Ganga Cultural Documentation
April, 2022

KANPUR NAGAR DISTRICT

National Mission for Clean Ganga

Indian National Trust for Art and Cultural Heritage
INTACH

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Azaadi Ke Rang Bharatiya Sanskriti Ke Sang

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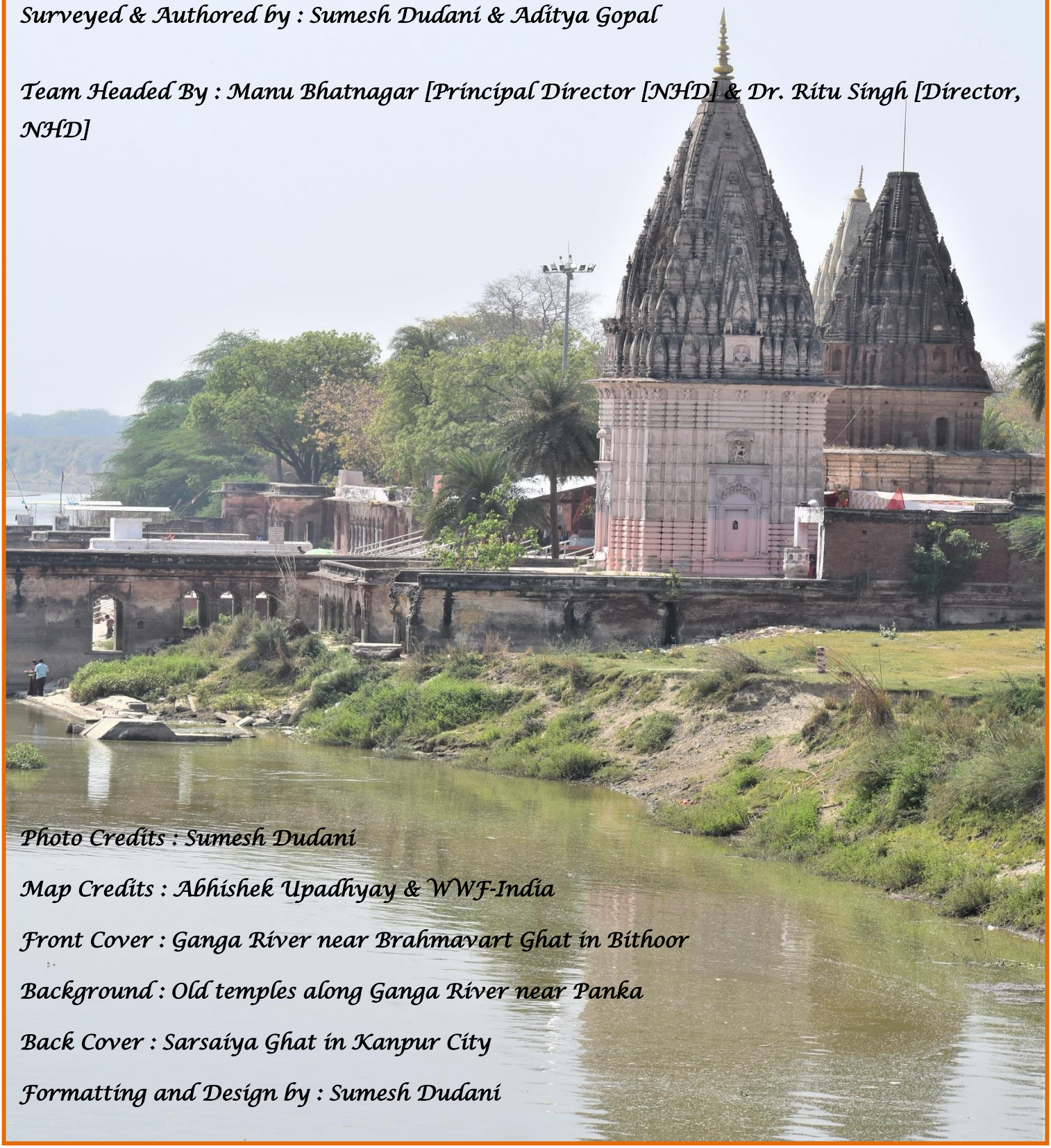

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Front Cover : Ganga River near Brahmavart Ghat in Bithoor

Background : Old temples along Ganga River near Panka

Back Cover : Sarsaiya Ghat in Kanpur City

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Contents

List of Images

List of Tables

List of Maps

Acknowledgement : The authors wish to thank and express their gratitude to Mr. Tariq Ibrahim, Convener, INTACH Chapter Kanpur for his continued guidance, support and valuable inputs during the field work in Kanpur Nagar Distt.

