GANGA CULTURAL DOCUMENTATION

KHAGARIA DISTRICT

[Natural Heritage]

2022

National Mission for Clean Ganga

Indian National Trust for Art and Cultural Heritage

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Front Cover : Kosi-Bagmati Confluence

Background : A Channel Of Ganga River, Khagaria Distt.

Back Cover : Floodplain Agriculture

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February, 2022

Sponsored By:

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1.0 Introduction

1.1 Khagaria Distt. is located between 25° 15' to 25° 44' North 86° 17' to 86° 52' East. Khagaria is one of the thirty-eight administrative Distt.s of Bihar state. The district, having an average elevation of 44 metres above MSL, is divided into two subdivisions and seven developmental blocks[1]. Khagaria was a part of the district of Munger, as a subdivision. The sub-division of Khagaria was created in the Year 1943-44. It was upgraded as district, with effect from 10th May, 1981, vide Government of Bihar notification no. 7/T-1-207/79 dated 30th April,1981[1].

1.2 With a total geographical area of over 1485 sq.km. the Distt. is bounded by Samastipur & Darbhanga Distt. on the north-west, Saharsa Distt. on the north, Madhepura & Bhagalpur Distt. on the east, while in the south it is bounded by Munger and in the west by Begusarai Distt [Refer Map No. 1]. The major rivers flowing through the Distt. are the Ganga, Burhi Gandak, Bagmati, Kamala Balan, Kosi [Kali Kosi and Ghugri], which causes floods almost every year. The Ganga River flows west to east covering a distance of approximately 29 km. forms huge riverine islands and active floodplain area. **Due to the regular flood inundation, entire region is called "*Dahnal*".**

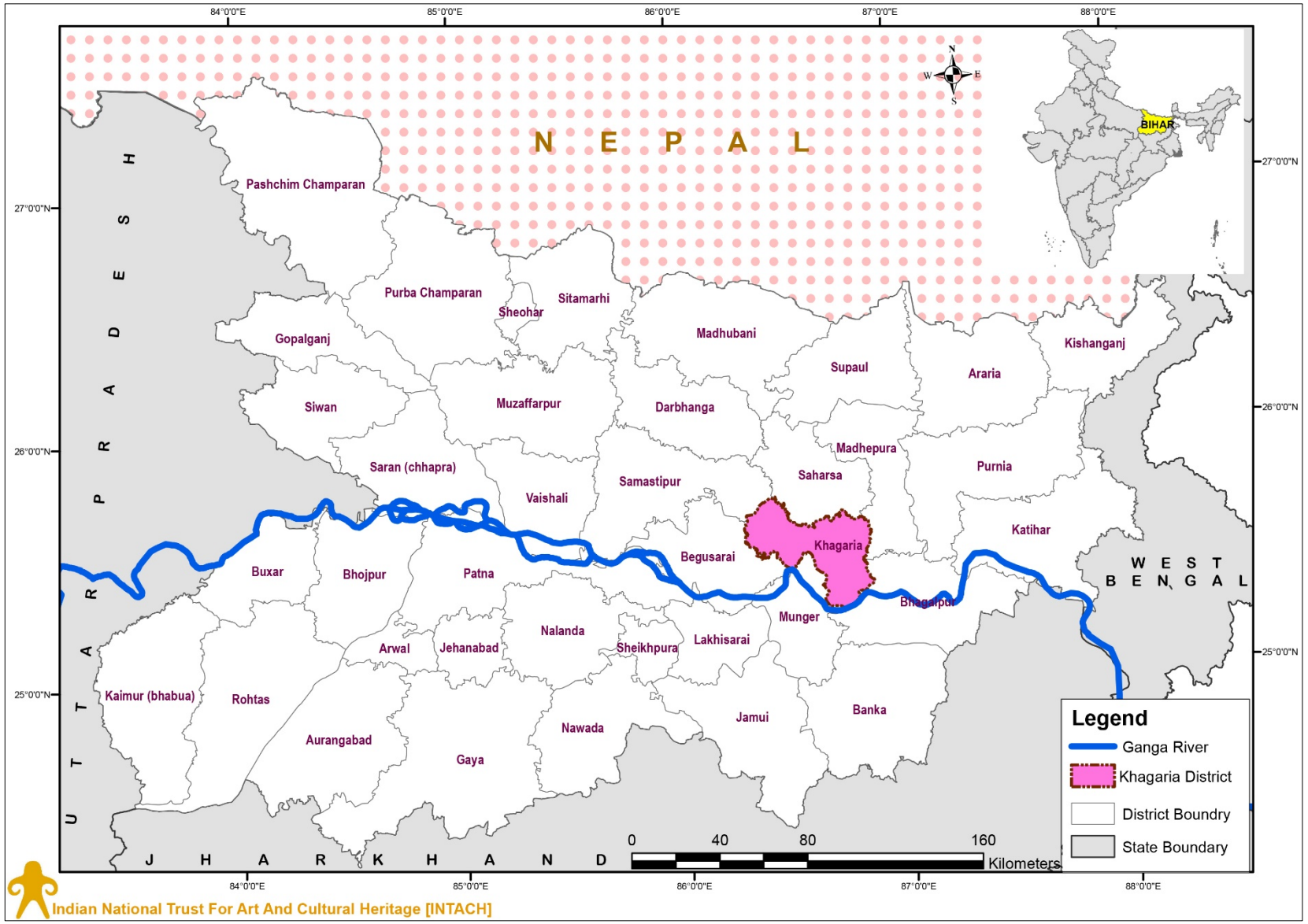
1.3 The normal annual rainfall of Khagaria Distt. is 1170.2 mm of which 83.95% occurs during the monsoon season. The normal rainfall during monsoon season is 982.4mm and during non-monsoon season is 187.8 mm. The rainy season receives Southwest monsoon and accounts for about 90% of the total rainfall.

1.4 Khagaria Distt. spreads over vast tracts of flat alluvial plain and swampy lands. The northern part of the district is an extensive plain formed by the rich alluvial soil. Floodplain (73.29 %) is the major physiography of the district followed by Alluvial plain (6.06%), Levees (3.23 %), Channel bed (2.99%), Stream bank (1.97 %) and Oxbow/Paleo channel (1.43%), Point bar complex (0.14%)[2]. Khagaria Distt. is characterized by a moderate climate and falls under the Agro-climatic zone I and II and. The soils in general, except those of the *diara* lands and Tal lands, are moderately well drained to somewhat poorly drained[3].

[1] https://khagaria.nic.in/about-district/ [Website Accessed Dated: 20.02.2022]
[2] http.www.slusi.dacnet.nic.in [Website Accessed Dated: 20.02.2022]
[3] 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*

1.5 The climate of Khagaria Distt. represents a transition between the dry and extreme climate of northern India and the warm and humid climate of Bengal. April and May are hottest month with rising temperature up to 44–45°C. The summer season continues up to mid-June. November to beginning of March is winter season. January is the coldest month when the temperature drops up to 4-5˚C. The monsoon season initiates from June and continues till the end of September. There is slight rainfall in October but November and December are quite dry.

According to the history, commonly known in this part, it is said that during the time of Emperor Akbar, Raja Todarmal had been entrusted with the duty of making a survey of the entire area, but as he failed to do it, he advised that this area should be excluded, in other words, he adopted the policy of "Farak Kiya" and that is why the area is Known as *Pharkiya Pargana*[1].



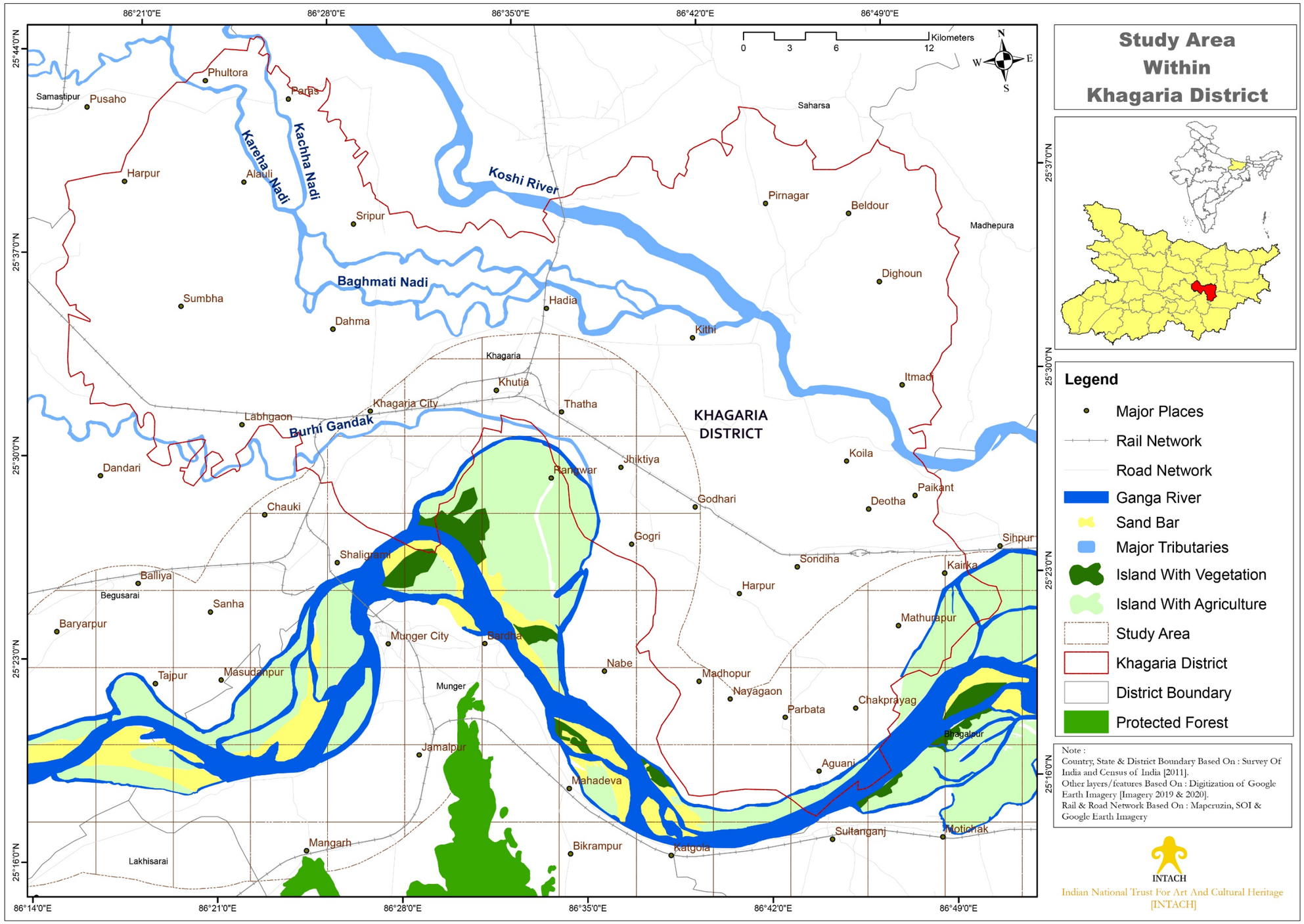
Map 1 : Location Map Of Khagaria Distt.

2.0 Ganga River In Khagaria Distt.

2.1 Khagaria Distt. is located at the left bank of the river Ganga. The river enters Khagaria Distt. at tri-junction of Khagaria-Munger-Begusarai Distt.s i.e. approximately 4 Km east to Munger Ghat/ Steamer Ghat of Begusarai Distt.]. Length of Ganga River in Khagaria District is approximately 29 km, while its width varies between 0.5 Km to 2.0 km [Refer Map No. 2].

2.2 The point where Ganga enters the district, it forms two huge riverine islands. After flowing 2.5 Km eastward, the River enters in Munger Distt.. A channel of River Ganga flows northward and forms southern boundary of the Distt. A tributary named Burhi Gandak joins the channel near *Tikarampur Diara* and empties to the main channel of Ganga River near Jhahwabahiyar in Munger Distt.. Flowing downward, the river enters the Khagaria Distt. at latitude 25°15'22.30"N and longitude 86°43'37.92"E and drains approximately 8 km and finally enters Bhagalpur Distt. In its journey of approximately 29 km, the River shows shifting tendencies resulting in the formation of vast tract of floodplain locally called *diara* [span over 5-7 km in the district]. The active floodplain of Ganga River is mainly under the cultivation excluding few patches of scrubland and plantation.

Image 1 : View of Ganga River In Khagaria Distt.



Map 2 : Study Area Within Khagaria District

3.0 Methodology

3.1 For carrying out surveys, a 7 km buffer [study area] of Ganga River in Khagaria Distt. was marked having a total area of 262.45 sq. km. covering left 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 Khagaria Distt. was carried out in November, 2021. 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 Khagaria Distt.

4.1 Major tributaries within the district are - Burhi Gandak, Baghmati, Kamla and Kosi or Koshi. Mainstream of the Kosi river is called Ghugri or Ghagri Nadi. Burhi Gandak is only major river which flows through the study area. The minor tributaries within the study area include - Malti Nadi, Tiloi Nadi, Balmjan Nadi, Kasraiya Dhar/ Nadi and Mandra Nadi. Detail of the minor and major tributaries are 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 of Ganga River 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 Khagaria Distt. near Bela Village [25°31'27.31"N, 86°18'59.32"E] and flows eastward to a distance of approximately 37 Km and enters the Munger Distt. at Latitude 25°29'38.06"N and Longitude 86°34'1.56"E. 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. 2 & 3]. The paleo-channel of the Burhi Gandak is still present

near Bishnupur in Khagaria Distt. [Refer Image No. 5]. The satellite imagery of the confluences [old and new] is presented in Image No. 3.

According to the District Gazetteer of Munger, this river used to be navigable throughout the year for large boats during rains and small boats during other times.

