Ganga Cultural Documentation
2021

SARAN DISTRICT

NAMAMI GANGE

National Mission for Clean Ganga

INTACH Indian National Trust for Art and Cultural Heritage

INDIA@75

Azaadi Ke Rang Bharatiya Sanskriti Ke Sang

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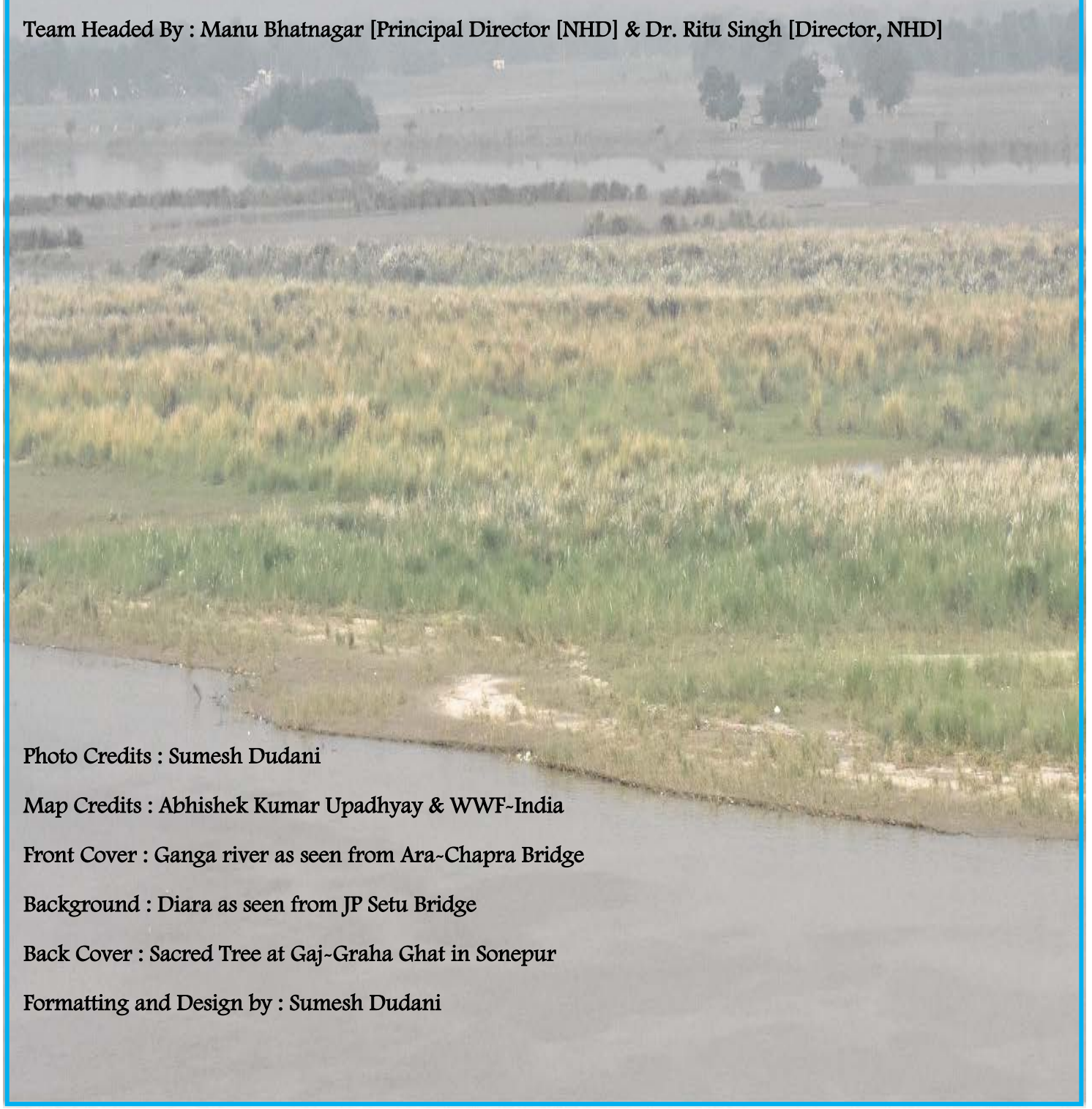

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Front Cover : Ganga river as seen from Ara-Chapra Bridge

Background : Diara as seen from JP Setu Bridge

Back Cover : Sacred Tree at Gaj-Graha Ghat in Sonepur

Formatting and Design by : Sumesh Dudani

GANGA CULTURAL DOCUMENTATION

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Sponsored by :

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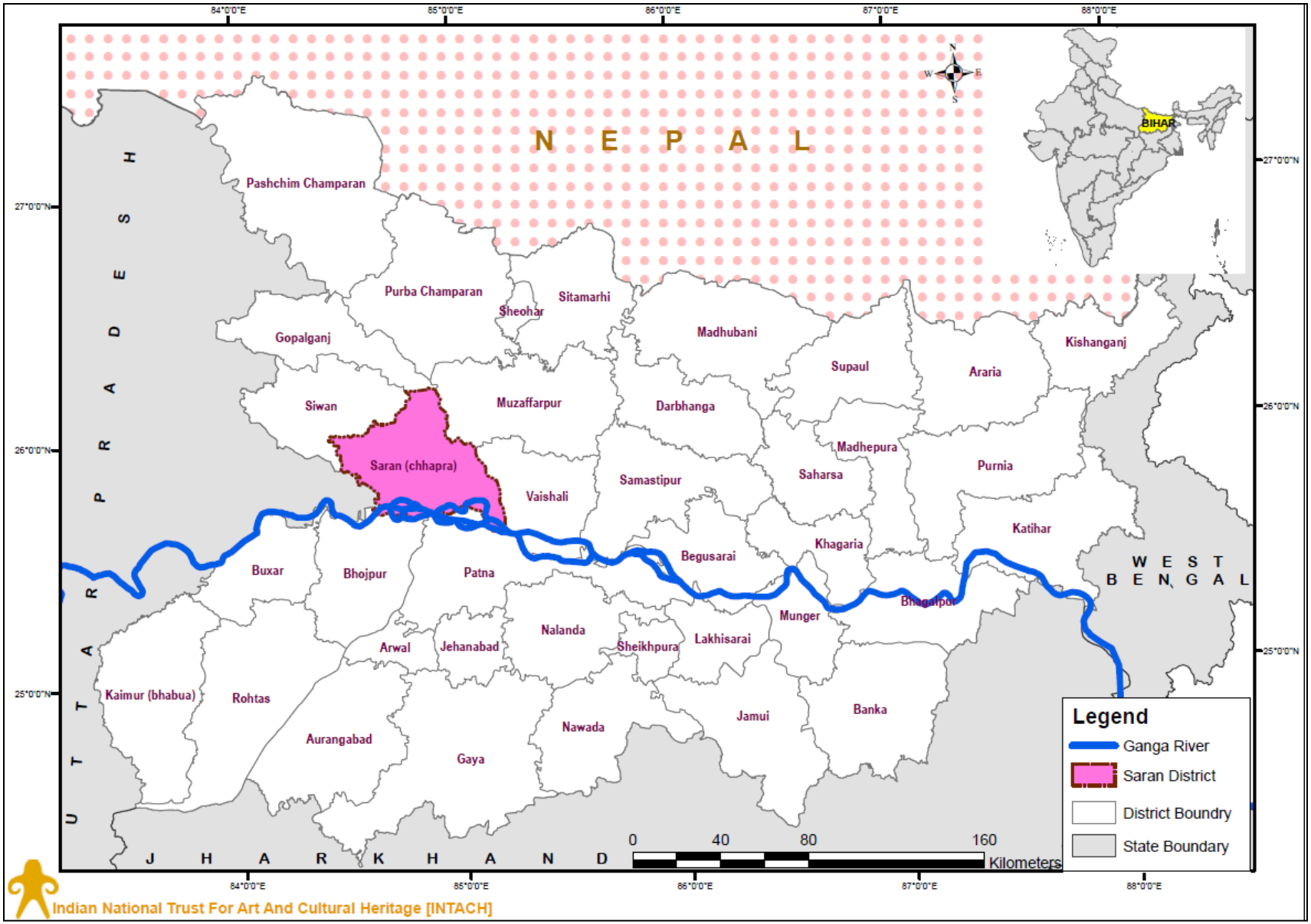
1.0 Introduction

1.1 Saran Distt. is one of the thirty-eight Districts of Bihar, situated in its western part. It is also known as Chapra Distt. after its headquarters at Chapra town. Situated between 25° 36' and 26° 13' North latitude and 84° 24' and 85° 15' East longitude, the distt. occupies a total geographical area of 2641 sq.km. It is divided into 3 sub-divisions: Marhaura, Chapra Sadar and Sonepur which are further sub-divided into 20 community development blocks and 1783 villages (CGWB, 2013). The Distt. is bounded on south by Ganga river which separates it from Patna and Bhojpur Distt.s [Refer Map 1]. Gandak River forms the Distt. boundary in east separating it from Vaishali and Muzzafarpur Distt.s while Ghaghra river bounds this Distt. In the west separating it from Ballia Distt. Of UP. [see Map 1]

1.2 The historical background of the district as available in the 'Ain-i-Akbari' records which show Saran as one of the six Sarkars (Revenue division) constituting the province of Bihar. At the time of grant of *diwani* to the East India Company in 1765, there were eight Sarkars including Saran and Champaran. These two were later combined to form a single unit named Saran. Saran (along with Champaran) was included in the Patna Division in 1829. It was separated from Champaran in 1866. Saran was made a part of Tirhut Division, when the latter was created in 1908. By this time there were three Sub-Divisions in this district namely Saran, Siwan and Gopalganj. In 1972 each sub-division of the old Saran district became an independent district (Census of India, 2011).

1.3 Saran Distt. is shaped roughly like a triangle with its apex at the junction of the boundary of Gopalganj Distt. and the Gandak River. The area has rich and fertile alluvial plain with quite a few depressions and marshes. The Distt. has three broad geomorphic divisions – (1) the alluvial plains along major rivers, (2) the region of uplands away from the river and (3) the *diara* areas in the beds of rivers Ganges, Gandak and Ghaghra. The Distt. is part of the Lower Ganga Basin with the perennial rivers – Ganga, Ghaghra and Gandak governing its drainage system. The climate of this Distt. is generally hot and humid with the temperatures going upto 46°C in summers and upto 7°C during winters. The monsoon season ranges from June to September and the monsoon rainfall accounts for about 80% of the annual rainfall in the Distt.

Various hypothesis have been put forward about the origin of the name Saran. General Cunningham suggested that Saran was earlier known as Sarana or asylum which was a name given to a stumbled (pillar) built by Emperor Ashoka to commemorate the conversion to Buddhism of some legendary demons who ate human flesh. He considered that the site of stupa must be somewhere near Arrah. Another view holds that the name Saran has been derived from saranga-aranya or the deer forest, the district being famous for its wide expanses of forest and deer in prehistoric times. According to another account, Saran is a derivative of Sakra Aranya, the forest of Sakra which is another name for Indra. This forest is said to have covered the country around Visala at which place king Sumati received Lord Ramchandra when he was proceeding with Vaishwamitra on way from Ayodhya to Mithila. Yet another legend explains the three names Arrah, Saran and Champaran as corrupt forms of old Sanskrit names Aranya, Saranya and Champaranya derived from the thick forests covering these areas.

