Ganga Cultural Documentation
2021

HAPUR DISTRICT
Natural Heritage

NAMAMI GANGE

National Mission for Clean Ganga

INTACH

Indian National Trust for Art and Cultural Heritage

71, Lodhi Estate, New Delhi – 110003

Website: www.intach.org

Email: intach@intach.org

Surveyed & Authored by: Mohd. Sajid Idrisi

Team Headed By: Manu Bhatnagar [Principal Director, NHD]

Dr. Ritu Singh [Director, NHD]

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Front Cover: Old Cenotaph On Bank of Ganges At Pooth, Distt. Hapur

Background: Small River Island At Kirawali, Distt. Hapur

Back cover: Ganga River Scenery From Kirawali, Distt. Hapur

Formatting and Design by: Mohd. Sajid Idrisi

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Sponsored by :

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1.0 Introduction

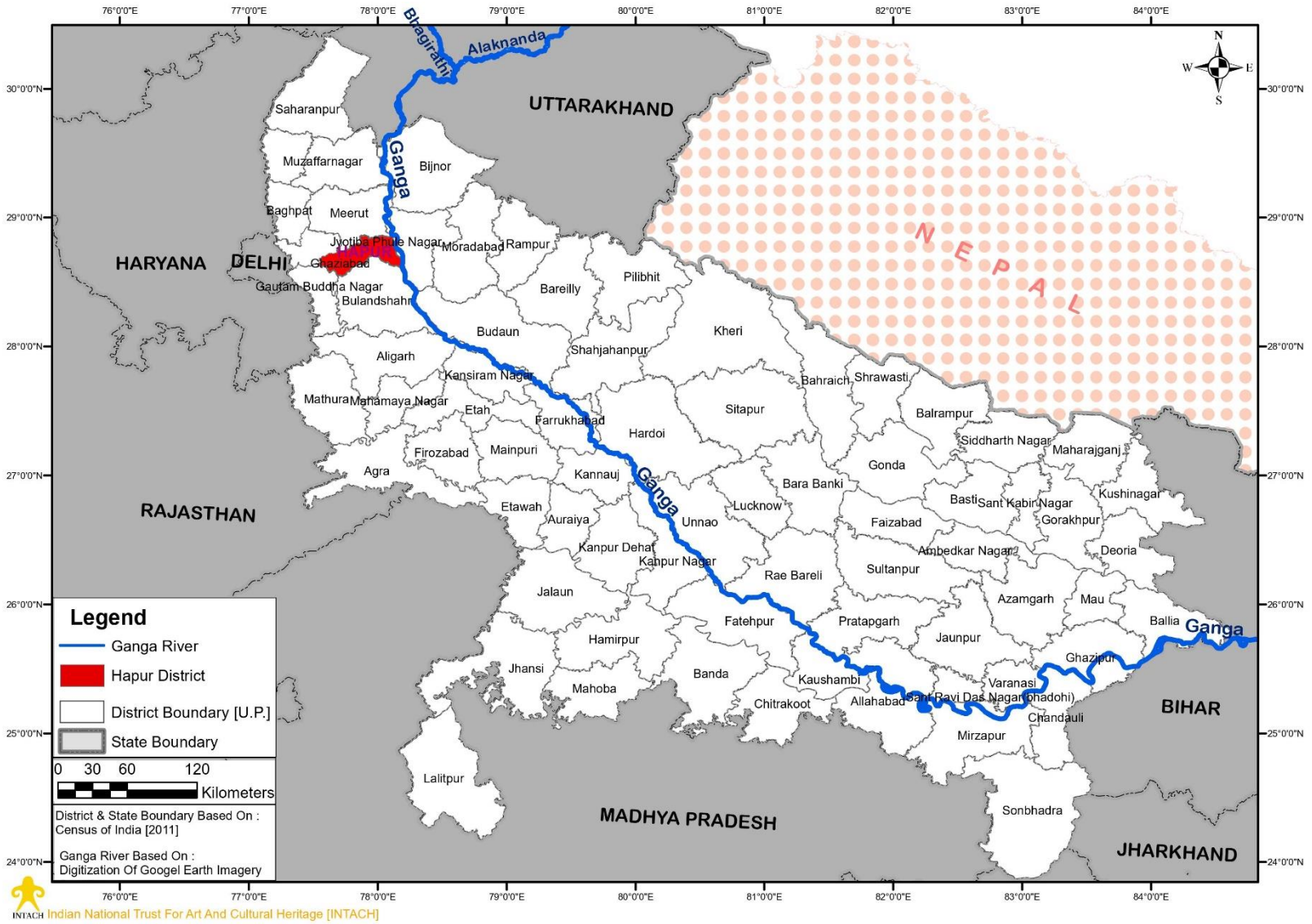
1.1 Distt. Hapur, situated on the right bank of Ganga River [approx. 30 km reach in the Distt.], occupies the central part of the Meerut Division. The district is part of National Capital Region [NCR] and was carved out of Ghaziabad Distt. on 28th Sept. 2011.

1.2 The geographical area of the Distt. is 660 Sq. Km which is about 0.27 percent of the total Uttar Pradesh area. It shares boundaries with Amroha Distt. in East [across Ganga River], Ghaziabad Distt. in West and Meerut Distt. in North and Bulandshahr Distt. in South. The Distt. is divided into 4 development blocks and 3 tehsils viz. Garhmukhteshwar, Dhaulana and Hapur.

1.3 Hapur Distt. is a part of the Doab region of Indo-Gangetic plains, sloping towards the South. The Madhya Ganga Canal coming from Bijnor Barrage and Anupshahr Branch of Upper Ganga Canal coming from Muzaffarnagar intersects here at Simbhaoli. There are is only one tributary of Ganga River passing through the district i.e. Kali Nadi [East]. Another smaller river – Chhoiya Nala joins Kali Nadi near village Chhapokali. Geomorphologically[1], the entire landscape of Hapur and Ghaziabad area is divided into 3 morpho units viz. i) Older Alluvial Plain [occupies entire upland and interfluve area between major rivers Yamuna, Hindon and Ganga River ii) Older Floodplain and (iii) Active Floodplain. The banks of rivers have been noted as steep and ravenous. The soil ranges from pure sand to stiff clays. The pure sand is called Bhur. Clay is called Matiyar. When the sand is mixed with clay in equal proportion the soil may be termed as Dumat or loam – a good agricultural soil.

1.4 Hapur City is known as a manufacturing hub of stainless-steel pipes. Smaller industry includes papad making units, paper cones and tubes. The primary occupation in the Distt. remains agriculture owing to the fertile loamy soils. Sugarcane farming dominates the agriculture fields. Wheat, Rice, Maize and Sugarcane are principal crops. There are a few places of religious and cultural importance such as Garhmukhteshwar, Brijghat and Pooth village along Ganga River.

[1] Ground Water Brochure of Ghaziabad District, U.P [2008-2009]



Map 1 : Location Of Hapur Distt. on Right Bank of Ganga River

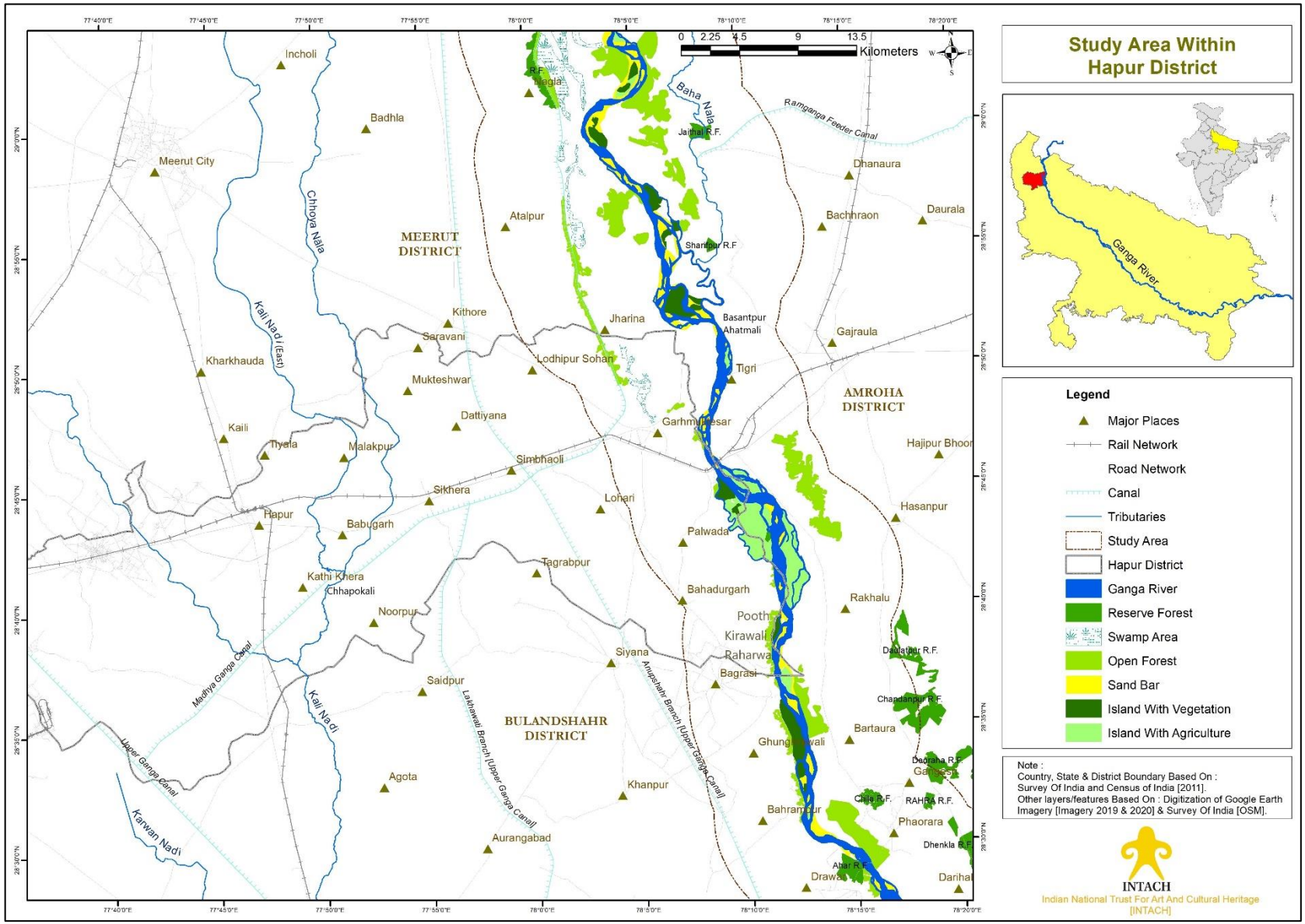
2.0 Ganga River in Hapur Distt.

2.1 Ganga River enters Hapur Distt. near Basantpur Ahatmali, after crossing Meerut district [See Map No.2]. The river channel is around 1 km wide here. The length of Ganga River in Hapur Distt. is around 30 km, coursing along Distt. boundary on the east. Most of the Distt. boundary area along Ganga River consists of flat floodplain areas which are under cultivation, scrub upland tracts at some places, depressions and paleochannels. Upland tracts are actually the levee deposits [older high tracts] of Ganga River ranging from 3 m to 18 m in height.

2.2 The point where Ganga enters the district, it takes south-easterly direction and then moves slightly westwards passing through the road and railway bridge of popular religious site Brijghat. There are various islands and sandbars of various scales occurring in this reach. Further downstream, Ganga takes slight easterly turn and flows down south into District Bulandshahr. The river width in this stretch varies between 1 km to 2. The river turns into narrow channels passing around these islands and sandbars.

2.3 Ganga River stretch in Distt.s Hapur and Bulandshahr falls under Upper Ganga Ramsar Site – a Ramsar wetland declared on 8th November, 2005 due to rich biodiversity and habitats under Ramsar criteria 2,3,4,5 and 7. The designated area starts from Brijghat, located in Hapur Distt. to Narora, located in Bulandshahar Distt. Ganga River exits Hapur district near Bhagwanpur, around 17 km downstream from Brijghat.

Image 1 : View of Ganga River At Brijghat, Distt. Hapur



Map 2 : Study Area In Hapur Distt

3.0 Methodology

3.1 For carrying out surveys, a 7 km buffer zone of Ganga River in the Distt. was considered. Before carrying out surveys, various access points and routes to the river were located with the help of Google Earth. Special emphasis was given to the sites and features of interest such as river channel, biodiversity, floodplain conditions, farming and fishing activities, sites of natural heritage interest. Some known local residents living in villages near Ganga were contacted for field assistance.

3.2 The survey was undertaken during September, 2021 with the help of taxi, boat, bike and on foot. Sites were visited from downstream floodplain areas in Distt. to upstream areas. Sony Digital Camera Cyber-shot DSC-HX300 with 50X optical zoom and OnePlus 9 Pro mobile phone were used for photography. Garmin handheld GPS eTrex30 was used for marking locations and understanding elevation difference. Pre-marked Google Earth's Kml files and Google Maps were used for navigation. Field guides were used for flora and fauna identification. Information was obtained through informal interviews and discussion with farmers, fishermen, boatmen and local people.