1.0 Introduction

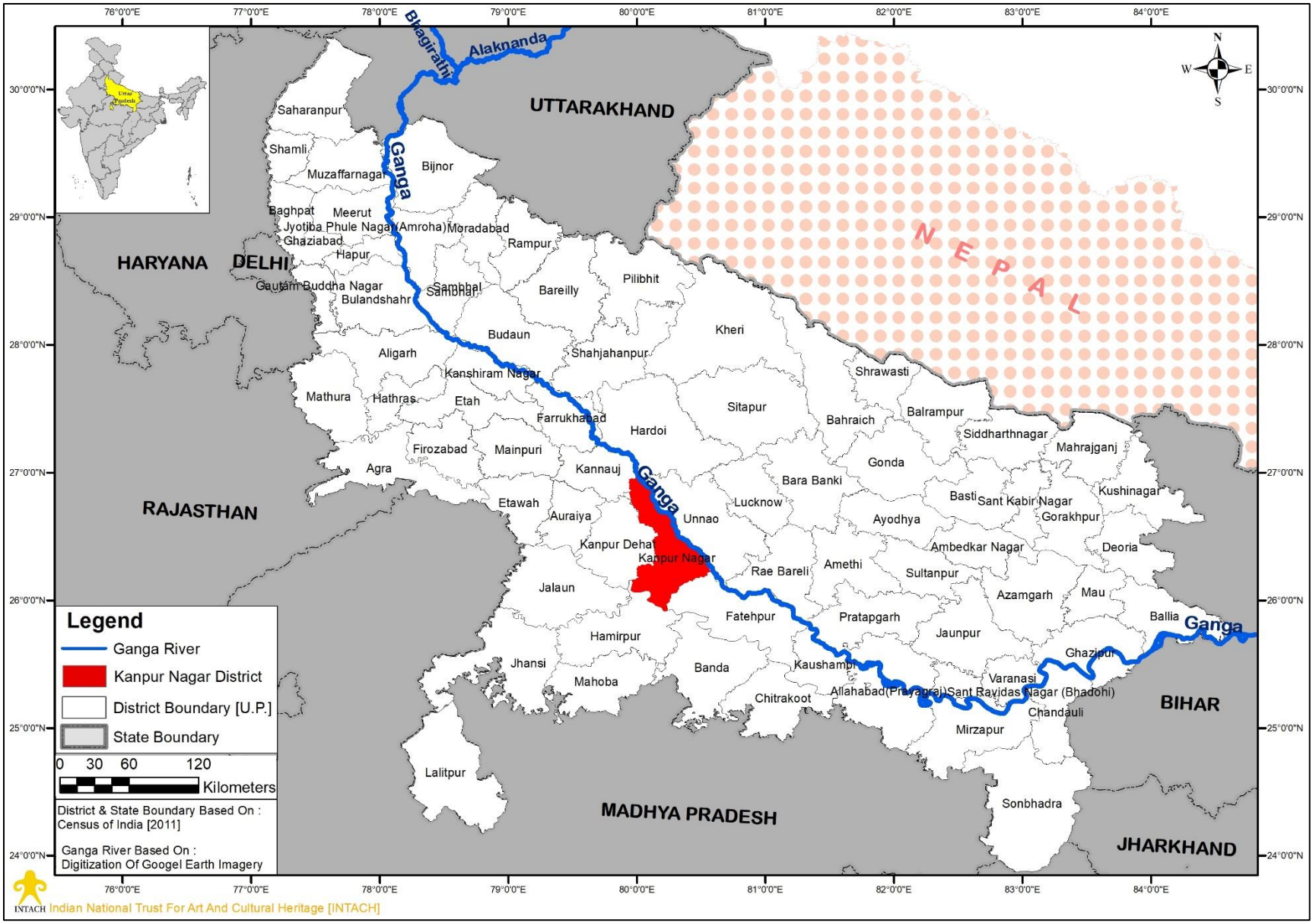
1.1 Kanpur Nagar Distt. is one of the important Distt.s of Uttar Pradesh state which falls in Kanpur Division with its headquarters being Kanpur City. The Distt. lies between 25°55' and 27° North latitude and 79°30' and 80°35' East longitudes covering an area of about 3155 sq.km. Due to high population, erstwhile Kanpur Distt. was divided into two Distt.s. namely – Kanpur Nagar and Kanpur Dehat in the year 1977. They were re-united in the year 1979 but were again separated in 1981 which remains unchanged till now (MSME, 2019). Presently Kanpur Nagar Distt. is divided into four tehsils namely – Sadar, Ghatampur, Narwal and Bilhaur which are further sub-divided into 10 administrative blocks. This Distt. is bounded by Kannauj and Hardoi Distt.s in the north, Unnao Distt. in the east, Kanpur Dehat Distt. in the west and Fatehpur Distt. in the south [Refer Map 1].

1.2 Kanpur city is a major industrial town and one of the most important cities of Uttar Pradesh state situated along Ganga River bank approximately 80 km from the capital city of Lucknow. It is often referred as 'Industrial Capital' of this state. Currently Kanpur is well known globally for its leather industries (tanneries) which form an important source of trade and livelihood for residents here. According to the historical perspective, Raja Kanh Deo of the Kanhpuria clan established the village of Kanhpur in 1207. The region was of little significance until 1765, when Shuja-ud-daulah, the Nawab of Avadh, was defeated in battle by the British at Jajmau. Kanpur was officially transferred to the British under a treaty signed in 1801 with the ruling Nawab of Avadh and was declared a district in 1803. Appreciating the strategic location of Kanpur on the banks of the Ganga, colonial traders started setting up business in the sleepy hamlet, converting it into a thriving garrison town (ICH, 2021).

1.3 Kanpur Nagar lies between two important rivers – Ganga and Pandu. Ganga River forms a natural boundary separating this Distt. from Unnao in the eastern side. This Distt. is part of the Indo-Gangetic alluvial plain with clay, silt, gravel and sands of different grades being the chief sedimentary constituents. Major part of the Distt. comprises of ordinary soils known locally as Bhur and Sand on ridges, Matiyar or clay in depressions and Domat or Loam in the Plains. The general climate of this Distt. is sub-humid characterized by hot summers and general dryness except in the south west monsoon. The average annual rainfall of this Distt. is 821.9 mm (Tripathi, 2009).