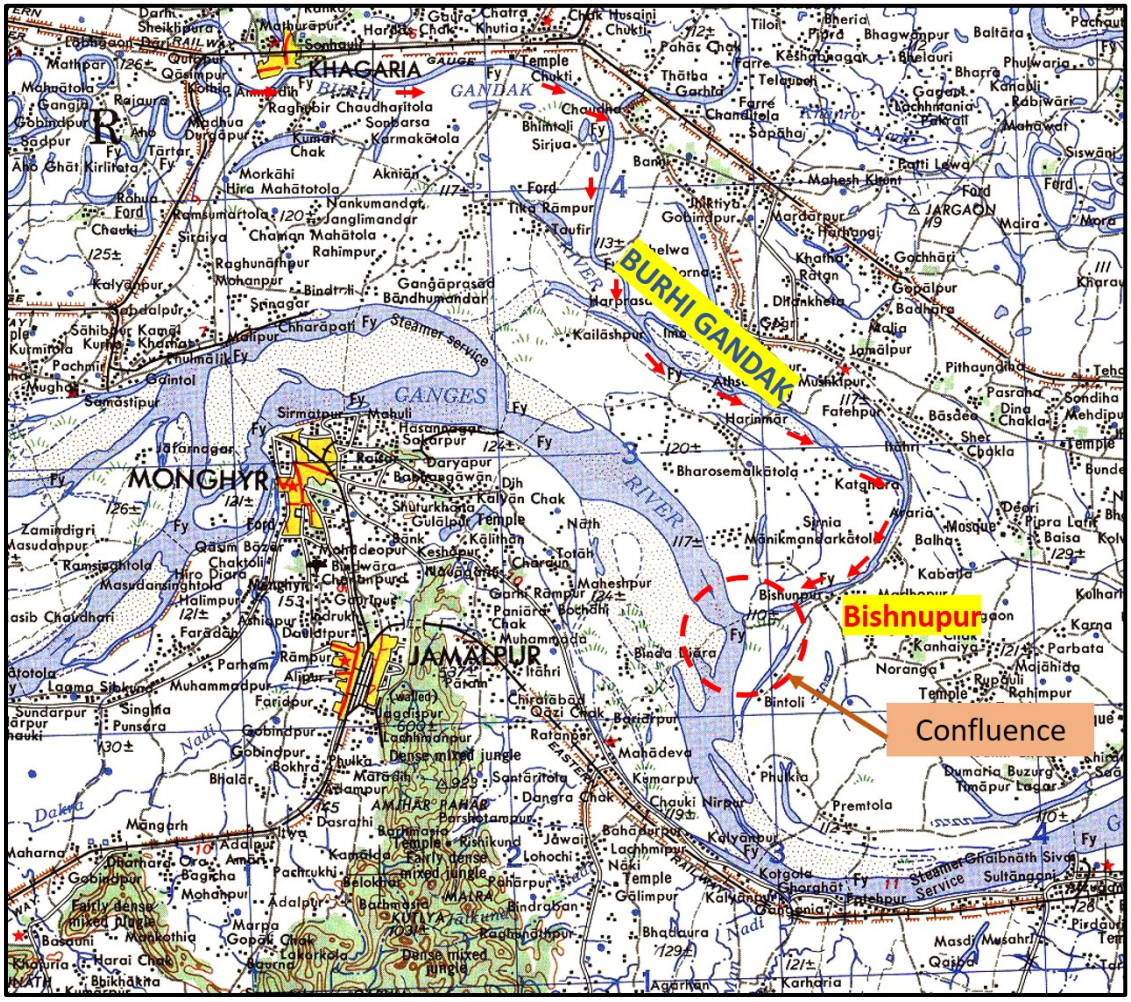


Image 2 : US Army Map Showing Old Confluence Of Ganga-Burhi Gandak

*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.

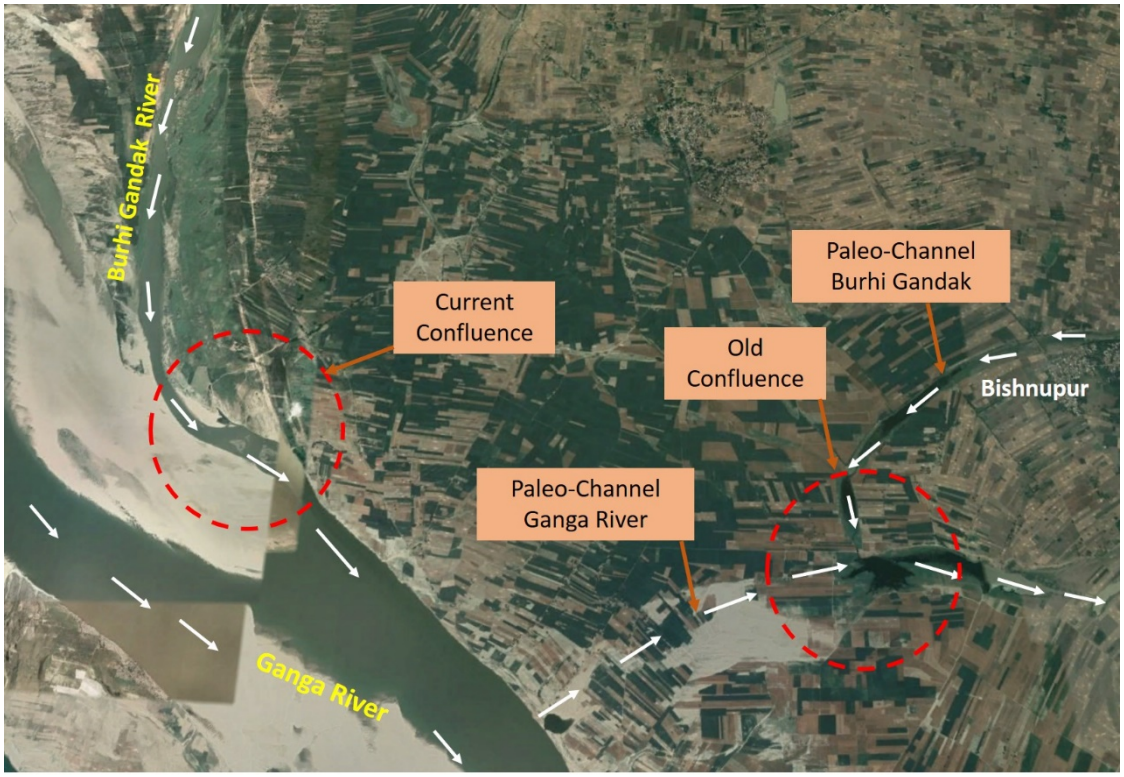


Image 3 : Old And Current Confluence Of Ganga-Burhi Gandak
[Source : Google Earth Imagery, January 2022]

Image 4 : Burhi Gandak River Near Tikarampur Diara

Image 5 : Paleo-Channel Of Burhi Gandak River As Seen From Nabe Village Bridge

[The Paleo-channel of Burhi Gandak River believed to be originated near Karimandantola and join the Ganga River near Bishnupur Village in Khagaria District (at old Ganga- Burhi Gandak confluence).
The Nabe Village Bridge is only bridge in the region which connects rest of the region to the Ganga Ghats. Earlier boats were only means of transportation]

4.3 Minor Tributaries: There are seven minor tributaries reported within the study area. Out of which two streams are completely faded and five are flowing within the study area. The lengths of these streams range between 4.4 Km. to 15.5 Km. Documentation of these small streams are important because minor stream within study corridor serve as migratory route for fish species, helps in flood management and livelihood opportunity for local communities. The Details of flowing streams are provided in Table 1 and partially faded and faded streams in section 6 of this report.

Table 1 : Minor Tributaries Within The Study Area

Stream	Origin	Confluence	Length and Potential Threat
Malti Nadi [Tributary	Near Sansarpur [25°30'55.57"N,	Empties to Bagmati near	Stream Length approximately 15.5

of Baghmati Nadi]	86°29'40.25"E]	Rasaunak Village [25°33'39.80"N, 86°30'49.85"E]	Km. Potential Threat : Siltation, encroachment for construction and flood control bund along Baghmati Nadi
Tiloi Nadi	Near Bhagwanpur [25°30'28.74"N, 86°39'14.12"E]	At 25°31'12.88"N, 86°41'7.28"E	Stream Length approximately 4.4 Km. Potential Threat : Siltation, encroachment for construction
Nadi	Originates from Farre from Kasraiya Nadi [25°30'15.50"N, 86°37'23.56"E]	At 25°25'30.44"N, 86°46'1.37"E	Stream Length approximately 15.0 Km. Potential Threat : Siltation, encroachment for construction and brick kiln.
Balamjan Nadi	At 25°25'54.20"N, 86°43'7.38"E	Joins Kasraiya Nadi near Chanditola 25°29'25.93"N, 86°36'47.41"E	Stream Length approximately 15.5 Km. Potential Threat: Siltation, encroachment for construction and brick kiln.
Kasraiya Nadi/Dhar [Refer Image 13]	Near Kasraiya Village [25°30'17.18"N, 86°37'40.03"E]	At 25°29'29.88"N, 86°35'15.67"E	Stream Length approximately 5.24 Km. Potential Threat: Siltation,

			encroachment for construction, solid waste dumping, embankment and brick kiln.

Image 6 : Kasraiya Dhar/Nadi

4.4 Kosi Kamla Balan & Baghmati River : Kosi or Koshi River originates in the Himalayan region of Nepal and Tibet. The river is formed by the confluence of three streams namely - **the Sun Kosi, the Arun Kosi and Tamur Kosi**. Kosi drains an area of 74,500 sq.km of which only 11,070 sq.km lie within Indian Territory[4]. A number of tributaries joins the river during its journey. Some of them are - **Trijunga, Bhutahi Balan, Kamla Balan and Bagmati.** Kamla Balan rises in the Mahabharat range of hills in Nepal while Bagmati rises in the Shivpuri range of hills in Nepal joins the Kosi river near Darjia and at upstream of Baltara in Khagaria Distt. respectively. After joining with Baghmati River, the

4 India Water Resources Information System [Website, Accessed dated – 20.02.2022] https://indiawris.gov.in/wiki/doku.php?id=kosi_basin

mainstream of Kosi River is called **Ghugri or Ghagri Nadi**. The Ghugri empties to River Ganga in Katihar Distt. after passing the Khagaria and Bhagalpur Distt.s. Kosi is very unstable and is known for its shifting tendencies. In last 200 years, the river has shifted westwards for a distance of about 112 km and has laid waste large tracks of agricultural land in Darbhanga, Saharsa and Purnea districts[3]. A few years ago (2008), the river course appeared to move towards east from its present course after Kusaha breach in Aug 2008.

It is one of the ancient rivers of India and has its mention in the old literatures as Kaushika. It is known as Sapt Kosi in Nepal because its seven tributaries the Sun Kosi, the Bhota Kosi, the Tamba Kosi, the Dudh Kosi, the Barun Kosi, the Arun Kosi and the Tamur[1].

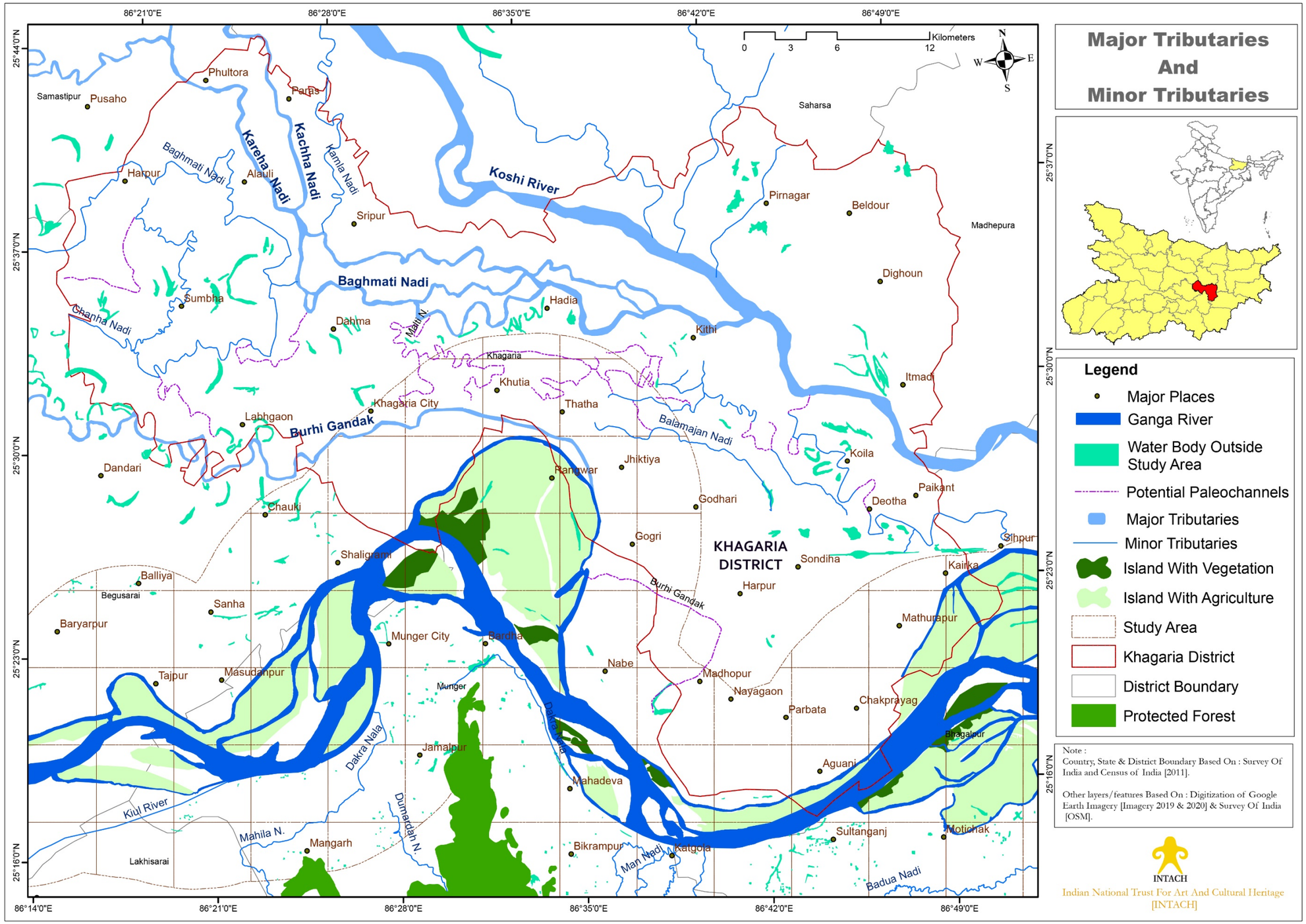
Francis Buchanan a British scientific explorer mentioned the Kosi river in his report named - An Account of the Districts of Purnea [1809-1810] as :

"Kosi on reaching the plains instead of running almost directly south to join the Ganges, as it does at persent, formerly proceeded from Chatra to the eastward, and joined the Ganges far below; and many old channels are still shown by the populace as having been formerly occupied by its immense stream, and are still called Burhi the old, or Mara the dead Kosi. The change seems to have been very gradual, and to be in some measure still going on; nor will it be completed until the channel north from the island of Khawaspur has become dry or dead. Even at persent three or four different routes may be traced by which the river seems to have successively deserted its ancient course towards the south-east, until finally it has reached a south or straight direction".

