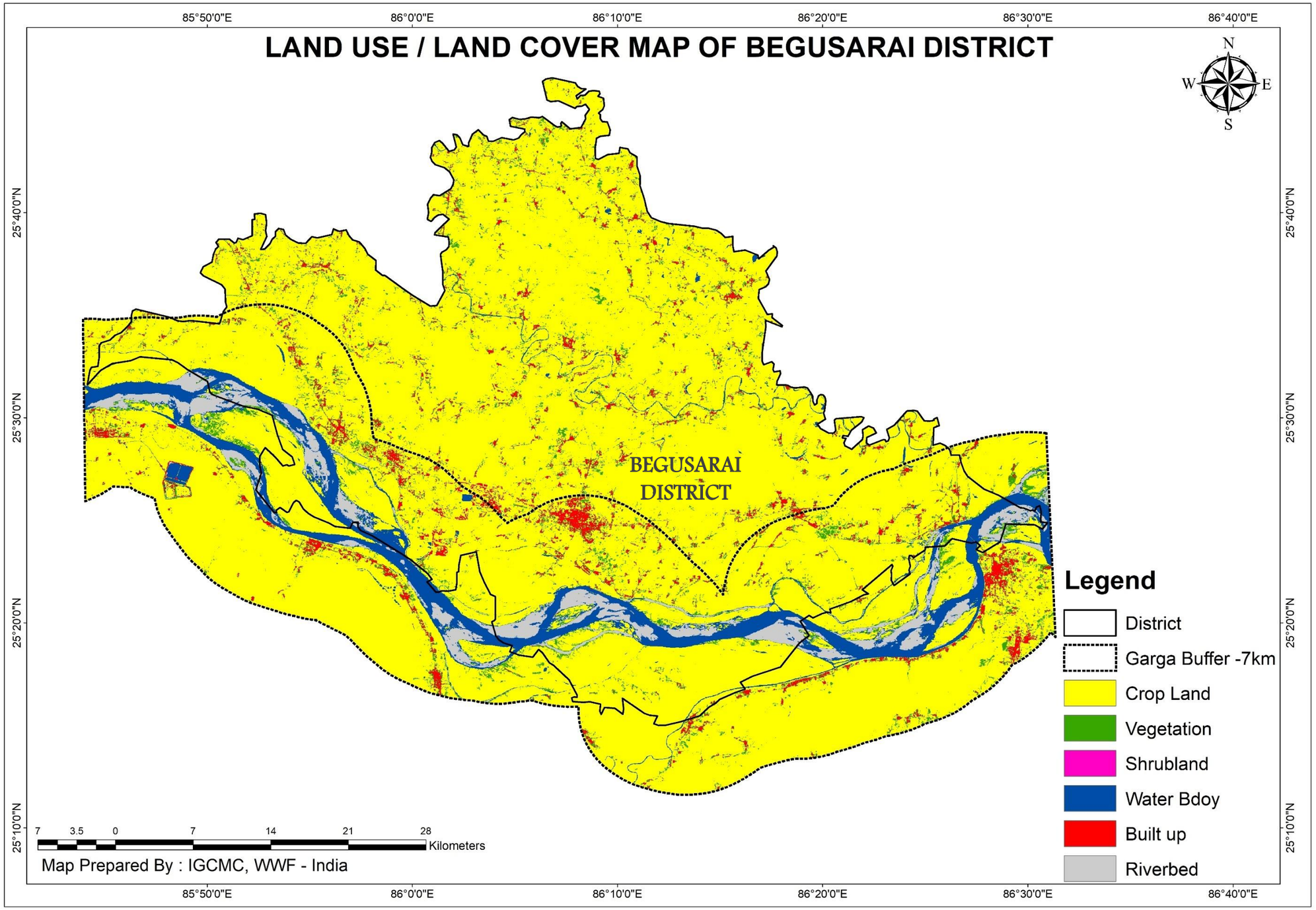
5.0 Land Use Land Cover [LULC]

5.1 Land Use Land Cover [LULC] map of the study area has been prepared from Landsat imagery for the year 2020 [Refer Table No. 2 & Map No. 4]. Using supervised classification system, 8 different classes were generated – Crop Land, Vegetation, Shrubland, Water Body, Built-up area, and Riverbed [Refer Map No. 4]. Study area constitutes 500.41 sq. km. covering right bank and left bank of River Ganga for which the following observations were drawn:

- Water body constitutes 34.86% which covers lentic and lotic system (river, paleochannels) of the study area. The lentic system includes flood affected areas and riverine wetlands.
- Vegetation constitutes 23.91% which covers riparian vegetation along Ganga River and plantation.
- The built-up land constitutes 15.80% of the total study area. This class covers the urbanised area at Begusarai City, villages and settlements along roads and industrial clusters in Barauni.

Table 1 : Land Use Land Cover of Study Area In Begusarai distt. [2020]

Begusarai (Ganga 7 Km Buffer)		
Class	Area (In Sq. Km)	Area (%)
Crop Land	19.10	3.82
Vegetation	119.66	23.91
Shrubland	0.08	0.02
Water Body	174.46	34.86
Built-up	79.08	15.80
Riverbed	108.03	21.59
Total	500.51	100



Map 4 : Land Use/Land Cover Map Of Study Area [Begusarai Distt.]

6.0 Paleochannels Of Ganga River

6.1 Palaeochannels are the remnants or old channels of once active rivers or streams, some of which are lie buried under the cover of younger sediments. They are formed when the river or stream migrate their courses and form new ones. Paleochannels are important to understand area geology, old river routes, sediment deposition and are considered suitable areas for ground water recharge. In Begusarai Distt. factors such as high silt load, extensive agricultural practices, brick kilns, and loss of vegetation act as a catalyst for the fading of river channels. Within these factors high silt load, brick kiln and loss of vegetation are the main reason behind the fading of streams. Loss of vegetation allows the soil to erode easily, which finally ends up in filling of the wetlands and accelerate the rate of migration of river.

6.2 In order to identify paleo-channels and threatened river channels in the study region, US Army Map [NG45-10, compiled 1953-1955] based on Survey of India (SOI) maps 1936-1937, SOI (OSM) 2005-2006 and Google Imagery upto December, 2021 were analysed [Refer Map 5 & 6]. Further, ground truthing carried out in January, 2022. Based on that, it has been found that :

- ❖ River channel of Ganga in Begusarai Distt. has migrated between 1936-1937 to 2005 - 2006 [Ref. Map No. 6].
- ❖ Major migration was recorded between Raili diara and Bhagwanpur [Left Bank], between Sherpur and Pathua [Right Bank], Ganga-Kiul confluence [Right Bank], and Between Mahendrapur and Ramsingh Tola [Left Bank].
- ❖ In recent years it has been observed that a channel of Ganga River has started fading between 25°24'2.59"N, 85°59'53.08"E and 25°28'10.24"N, 85°56'35.66"E and is navigable in monsoon only [Refer Image No. 13].

6.3 **Paleochannel of Baya Nadi :** Ganga-Baya confluence has been shifted due to river capture [Refer 4.4 of this report]. Due to this, a paleo-channel of Baya Nadi of around 8-9 Km has been created. Currently, the paleo-channel is used as a source of irrigation and for aquaculture. In some areas the riverbed is encroached for brick kilns.

Image 13 : A Fading Channel Of Ganga River
[Navigable In Monsoon Only]

Image 14 : Paleo-Channel of Baya Nadi Near Ganjtola
[This paleo-channel is a source of irrigation and fish farming for the local communities]

6.4 **Fading of Chandrabhaga River :** This river of Begusarai distt. has an old history where it finds its mention in different texts and panchangas written during the vedic-period. Many people refer to it as *'Papaharini'* (remover of sins) which is also the main behind many local villagers performing last rites of their family members on the bank of this river [Anonymous, 2015]. It is said that till about 1915, this river flowed in its natural form from Rosra subdivision area via Nayanagar, Sihama, Sakarpura, Rampur, Koray, Sujanpur, Kumhars of Garhpura block of Begusarai district. It was also an important means of irrigation for the local farmers in the region [Anonymous, 2020]. Due to siltation the river has lost its depth and is almost dried in some areas. It has been reported that, the riverbed has been gradually encroached for agriculture and construction purpose[3] [Refer Image No. 15]. There is a growing need for the authorities to step in for its rejuvenation.

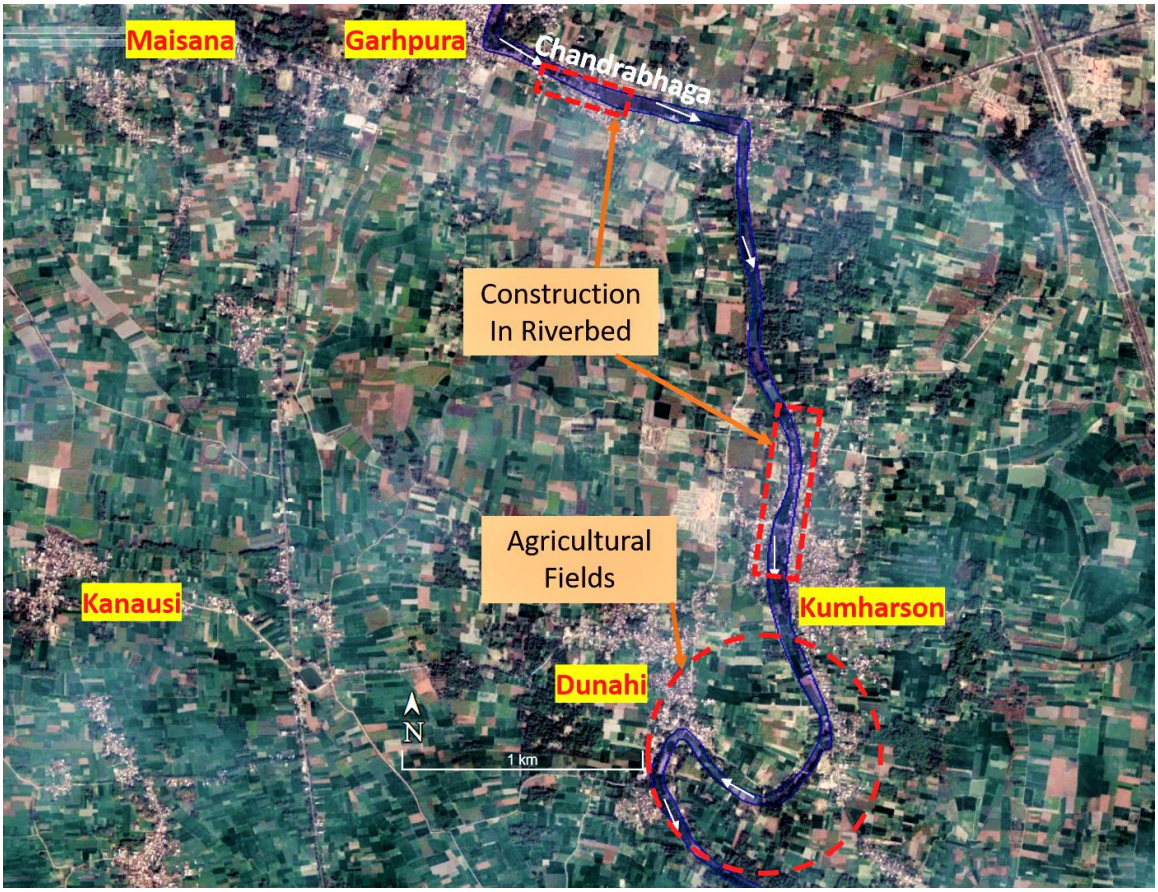
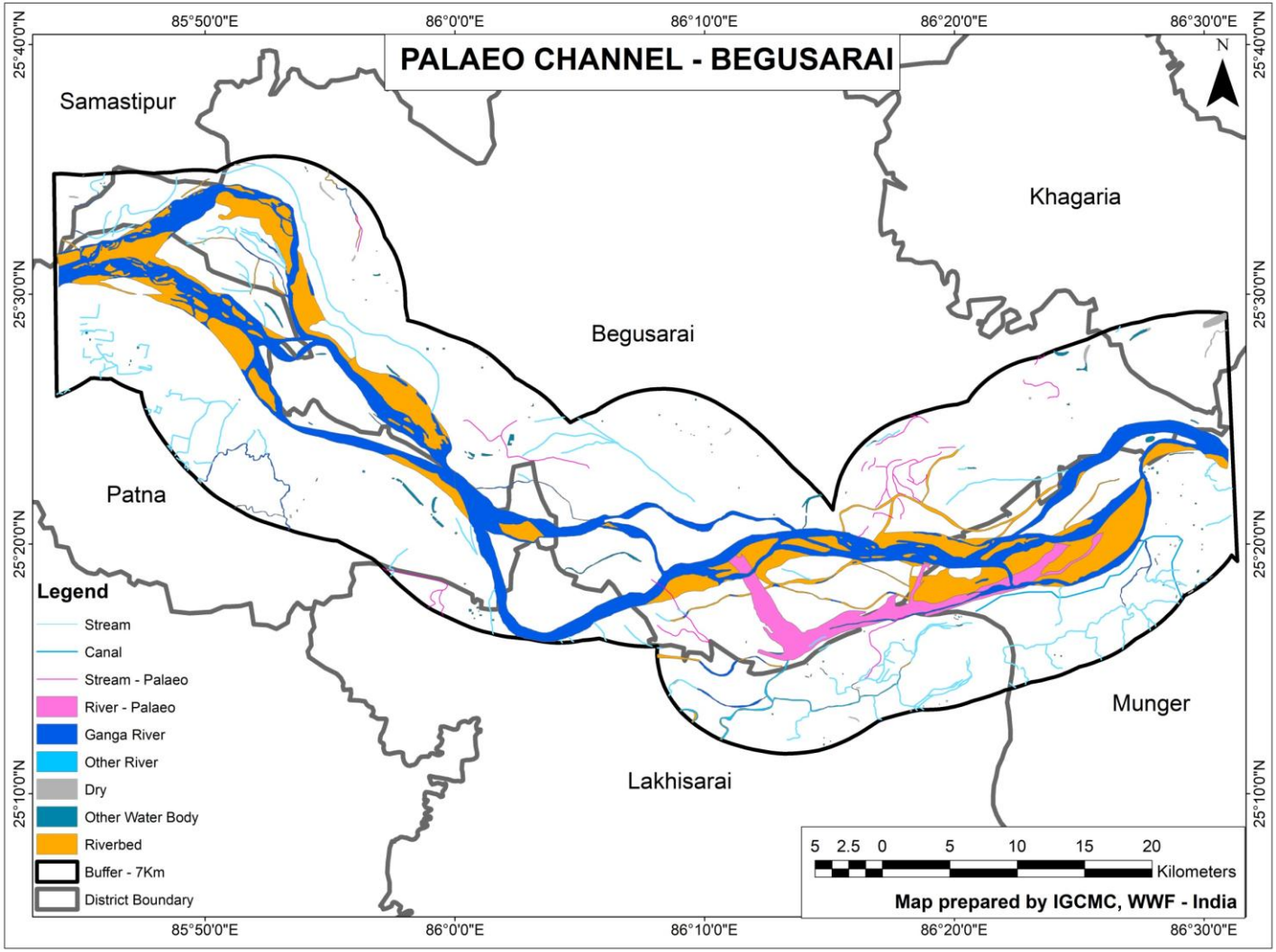