- *It is believed that this city was founded by Raja Hindu Singh of the Sankandi state. Kanpur's original name was Kanhpur. Whether it is suspected to be associated with the King Hindusi of the realty of the origin of the city, or belonging to the heroic Karna of Mahabharata period, it is so certified that in the last phase of the reign of Awadh, this city is situated in old Kanpur, Patkapura, Kuraswam, Juhi and Seemamau villages. It was made by meeting.With the neighboring state the rule of this town remained in the hands of the rulers of Kannauj and Kalpi and later the rulers of the Muslim rulers. From 1773 to 1801, Nawab Alamas Ali of Awadh had a decent government here. After the Treaty of 1773, the city came under the rule of the British, resulting in an English camp here in 1778 AD.*

- *Being located on the banks of the Ganges, there was a facility of traffic and industry. Therefore, the British gave birth to the industry and here the development of the city started. First of all, East India Company started the business of Neel here. After the construction of the Grand Trunk Road in 1832, the town was connected to Allahabad. In 1864 AD, Lucknow, Kalpi etc. were added by roads to the main places. Upper Ganges canal has also been constructed. With this development of traffic, the city's business re-accelerated.* (https://kanpurnagar.nic.in/history/)



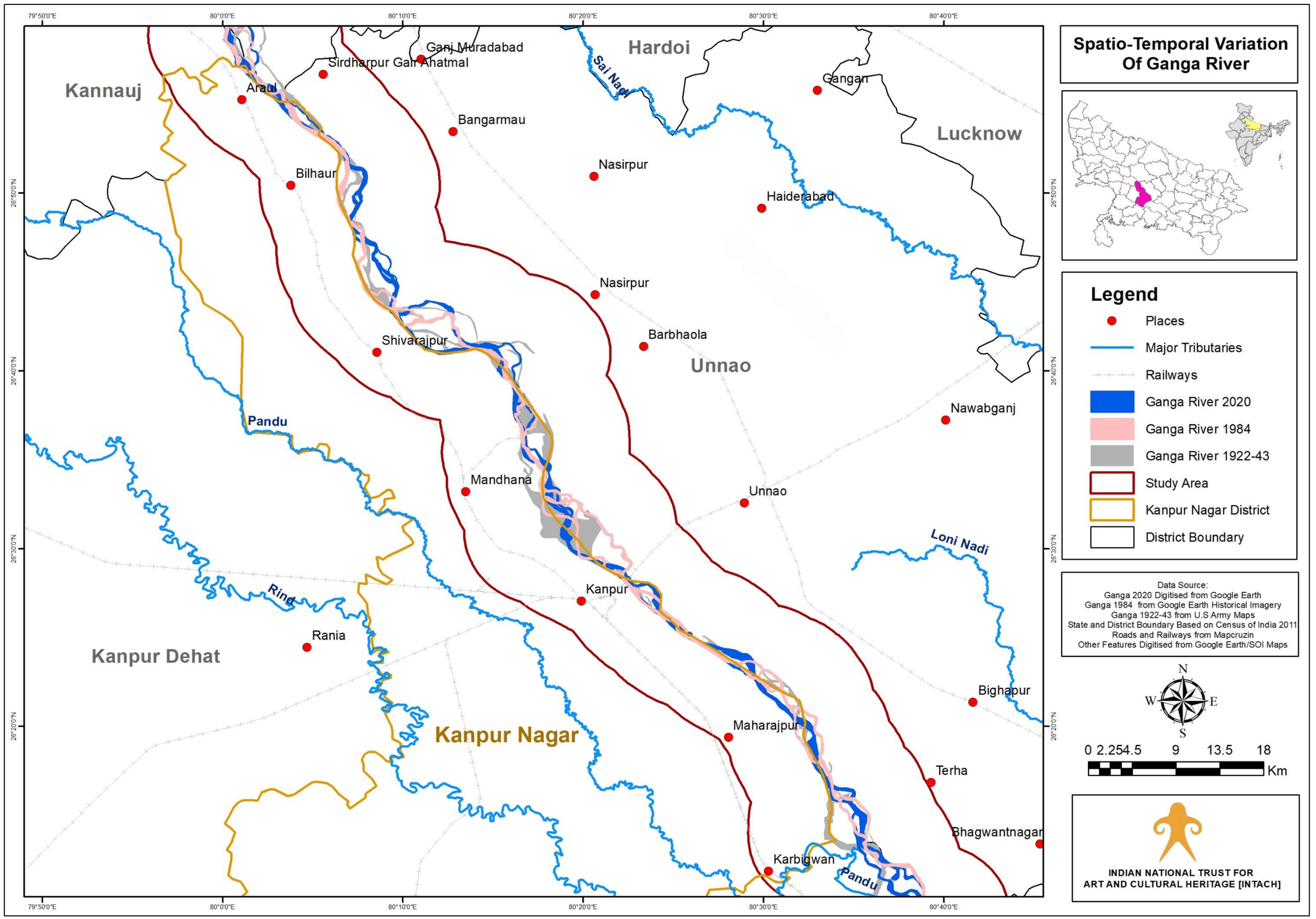
Map 1 : Location Of Kanpur Nagar Distt.