Image 7 : Kosi-Baghmati Confluence As seen From B.P. Mandal Bridge

[Note light green colour water of Baghmati River and muddy water of Kosi River]

Image 8 : Ghugri Nadi As Seen From B.P. Mandal Bridge



Map 3 : Major And Minor Tributaries In The Study Area

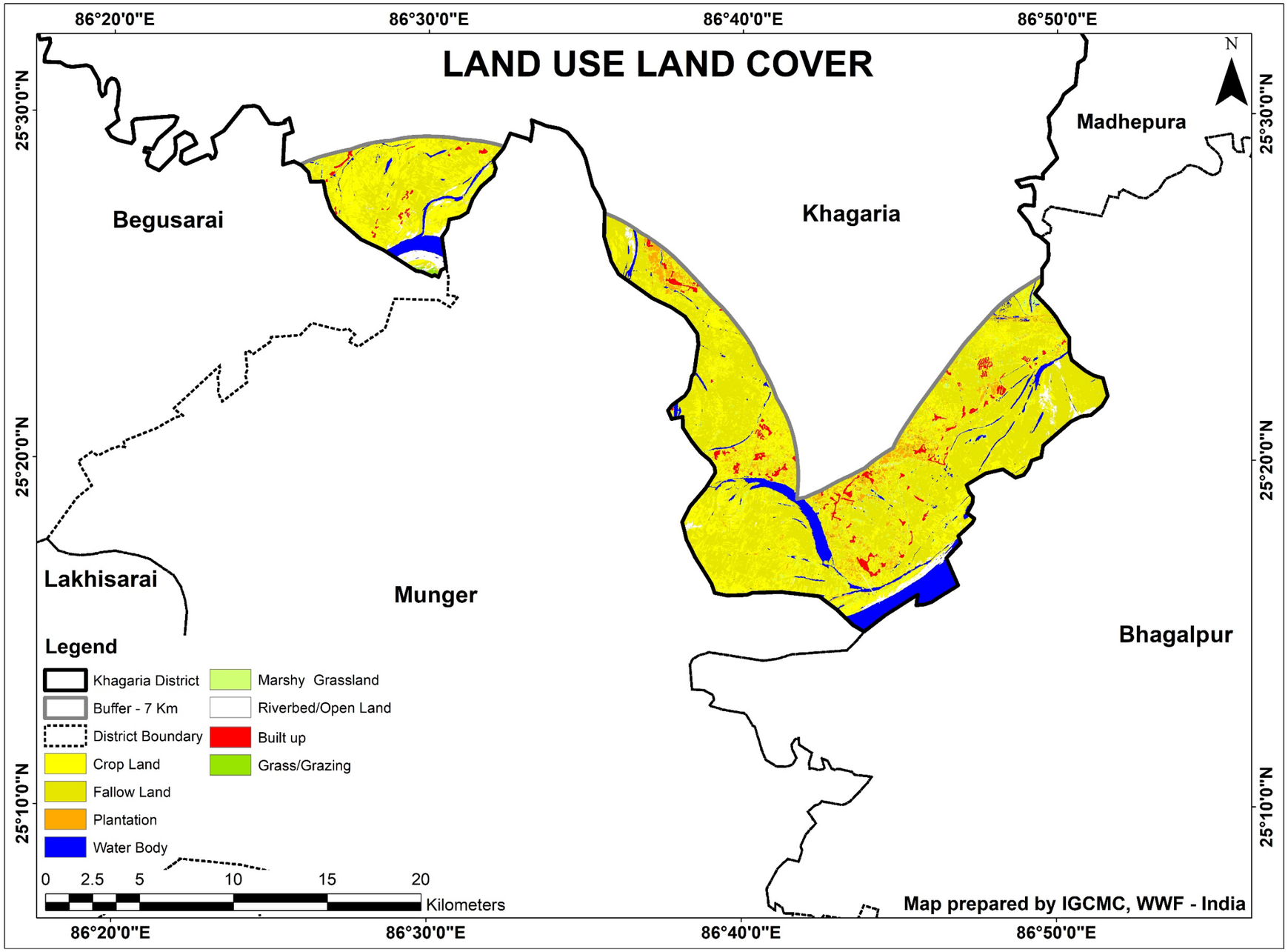
5.0 Land Use Land Cover [LULC]

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, Fallow Land, Plantation, Water Body, Swampy Land, Riverbed/Open Land, Built up, and Grass/Grazing [Refer Map No. 4]. Study area constitutes 262.45 sq. km. covering right bank and left bank of River Ganga for which the following observations were drawn:

- Crop land fallow land together represents the fallow land and constitutes 80.03% of the study area. Parts of fallow area is usually under flood inundation and is used mono crops only.
- Water body constitutes 7.21 % and covers lentic and lotic system of the study area. The lentic system includes flood affected areas and riverine wetlands.
- The built-up land constitutes 2.02% of the total study area. This class covers the urbanised area at Khagaria City and Mansi and villages and settlements [mainly along national highway].

Table 2 : Land Use Land Cover of Study Area In Khagaria distt. [2020]

Khagaria (Ganga 7 Km Buffer)		
Class	**Area (In Sq. Km)**	**Area (%)**
Crop Land	81.075	30.89
Fallow Land	128.982	49.14
Plantation	11.7955	4.49
Water Body	18.9189	7.21
Swampy Land	9.2637	3.53
Riverbed/Open Land	6.7947	2.59
Built up	5.2924	2.02
Grass/Grazing	0.3307	0.13
Total	**262.4529**	**100**



Map 4 : Land Use/Land Cover Map Of Study Area [Khagaria 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 Khagaria Distt. factors such as encroachment, extensive agricultural practices, brick kilns, high silt load and loss of vegetation act as a catalyst for the fading of river channels and wetlands. 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 Khagaria Distt. has migrated between 1936-1937 to 2005 - 2006 [Ref. Map No. 6].
- Major migration was recorded at 25°26'30.38"N, 86°29'36.59"E [Left Bank], Ganga-Burhi Gandak confluence [Left Bank], Jhalwabahiyar Village [25°20'22.46"N, 86°36'9.47"E (Left Bank)], and Between Mathurapur, Bharatkhand and Korchhaka Village [Refer Map No. 6].
- Between 2005-2006 and 2019-2020, a channel of Ganga River has completely faded near Bishnupur village and the main channel of the river has shifted southward. Near Bishnupur Village there was confluence of Ganga and Burhi Gandak, now it has shifted eastward [details provided in section 4 of this report]. The paleo-channel of Ganga River is shown in Image No. 9 & 10.
- In recent years it has been observed that a channel of Ganga River has started fading between Nurpur [Right Bank] and Kala Tola [Right bank]. Fading channel is navigable in few months of the year.

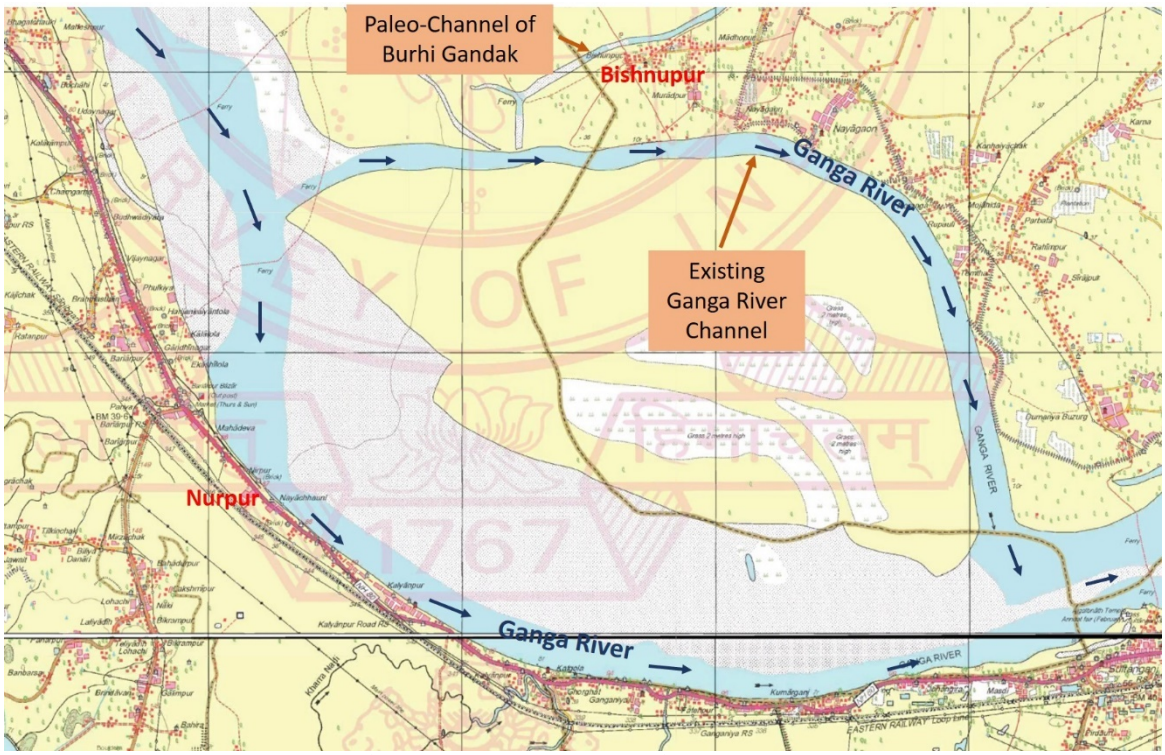


Image 9 : SOI [OSM] Toposheet [G45O11 & 12] Showing Existing Ganga River Channel At Left Bank

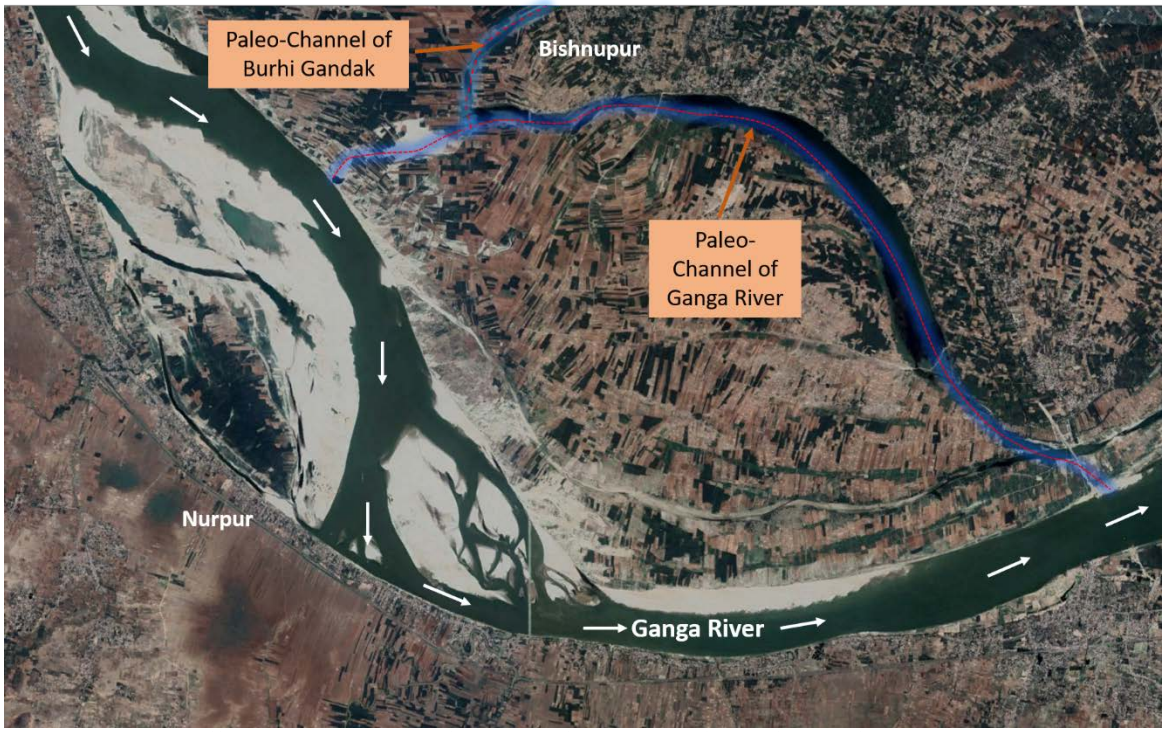


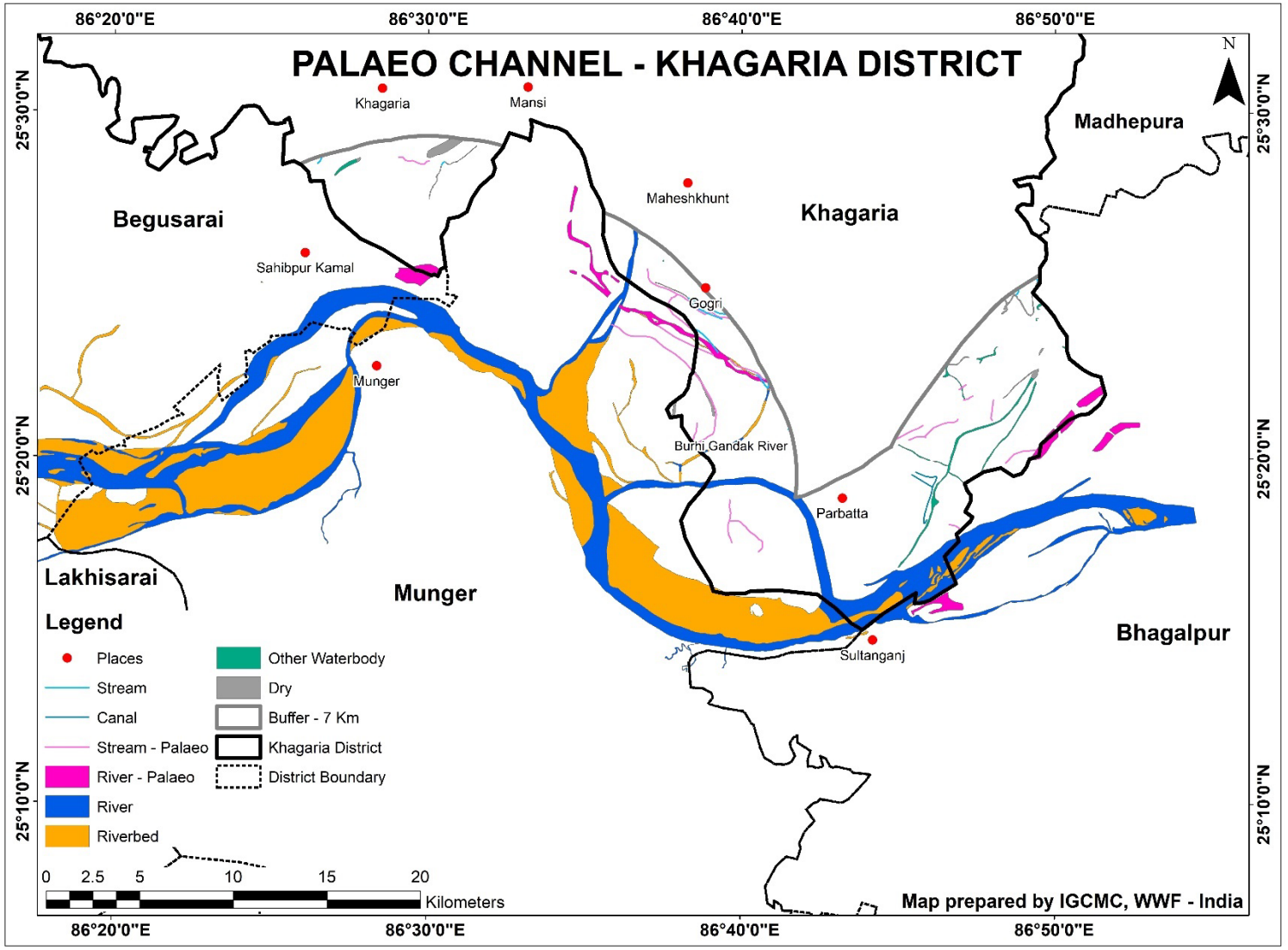
Image 10 : Satellite Imagery, April, 2020 Showing Paleo-Channel Of Ganga River
[Source : Google Earth Imagery , Dated April 2020]