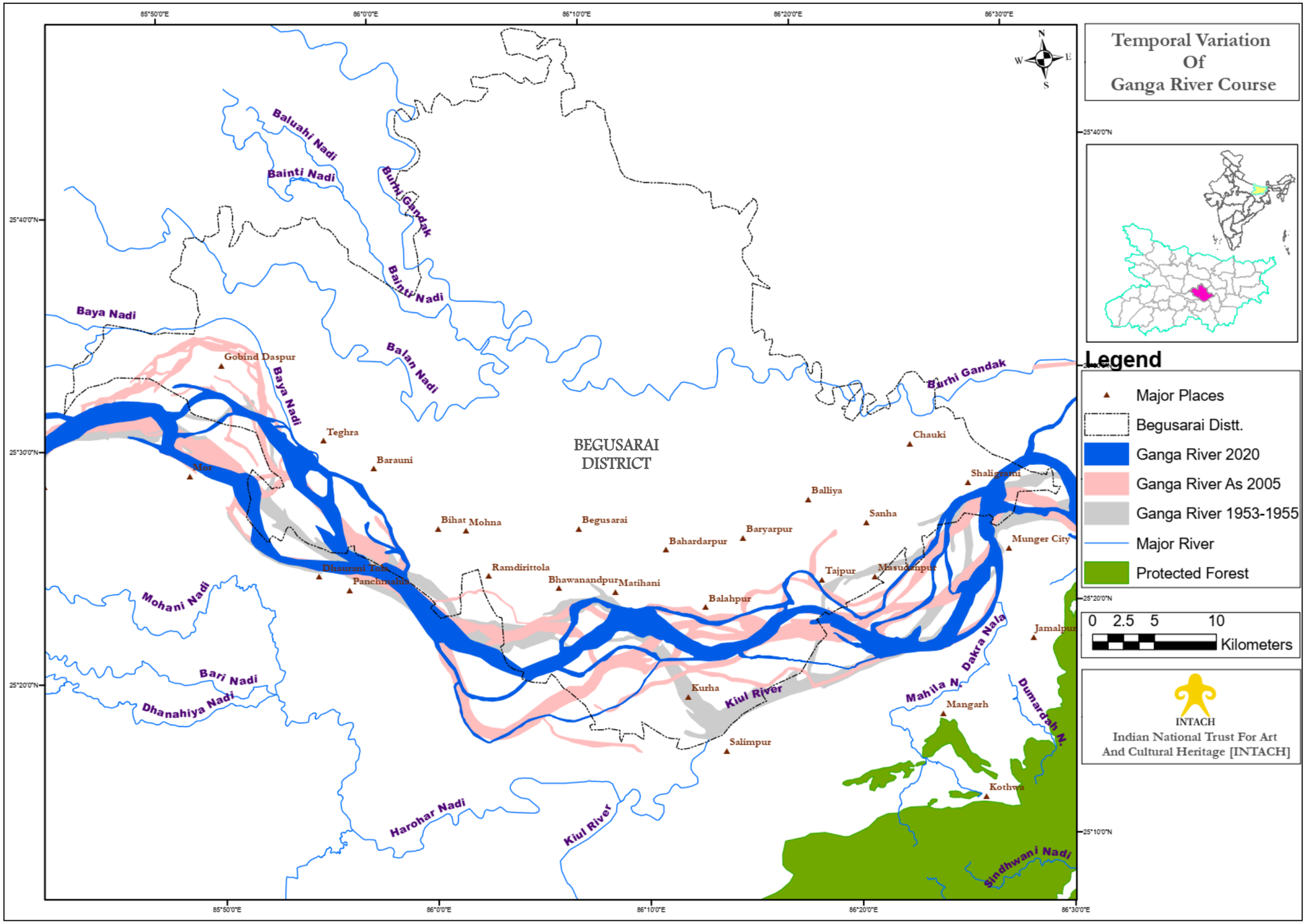
Image 15 : Satellite Imagery of Chandrabhaga River Between Garhpura And Dunahi
[Source : Google Earth Imagery, February 2021]

[Image showing Construction and Agricultural activities in Riverbed]

[3] Dainik Jagran [21.03.2021]
https://www.jagran.com/bihar/begusarai-chandrabhaga-river-on-the-verge-of-extinction-dozens-of-houses-built-in-river-21486484.html



Map 5 : Paleochannels In Study Area [Begusara Distt.]

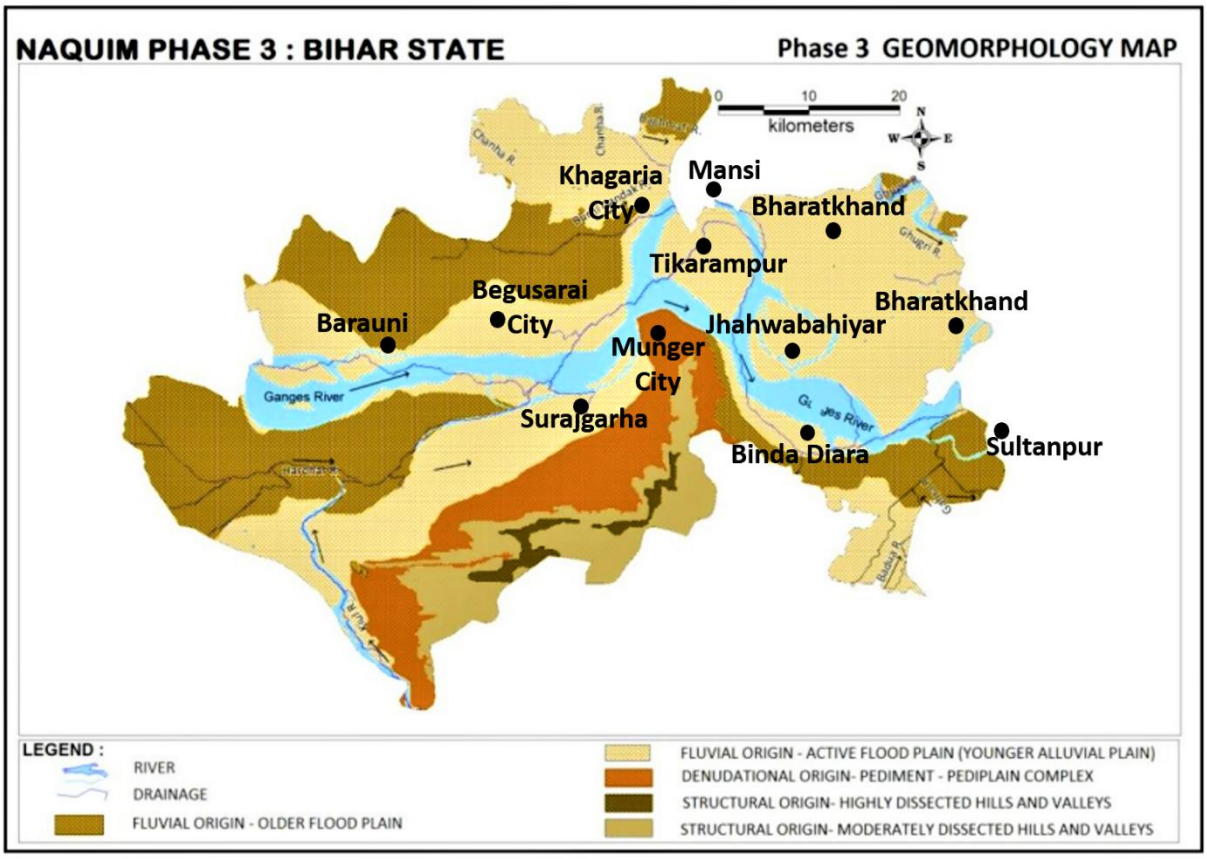


Map 6 : Temporal And Spatial Variation Of Ganga River Course In Begusarai Distt.

7.0 Floodplain Of River Ganga In Begusarai Distt.

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 Begusarai Distt. is a part of Middle Ganga plain. physiographically it represents a monotonous flat topography. The study area in Begusarai Distt. [Left Bank] falls in doab region between the Ganga and the Burhi-Gandak. The general slope of left bank of River Ganga is towards the south-east while right bank of River Ganga is towards north-east. Geo-morphologically, the study area in Begusarai Distt. has been characterised into Younger alluvial plain [Active floodplain] and older alluvial plain [Older floodplain] [Refer Map No. 7]. Active floodplain covers most of the area within the study corridor [left and right bank] while older floodplain dominates the area near Barauni [left bank]. In the south of the natural levee of Ganga [Between Patna and Munger], there is a vast stretch of backwaters known as ***Taal or Tal***. The active flood plain area within the study corridor may be divided into the Ganga River floodplain and Kiul-Harohar-Ganga River floodplain. A low laying area locally called Taal or Tal has been developed along right bank of River Ganga; which usually submerged for 4-5 months.



Map 7 : Geomorphology Map
[Source : Report On Aquifer Mapping, CGWB, 2017]

Image 16 : Low Laying Area At Right Bank Of River Ganga
[Area showing in the image is usually under flood inundation for 4-5 months].

7.3 Begusarai Distt. and its adjacent Khagaria Distt is predominantly an agrarian Distt. falling in agro-climatic Zone I & II. The soil of the region is categorised by the sandy loam, loam and clay loam soils having pH range between 6.5-8.4[4]. The majority of the soil is medium to heavy texture, very deep, alkaline in reactions and medium to highly fertile. All these soils are highly suitable for maize, paddy, wheat, gram, oilseeds such as mustard, aniseed and sunflower along with lentils such as arhar, urad and masur and vegetable crops. Soil nearby the Burhi Gandak river is mostly calcareous having different amount of lime content in them. In general, soils within the study corridor are moderately well drained to poorly drained except the *diara area* and *Tal area.* Other important horticultural crops grown in the distt. include banana, mango, guava, litchi, papaya and lemon. Litchi is widely cultivated along the flood control bund in the study.

7.4 Common cropping sequence practised within the district are: Rice-Wheat, Maize-Wheat, Rice-Wheat- Green gram, Vegetable-Wheat, Rice-Rabi Maize, Maize-Rabi Maize, Rice-Pulses, Rice-Oilseeds, Rice-Vegetables, Rice-Potato & Soybean-Wheat. Major vegetable crop in the district includes - (Bitter gourd, Lady's Finger (Okra), Onion, Cucumber, Cabbage, Tomato, Cauliflower, Bottle gourd, Radish, Carrot, Sponge gourd, Chili and Potato.

Image 17 : Active Floodplain Agriculture [Left Bank]

[4] Parts of Begusarai, Bhagalpur, Khagaria, Munger and Lakhisarai District (Phase III), Bihar *http://cgwb.gov.in/AQM/NAQUIM_REPORT/Bihar/Parts%20of%20Begusarai,%20Bhagalpur,%20Khagaria,%20Munger%20and%20Lakhisarai%20Districts.pdf*

Image 18 : Farmer Spraying Pesticides In Gram-Mustard Field In Ganga River Floodplain

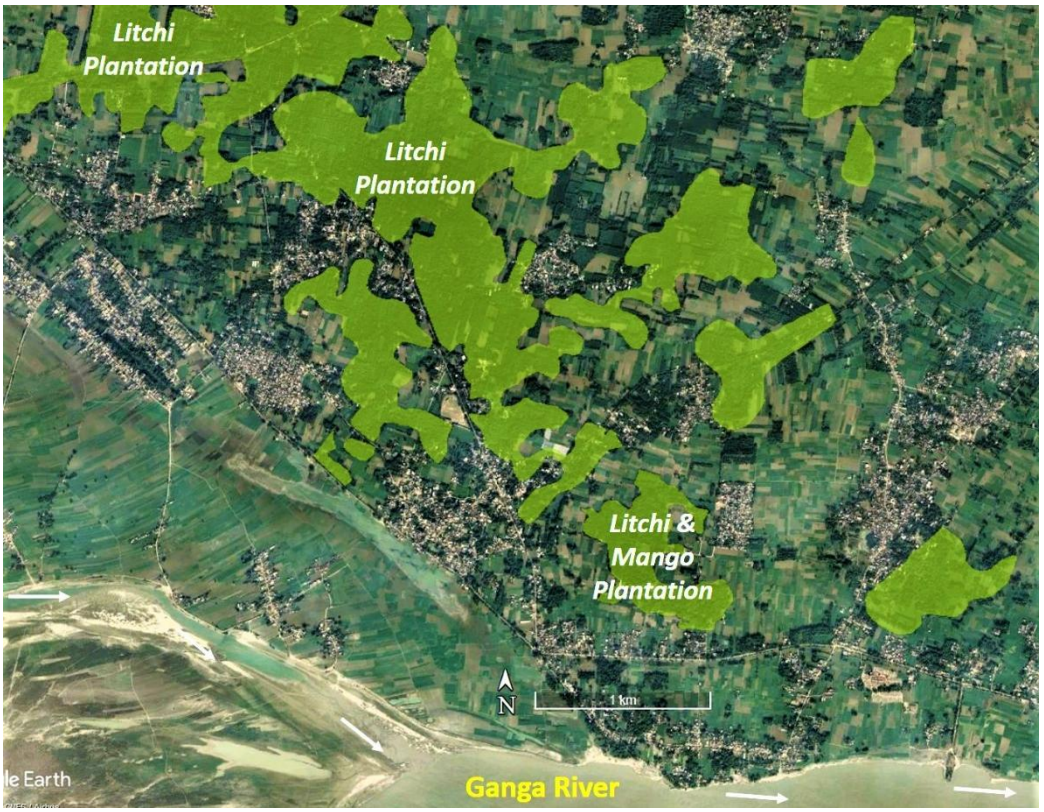


Image 19 : Satellite Imagery Showing Litchi And Mango Plantation

Image 20 : Mixed Plantation [Litch & Mango] And Vegetable Crop

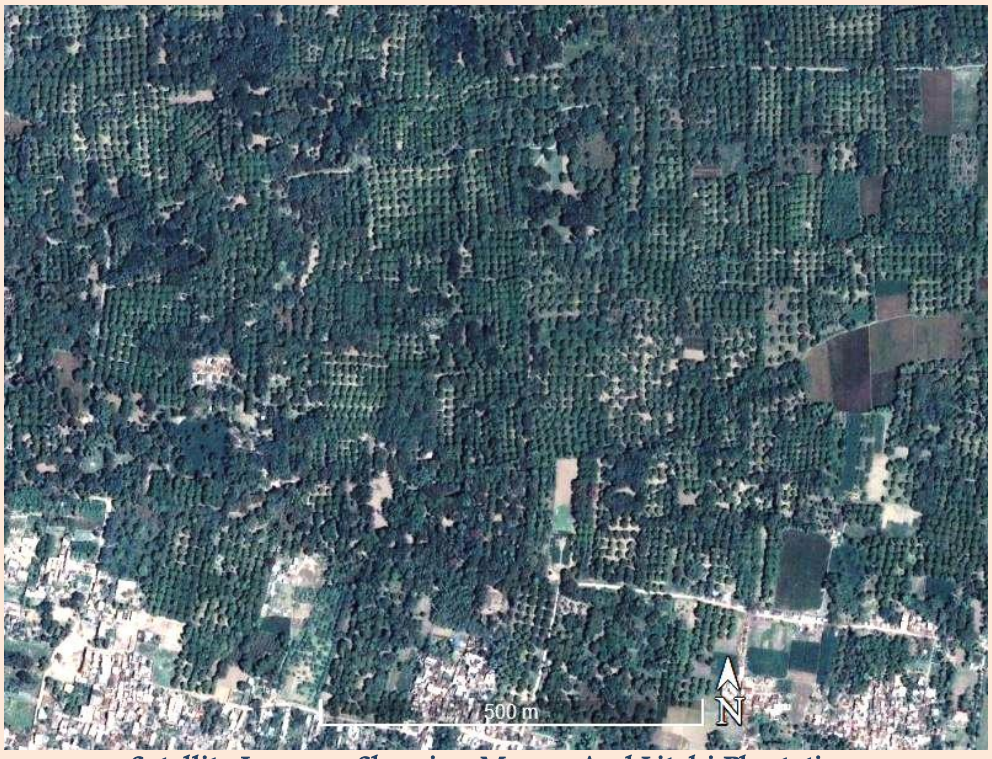
Image 21 : Pomelo locally called *Gagar Nimboo*

Plantation In Begusarai Distt.

Begusarai Distt. has ample amount of Plantation area. Majorly south of the distt and north [left bank] of the Ganga has plantation area which locally called *"Gachhi"* or *"bagichha"*. The major plantation in the region is Mango & Litchi. Around 60-70% of the plantation is of Mango. Major verities of mango harvest at Begusarai are Malda, Biju, Dhashari etc. which are sold to Kolkata & Patna markets.

Begusarai Distt. is the second-largest litchi producer after Muzaffarpur. Around 20-30% of the plantation is of Litchi. **As per State Government every year 325 metric tons of litchi produces in 150 hectares of land in Begusarai Distt**. Analyzing the potential, State Govt. has planned to install a Litchi Processing Unit in Begusarai to produce Litchi based products and also generate local livelihood.

Other than Mango and Litchi, Papaya is another fruit which produces in immense amounts in the Distt.. Papaya plantation usually done in monsoon period as it requires proper irrigation. Papaya starts flowering in November - December and starts producing fruits in month of March. Most of the papaya is sold to the Patna *mandi* and further distributed to the other part of the state.



Satellite Imagery Showing Mango And Litchi Plantation

8.0 Wetlands In Begusarai Distt.

As per the Wetlands (Conservation and Management) Rules, 2017 - "Wetland means an area of marsh, fen, peatland or water; whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters, but does not include river channels, paddy fields, human-made water bodies/ tanks Specifically constructed tor drinking water purposes and structures specifically constructed for aquaculture, salt production, recreation and irrigation purposes.''