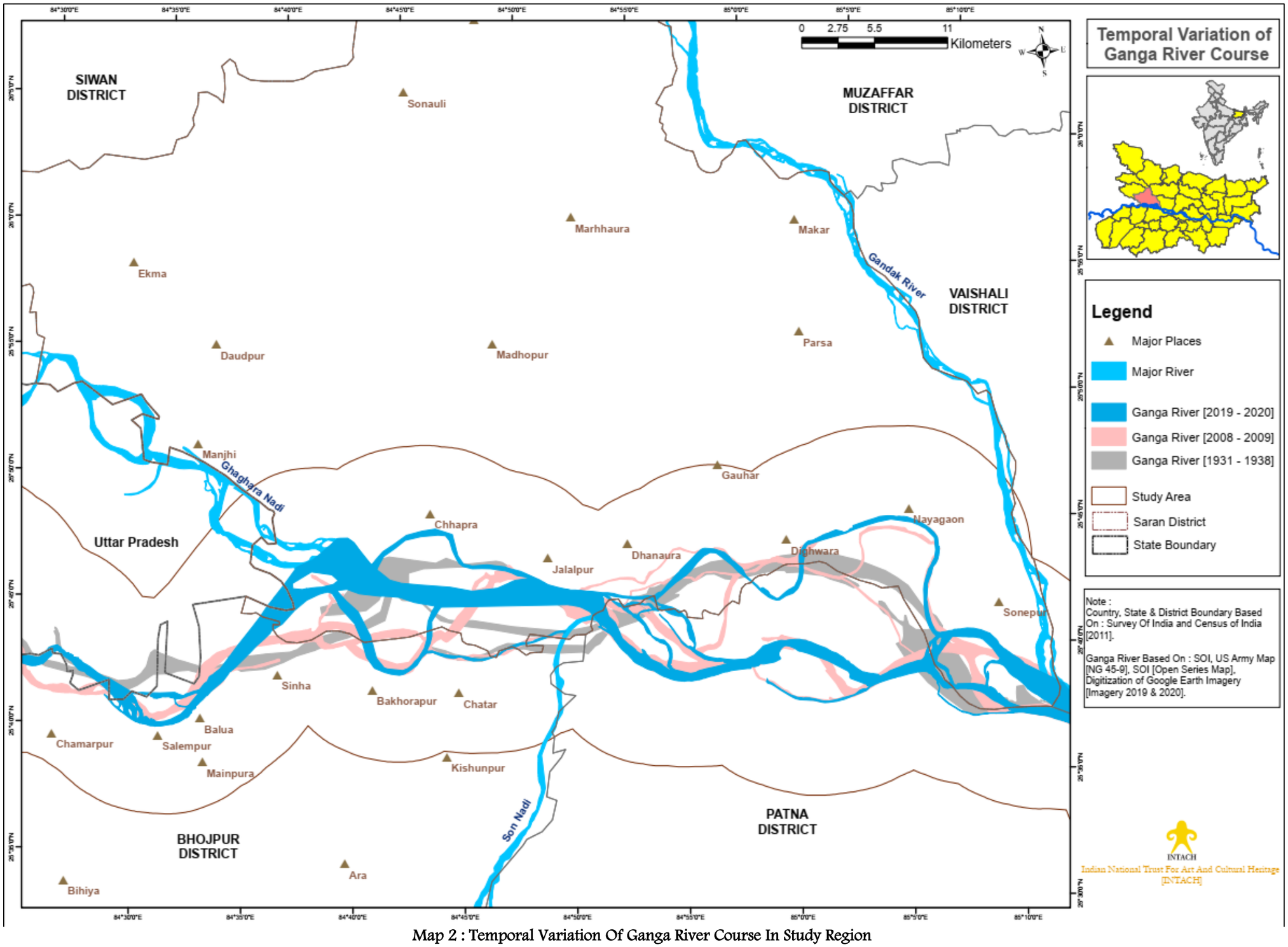


Map 1 : Location Of Saran Distt.

2.0 Ganga River In Saran Distt.

2.1 Downstream of its confluence with Ghaghra River near Sitab *diara* in Ballia Distt. of Uttar Pradesh, Ganga River enters Saran Distt. of Bihar and immediately adjoins the town of Chapra. Thereafter, it flows eastwards for a distance of about 44 km., forming the southern boundary of this Distt. separating it from Bhojpur and Patna Distt.s. Further ahead, it confluences with another important tributary – Gandak River flowing from northern direction near Sonepur. This confluence of Gandak-Ganga also forms the point where Ganga River exits Saran and enters Vaishali Distt. Between these two confluences, the river is braided into different channels due to presence of irregularly shaped *diaras* and sand bars. Ganga along with Gandak and Ghaghra Rivers swell up during monsoons which also serves as an important recharge source for the aquifers in the study region. Ganga River has shifted its course in the study region as mentioned in the Distt. Gazetteer (Roy Chaudhury, 1960) and as evident from the spatio-temporal variations depicted in Map 2.

Image 1 : Ganga River From Ara-Chapra Bridge On 23rd October, 2021

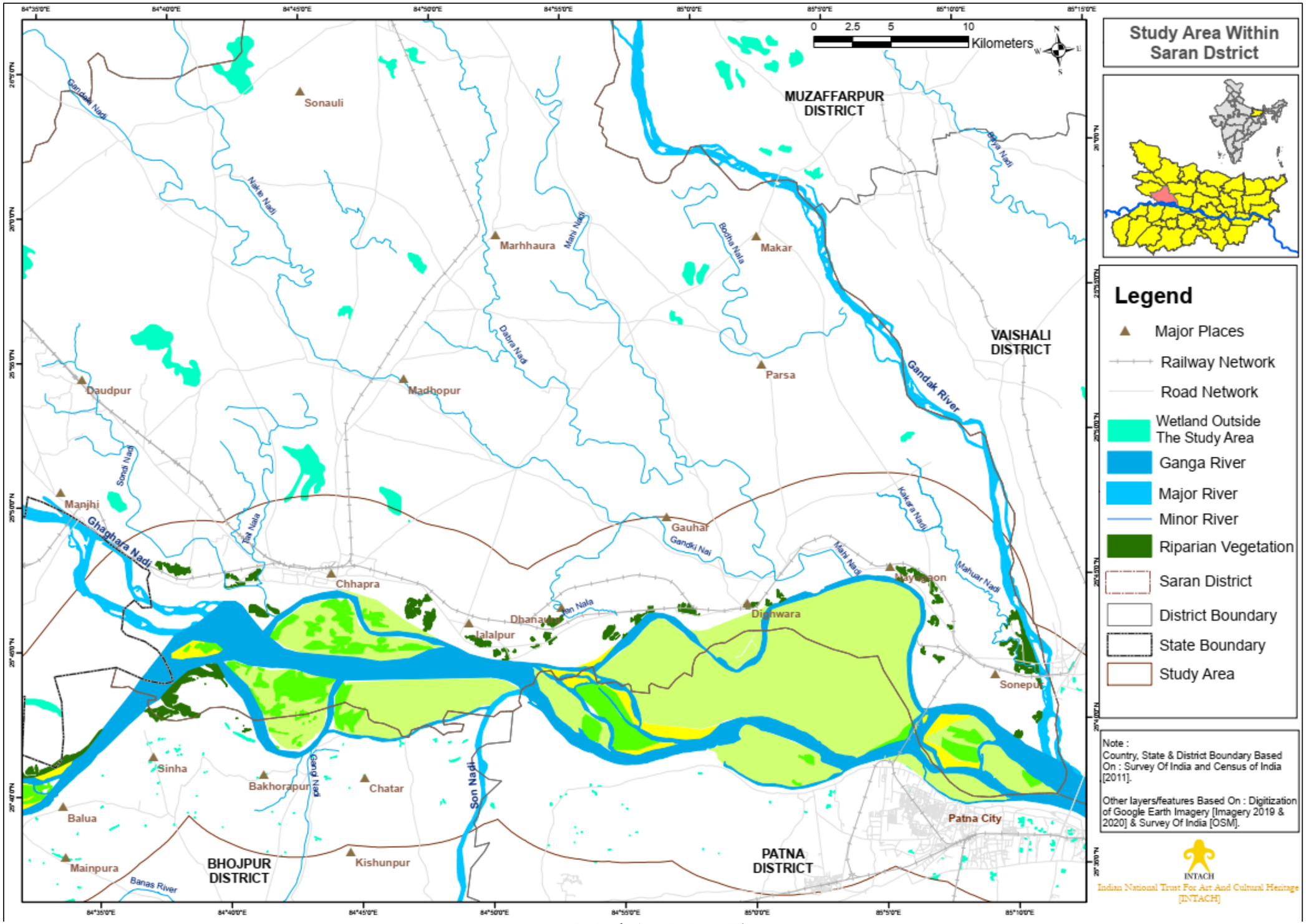


Map 2 : Temporal Variation Of Ganga River Course In Study Region

3.0 Methodology

3.1 Ganga River flows in Saran Distt. for approximately 44 kms adjoining it mainly on the left bank. Hence for carrying out the ground survey, a 7 km of buffer zone was selected on the left bank of Ganga River in the Distt. [Refer Map 3]. Based on the secondary information analyzed and the features noted from Google Earth satellite imagery, plan for the fieldwork was constituted to cover different elements of natural heritage in these grids. Special focus was laid on denoting the sites important for riparian biodiversity, riverine fishing, boat making communities, river and stream confluences, important water bodies and oxbow lakes. Furthermore, contacts were developed with various stakeholders including riparian and *Diara* communities in the Distt. for carrying out relevant interactions.

3.2 The field survey in study region of Saran Distt. was carried out from 22-25 October, 2021. High-quality pictures related to the study were recorded using Nikon D3400 DSLR camera. The GPS locations were also recorded using Garmin hand-held GPS and videography at the study sites was carried out using Sony Handycam. The plants observed in the survey were identified based on available handbooks and online databases while the birds observed in the survey were identified using Grimmett *et al.* (2011). The information on current status of Ganga River and changes from the past was obtained from detailed interactions with different stakeholders such as agriculturists and dairy farmers, temple priests, village heads, fishermen, boatmen and general public.



Map 3 : Study Area In Saran Distt.

4.0 Tributaries Of Ganga River In The Distt.

4.1 **Ghaghra River :** Ghaghra River (also known as 'Karnali' in Nepali) is a perennial, trans-boundary river originating in the Tibetan plateau near Lake Mansarovar. Rising from an altitude of 3962 m, the Karnali river cuts through the Himalayas in Nepal on its way to the condfluence with the Sarda River at Brahmaghat in India from where it flows as Ghaghra River. It is the largest tributary of Ganga River by volume and the second longest tributary of Ganga River by length after Yamuna. After entering India, the river flows southeast through the states of Uttar Pradesh and Bihar to join Ganga river between Chhapra in Saran Distt. and Sitab Diara in Ballia Distt [Refer Map 4]. It travels a total distance of 1080 km throughout and carries more water than Ganga River before its convergence near Chhapra. Through its flow in Saran Distt., it acts as a boundary marker channel between Chhapra in Bihar with Ballia in UP. During field survey, the river was observed to have swelled up with monsoon water [Image 2]. According to the interlocutors, the river bank in study region was prone to flooding and erosion often leading to losses of agricultural land and settlements alongside the river. According to a study (Singh & Awasthi, 2011), the chief reasons for this lateral erosion along Ghaghra river are the sandy facies, low degree of compaction, scouring, fractures, palaeocurrent and mass movement.

Image 2 : Ghaghra River Near Durgapur In Saran Distt. On 25th October, 2021

4.2 **Gandak River :** It is a left bank tributary of Ganga River [Refer Map 4] and one of the major rivers in Nepal. After entering India, the river flows for an extended length of about 300 kms across the Gangetic plains of Bihar state. It finally confluences with Ganga river near Sonepur in Saran Distt. During the field survey, this river was observed near Gaj-Graha Ghat in Sonepur town near Sonepur-Hajipur Bridge [Image 3].

4.3 This Ghat derives its name from a mythological legend according to which a fight between an elephant (*Gaja*) and a crocodile (*Graah*) took place at Kaunhara Ghat in Hajpur on its opposite bank in Vaishali Distt. A series of other Ghats also exist alongside it on the Gandak River bank in the study region most of which have been re-developed and maintained by the concerned authorities. During festivals such as Chhath Puja and other auspicious occasions, thousands of worshippers gather on these Ghats for performing the rituals. Fishing in Gandak River is an important activity which was also observed during the field survey [Image 4]. Major fish caught from this river include – Sidhari, Rohu and Tengara.