Image 11 : A Paleo Channel Of Ganga River Near Bharatkhand Village

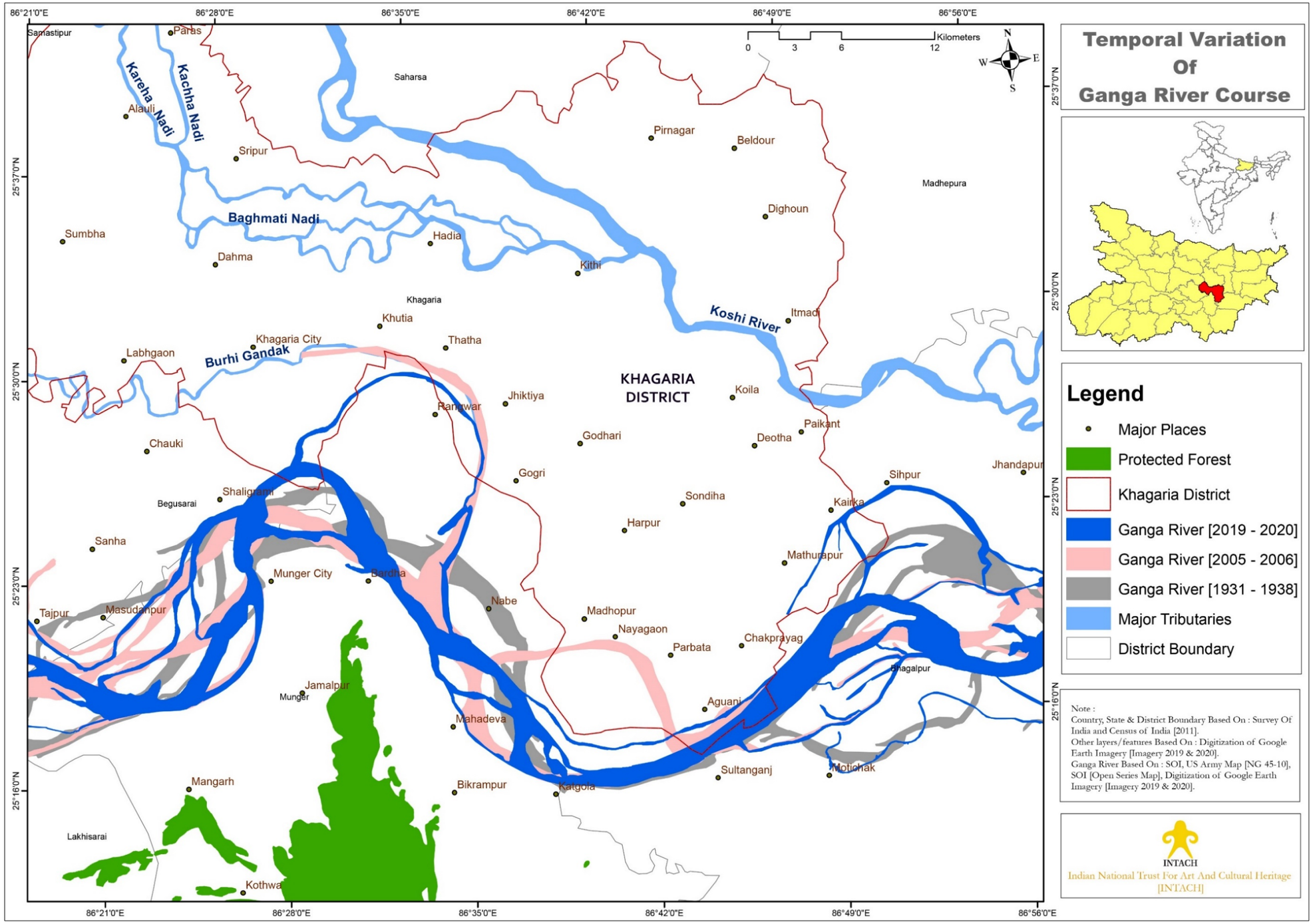
6.3 The study of SOI map series, Google Imagery (in time series) and ground survey highlighted there is one small stream named Malti Nadi [river length 15.5 Km] whose courses has partially faded and two streams whose course has completely faded or disappeared altogether. Streams have faded maybe due to and high silt load, encroachment and brick kilns. Details of faded streams provided in table No.3.

Table 3 : Faded Streams Within The Study Area

Stream	Origin	Confluence	Reason for the fading of the stream
Mandra Nadi [Tributary of Malti Nadi]	Kamathan Ekania [25°30'34.46"N, 86°32'11.02"E]	Joins Malti Nadi at Marar [25°32'14.64"N, 86°30'20.50"E]	High silt load and encroachment **Completely Faded**
Nadi [Tributary of Ghugri Nadi]	Near Bhrampur [Bhagalpur] [25°24'44.92"N, 86°53'16.52"E]	Joins Ghugri Near Baltara [25°29'43.98"N, 86°45'1.17"E]	High silt load encroachment for construction, dumping of waste. **Completely Faded**



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

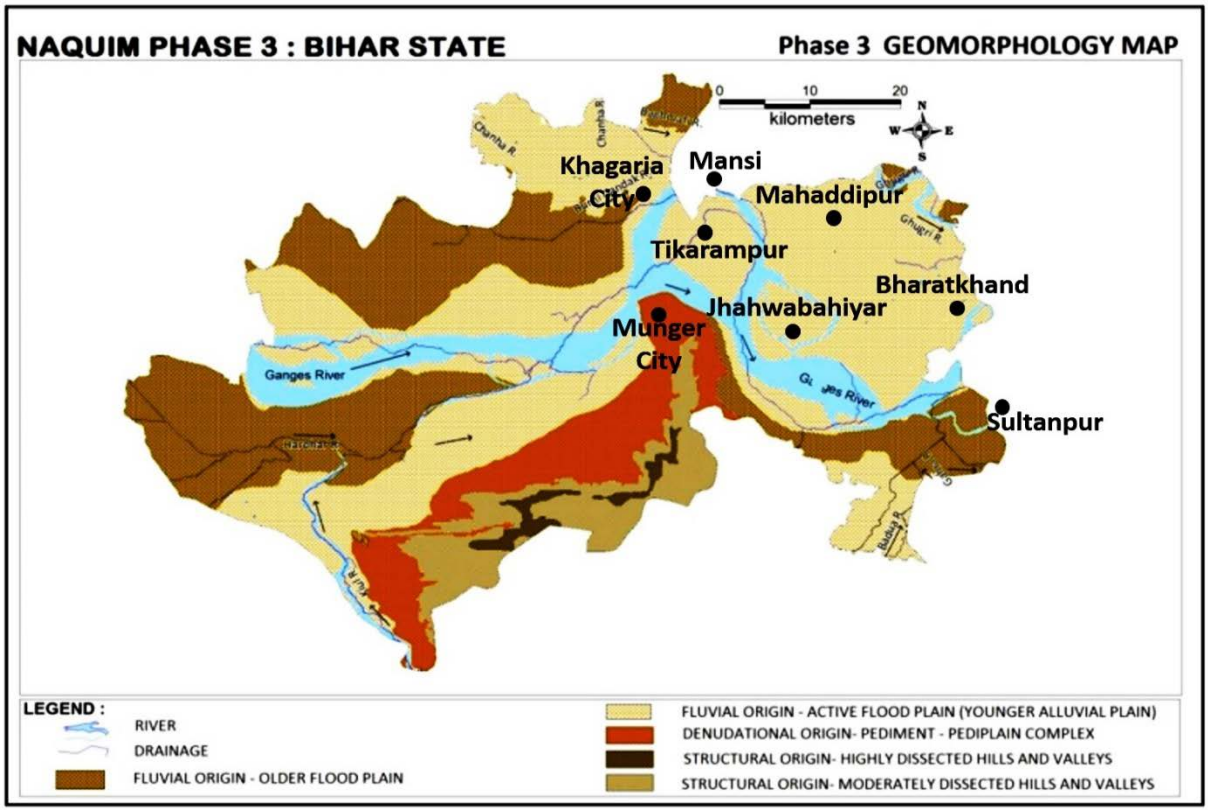


Map 6 : Temporal And Spatial Variation Of Ganga River Course In Khagaria Distt.

7.0 Floodplain Of River Ganga In Khagaria 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 Khagaria Distt. is part of Middle Ganga plain and physiographically it represents a monotonous flat topography. The study area in Khagaria Distt. [left bank] shows a general slope towards the south-east while the study area within Munger Distt. [right bank] shows general slope towards north-east. Geo-morphologically, the study area in Khagaria 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 while older floodplain dominates the area nearby the Khagaria city. 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 Ghughri-Baghmati River floodplain [Refer Image No. 12]. The railway track and National Highway- 31 which runs almost parallel to the Ganga River roughly divides the floodplain of both rivers. The flood plain area of Ghugri-Baghmati in the study corridor has general slope towards the south-west. A low laying area locally called Taal or Tal has been developed along National highway [Refer Image No. 13].



Map 7 : Geomorphology Map

[Source : Report On Aquifer Mapping, CGWB, 2017]

Image 12 : Image Showing The Active Flood Plain Of Ganga River [Left Bank Bank]

Image 13 : Low Lying Area As Seen From National Highway-31

[Area showing in the image is usually under flood inundation for 4-5 months. This year (2021-2022), the area is flooded for almost 6-7 months. This because the area has witnessed flood twice in a year (July-August & October-November)].

7.3 Khagaria Distt. and its adjacent Begusarai 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[5]. The majority of the soil are medium to heavy texture, very deep, alkaline in reactions and medium to highly fertile. All these soils are highly suitable for maize, paddy, wheat, banana and other plantation 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.*

7.4 Common cropping sequence practised within this zone includes:

- ❖ Zone I : Rice-Wheat, Rice-Rai, Rice -Sweet Potato, Rice-Maize (Rabi), Maize-Wheat, Maize-Sweet Potato, Maize-Rai, Rice-Lentil, Rice-linseed;
- ❖ Zone II : Rice-Wheat-Moong [Maize within active floodplain]

[5] 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 14 : Agricultural Activities In The Active Flood Plain Of Ganga River In Bharatkhand

Image 15 : Farmers Mixing Urea And DAP Fertilizer For Maize Field

*[**Image 14 & 15** showing Rabi crops mainly wheat, barley, mustard, and Maize and vegetables in few areas. Maize is major crop in active floodplain area and is grown in both seasons [rabi and kharif]. Utilization of large amount of chemical fertilizers [100-120 Kg/Acres] is major environmental concern.*
(Plastic bags carrying fertilizers usually have capacity of 50 Kg)].

7.4 Crop cultivation throughout the study corridor differs as per the flood inundation. The active floodplain area is used for sowing *rabi* and *zaid* crops. The *kharif* crops are restricted in high land areas. **Tal areas** in the study region support crops mainly in *rabi* season. High water demanding crops are grown mainly nearby the ***Pain*** **or** ***Pan*** **area**. Some vegetables such as potato, tomato, green peas, cabbage, cauliflower and brinjal are also cultivated in the Distt. Maize is a major crop of active floodplain is and is grown in a large scale. Floodplain produce recorded within the villages in study corridor are provided in the table no. 4.

Tal Area : Tal area is termed as the stretch of land having bowl shaped depression inundated in kharif season due to spill/overflow from rivers or runoff from upstream.

Pan or Pain : Artificial water bodies constructed along linear infrastructure [roads, railway track etc.] due to construction activities are locally called Pan or Pain.

Table 4 : Floodplain Agricultural Produce Of Villages In Khagaria Distt.

Village	Floodplain produce
Bharatkhand	Maize, Wheat, Mustard, Green peas [Few Area], vegetables [few areas], Paddy [along road]
Mathurapur	Maize, Wheat, Mustard, Green peas [Few Area], vegetables [few areas], Paddy [along road], Sunflower
Sadatpur,	Wheat, Mustard, Green peas, Gram, Maize in few areas
Khirarahi	
Dumariua Buzurg	Wheat, Mustard, Flax seed, Pulses, Barley Maize, Banana plantation [few area], Maize, Paddy [few area]
Temtha	

Image 16 : Banana Farm In Study Area

Image 17 : Sunflower, Wheat And Mustard Fields

8.0 Wetlands In Khagaria 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 2.89 % area of the Khagaria Distt. The majority [69.42%] area within the wetlands covered by the lotic system i.e., River/stream. The remaining 30.58% area is covered by oxbow lakes/ cut-off meanders [10.85%], riverine wetlands [4.37%], tanks [0.69%], lakes/ponds [3.57%] and waterlogged area [10.45%][6].

8.2 In the current exercise, 108 wetlands have been mapped in the study area with the help of Google Earth satellite imagery and SOI-OSM available maps. **Total area of the mapped wetlands is 993 Hectares i.e. 3.78 % of the study area excluding the lotic system and flood inundation area**. The area of identified wetlands ranges between 0.12 ha to 386 ha. Out of 108 wetlands, the area of 34 wetlands is less than 1 ha, 30 wetlands have area between 1 ha and 2.5 ha and 44 wetlands have area greater than 2.5 ha. Area of the five largest wetlands constitutes 61.98 % of the total study area. The list of identified wetlands is provided in Table No. 5 and their spatial distribution is shown in Map No. 8.

[6] 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 5 : List of Water Bodies within Study Area [Khagaria Distt.]