8.1 Wetlands are highly productive ecosystems and help in maintaining ecological balance by providing food and habitat to large number of living organisms. They also help in controlling floods, recharging groundwater, nutrient recycling, climate stabilization and carbon sequestration. According to National Wetland Atlas [Bihar], Wetlands constitute 4.4% geographic area of Bihar state and 10.78 % area of the Begusarai Distt. The majority [74.35%] area within the wetlands covered by the lotic system i.e., River/stream. The remaining 25.65% area is covered by oxbow lakes/ cut-off meanders [5.78%], riverine wetlands [1.19%], tanks [0.50%], lakes/ponds [15.91%] waterlogged area [1.70%] and Wetlands (<2.25 ha) [0.57%][5].

8.2 In the current exercise, 152 wetlands have been mapped in the study area with the help of Google Earth imagery and SOI-OSM available maps. **Total area of the mapped wetlands is 531.2 Hectares i.e. 1.06% of the study area; excluding the lotic system and flood inundation area**. The area of identified wetlands ranges between 0.11 ha to 58.7 ha. Out of 152 wetlands, the area of 74 wetlands is less than 1 ha, 38 wetlands have area between 1 ha and 2.5 ha and 40 wetlands have area greater than 2.5 ha. Area of the five largest wetlands constitutes 40.66% of the total study area. The list of identified wetlands is provided in Table No. 2 and their spatial distribution is shown in Map No. 8.

[5] National Wetland Atlas: Bihar, SAC/RESA/AFEG/NWIA/ATLAS/23/2010, Space Applications Centre (ISRO), Ahmedabad, India, 222p.
https://vedas.sac.gov.in/en/National_Wetland_Inventory_and_Assessment_(NWIA)_Atlas.html

Table 2 : List of Water Bodies within Study Area [Begusarai Distt.]

Sr. NO.	Wetland Name/Number	Coordinates		Area [Hectares]
		Latitude	Longitude	
01	01	25°32'16.73"N	85°44'28.35"E	2.66
02	02	25°32'32.47"N	85°45'17.73"E	7.67
03	03	25°34'57.93"N	85°46'23.09"E	0.32
04	04	25°34'41.24"N	85°46'35.50"E	0.52
05	05	25°34'40.08"N	85°48'33.56"E	0.13
06	06	25°35'31.40"N	85°51'20.05"E	1.54
07	07	25°34'29.95"N	85°51'2.40"E	0.50
08	08	25°34'11.93"N	85°51'17.27"E	1.95
09	09	25°35'15.95"N	85°51'26.02"E	0.86
10	10	25°34'21.05"N	85°51'28.51"E	0.39
11	11	25°33'59.26"N	85°52'35.98"E	2.75
12	12	25°31'54.68"N	85°52'35.23"E	6.16
13	13	25°32'58.21"N	85°53'42.24"E	29.0
14	14	25°34'34.10"N	85°53'53.11"E	0.36
15	15	25°32'32.94"N	85°53'47.16"E	0.74
16	16	25°32'19.93"N	85°53'43.85"E	3.33
17	17	25°32'7.22"N	85°53'38.27"E	1.00
18	18	25°33'40.90"N	85°54'20.26"E	0.27
19	19	25°28'9.51"N	85°54'12.81"E	2.69
20	20	25°31'6.46"N	85°55'13.31"E	0.34
21	21	25°31'8.77"N	85°55'11.64"E	0.46
22	22	25°29'58.30"N	85°55'2.63"E	2.64
23	23	25°31'22.13"N	85°55'50.66"E	3.25
24	24	25°29'47.30"N	85°56'26.75"E	0.54
25	25	25°31'44.00"N	85°56'51.49"E	0.35
26	26	25°30'46.08"N	85°56'51.62"E	5.19
27	27	25°30'7.30"N	85°57'8.49"E	0.88
28	28	25°29'52.31"N	85°56'47.03"E	1.31
29	29	25°29'55.26"N	85°56'34.76"E	0.11
30	30	25°29'41.91"N	85°56'31.18"E	0.29
31	31	25°29'15.46"N	85°56'26.50"E	0.36

32	32	25°29'10.50"N	85°56'28.91"E	0.77
33	33	25°29'6.25"N	85°56'3.19"E	1.23
34	34	25°28'58.70"N	85°56'24.73"E	0.80
35	35	25°30'28.77"N	85°57'16.50"E	2.73
36	36	25°29'42.71"N	85°57'26.26"E	1.64
37	37	25°29'44.06"N	85°57'13.95"E	0.59
38	38	25°30'3.34"N	25°30'3.34"N	0.16
39	39	25°30'8.35"N	85°57'38.77"E	0.80
40	40	25°31'32.70"N	85°57'55.53"E	0.42
41	41	25°31'39.81"N	85°58'2.80"E	1.80
42	42	85°58'2.80"E	85°58'15.99"E	0.17
43	43	25°28'43.80"N	85°58'19.59"E	0.37
44	44	25°28'38.53"N	85°58'17.49"E	0.15
45	45	25°29'13.86"N	85°58'32.37"E	0.78
46	46	25°29'35.69"N	85°58'15.09"E	0.37
47	47	25°29'34.83"N	85°58'23.17"E	1.37
48	48	25°29'46.05"N	85°58'18.32"E	0.66
49	49	25°29'44.59"N	85°58'24.66"E	0.51
50	50	25°29'50.92"N	85°58'21.12"E	0.21
51	51	25°29'57.13"N	85°58'21.03"E	0.81
52	52	85°58'21.03"E	85°58'45.39"E	0.84
53	53	25°27'33.33"N	85°58'10.29"E	0.48
54	54	25°29'2.35"N	85°58'52.00"E	2.54
55	55	25°29'8.16"N	85°59'13.22"E	3.27
56	56	25°29'3.02"N	85°59'17.47"E	0.59
57	57	25°29'3.60"N	85°59'26.52"E	1.28
58	58	25°29'4.22"N	85°59'38.86"E	1.27
59	59	25°29'43.60"N	85°59'24.71"E	1.64
60	60	25°29'36.91"N	85°59'29.74"E	2.24
61	61	25°29'26.00"N	85°59'40.18"E	2.58
62	62	25°29'11.60"N	85°59'58.78"E	1.53
63	63	25°27'28.52"N	85°59'58.19"E	2.54
64	64	25°27'22.86"N	85°59'45.60"E	0.89
65	65	25°27'22.86"N	85°59'50.60"E	1.64

66	66	25°26'56.23"N	86° 0'0.35"E	2.00
67	67	25°27'7.83"N	85°59'50.46"E	1.00
68	68	25°27'13.06"N	86° 0'52.44"E	2.20
69	69	25°28'5.49"N	86° 0'46.34"E	0.53
70	70	25°27'54.46"N	86° 1'15.77"E	0.33
71	71	25°28'5.04"N	86° 1'20.15"E	2.22
72	72	25°28'7.74"N	86° 1'33.28"E	0.21
73	73	25°27'28.55"N	86° 1'1.01"E	1.71
74	74	25°27'4.66"N	86° 1'5.23"E	0.51
75	75	25°26'46.02"N	86° 0'46.42"E	0.45
76	76	25°23'51.40"N	86° 0'49.87"E	9.91
77	Bihat Pokhara	25°25'15.79"N	86° 1'21.29"E	3.31
78	78	25°26'26.66"N	86° 1'40.78"E	0.60
79	79	25°26'26.66"N	86° 1'40.78"E	0.40
80	80	25°26'25.07"N	86° 2'15.99"E	0.23
81	81	25°24'12.89"N	86° 1'27.24"E	7.49
82	Papraur Pond	25°26'5.57"N	86° 2'42.66"E	58.7
83	83	25°26'38.05"N	86° 2'40.52"E	0.92
84	84	25°25'44.47"N	86° 2'52.72"E	6.66
85	85	25°25'43.02"N	86° 2'38.59"E	0.75
86	86	25°25'29.94"N	86° 2'24.14"E	0.21
87	87	25°25'32.82"N	86° 2'33.74"E	0.32
88	88	25°25'30.97"N	86° 2'41.60"E	0.26
89	89	25°23'40.89"N	86° 1'24.85"E	3.66
90	90	25°22'30.10"N	86° 1'5.80"E	4.25
91	91	25°22'20.60"N	86° 1'40.66"E	2.10
92	92	25°23'9.38"N	86° 6'56.86"E	37.5
93	93	25°22'38.91"N	86° 6'30.38"E	2.56
94	94	25°22'50.95"N	86° 6'42.83"E	0.67
95	95	25°24'24.75"N	86° 8'45.24"E	O.40
96	96	25°24'32.79"N	86° 9'2.22"E	0.26
97	97	25°24'40.00"N	86° 8'59.61"E	0.58
98	98	25°24'43.35"N	86°10'7.96"E	0.61
99	99	25°24'1.59"N	86° 9'52.73"E	0.54

100	100	25°23'55.30"N	86° 9'43.83"E	0.57
101	101	25°24'42.16"N	86°10'29.08"E	0.79
102	102	25°24'27.83"N	86°10'56.21"E	2.28
103	103	25°24'31.84"N	86°11'51.91"E	1.10
104	104	25°24'27.68"N	86°11'31.62"E	0.67
105	105	25°21'55.88"N	86°10'59.63"E	0.41
106	106	25°22'15.19"N	86°11'21.96"E	0.61
107	107	25°22'7.95"N	86°12'12.62"E	0.85
108	108	25°22'1.51"N	86°14'45.54"E	12.7
109	109	25°25'6.53"N	86°15'49.74"E	1.12
110	110	25°25'11.23"N	86°16'19.47"E	0.21
111	111	25°25'16.30"N	86°16'22.68"E	0.31
112	112	25°25'18.18"N	86°16'29.97"E	0.49
113	113	25°25'10.14"N	86°16'29.56"E	0.43
114	114	25°25'29.84"N	86°16'30.94"E	4.72
115	115	25°25'16.45"N	86°17'12.05"E	1.26
116	116	25°25'25.06"N	86°19'0.36"E	1.24
117	117	25°25'14.66"N	86°18'53.32"E	1.10
118	118	25°25'12.58"N	86°18'40.14"E	0.45
119	119	25°26'8.44"N	86°22'33.99"E	4.20
120	120	25°22'55.76"N	86°21'8.32"E	3.61
121	121	25°22'56.09"N	86°22'18.40"E	2.30
122	122	25°23'48.45"N	86°22'18.16"E	15.5
123	Murdaha/Chauki Tal	25°27'35.62"N	86°24'16.21"E	49.7
124	124	25°27'31.88"N	86°23'58.17"E	2.47
125	125	25°27'21.91"N	86°24'11.15"E	1.15
126	126	25°24'56.76"N	86°23'30.85"E	0.89
127	127	25°23'1.03"N	86°22'55.72"E	2.27
128	128	25°23'55.10"N	86°23'52.34"E	28.2
129	Sahebpur Tal	25°25'36.76"N	86°24'30.35"E	15.1
130	Rahua Tal	25°27'16.55"N	86°25'14.74"E	41.1
131	131	25°27'6.55"N	86°25'49.25"E	3.36
132	132	25°26'43.07"N	86°25'52.22"E	1.73

133	133	25°24'4.82"N	86°24'45.61"E	4.12
134	134	25°26'6.27"N	86°26'18.60"E	0.84
135	135	25°26'22.63"N	86°25'56.13"E	1.67
136	136	25°26'21.81"N	86°26'22.92"E	2.38
137	137	25°27'1.86"N	86°26'38.79"E	1.00
138	138	25°24'57.21"N	86°23'19.26"E	0.52
139	139	25°27'40.76"N	86°26'40.70"E	2.00
140	140	25°25'46.16"N	86°26'28.17"E	1.10
141	141	25°15'16.77"N	86°12'23.54"E	8.59
142	142	25°16'5.03"N	86°11'40.23"E	2.82
143	143	25°18'5.06"N	86°11'55.93"E	13.7
144	144	25°27'50.71"N	85°58'55.58"E	1.47
145	145	25°27'40.11"N	85°59'12.86"E	6.78
146	146	25°27'59.60"N	85°58'52.71"E	0.78
147	147	25°28'2.73"N	85°58'58.78"E	0.53
148	148	25°29'28.01"N	86° 0'14.33"E	0.75
149	149	25°23'24.16"N	86°13'41.74"E	1.15
150	150	25°23'11.46"N	86°13'28.69"E	0.38
151	151	25°24'53.36"N	86°19'30.33"E	5.17
152	Badi Pokhra	25°24'39.97"N	86° 8'24.59"E	0.66
		Total		**531.2 Ha.**

8.3 The identified wetlands are located in the floodplain of Ganga and Burhi Gandak River. The identified wetlands maybe classified into – oxbow/river remnants/meanders, village ponds and urban ponds. The details of wetlands surveyed in Begusarai District are provided below :

8.3.1 **Murdaha/ Chauki Tal :** The wetland is located in Chauki Village at latitude 25°27'35.62"N and longitude 86°24'16.21"E having water spread area of 49.7 hectares [Refer Map 8 & Table No. 2 (Wetland No. 123)]. The wetland is named as Murdaha Talab as it is a remnant of Murdaha Nala. Earlier, the bank of the wetland was used for cremation and burial. In recent days, cremation has been stopped and is now performed along Burhi Gandak River.

Maximum depth of the wetland is reported as 25-30 feet [based on conversation with fishermen community] and its width varies between 290 m to 60 m. North-western part of the wetland usually dries in summer and is used for sowing maize and *Zaid* crops. The south-eastern part of wetland is connected to Burhi Gandak River through a *Nala* [Refer Image No. 26]. The overflow of the wetland goes to Burhi Gandak. The Inflow and outflow to Burhi Gandak river is controlled through a sluice gate located near flood control bund. The flood control bund which runs throughout the stretch of Burhi Gandak river in the district separates the catchment of Murdaha Tal from the river [Refer Image No. 26]. The bank of wetland along Chauki village is vulnerable to lateral erosion. Villagers claimed that the rate of erosion has increased in recent years.

Currently, wetland is on lease and is used for the fish farming [Refer Image No. 23]. Fish species found in the wetland includes both local and introduced species namely – Rohu [*Labeo rohita]*, Catla [*Labeo catla]*, Brigid, Silver carp, Grass carp, Sawri, Padhina, Bhakur, Lodhwa, Pothia [*Puntius chola]*, Chana, Gagri, Mirki, Marwa, Bowari [*Wallago attu*] and Tengra [*Mystus tengara].*

Image 22 : Murdaha Talab [Looking North-West]

Image 23 : Fishing Activities In Murdaha Tal [Looking East]

8.3.2 **Rahua Tal :** The wetland is located in Rahua Village at latitude 25°27'16.55"N and longitude 86°25'14.74"E having water spread area of 41.1 hectares [Refer Map 8 & Table No. 2 (Wetland No. 130)]. The wetland is a remnant of a *Nala* which empties to Burhi Gandak. Maximum depth of the wetland is reported as 20-22 feet [based on conversation with fishermen community] and its width varies between 233 m to 70 m. Western part of the wetland usually dries in summer and is used for sowing maize, mustard and *Zaid* crops. The eastern part of wetland is connected to the Burhi Gandak River through a *Nala* [Refer Image No. 26]. The overflow of the wetland goes to Burhi Gandak. The Inflow and outflow to Burhi Gandak river is controlled through a sluice gate located near flood control bund. The flood control bund which runs throughout the stretch of Burhi Gandak river in the district separates the catchment of the wetland from the river [Refer Image No. 26].

Currently, wetland is on lease and is used for the fish farming. Fish species found in the wetland is similar to the Murdaha Tal. The wetland is an important site for avian species. As per local communities several bird species used to visit the wetland in winter season.