2.0 Ganga River In Kanpur Nagar Distt.

2.1 Ganga River exits Kannauj Distt. near Daipur village to enter Kanpur Nagar Distt. near Aakin village. It then flows mostly north-eastwards and eastwards separating this Distt. from Unnao Distt. towards its east. Along its course of about 67 kms in this Distt., the river crosses some important sites such as Aakin Ghat, Bithoor, Kanpur city and Najabgarh. Throughout its course in this region, the river is braided due to the presence of several riverine islands and sandbars. According to the Distt. Gazetteer (Pande, 1984), Ganga river has a wide and sandy bank in this region with fluctuations in its channel almost every year as new sandbanks are formed and washed away. The river swells and widens up its channel during monsoon season but during summers, the water reduces greatly exposing the river bed, sandbars and riverine islands in several parts. Because of this, the river channel in this region is almost non-navigable for a major part leaving the boats plying only in few sites mainly for tourism purposes. The spatio-temporal variation of Ganga river course in this region is depicted in Map 2 whereas Images 1-2 depict different parts of river observed during the field survey.

Image 1 : Ganga River As Seen Near Bithoor On 5th April, 2022

Image 2 : Ganga River As Observed Near Panka On 7th April, 2022

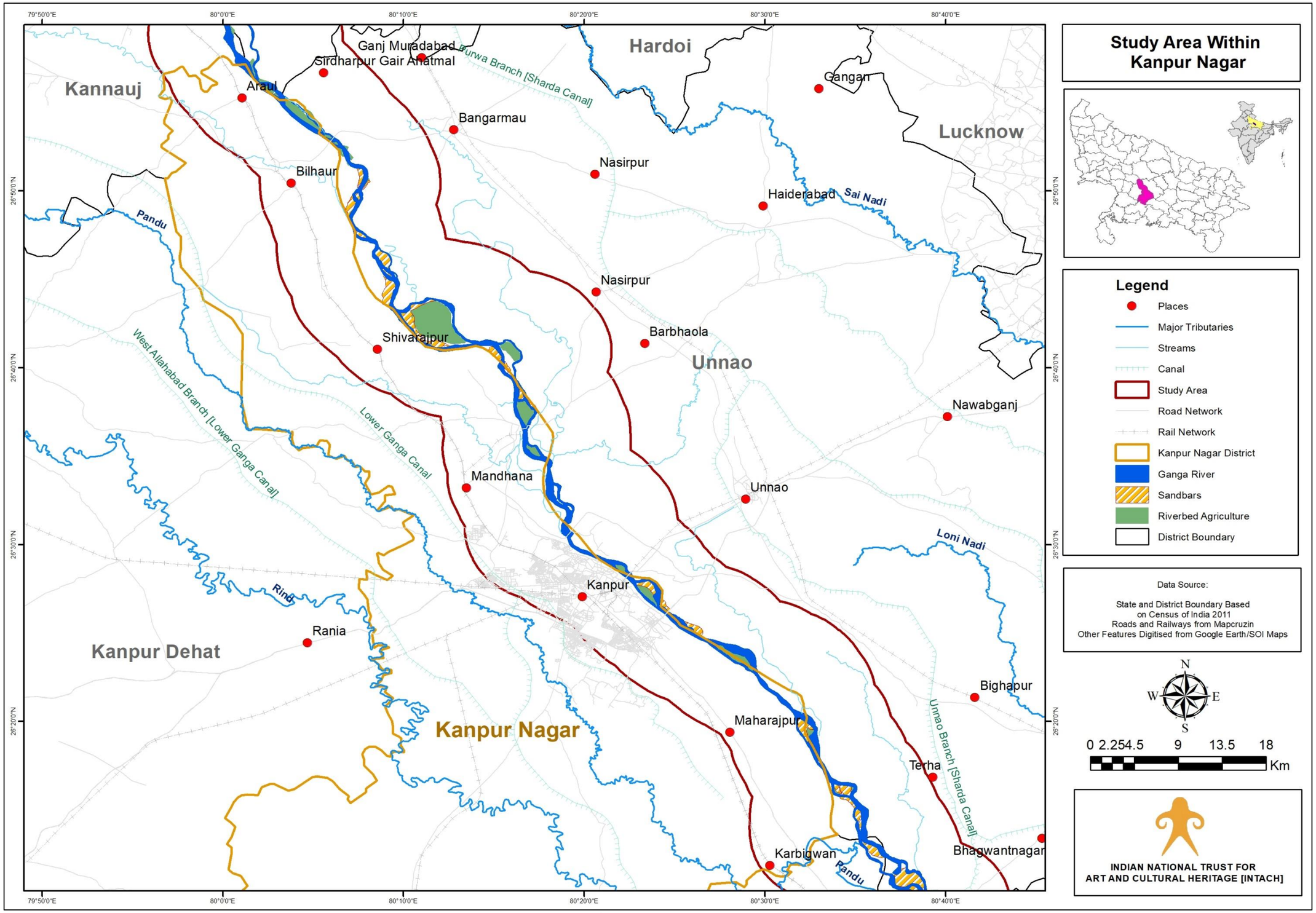


Map 2 : Temporal Variation Of Ganga River Course In Study Region

3.0 Methodology

3.1 Ganga River flows in Kanpur Nagar Distt. for approximately 67 kms adjoining it mainly on the left bank and a small part on the right bank. Hence for carrying out the ground survey, a 7 km of buffer zone was selected on the both the banks 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 for Natural Heritage documentation in the study region of Kanpur Nagar Distt. was carried out from 4-8 April, 2022. The high-quality pictures related to the study were recorded using Nikon D3400 DSLR camera. The GPS locations were also recorded using Garmin hand-held GPS. 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 Kanpur Nagar Distt.