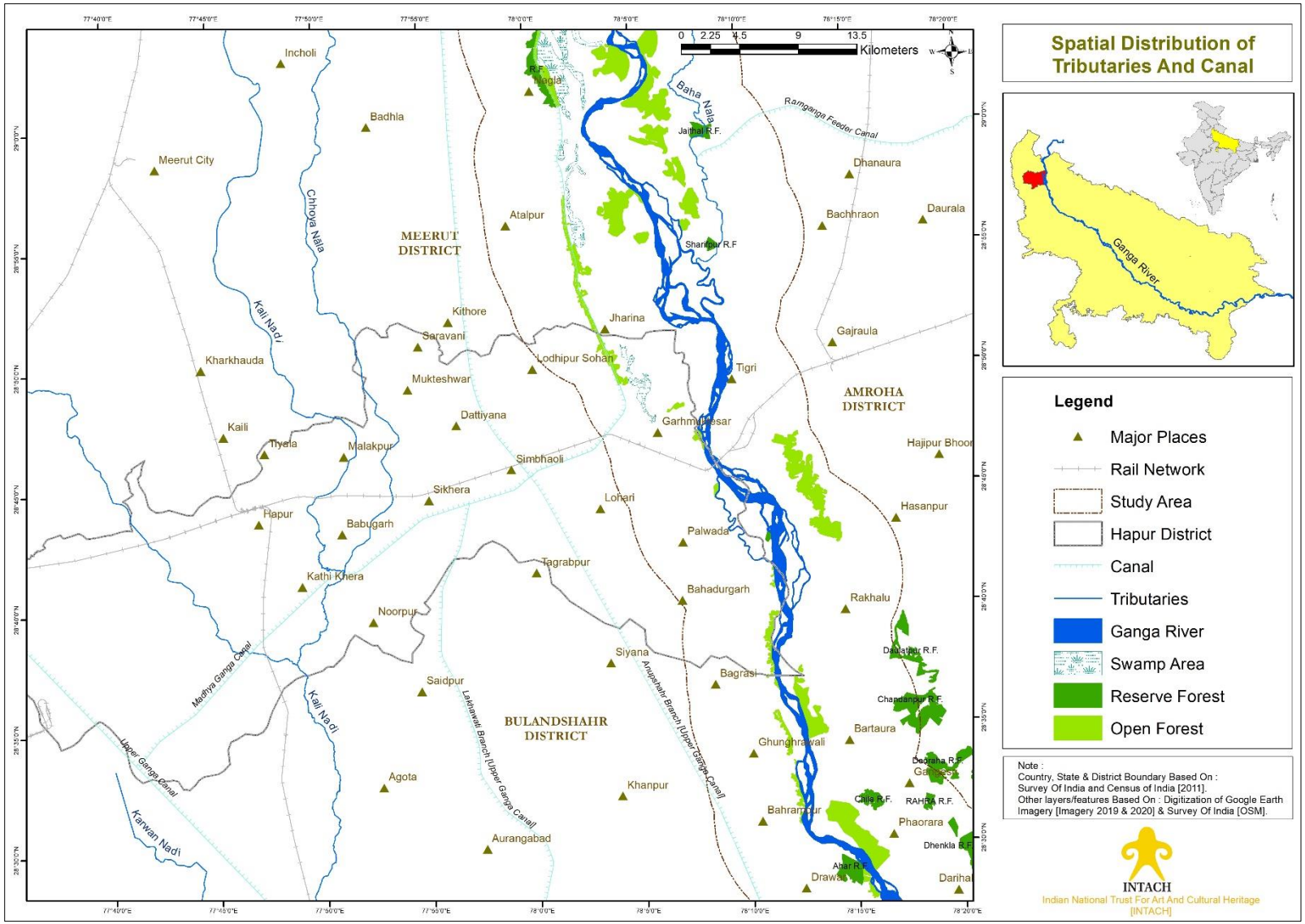
4.0 Tributaries of Ganga River

4.1 There are no major tributaries of Ganga River in Hapur district except Kali Nadi [East], which crosses the district around 6 km east of Hapur main town. Around 7 km downstream, another smaller rivulet – Chhoiya Nala joins Kali Nadi [East] near village Chhapokali. The details are given below:

1) **Kali River [East] :** It is generally known as Kali River [East] to distinguish it from Kali River [West] – a tributary of Hindon River. Kali River [East] rises in Distt. Muzaffarnagar and flows southwards into Bulandshahr finally joining River Ganga in District Fatehpur. The Meerut Gazetteer of 1904[2], describes the river as Kali River [East] as :

"The Kali River is the chief river of eastern tract which rises in Muzaffarnagar district and flows southwards into Bulandshahr, finally joining Ganges in Fatehpur. This stream which should properly be called the Kalindi, is also known as the Nagan, or again as the eastern Kali, to distinguish it from the western Kali, a tributary of Hindan. The Kali nadi has no important towns on its banks. It is crossed by the bridges on the roads from Meerut to Mawana, Parichhatgarh, Garhmukteshwar, and near Babugarh on the road between Hapur and Garhmukteshwar. The stream contains very less water except in the rains and is never navigable. It has three smaller tributaries [smaller streams] which form part of the same central drainage system. Two of those are known under the generic name of Chhoiya. One of them lies on the left bank and traverses nearly the whole length of the district, rising at a point close to Niloha in pargana Hastinapur; while the other is on the right bank and has its origin in the central depression, a short distance to the south of Meerut. The eastern Chhoiya closely resembles the Kali in character. In the early parts of its course, it is an ill-defined straggling watercourse, running through low, ill cultivated land and, except in the rains, is perfectly dry. In the latter part of its course, it carries a sluggish stream through a deep section with a more or less extended valley. It has a total length of about 30 miles and joins the Kali about nine miles below Hapur."

[2] Meerut : A Gazetteer being Volume IV of the District Gazetteers of the United Provinces of Agra and Oudh [1904]. Compiled and Edited by H.R. Nevill, I.C.S . Govt. Press, United Provinces



Map 3 : Major and Minor Tributaries In Study Area

5.0 Land Use Land Cover [LULC]

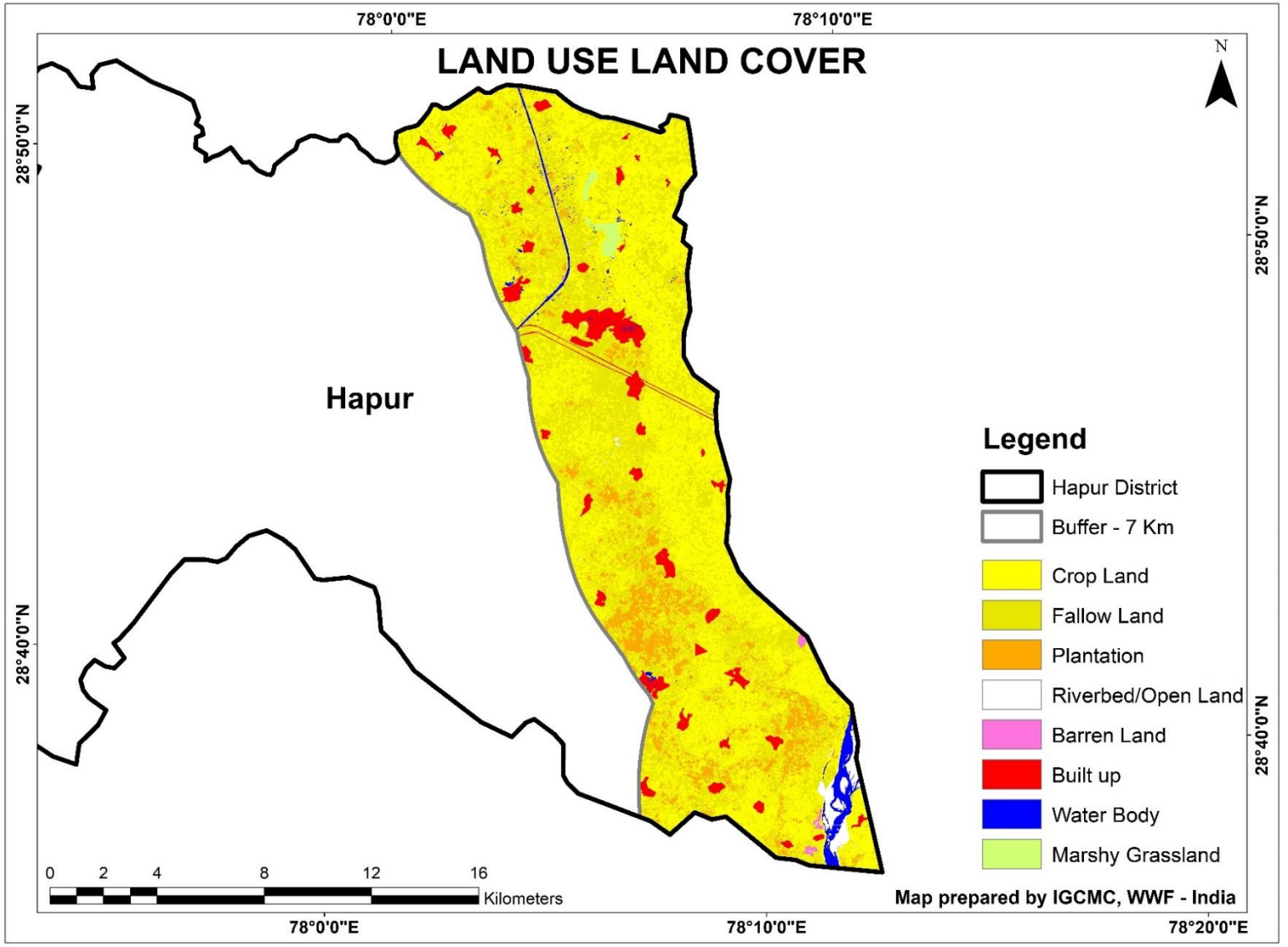
5.1 Land Use Land Cover [LULC] map of the study area has been prepared from Landsat imagery for the year 2020. [Table No.1] Using supervised classification system, 8 different classes were generated – crop land, fallow land, plantation, riverbed/open land, barren land, built up, water body, marshy grassland [Map 4]. Since agriculture is the primary occupation in the Distt., cropland and fallow land area dominate other classes.

5.2 Major insights are the following :

i. Crop land is the dominant land use with 51.64 % of the total area [105.69 Sq.Km]
ii. Fallow land comes second with 30.54 % area under cultivation [62.50 Sq.Km]
iii. Together, the total area under agriculture is around 82.18% [168.19 Sq.km]
iv. Forest could not be detected. Although there are some patches of forest in the study area, the currently available district boundary does not cover entire area of the floodplains.
v. Plantation comes third with 9.33 % area [i.e. 19.08 Sq. km]
vi. Built-up area is 4.46% [9.13 Sq.km]
vii. Riverbed and Open land area constitute 1.19 % [i.e. 2.44 Sq. km]
viii. Waterbody which also includes river area is around 2.13 % [i.e. 4.36 Sq.km]
ix. Marshy grassland is around 0.54% [1.09 Sq.km]
x. Barren land is only 0.18% [0.35 Sq.km]

Table 1 : Land Use Land Cover of Study Area in Hapur Distt. [2020]

S.No.	Classes	Area (Ha)	Area (Sq.Km)	Area (%)
1	Crop Land	10569.20	105.69	51.64
2	Fallow Land	6250.87	62.50	30.54
3	Plantation	1908.79	19.08	9.33
4	Riverbed/Open Land	244.23	2.44	1.19
5	Barren Land	35.99	0.35	0.18
6	Built up	913.64	9.13	4.46
7	Water Body	436.36	4.36	2.13
8	Marshy Grassland	109.70	1.09	0.54
	Total	**20468.78**	**204.68**	**100%**