Image 24 : Rahua Tal [Looking South]

Image 25 : Rahua Tal [Looking North]

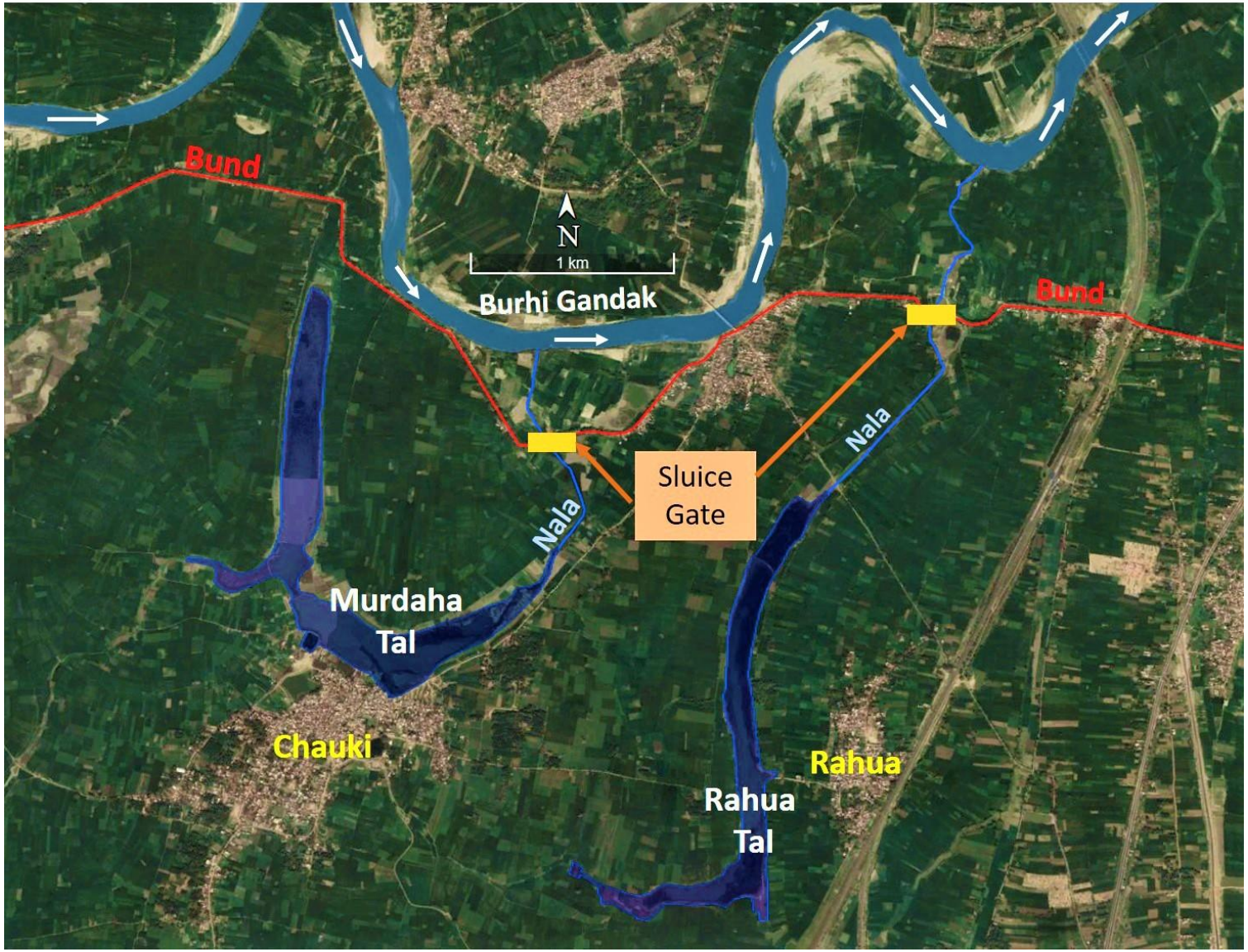


Image 26 : Satellite Image Showing Murdaha Tal And Rahua Tal

[Source : Google Earth Imagery, January 2022]

8.3.3 **Sahebpur Tal :** The wetland lies between North-Western railway main line and NH-31, near Sahebpur Kamal village at latitude 25°25'36.76"N and longitude 86°24'30.35"E having water spread area of 15.1 hectares [Refer Map 8 & Table No. 2 (Wetland No. 129)]. The wetland was a depression that further deepened due to clay digging. Maximum depth of the wetland is around 30-35 feet [based on conversation with fishermen community].

Currently, wetland is on lease and is used for the fish farming. Fish species found in the wetland includes both local and introduced species namely – Rohu [*Labeo rohita]*, Catla [*Labeo catla]*, Brigid, Silver carp, Bowari [*Wallago attu*], Mirka and ichna.

Image 27 : Sahebpur Talab [Looking East]

8.3.4 **Flood inundated Area :** Apart from the identified wetlands there is a huge area which inundates and remain flooded for four-six month in a year. This is because the study area is located in the floodplain of Ganga, Burhi Gandak, Kiul-Harohar and Baya Nadi. The paleo-channels in the study corridor also gets active in the monsoon season. The Satellite Imagery of August 2016 showing the flooded study area [left bank and Right Bank] is provided in Image No. 28.

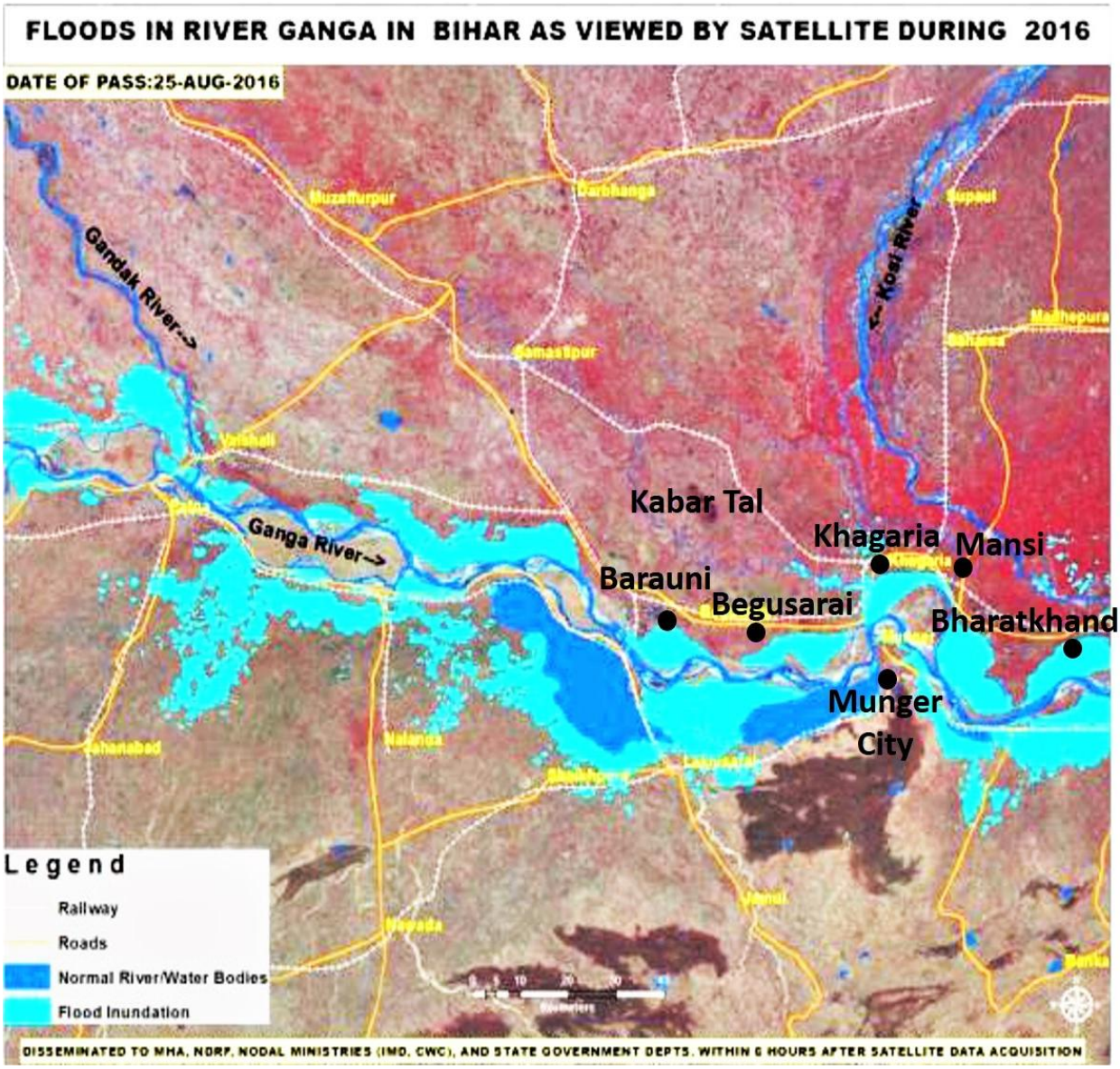


Image 28 : Satellite Imagery Of August 2016 Showing The Flood Inundated Area Along Ganga River

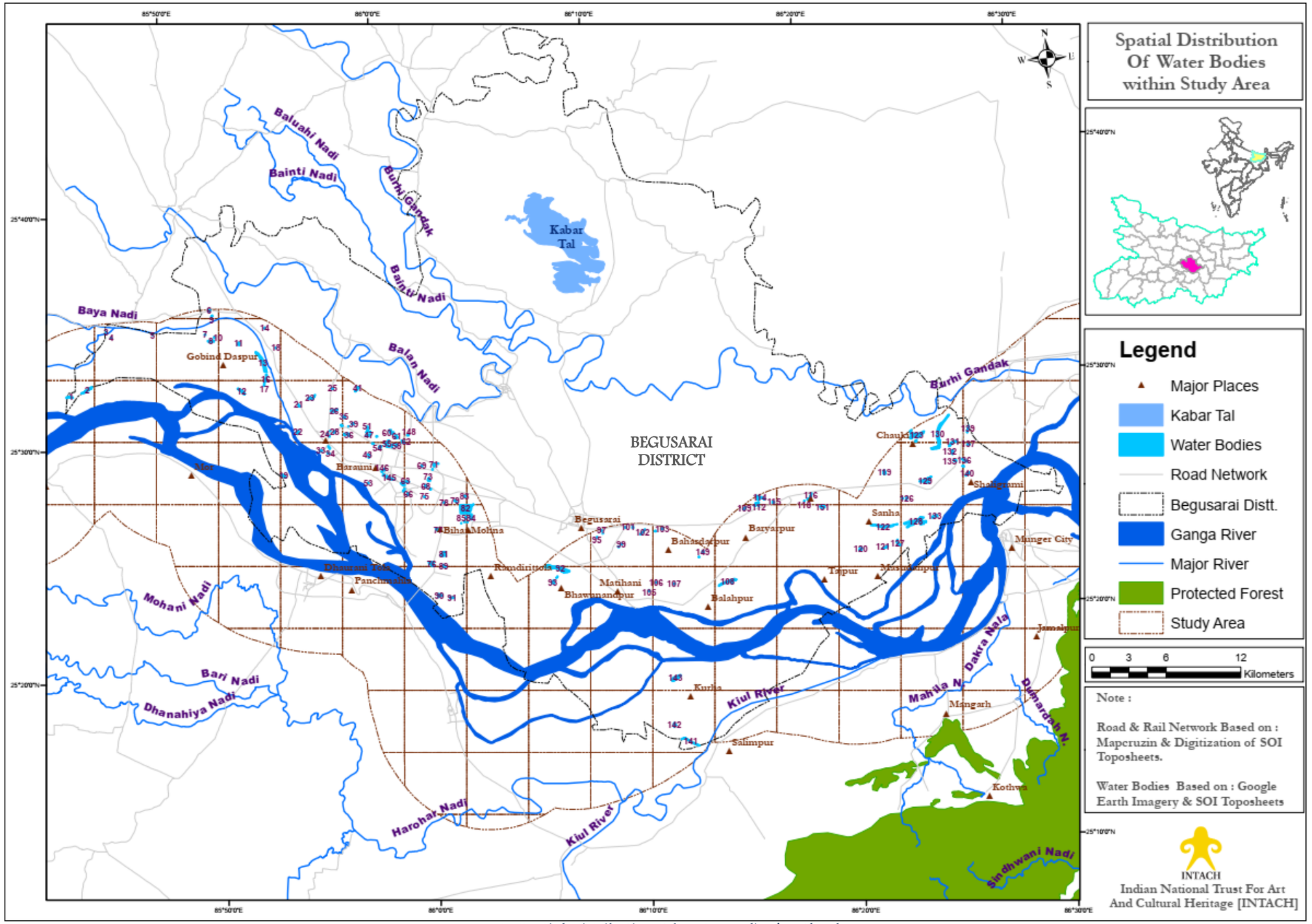
[Source : Flood Hazard Atlas - Bihar - A Geospatial Approach]

8.3.5 **Kabar Tal:** The Kanwar Taal (also known as Kanwar Tal or Kabar Tal) is Asia's largest natural oxbow lake formed due to meandering of Gandak river in Begusarai distt. [Refer Image No. 29 & Map No. 8]. This freshwater wetland was notified as a protected area under the Wildlife (Protection) Act, 1972 by Bihar State Govt. in 1986. Further, wetland was designated as Ramsar site in July, 2020 [Ramsar site No. 2436]. Despite being accorded the legal protection, the area of this wetland has drastically reduced from 6786 ha in 1984 to 2032 ha in 2012 [Kumar & Pandey, 2017]. Studies conducted by Ghosh et al. [2004] & Roy et al. [2008] reported that in the past few years maximum area of the

lake has brought under intensive cultivation while a study by Singh & Jayakumar [2016] reported severe deterioration of water quality in this lake due to significant silting of its connecting river channels.

Image 29 : Kabar Tal, Begusarai

[Kabar Tal (located outside study corridor at 25°36'59.70"N, 86° 8'46.27"E) is representative of an extensive floodplain wetland. It is a Freshwater; Shrub dominated Wetland]



Map 8 : Spatial Distribution Of Water Bodies/Wetlands

9.0 Riparian Flora Along Ganga River In Begusarai Distt.

9.1 The riparian areas, 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 [Uttarakhand] to Chinasura [West Bengal].

9.3 The pattern of riparian vegetation within study area [Begusarai Distt.] is similar to study regions in Samastipur, Patna, Khagaria and Munger District. The right bank of River Ganga in Begusarai and Munger district is lacking the riparian vegetation. This is because of the extensive agricultural practice and settlements along the river bank. The number of settlements along the National Highway [runs parallel to the Ganga] is still increasing. The left bank of River Ganga between Samastipur-Begusarai boarder and Simaria Ghat is devoid of riparian vegetation. This is because of lateral erosion, extensive farming and gradual increase in settlements. The flood control bund which runs almost parallel to River Ganga work as buffer between the river and the noosphere.

9.4 Major riparian patches identified between Simaria Ghat and upto Begusarai-Khagaria boarder are located at –25°26'1.98"N & 86°28'38.07"E [Left Bank], 25°21'38.66"N & 86°17'33.92"E [Left Bank], 25°20'53.86"N & 86°17'18.86"E [Left

Bank], 25°20'33.22"N & 86°13'40.59"E [Left Bank], 25°18'55.27"N & 86°16'8.50"E [Right Bank], 25°19'4.23"N & 86°11'47.74"E [Right Bank], 25°20'36.85"N & 86°17'4.84"E [Riverine Island], 25°19'37.98"N & 86°14'2.98"E [Riverine Island] 25°21'12.17"N & 86° 8'19.13"E [Riverine Island] and 25°24'43.31"N & 85°57'59.93"E [Riverine Island].

9.5 The riparian patches are mostly dominated by *Saccharum spontaneum* [Kaas/ Kans], *Saccharum munja* [Munj], *Ziziphus nummularia* [Wild Ber], Sesbania spp. [Dhaicha], *Polygonum glabrum, Desmostachya bipinnata* [Kusha], *Ailanthes excelsa*, *Calotropis* spps., *Ricinus communis, Achyranthes aspera*, *Boerhavia diffusa*, *Cassia* sp., *Ocimum* sp., *Parthenium hysterophorus* (invasive) and *Pithecellobium dulce* [Jungle Jalebi]. The canopy in this stretch mainly comprises of trees such as *Bombax ceiba* [Semal], *Mangifera indica* [Aam], *Ficus religiosa* [Peepal], *Acacia nilotica* [Babool], *Aegle marmelos* [Sirfal/Bel], *Phoenix dactylifera* [Khajur], *Borassus flabellifer* [Taad/Tar], *Tamarindus indica* [Imli], *Gmelina arborea and Azadirachta indica* [Neem]. The grasses in this region are mainly members of Cyperaceae and Poaceae plant families. List of recorded riparian species are provided in Table No. 3.

Image 30 : *Borassus flabellifer* [Taad/Tar] Trees In Mustard Fileds
[Ground Cover has been converted for agricultural activities]

9.6 Some riparian grasses are economically valuable in the district. *Saccharum spontaneum* and *Saccharum munja* are used for making huts, basket and ropes. Leaves of *Borassus flabellifer* [Taad/Tar] are used for making handmade fan, mats

and for thatching roofs of huts. Small sized baskets made from *munj* are locally called *daliya* and large sized baskets are called *Dala*. Baskets made from *munj* are generally considered as sacred and are widely used for performing rituals especially *Chhath Puja*. A large sized basket costs around 100-200 and is sold at local market in Barauni and Begusarai City. Ropes [locally called Baadh] made of *Saccharum spontaneum* are more durable. A bundle of rope of nearly 1.5 Kg weight costs around 35 rupees and is also sold at local market. Bamboo baskets and mats are also common in the distt. [Refer Image No. 32].