4.0 Tributaries Of Ganga River

4.1 **Pandu River** : According to the Distt. Gazetteer (Pandey, 1984), this is one of the important tributaries of Ganga River in this region which originates in the Farrukhabad Distt. This river flows for about 242 km towards right bank of Ganga with most of its catchment being dominated by agricultural landscape. It confluences with Ganga River in Fatehpur Distt. just a short distance after exiting Kanpur Nagar Distt. Based on the available literature and interactions with interlocutors in the region, it could be noted that this river was once an important source of water which was used for irrigation and domestic purposes as well till about 2-3 decades ago. However, massive industrialization coupled with rapid urbanization in Kanpur city and its surrounding regions led to heavy discharge of industrial effluents and sewage into this river. This has resulted in deterioration of river water quality that has been reported in several studies (Tangri, 2008; Rahul, 2010; Tiwari & Bajpai, 2012; Sen *et al.*, 2018). During the field, this river was observed near Tikra village where its water was found to be blackish-greenish in color [Image 3] and emitting foul smell due to severe pollution issues.

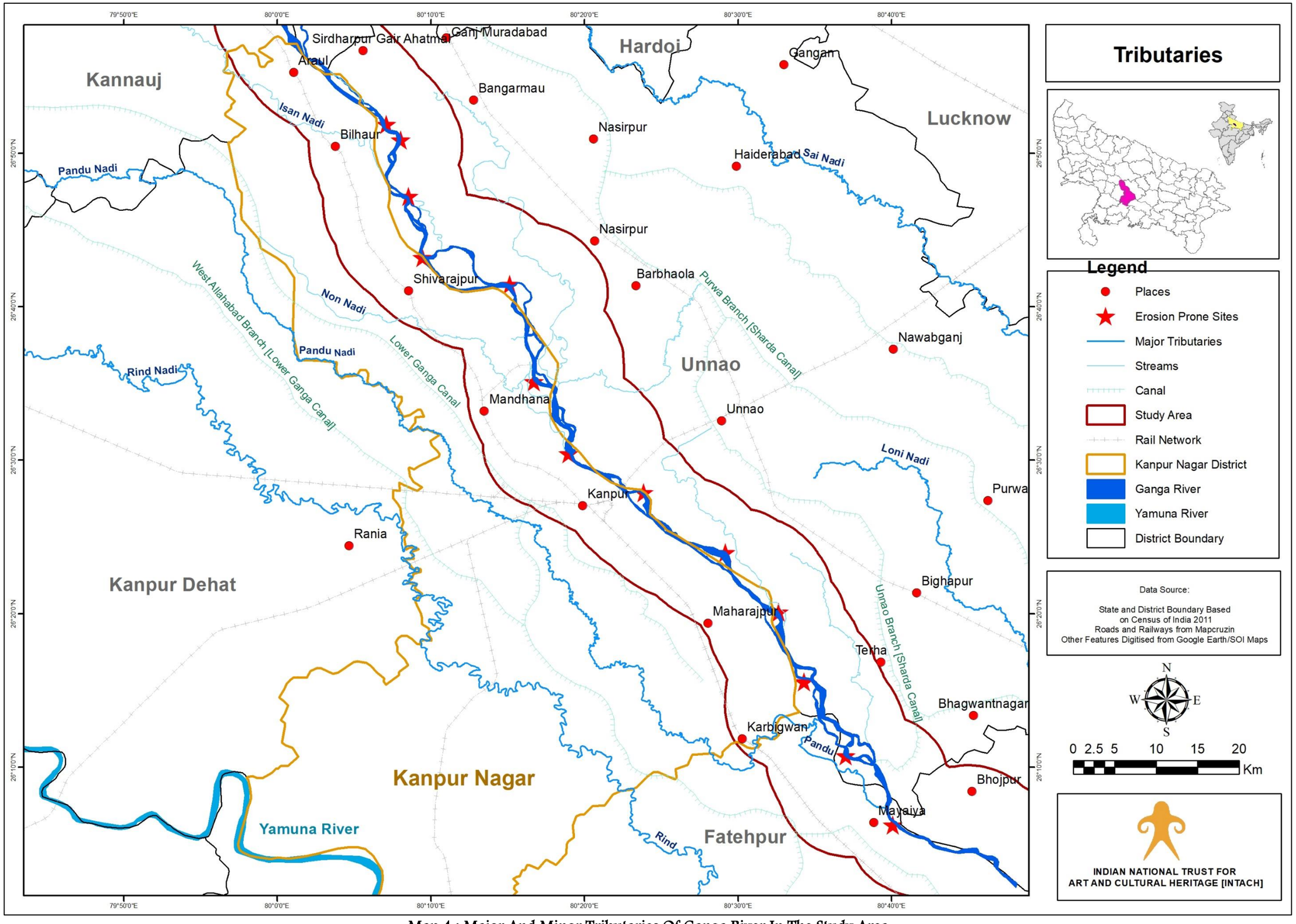
Image 3 : Part of Pandu River As Observed Near Tikra Village On 8th April, 2022

4.2 **Isan Nadi :** According to the Distt. Gazetteer (Nevill, 1909), this is one of the direct and important tributaries of Ganga River in this region. After its origin in south-eastern part of Aligarh, this river crosses through Etah, Mainpuri, Farrukhabad and part of Kannauj to enter Kanpur Nagar Distt. in its northern part near Makanpur. This river then flows south-eastwards cutting through the high bank to confluence with Ganga River near Mohiuddinpur village where it was observed during the field survey [Image 4]. The interlocutors reiterated that this river expands considerably during the monsoons with influx of water which remains even during remaining part of the year making it an invaluable source of irrigation. Residents of Mohiuddinpur were also involved in fishing activities from Isan river as observed during field survey.