Image 3 : Gandak River Below Sonepur-Hajipur Bridge At Gaj-Graha Ghat on 22nd October, 2021

Image 4 : Children From Nearby Areas Trying To Catch Small Fish From Gandak River Near Gaj-Graha Ghat In Sonepur

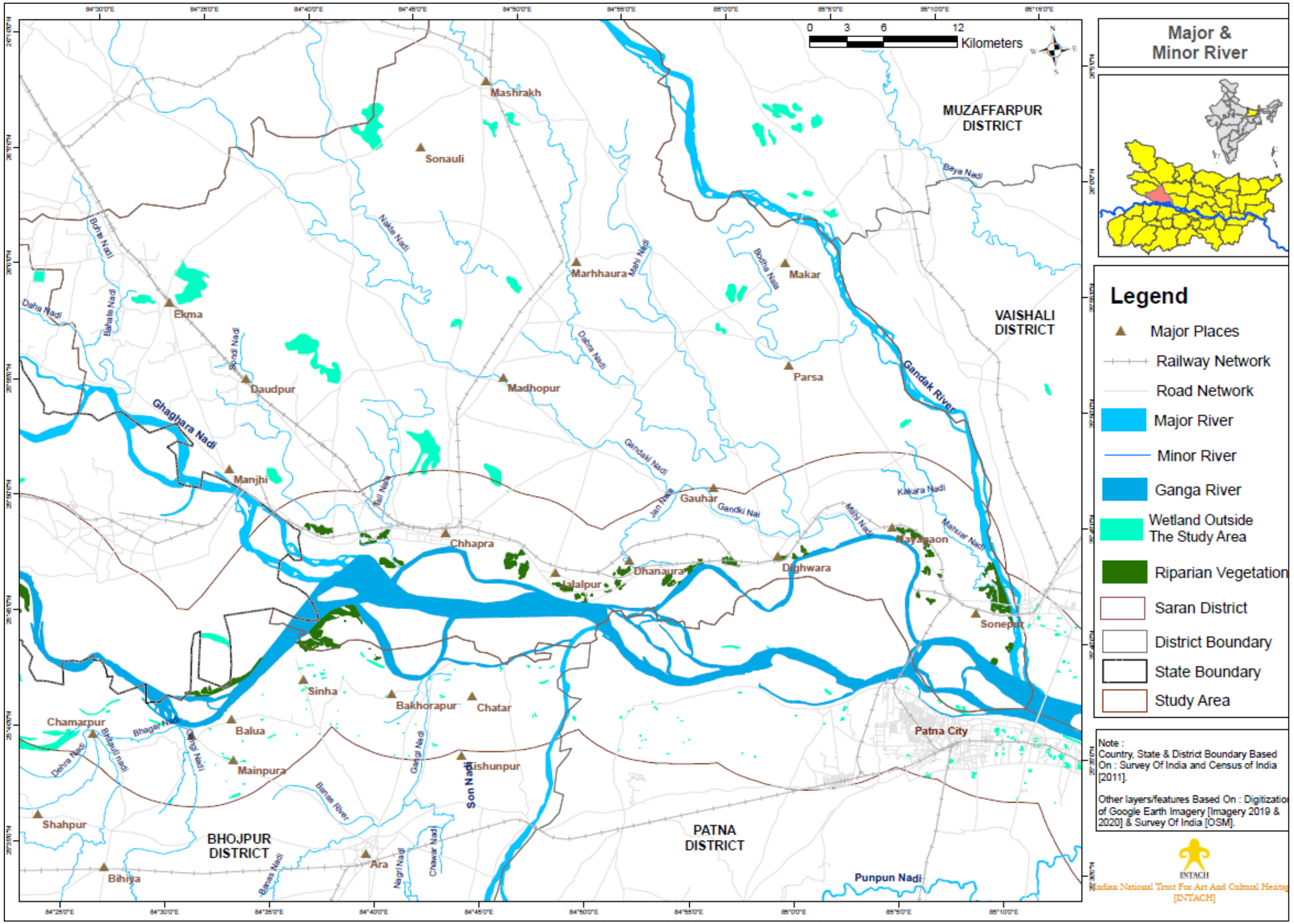
4.4 **Dabra/Mahi River :** It is another important tributary of Ganga River flowing from northern direction towards its left bank [Refer Map 4]. Dabra and Gandaki Rivers confluence near Barua in Saran Distt. Thereafter, they flow as a single river to confluence with Ganga and during this part of the course, the river is referred as 'Mahi River'. During the field survey, it was observed from a bridge near Chittu Pakar village and close to its confluence with Ganga near Hasilpur village in the study region [Images 5-6]. Upon interactions, the interlocutors at these sites reiterated that this river swells up with water during monsoon season which subsides during remaining part of the year. The river was found to be receiving sewage water from the surrounding villages along with solid waste which led to foul smell and polluted water in many places. Fishing was found to be a prominent activity at these sites wherein the local community chiefly made use of fishing nets having varying sizes for catching different fish. Major species caught from this river was similar to those from Ganga River such as Common carp, *Rohu, Tengara, Baam* and *Buari.*

Image 5 : Mahi River From Bridge Near Chittu Pakar Village On 23rd October, 2021

Image 6 : Mahi-Ganga Confluence Near Hasilpur Village

4.5 **Gandaki River :** This is another left bank tributary flowing from northern direction which confluences with Dabra River to form Mahi River that further confluences with Ganga [Refer Map 4]. During the field survey it was observed from Bharhapur bridge in the study region [Image 7]. Fishing was a prominent activity from this river too similar to that of Dabra river especially during monsoon season when this river swells with water. During remaining part of the year, water recedes and this river flows with the sewage influx from surrounding villages.

Image 7 : Gandaki River From Bharhapur Bridge In Study Region On 23rd October, 2021



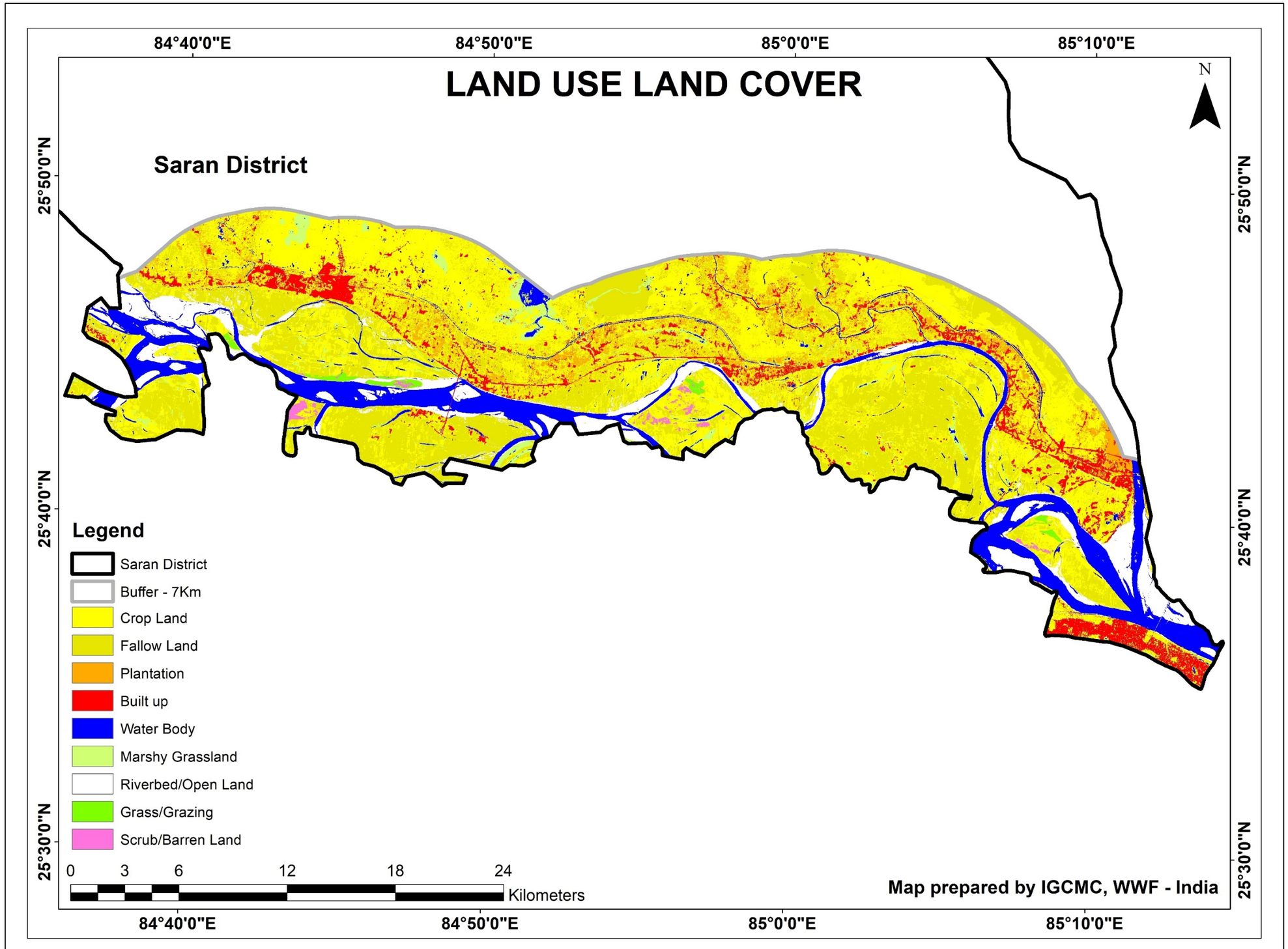
Map 4 : Major And Minor Tributaries Of Ganga River In The Study Area

5.0 Land Use/Land Cover

5.1 Land Use Land Cover (LULC) Map of the study corridor has been prepared from Landsat imagery. Using supervised classification system, 9 different classes were generated –crop land, fallow land, plantation, water body, built up, swampy land, riverbed/open land, grass/grazing and scrub/barren land. Agriculture being a dominant source of income, occupies major part of the land use system in this Distt. The water body component covering 11.02% of the total geographical area of this Distt. chiefly includes Ganga river, parts of Ghaghra and Gandak rivers and other wetlands. The built up area includes Chapra as the major city along with other towns and villages spread along in the study region. Table 1 provides the statistics while Map 5 depicts the various land use/land cover classes as analysed for the study region.