Image 31 : Harvested *Saccharum* At Ganga River Bank

Image 32 : A Temporary Hut Made From Bamboo On Flood Control Bund

Table 3 : Recorded Riparian Plant Species Within Study Area [Begusarai Distt.]

Sr. No.	Botanical Name	Family	Common Name
1.	*Saccharum spontaneum* L.	Poaceae	Kaans
2.	*Saccharum munja* Roxb.	Poaceae	Munj
3.	*Tamarindus indica*	Fabaceae	Imli
4.	*Desmostachya bipinnata*	Poaceae	Kusha
5.	*Ipomea carnea*	Convolvulaceae	Besaram
6.	*Ipomea aquatica*	Convolvulaceae	Besaram
7.	*Ziziphus nummularia (Burm.f.) Wight & Arn.*	Rhamnaceae	Ber
8.	*Pithecellobium dulce*	Fabaceae	Jungle Jalebi
9.	*Acacia nilotica* (L.) Delile	Fabaceae	Babool
10.	*Aegle marmelos* (L.) Corrêa	Rutaceae	Bel or sirphal
11.	*Azadirachta indica* A. Juss.	Meliaceae	Neem
12.	*Bombax ceiba* L.	Bombacaceae	Semal/Semar
13.	*Dalbergia sissoo* DC.	Fabaceae	Shisham
14.	*Delonix regia* (Hook.) Raf.	Fabaceae	Gulmohar
15.	*Ficus benghalensis* L.	Moraceae	Banyan
16.	*Ficus religiosa* L.	Moraceae	Peepal
17.	*Ficus virens* Aiton	Moraceae	Pakad/Pakar
18.	*Borassus flabellifer L.*	Arecaceae	Taad/Tar
19.	*Phoenix dactylifera*	Arecaceae	Khajur
20.	*Madhuca longifolia var. latifolia* (Roxb.) A.Chev.	Sapotaceae	Mahua
21.	*Peltophorum pterocarpum* (DC.) K.Heyne	Fabaceae	Peela Gulmohar
22.	*Sesbania aculeata*	Fabaceae	Dhaicha
23.	*Polyalthia longifolia* (Sonn.) Thwaites	Annonaceae	False Ashok
24.	*Tectona grandis* L.f.	Lamiaceae	Teak
25.	*Nyctaanthes arbor-tristis*	Oleaceae	Harsringar
26.	*Thevetia peruviana*	Apocynaceae	Kaner
27.	*Calotropis gigantea* (L.)	Apocynaceae	Safed Aak

	Dryand.		
28.	*Calotropis procera* (Aiton) Dryand.	Apocynaceae	Aak
29.	*Lantana camara* L.	Verbenaceae	~~~~~
30.	*Malvastrum coromandelianum* (L.) Garcke	Malvaceae	False Mallow
31.	*Psidium guajava*	Myrtaceae	Guava
32.	*Carica papaya* L.	Caricaceae	Papaya
33.	*Phyllanthus emblica*	Phyllanthaceae	Amla or Awla
34.	*Magnifera Indica*	Anacardiaceae	Mango
35.	*Prosposis julifora*	Fabaceae	Vilayti Keekar
36.	*Ocimum tenuiflorum L.*	Lamiaceae	Tulsi
37.	*Polygonum glabrum* Willd.	Polygonaceae	Common marsh buckwheat
38.	*Ricinus communis* L.	Euphorbiaceae	Arandi
39.	*Ziziphus nummularia* (Burm.f.) *Wight &Arn.*	Rhamnaceae	Wild Ber
40.	*Achyranthes aspera* L.	Amaranthaceae	Chirchira
41.	*Amaranthus spinosus* L.	Amaranthaceae	Prickly Amaranth
42.	*Croton bonplandianus* Baill.	Euphorbiaceae	Ban Tulsi
43.	*Parthenium hysterophorus* L.	Asteraceae	Congress grass
44.	*Rumex dentatus* L.	Polygonaceae	Jungli Palak
45.	*Solanum xanthocarpum* Schrad. & H. Wendl.	Solanaceae	Kateli
46.	*Tephrosia purpurea* (L.) Pers.	Fabaceae	Sharpunkha
47.	*Tridax procumbens* (L.) L.	Asteraceae	~~~~~
48.	*Xanthium strumarium* L.	Asteraceae	Chhota Dhatura
49.	*Cyperus difformis* L.	Cyperaceae	~~~~~
50.	*Cyperus rotundus* L.	Cyperaceae	Nut grass
51.	*Dicanthium annulatum*	Poaceae	~~~~~
52.	*Datura metel L.*	Solanaceae	Dhatura

Image 33 : *Aegle marmelos* [Bel or Sirfal] In A Small Riparian Patch

Image 34 : *Phoenix dactylifera* [Khajur]

[Matka attached to get *Khajur Tari*]

Palm Juice [Toddy]

Taad or Tar tree or doub palm, scientific name *Borassus flabellifer* is commonly found in the Magadh, Angika and Mathili region of Bihar. Taad tree has a long grey trunk and reaches a height of 30 meters. Juice obtained from Taad tree is a very famous local beverage called "toddy". "Pasi" a local community, is associated with collection of toddy from the sap and are famous for their Taad tree climbing skill. This is the major source of income for Pasi community.

Pasi community collects juice from the sap twice a day where fermentation starts naturally as soon as the juice begins to trickledown in the earthenware or gourd. Fresh palm juice is non-alcoholic and is healthy for the digestive system but as time passes fermentation takes place and the juice becomes alcoholic in nature.

As Alcohol is prohibited in Bihar, a few awful practices have been observed to compensate for the alcohol, some medicine such as *Alprazplam, Codine*, etc. are mixed with toddy to enhance the fermentation process to make it more alcoholic.

To discourage consumption of toddy, the Bihar government is commercially licensing the production of Neera (toddy), under ***Bihar Neera (Unfermented Juice of Palms) Rules, 2017***. Under the law it has been mentioned that the Inspecting officer shall inspect the palm tree product (toddy) for the presence of intoxicants and alcohol content and any adulteration may leads to cancellation of license. All those applying for a license have to submit to test, showing whether they can climb palm trees.

10.0 Faunal Diversity In Begusarai Distt.

10.1 According to India State of Forest Report [2019], 2.78% geographical area of the district is under open forest, moderately dense forest accounts for 1.49% while very dense forest is not present in the district[6]. Few patches of riparian vegetation are found at the river bank and diaras and plantation along flood control bund provide habitat to Jungle Cat, Golden Jackal [*Canis aureus*], Fox [*Vulpes bengalensis*], Hare [*Lepus ruficaudatus*], Nilgai [*Boselaphus tragocamelus] and* Indian wild boar [*Sus scrofa*]. Plantation mainly of *Litchi senensis, Bombax ceiba, Mangifera indica and Psidium guyava* provides the habitat to Monkey [*Rhesus macaque*] and Langur [*Semnopithecus spp.*].

Image 35 : Group of Monkey [*Rhesus macaque*] In a Temple Complex

10.2 **Nilgai Conflict:** 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

[6] India State of Forest Report [Bihar], 2019
https://fsi.nic.in/isfr19/vol2/isfr-2019-vol-ii-bihar.pdf

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. According to various news articles published online, the increased population of nilgai in Begusarai has caused nightmares for the farmers who face large scale crop destructions due to them. Numerous fields of wheat, maize, pulses and vegetables are destroyed by nilgai for the protection of which the farmers have begun barricading the fields. The farmers in the distt. also claim that they are attacked by herd of nilgai if they venture in the field alone or try to disperse them and hence, they have to resort violently for dealing with this menace.

10.3 **Gangetic Dolphin:** 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. This species is also found inhabiting the Ganga river stretch in Begusarai which together with Patna and Munger forms one of the most important stretches for dolphins. The presence of Gangetic River Dolphin is reported throughout the study corridor. However, major sighting occurred Near Steamer Ghat [Munger Ghat], Simaria Ghat and at Ganga-Baya Nadi Confluence.

10.4 **Avian Diversity :** The entire study area is a floodplain, Thus liable to flood. After flood the small depressions, paleo-channels and meanders usually filled up and provide the suitable habitat to migratory, local migratory and resident birds. In current study, the avian diversity survey was conducted in January 2022. The diversity was recorded using binoculars and identified using field guides (Salim Ali, 2012; Grimmett et al., 2016). Major sites for recorded avian species are- Kabar Tal, Murdaha Tal, riverine wetlands, depression near Simaria Ghat and Paleo-Channel of Baya river. The conservation status of the species was listed by using IUCN Red Data List. A list of identified birds is provided in the Table No. 4.

Table 4 : Recorded Avian Species

Common Name	Scientific Name	IUCN Red List Status
Oriental Darter	***Anhinga melanogaster***	**Near Threatened**
Little Cormorant	*Phalacrocorax niger*	Least Concern
Indian Cormorant	*Phalacrocorax fuscicollis*	Least Concern
Great Cormorant	*Phalacrocorax carbo*	Least Concern
Little Egret	Egretta garzetta	Least Concern
Red - Wattled Lapwing	*Vanellus indicus*	Least Concern
White-Breasted Waterhen	*Amaurornis phoenicurus*	Least Concern
Common Moorhen	*Gallinula chloropus*	Least Concern
Purple Mooorhen	*Porphyrio porphyrio*	Least Concern
Red-naped Ibis	*Pseudibis papillosa*	Least Concern
Indian Pond Heron	Ardeolagrayii	Least Concern
Common Greenshank	*Tringa nebularia*	Least Concern
Common Redshank	*Tringa totanus*	Least Concern
Common Kingfisher	*Alcedo atthis*	Least Concern
Greater Coucal	*Centropus bengalensis*	Least Concern
Black Kite	*Milvus migrans*	Least Concern
Asian openbill stork	*Anastomus oscitans*	Least Concern
Black-necked Stork	***Ephippiorhynchus asiaticus***	**Near Threatened**
Lesser Adjutant	***Leptoptilos javanicus***	**Vulnerable**
Greater Adjutant	***Leptoptilos dubius***	**Endangered**
Little Stint	*Caldris minuta*	Least Concern
Woolly-necked Stork	***Ciconia episcopus***	**Near Threatened**
Lesser Whistling-duck	*Dendrocygna javanica*	Least Concern
Cotton Pygmy-goose	*Nettapus coromandelianus*	Least Concern
Bar-headed Goose	*Anser indicus*	Least Concern

Tufted Duck	*Aythya fuligula*	Least Concern
River Lapwing	***Vanellus duvaucelii***	**Near Threatened**
Scaly-breasted Munia	*Lonchura punctulate*	Least Concern
Indian Roller	*Coracias benghalensis*	Least Concern
Green Bee-Eater	*Meropsorientalis*	Least Concern
Common Hoopoe	*Upupa epops*	Least Concern
Common Myna	*Acridotherestristis*	Least Concern
Bank Myna	*Acridotheres ginginianus*	Least Concern
Asian Pied Starling	*Sturnus contra*	Least Concern
Common Stonechat	*Saxicola torquatus*	Least Concern
Pied Bushchat	*Saxicola caprata*	Least Concern
Indian Bushlark	*Mirafra erythroptera*	Least Concern
Paddyfield Pipit	*Anthus rufulus*	Least Concern
Common Babbler	*Argya caudata*	Least Concern
Jungle Babbler	*Argya striata*	Least Concern
Large Grey Babbler	*Argya malcolmi*	Least Concern
Black-hooded Oriole	*Oriolus xanthornus*	Least Concern
Indian Golden Oriole	*Oriolus Kundoo*	Least Concern
White Wagtail	*Motacilla alba*	Least Concern
Black Drongo	*Dicrurus macrocercus*	Least Concern
Eurasian Collared Dove	*Streptopelia decaocto*	Least Concern
Spotted Dove	*Spilopelia chinensis*	Least Concern
House Sparrow	*Passer domesticus*	Least Concern
House Crow	*Corvus splendens*	Least Concern

Image 36 : Group Of Cormorants

Image 37 : Group Of Asian Openbill Stork In A Riverine Wetland

11.0 Ganga Riverine Islands/Diaras In Begusarai Distt.

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]. 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].

11.1 Many riverine islands are existent in the Ganga River stretch throughout Bihar state which is locally referred as *Diaras*. This term is derived from the word *Diya* (which means an earthen oil lamp) and has been coined for a land where a *Diya* is never lit [Udas *et al.*, 2018]. In local parlance in different parts of Bihar state, it symbolizes a village which is located outside the embankments of Ganga River floodplain. Some of the major *Diaras* surveyed in the study are described in this section.

11.2 There are fourteen major islands identified and documented within the district. Jurisdiction of the riverine islands lies in Patna-Begusarai and Begusarai-Munger-Khagaria Distt.s. The species – *Saccharum spontaneum, Saccharum munja* and *Ziziphus spp.* dominates the riparian flora of the island. Details of the riverine island are provided in Table No. 5.

Table 5 : Details Of The Riverine Island Within Begusarai Distt.

Sr. No.	Nearest Settlement	Coordinates		Status
		Latitude	Longitude	
1	Risalpur [Right Bank] [Refer Image No. 38]	25°19'9.86"N	86°19'33.94"E	Area approx. 4.19 Sq. Km. Jurisdiction: Munger and Begusarai Distt. Land Use: Agriculture Vegetation: Mainly *Saccharum spp.*
2	Shivnagar, Masudhanpur	25°20'50.39"N	86°23'44.56"E	Area approx. 5.84 Sq. Km. Jurisdiction: Munger and

	[Left Bank] [Refer Image No. 39]			Begusarai Distt. Land Use: Mainly Agriculture Vegetation : Few hectares only [*Saccharum spontaneum*, Saccharum munja]
3	Shivnagar, Masudhanpur [Left Bank] [Refer Image No. 39]	25°21'38.17"N	86°24'52.51"E	Area approx. 0.96 Sq. Km. Jurisdiction: Munger and Begusarai Distt. Land Use: Mainly Agriculture
4	Shivnagar, Masudhanpur [Left Bank] [Refer Image No. 39]	25°19'22.93"N	86°22'16.46"E	Area approx. 2.0 Sq. Km. Jurisdiction: Munger and Begusarai Distt. Land Use: Mainly Agriculture
5	Near Munger City [Refer Image No. 40]	25°21'59.60"N	86°26'12.83"E	Area approx. 8.44 Sq. Km. Jurisdiction: Munger and Begusarai Distt. Land Use: Mainly Agriculture Vegetation : Few hectares only [*Saccharum spontaneum*, Saccharum munja]
6	Near Munger City [Refer Image No. 40]	25°20'7.94"N	86°26'54.28"E	Area approx. 2.83 Sq. Km. Jurisdiction: Munger and Begusarai Distt. Land Use : Mainly Agriculture Vegetation: Few hectares only [*Saccharum spontaneum*, Saccharum munja]

7	Near Munger City [Refer Image No. 41]	25°20'7.94"N	86°26'54.28"E	Area approx. 7.84 Sq. Km. Jurisdiction: Munger, Begusarai and Khagaria Distt. Land Use: Mainly Agriculture Vegetation: Few hectares only [*Saccharum spontaneum*, Saccharum munja]. Vegetation is shrinking due extensive agricultural activities.
8	Near Hasanpur [Left Bank]	25°20'26.96"N	86°16'32.65"E	Area approx. 3.28 Sq. Km. Jurisdiction: Begusarai Distt. Land Use: Nil Vegetation: *Saccharum spp.*
9	Near Mahendrapur [Left Bank]	25°19'32.73"N	86°16'32.65"E	Area approx. 9.1 Sq. Km. Jurisdiction: Begusarai Distt. Land Use: Nil Vegetation: *Saccharum spp.*
10	Near Samho [Right Bank]	25°19'4.80"N	86°12'1.23"E	Area approx. 1.89 Sq. Km. Jurisdiction: Begusarai Distt. Land Use: Nil Vegetation: *Saccharum spp.*
11	Near Khutaha [Right Bank]	25°17'27.81"N	86° 5'21.74"E	Area approx. 54.1 Sq. Km. Jurisdiction: Begusarai and Patna Distt. Land Use: Mainly Agriculture Vegetation: Few hectares only [*Saccharum spontaneum*, Saccharum

				munja]. Vegetation is shrinking due extensive agricultural activities.
12	Near Matihani [Left Bank]	25°20'38.46"N	86° 7'55.75"E	Area approx. 6.26 Sq. Km. Jurisdiction: Begusarai Distt. Land Use: Nil Vegetation: *Saccharum spp.*
13	Simaria Diara [Left Bank] [Refer Image No. 42]	25°25'11.48"N	85°58'18.05"E	Area approx. 18.3 Sq. Km. Jurisdiction: Begusarai Distt. Land Use: Mainly Agriculture Vegetation: Few hectares only [*Saccharum spontaneum*, Saccharum munja]. Vegetation is shrinking due extensive agricultural activities.
14	Near Mokama [Right Bank]	25°26'18.31"N	85°54'1.35"E	Area approx. 44.5 Sq. Km. Jurisdiction: Begusarai and Patna Distt. Land Use: Mainly Agriculture Vegetation: Few hectares only [*Saccharum spontaneum*, Saccharum munja].