Image 4 : Isan Nadi As Observed During Field Survey On 6th April, 2022

4.3 **Non Nadi :** The Distt. Gazetteer (Pande, 1984) mentions Non as a right bank tributary of Ganga River arising from the low, swampy tracts on the northern borders of Bilhaur Tehsil. The overflow from these large and shallow swamps makes its way southwards to form Non which takes a definite shape of a stream channel only after crossing Shivrajpur in Kanpur Nagar Distt. It confluences with Ganga river near Bithoor and was observed during the field survey from a bridge over this stream [Image 5]. The water of this stream was found to be infested with aquatic vegetation including green algae. The interlocutors reiterated use of water from this stream for agriculture shortly after monsoon season.

Image 5 : Non Nadi As Observed On 5th April, 2022



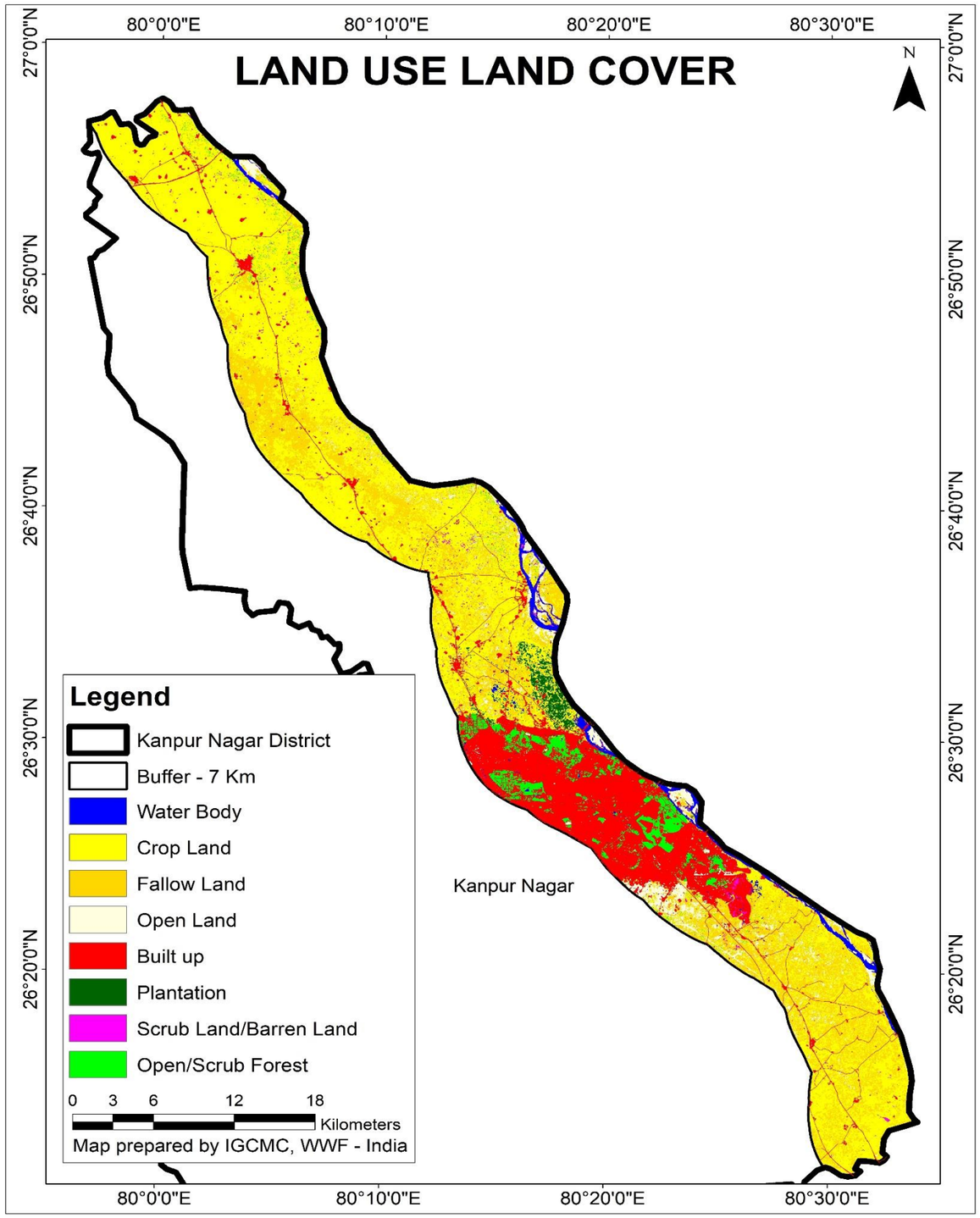
Map 4 : Major And Minor Tributaries Of Ganga River In The Study Area