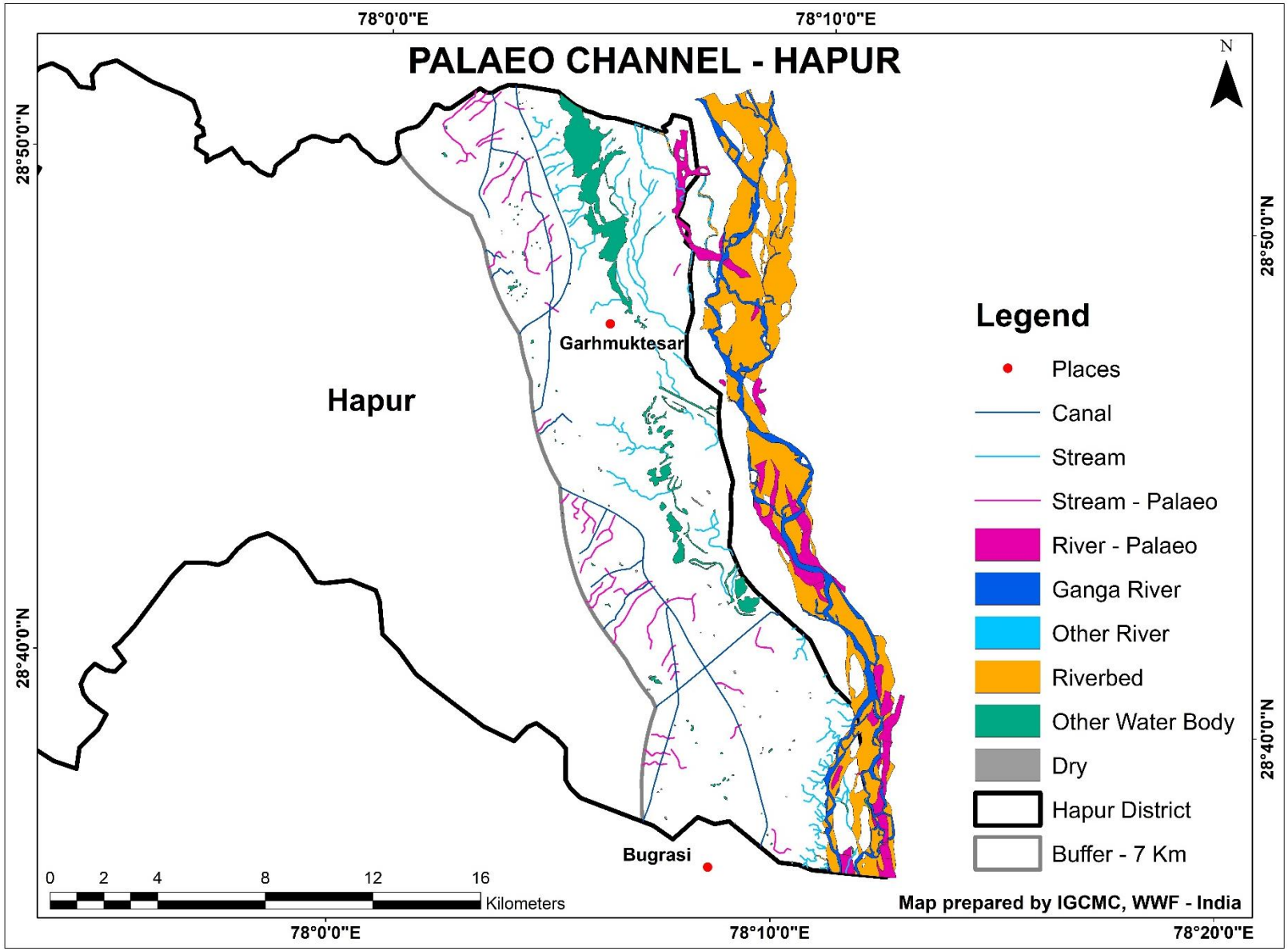


Map 4 : Landuse Landcover Map of Study Area

6.0 Palaeochannels Of Ganga River In Hapur Distt.

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 rivers or streams 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. Factors such as change in land use pattern, sand mining, agricultural practices, and industrial activities lead to disappearance of such channels along rivers. Generally, such old channels do not carry water during most of the year but may flow during flood events. Such abandoned and silted palaeochannels can be mapped using old maps and remote sensing techniques. Based on the available satellite data and remote sensing technique, Map No.5 was prepared, which depicts the various palaeochannels in the study area of Hapur Distt.

Image 2 : Palaeochannel Near Pooth, District Hapur



Map 5 : Palaeochannels In The Study Area

7.0 Floodplain Of Ganga River In Hapur 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 Distt.s, where it passes through, for agricultural purposes.

7.2 Ganga River floodplains in Hapur Distt. are generally flat except at some places such as Pooth, Raharwa and Kirawali where the upland tracts are clearly visible with riparian trees and scrub vegetation. Flat floodplain areas are cultivated for major crops such as wheat, rice, maize, sugarcane and seasonal vegetables. The agriculture fields could be observed extended up to the edge of the active channel of the river and between the palaeochannels similar to pattern observed in adjacent district Bulandshahr. Agriculture is one of the major sources of income in the Distt. and farmers of floodplain areas are benefitted by the fertile alluvium brought in by the river. Sugarcane remains the dominant crop. Cucurbit and vegetable cultivation is mostly done in dry river bed areas and on river islands. According to riparian communities, the river reclaims its original channel every monsoon season, washing away these agriculture fields and changing their structure as it meanders downstream. Closer vicinity to Ganga River ensures water availability and thus irrigation of crops is easier.

Image 3 : Natural Upland Tracts Of Ganga River Near Kirawali, Distt. Hapur

Image 4 : River Bank Area At Pooth, Distt. Hapur

8.0 Wetlands In Hapur Distt.

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. A report 'Wetland Report for Ganga River Basin Management Plan' published in 2012 by consortium of IITs mentions that 57% of the wetlands in Uttar Pradesh are related to river/streams with 181935 ha area while the National Wetland Atlas [Uttar Pradesh] published by SAC, ISRO in 2010 as a part of project 'National Wetland Inventory and Assessment' of MoEF, estimates it to be 48.88%. It clearly indicates the majority of riverine wetlands and floodplain lakes in the state.

8.2 In the current exercise, a total of 28 wetlands have been mapped in the study area with the help of Google Earth satellite imagery and available maps. The list of mapped wetlands is given in Table No. 2 and their spatial distribution is shown in Map No. 6.

Table 2 : List Of Wetlands In The Study Area

Sr. No.	Wetland	Coordinates		Area [Hectares]
		Latitude	Longitude	
01	01	28°37'59.45"N	78° 6'56.56"E	0.28
02	02	28°38'2.83"N	78° 8'50.20"E	1.40
03	03	28°38'18.42"N	78° 8'34.42"E	1.79
04	04	28°39'7.07"N	78° 8'5.44"E	0.92
05	05	28°38'57.17"N	78° 8'41.67"E	0.89
06	06	28°39'6.06"N	78° 8'37.27"E	0.47
07	07	28°39'5.20"N	78° 9'46.28"E	1.79
08	08	28°39'22.94"N	78° 7'57.70"E	2.32
09	09	28°39'26.24"N	78° 7'33.74"E	0.42
10	10	28°40'6.12"N	78° 6'58.81"E	0.39
11	11	28°40'0.64"N	78° 6'55.80"E	0.56
12	12	28°40'7.79"N	78° 6'47.10"E	2.30
13	13	28°40'6.73"N	78° 6'51.75"E	0.19
14	14	28°40'18.88"N	78° 8'54.52"E	0.30
15	15	28°40'18.80"N	78° 6'59.12"E	6.69
16	16	28°40'35.48"N	78° 8'48.70"E	1.67
17	17	28°41'42.11"N	78° 5'51.53"E	1.30

18	18	28°42'31.36"N	78° 5'24.82"E	1.10
19	19	28°45'36.87"N	78° 8'20.78"E	11.3
20	20	28°47'22.46"N	78° 5'45.84"E	1.21
21	21	28°47'17.02"N	78° 6'10.24"E	0.84
22	22	28°47'46.30"N	78° 3'22.89"E	1.54
23	23	28°47'54.14"N	78° 3'7.21"E	7.84
25	25	28°48'36.22"N	78° 3'19.03"E	1.82
26	26	28°50'26.11"N	78° 1'21.90"E	1.92
27	27	28°48'46.38"N	78° 3'28.09"E	0.59
28	28	28°51'34.70"N	78° 1'8.01"E	0.33
Total Area [Hectares]				52.17

8.3 **Sherpur Talab :** The talab lies on the southern edge of Sherpur village [Wetland No. 7] . It has been fragmented by the village road into three parts – one lies north and other in west. The northern part is smaller and filled with solid waste primarily plastic. The western part is a depression converted into agriculture land. The main talab receives sewage runoff from the village and also threatened by solid waste thrown on its edges by villagers. Its riparian edge towards south is natural and dotted with shrubs and trees such as Sheesam [*Delonix regia*], Pipal [*Ficus religiosa*], Jamun [*Syzygium cumini*], Neem [*Azadirachta indica*], Pongamia [*Millettia pinnata*], Bamboo [*Bambusa vulgaris*], Country Mallow [*Abutilon indicum*], Kasaunda [*Senna sophera*], Colocasia [*Colocasia esculenta*], Tall Reed [*Phragmites Karka*] and Castor Oil Plant [*Ricinus communis*]. Resident birds such as Black-winged Stilt [*Himantopus Himantopus*], Common Moorehen (*Gallinula chloropus*), White-breasted Waterhen (*Amaurornis phoenicurus*), Cattle Egret [*Bubulcus ibis*] were sighted during the field visit.

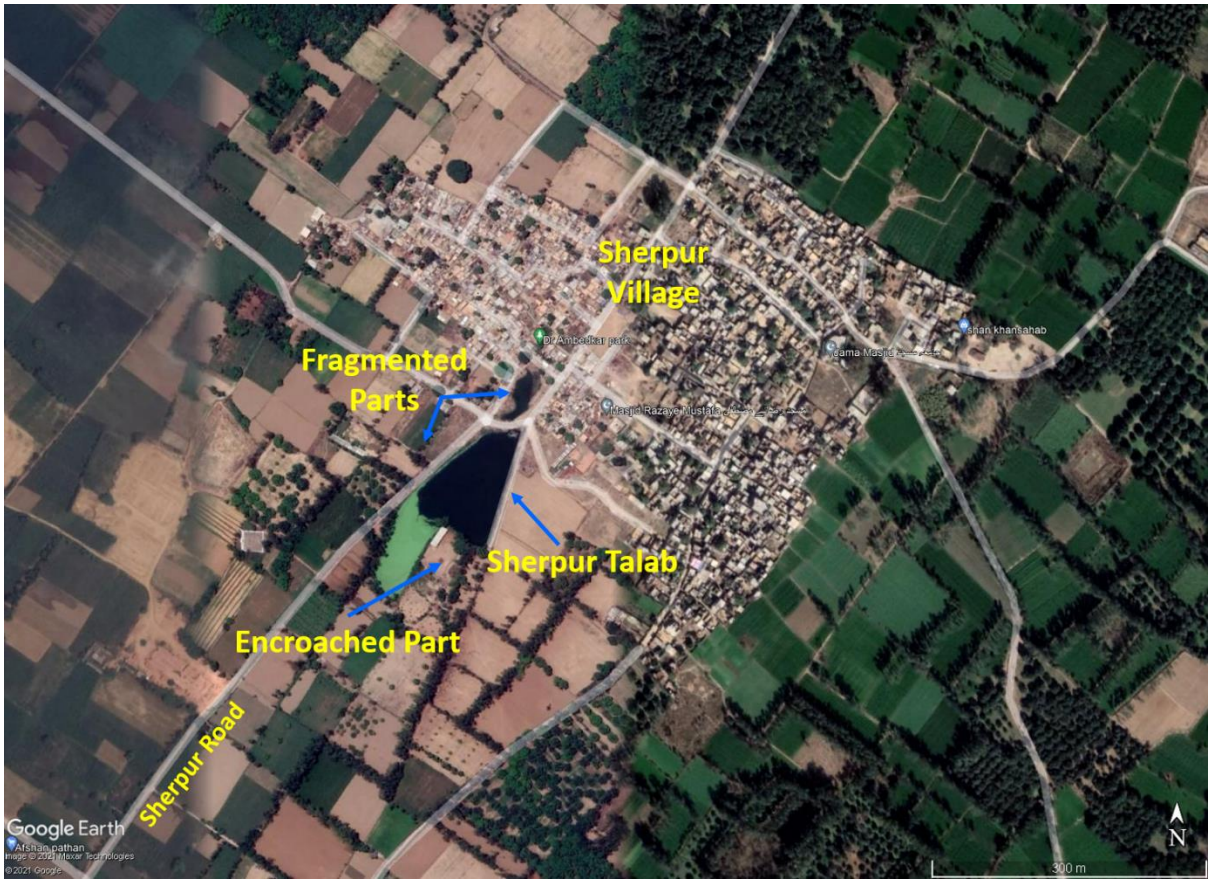


Image 5 : Location of Sherpur Talab [28°39'5.74"N, 78° 9'44.45"E]

Image 6 : Sherpur Talab [Looking Southeast]

Image 7 : Fragmented Northern Part of Sherpur Talab

8.4 **Bhadsiyana Talab :** This pond is located on the eastern edge of Bhadsiyana village around 200 m from the main Pooth road [Wetland 8]. It is the main and largest water body of the village. It is surrounded by agriculture fields with small village roads passing through its edges. Some part of it lies in the southeastern side fragmented by the road. At its western edge [village side] the progressing encroachment is clearly visible jutting out of riparian trees. The major trees species are Jamun [*Syzygium cumini*], Neem [*Azadirachta indica*], Sheesam [*Delonix regia*], Mango [*Mangifera indica*], Safeda [*Eucalyptus spp.*]. The pond is used by villagers for fishing. Main fish species are Manghur (*Clarias batrachus*) and Kari or Pangas (*Pangasianodon hypophthalmus*) which are sold locally in the Distt.. It receives sewage discharge from the village, however the water quality seemed better from its visible appearance. Dilution due to monsoon rains may have been a reason. During summer season when water level gets down in the pond, it is filled with ground water through tube wells in order to sustain the fishing business. White-breasted Waterhen [*Amaurornis phoenicurus*] was observed with her chick at the fragmented part of the waterbody across the road.