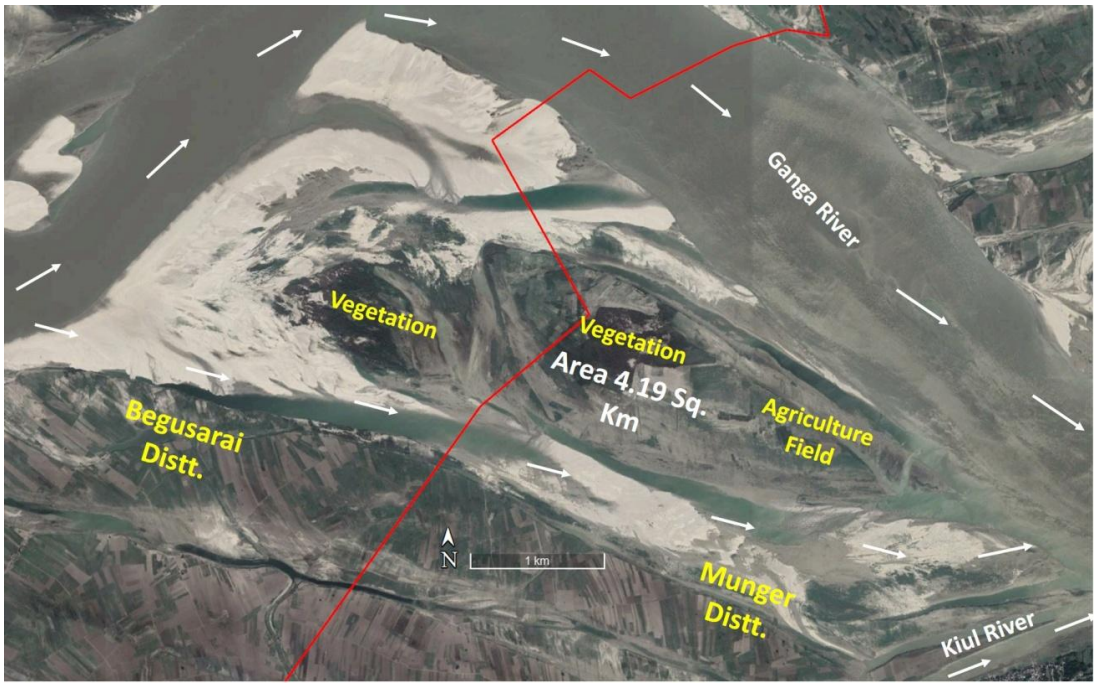


Image 38 : Riverine Island Near Risalpur [Refer Table 5, Sr. No. 1]

[Source : Google Earth Imagery, November 2021]

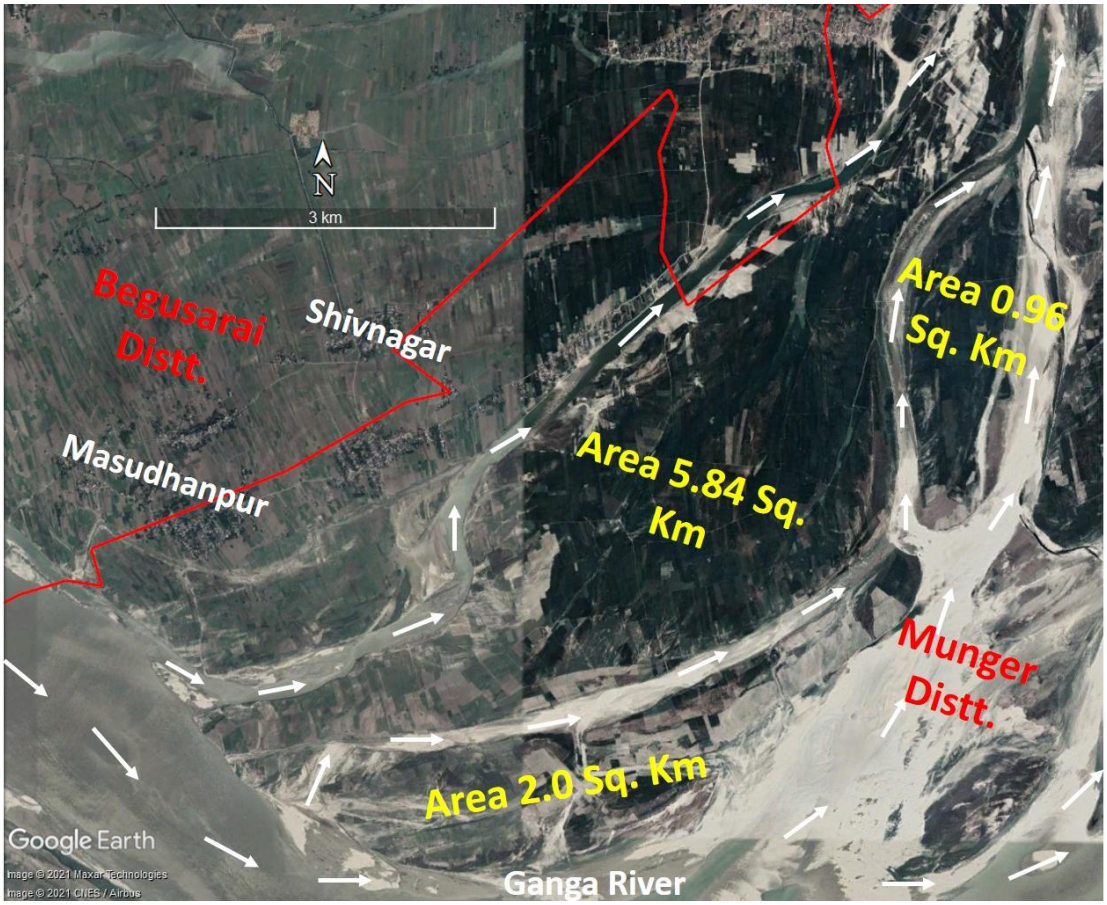


Image 39 : Riverine Island Near Masudhnagar [Refer Table 5, Sr. No. 2,3 & 4]

[Source : Google Earth Imagery, November 2021]

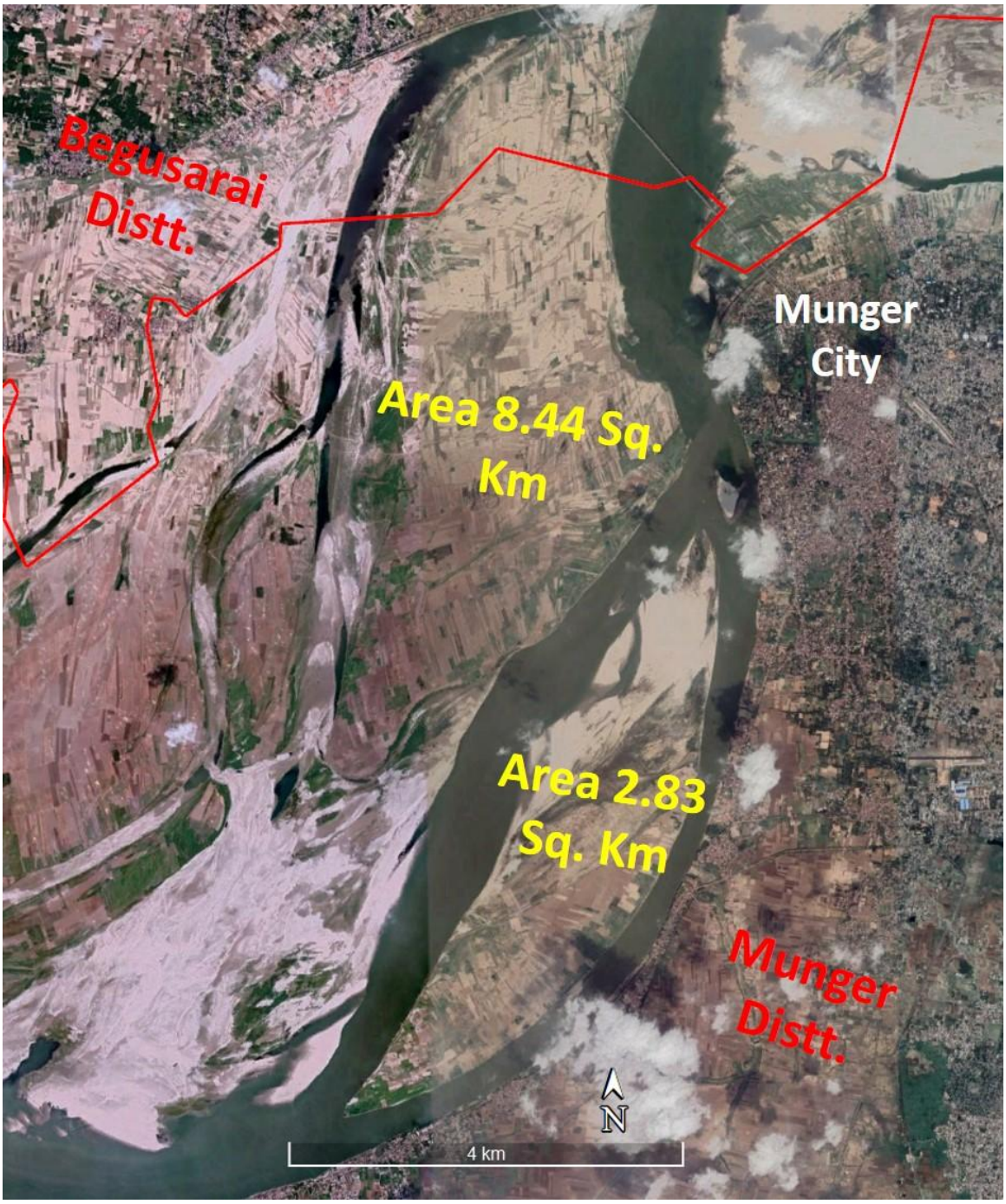


Image 40 : Riverine Island Near Munger City [Refer Table 5, Sr. No. 5 & 6]

[Source : Google Earth Imagery, May 2021]

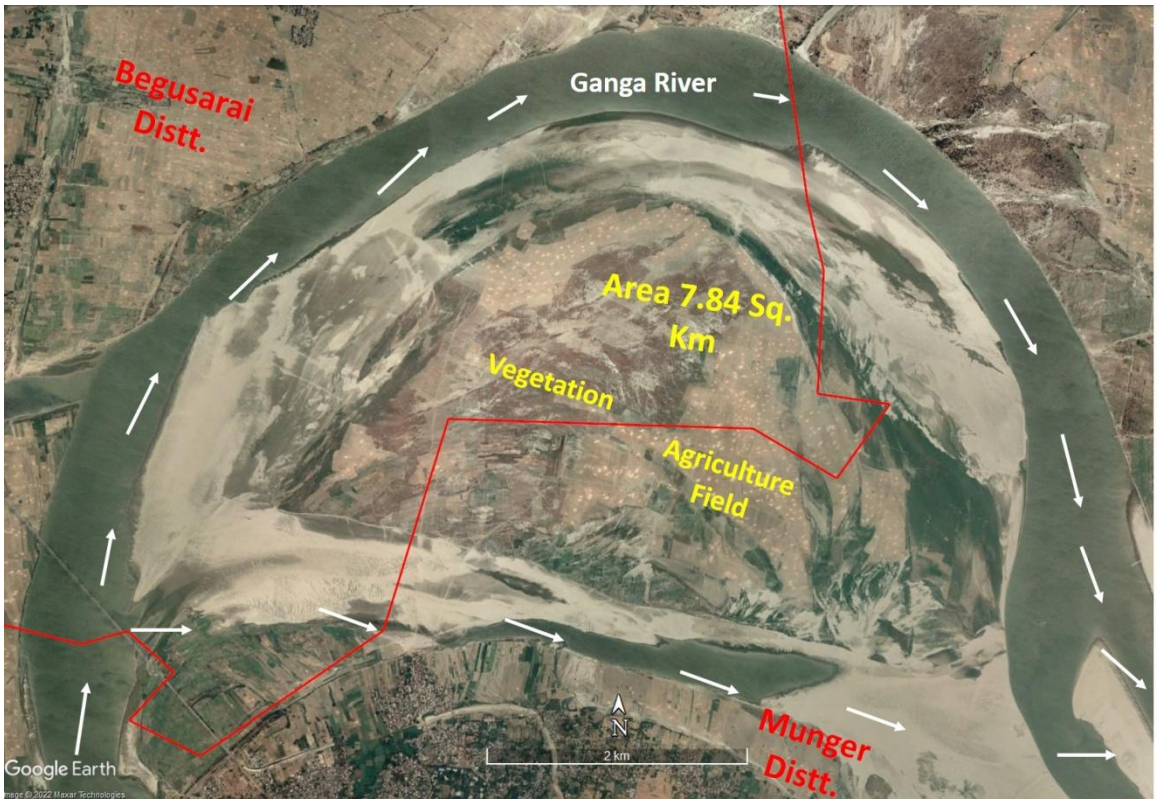


Image 41 : Riverine Island Near Munger City [Refer Table 5, Sr. No. 7]
[Source : Google Earth Imagery, May 2021]

Image 42 : Agriculture Fields At Simaria Diara

12.0 Fishing In Begusarai Distt.

12.1 Ganga River supports a rich diversity of fish fauna with about 260 fish species reported for Indian waters [Sinha & Khan, 2001]. About 35 species have been identified as having highest commercial value, including carps (Cyprinidae), snakeheads (Channidae), and catfishes (Siluriformes) [Islam et al. 2006]. However, most of these high value fish species have declined in numbers and many are also on the brunt of extinction today owing to a variety of environmental and anthropogenic factors. In Khagaria Distt., fishing is carried out by local communities often for their own consumption and for selling in nearby areas. Some of the important fishing gears used in this region include scoop nets, gill nets [Mathur et al., 2012] and hook and line technique.

12.2 A detailed study carried out by Sarkar et al., [2012] highlighted the presence of 59 different fish species in Ganga river stretch of Patna to Bhagalpur including Khagaria Distt. Some of the common fish species occurring in Khagaria stretch of Ganga include – *Aspidoparia morar*, *Mystus tengara*, *Mystus cavasius*, *Mystus menoda* and *Nangra punctata*. However, the major economically important fish species caught in this region included – *Labeo rohita*, *Labeo bata*, *Ailia coila*, *Cirrhinus mrigala* and *Mystus vittatus*. The study also reiterated the changes in fish diversity, overall decline in fish catch, and increasing number of exotic fishes in the region and pressed for improved conservation efforts to conserve the native species.

12.3 A large range of fish is found in the River Ganga and in its supporting rivers, & existing wetlands. Mostly two types of fishing activities have been noticed on the ground in Begusarai Distt. Traditional fishing activities are carried out by Malaah communities, where they use a net and boats to catch the fish. Commercial fish rearing is practiced by the businessman, where commercial breeding of fish is done in the fish tanks. Although, compared to adjacent distt. such as Khagaria & Munger, the production of fish is low. Most of the fish are sold in the local markets and a few are supplied to Patna fish market.

12.4 Rehu & Catla are the costliest fish in the market due to their high demand among the localities. Its price varies from Rs 250 -350 per kg. In the artificial fish tank mostly these two categories of fish are reared for commercial purposes. Fish species recorded during field visit are provided in Table No. 6.

Table 6 : Recorded Fish Species

Sr. No.	Common Name	Scientific Name
1	Rohu	*Labeo Rohita*
3	Striped Dwarf Catfish	*Mystus vittatus*
4	Indian Potasi	*Pseudeutropius atherinoides*
5	Grass carp	*Ctenopharyngodon idella*
6	Spiny Eel	*Mastacembelus armatus*
7	Indian knifefish	*Chitala chitala*
8	Bata	*Labeo bata*
10	Tengara catfish	*Mystus tengara*
11	Tengra	*Mystus cavasius*
12	Swamp barb	*Puntius chola*
13	Bighead carp	*Hypophthalmichthys nobilis*
14	Dwarf Goonch	*Bagarius bagarius*
15	Catla	*Labeo catla*

Image 43 : Fishing In Ganga River Near Simaria Ghat

13.0 Groundwater In Begusarai Distt.

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. It is also influenced by human induced factors like groundwater withdrawal and changes in land use pattern. According to CGWB (2013), based on the geological diversities and relative ground water potentialities in the aquifer, the Begusarai distt. can be subdivided broadly into two hydrogeological units – Older alluvium (Ganga formation) and Newer alluvium (Diara formation). The alluvium of Ganga plain comprises of alterations of gravel, sand of various grades and clay beds that constitute the prolific aquifers in the region. The groundwater in the distt. occurs under water table condition and semi-confined to confined conditions. The dug wells in this region tap the groundwater from shallow aquifers in a range of 5-15 m bgl while shallow tube wells tap the groundwater from unconfined aquifers in the depth range of 20-60 m bgl. In general the ground water obtained in the distt. is suitable for drinking and irrigation purposes.