Sr. No.	Wetland Name/ Number	Coordinates		Area [Hectares]
		Latitude	Longitude	
01	1	25°28'31.65"N	86°26'14.29"E	2.50
02	2	25°28'11.31"N	86°27'1.08"E	4.10
03	3	25°29'5.51"N	86°28'25.48"E	7.32
04	4	25°28'20.42"N	86°27'16.92"E	8.63
05	5	25°27'34.89"N	86°28'41.86"E	2.45
06	6	25°29'15.38"N	86°28'28.18"E	1.95
07	7	25°29'30.87"N	86°28'35.87"E	4.51
08	8	25°28'47.46"N	86°30'15.38"E	9.47
09	9	25°30'6.90"N	86°27'32.56"E	3.25
10	10	25°29'56.87"N	86°27'44.70"E	9.74
11	11	25°30'26.26"N	86°28'5.98"E	2.77
12	12	25°29'37.90"N	86°31'51.43"E	15.6
13	13	25°32'38.36"N	86°32'48.37"E	6.54
14	14	25°31'54.31"N	86°33'16.58"E	5.86
15	15	25°32'37.71"N	86°33'37.48"E	7.1
16	16	25°30'55.74"N	86°30'32.93"E	2.12
17	17	25°31'14.83"N	86°30'44.97"E	2.98
18	18	25°31'34.34"N	86°30'15.33"E	1.94
19	19	25°31'29.99"N	86°30'50.40"E	0.77
20	20	25°32'21.88"N	86°32'48.01"E	2.10
21	21	25°32'27.11"N	86°32'56.96"E	2.41
22	22	25°32'21.64"N	86°33'18.80"E	5.92
23	23	25°32'21.68"N	86°34'7.58"E	0.75
24	24	25°31'21.17"N	86°33'15.04"E	0.95
25	25	25°31'10.43"N	86°32'44.61"E	1.47
26	26	25°31'19.64"N	86°33'3.98"E	1.17
27	27	25°31'12.23"N	86°33'5.38"E	0.63
28	28	25°30'48.53"N	86°33'8.68"E	0.69
29	29	25°30'57.86"N	86°33'6.81"E	0.73

30	30	25°30'30.23"N	86°33'30.57"E	4.18
31	31	25°30'38.76"N	86°33'20.15"E	0.89
32	32	25°30'43.18"N	86°33'57.61"E	1.94
33	33	25°30'50.38"N	86°33'51.85"E	1.81
34	34	25°30'38.25"N	86°33'38.41"E	1.75
35	35	25°30'12.92"N	86°33'37.53"E	1.42
36	36	25°32'19.67"N	86°34'57.33"E	11.6
37	37	25°31'58.27"N	86°34'51.57"E	7.1
38	38	25°31'25.15"N	86°34'38.29"E	14.1
39	39	25°30'16.47"N	86°35'13.18"E	1.97
40	40	25°29'48.33"N	86°34'41.78"E	1.97
41	41	25°29'31.97"N	86°35'1.19"E	3.94
42	42	25°29'40.87"N	86°35'43.99"E	94.7
43	43	25°24'57.34"N	86°37'33.75"E	1.57
44	44	25°24'49.50"N	86°37'55.54"E	4.55
45	45	25°25'11.61"N	86°37'29.57"E	1.00
46	46	25°25'0.77"N	86°37'46.95"E	1.84
47	47	25°25'40.95"N	86°37'29.63"E	1.89
48	48	25°27'14.04"N	86°37'34.76"E	0.47
49	49	25°27'39.20"N	86°37'43.04"E	0.48
50	50	25°27'48.78"N	86°37'35.46"E	0.38
51	51	25°27'48.97"N	86°37'46.92"E	0.83
52	52	25°27'51.88"N	86°37'53.69"E	0.54
53	53	25°27'46.29"N	86°37'52.59"E	0.45
54	54	25°30'27.63"N	86°38'15.33"E	7.20
55	55	25°31'30.31"N	86°37'20.36"E	2.45
56	56	25°31'52.95"N	86°37'18.11"E	6.18
57	57	25°32'20.13"N	86°36'41.91"E	3.95
58	58	25°30'6.32"N	86°39'6.93"E	13.7
59	59	25°29'20.66"N	86°38'42.59"E	0.48
60	60	25°27'9.76"N	86°38'23.82"E	6.69
61	61	25°26'33.76"N	86°39'22.10"E	19.3
62	62	25°26'10.65"N	86°38'37.39"E	1.43
63	63	25°25'12.40"N	86°37'57.24"E	0.48

64	64	25°25'12.62"N	86°38'1.90"E	0.12
65	65	25°24'51.87"N	86°38'11.79"E	0.91
66	66	25°24'44.94"N	86°38'35.27"E	1.43
67	67	25°25'44.04"N	86°39'25.68"E	19.2
68	68	25°25'44.48"N	86°39'56.26"E	5.36
69	69	25°25'3.52"N	86°39'22.82"E	0.76
70	70	25°24'48.16"N	86°39'32.88"E	1.61
71	71	25°24'18.86"N	86°39'49.72"E	4.65
72	72	25°24'26.58"N	86°39'45.13"E	2.29
73	73	25°24'22.99"N	86°40'14.20"E	0.25
74	74	25°24'18.91"N	86°40'7.98"E	0.24
75	75	25°24'22.33"N	86°38'33.63"E	0.97
76	76	25°23'45.28"N	86°39'18.25"E	0.46
77	77	25°22'59.58"N	86°39'22.13"E	1.66
78	78	25°21'33.52"N	86°37'52.59"E	8.72
79	79	25°20'23.84"N	86°39'44.15"E	17.0
80	80	25°18'3.51"N	86°42'18.10"E	386
81	81	25°16'55.13"N	86°44'53.33"E	7.94
82	82	25°16'31.51"N	86°42'18.21"E	7.83
83	83	25°18'54.71"N	86°39'43.71"E	11.6
84	84	25°18'36.09"N	86°43'34.76"E	0.56
85	85	25°18'50.69"N	86°43'42.92"E	0.37
86	86	25°19'14.55"N	86°43'36.14"E	0.38
87	87	25°21'2.08"N	86°43'42.72"E	0.65
88	88	25°18'23.28"N	86°45'54.16"E	0.58
89	89	25°19'47.33"N	86°46'7.86"E	0.19
90	90	25°21'24.38"N	86°45'51.43"E	1.60
91	91	25°22'34.71"N	86°46'7.73"E	0.76
92	92	25°22'29.63"N	86°46'26.24"E	5.50
93	93	25°22'46.41"N	86°46'42.50"E	0.55
94	94	25°18'11.24"N	86°46'32.02"E	11.8
95	95	25°18'57.33"N	86°47'12.42"E	2.38
96	96	25°19'45.60"N	86°46'26.59"E	6.37
97	97	25°19'32.69"N	86°46'39.01"E	2.10

98	98	25°19'35.48"N	86°46'32.81"E	1.00
99	99	25°21'5.86"N	86°48'0.98"E	94.0
100	100	25°22'13.56"N	86°48'13.43"E	3.62
101	101	25°23'0.74"N	86°47'48.47"E	7.13
102	102	25°23'20.11"N	86°48'30.50"E	21.5
103	Bharatkhand Talab	25°22'55.96"N	86°49'19.72"E	10.0
104	104	25°22'43.80"N	86°49'17.69"E	0.52
105	105	25°23'17.75"N	86°50'5.21"E	1.32
106	106	25°31'16.85"N	86°29'52.69"E	0.56
107	107	25°31'11.97"N	86°29'53.36"E	0.23
108	108	25°26'28.26"N	86°40'28.38"E	0.68
Total Area [In Hectares]				993

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 located in Khagaria city. The details of wetlands surveyed in Khagaria District are provided below :

8.3.1 **Bharatkhand Talab :** It is a village pond located near Bharatkhand and Dudhela Village at latitude 25°22'57.48"N and longitude 86°49'19.46"E [Refer Map 8 & Table No. 5 (Wetland No. 103)] having water spread area of 10.0 hectares [Refer Image No 19]. Wetland has been fragmented into almost two equal parts due to construction of Aguwani - Salarpur branch road [Refer Image No. 18]. Maximum depth of the wetland is reported as 12-15 feet. The northern part of the wetland usually dries in summer and is used for sowing maize crop. The southern part of wetland is under encroachment mainly for construction activities. The wetland gets its water from rainfall, runoff from the surrounding areas and flood water of Ganga River [Refer Image No. 18].

Currently, wetland is on lease and is used for the fish farming. Fish species found in the wetland includes – Rohu [*Labeo rohita]*, Catla [*Labeo catla]*, Brigid, Silver carp, Sawri, Padhina, Bhakur, Lodhwa, Pothia [*Puntius chola]*, Chana, Gagri, Mirki, Marwa, Bowari [*Wallago attu*] and Tengra [*Mystus tengara].*

Trees, mainly Gamhar/Khamer [*Gmelina Arborea*], Mahua [*Madhuca longifolia*] and Peepal [*Ficus religiosa*] are found along the wetland. Gamhar/Khamer [*Gmelina Arborea*] trees are planted throughout the flood control bund [Aguwani-Salarpur Road] to provide stability [Refer Image No. 20]. The northern part of the wetland is in eutrophic condition due to sewage discharge from Dudhela village. Currently, northern end of the wetland is covered with Jalkumbhi [*Eichhornia crassipes*].

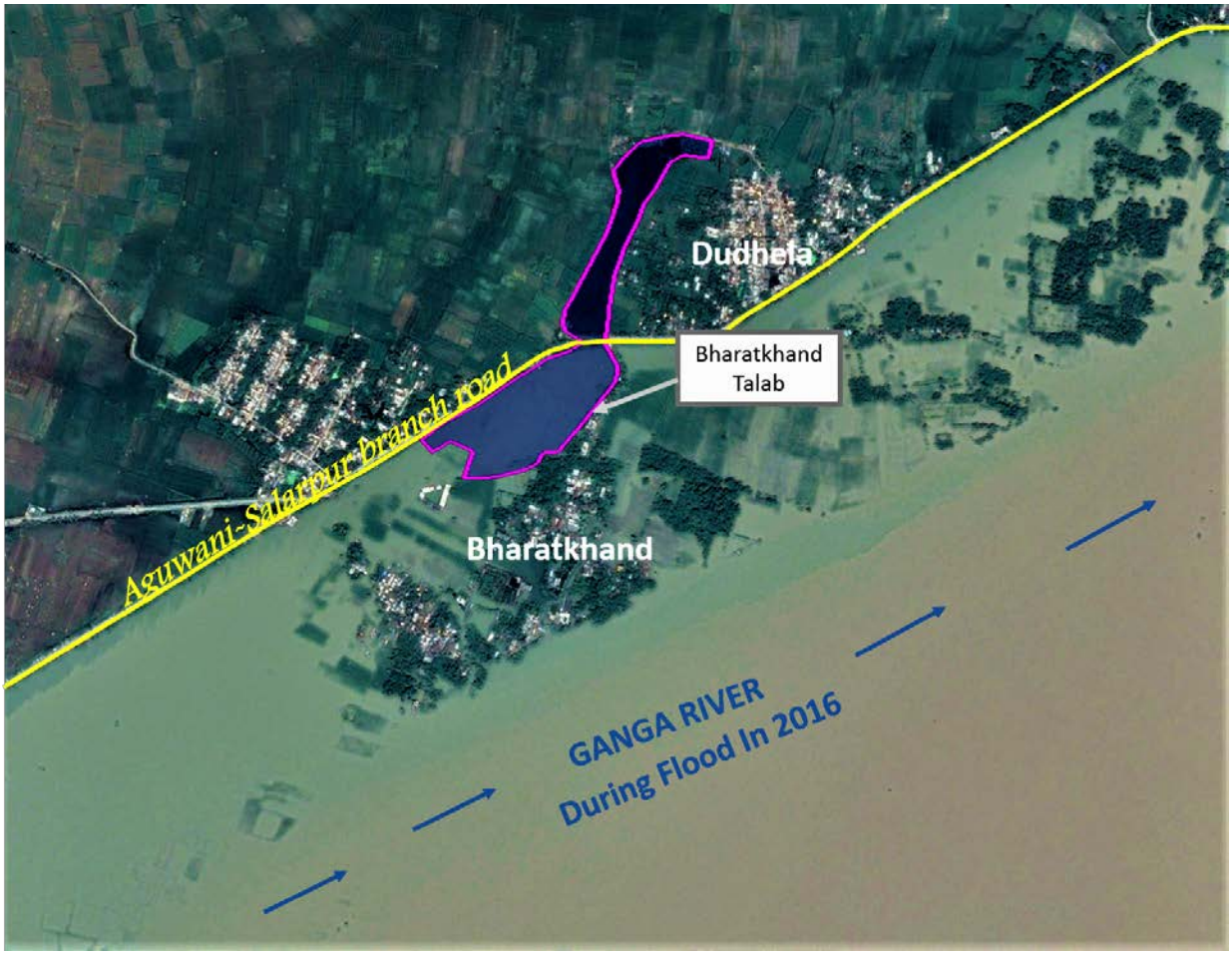


Image 18 : Bharatkhand Talab During Flood
[Source : Google Earth Imagery, Dated : August, 2016]

[Satellite imagery showing flood inundated settlements [Bharatkhand and Dudhela] and Bharatkhand Talab. The wetland is located at a distance of 5.87 Km from the Ganga Mainstem. Aguwani-Salarpur Road is constructed over the flood control bund which runs parallel to the Paleo-Channel of Ganga River which divides the wetland into two parts]

Image 19 : Bharatkhand Talab

Image 20 : Gamhar Trees Along Bharatkhand Talab

8.3.2 Mahaddipur Talab: It is a group of wetlands [three wetlands] located in Mahaddipur village [outside the study area] at latitude 25°23'34.03"N and longitude 86°44'17.15"E having water spread area of 4.0 hectares [Refer Image No. 21]. The wetland gets its water from rainfall, runoff from the surrounding areas and sewage discharge. Maximum depth of the wetland is reported as 10-12 feet. Wetland belongs to village temple and is on lease for fish farming. The revenue generated from the fish farming is used for the construction and development of the temple complex.

Image 21 : Mahaddipur Talab

8.3.3 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, Baghmati and Ghugri Nadi [Kosi Mainstem]. The area which is under inundation is locally termed as *Tal or Taal area.* 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].