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

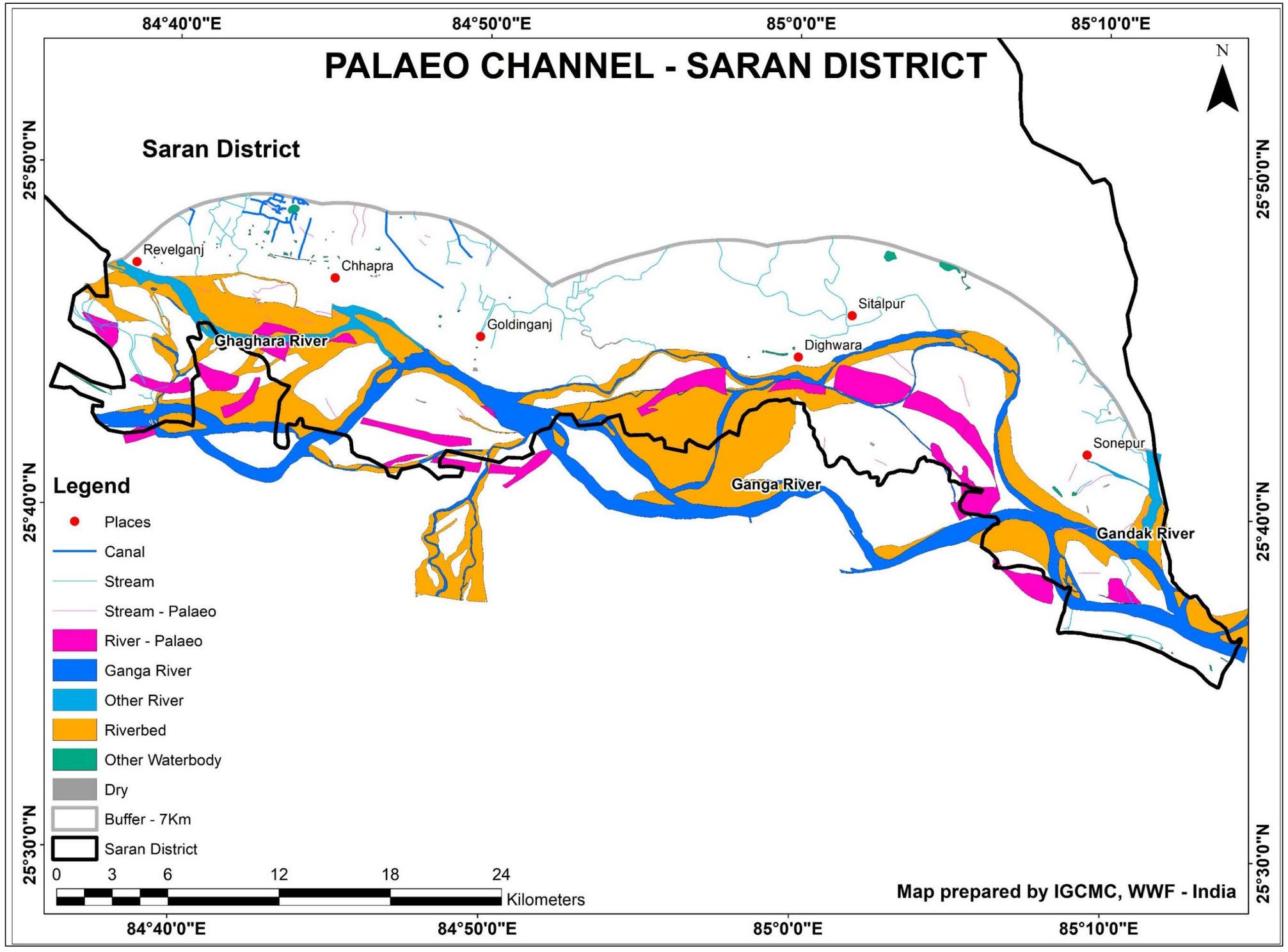
Saran Distt.		
Class Name	**Area (Ha)**	**Area (%)**
Crop land	24414.4	36.87
Fallow land	19180.9	28.97
Plantation	3390.69	5.12
Built up	4202.89	6.35
Water body	7298.65	11.02
Swampy land	1866.29	2.82
Riverbed/Open land	5289.65	7.99
Grass/Grazing	298.724	0.45
Scrub/Barren Land	274.487	0.41
Total	**66216.68**	**100**



Map 5 : Land Use/Land Cover Map Of Study Region In Saran Distt.

6.0 Paleo-channels Of Ganga River

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


PALAEO CHANNEL - SARAN DISTRICT
Saran District
84°40'0"E
84°50'0"E
85°0'0"E
85°10'0"E
25°50'0"N
25°40'0"N
25°30'0"N
N
Revelganj
Chhapra
Goldinganj
Sitalpur
Dighwara
Sonepur
Ghaghara River
Ganga River
Gandak River
Legend
Places
Canal
Stream
Stream - Palaeo
River - Palaeo
Ganga River
Other River
Riverbed
Other Waterbody
Dry
Buffer - 7Km
Saran District
0 3 6 12 18 24
Kilometers
Map prepared by IGCMC, WWF - India

Map 6 : Paleochannels In The Study Region

7.0 Floodplain Of River Ganga In Saran

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 Saran Distt. falls in the North West Alluvial Plain Zone with the major soils being alluvial saline soil, alluvial soils, heavy clay soils with sodicity and light sandy soils (NICRA-ICAR, 2013). Agriculture is the major sources of income for the residents of the Distt. and it is benefitted by the fertile alluvium brought by Ganga River and its tributaries. Vast floodplain lands along Ganga, Ghaghra and Gandak Rivers were observed to be under crop cultivation during the field survey in study region. Rice is the chief Kharif crop while Wheat is the chief Rabi crop grown in the Distt. Other major crops grown here include maize, mustard, chana, various pulses and vegetables such as potato, onion, chillies, green peas and tomato. This region is also an important hub for parwal cultivation which is a popular vegetable throughout Bihar state. The details of some villages surveyed along with their floodplain agriculture produce is provided in Table 2 while Image 8 depicts a floodplain agriculture field as recorded during the survey.

Table 2 : Some Floodplain Villages And Their Agriculture Produce In Saran Distt.

Sr. No.	Village Name	Agricultural Produce
1.	Hasilpur	Rice, wheat, mustard, maize, onion
2.	Doriganj	Rice, mustard, chana, bajra, potato
3.	Dighwara	Rice, wheat, bajra, potato, chillies
4.	Maharajganj	Rice, wheat, brinjal, onion, chana
5.	Enai	Rice, maize, mustard, parwal, potato

Image 8 : Floodplain Rice Fields Near Dighwara Village In Study Region

7.3 **Floodplain grasses:** The chief floodplain grasses growing throughout study region are – *S. spontaneum* (commonly known as *Kans*) [Image 10], *S. bengalense* (commonly known as *Munj/ Sarkanda*) [Image 9] and *Cynodon dactylon* (L.) Pers. (commonly known as Doob or Durva grass). Among these, the *Saccharum* grasses are dominant and luxuriant along the Ganga River banks and on the *diaras*. They are tall, perennial wild grasses growing upto 2-3 m height. They form extensive root networks that bind the soil/pebbles and form tall thick clumps with high biomass tufts. The dried *Saccharum* grasses are widely used throughout the Distt. for roof thatching in villages. Along with this some local residents also use these grasses in construction of temporary huts to monitor their agricultural fields. The abundance of this grass and availability throughout the year makes it an excellent resource for the residents in this region.

Image 9 : *Saccharum bengalense* (Munj Grass)

Image 10 : Luxuriant Growth Of *Saccharum spontaneum* On Diara

8.0 Wetlands In Saran Distt.

8.1 Wetlands are one of the most productive and unique ecosystems. They help in maintaining the food web and provide habitat for the aquatic biodiversity. They also help in controlling floods, recharging groundwater, nutrient recycling, climate stabilization and carbon sequestration. According to the report prepared by Tare et al. (2012) about 543 wetlands are reported in Saran Distt. which include – lakes/ponds, oxbow lakes, riverine wetlands, waterlogged areas, rivers/streams, tanks or ponds and wetlands of smaller areas (<2.25 ha). However, during the current study about 172 different wetlands are recorded whose details are provided in Table 3. Map 7 shows the spatial distribution of these wetlands in the study region. Some notable wetlands as observed during the field survey are discussed in this section. [see Map 7]

Table 3 : List Of Wetlands In The Study Region

Sr. No.	Wetland	Coordinates		Area [Ha]
		Latitude	Longitude	
1	1	25°40'8.14"N	85°10'40.31"E	2.13
2	2	85°10'40.31"E	85°11'2.90"E	2.74
3	Unnamed wetland in Sabalpur Pachami	25°40'16.86"N	85°10'49.81"E	10.0
4	4	25°41'26.57"N	85°11'1.06"E	0.43
5	5	25°41'26.00"N	85°11'13.86"E	0.22
6	6	25°41'37.60"N	85°10'41.88"E	0.65
7	7	25°41'50.66"N	85°11'4.60"E	0.72
8	8	25°45'4.02"N	85° 9'43.59"E	0.68
9	9	25°45'0.11"N	85° 9'48.88"E	0.26
10	10	25°44'26.82"N	85° 9'56.93"E	2.00
11	11	25°41'57.79"N	85°10'0.56"E	1.12
12	12	25°41'44.93"N	85°10'1.69"E	1.76
13	13	25°41'3.22"N	85° 8'42.31"E	5.53

14	14	25°41'57.93"N	85° 8'50.57"E	2.37
15	15	25°41'48.90"N	85° 9'8.51"E	1.00
16	16	25°41'41.85"N	85° 9'28.21"E	19.0
17	17	25°42'31.11"N	85° 9'5.01"E	0.41
18	18	25°42'29.75"N	85° 9'28.21"E	3.37
19	19	25°43'41.11"N	85° 9'14.92"E	2.48
20	20	25°45'34.48"N	85° 9'2.49"E	0.18
21	21	25°46'19.98"N	85° 9'7.50"E	3.60
22	22	25°46'27.71"N	85° 8'54.98"E	0.98
23	23	25°47'1.80"N	85° 8'12.42"E	1.72
24	24	25°45'7.70"N	85° 7'37.83"E	44.0
25	25	25°43'17.87"N	85° 8'5.35"E	0.37
26	26	25°44'55.81"N	85° 7'45.19"E	14.7
27	27	25°42'7.55"N	85° 8'0.69"E	1.38
28	28	25°41'10.82"N	85° 7'31.93"E	0.48
29	29	25°42'47.73"N	85° 7'33.69"E	0.97
30	30	25°46'45.70"N	85° 6'46.69"E	2.90
31	31	25°41'59.72"N	85° 6'59.60"E	4.00
32	32	25°42'14.89"N	85° 6'59.19"E	3.69
33	33	25°44'28.11"N	85° 6'30.30"E	21.6
34	34	25°46'32.52"N	85° 5'45.27"E	1.26
35	35	25°46'36.11"N	85° 5'57.58"E	3.77
36	36	25°47'9.68"N	85° 6'4.26"E	1.23
37	37	25°46'38.33"N	85° 6'11.45"E	2.81
38	38	25°47'2.76"N	85° 5'25.84"E	6.72
39	39	25°47'8.59"N	85° 5'37.64"E	2.38
40	40	25°48'38.99"N	85° 5'27.46"E	0.42