13.2 On the basis of groundwater resource utilization, Central Ground Water Board (CGWB) has assessed the block wise ground water resource throughout the country. According to 2017 and 2020 assessment, Bachhwara, Barauni, Begusarai, Teghra, Matihani, Balia, Sahebpur Kamal and Samho Akha Kurha blocks fall under Safe category[7,8]. According to partially ground water contaminated area study of CGWB, ground water of Begusarai distt. is contaminated with Arsenic and Iron contaminants having values above 0.01 mg/l and 1 mg/l respectively[9]. The dug wells in this region tap the groundwater from shallow aquifers in a range of 5-15 m bgl while shallow tube wells tap the groundwater from unconfined aquifers in the depth range of 20-60 m bgl. In general the ground water obtained in the distt. is suitable for drinking and irrigation purposes.

13.3 During field visits, the survey team has interacted with local communities throughout the study corridor. Currently dug wells are not preferred source for the ground water withdrawal. Based on the interaction with the local communities it has

7 Block wise Ground Water Resources Assessment, CGWB, 2017
8 Block wise Ground Water Resources Assessment, CGWB, 2020
9 States Wise Details of Partly Affected Districts with Select Contaminants in Ground Water of India, CGWB http://cgwb.gov.in/WQ/Districts%20contamination.pdf

been found that people bore 70-130 ft for ground water withdrawal. This is because the groundwater is contaminated with arsenic and people believe that they may get uncontaminated water if they dig deeper. Based on local interaction ground water levels recorded at different villages are provided in the table below :

Table 7 : Water Levels (Based on interactions with local communities)

Location	Coordinates	GW Level (in feet)
Chauki Village	25°27'28.21"N, 86°24'9.21"E	40-50
Rahua Village	25°27'17.46"N, 86°25'32.48"E	40-50
Kurha Village	25°25'31.29"N, 86°24'16.65"E	40-50
Malhipur Village [Near Steamer Ghat]	25°25'0.28"N, 86°26'37.16"E	50-60
Kharhat Village	25°24'50.87"N, 86°25'59.54"E	50-60
Sanha Village	25°24'5.00"N, 86°21'33.82"E	50-60
Sadipur Village	25°22'32.59"N, 86°18'26.84"E	40
Manesarpur Village	25°24'19.65"N, 86°17'59.86"E	40-50
Bariyarpur Village	25°23'50.92"N, 86°15'47.55"E	60-70
Kasimpur Village	25°21'18.14"N, 86°14'49.37"E	60-70

14.0 Ganga River Bank In Begusarai Distt.

14.1 Study area is located in a *doab* region of Ganga-Burhi Gandak River and is liable to flood. A flood control bund has been constructed along both rivers to limit the severity of flood. Most of the area of the River Bank is prone to lateral erosion. The area between Samastipur-Begusarai boarder and Simaria Ghat is eroded while the area between Balhapur and Shaligrami is somehow stable. The accessibility to river bank in most of the area is limited. This is because, several paleo-channels which usually connect with River Ganga gets flooded and remain active for six to eight months of the year. There are two major ghats namely Steamer Ghat/ Munger Ghat [25°25'1.12"N, 86°26'55.08"E] and Simaria Ghat [25°22'44.07"N, 86° 0'11.15"E] in the study area which is easily accessible. However, these ghats lack the basic infrastructure.

Image 44 : Simaria Ghat, Begusarai Distt.

Simaria has a rich cultural and religious legacy and could easily be turned into a religious tourist spot associated with the Ganga River

Importance of Simaria Ghat

Simaria Ghat is situated on the northern bank of Ganga River in Simaria Village. It witnesses two important religious gathering – (1) *Kalpwas mela* [every year] and (2) *Ardh Kumbha* [once in six years].

(1) Kalpwas mela:

Kalpvas' means temporary stay on the banks of the Ganga to fulfill cherished wish of daily bath in Ganga [called *Ganga snaan*]. It is believed that a daily dip in the river during the month gets one rid of all his sins. Kalpwas mela starts with the end of Sharad Poornima, Kartik Snaan at Simaria ghat and run upto one month [Kartik Maah]. The Devotees are called '*kalpvasis*'. During their stay kalpvasis, observe purity and simplicity by living in thatched houses on the bank of the Ganga River and cooking on earthen stoves. The mela recorded a footfall of over 25,000 'kalpvasis' with 2,500 thatched roof cottages from northern Bihar, along with Nepal and Bhutan.

(2) Ardh Kumbh:

Ardh Kumbh a devotional congregation was held here in 2011 for the first time in an attempt to re-establish the lost importance of other 8 places where Kumbha was held according to scriptures. According to Simaria Kumbh Sewa Samiti, along with Religious Guru, Sadhu & Saint, lakhs of devotees from far-off places like Assam, Chhattisgarh, Haryana, and Uttar Pradesh etc. thronged the Simaria Ghat during Ardh Kumbh.

14.2 Cremation And Burial Ground

14.2.1 Ganga River Banks are used for cremation and burial ground for generations. Burial is not a common practice in Begusarai and nearby Distt.. However, few burial sites are reported near Amarpur Ghat. There are only two dedicated cremation ghats in Begusarai Distt. Namely – Rampur Ghat (Near Simaria Ghat) [25°22'30.33"N, 86°0'22.17"E] and Steamer Ghat/ Munger Ghat [25°25'1.12"N, 86°26'55.08"E]. [Refer Image No. 45 & 46]

Image 45 : Cremation At Munger/Steamer Ghat

Image 46 : Cremation At Rampur Ghat

14.3 Ganga Bank Erosion

14.3.1 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, and cultivation without taking proper conservation measures, destruction of forest and riparian vegetation. It is well known that exposed soils may erode rapidly (Singh et al., 2004).

14.3.2 The erosion prone sites along Ganga River in Begusarai Distt. are provided in table No.8 and also depicted in Map No. 9.

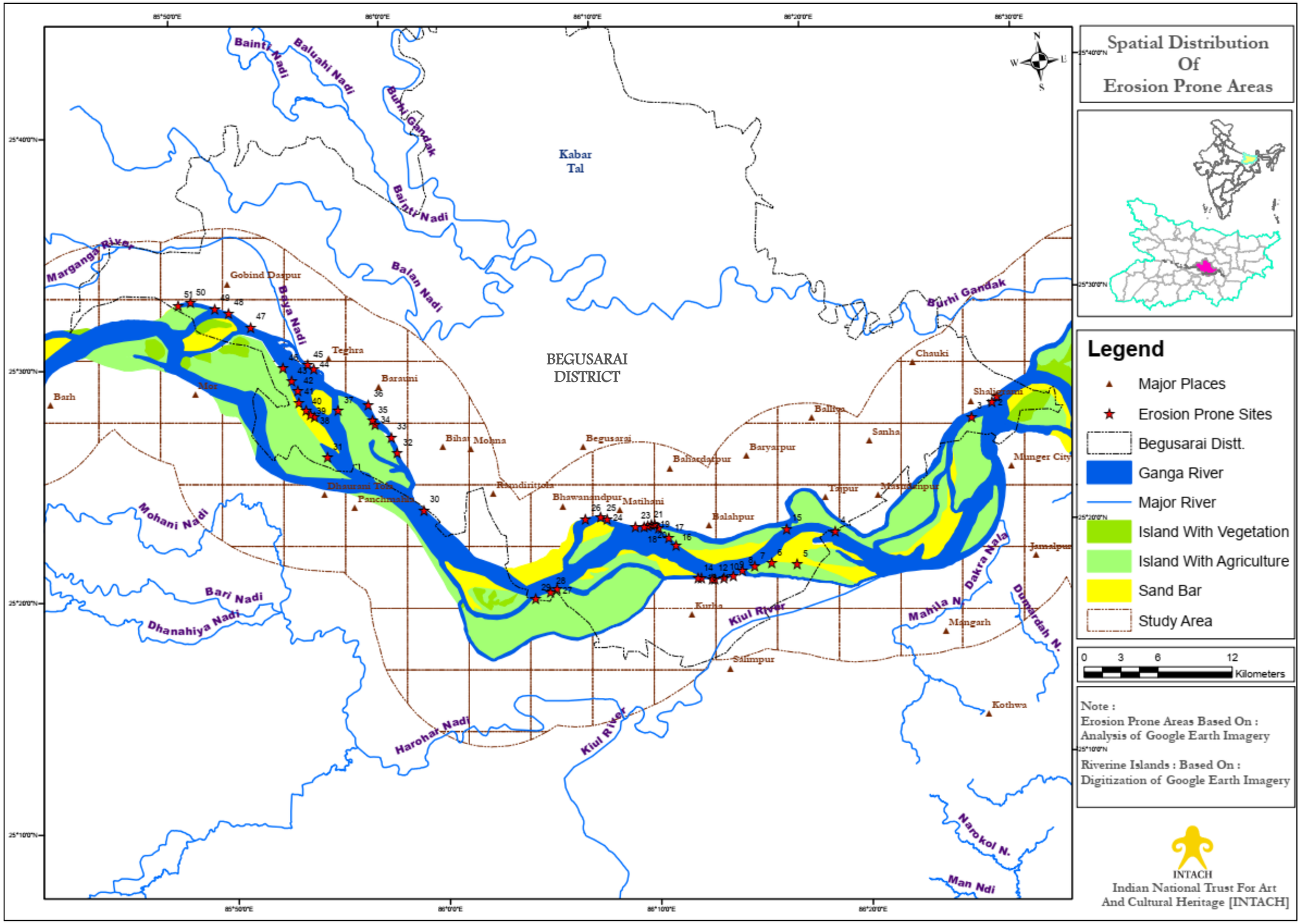
Table 8 : Eroded and Erosion Prone Sites Along Ganga River Bank in Begusarai Distt.

Sr. NO.	Coordinates		Nearest Settlement
	Latitude	Longitude	
01	25°25'29.40"N	86°27'51.02"E	Sites are located between Mohanpur (Steamer Ghat) and Malhipur [Left Bank]
02	25°24'42.41"N	86°26'35.08"E	
03	25°24'42.41"N	86°26'35.08"E	
04	25°20'19.33"N	86°19'39.70"E	Near Bahadur Nagar [Left Bank]
05	25°19'0.39"N	86°17'43.39"E	Sites are located between Haibatganj village and Sonbarsa village [Right Bank]
06	25°19'9.30"N	86°16'31.36"E	
07	25°19'4.83"N	86°15'41.70"E	
08	25°18'56.45"N	86°15'5.90"E	
09	25°18'46.16"N	86°14'39.49"E	
10	25°18'41.20"N	86°14'11.35"E	
11	25°18'41.81"N	86°13'45.58"E	
12	25°18'41.18"N	86°13'38.64"E	
13	25°18'45.16"N	86°13'8.16"E	
14	25°18'45.87"N	86°12'58.17"E	
15	25°20'35.61"N	86°17'21.65"E	Near Hanpur village [Left Bank]
16	25°20'16.58"N	86°12'3.42"E	Between Nayagaon and Chakor/Chhitraur Village [Left Bank]
17	25°20'36.10"N	86°11'44.45"E	
18	25°21'3.97"N	86°11'18.05"E	
19	25°21'13.34"N	86°11'7.16"E	
20	25°21'14.50"N	86°10'58.68"E	
21	25°21'14.06"N	86°10'48.14"E	
22	25°21'11.64"N	86°10'36.99"E	

23	25°21'13.98"N	86°10'11.93"E	
24	25°21'37.91"N	86° 8'53.43"E	Near Sihma Village [Left Bank]
25	25°21'46.43"N	86° 8'35.43"E	
26	25°21'43.63"N	86° 7'51.97"E	
27	25°18'49.23"N	86° 6'14.08"E	Near Siman Village [Left Bank]
28	25°18'43.55"N	86° 5'54.67"E	
29	25°18'30.15"N	86° 5'11.01"E	
30	25°22'41.57"N	86° 0'14.83"E	Near Simaria Village [Left Bank]
31	25°25'18.86"N	85°55'52.83"E	Near Dharauni Tola [Right Bank]
32	25°25'14.45"N	85°59'11.85"E	Between Jai Nagar and Nipania Village [Left Bank]
33	25°25'57.59"N	85°58'58.95"E	
34	25°26'33.55"N	85°58'15.48"E	
35	25°26'44.12"N	85°58'9.21"E	
36	25°27'25.87"N	85°58'0.41"E	Near Barauni [Left Bank]
37	25°27'17.90"N	85°56'33.99"E	
38	25°27'6.44"N	85°55'24.68"E	Near Madhurapur Chauthia Village [Right Bank]
39	25°27'13.40"N	85°55'14.18"E	
40	25°27'25.01"N	85°55'3.15"E	
41	25°27'46.83"N	85°54'43.66"E	
42	25°28'17.77"N	85°54'43.90"E	
43	25°28'43.82"N	85°54'28.29"E	
44	25°29'19.65"N	85°54'7.03"E	
45	25°29'9.81"N	85°55'34.56"E	Near Teghra Village [Left Bank]
46	25°29'22.19"N	85°55'17.52"E	
47	25°31'11.24"N	85°52'43.72"E	Near Mohazi Mekra [Right Bank]
48	25°31'53.23"N	85°51'44.04"E	
49	25°32'8.09"N	85°51'5.77"E	
50	25°32'28.11"N	85°49'57.57"E	
51	25°32'23.49"N	85°49'22.72"E	

Image 47 : Eroded Bank [Left Bank]

Image 48 : Vertical Erosion [Right Bank]



Map 9 : Spatial Distribution Of Erosion Prone Sites [Begusarai Distt.]

15.0 Mining & Brick Kilns In Begusarai Distt.

15.1 **Sand Mining :** Sand is one of the major minerals resource extracted from the Ganga River and its tributaries. The demand is ever increasing due to rapid expansion of settlements and their upgradation across the country. Often carried out illegally and excessively to earn large profits, sand mining is altering rivers' overall health. Excessive sand mining results in the destruction of aquatic and riparian habitats and poses threat to bridges, river banks and nearby structures[10]. Sand mining in Ganga River within the district is reported at two sites namely –

1. Near Steamer Ghat [Shaligrami Village] at Latitude 25°25'1.12"N and Longitude 86°26'55.08"E.
2. At Latitude 25°24'2.35"N and Longitude 85°59'53.35"E.