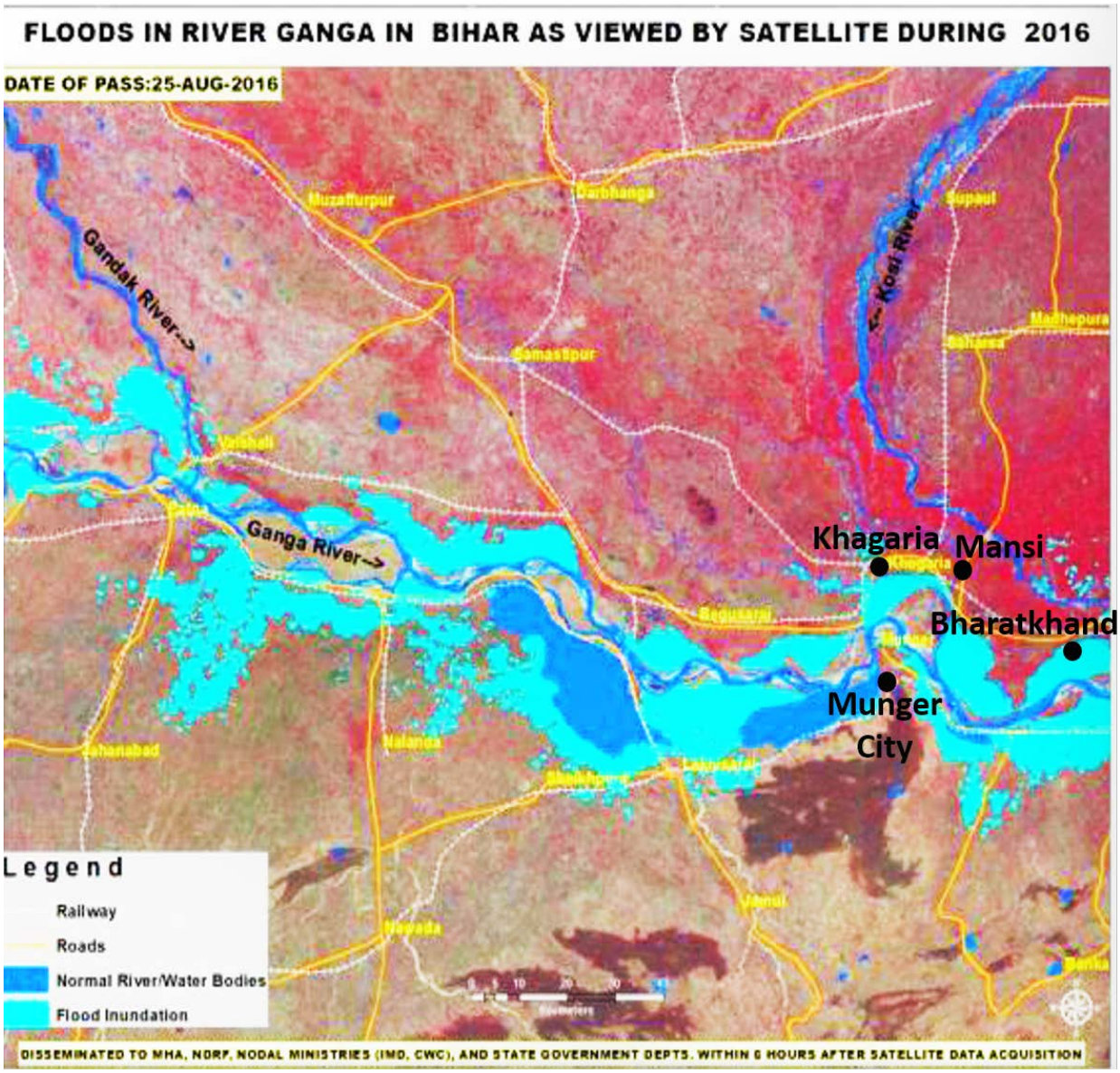
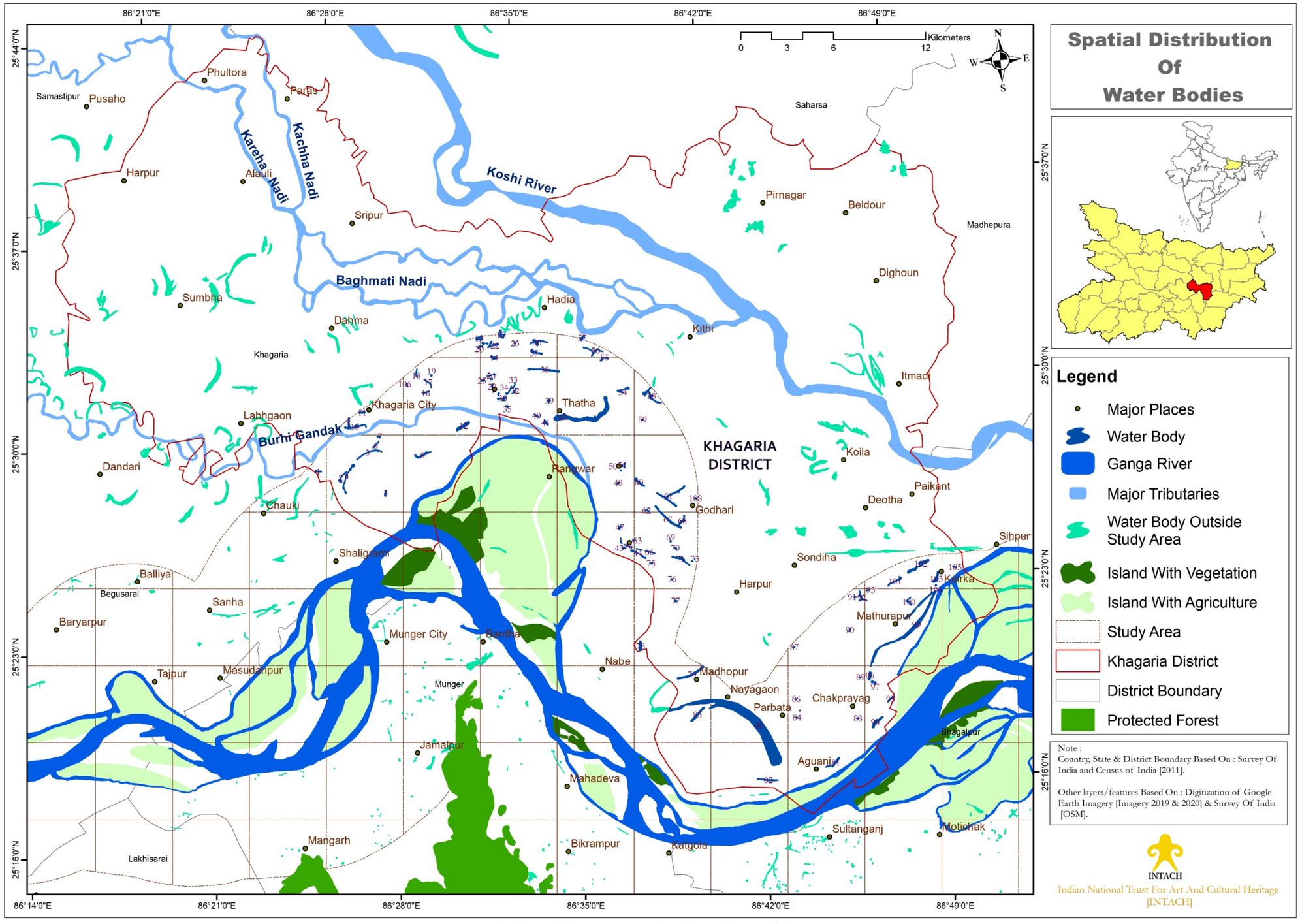


Image 22 : Satellite Imagery Of August, 2016 Showing The Flood Inundated Area Along Ganga River

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



Map 8 : Spatial Distribution Of Water Bodies/Wetlands

9.0 Riparian Flora Along Ganga River In Khagaria Distt.

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

9.2 Till some time ago, no proper systematic sampling had been undertaken or record had been maintained for the riparian plant diversity all along Ganga River. There are however, some scattered but significant works of Pallis [1934], Auden [1941], Sahai [1953], Gupta [1960], Bhattacharyya and Goel [1982], Groffman*et al.* [1990], Krishanmurti [1991], Castelle *et al.* [1994], Shyam [2008], Gangwar and Joshi [2006] and Gangwar and Gangwar [2011] which have explored the biodiversity of Ganga River basin. Also, a detailed study published in the form of a book titled – "The Ganga – A Scientific Study" edited by Krishnamurti [1991] documents 475 riparian plant species from Rishikesh [Uttarakhand] to Chinasura [West Bengal].

9.3 Khagaria Distt. forms a part of Munger – Farakka stretch of Ganga River having humid, sub-tropical and tropical climatic conditions [Prasad et al., 2012]. A study conducted by Bilgrami [1991] reported 212 different macrophyte species along Ganga River in this stretch. The pattern of riparian vegetation within study area is similar to study regions in Patna, Begusarai, Lakhisarai Munger and Bhagalpur 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 in Khagaria and Munger Distt. is mostly gets flooded. Major riparian patch is found in Tikarampur Diara, at Ganga-Burhi Gandak confluence, near Aguwani

Ghat [Near Aguwani-Sultanpur Bridge. The riparian patches are mostly dominated by *Saccharum spontaneum* [Kaas/ Kans], *Saccharum munja* [Munj], *Ziziphus nummularia* [Wild Ber], Sesbania spp. [Dhaicha], *Desmostachya bipinnata* [Kusha] and *Pithecellobium dulce* [Jungle Jalebi]. List of recorded riparian species are provided in Table No. 7.

9.4 Some riparian grasses are economically valuable in the district. *Saccharum spontaneum* and *Saccharum munja* are used for making huts, basket and ropes. Small sized baskets are locally called daliya and large sized baskets are called Dala. A large sized basket costs around 100-200 and is sold at local market in Khagaria City and Mansi. 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 are common in the distt.. Local community belonging to Bind community mainly involve in making of bamboo baskets. A large sized basket costs around 70-80 rupees.

Image 23 : A Worker Engaged In Basket Weaving

Table 6 : Recorded Riparian Plant Species Within Study Area [Khagaria Distt.]

Sr. No.	Botanical Name	Family	Common Name
1.	*Saccharum spontaneum* L.	Poaceae	Kaans
2.	*Saccharum munja* Roxb.	Poaceae	Munj
3.	*Butea monosperma (Lamb.) Taub.*	Fabaceae	Palash
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.) Dryand.	Apocynaceae	Safed Aak
28.	*Calotropis procera* (Aiton)	Apocynaceae	Aak

	Dryand.		
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 24 : *Saccharum spp.* along Ganga River Near Aguwani Ghat

Image 25 : A Small Patch OF *Phragmites spp.* Along Paleo-Channel of Ganga River In Bharatkhand Village

10.0 Faunal Diversity In Khagaria Distt.

10.1 According to India State of Forest Report [2021], 15.27% geographical area of the district is under open forest, moderately dense forest accounts for 3.18% while very dense forest is not present in the district[7]. Few patches of riparian vegetation are found at the confluences, diaras and at the river bank within the study corridor. The riparian patches provide habitat to Fox [*Vulpes bengalensis*], Hare [*Lepus ruficaudatus*], Golden Jackal [*Canis aureus*], 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.*].

10.2 Nilgai [*Boselaphus tragocamelus*] are found in variable numbers across the district and known to destroy crops. The Nilgai antelope [*Boselaphus tragocamelus*] is widely distributed throughout the country. However, due to prolonged breeding activity and lack of potential predators, the numbers of Nilgai have increased considerably and become locally overabundant in states of Gujarat, Bihar, Uttar Pradesh, Haryana, Punjab, Rajasthan, Madhya Pradesh and Delhi (Meena, 2017). In the due course of time, this species has been successful in adjusting to the human-altered landscapes and in many places have become serious pests of agricultural crops. It is found extensively foraging on the agricultural fields in the riverine areas of Ganga River and Gandak River in Khagaria and other districts of Bihar state thereby destroying crops such as wheat, maize, pulses and vegetables [Anonymous, 2016].

10.3 Diara and the surrounding areas are habitat to the Indian Wild Boar [*Sus scrofa*] population. Their highly adaptive behaviour and wide range of habitat have led the species' population to flourish. In recent years, wild boar has become a regular menace for farmers, causes crop damage right from planting till the maturity of the crop [Vasudeva Rao et. al., 2015]. Famous for attacks on human, the wild boars are usually nocturnal species. The presence of wild boars is reported mainly at Munger-Khagaria boarder. During the survey, the locals stated that the boars are responsible for destroying the crops and other vegetables.

[7] India State of Forest Report [Uttar Pradesh], 2021
https://fsi.nic.in/isfr-2021/chapter-13.pdf [Accessed dated 01.02.2021]

10.4 The Gangetic River Dolphin is exclusively aquatic and piscivorous, 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. A detailed dolphin survey carried out by Sinha (2013) in Bihar state revealed the presence of 83 dolphin individuals in Ganga River stretch between Munger and Hamzapur. The study considered this region as a 'Critical Stretch' for dolphins and recommended to declare it as **Dolphin Conservation Reserve**. The presence of Gangetic River Dolphin is reported throughout the study corridor. However, major sighting occurred at Ganga-Burhi Gandak Confluence and at Aguwani Ghat [Left Bank, opposite to the Sultanpur Ghat]. At Aguwani ghat around 8-10 Dolphins of different aged group were reported [Refer Image No. 27].

Image 26 : Gangetic Dolphin Sighted At Ganga-Man Confluence

10.5 **Avian Diversity :** The entire study area is 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). The conservation status of the species was listed by using IUCN Red Data List. A list of identified birds are provided in the Table No. 7.

Table 7 : Recorded Avian Species

Common Name	Scientific Name	IUCN Red List Status
Little Cormorant	*Phalacrocorax niger*	Least Concern
Indian Cormorant	*Phalacrocorax fuscicollis*	Least Concern
Great Cormorant	*Phalacrocorax carbo*	Least Concern
Oriental Darter	***Anhinga melanogaster***	Near Threatened
Red-naped Ibis	*Pseudibis papillosa*	Least Concern
Indian Pond Heron	Ardeolagrayii	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
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 27 : Lesser Adjutant In A Riverine Wetland

Image 28 : Group Of Asian Openbill Stork In Agricultural Field

11.0 Ganga Riverine Islands/Diaras In Khagaria 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 are locally referred to 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 three major islands identified and documented within the district. Jurisdiction of the riverine islands lies in Khagaria-Munger-Begusarai and Khagaria- Munger Distt.. 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. 8.

Table 8 : Details Of The Riverine Island Within Khagaria Distt.

Sr. No.	Nearest Settlement	Coordinates		Status
		Latitude	Longitude	
1	Near Munger City [Right Bank]	25°20'7.94"N	86°26'54.28"E	Area approx. 7.84 Sq. Km. Jurisdiction: Khagaria, Munger and Begusarai Distt. Land Use: Mainly Agriculture Vegetation: Few hectares only [*Saccharum spontaneum*, Saccharum

				munja]. Vegetation is shrinking due extensive agricultural activities.
2	Dumaria Buzurg [Left Bank]	25°15'21.41"N [Refer Image No. 29, 30 & 31]	86°40'26.05"E	Area approx. 16.0 Sq. Km. Jurisdiction: Munger and Khagaria Distt. Land Use: Agriculture
3	Tikarampur Diara [Refer Image No. 32]	25°25'41.41"N	86°33'41.91"E	Area approx. 90.5 Sq. Km. Jurisdiction: Khagaria and Munger Distt. Island formed at the confluence of Ganga-Burhi Gandak River Land Use: Mainly Agriculture Vegetation: Dominant species - *Saccharum spontaneum*, Saccharum munja].