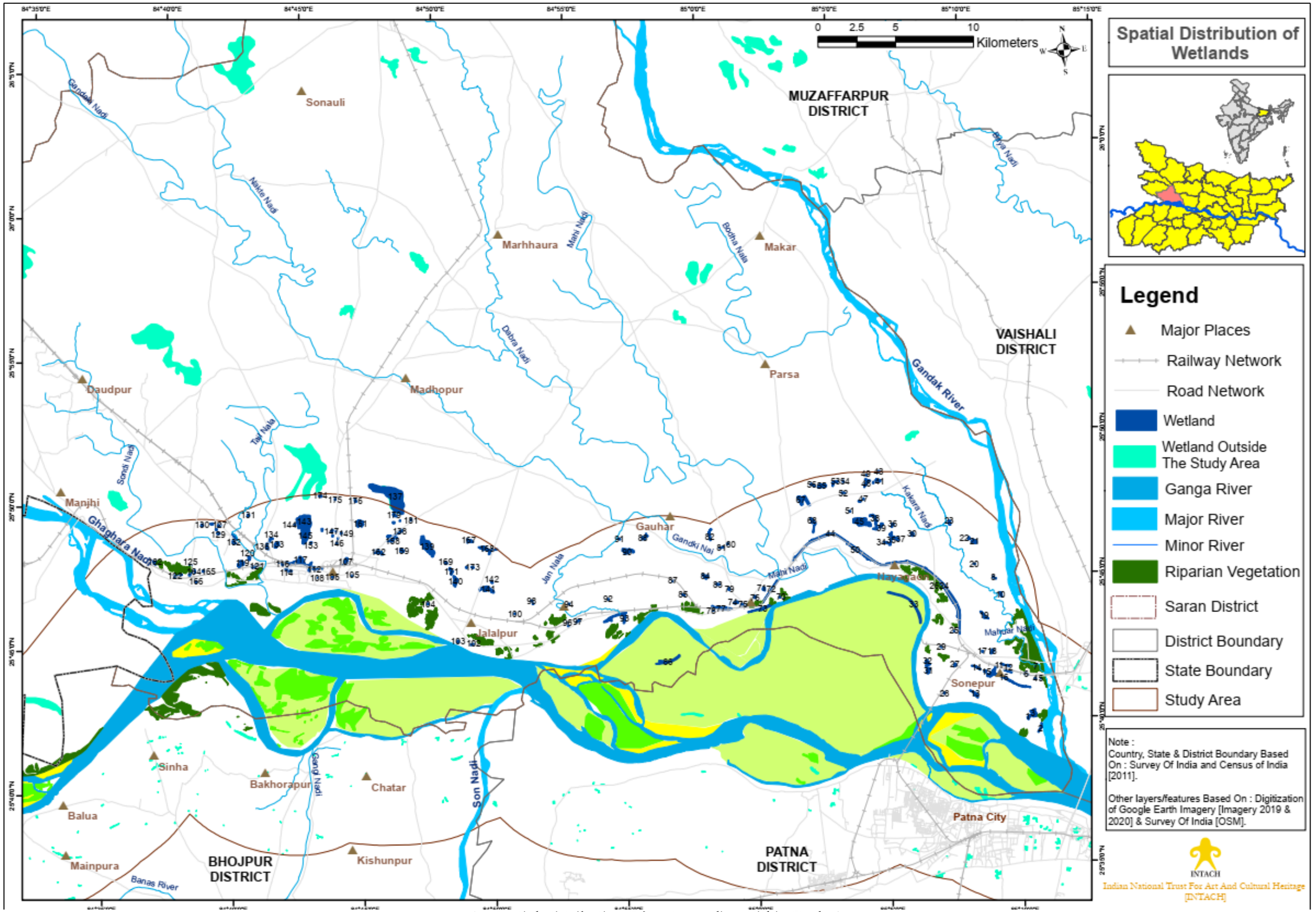
41	41	25°48'41.13"N	85° 5'42.34"E	0.68
42	42	25°48'43.06"N	85° 5'34.57"E	0.53
43	43	25°49'1.24"N	85° 5'41.35"E	0.73
44	44	25°46'47.35"N	85° 4'6.84"E	36.5
45	45	25°47'17.77"N	85° 4'52.12"E	36.3
46	46	25°48'2.03"N	85° 4'53.22"E	0.43
47	47	25°48'6.04"N	85° 5'1.97"E	0.34
48	48	25°48'37.99"N	85° 5'10.67"E	3.33
49	49	25°48'55.27"N	85° 5'12.67"E	0.19
50	50	25°46'12.69"N	85° 4'48.48"E	4.92
51	51	25°47'43.18"N	85° 4'28.84"E	0.30
52	52	25°48'22.26"N	85° 4'17.43"E	0.80
53	53	25°48'44.56"N	85° 3'55.71"E	1.60
54	54	25°48'46.51"N	85° 4'19.19"E	0.61
55	55	25°48'40.23"N	85° 3'28.48"E	6.54
56	56	25°48'45.60"N	85° 3'6.64"E	0.60
57	57	25°48'13.30"N	85° 2'38.78"E	19.8
58	58	25°47'22.75"N	85° 3'7.91"E	4.33
59	59	25°44'51.72"N	85° 1'43.77"E	0.28
60	60	25°44'55.97"N	85° 1'34.22"E	0.35
61	61	25°45'15.17"N	85° 0'59.49"E	1.67
62	62	25°45'4.97"N	85° 1'9.39"E	6.16
63	63	25°44'34.30"N	85° 0'53.93"E	10.0
64	64	25°44'51.91"N	84°59'54.57"E	2.73
65	Wetland 'B'	25°44'46.18"N	85° 0'9.90"E	3.00
66	66	25°45'0.07"N	85° 0'38.10"E	1.73
67	Wetland 'A'	25°44'41.11"N	84°59'22.01"E	12.4

68	68	25°44'38.94"N	84°59'0.20"E	0.25
69	69	25°45'20.43"N	84°59'41.85"E	1.65
70	70	25°46'54.60"N	84°59'44.95"E	0.28
71	71	25°46'47.63"N	84°59'29.01"E	0.71
72	72	25°47'12.00"N	84°59'5.82"E	2.54
73	73	25°45'32.83"N	84°59'14.74"E	1.45
74	74	25°45'49.60"N	84°58'50.75"E	3.32
75	75	25°45'16.09"N	84°57'55.77"E	0.78
76	76	25°42'58.83"N	84°57'13.70"E	11.9
77	77	25°45'46.74"N	84°57'34.03"E	0.56
78	78	25°47'20.27"N	84°56'33.18"E	1.97
79	79	25°47'24.00"N	84°56'41.64"E	0.75
80	80	25°46'54.41"N	84°55'53.59"E	12.0
81	81	25°47'21.40"N	84°55'39.91"E	0.47
82	82	25°45'18.56"N	84°55'3.60"E	0.26
83	83	25°44'37.71"N	84°55'37.30"E	17.5
84	84	25°45'14.96"N	84°53'33.48"E	0.25
85	85	25°44'28.87"N	84°53'28.04"E	0.17
86	86	25°44'35.74"N	84°53'27.24"E	0.30
87	87	25°44'36.56"N	84°53'49.98"E	1.79
88	88	25°45'26.79"N	84°52'9.23"E	0.46
89	89	25°45'20.63"N	84°52'11.73"E	0.20
90	90	25°45'3.33"N	84°51'28.49"E	0.24
91	91	25°44'5.46"N	84°49'43.86"E	0.36
92	92	25°44'7.45"N	84°49'49.43"E	0.47
93	93	25°44'13.63"N	84°49'14.21"E	1.12
94	94	25°45'36.95"N	84°48'12.69"E	0.60

95	95	25°46'48.00"N	84°45'24.74"E	0.46
96	96	25°46'47.76"N	84°44'39.58"E	0.67
97	Jatahi Pokhara	25°47'16.67"N	84°45'12.19"E	4.23
98	98	25°46'49.30"N	84°44'4.68"E	0.33
99	Rajendra Sarovar	25°47'7.66"N	84°44'16.32"E	0.85
100	100	25°47'7.55"N	84°44'9.35"E	0.63
101	101	25°47'5.16"N	84°43'47.80"E	1.00
102	102	25°47'6.55"N	84°44'0.44"E	2.52
103	103	25°47'5.03"N	84°43'0.74"E	0.44
104	104	25°47'9.71"N	84°42'56.89"E	0.70
105	105	25°47'6.77"N	84°43'5.82"E	0.58
106	106	25°47'22.81"N	84°42'47.92"E	1.77
107	107	25°47'23.15"N	84°43'30.46"E	25.3
108	108	25°47'26.11"N	84°41'8.65"E	2.41
109	109	25°47'29.22"N	84°41'17.52"E	3.75
110	110	25°47'38.58"N	84°41'33.02"E	2.61
111	111	25°47'21.11"N	84°41'46.39"E	3.44
112	112	25°47'13.53"N	84°38'41.07"E	1.16
113	113	25°47'16.85"N	84°38'47.33"E	0.40
114	114	25°47'15.16"N	84°38'54.59"E	0.69
115	115	25°47'32.99"N	84°39'17.45"E	0.81
116	116	25°48'56.31"N	84°40'13.69"E	1.11
117	117	25°48'53.35"N	84°40'30.82"E	1.32
118	118	25°48'44.03"N	84°40'22.88"E	0.38
119	119	25°48'36.01"N	84°40'26.41"E	1.19
120	120	25°48'54.94"N	84°39'51.45"E	1.18
121	121	25°49'8.81"N	84°41'38.37"E	1.00

122	122	25°48'16.40"N	84°41'2.89"E	6.84
123	123	25°48'2.15"N	84°42'37.45"E	5.10
124	124	25°48'16.95"N	84°42'26.42"E	1.10
125	125	25°48'12.47"N	84°42'22.79"E	1.10
126	126	25°47'59.51"N	84°42'16.03"E	3.86
127	127	25°49'14.69"N	84°47'21.50"E	164
128	128	25°48'12.37"N	84°47'20.10"E	4.13
129	129	25°47'33.15"N	84°48'23.23"E	46.9
130	130	25°46'19.97"N	84°49'18.94"E	10.0
131	131	25°46'0.37"N	84°50'30.30"E	13.9
132	132	25°46'12.86"N	84°50'41.23"E	1.24
133	133	25°48'43.29"N	84°43'45.73"E	62.1
134	134	25°48'41.94"N	84°43'23.53"E	0.48
135	135	25°48'17.91"N	84°43'44.57"E	35.4
136	136	25°47'57.18"N	84°44'55.37"E	0.44
137	137	25°48'24.29"N	84°44'46.80"E	0.89
138	138	25°48'21.75"N	84°44'55.95"E	0.49
139	139	25°48'17.59"N	84°45'7.17"E	0.52
140	140	25°48'13.66"N	84°44'47.26"E	0.45
141	141	25°48'6.84"N	84°44'59.53"E	0.39
142	142	25°48'26.57"N	84°44'23.62"E	0.88
143	143	25°48'1.86"N	84°43'56.52"E	0.74
144	144	25°48'1.00"N	84°46'56.84"E	2.32
145	145	25°48'4.81"N	84°47'9.17"E	0.29
146	146	25°47'57.83"N	84°47'12.22"E	0.40
147	147	25°47'54.94"N	84°46'59.34"E	3.37
148	148	25°47'58.47"N	84°47'3.44"E	3.65

149	149	25°47'30.52"N	84°47'22.71"E	1.65
150	150	25°47'30.65"N	84°47'25.58"E	0.36
151	151	25°48'33.06"N	84°45'51.96"E	10.4
152	152	25°47'32.19"N	84°46'29.18"E	5.93
153	153	25°47'13.90"N	84°39'14.71"E	0.95
154	154	25°47'20.25"N	84°39'24.87"E	1.91
155	155	25°47'19.20"N	84°39'46.30"E	0.69
156	156	25°46'58.40"N	84°39'28.37"E	0.37
157	157	25°47'43.56"N	84°49'55.17"E	2.00
158	158	25°47'20.63"N	84°50'36.62"E	7.26
159	159	25°46'59.38"N	84°49'0.58"E	0.47
160	160	25°46'45.92"N	84°49'8.39"E	1.10
161	161	25°46'37.94"N	84°49'11.40"E	1.53
162	162	25°46'46.67"N	84°49'46.06"E	0.38
163	163	25°46'46.36"N	84°50'0.87"E	0.58
164	164	25°49'37.57"N	84°44'25.55"E	1.55
165	165	25°49'28.77"N	84°44'59.11"E	0.34
166	166	25°49'21.44"N	84°45'44.82"E	0.87
167	167	25°48'31.03"N	84°47'8.38"E	0.77
168	168	25°48'34.12"N	84°47'22.69"E	0.25
169	169	25°48'46.20"N	84°47'9.87"E	1.10
170	170	25°48'44.24"N	84°47'14.48"E	0.24
171	171	25°48'33.78"N	84°47'48.63"E	0.41
172	172	25°47'43.98"N	84°37'58.39"E	2.75
173	Brahm Baba Pokhara	25°45'47.27"N	84°49'3.06"E	1.0
Total [Area in Hectares]				**872.0**



Map 7 : Spatial Distribution Of Water Bodies Within Study Area

8.2 **Rajendra Sarovar:** It is located in the Chapra town [Image 11] and is believed to be one of the oldest water bodies here. According to the interlocutors, this pond was built by the British officers and was revamped post-independence. It was named after the then President of India – Dr. Rajendra Prasad who inaugurated this revamped pond and dedicated to the residents of this town. Despite many local residents visiting this pond, it lies in a neglected condition for the want of management [Image 12].