5.0 Land Use/Land Cover

5.1 Land Use Land Cover (LULC) Map of the study corridor has been prepared from Landsat imagery. Using supervised classification system, 8 different classes were generated – water body, crop land, fallow land, open land, built up, plantation, barren land and open/scrub forest. Agriculture being one of the major sources of income in this Distt., crop land and fallow land components occupy major part of the land use system in this Distt., together covering 70.49% of the total geographical area. The water body component covering 2.592% of the total geographical area of this Distt. chiefly includes Ganga river, its tributaries and other wetlands. The built-up area is a second major land use category covering about 16.538% which chiefly includes Kanpur city and its surroundings; towns such as Bithoor and Bilhaur along with other major villages 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

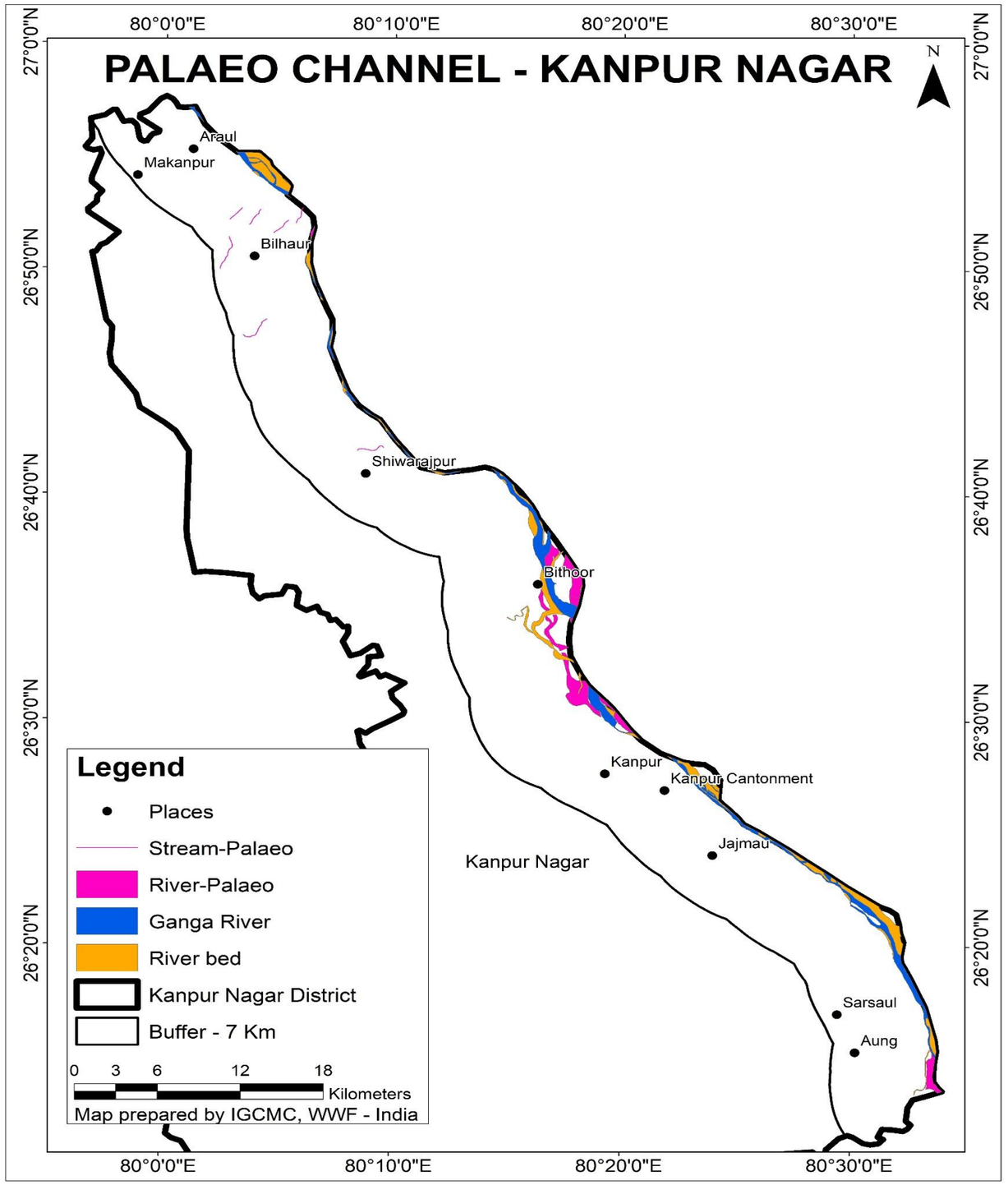
Kanpur Nagar (LULC)		
Class	**Area (Ha)**	**Area (%)**
Water Body	2093.850	2.592
Crop Land	37898.100	46.911
Fallow Land	19051.800	23.583
Open Land	3778.920	4.678
Built Up	13360.900	16.538
Plantation	971.280	1.202
Barren Land	541.890	0.671
Open/Scrub Forest	3090.690	3.826
Total	**80787.430**	**100**



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

6.0 Palaeochannels Of Ganga River

6.1 Decline in natural flow of a River or stream decreases the sediment flushing ability of the Rivers. It may be a reason behind the disappearing of River channels in the Ganga River basin. Apart from that various other factors such as change in land use pattern, sand mining, agricultural practices and brick kilns may also lead to disappearance of streams and river channels in the region. These palaeo-channels do not carry water during most of the year but may flow during flood events. Such abandoned and silted palaeo-channels 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 Kanpur Nagar Distt.