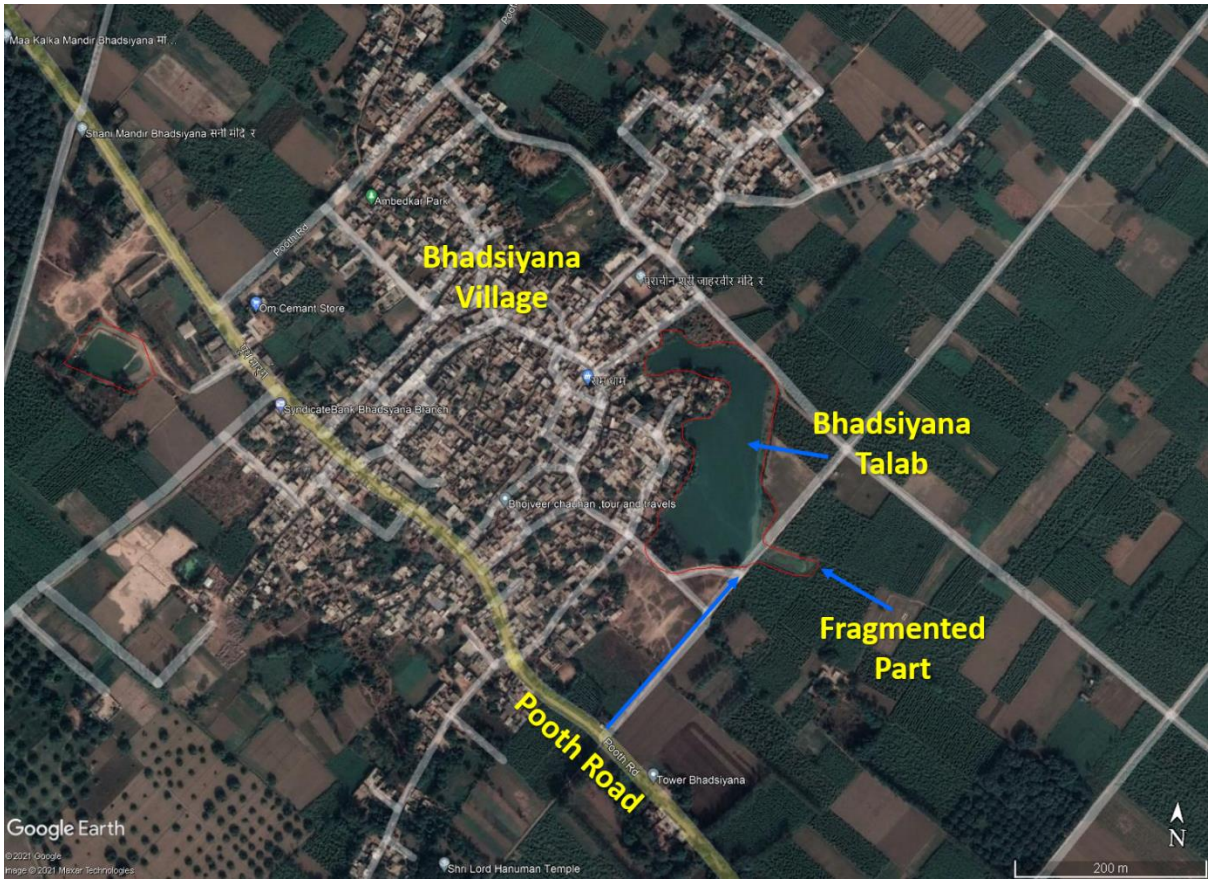
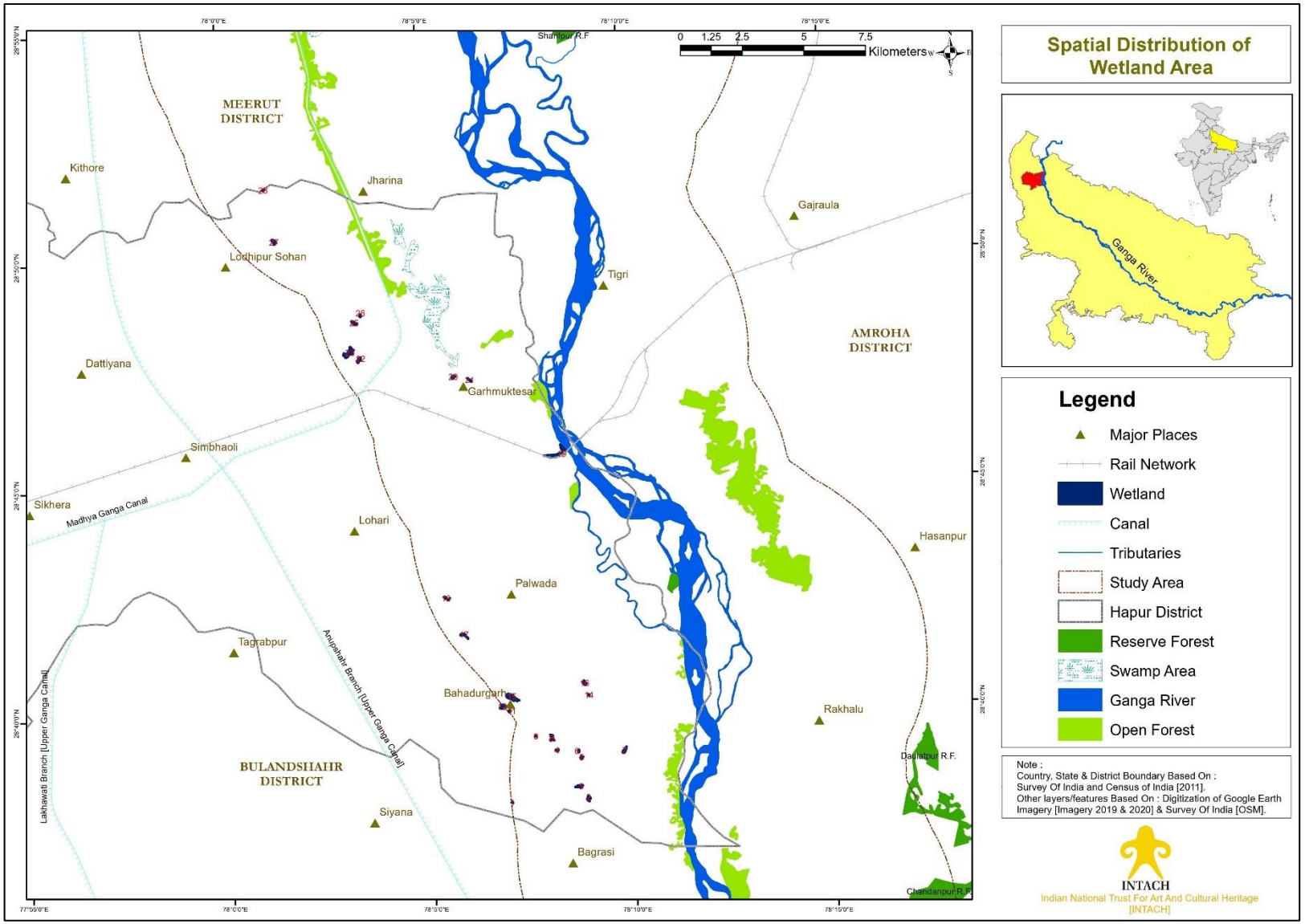


Image 8 : Location Of Bhadsiyana Talab [28°39'20.34"N, 78° 7'58.97"E]

Image 9 : Bhadsiyana Talab [Looking Northwest]

Image 10 : White-breasted Waterhen [*Amaurornis phoenicurus*] With Her Chick

Image 11 : Little Grebe [*Tachybaptus ruficollis*]



Map 6 : Spatial Distribution Of Wetlands In The Study Area

9.0 Riparian Flora Along Ganga River In Hapur 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 harbour 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, harbouring faunal diversity and providing livelihood resources [Groffmanet al., 1990; Castelle 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], Groffmanet al. [1990], Krishanmurti [1991], Castelle 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.

9.3 The pattern of riparian flora in Hapur district is very similar to that of Bulandshahr Distt. located across the river. Although most of the floodplain area/island area is under agriculture, there are considerable patches of riparian vegetation on the upland tracts at Pooth, Reharwa and Kirawali and aquatic weeds in the swampy areas along the river. Patches of Munj [*Saccharum munja*], Kaans [*Saccharum spontaneum*], Common Cattail [*Typha latifolia*], Narkul [*Phragmites Karka*], Doob [*Cynodon dactylon*], Giant cane or Elephant Grass [*Arundo donax*] were observed thriving along the river. The upland tracts have mix cover of various shrub and tree species. Main tree species are Sheesham [*Dalbergia sisso*], Neem [*Azadirachta indica*], Banyan [*Ficus benghalensis*] Jamun [*Syzygium cumini*], Siris [*Albizia lebbeck*], Leucaena [*Leucaena leucocephala*], Peepal [*Ficus religiosa*], Mango [*Mangifera indica*], Bamboo [*Bambusa vulgaris*], Ber [*Ziziphus mauritiana*], and Eucalyptus spp.

9.4 Some herb/shrub species observed are Common Tephrosia [*Tephrosia purpurea*], Congress Grass [*Parthenium hysterophorus*], Coffee Senna [*Cassia occidentalis*], Sickle Pod [*Cassia tora*], Country Mallow [*Abutilon indicum*], Goat Weed [*Ageratum*

conyzoides], Buffel Grass [*Cenchus ciliaris*], Calotropis [*Calotropis procera*], Lantana [*Lantana camara*] along with riparian grasses such as Phragmites [*Phragmites karka*] and Kaans [*Saccharum spontaneum*]. Himalayan mimosa [*Mimosa rubicaulis*] was found thriving along the edges with pink spherical flowers. [See Image-13]

9.5 Some riparian grasses are economically valuable in the district. Kaans [*Saccharum spontaneum*] and Patera [*Typha elephantina*] are harvested from Ganga Khadar by local people. They are used for making hedges and thatch roof.

9.6 Major tree species found in the study are mentioned in table below:

Table 3 : Main Tree Species Recorded In The Study Area

S. No.	Botanical Name	Common Name	Family
1.	*Syzygium cumini*	Jamun	Myrtaceae
2.	*Terminalia arjuna*	Arjun	Combretaceae
3.	*Azadirachta indica* A. Juss.	Neem	Meliaceae
4.	*Acacia nilotica* L.	Babool/Kikar	Fabaceae
5.	*Dalbergia sissoo DC.*	Sheesham	Fabaceae
6.	*Ficus religiosa* L.	Peepal	Moraceae
7.	*Ficus benghalensis* L.	Banyan	Moraceae
8.	*Ficus virens*	Pilkhan	Moraceae
9.	*Ficus racemosa*	Gular	Moraceae
10.	*Bombax ceiba L.*	Semal	Bombacaceae
11.	*Mangifera indica*	Aam	Anacardiaceae
12.	*Populus spp.*	Poplar	Salicaceae
13.	*Eucalyptus spp.*	Liptis	Myrtaceae
14.	*Phoenix dactylifera L.*	Khajur	Arecaceae
15.	*Tectona grandis* L.f.	Teak/Saagwan	Lamiaceae
16.	*Ziziphus mauritiana*	Indian Jujube	Rhamnaceae
17.	*Delonix regia*	Gulmohar	Fabaceae
18.	*Melia azedarach*	Bakain	Meliaceae
19.	*Leucaena leucocephala*	Subabool	Fabaceae
20.	*Albizia lebbeck*	Siris	Fabaceae
21.	*Aegle marmelos*	Bel	Rutaceae
22.	*Butea monosperma*	Dhak	Fabaceae
23.	*Morus alba*	Shahtoot	Moraceae
24.	*Bambusa vulgaris*	Bamboo	Poaceae
25.	*Putranjiva roxburghii*	Putranjiva	Putranjivaceae

Image 12 : Riparian Vegetation Near Kirawali

Image 13 : Himalayan mimosa [*Mimosa rubicaulis*] In Flowering

Image 14 : Buffel Grass [*Cenchrus ciliaris*]

10.0 Faunal Diversity Along Ganga River In Hapur Distt.

10.1 Due to very little forest in the study area, the mammal diversity is poor and includes common terrestrial mammals which are sighted occasionally on floodplain areas along the Ganga. Although the part of Hastinapur Wildlife Sanctuary covers Ganga floodplains in the Distt., but most of it is agriculture landscape with little forest cover. Common mammals presently found in the district include Indian Jackal [*Canis aureus indicus*], Indian Fox [*Vulpes bengalensis*], Monkey [*Rhesus macaque*], Langur [*Semnopithecus spp.*], Indian Hare [*Lepus nigricollis*]. There are no any recent incident of Indian Leopard [*Panthera pardus fusca*] presence. Nilgai (*Boselaphus tragocamelus*) and Wild Boar (*Sus scrofa*) are also found in small numbers and known to destroy crops. Insects and Arthropods are poorly recorded groups, especially along rivers. During field visit many insects were sighted in riparian vegetation along Ganga River, near palaeochannels, near waterbodies. Most common were Dragonflies and Damselflies (Order: Odonata), Grasshoppers and Crickets (Order: Orthoptera), Stick insects and Leaf insects (Order: Phasmatodea), Butterflies and Moths (Order: Lepidoptera). Among Dragonflies and Damselflies, Ruddy Marsh Skimmer [*Crocothemis servilla*] and Coromandel Marsh Dart [*Ceriagrion coromandelianum*] were frequently sighted. The Indian Pierrot butterfly [*Tarucus indica*] were also sighted in groups at some places along the river.