Image 11 : Location Of Rajendra Sarovar [25°47'7.66" N; 84°44'16.32" E]

Image 12 : Rajendra Sarovar As Observed On 24th October, 2021

8.3 **Jatahi Pokhara:** This is a natural wetland located in Chapra town [Image 13] spread in an area of about 4.23 ha [Refer Map 7]. It derives its name owing to a small Shiva temple along its bank which is believed to be an old temple. Once an important source of water for the local residents, this wetland lies in a mistreated state [Image 14] receiving sewage from the surroundings along with solid waste that has led to severe pollution. It is also falling prey to encroachments in its surroundings and might disappear very soon if immediate steps are not taken to ensure its proper management and conservation.

Image 13 : Location Of Jatahi Pokhara [25°47'16.67" N; 84°45'12.19" E]


Image 14 : Jatahi Pokhara As Observed On 24th October, 2021

8.4 **Unnamed wetland in Sabalpur Pachami:** During the field survey, a wetland spread in an area of about 10 ha was located in Sabalpur Pachami village close to the Ganga-Gandak confluence [Image 15]. Upon interaction, it was recorded that this wetland was formed due to excavations by the brick kilns situated around it. The excavated crater received water during the monsoons from Gandak River and over a period of time has become a wetland [Image 16]. The interlocutors reiterated that fish catching by local residents was a prominent activity here as this wetland received different fish species of Ganga and Gandak Rivers during monsoon season. They also claimed that many birds visited this wetland during winter season.

Image 15 : Location Of The Unnamed Wetland In Sabalpur Pachami Village [25°40'16.86" N; 85°10'49.81" E]

Image 16 : The Wetland As Observed On 23rd October, 2021

8.3 **Two unnamed wetlands along Chapra-Patna Highway:** During the field survey, two different wetlands were located at little distance from each other alongside Chapra-Patna Highway [Image 17]. The biggest among these two is a roughly rectangular shaped wetland spread in an area of about 12.4 ha while the other is a roughly circular wetland spread in an area of about 3 ha. Both these wetlands were in a grossly neglected state with sewage and solid waste being dumped in and around them. This had resulted in excessive growth of water hyacinth at these sites rendering the wetlands practically unusable. Images 18-19 depict these wetlands as observed during the field survey.

Image 17 : Wetlands A [25°44'41.11" N; 84°59'22.01" E] & B [25°44'46.18" N; 85° 0'9.90" E] Situated Alongside Chapra-Patna Highway

Image 18 : Wetland 'A' As Seen On 24th October, 2021

Image 19 : Wetland 'B' As Seen On 24th October, 2021

8.5 **Brahm Baba Pokhara:** A small pond known locally as 'Brahm Baba Pokhara' was located in Maharajganj village of Saran Distt. [Image 20]. The pond had a small temple and a sacred Banyan tree associated with it [Image 21]. The interlocutors claimed that this pond was sacred and they did not kill any fish in it. Although the water from this pond was being used for domestic purposes and the waste from the surrounding houses was being dumped all alongside the pond.

Image 20 : Location Of Brahm Baba Pokhara [25° 45' 47.27" N; 84° 49' 3.06" E]

Image 21 : Brahm Baba Pokhara As Seen On 24th October, 2021

9.0 Riparian Flora Along Ganga River In Saran 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 to Chinasura. Earlier workers have reported from Buxar to Barh, the presence of 7 shrubs, 41 herbs, 6 grasses and 2 sedges, besides these a number of tree species along the banks of river during 1987-88 (Kumar, 2001).

9.3 During the field survey the riparian vegetation was found to have patchy distribution with it being dense in few places and sparse in most [Image 22]. Shrubs and herbs were dominant in terms of growth and extent of distribution as compared to the trees. Rapid expansion of villages and associated agricultural activities in the floodplain regions is one of the chief reasons for the disappearance of natural vegetation. The common tree species in study region included – Mango, Peepal, Banyan, Neem and Bel Patra among which Peepal and Banyan were also found associated with various religious sites. The commonly found shrubs and herbs in the study region included – *Croton bonplandianus* [Image 23], *Parthenium hysterophorus* and *Zizyphus* sp. The floodplain grass – *Saccharum* sps. were also a major component of riparian vegetation throughout with its luxuriance dominating the other flora at some sites. Some notable riparian flora is presented in Table 3.

Table 4 : Riparian Plant Species Recorded In The Study Area

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

Image 22 : Riparian Vegetation As Observed Along Ganga River Near Enai Village

Image 23 : *Croton bonplandianus*

10.0 Faunal Diversity In Saran Distt.

10.1 **Gangetic Dolphins:** The Gangetic River Dolphin is exclusively aquatic and piscivorus, occasionally found in small groups. It 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 during last 3-4 decades. A detailed census of this endangered species was conducted by a multi-institutional team in 2018 which revealed the occurrence of 300 dolphins in Ganga river stretch from Buxar to Mokama and 700 dolphins in Ganga river stretch from Mokama to Maniari in Bihar state (Ranjan, 2019). No direct dolphin sightings were recorded during the survey. However, their presence in the study region was reiterated by interlocutors.

10.2 **Turtles:** Turtles form an important component of Ganga riverine biodiversity and play a critical ecological role by controlling aquatic vegetation, serve as scavengers and help maintain rivers (WII-GACMC, 2017). **During the field survey, interactions with local fishermen revealed a significant decrease (almost 80-90%) in the turtle population during last couple of decades.** According to them, turtles would be seen earlier on the sandy river banks and exposed *diaras*. However, especially since last two decades there have been negligible sightings of turtles in the study region.

10.3 **Nilgai:** The Nilgai antelope – *Boselaphus tragocamelus* is widely distributed throughout the country. However, due to prolonged breeding activity and lack of potential predators, the numbers of Nilgai have increased considerably and become locally overabundant in states of Gujarat, Bihar, Uttar Pradesh, Haryana, Punjab, Rajasthan, Madhya Pradesh and Delhi (Meena, 2017). In the due course of time, this species has been successful in adjusting to the human-altered landscapes and in many places have become serious pests of agricultural crops. The farmers in this region often complained about the large-scale damage to agricultural produce caused by nilgai but despite this they never retaliated violently towards it. The villagers often enclosed their fields with mesh nets or wires or thorny plants to prevent intrusion of nilgai and used to drive them away with the help of sticks and stones. Image 24 depicts the nilgai as spotted during the survey in study region.

Image 24 : Nilgai Spotted During The Field Survey Near Dighwara In Study Region

10.7 **Wild boar:** The Indian wild boar (*Sus scrofa* L.) also known as the wild pig is one of the widespread animals throughout the world. In recent times, wild boar has become a regular menace for farmers as it generally causes damage right from planting till the maturity of the crop (Vasudeva Rao et al., 2015).The floodplain farmers in villages such as Dighwara, Hasilpur, Sonepur and Doriganj complained about the menace caused by wild boars especially to crops such as potato and onion. **They claimed that the boars destroyed entire fields sometimes resulting in huge losses and even attacked small children or some local residents who tried to drive them away.** Hence, in some cases the local villagers had to resort to killing these boars in order to safeguard themselves and their agriculture produce.

10.8 **Avifauna Diversity:** Ganga River, with its mosaic of habitats, supports a rich diversity of avifauna which include both resident and migratory species. Some iconic and globally threatened birds such as the black-bellied tern (*Sterna acuticauda*), Indian skimmer (*Rynchops albicollis*), sarus crane (*Antigone antigone*) and river lapwing (*Vanellus duvaucelii*) also breed on the islands, sandbars and banks of the Ganga River. During the survey in study region of Saran Distt., a total of 42 different bird species were sighted, out of which 15 were wetland birds' species while remaining 27 species were of forest and grassland including some common species like House Sparrow, Indian Jungle Crow, House Crow, Common Pigeon, Common Myna and Eurasian Collared Dove. **River Lapwing which was sighted comes under Near Threatened Category while River Tern has Vulnerable status of IUCN Red List of Threatened Species.** The details of all birds recorded is presented in Table 5.

Table 5 : List Of Birds Recorded In The Study Region

Sr. No	Common Name	Scientific Name	Conservation Status
1.	White throated Kingfisher	*Halcyon smyrnensis*	Least Concern
2.	Cattle Egret	*Bubulcus ibis*	Least Concern
3.	Little Egret	*Egretta garzetta*	Least Concern
4.	Great Egret	*Ardea alba*	Least Concern
5.	Indian Pond Heron	*Ardeola grayii*	Least Concern
6.	Common Sandpiper	*Actitishypoleucos*	Least Concern
7.	Asian Openbill	*Anastomus oscitans*	Least Concern
8.	Little Cormorant	*Microcarbo niger*	Least Concern
9.	Little Ringed Plover	*Charadrius dubius*	Least Concern
10.	White breasted - Waterhen	*Amaurornis phoenicurus*	Least Concern
11.	Common Moorhen	*Gallinula chloropus*	Least Concern
12.	**River Tern**	***Sterna aurantia***	**Vulnerable**
13.	Red-naped Ibis	*Pseudibis papillosa*	Least Concern
14.	Black-winged Stilt	*Himantopus himantopus*	Least Concern
15.	**River Lapwing**	***Vanellus duvaucelii***	**Near Threatened**
16.	Red-wattled Lapwing	*Vanellus indicus*	Least Concern
17.	Black Drongo	*Dicrurus macrocercus*	Least Concern

18.	Common Myna	*Acridotheres tristis*	Least Concern
19.	Bank Myna	*Acridotheres ginginianus*	Least Concern
20.	Common Stonechat	*Saxicola torquatus*	Least Concern
21.	Jungle Babbler	*Turdoides striata*	Least Concern
22.	Common Babbler	*Argya caudata*	Least Concern
23.	White Wagtail	*Motacilla alba*	Least Concern
24.	White-browed Wagtail	*Motacilla maderaspatensis*	Least Concern
25.	Asian Plain Martin	*Riparia chinensis*	Least Concern
26.	Streak-throated Swallow	*Petrochelidon fluvicola*	Least Concern
27.	Barn Swallow	*Hirundo rustica*	Least Concern
28.	Common Tailorbird	*Orthotomus sutorius*	Least Concern
29.	House Sparrow	*Passer domesticus*	Least Concern
30.	Indian Jungle Crow	*Corvus culminatus*	Least Concern
31.	House Crow	*Corvus splendens*	Least Concern
32.	Oriental Magpie Robin	*Copsychus saularis*	Least Concern
33.	Common Pigeon	*Columba livia*	Least Concern
34.	Red-whiskered Bulbul	*Pycnonotus jocosus*	Least Concern
35.	Red-vented Bulbul	*Pycnonotus cafer*	Least Concern
36.	Black-winged kite	*Elanus caeruleus*	Least Concern
37.	Black Kite	*Milvus migrans*	Least Concern
38.	Spotted Dove	*Spilopelia* chinesis	Least Concern
39.	Eurasian Collared Dove	*Streptopelia decaocto*	Least Concern
40.	Laughing Dove	*Spilopelia senegalensis*	Least concern
41.	Common Hoopoe	*Upupa epops*	Least Concern
42.	Black Redstart	*Phoenicurus ochruros*	Least Concern

11.0 Ganga Riverine Islands/*Diaras* In Saran Distt.

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

11.2 The biggest *diara* in the study region is roughly dumbbell shaped [Image 25] located between the Ganga-Sone and Ganga-Gandak confluences. It has dense settlements with most residents involved in agriculture as their chief source of occupation followed by fisheries and sand mining. Crops such as mustard, maize, rice, wheat and different vegetables are grown on this *diara*. Parwal is one of the major agriculture produce on this *diara* along with watermelon. Boats are used to commute from this *diara* towards Saran Distt. as well as pontoon bridges are laid during non-monsoon period. Luxuriant growth of *Saccharum* grasses could be observed on the fringes of this island [Image 26] which are widely collected in dried form for thatching roofs and making boundaries on agricultural fields.