Image 49 : Sand Mining Near Steamer Ghat

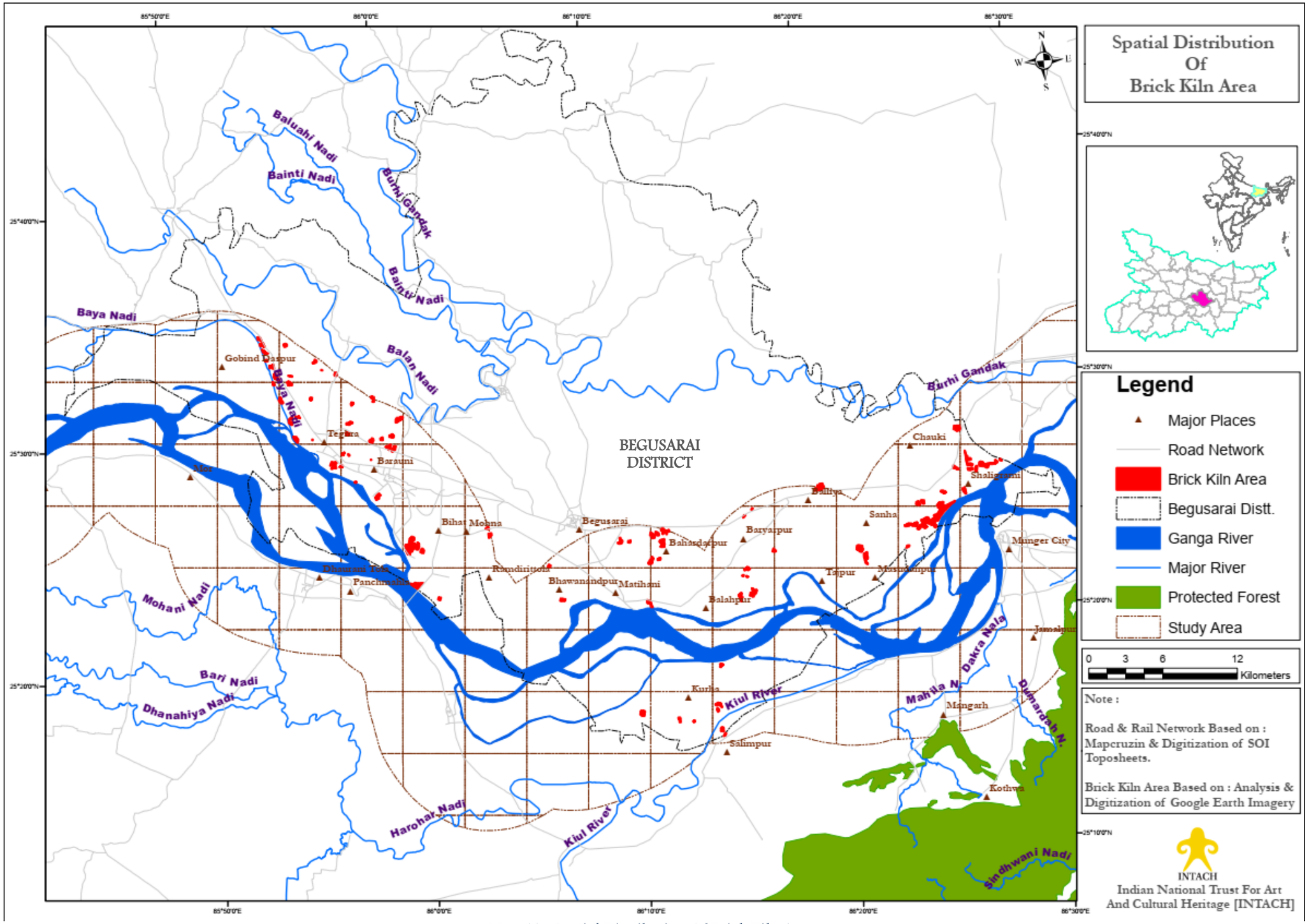
15.3 **Brick Kilns:** With rapid urbanization, bricks have become an important building material for construction activities. Brick kilns in the study area provide livelihood opportunity to the local community. However, this industry has posed current and

[10] Impacts of Sand Mining, ENVIS Centre on Environmental Problems of Mining, IIT Dhanbad, Jharkhand

potential future threats to the soil, air, biota and water system of the region. The clay digging process deteriorates the soil quality and productivity as the bricks are made from the top soil thereby leading to soil erosion during floods. According to IEE (2018), total 163 operational units of brick kilns were recorded in Begusarai distt. during 2016-17. Brick kilns falling in the study area of Begusarai distt. are depicted in Map 10.

Image 50 : Brick Kiln In Floodplain [Left Bank]

Image 51 : Brick Kilns In Active Floodplain [Left Bank]



Map 10 : Spatial Distribution Of Brick Kiln Area

16.0 Boatmaking In Begusarai Distt.

16.1 Boat making is a popular and profit-making profession in Begusarai and nearby districts. Village carpenters belonging to *Badhai community* are generally under the profession of boat construction. Small sized boats are used only in wetlands and paleo-channels. Medium sized to large sized boats having capacity of 30-40 to 100-120 people are used for ferry services. Boats are mainly made up of Sal (locally known as Sekhua) wood [*Shorea robusta*] and Jamun [*Syzygium cumini*] as it is very durable. However, the smaller dongis were also made from Babool [*Acacia nilotica*] and mango [*Mangifera indica*] wood. Iron boats, which are common and popular options in Uttar Pradesh is not in practice in eastern Bihar.

16.2 Boat making expenditures are same in Begusarai, Munger and Khagaria District. Medium sized traditional boats cost around Rs.3, 00,000/- to Rs.4, 00,000/- While large sized boats costs upto 1, 00, 000/-. Construction of large sized boat requires atleast two months.

Image 52 : Small sized Fishing Boats Kept At Kabar Tal For Repairing

17.0 Inland Navigation In Begusarai Distt.

17.1 The stretch of Ganga River in Begusarai Distt. is a part of 1620 km long National Waterway [NW-1]. Ganga-Bhagirathi-Hooghly River system from Allahabad to Haldia was declared as National Waterway No.1 vide National Waterway (Allahabad-Haldia stretch of the Ganga Bhagirathi-Hooghly River) Act 1982. It became operative from 27th Oct 1986 after the formation of the Inland Waterways Authority of India (IWAI)[11].

In a recent development, National Waterway-1 [River Ganga] is connected to National Waterway-2 [River Brahmaputra] and National Waterway-16 [River Barak] through Indo-Bangladesh Protocol (IBP) routes. An inland waterway vessel named MV Lal Bahadur Shastri having capacity of 200 MT has started its journey from Patna to Guwahati on 5th February 2022. In its 25 days long journey, the vessel sailed through National Waterway -1, National Waterway -2 and National Waterway -16[12].*

**Indo-Bangladesh Protocol (IBP) : The Protocol on Inland Water Transit and Trade (PIWTT) between India and Bangladesh allows mutually beneficial arrangements for the use of their waterways for the movement of goods between the two countries by vessels of both countries.*

17.2 **Ferry Services :** Ferrying is a crucial livelihood activity of the Mallah community living in the villages on the banks of River Ganga. Historically, people of Mallah community in Begusarai have been ferrying passengers for generations. Ferrying is common in almost every river in the Distt. [Ganga, Burhi Gandak, Baya, Balan and Bainti Nadi]. Within study area, ferrying is reported at five sites. Details are provided in Table No. 9.

[11] Inland Waterways Authority of India
https://iwai.nic.in/waterways/national-waterways/national-waterways-1?id=2523
12 Press release, Ministry of Ports, Shipping and Waterways, 5th February 2022
https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1795821 [Accessed February 2022]

Table 9 : Details of Ferry Sites And Status Within The Study Area

Latitude	Longitude	Nearest Settlements	No. of Boat & Ferry Season
25°18'4.14"N	86°21'39.67"E	Between Bahadurnagar and Durgapur	October to June
25°17'40.99"N	86°20'29.24"E	Between Shivnagar and Salarpur	Ferrying stopped
25°22'2.60"N	86°27'53.72"E	Between Munger Ghat [Begusarai] and Kankar Ghat [Munger]	Four –Six Boats (October to June).
25°22'25.48"N	86°27'49.03"E	Between Munger Ghat [Begusarai] and Sonjhi Ghat [Munger]	Four –Six Boats (October to June)
25°20'37.31"N	86°13'50.29"E	Between Mahendrapur and Riverine Island	Two-four Boats (October to June)

Image 53 : Ferrying At Steamer/Munger Ghat, Begusarai Distt.

18.0 Old And Sacred Trees In Begusarai Distt.

18.1 Plant species *Ficus benghalensis* [Bargad], Ficus *religiosa* [Peepal], *Ficus virens* [Pakad] *Mangifera indica* [Aam], *Azadirachta indica* [Neem], *Phyllanthus emblica* [Awla] are considered as sacred and is found in association with ashrams, ghats, cremation sites, temple complexes and along flood control bund across the study corridor. Out of all sacred trees, Ficus *religiosa* [Peepal] is most sighted species, generally found to be associated with temple. Peepal tree is also used to perform different rituals after cremation. Apart from the sacred trees, there are several old imli trees [*Tamarindus indica*] present at ghats and in villages.

Table 10 : Old And Sacred Trees

Plant Species	Location and Nature of Tree	Coordinates	
		Latitude	Longitude
Peepal *[Ficus religiosa]*	Peepal Tree associated with Durga Temple, Chauki Village	25°27'10.52"N	86°23'49.15"E
Peepal *[Ficus religiosa]*	Peepal Tree associated with Temple, Chauki Village	25°27'18.8"N	86°24'03.7"E
Bargad *[Ficus benghalensis]*	Banyan tree associated with Shiva Temple	25°27'24.3"N	86°24'12.4"E
Peepal *[Ficus religiosa]*	Peepal Tree associated with Temple , Rahua Village	25°27'36.4"N	86°25'32.8"E
Peepal *[Ficus religiosa]*	Old Peepal Tree, Rahua Village	25°27'28.1"N	86°25'36.1"E
Ficus virens [Pakad]	Old Pakad Tree, Rahua Village	25°27'31.2"N	86°25'35.8"E
Peepal *[Ficus religiosa],* Bargad *[Ficus benghalensis]*	Peepal and Bargad Tree, Rahua Village	25°27'34.6"N	86°25'49.0"E
Semal [*Bombax ceiba*]	Old Semal Tree	25°25'40.9"N	86°24'27.5"E

Peepal *[Ficus religiosa]*	Peepal Tree associated with Temple	25°25'43.2"N	86°24'20.2"E
Peepal *[Ficus religiosa]*	Peepal Tree associated with Hanuman Temple	25°25'48.5"N	86°24'11.4"E
Peepal *[Ficus religiosa]*	Old Peepal Tree	25°25'14.5"N	86°24'32.9"E
Peepal *[Ficus religiosa]*, Mango *[Mangifer indiaca]*	Group of Trees in Masjid complex	25°25'15.5"N	86°25'13.2"E
Peepal *[Ficus religiosa]*	Peepal Tree associated with Hanuman Temple	25°24'19.5"N	86°22'59.4"E
Bargad *[Ficus benghalensis]*	Old Banyan Tree	25°24'20.0"N	86°22'57.6"E
Bargad *[Ficus benghalensis]*	Three old Banyan Tree	25°24'28.0"N	86°22'22.6"E
Bargad *[Ficus benghalensis]*	Old Banyan Tree	25°24'39.7"N	86°21'43.4"E
Bargad *[Ficus benghalensis]*	Old Banyan Tree	25°24'38.1"N	86°21'25.1"E
Bargad *[Ficus benghalensis]*	Old Banyan Tree	25°24'31.5"N	86°20'33.5"E
Semal [*Bombax ceiba*]	Old Semal Tree	25°24'32.4"N	86°14'51.1"E
Peepal *[Ficus religiosa]*	Old Peepal Tree	25°24'47.4"N	86°09'48.8"E
Peepal *[Ficus religiosa]*	Old Peepal Tree	25°24'46.2"N	86°09'28.2"E
Peepal *[Ficus religiosa]*, Bargad *[Ficus benghalensis]*	Old Peepal and Banyan Tree	25°24'01.0"N	86°06'40.3"E
Bargad *[Ficus benghalensis]*	Old Banyan Tree	25°24'44.0"N	86°05'37.4"E

Image 54 : Old And Sacred Trees At Simaria Ghat

Image 55 : Sacred Peepal Tree

19.0 Key Observation And Recommendations

19.1 **Fading of Chandrabhaga Nadi :** Chadrabhaga is gradually fading due to high siltation, lack of riparian vegetation, encroachment for construction and allied activities [Refer Image No. 56]. Twenty to thirty years back, the river was flowing in its shape is now a small Nala and is faded at several places in its course. Disappearing of Chandrabhaga may damage local biota.

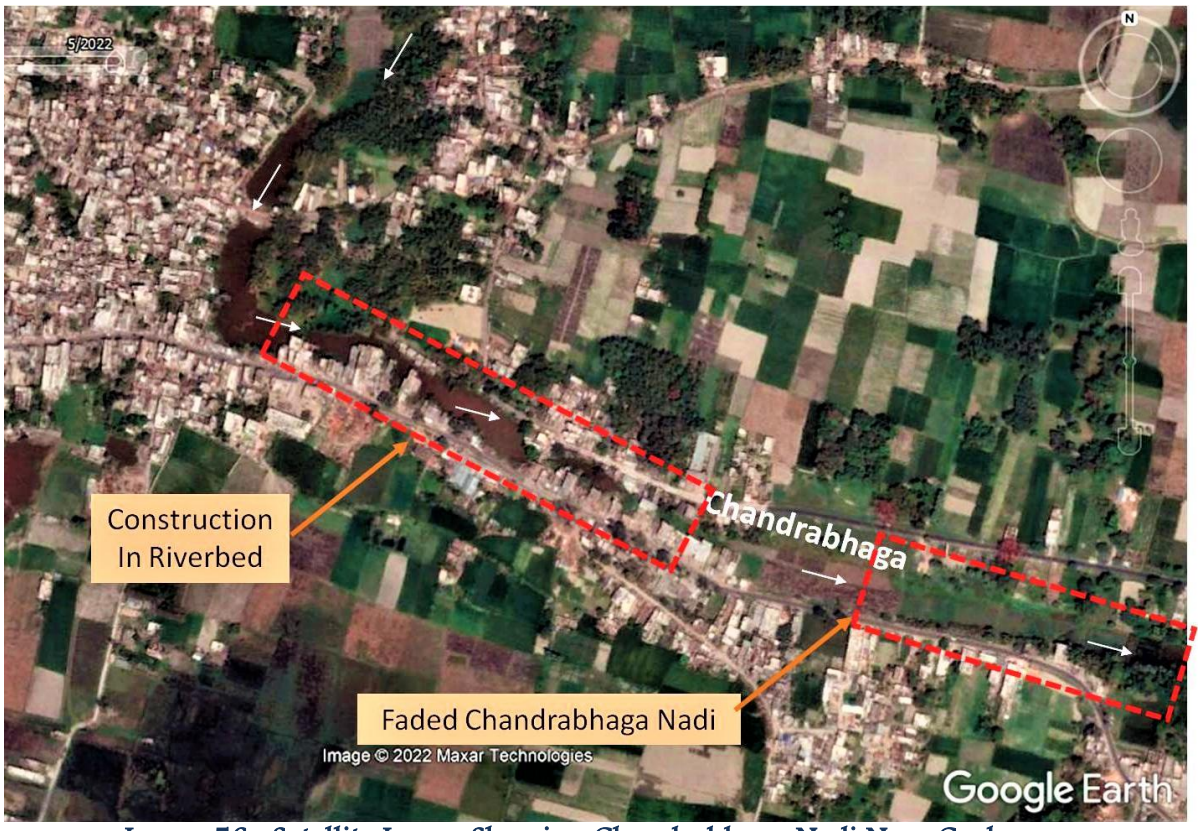


Image 56 : Satellite Image Showing Chandrabhaga Nadi Near Garhpura

19.2 **Threat to Wetlands :** Riverine wetlands are facing serious threat due to loss of riparian vegetation, encroachment, dumping of waste and conversion of wetland area into agricultural field [Refer Image No. 57]. The riverine wetlands are habitat to threatened and migratory avian species. There are several oxbow lakes reported in the distt. which plays a critical role in flood management and provides livelihood opportunities and staging and breeding ground to the avian fauna. Below-mentioned points may be a path for the conservation of the wetlands in the study area :

- Inventory of wetlands should be maintained with the details highlighting the current land use, ownership and values of the wetland.
- There is a need of the hour to notify the riverine wetlands under the provisions of the Wetlands (Conservation and Management) Rules, 2017.
- A Comprehensive Management and Action Plan (CMAP) should be prepared for each wetland or group of wetlands. CMAP should focus on the ecological, hydrological, social, and economic and tourism aspects of the wetland.
- Local communities should be encouraged and their participation in wetland conservation should be fixed.
- Lease of wetland to fishermen community maybe an alternative to maintain water level.
- Forest department and concerned agencies should plant native riparian flora along the wetland.
- Developmental activities may be restricted at least 500 m from the riverine wetland area.

Image 57 : Solid Waste Dumping In Murdaha Tal

19.3 **Hunting of Birds :** During filed visit, hunting is reported in Murdaha Tal, Rahua Tal and **Kabar Tal (Ramsar Site)** [Refer Image No. 58]. Two birds namely –Red crested Pochard and Cormorant locally called *Lalsar* and *Adhang* are preferred hunt.

Image 58 : Nets With Hooks Installed At Kabar Tal For Bird Hunting

19.4 **Groundwater Conditions** : The study area is going through fluoride and arsenic contamination. It is required to install community-based fluoride and arsenic removal plant to tackle the menace. Nalgounda technique may also a simple and effective technique to tackle fluoride contamination.

19.5 **Cremation and Burial :** Cremation of dead bodies and immersion of their remains is reported throughout the stretch. Lack of cremation infrastructure, their maintenance and lack of awareness are reason behind such ongoing practices. Proper cremation infrastructure including the modern crematoria is required atleast at Munger Ghat/ Steamer Ghat and Ram Ghat [Near Simaria Ghat]. Proper site should be provided and area should be demarcated for burials.

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