10.2 Some major aquatic fauna found in this stretch of Ganga River stretch have been described briefly below:

10.3 **Gangetic Dolphin** : The Gangetic River Dolphin (*Platanista gangetica gangetica*) is exclusively aquatic and piscivorous, occasionally found in small groups. It is one of the three freshwater dolphin species in the world and is distributed in the Ganga–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 joint census[3] carried out in October, 2019 by Uttar Pradesh Forest Department's divisions of 5 Distt.s namely Bijnor, Meerut, Hapur, Amroha and Bulandshahr and WWF-India recorded 36 dolphins which also included 3 calves. Most of them (31) were recorded in Hastinapur Wildlife Sanctuary which stretches from Bijnor Ganga Barrage to Garhmukteshwar. Based on the interactions with local people, it was known that dolphins are sighted regularly both upstream and downstream Brijghat bridge. They are sighted frequently during monsoon season when the water level is high.

10.4 **Gharial** : Indian Gharial (scientifically known as *Gavialis gangeticus*) is the only surviving member of an ancient family of crocodiles found to reside mainly in Indian sub-continent. It derives its popular name – gharial or gavial from the bulbous knob like protuberance on a breeding male's snout which resembles a 'Ghara' meaning an earthen pitcher (Saikia, 2012). This species is endemic to the Indian sub-continent and is considered to be 'Critically Endangered' in the IUCN Red List. Once distributed across several major river systems in India and neighbouring countries, this species has seen an estimated 96-98% decline in its population owing and is now restricted to only few scattered locations in India and Nepal (Sinha, 2018).

10.5 Gharials are occasionally sighted by fisherman especially during summer season when the sandbars and island are exposed. In 2015, a batch of 678 Gharials was released in 2015 near Makhdumpur village [District Meerut – upstream area of Hapur] in Hastinapur Wildlife Sanctuary – out of which only 16 Gharials survived[4]. During field visit, no gharial or crocodile was sighted.

10.6 **Turtles :** India is one of the world's hotspots for turtle diversity representing 29 species of tortoises and freshwater turtles among which 13 different species find their abode in the Ganga river system. These turtles play a significant role in the river by scavenging

[3] With three calves, Ganges dolphin population up to 36 in UP, Times of India, Oct.16, 2019
[4] WWF rescues Gharial trapped in Ganga canal after gates shut monsoon. Oct.28, 2017

dead organic material and diseases fish, controlling fish population as predators and controlling aquatic plants and weeds (WII, 2017). Variety of habitats such as muddy and sand banks, islands, varying depth of water in Ganga, and floodplain lakes supports chelonian diversity but major threats such as floodplain agriculture, increasing pollution, irregular flow of water and sandmining activities are altering their habitats and thus their population is continuing to decline.

10.7 A report published by WWF-India[5] in 2011 mentioned the presence of 12 species of turtles between Bijnor and Kanpur stretch of Ganga River [Table-4]. Based on collections of shell and live specimens, eight species belonging to four genera and one family of hard-shell turtles, and four species belonging to three genera and one family of soft-shell turtles were identified by them. During the current field visit, no turtle was sighted as the water level was high in the Ganga River with rarely visible islands. However, their presence was confirmed from the local community and fishermen.

Table 4 : Freshwater Turtles In Ganga River Between Bijnor and Kanpur

S.No.	Family	Genus	Species	Common Name
1.	Emydidae	*Hardella*	*thurjii*	Crown River Turtle
2.		*Geoclemys*	*hamiltonii*	Spotted Pond Turtle
3.		*Melanochelys*	*trijuga*	Indian Black Turtle
4.		*Batagur*	*kachuga*	Red-crowned Turtle
5.		*Pangshura*	*smithii*	Brown-roofed Turtle
6.		*Pangshura*	*tecta*	Indian-roofed Turtle
7.		*Pangshura*	*tentoria*	Indian Tent Turtle
8.		*Batagur*	*dhongoka*	Striped Roof Turtle
9.	Trionychidae	*Lissemys*	*punctata*	Indian Flapshell Turtle
10.		*Chitra*	*indica*	Narrow-headed soft-shell Turtle
11.		*Nilssonia*	*gangeticus*	Indian soft-shell Turtle
12.		*Nilssonia*	*hurum*	Indian Peacock Soft-shelled Turtle

Source: WWF-India, 2011

10.8 **Avian Diversity:** During field survey, the diversity of avian species was recorded using binoculars and identified using field guides (Grimmett et al., 2016 and others). During the field visit, a total of 46 bird species were sighted. Out of which 16 are aquatic species and remaining 32 are terrestrial birds [Table-5].

10.9 Important observations are:

[5] Behera, S., G. Areendran, P. Gautam and V. Sagar (2011), For A Living Ganga–Working with People and Aquatic Species, New Delhi: WWF-India, 84 pp.

- On the basis of field experience, it can be said, the Distt. harbours rich bird diversity due various kind of habitats – rivers, swamps, depressions, lakes, riparian buffer of channels, open lands, and agriculture fields.
- Aquatic vegetation and riparian grasses of palaeochannels, waterbodies and depressions are serving as important habitats for birds in the river basin.
- Common birds sighted more often in and around the river are Red-wattled Lapwing, Yellow-wattled Lapwing White-throated Kingfisher, River Tern, Grey Heron, Indian Pond Heron, Cattle Egret, Cormorants, and River Lapwing.
- Birds sighted more frequently in and around waterbodies are Indian Pond Heron, Egrets, White-throated Kingfisher, Bronze-winged Jacana, Common Moorhen, and White Breasted Waterhen.
- River Lapwing fall under IUCN's 'Near Threatened' category and River Tern fall under 'Vulnerable Category'.

Table 5 : List Of Birds Sighted During Field Visit

S. No.	Common Name	Scientific Name	Conservation Status
1.	Little Cormorant	*Microcarbo niger*	Least Concern
2.	Indian Cormorant	*Phalacrocorax fuscicollis*	Least Concern
3.	White-breasted Waterhen	*Amaurornis phoenicurus*	Least Concern
4.	Indian Pond Heron	*Ardeola grayii*	Least Concern
5.	Cattle Egret	*Bubulcus ibis*	Least Concern
6.	Little Egret	*Egretta garzetta*	Least Concern
7.	Great Egret	*Ardea alba*	Least Concern
8.	White-throated Kingfisher	*Halcyon smyrnensis*	Least Concern
9.	**River Lapwing**	***Vanellus duvaucelii***	**Near Threatened**
10.	**River Tern**	***Sterna acuticauda***	**Vulnerable**
11.	Yellow-wattled Lapwing	*Vanellus malabaricus*	Least Concern
12.	Red-wattled Lapwing	*Vanellus indicus*	Least Concern
13.	Grey Heron	*Ardea cinerea*	Least Concern
14.	Common Moorehen	*Gallinula chloropus*	Least Concern
15.	Common Coot	*Fulica atra*	Least Concern
16.	Bronze-winged Jacana	*Metopidius indicus*	Least Concern
17.	Oriental Skylark	*A. Gulgula*	Least Concern
18.	Black Drongo	*Dicrurus macrocercus*	Least Concern
19.	Bank Myna	*Acridotheres ginginianus*	Least Concern

20.	Common Myna	*Acridotheres tristis*	Least Concern
21.	Oriental Dove	*Streptopelia orientalis*	Least Concern
22.	Spotted Dove	*Spilopelia chinesis*	Least Concern
23.	Black-winged Kite	*Elanus caeruleus*	Least Concern
24.	Shikra	*Accipiter badius*	Least Concern
25.	Asian Koel	*Eudynamys scolopaceus*	Least Concern
26.	Greater Coucal	*Centropus sinensis*	Least Concern
27.	Red-vented Bulbul	*Pycnonotus cafer*	Least Concern
28.	Red-whiskered Bulbul	*Pycnonotus jocosus*	Least Concern
29.	Indian Robin	*Saxicoloides fulicatus*	Least Concern
30.	Common Pigeon	*Columba livia*	Least Concern
31.	Common Koel	*Eudynamys scolopaceus*	Least Concern
32.	House Sparrow	*Passer domesticus*	Least Concern
33.	Indian Jungle Crow	*Corvus culminatus*	Least Concern
34.	House Crow	*Corvus splendens*	Least Concern
35.	Rose-ringed Parakeet	*Psittacula krameri*	Least Concern
36.	Common Tailorbird	*Orthotomus sutorius*	Least Concern
37.	Indian Silverbill	*Euodice malabarica*	Least Concern
38.	Yellow Wagtail	*Motacilla flava*	Least Concern
39.	White Wagtail	*Motacilla alba*	Least Concern
40.	Common Babbler	*Turdoides caudatus*	Least Concern
41.	Jungle Babbler	*Turdoides striata*	Least Concern
42.	Asian Pied Starling	*Gracupica contra*	Least Concern
43.	Black Drongo	*Dicrurus macrocercus*	Least Concern
44.	Rufous Treepie	*Dendrocitta vagabunda*	Least Concern
45.	Ashy Prinia	*Prinia socialis*	Least Concern
46.	Green bee-eater	*Merops-orientalis*	Least Concern

Image 15 : Common Moorehen [*Gallinula chloropus*]

Image 16 : Cormorants Resting On Exposed Sandbar

Image 17 : Millipedes Feeding On Nutrient Rich Floodplain Soil

Image 18 : Blister Beetle Feeding On Ipomoea Flowers

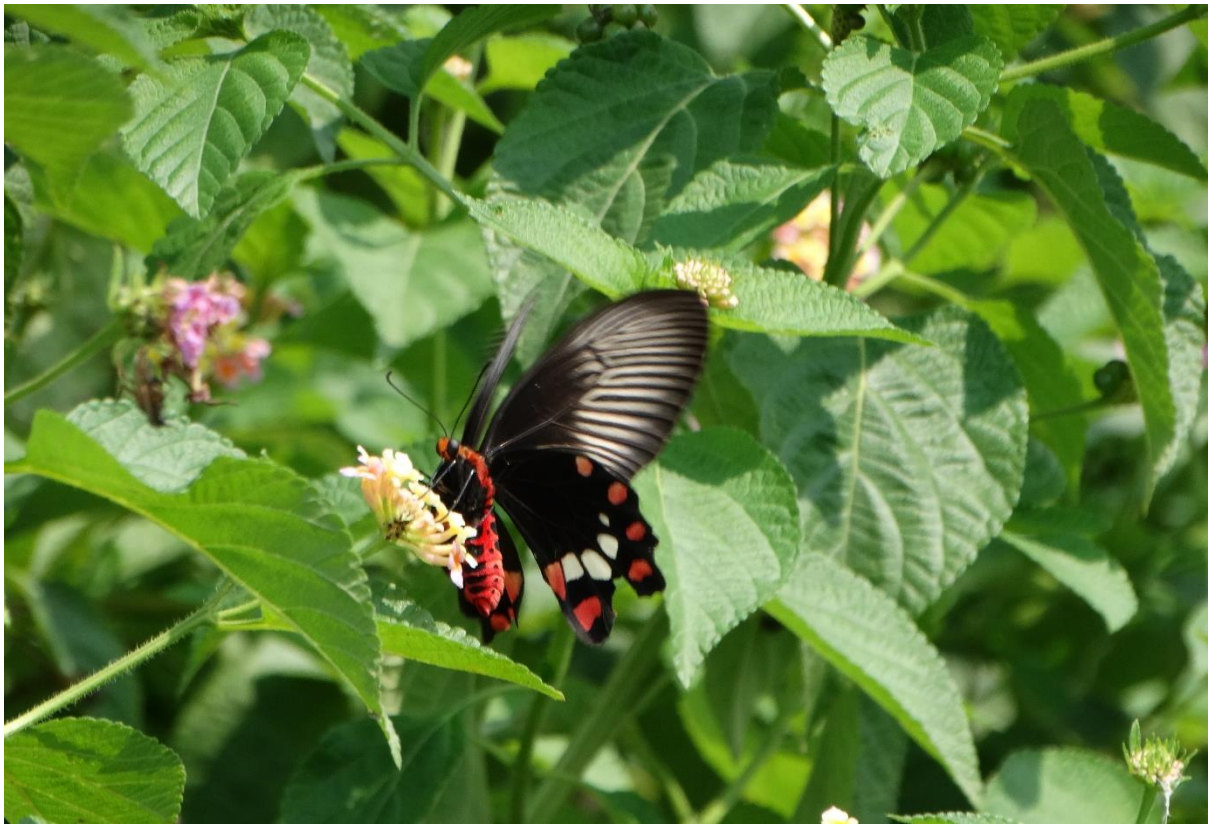


Image 19 : Common Rose Butterfly [*Pachliopta aristolochiae*] Feeding on Lantana Flowers

Image 20 : Indian Pierrot Butterfly [*Tarucus indica*] Feeding On Nutrient Rich Soil

11.0 Ganga Riverine Islands In Hapur 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]. Islands are generally formed by sand or sediments mass by currents during higher level of river flow and are exposed during dry season. River islands provide habitat to a large variety of living organisms such as birds, butterflies, insects and smaller mammals.