11.3 A group of irregularly shaped *diaras* can also be observed between Ganga-Ghaghra and Ganga-Sone confluences [Image 27]. Part of these islands was observed from the Ara-Chapra Bridge during the field survey [Image 28]. Though these diaras are not inhabited as compared to earlier one, agriculture is being practiced here by the residents from nearby villages in Chapra towards left bank and Bhojpur Distt. on opposite bank. Parwal and watermelon are the major produce here too along with other crops such as mustard, potato and tomato. The riparian vegetation on these *diaras* are chiefly dominated by *Saccharum* grasses.

Image 25 : The Biggest Riverine Island In Study Region Of Saran Distt.

Image 26 : Part Of This Riverine Island As Seen From JP Setu On 23rd October, 2021

Image 27 : A Group Of Riverine Islands Between Saran And Bhojpur Distt.S


Image 28 : Part Of A Diara As Seen During Field Survey Near Ara-Chapra Bridge

12.0 Fishing In Saran Distt.

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

12.2 Fishing from Ganga River and its tributaries (Ghaghra, Gandak, Dabra and Gandaki in this region) is an important source of livelihood and food for local residents. The main fishing techniques used here include fine mesh sized nets [Image 29] spread across the stream which are mostly made of plastic and available from nearby markets. These nets are mainly employed for catching smaller fish while nets having slightly bigger mesh sizes are employed for catching bigger fish species. Other common fishing techniques involve rope based drag nets, locally made fishing rods and circular shaped fishing nets which are employed for catching Chepua fish. An interesting fishing technique recorded here involves the use of Babool wood sticks which are woven together in a particular manner [Image 30] and installed alongside river/stream banks dipped inside the water. According to the interlocutors, this technique is locally known as 'Jharkat' and is mainly employed for catching Buari fish. The fishing nets are generally available from local market at rates varying from Rs. 50-100 per meter depending upon material, quality, mesh size and various other parameters.

12.4 The boats used for fishing are small sized and hand-rowed made chiefly from 'Sakhua/Sal' wood (*Shorea robusta*) which is available from the market. These boats were earlier mainly constructed using the raw materials available in the villages by local Mallah community members. However, currently only some natives construct these boats by themselves while majority are dependent upon 'Mistry' (carpenters) from other villages for this. The cost of constructing these boats can go upto Rs. 3 lakhs depending upon various factors.

Image 29 : Fine Meshed Fishing Nets For Catching Small Fish

Image 30 : Small Wooden Boats Used For Fishing And Jharkat Made Of Babool Wood Seen In This Picture

12.4 The major fish caught from these rivers include - Rohu (*Labeo rohita*), Catla (*Labeo catla*), Tengara (M*ystus tengara*), Buari/Barari (*Wallago attu*) and Sidhari (*Puntius* sp.). These fish, especially Rohu and Catla, are found in plenty during monsoons while Tengara is found more during the summer months. Some of the important fish species caught from the region are represented in Table 6. The fish caught are generally sold in Chapra town or local markets of nearby villages. Rohu fish is usually sold for Rs. 200-300 per kg which is also the rate for Bachwa fish. Buari is sold for Rs. 150-180 per kg while Tengara is sold for about Rs. 120 per kg in the markets. They also reiterated the increase of exotic fish – common carp/Chinese carp (*Cyprinus carpio*) in the region which is found in more quantity especially during pre-monsoon season.

12.5 The fishermen in this region unanimously reiterated their concerns over decreasing fish catch and yield during the last few decades. Various important factors such as overexploitation of fisheries, water pollution, and variations in river flow and depth along with changes in climatic conditions such as uncertain monsoons and higher temperatures during summers were believed to be chief reasons for this decrease. Besides this, the increase in population of exotic carps also proved to be a tough competition for survival of Indian major carps in Ganga River. This had significantly impacted the livelihoods of fishermen in the region who are forced to look for alternate modes of earning income for family. **The respondents also reiterated that Hilsa fish, which was once available in the Ganga river stretch of Saran Distt. was no longer seen since the last few decades. Similarly another fish – Silver carp was also absent from the catch but was known from this region till about a decade ago.** Despite these difficulties, no aid or help of any kind was provided to these people from the authorities as claimed by them.

Table 6 : Major Fish Caught From Rivers In The Study Region

Sr. No.	Scientific Name	Common Name
1.	*Labeo rohita*	Rohu
2.	*Labeo catla*	Catla/Bhakur
3.	*Wallago attu*	Buari/Barari
4.	*Mystus tengara*	Tengara
5.	*Puntius sp.*	Sidhari
6.	*Cyprinus carpio*	Common/Chinese carp

7.	*Channa punctata*	Garai
8.	*Eutropiichthys vacha*	Bachwa
9.	*Anguilla bengalensis*	Baam
10.	*Cirrhinus mrigala*	Naini
11.	*Mastacembelus armatus*	Gaichi
12.	*Cabdio morar*	Chepua

13.0 Groundwater In Saran 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. Geomorphologically, Saran Distt. has rich and fertile alluvial plain with quite a few depressions and marshes. It can be divided into three broad geomorphic divisions: (1) the alluvial plains along the major rivers which are subjected to periodic inundation; (2) the region of uplands away from the river and not subjected to floods; and (3) the *diara* areas in the river beds of Ganga, Ghaghra and Gandak. The two major soil types found in the Distt. include – Younger alluvial soil which is restricted in north Gangetic plain and is one of the most fertile soils and Calcareous alluvial soil which occurs mostly in the central part of the Distt. (CGWB, 2013).

13.2 According to the Groundwater board (CGWB, 2013), the entire Saran Distt. is underlain by thick unconsolidated sediment of Quaternary period with the thickness of alluvium ranging from 500-700 m. The water bearing granular shallow zones is restricted upto a depth of 50m and deeper zones between 50m and 200m. Ground water occurs under unconfined conditions in the shallow zone and under semi-confined to confined condition in the deeper zones. Though the chemical quality of groundwater is found to be suitable for irrigation and drinking purposes, the presence of arsenic has been reported from some villages in Sonepur, Dighwara, Chapra Sadar and Revelganj blocks of the Distt.

13.3 During the survey in this Distt., ground water levels of different villages were recorded based on the interactions with local residents. The details of these villages and the ground water availability is provided in Table 7. The groundwater level varied between 40-80 feet [below ground level] in these villages situated alongside Ganga River in the study region. The use of dug wells for groundwater was found to have decreased with hand pumps being the major source of water extraction in most villages.

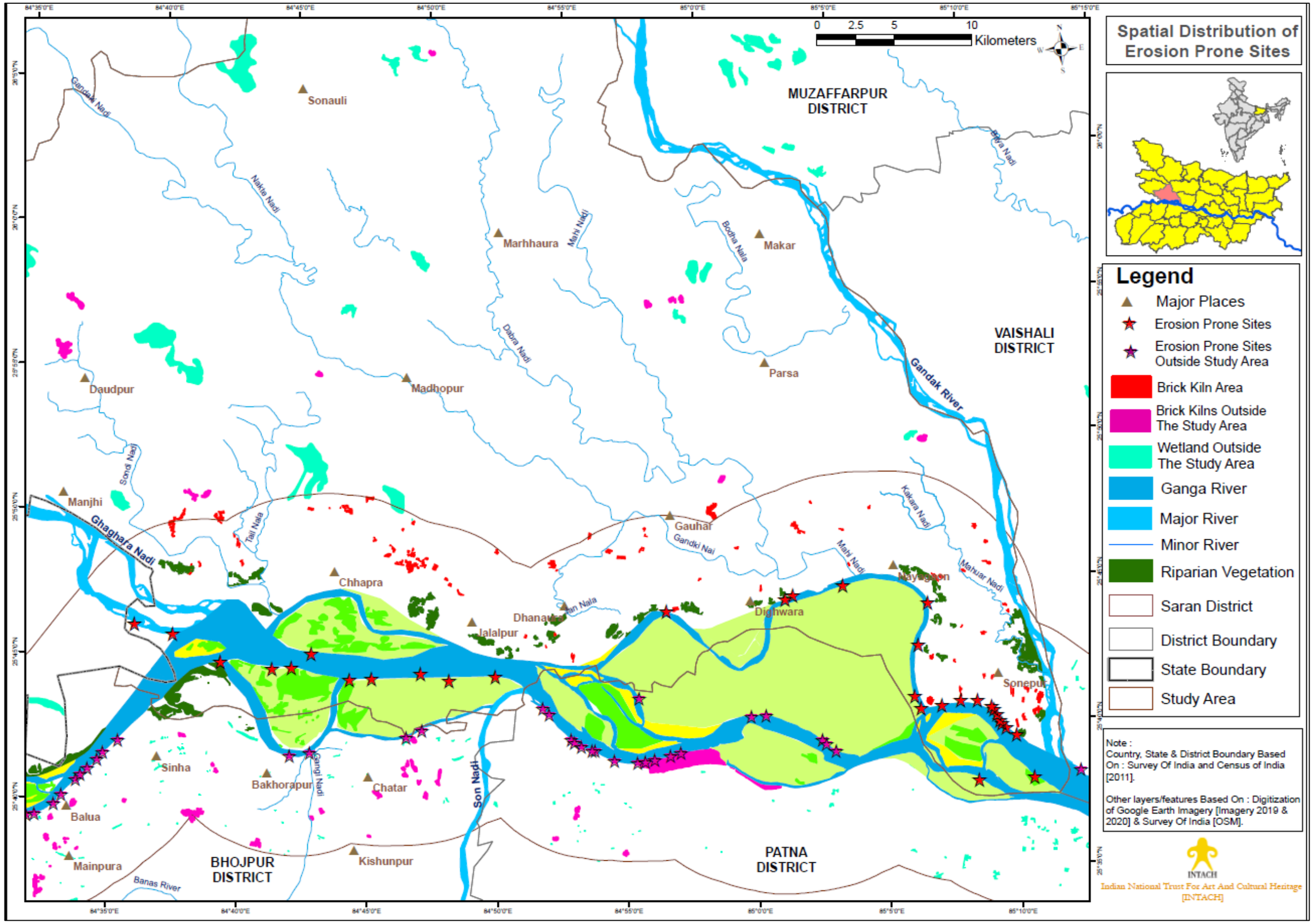
Table 7 : Grounwater Levels Recorded From Different Villages In Study Region

Place	Coordinates		Ground Water Table in Feet
	Lat.	Long.	
Dighwara	25°44'45.91"N	85° 0'46.05"E	80
Garkha	25°50'9.20"N	84°51'15.19"E	60
Chapra Town	25°46'46.07"N	84°44'52.83"E	40
Mukurera	25°46'35.43"N	84°43'43.74"E	50
Revelganj	25°45'39.63"N	84°40'25.35"E	60
Diliya Rahimpur	25°46'19.44"N	84°43'23.20"E	70
Doriganj	25°43'56.93"N	84°49'54.74"E	45

14.0 Ganga River Bank Erosion In Saran Distt.

14.1 Weathering of soils by natural forces is both constructive and destructive. Erosion is the chief agent responsible for the natural topographic cycles as it wears down higher elevations, banks (lateral erosion) and deposits sediments in the plains. However, erosion gets aggravated due to human interventions through change in land use, excessive grazing, extensive farming, cultivation without taking proper conservation measures, destruction of forest and riparian vegetation. It is well known that exposed soil may erode rapidly. During the field survey bank erosion was observed along Ganga and Gandak Rivers in Sonepur and nearby villages. Other erosion prone sites along Ganga included Dighwara village and some nearby sites and near Revelganj along Ghaghra River. One such site is depicted in Image 31 while all the erosion prone sites in the study region are marked on Map 8. Intense rainfall coupled with torrential water flow in Ganga River and its tributaries result in bank erosion at these sites. Various other factors such as decrease in riparian vegetation and large scale land-use changes have also contributed to this severe erosion. The interlocutors reiterated about huge losses caused by floods and associated erosion to their villages and floodplain agriculture fields. They also claimed to have no kind of aid or assistance in this matter from anyone including authorities thereby bearing the brunt of these losses all by themselves.