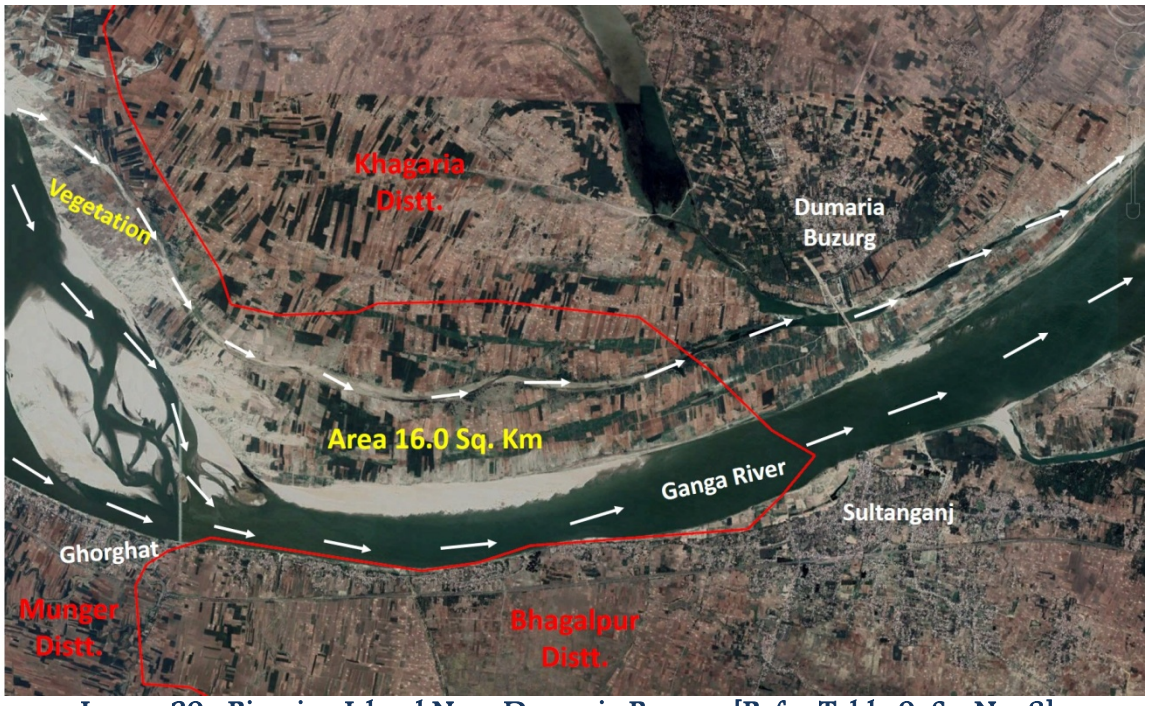


Image 29 : Riverine Island Near Dumaria Buzurg [Refer Table 9, Sr. No. 8]
[Source : Google Earth Imagery, May 2021]

Image 30 : Agriculture Fields At Island Near Dumaria Buzurg

Image 31 : Dried Ganga River Channel Near Riverine Island Is Currently Under Cultivation

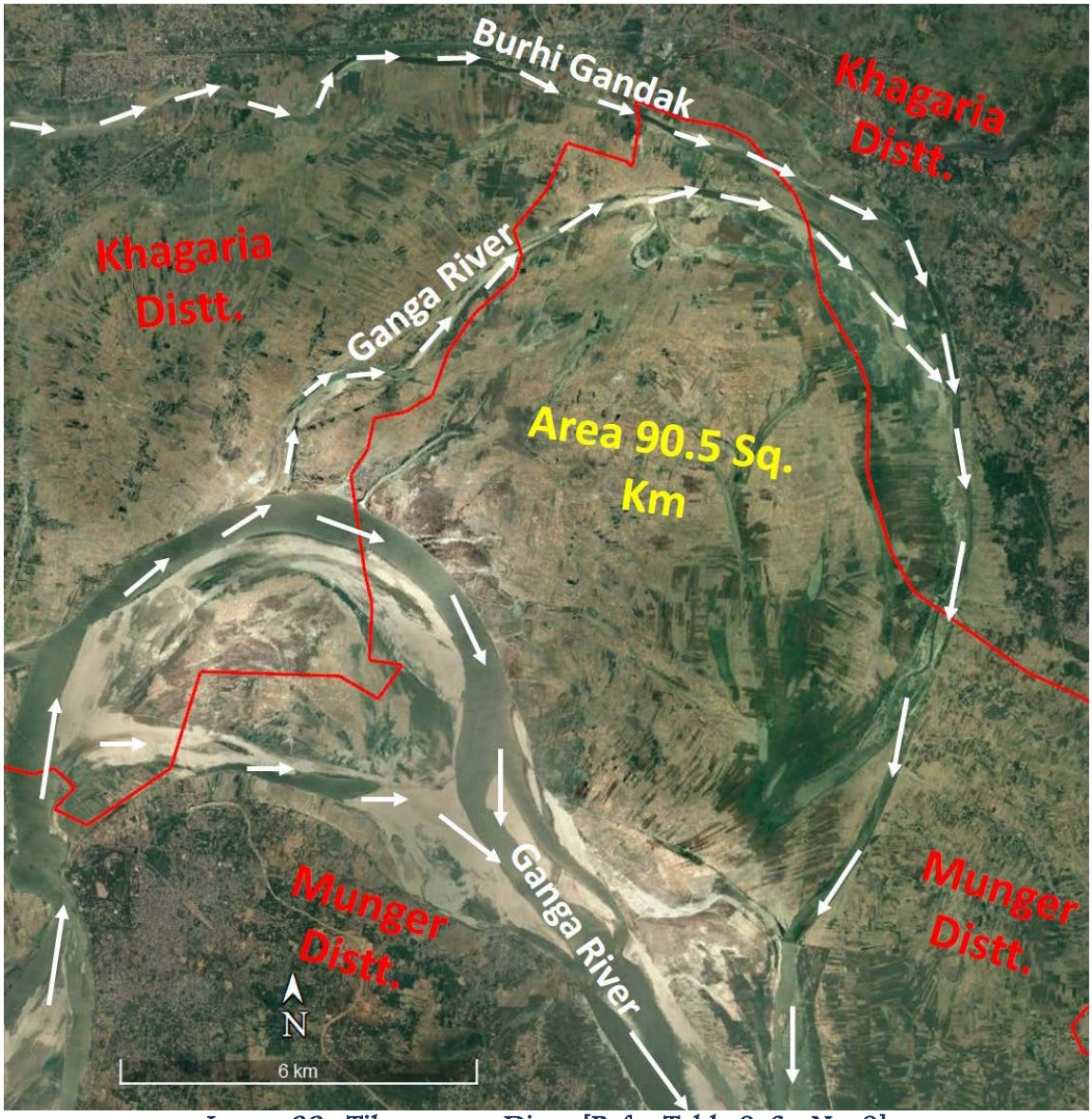


Image 32 : Tikarampur Diara [Refer Table 9, Sr. No. 9]

[Source : Google Earth Imagery, May 2021]

12.0 Fishing In Khagaria 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, canals & creeks at Khagaria Distt. in Bihar. In the several parts of the Ganga's tributaries and major canals, fishing is allowed. Mostly, traditional fishing is practiced in the main Ganga River and its channels [Refer Image No. 33]. Unlike Munger, at very few locations ***"Jalad"*** system of fishing was observed in the study corridor of Khagaria Distt.. Fishing activities are commonly carried out by the Mallah Community [Refer Image No. 34]. A group of 8-10 Mallahs spread the fishing net and recollect it together with the help of two boats. Further, they sell the catch in the local market only.

12.4 The most common category of fish that are consumed by local communities are Rohu [*Labeo rohita*] & Catla [*Labeo catla*], which are moderate in price, varying from Rs 200/- to Rs.300/- per kg. These fishes are found abundantly in River Ganga, also reared in the pond and pain in the neighboring districts such as Munger. These are

the fast-growing fishes with minimal maintenance and have good economic return value.

12.5 The most expensive fish found in the region is Dawrf Goonch or devil catfish, the price varies from Rs 800- 1000 per kg. This is a species of catfish whose size has been recorded up to 6 ft. Generally, Dwarf Goonch are found in the main stream of the River Ganga. Due to its size and aggressive nature, it is hard to catch. As per IUCN Dwarf Goonch has been marked as near threatened species. Fish species recorded during field visit are listed below :

Table 9 : Recorded Fish Species

Sr. No.	Scientific Name	Common Name
1.	*Labeo rohita*	Rohu
2.	*Systomus sarana*	Olive Barb
3.	*Mystus vittatus*	Striped Dwarf Catfish
4.	*Pseudeutropius atherinoides*	Indian Potasi
5.	*Anabas testudineus*	Climbing Perch
6.	*Labeo catla*	Catla
7.	*Wallago attu*	Buari/Barari
8.	*Mystus cavasius*	Tengra
9.	*Mystus tengara*	Tengra
10.	*Cyprinus carpio*	Common/Chinese carp
11.	*Channa punctata*	Garai
12.	*Eutropiichthys vacha*	Bachwa
13.	*Anguilla bengalensis*	Baam
14.	*Cirrhinus mrigala*	Naini
15.	*Mastacembelus armatus*	Gaichi/ Spiny Eel
16.	*Chitala chitala*	Indian knifefish
17.	*Labeo bata*	Bata
18.	*Channa striata*	Snakehead Murrel
19.	*Cabdio morar*	Chepua
20.	*Heteropneustes fossilis*	Singhi
21.	*Puntius chola*	Pothiya/ Pothia

22.	*Sperata seenghala*	Singhara
23.	*Bagarius Bagarius*	Bhagar/Gooch
24.	*Bagarius yarrelli*	Gosta/Gooch
25.	*Hypophthalmichthys nobilis*	Bighead carp

Image 33 : Fishing In Ganga River Channel Near Dumaria Buzurg

Image 34 : Jalad Installed In A Paleo Channel Of Ganga River In Bharatkhand Village

13.0 Groundwater In Khagaria 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. Khagaria Distt a part of the Gangetic plain underlain by immensely thick alluvial deposits comprising sediments [sand, gravel and clay] of Quaternary age deposited unconformably over the Precambrian basement. The alluvial deposits are characteristically divided into Older and Younger Alluvium[8]. Almost entire study area lies in younger alluvium deposits of Ganga and Burhi-Gandak river system.

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, Khagaria, Mansi, Gogri and Parbatta blocks fall under Safe category[9,10]. According to partially ground water contaminated area study of CGWB, ground water of Khagaria distt. is contaminated with Arsenic and Iron contaminants having values above 0.01 mg/l and 1 mg/l respectively[11].

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. People prefer hand pumps; also, most of the household [except the settlements at Diara] has the access of supply water. Dug wells near river banks are lacking maintenance and are mostly abandoned. Based on the interaction with the local communities it has been found that people usually bore between 40-60 ft for ground water withdrawal. Based on local interaction ground water levels recorded at different villages are provided in the table below

8 Report On Aquifer Mapping, CGWB
http://cgwb.gov.in/AQM/NAQUIM_REPORT/Bihar/Parts%20of%20Begusarai,%20Bhagalpur,%20Khagaria,%20Munger%20and%20Lakhisarai%20Districts.pdf
9 Block wise Ground Water Resources Assessment, CGWB, 2017
10 Block wise Ground Water Resources Assessment, CGWB, 2020
11 States Wise Details of Partly Affected Districts with Select Contaminants in Ground Water of India, CGWB
http://cgwb.gov.in/WQ/Districts%20contamination.pdf

Table 10 : Water Levels (Based on interactions with local communities)

Location	Coordinates	GW Level (in feet)
Bharatkhand Village	25°22'42.87"N, 86°49'17.43"E	50-60
Dudhela Village	25°23'5.27"N, 86°49'35.12"E	50-60
Raka Village	25°17'13.24"N, 86°45'2.96"E	50-60
Aguwani Village	25°16'41.12"N, 86°44'14.98"E	50-60
Mahaddipur	25°23'34.14"N, 86°44'15.11"E	50-60
Temtha Village	25°18'21.5"N, 86°42'32.8"E	40-50

Image 35 : Abandoned Dugwell In Temtha Village

[The underground part of the well (15 feet) has been exposed due to sand mining and soil digging process involved in brick kiln activities]

14.0 Ganga River Bank In Khagaria Distt.

14.1 Ganga River flows to a distance of 29 km in which the main channel of the River covers approximately 6 km in the distt. Most of the area of the River Bank is inaccessible. 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 ghats namely Aguwani ghat [25°16'20.18"N, 86°44'11.84"E], Bharatkhand Pakka Ghat [25°22'43.61"N, 86°49'29.92"E] in the study area which is easily accessible. However, these ghats lacks the basic infrastructure. Villages nearby the Munger Distt. uses Jhahwabahiyar Ghat [25°20'13.42"N, 86°35'19.74"E] for ferrying and to perform various rituals. The Sultanpur Ghat [Right Bank] of Bhagalpur Distt. is a major ghat in the region due to its religious significance.

14.2 The study area witnesses the weekly and monthly fair and festival. There is a fair named ***Kartik mela*** which were once organised yearly in Bharatkhand and surroundings areas is now closed. In Mansi [a small town eight km from Khagaria Distt.] a fair named ***Pashu mela*** is held weekly. An image of the Pashu Mela is shown Image No 36.

Image 36 : Weekly Pashu Mela In Mansi, Khagaria Distt.

14.3 Cremation And Burial Ground : Ganga River Banks are used for cremation and burial ground for generations. Burial is not a common practice in Khagaria and nearby Distt.. However, few burial sites are reported near Jhahwabahiyar Ghat of Munger Distt. The Ghat is usually utilized by local communities of Munger and Khagaria Distt.. During field visits it has been observed that burial ground is not restricted to particular site and can been done at any sand bar of the Ganga River. This is because Ganga River and its active floodplain is considered as sacred and burial within the region is equivalent to the cremation. There are no dedicated cremation ghats in Khagaria Distt.. People cremate at any site as per the convenience. The ongoing cremation at Ghats lack basic infrastructure. There are three Ghats namely Aguwani Ghat [Khagaria Distt.], Jhahwabahiyar Ghat [Munger Distt., Ganga-Burhi Gandak Confluence] and Steamer Ghat/ Munger Ghat [Begusarai Distt.] which is used for cremation. The Sultanpur Ghat is also used for cremation due to its religious significance.