11.2 During the field visit it was observed that in Hapur stretch of Ganga River, there are many exposed and partially exposed river islands of varying shape and size. Almost, the entire channel of Ganga River in the district has such islands and sandbars. As per the fluvial island classification proposed by Wyrick & Klingeman (2011), the islands here would be fall under 'Braided' category – which means many channels divided by islands and bars, which may be washed out in high flows. These islands and sandbars get immersed with the increased water flow in river – especially during monsoon season along with the river channels in between them. Such sand bars make it difficult for motor boats to navigate through as their outboard motor with propellor fan gets stuck in the sand. Local boatmen and fishermen identify these channels with the help of long bamboo or wooden poles which they use to propel their boats.

11.3 These river islands are used for agriculture by local farmers except smaller or less stable ones. Cucurbits such as cucumber, melons, bitter and bottle gourds, tomatoes, pumpkins are grown and known as '*Palez*'. Smaller wooden boats are used for to and fro movement from the main land. As mentioned in faunal diversity section, all the main river islands are under cultivation, the smaller islands and exposed sand beds are proving as last refuge for aquatic biodiversity especially migratory birds, turtles, gharials and crocodiles. The width of the islands varies between 200 m – 1 km and length 1 km to 3 km as observed via Google Earth's satellite imagery. [Image-21 & 22]

11.4 During monsoon season, as observed during field visit, these islands either get submerged under water or get covered with luxuriant growth of riparian grasses and aquatic vegetation. Plants such as Bush Morning Glory [*Ipomoea carnea*], Tall Reed [*Phragmites Karka*], Kaans [*Saccharum spontaneum*] along with patches of Water Hyacinth [*Eicchornia crassipes*] were sighted on the some exposed islands.

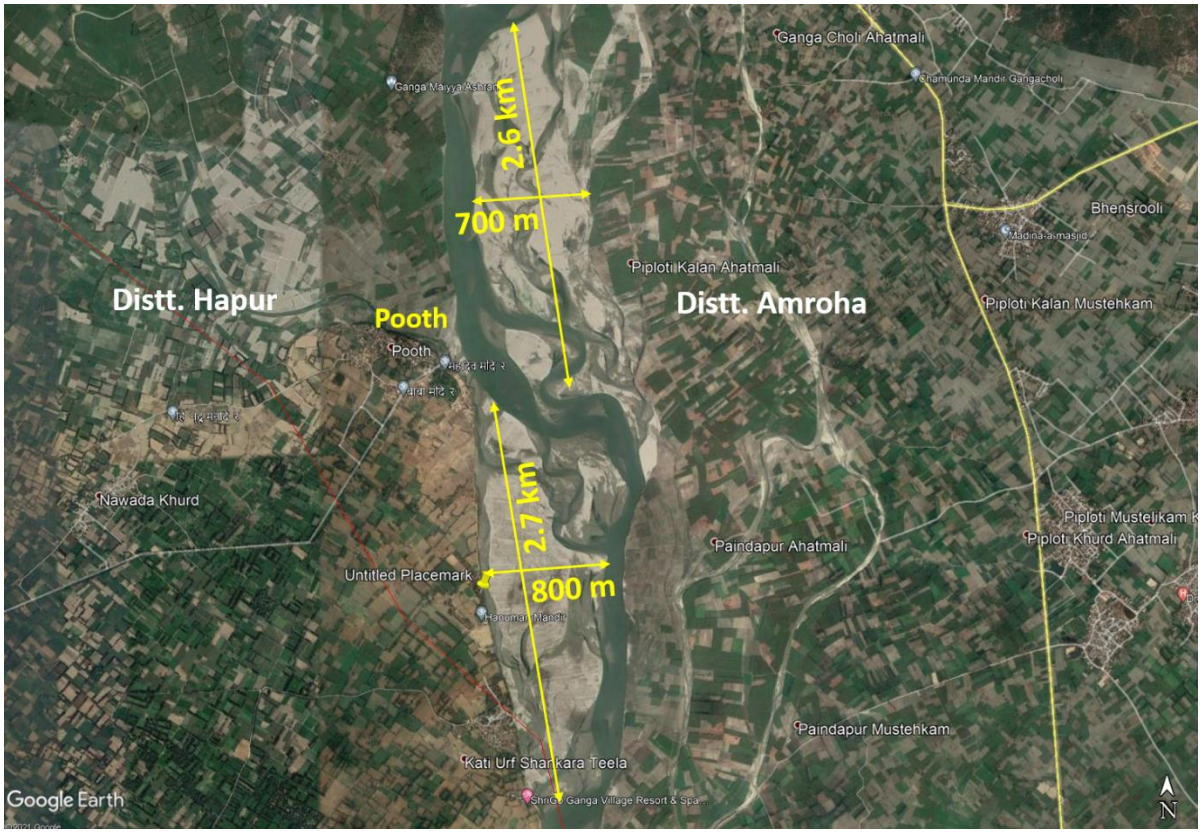


Image 21 : River Islands Near Pooth As Seen Through Google Earth Imagery

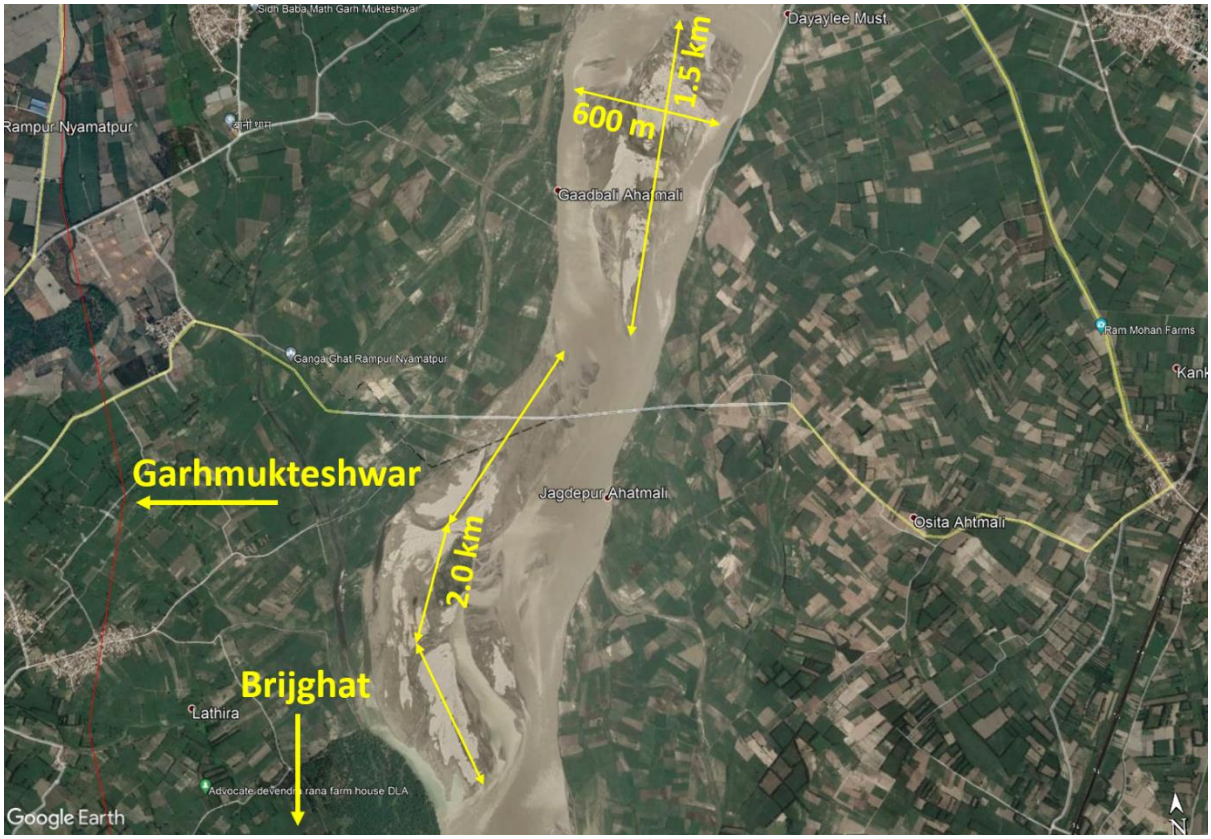


Image 22 : River Islands Upstream Of Brijghat

Image 23 : A Small Island With *Saccharum spontaneum* Downstream Brijghat

Image 24 : Island With *Saccharum spontaneum* Grass Near Kirawali

12.0 Fishing In Hapur 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 is an important source of income for fishermen and daily wagers in Hapur Distt. Fishing is carried out by various means – nylon & rope nets, rods and nylon fishing lines (threads). Fishing is a favourite hobby of the local community especially for those living near to the Ganga River. Fish captured by fishermen are sold in the local markets and occasionally out of the district.

12.3 Upon interaction with local fishermen, it was found that most of the fish species are found in this stretch of Ganga River. The fish species diversity increases during monsoon season and decreases as water level goes down post monsoon every year. There are no specific techniques to identify the spots for fishing in river. It entirely depends on accessibility and area divided between fishermen. For rod fishing, stable embankments and levees are preferred.

12.4 The most common fish species are Rohu (*Labeo rohita*), Catla (*Labeo catla*), Carp (*Cyprinus carpio*), Singhi (*Heteroneustes fossilis*), Singhara (*S. seenghala*), Gonch (*Bagarius bagarius*), or Sawli (*Channa striatus*) and (*Channa punctata*) *Naini* (*Cirrhinus mrigala*). All the fish species noted during field survey are mentioned in Table No.6 below:

Table 6 : Riverine Fish Common in Hapur Distt.

S. No.	Common Name	Scientific Name
1.	Rohu	*Labeo rohita*
2.	Catla	*Labeo catla*
3.	Common Carp	*Cyprinus carpio*
4.	Grass Carp	*Ctenopharyngodon idella*
5.	Silver Carp	*Hypophthalmichthys molitrix*
6.	Karaunch	*Labeo calbasu*

7.	Pabda	*Ompak pabda*
8.	Katera	*Mystus vitatus*
9.	Tenghra/Teenghra	*Mystus cavessius*
10.	Sauli or Sawli	*Channa punctata*
11.	Sauli or Sawli	*Channa striatus*
12.	Naini	*Cirrhinus mrigala*
13.	Gonch	*Bagarius bagarius*
14.	Singhi	*Heteroneustes fossilis*
15.	Singhara	*Sperata seenghala*
16.	Chilwa	*Oxygaster bacaila*
17.	Chaal	*Chela bacaila*
18.	Puthi	*Puntius sarana (Ham.)*
19.	Bata	*Labeo bata*
20.	Laanchi	*Wallagu attu*
21.	Manghur	*Clarias batrachus*
22.	Manghur	*Clarias gariepinus*
23.	Cheetal or Mau	*Chitala chitala*

Image 25 : Sauli [*Channa punctata*] Caught by Fishermen From Ganga River

13.0 Groundwater Condition In Hapur Distt.

13.1 As per Aquifer Mapping and Groundwater Management Plan [Parts of NCR] Report[6] of the CGWB, the NCR area [including Ghaziabad and Hapur] is a monotonous plain with sporadic occurances of sand dunes, and sandy ridges, ravine tracts and depressions close to River Ganga. Minor sandy mounds can be seen near minor rivers. In some parts, close to the river system badland topography has developed due to the differential erosion. In such areas, exposed kankar-lenses and beds form mounds. The general slope of the area is northwest to southeast. Geologically, the area is underlain by alluvial deposits of Quarternary age, deposited over Precambrian basement. Thickness of alluvium increases from west to east i.e. From Yamuna River side towards Ganga River.

13.2 In NCR, 3-tier aquifer system exists with presence Aquifer-IV at some places. The granular zones in Aquifer Group–I are generally thick-bedded, very extensive and are consisting of comparatively coarser material than the deeper Aquifer Group – II, and III where these are thinly bedded sometimes lensoid in nature consisting of finer sediments with the domination of silty and clayey material. As deciphered from the maps given in Aquifer Mapping and Groundwater Management Plan [Parts of NCR] Report, depth to water levels [pre-monsoon-2013] along Ganga River range from 10 mbgl to 20 mbgl and 5 mbgl to 10 mbgl in post monsoon season [2013].