Image 31 : Erosion Prone Bank Along Gandak River As Observed In Sonepur



Map 8 : Spatial Distribution Of Erosion Prone Sites In Saran Distt.

15.0 Mining And Brick Kilns In Saran

15.1 Yellow sand in Sone river and Ganga River are major source of revenue collection in district as well as soil/clay is actively mined for bricks and pottery industry (MSME-DI, 2020). While sand is vastly collected with the help of big-sized sand boats in the Ganga river stretch of study region, Sone River is also exploited unsustainably for sand mining. Map 9 depicts some sand mining sites located at and around the Sone-Ganga confluence, parts of which fall in the study region. During the field survey, heaps of these sand resources collected from the rivers were being dumped alongside Ganga River Bank in Saran Distt. especially near Chapra town. The local residents reiterated that due to the shift in course of Ganga and Sone Rivers, vast floodplain areas were exposed which has become a paradise for illegal miners especially during last decade. Hundreds of heavy vehicles visit these sites throughout the day and sometime during night as well to collect sand for selling in nearby districts of Bihar and Uttar Pradesh.

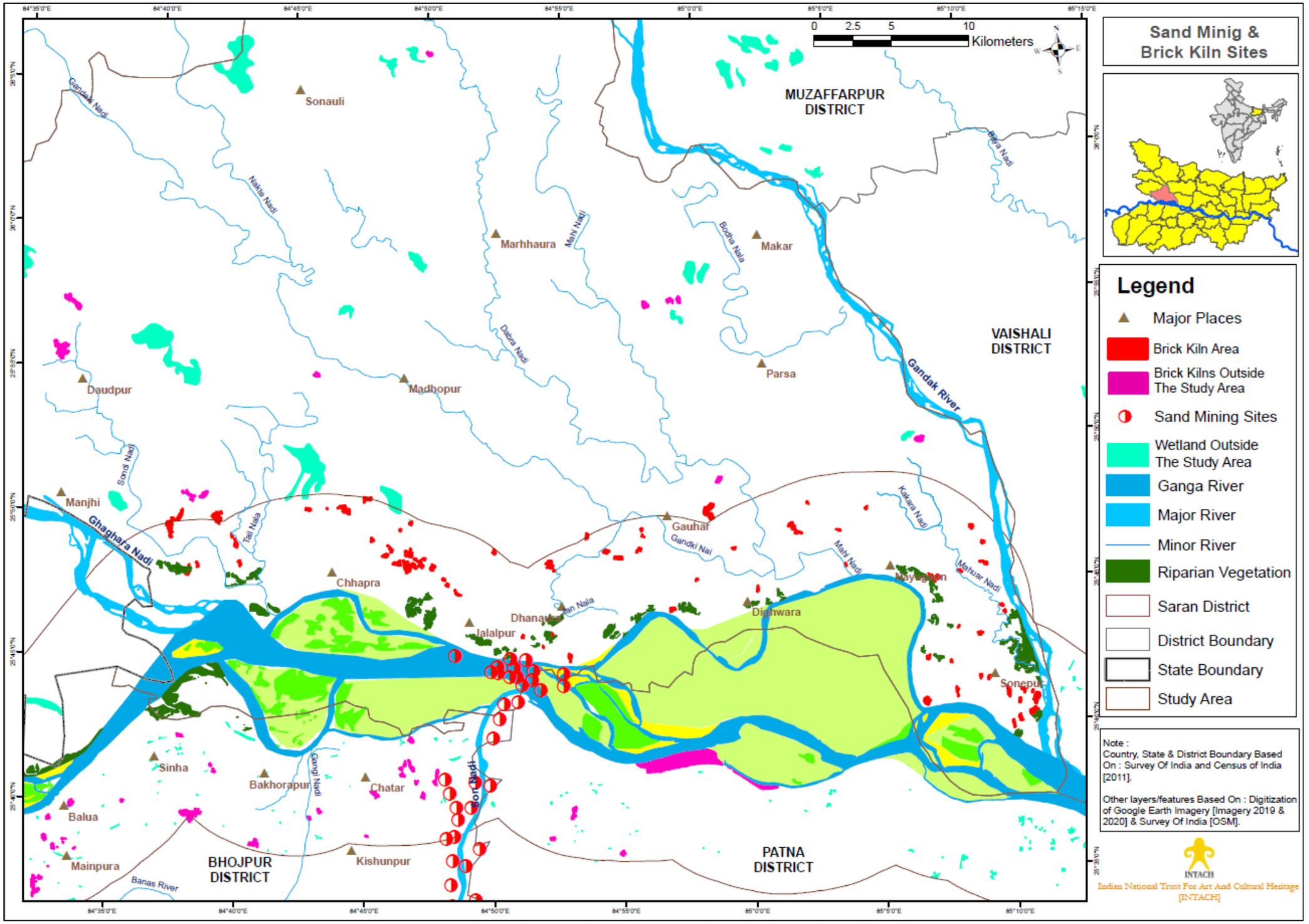
15.2 Apart from this, big-sized sand collection boats plying in the Ganga River approach Sone from their confluence and travel throughout the year for sand collection. These activities not only significantly harm the hydrology and biota of these rivers but also pose serious threat to the life of anyone who tries to object or stop these miners. Various reports and news articles have been published highlighting this issue in the region. Images 32 depicts some mining activities in the study region as recorded during the field survey. Some respondents claimed that in recent months, the authorities have increased their actions against such reckless mining which has resulted in several boats being seized and even destroyed in the river itself [Image 33]. The **'Enforcement and Monitoring Guidelines for Sand Mining 2020'** needs to be implemented seriously in the study region to continue the deterring of such illegal activities.

Image 32 : Sand Mining Activities As Recorded Near Doriganj In The Study Region

Image 33 : Sand Mining Boats Seized And Destroyed By The Local Authorities Near Sone-Ganga Confluence

15.2 **Brick Kilns:** An important economic activity in the Distt. is production of bricks in the brick kilns. With rapid urbanization, bricks have become an important building material for construction activities. Brick kilns in the study area provide livelihood opportunity to the local community. However, this industry has posed current and potential future threats to the soil, air, biota and water system of the region. Several brick kilns are distributed in the study region with some of them situated close to Ganga River and its floodplain. The spatial distribution of brick kilns in the study region is depicted in Map 9 and one such brick kiln is depicted in Image 34 as observed during the field survey.

Image 34 : A Brick Kiln As Seen During The Field Survey



Map 9 : Spatial Distribution Of Stone Quarry And Brick Kilns In The Study Region

16.0 Boatmaking And Inland Navigation In Saran Distt.

16.1 Boats play a crucial role in the livelihood and day-to-day activities of riparian communities in the study region. Different types of boats ply on the Ganga River and its tributaries depending upon its purpose. The smaller wooden boats are hand-rowed and generally made of Sekhua/Sal wood (*Shorea robusta*) which is purchased from the markets. These boats are principally employed for fishing activities in the study region [Image 35]. Slightly bigger sized wooden boats are either hand-rowed or motor based and are principally employed for transportation of people, their vehicles such as bike or bicycle and other goods from one bank to the other or from the bank to *diaras* [Image 36]. The biggest boats in the study region are mechanized, made up of wood and metal and are principally employed for sand mining activities in Ganga River and its tributaries [Image 37]. Upon interaction, the interlocutors reiterated that these boats are constructed with the help of 'Mistry' (carpenters) which are called from nearby towns and cities. The cost of constructing these boats range from Rs. 2-3 lakhs for smaller boats and from Rs. 5-7 lakhs for bigger boats depending upon various factors. The boats ferrying passengers generally charge Rs. 5-15 per passenger depending upon different factors such as luggage, distance to be traveled and so on.

Image 35 : Small Hand-Rowed Wooden Boats Employed For Fishing In The Study Region

Image 36 : Medium Sized Wooden Boats With Motor For Ferrying People In The Study Region

Image 37 : Larger Mechanized Boats Employed For Sand Mining In The Study Region

17.0 Sacred Sites And Sacred Trees In Saran Distt.

17.1 **Bengali Baba Ghat:** During the survey a sacred Ghat along Ganga River known popularly as 'Bengali Baba Ghat' [Image 38] by the local residents was located in Chirand village of Saran Distt. Upon interaction, the interlocutors reiterated that a saint from Bengal had migrated here in 1962 and did penance at the bank of Ganga River. The saint also established a temple dedicated to Lord Shiva which soon became a popular site for religious activities in this region. Upon his death, the Ghat came to be known as Bengali Baba Ghat and is thronged by numerous visitors especially on auspicious occasions and festivities such as Shivratri and Chhath Puja. A 'Mela' is also organized at this site on Kartik Purnima and Makar Sankranti.

Image 38 : Bengali Baba Ghat In Chirand Village Of Study Region

17.2 Further interactions with interlocutors in this region led to the location of a temple [Image 39] which is dedicated to Lord Ram and was built in 17th century situated close to the Bengali Baba Ghat. It could be recorded based on their information that this site was part of the kingdom of Raja Mordhwaj. One day Lord Krishna and one of the Pandavas – Arjuna came in disguise to take a test of Mordhwaj's belief in God. They asked the King and his wife to cut their only son in two halves – one half for their tiger and one half for them. They had to do so without shedding a single drop of tear. When they both accomplished this, their faith was proved and Lord Krishna brought their son back alive after the test. A depiction of this story was also found in the temple premises [Image 40]. Worshippers from different places come to offer their prayers at this temple and an annual *mela* is also held at this site.

Image 39 : The Temple As Seen During Field Survey

Image 40 : A Depiction Of Raja Mordhwaj's Story At This Temple

17.3 **Sacred Trees:** Various sacred trees were observed during the field survey in study region. Peepal (Ficus religiosa) is the major tree species often found associated with temples and other religious sites throughout. The worship of this tree is usually done by the female residents in that region by tying threads around it and offering water along with sindoor, coconuts or incense sticks. Another tree species that is also found commonly associated with sacred sites is Ficus benghalensis (Banyan tree). Owing to their protection these sacred trees often develop trunks with huge girths and a luxuriant canopy. Some such examples of sacred trees as observed during field survey are depicted in Images 41-42.

Image 41 : Sacred Banyan Tree At Gaj-Graha Ghat Along Gandak River In Study Region

Image 42 : Sacred Peepal Trees Along Ghaghra River In Study Region

18.0 Key Observations and Recommendations

18.1 One important Hindu ritual associated with Ganga river throughout India is cremation of dead bodies as it is widely believed that by immersing your burnt remains in the holy Ganga water, the person will attain 'Moksha'. The remains of these rites along with other substances such as pots, flowers, clothes, threads and so on are often dumped directly into the river thereby impacting the riparian and in stream biodiversity. Hence, it is recommended to designate another site for cremation little away from Ganga River and develop appropriate facilities in order to prevent further pollution and ecosystem damage.

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

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

17.5 Reckless and unchecked sand mining in the study region poses imminent danger to the ecosystem of Sone and Ganga Rivers. Along with this, it also results in numerous criminal activities by hooligans involved in this activity. It is recommended very strongly in this report for the authorities to continue taking decisive actions against this in order to safeguard the natural resources and human lives.

17.6 The wetlands observed in the study serve as crucial resources for livelihoods and day to day needs of local residents associated with them. However, no effort has been made to ensure conservation and maintenance of these resources which has resulted in issues like sewage influx and dominance of invasive species. These wetlands if conserved properly have the potential to not only provide good fish resources, but also harbor

other flora and fauna diversity, provide aesthetic benefits and clean water for various uses. Hence, it is strongly recommended to pay immediate attention for maintenance of these water bodies especially in conjunction with local stakeholders.

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

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