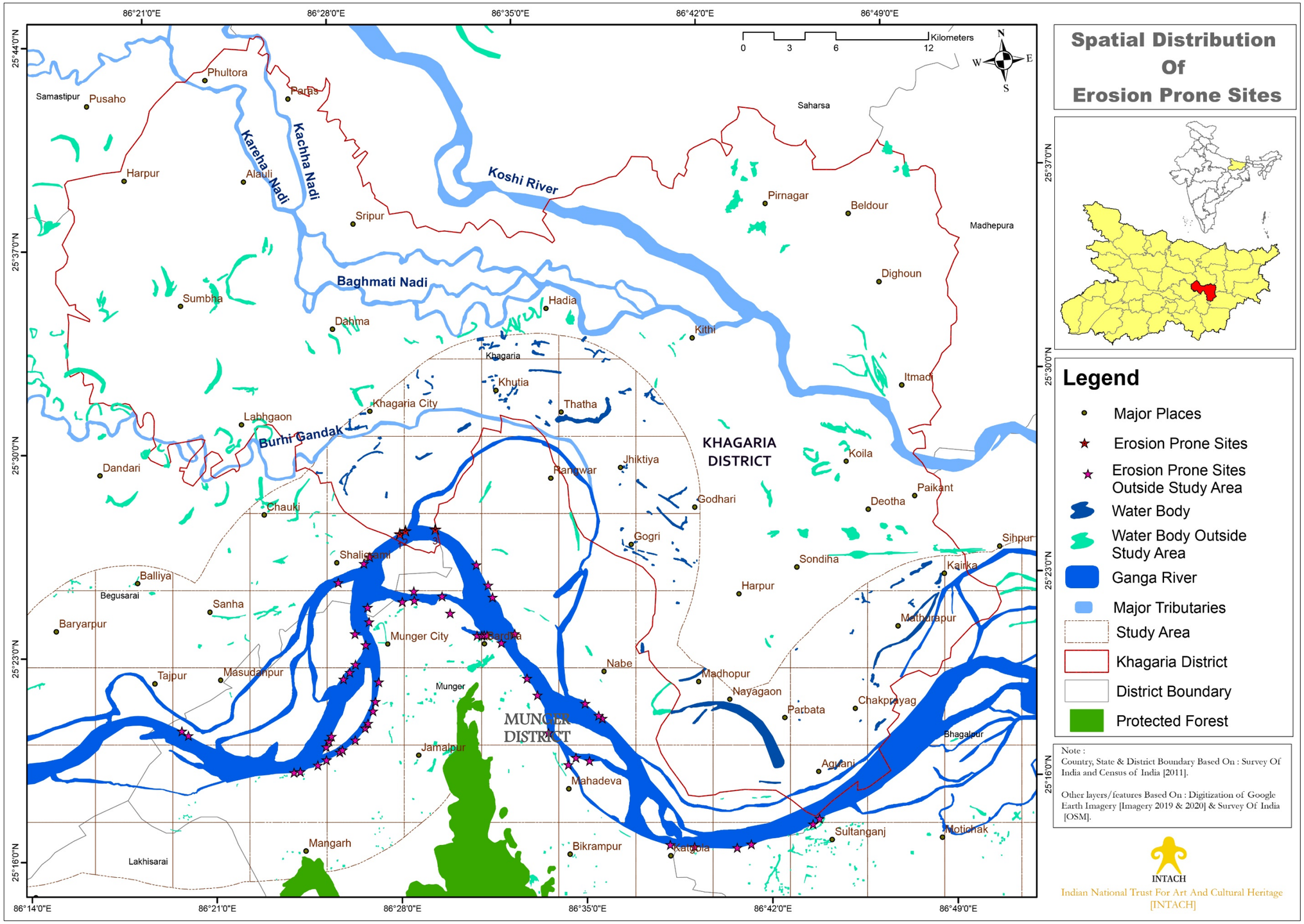
Image 37 : Cremation At Munger/Steamer Ghat

14.4 Ganga Bank Erosion : 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).

14.5 Depending on the intensity and severity of erosion, the study area [7km Buffer] maybe grouped under slight erosion category. However, increasing number of brick kilns, decrease in riparian vegetation and extensive agricultural activities may increase the rate of erosion. The lateral erosion of the banks occurs under intense rainfall accompanied by torrential flow in rivulets generating vast quantities of sediment transported downstream. There are three lateral erosion sites marked within the study area with the help of satellite imagery [2020-2021]. The sites area located at the trijunction of Khagaria, Begusarai and Munger Distt.. During field visit, few recently developed eroded sites were reported at Aguwani Ghat and near Siadatpur Village.

Image 38 : Eroded Bank At Aguwani Ghat



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

15.0 Mining & Brick Kilns In Khagaria 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[12]. Sand mining in Ganga River within the district is reported at two sites on riverine island –

1. Near Siadatpur Village at Latitude 25°16'47.23"N and Longitude 86°45'25.67"E

2. Near Aguwani Village at Latitude 25°16'5.96"N and Longitude 86°44'38.05"E

Image 39 : Sand Mining At Riverine Island Near Siadatpur Village

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

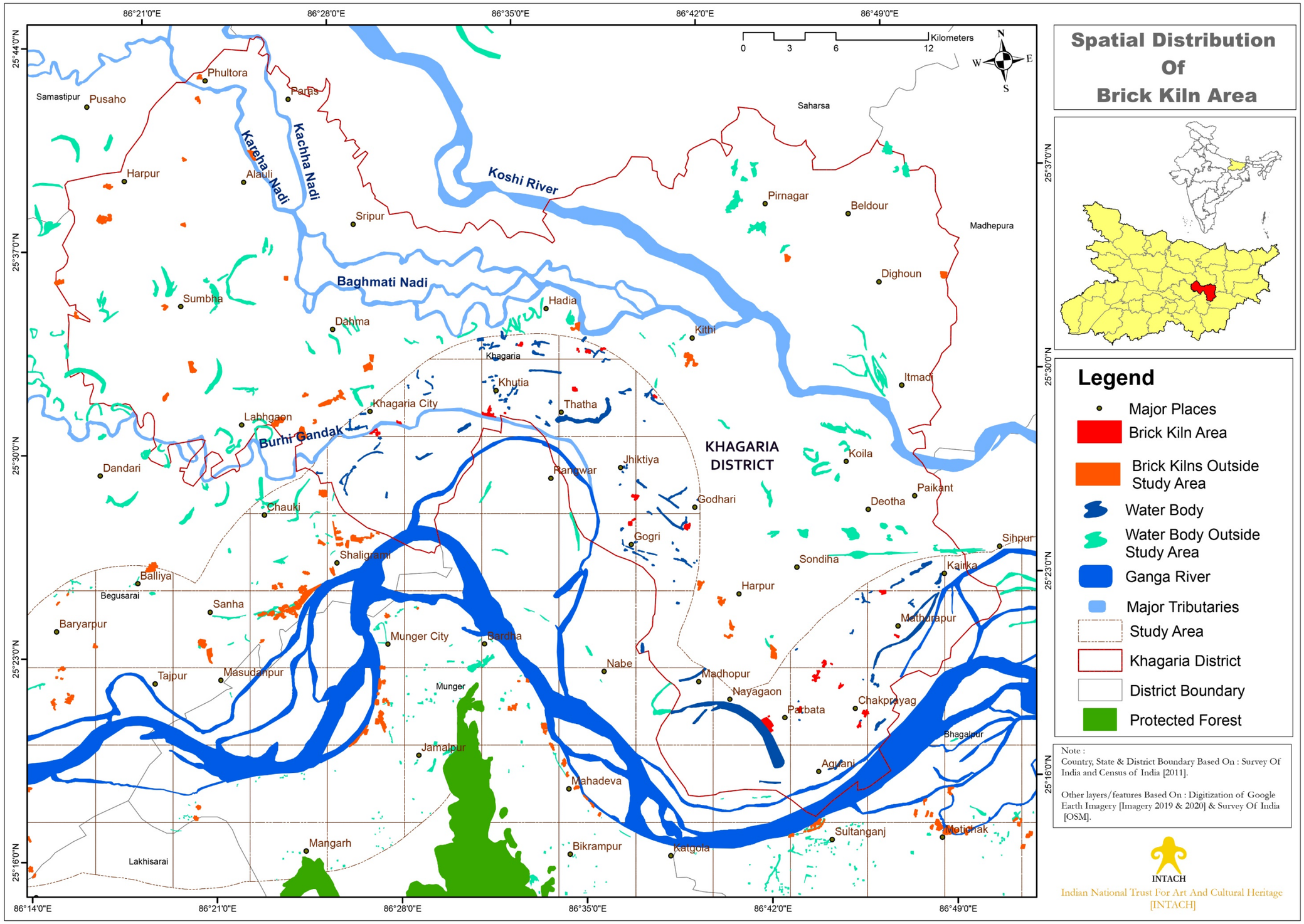
Image 40 : Sand Mining At Riverine Island Near Aguwani Village

15.3 Brick Kilns: With rapid development bricks have become one of the important building materials for construction activities. Brick kilns in the study area provide livelihood opportunity to the local community. However, this industry has posed current and potential future threats to the soil, air, biota and water system of the region. The clay digging process deteriorates the soil quality and productivity of the soil because the bricks are made from the top soil. It has been found that brick kiln sites in floodplain areas increases the rate of soil erosion.

15.4 Brick kiln sites within study area are mainly clustered near Bharatkhand, Mathurapur, Chakprayag, Parbatta, Dodhri, Gogri, Temtha and Khutia and at boarder area of Khagaria and Begusarai Distt [Refer Map No. 10 and Image No.41]. Brick Kilns at left bank of River Ganga in Khagaria and Begusarai Distt. is less compared to the right bank of River Ganga in Munger and Bhagalpur Distt. [Refer Image No. 42]. This is because the left bank is flat and is liable to flood.

Image 41 : Brick Kiln In Bharatkhand Village In Khagari Distt. [Left Bank]

Image 42 : Brick Kiln Along Ganga River In Munger Distt. [Right Bank]



Map 10 : Spatial Distribution Of Brick Kiln Area

16.0 Boatmaking In Khagaria Distt.

16.1 Boat making is a popular and profit-making profession in Khagaria 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 Khagaria, Munger and Begusarai 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 43 : Repaired Fishing Boat At Temtha Ghat

17.0 Inland Navigation In Khagaria Distt.

17.1 The stretch of Ganga River in Khagaria 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)[13].

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 will sail through National Waterway -1, National Waterway -2 and National Waterway -16[14].*

**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 Khagaria Distt. have been ferrying passengers for generations. Ferrying is common in almost every river in the Distt. [Ganga, Burhi Gandak, Baghmati, Kamla, Kosi and Ghugri Nadi]. Within study area, ferrying is reported only at Aguwani Ghat [25°15'50.66"N, 86°44'21.88"E], which operates between Aguwani Village [Khagaria Distt.] and Sultanpur [Bhagalpur Distt.]. Currently, ferry service is on lease and operates between October-June.

[13] Inland Waterways Authority of India [Website Accessed December 2021]
https://iwai.nic.in/waterways/national-waterways/national-waterways-1?id=2523
14 Press release, Ministry of Ports, Shipping and Waterways, 5th February 2022
https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1795821 [Accessed February 2022]

Image 44 : Ferrying At Aguwani Ghat
[Bridge over Ganga River is under-construction. It will connect the flood affected North Bihar to South Bihar]

18.0 Old And Sacred Trees In Khagaria 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, a and 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 11 : Old And Sacred Trees

Plant Species	Location and Nature of Tree	Coordinates	
		Latitude	Longitude
Peepal *[Ficus religiosa]*	Bharatkhand Old tree	25°22'45.0"N	86°49'14.9"E
Peepal *[Ficus religiosa]*	Akha Village Peepal Tree associated with Shiva Temple	25°21'23.30"N	86°47'25.38"E
Peepal *[Ficus religiosa]*	Peepal Tree associated with Temple	25°19'58.4"N	86°45'51.2"E
Peepal *[Ficus religiosa]*	Peepal Tree associated with Temple	25°19'57.5"N	86°45'50.9"E
Peepal *[Ficus religiosa]*	Raka Village Old Peepal Tree	25°17'10.70"N	86°45'6.24"E
Peepal *[Ficus religiosa]*	Old Peepal Tree	25°16'51.6"N	86°44'46.8"E
Bargad *[Ficus benghalensis]*	Old Banyan Tree	25°16'50.7"N	86°44'42.7"E
Peepal *[Ficus religiosa]*	Old Peepal Tree	25°16'50.7"N	86°44'40.5"E
Bargad *[Ficus benghalensis]*	Old Banyan Tree [150-170 years]	25°16'35.4"N	86°44'07.5"E
Semal *[Bombax ceiba]*	Old Semal Tree	25°17'22.9"N	86°43'33.1"E
Peepal *[Ficus religiosa]*	Two old Peepal Tree	25°17'58.1"N	86°43'13.5"E
Peepal [*Ficus religiosa*]	Old Peepal Tree	25°18'22.2"N	86°42'52.9"E
Peepal [*Ficus religiosa*]	Peepal Tree associated with Temple	25°19'03.4"N	86°43'10.6"E
Bargad [Ficus benghalensis]	Old Banyan Tree	25°21'17.3"N	86°43'24.0"E
Bargad [*Ficus benghalensis*]	Old Banyan Tree	25°24'49.6"N	86°39'04.7"E
Peepal [*Ficus religiosa*]	Old Peepal tree associated with	25°26'21.8"N	86°38'27.2"E

	Vishwakarma Temple		
Bargad [*Ficus benghalensis*], Peepal [*Ficus religiosa*]	Old banyan and Peepal tree	25°28'06.1"N	86°37'12.7"E
Bargad [*Ficus benghalensis*]	Old banyan tree	25°29'40.0"N	86°35'59.9"E
Bargad [*Ficus benghalensis*]	100 years old banyan tree	25°30'25.1"N	86°33'14.7"E
Peepal [*Ficus religiosa*]	Old Peepal tree	25°30'26.2"N	86°32'59.6"E
Bargad [*Ficus benghalensis*]	Old banyan tree	25°30'25.5"N	86°30'57.8"E
Bargad [*Ficus benghalensis*]	Old banyan tree in Khagaria City	25°30'14.9"N	86°28'45.6"E
Peepal [*Ficus religiosa*]	Old Peepal tree associated with Sun Temple	25°30'06.4"N	86°28'25.9"E

Image 45 : People Gathered To Hear Ram Katha Below The Sacred Banyan Tree In Temtha Village

19.0 Key Observation And Recommendations

19.1 Fading of Stream/Nara : Small stream/ Nala which directly drain within study area are under threat due to removal of riparian vegetation, agriculture activities on stream bank, brick kiln, high silt load and encroachment. Due to mentioned threats, two streams have completely faded. Stream/Nala holds the vulnerable riparian zone, which protect from erosion, helps in flood management, provides habitat to riparian fauna and serve as migratory routes to fish species in monsoon season. Disappearing of streams may damage local biota.

19.2 Threat to Wetlands : Riverine wetlands are facing serious threat due to loss of riparian vegetation, encroachment and conversion of wetland area into agricultural field. The riverine wetlands are habitat to threatened and migratory avian species. Wetlands in villages and city area are mostly under eutrophic condition. Wetland like Bharatkhand Talab has been fragmented into two parts due to construction of road and some of its area is encroached for construction activities. 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.

19.3 Hunting of Birds : During filed visit, hunting is reported in Bharatkhand and Mathurapur village of Parbatta Block. Two birds namely –Red crested Pochard and Cormorant locally called Lalsar and Adhang are preferred hunt.

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 Bharatkhand and Aguwani Ghat in Khagaria Distt. and Munger/ Steamer Ghat [Begusarai Distt.] and Jhahwabahiyar Ghat [Munger Distt.]. Proper site should be provided and area should be demarcated for burial.

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