13.3 As per the 'National Compilation of Dynamic Groundwater Resource Assessment' of India (2017), the 'Total Annual Groundwater Recharge' of Hapur district is 48190.18 Ham [Hectare metre] against 'Annual Extractable Ground Water Resources' of 45780.67 Ham. The 'Stage of Groundwater Development' is 107.34% which indicates over exploitation.

13.4 Major sources of irrigation are Upper Ganga Canal [Anupshahr Branch], Madhya Ganga Canal, govt. and private tube wells, permanent wells and ponds. Out of 4 blocks, 3 blocks, Ghar, Hapur and Simbhaoli were noted as 'Over Exploited' in 2013 by Aquifer Mapping and Groundwater Management Plan [Parts of NCR] Report. Only one block i.e., Dholana was considered as safe.

13.5 Groundwater levels noted in few villages in the study area during the survey are given below:

[6] Report on Aquifer Mapping and Groundwater Management Plan, Parts of NCR, Uttar Pradesh by CGWB [2013]

Table 7 : Groundwater Levels Of Some Villages Along Ganga In Hapur Distt.

S. No.	Village	Coordinates		Depth to Water Table in Feet
		Lat.	Long.	
1.	Raharwa	28°38'21.82"N	78°10'45.94"E	60-70
2.	Kirawali	28°39'7.28"N	78°10'44.25"E	50-70
3.	Sherpur	28°39'7.88"N	78° 9'47.27"E	100-150
4.	Bhadsiyana	28°39'16.94"N	78° 7'50.48"E	150-200
5.	Pooth	28°41'36.78"N	78°10'55.00"E	80-100
6.	Brijghat	28°45'23.36"N	78° 8'29.44"E	50-100
7.	Faridpur Ahatmali	28°49'35.87"N	78° 7'48.10"E	100-120
8.	Tigree	28°50'25.62"N	78° 8'22.18"E	80-150

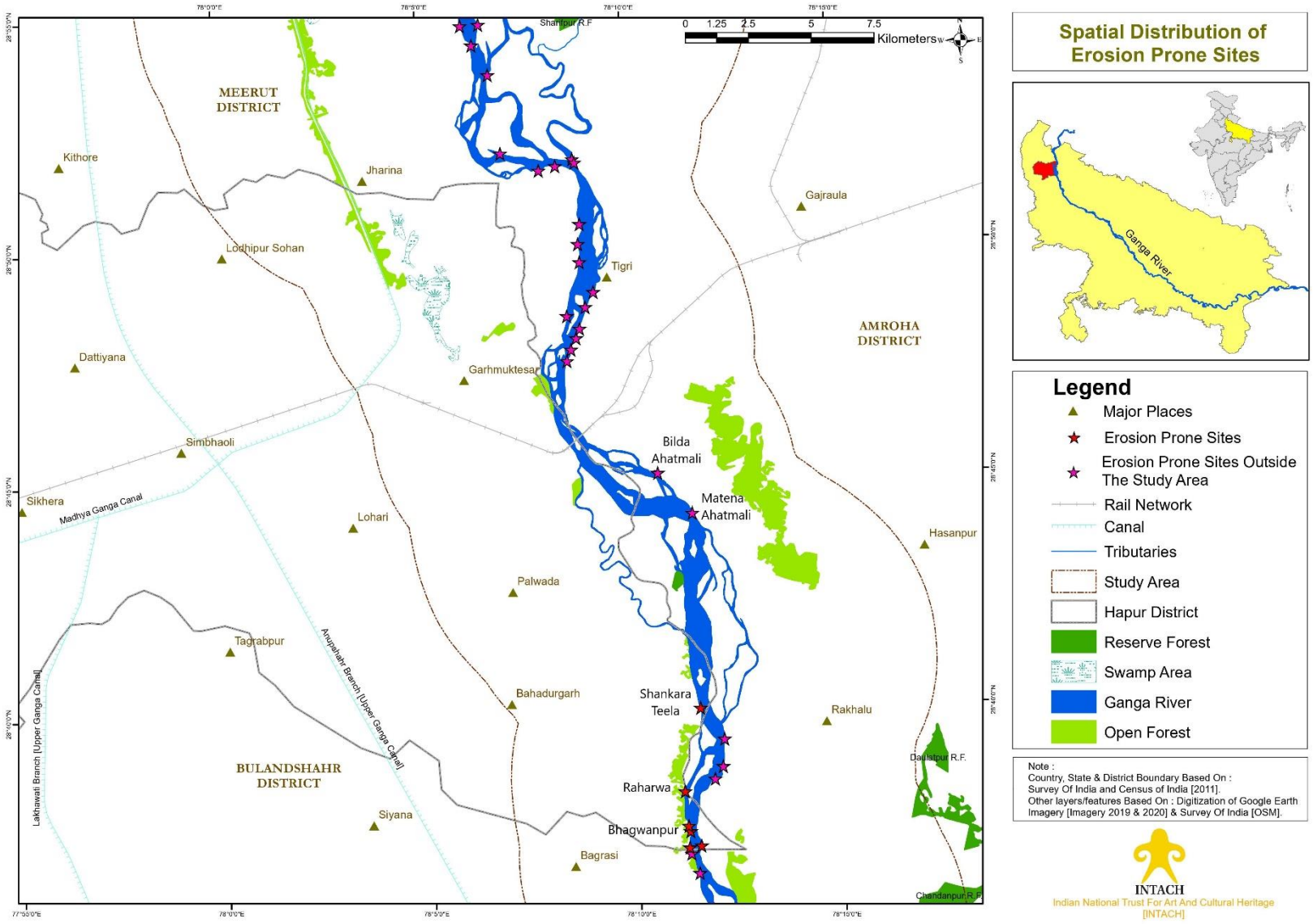
14.0 Ganga Bank Erosion In Hapur Distt.

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 land use change, excessive grazing and farming, deforestation and removal of riparian vegetation along river banks. It is well known that exposed soil may erode rapidly (Singh et al., 2004).

14.2 In a recent attempt to make river banks greener, the Uttar Pradesh State govt. claims to have planted more than 2.2 Crore trees along river banks as a part of annual plantation drive. The Ganga River has got the maximum – around 67 lakh trees and the plantation has been done in all the 27 Distt.s along Ganga in the State as noted by Times of India [August 20, 2020][7]. ***However, this exercise cannot prevent bank erosion which is preventable only through the binding of an extensive root system as available in native riparian grasses.***

14.3 As assessed from the Google Earth imagery [2020], there are few major erosion prone sites on Ganga River in Hapur Distt.. Two such locations are downstream of Brijghat at Bilda Ahatmali and Matena Ahatmali, where Ganga River, takes a south-eastern turn [See Map No.7]. Further downstream there are few ero sion prone sites at Shankara teela, Raharwa and Bhagwanpur due to southwest meandering of the river. The erosion prone sites could not be observed due to high flow in the river.

[7] River banks made greener in Uttar Pradesh. Aug.20, 2020. Times of India



Map 7 : Spatial Distribution Of Erosion Prone Sites In The Study Region

15.0 Mining And Brick Kilns In Hapur Distt.

15.1 **Sand Mining** : Sand is one of the major minerals resource extracted from the Ganga River, especially in its mid and lower stretch. 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 also poses threat to bridges, river banks and nearby structures[8].

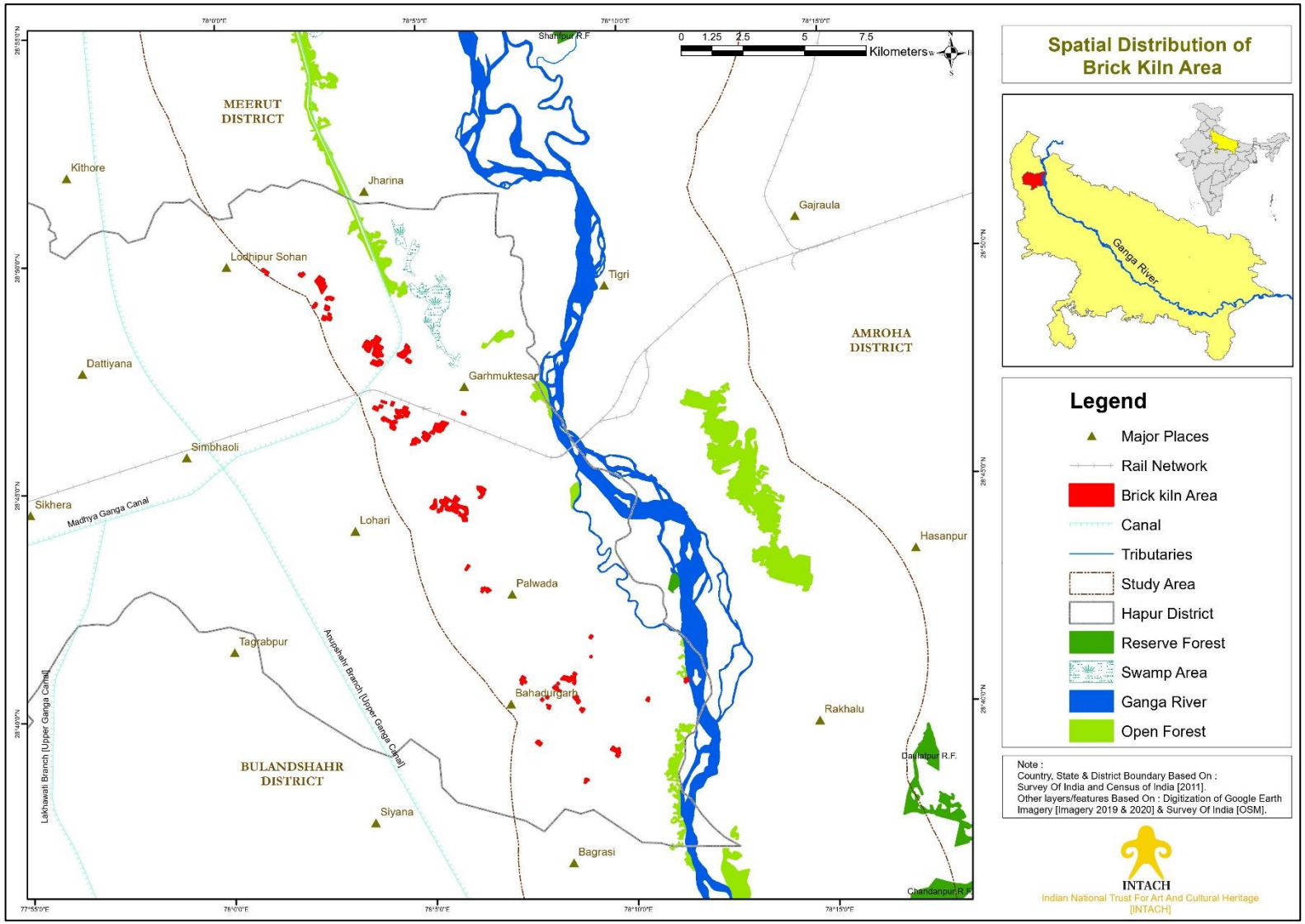
15.2 In Hapur Distt., areas near Brijghat have been the hotspots of sand mining. The issue has been highlighted multiple times by local news papers. One such news of sand mining at Brijghat was published by Jagran newspaper[9] on 1st January, 2021. A huge sand mound was also seen during field visit across the Ganga River at Brijghat [See Image-26]. As per information obtained during field surveys, small scale sand mining is carried out at Ganga River and the canals running through the districts. Local community members from villages situated along carry out sand mining regularly and transport it with the help of their bullock carts. The sand is sold locally for construction purposes. It becomes difficult during monsoon season when sand bars and accessible routes to the river bed are submerged under water.

15.3 **Brick Kilns:** Brick making is one of the major economic activities in the Distt., providing employment to many daily wage workers. With rapid urbanisation, bricks have become important building material with ever increasing demand. However, the industry has current and future implications for the soil, agriculture land and air quality of the region. In Hapur district, there are many brick kilns that fall within study area – at Popai, Dotai, Badarkha, Sikandarpur and few scattered near Bahadurgarh village [Map-8]. Expansion of various towns and villages has increased the demand for bricks and other construction materials. In the study area, the brick kilns are mostly located between 4 km to 10 km away from the main Ganga River in a cluster of 4-5 units. There are distance obligations for establishment of brick kilns from roads, railways, villages, mango orchards etc. set in 'The Uttar Pradesh Brick Kilns (Siting Criteria from Establishment) Rules 2011' but there is no mention of distance from river, floodplains or a waterbody in these rules.

[8] Impacts of Sand Mining. ENVIS Centre on Environmental Problems of Mining, IIT Dhanbad, Jharkhand
[9] https://www.jagran.com/uttar-pradesh/hapur-city-sand-mining-is-taking-place-in-ganga-21228404.html

Image 26 : Huge Sand Mound Seen Across Ganga River At Brijghat

Image 27 : Brick-Kiln Near Sherpur Village



Map 8 : Brick Kilns Sites In The Study Area

16.0 Boatmaking In Hapur Distt.

16.1 Boatmaking is not a popular profession or income source in the Distt. Several fishermen or farmers whose livelihoods depend on the fishing or floodplain farming keep the smaller wooden boats. In district Hapur, boats are made at Garhmukteshwar situated around 5 km on right bank of Ganga River. They are also made by local carpenters and blacksmiths from villages situated along Ganga River in Distt.s. Hapur and Bulandshahr.

16.2 Boat making expenditures are same in Bulandshahr and Hapur Distt.s and the boats are sourced from the same carpenters or blacksmiths. iron boat with motor costs around between 1,00,000 to Rs. 1,60,000 and without motor between Rs. 70,000-80,000. A simple wooden boat would cost around between Rs. 30,000 to Rs. 50,000. Now a days, wooden boats are being replaced by boats made up of iron because of their longevity and fewer leakage issues. There are around more than 100 iron boats at Brijghat. They are mainly used to ferry visitors who come to Brijghat for various religious and cultural ceremonies.

Image 28 : Iron Boats Parked At Brijghat

17.0 Inland Navigation In Hapur Distt.

17.1 The Ganga River at Hapur Distt. has poor navigability. River route is hardly used by people to travel downstream villages. Island farmers and fishermen use small wooden boats to move around the river landscape.

17.2 As observed on Google Earth satellite imagery and during field visit, the Ganga River in the district is navigable only during monsoon season when the water level is high. During rest of the months, it changes into narrow channels interspersed by islands and sandbars which are crossed with the help of wooden boats by fishermen and riparian farmers.

Image 29 : Locals Crossing River At Brijghat

18.0 Key Observations and Recommendations

18.1 **Flattening of Upland Tracts :** Naturally formed levees and upland tracts support growth of riparian vegetation and keep riverbanks stable – making them resilient to erosion. They also act as vantage points to enjoy the river scenery. As observed during field visit, they are being flattened by farmers to extend their agriculture lands or build resorts along the Ganga River. In absence of any legislation to protect river floodplains, such natural upland areas under serious threat. Authorities must take note of this ongoing practice and take appropriate measures to halt it.

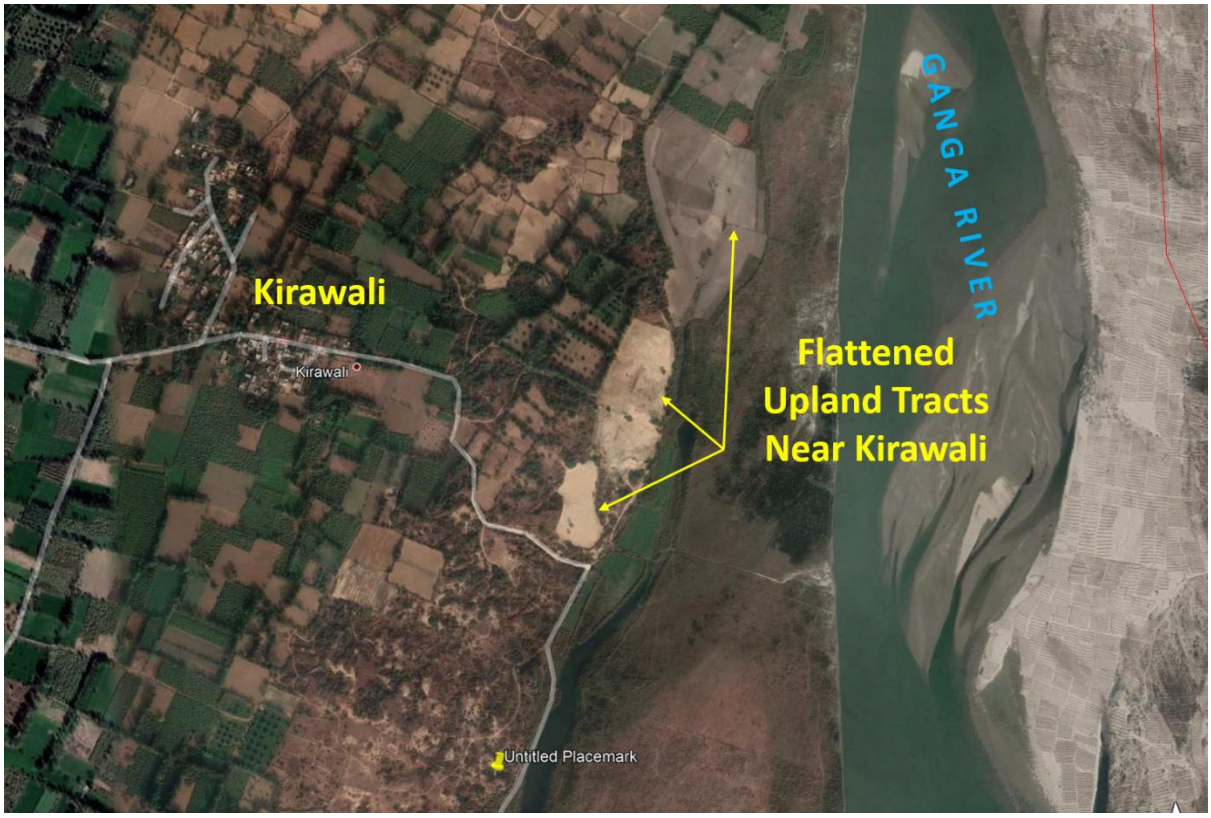


Image 30 : Flattened Upland Tracts Near Village Kirawali, Distt. Hapur

18.2 **Palaeochannels and Floodplain Lakes :** The Distt. authorities as well as farmers must acknowledge the role of palaeochannels, floodplain lakes and depressions along the Ganga River in the Distt. From acting as groundwater recharge zones to maintaining river biota especially aquatic plant species and fish diversity, their role along rivers have been undervalued. Their edges provide space for riparian grasses and trees and thus help in maintaining food chains by providing habitat to various birds, reptiles and insects. They provide invaluable service to farmers as water retention ponds for irrigation. They also add visual appeal to large and monotonous agricultural landscapes – especially in a state like Uttar Pradesh.

18.3 **Waterbodies Encroachment :** Waterbodies in the Distt. are highly threatened by encroachment, pollution and increasing eutrophication. During the field visit, it was observed that not even a single waterbody has been spared from solid waste dumping and illegal encroachment. There are settlements coming on their edges and thus decreasing their area and water spread. Healthy water bodies in villages and towns of the Distt. would ensure income generation options for the local people through fisheries and water chest nut production. They would also help in groundwater recharge as the current rate of withdrawal is high across villages due to installation of private submersible pumps.

18.4 **Riparian Flora :** The river banks along forest uplands are comparatively rich in riparian vegetation partly due to presence of swampy areas and palaeochannels. In addition to providing habitat to many aquatic and terrestrial species, riparian vegetation provides bank stability. Such areas may be marked and considered as 'Riparian and Aquatic Vegetation Bank' for Ganga River River ecological studies.

18.5 **Aquatic Fauna:** The stretch of Ganga is an important habitat of major aquatic fauna such as Gangetic Dolphin, Gharial, Crocodile and at least 12 species of turtles – many of which are threatened by multiple factors. And there are many other associated species such as frogs, toads, butterflies, insects, aquatic invertebrates that are poorly documented but form important part of the food web. Forest dept. should carry out annual faunal surveys in collaboration with expert institutions besides bird census. Such annual exercise would supplement the existing data on Ganga River biodiversity.

18.6 **Protection for River Islands :** River islands support better bird diversity in rivers and act as safe habitats for turtles, gharials, and crocodiles. Such islands and exposed sand-beds should be seen as refuges for biodiversity. River islands must be protected. Agriculture practices on such islands and sand-beds should be curbed and a central 'River Island Policy' must be drafted. Any conservation planning or initiative for rivers in the state should consider protection of islands an important priority.

18.7 **Sand and River Bed Mining** should be checked and curbed completely. Excessive mining alters the natural river bed forcing the river to change course and thus promotes banks erosion. It has also been noted that deep excavations due to mining transforms into deeper pools after the high flow in the river and thus endanger lives of people who come for bathing during religious ceremonies. To keep a regular track, distt. authorities may utilise Google Earth and drones to keep themselves updated. Excessive sand mined areas could be easily spotted from the Google Earth or other high resolution satellite imageries.

18.8 **Cremation :** Cremation of dead bodies and immersion of their remains is quite common along the Ganga River and its tributaries. The ongoing practice of cremation by local communities at their nearest river banks instead of designated crematorium sites pollutes the river. This, on a daily basis is contributing to the pollution levels in the river. Distt. authorities should encourage them to cremate at the designated crematorium facilities.

19.0 References

Auden, J.B. (1941). An excursion to Gangotri. Himalayan Journal, 7:96-102.

Behera, S., G. Areendran, P. Gautam and V. Sagar (2011), For A Living Ganga–Working with People and Aquatic Species, New Delhi: WWF-India, 84 pp.

Bhattacharyya, U.C. and Goel, A.K. (1982). Studies on the vegetation of Tehri dam and some rare plants in Garhwal Himalayas. B.S.I., Howrah. pp. 1-38.

Castelle, A.J., Johnson A.W. and Conolly, C. (1994). Wetland and stream buffer size requirements: A review. Journal of Environmental Quality, 23:878-882.

CGWB (2013) Report on Aquifer Mapping and Groundwater Management Plan, Parts of NCR, Uttar Pradesh, Ministry of Water Resources, River Development and Ganga Rejuvenation, GoI

Distt. Census Handbook, Ghaziabad, 2011, Directorate of Census Operations, Uttar Pradesh. Series-10, Part XII-B

Grimmett R., Inskipp C. and Inskipp T. (2016), Birds of the Indian Sub-continent: India, Pakistan, Sri Lanka, Nepal, Bhutan, Bangladesh and the Maldives. Bloomsburry Publishing, India.

Gangwar, R.S and Gangwar,K.K. (2011). Taxonomic and riparian floral diversity along river Ganga in Garhwal. Researcher, 3 (4): 5-14

Gangwar, R.S.; Joshi, B.D. Some medicinal flora in the riparian zone of river Ganga at Saptrishi, Haridwar, Uttaranchal. Himal. J. Environ. Zool. 2006, 20, 237–241.

Groffman, P.M., Gold, A.J., Husband, T.P., Simmons R.C. and Eddleman W.R. (1990). An investigation into multiple uses of vegetated buffer strips. RI: University of Rhode Island, Kingston.

Ground Water Brochure of Ghaziabad District, U.P [2008-2009]

Gupta, R.K. (1960). On a botanical trip to the source of the rive Ganga in Tehri Garhwal Himalayas. Indian Forester, 86:547-552

Groundwater Year Book of Uttar Pradesh [2015-2016], Central Ground Water Board, Ministry of Water Resources, River Development and Ganga Rejuvenation, Govt. of India, December, 2016

Islam Md.S., Rahman M.M., Halder C.G. & Tanaka M. (2006), Fish assemblage of a traditional fishery and seasonal variation in diet of its most abundant species Wallago attu (Siluriformes: Siluridae) from a tropical floodplain. Aquatic Ecology, 40: 263-272

Kehimkar, I, (2008). The Book of Indian Butterflies. Bombay Natural History Society. Oxford Publishers.

Krishanmurti, C.R. (1991). The Ganga: A Scientific Study. Ganga Project Directorate Report, New Delhi, India.

Osterkamp WR. 1998. Processes of fluvial island formation, with examples from Plum Creek, Colorado and Snake River, Idaho. Wetlands 18(4): 530–545.

Rao, R.J. (1994). Ecological studies of Indian crocodile. An overview Proc. 12th working meeting of the IUCN/SSC/CSG. Thailand, **1:** 259-273.

Sinha M. & Khan M.A. (2001) Impact of environmental aberrations on fisheries of the Ganga (Ganga) River. Aquatic Ecosystem Health and Management Society, 4: 493-504.

Sinha R.K. and Kannan K. (2014), Ganges River Dolphin: An overview of Biology, Ecology and Conservation status in India. Ambio, DOI 10.1007/s13280-014-0534-7.

Singh S.P., Ram Jagat., Walia C.S., Sachdev C.B., Dhankar R.P., Rana K.P.C., Sehgal J., Velayutham M. and Gajbhiye (2004), Soils of Uttar Pradesh for Optimizing Land Use. NBSS Publ.68. National Bureau of Soil Survey and Land Use Planning, Nagpur.

Tripathi S., Gopesh A. and Swivedi A.C. (2017), Fish and fisheries in the Ganga River: Current assessment of the fish community, threats and restoration. Journal of Experimental Zoology India, 20(2): 907-912.

Wildlife Institute of India (WII) (2017), Turtles of Ganga River. Leaflet published for National Mission for Clean Ganga.

Wyrick, J.R. & Klingeman, P.C. (2011) Proposed fluvial island classification scheme and its use for river restoration. *River Research and Applications*. 7 (7). p.814-825

Weblinks :

http://www.flowersofindia.net/

http://www.fishbase.in

https://hapur.nic.in/

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