Map 6 : Paleochannels In The Study Region

7.0 Floodplain Of River Ganga In Kanpur Nagar

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 Kanpur Distt. falls in the Central Plain Zone/Upper Gangetic Plain Region with the major soils being deep, fine soils moderately saline and sodic; deep, loamy soils and deep, loamy soils associated with sandy soils. The net sown area in the district is 221.9 hectares in which 71.5 hectares of area is sown more than once (NICRA-ICAR, 2014). Agriculture is one of 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, Pandu and Isan rivers along with other minor streams in the study region were observed to be under extensive crop cultivation during the field survey. Rice and wheat are the major crops grown along with other crops such as arhar, chana, bajra and vegetables such as tomato, potato, pumpkin, cabbage and chillies. In some floodplain agriculture sites in the study region, different varieties of marigold flowers were also found to be cultivated. The details of some villages surveyed along with their floodplain agriculture produce is provided in Table 2 while Images 6-7 depict floodplain agriculture fields as recorded during the survey.

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

Sr. No.	Village Name	Agricultural Produce
1.	Bithoor	Wheat, Maize, Mustard, Arhar, Melon, Cucumber
2.	Domanpur	Wheat, Arhar, Potato, Onion, Mustard
3.	Mohiuddinpur	Wheat, Pumpkin, Cucumber, Melon, Chillies
4.	Aakin	Wheat, Mustard, Gourd, Onion, Tomato
5.	Rahanas	Wheat, Maize, Gourd, Pumpkin, Cucumber

Image 6 : Floodplain Wheat Cultivation Near Mohiuddinpur Village

Image 7 : Cultivation Of Marigold Flowers In Floodplain Villages Near Domanpur

7.3 Floodplain Grasses : The Ganga floodplain region and riverine islands in Kanpur Distt. were dominated by riparian grasses including species such as *S. spontaneum* (commonly known as *Kans*) and *S. bengalense* (commonly known as *Munj/ Sarkanda*) [Images 8-9] along with other grasses such as *Cynodon dactylon* (L.) Pers. (commonly known as Doob or Durva grass). *Saccharum* species 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 utilize these grasses in construction of temporary huts to monitor their agricultural fields as well as for constructing temporary boundaries to distinguish their fields. These grasses are also used in making mats/ *chatai*. The abundance of this grass and availability throughout the year makes it an excellent bio resource for the residents in this region.

Image 8 : Lush Growth Of *Saccharum* Grasses Along Ganga River Near Domanpur In Kanpur Nagar Distt. – Retarding Bank Erosion

Image 9 : Dried Saccharum Grasses Employed For Boundaries Demarcation In Agricultural Fields Along Ganga River Near Katri Anakin Village

8.0 Wetlands In Kanpur Nagar 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), a total of 1527 different wetlands are situated in Kanpur Nagar Distt. together covering an area of about 14770 ha. However, during the current study about 104 different wetlands are recorded from the selected study region covering a total area of about 232.78 ha whose details are provided in Table 3. The Map 7 shows the spatial distribution of these wetlands in the study region while some significant wetlands are discussed in detail under this section.

Table 3 : List Of Wetlands In The Study Region

Sr. No.	Wetland Name/Wetland No.	Latitude	Longitude	Area [Hectares]
1.	1	26.224146	80.520042	0.90
2.	2	26.223225	80.510515	1.20
3.	3	26.242334	80.524213	1.77
4.	4	26.237738	80.487737	0.88
5.	Rahnas Jheel	26.31864	80.505546	27.39
6.	6	26.284017	80.491704	7.54
7.	7	26.283334	80.486312	1.29
8.	Shyamsi Jheel	26.330011	80.498712	16.49
9.	9	26.336378	80.486784	0.96
10.	10	26.335822	80.492657	1.14
11.	11	26.310747	80.467634	1.17
12.	12	26.327638	80.457828	1.20
13.	13	26.326239	80.455612	0.78
14.	14	26.342786	80.427929	1.45
15.	15	26.344519	80.425713	0.55
16.	16	26.377627	80.449996	1.63
17.	17	26.375928	80.374806	2.38
18.	18	26.378545	80.371231	3.05
19.	Jhakarkati Talab	26.448951	80.340839	3.65
20.	Diggi Talab	26.447144	80.339575	2.35
21.	21	26.4465	80.328423	1.56
22.	22	26.447196	80.325079	0.85
23.	Moti Jheel	26.476129	80.314019	7.22
24.	24	26.464079	80.275355	11.20
25.	25	26.501131	80.301188	4.32

26.	26	26.486186	80.262125	2.90
27.	27	26.556256	80.281067	3.09
28.	28	26.555118	80.283415	3.03
29.	29	26.560349	80.279287	4.35
30.	30	26.561634	80.216116	1.40
31.	31	26.553637	80.218592	0.68
32.	32	26.578779	80.206192	1.80
33.	33	26.631803	80.238256	0.44
34.	34	26.638141	80.242973	0.84
35.	35	26.63934	80.25061	0.51
36.	36	26.608895	80.206852	1.56
37.	37	26.646254	80.232342	0.56
38.	38	26.648219	80.229967	0.38
39.	39	26.657593	80.227004	1.25
40.	40	26.659176	80.22234	0.81
41.	41	26.656382	80.219564	1.24
42.	42	26.655414	80.220824	0.57
43.	43	26.628133	80.191378	0.95
44.	44	26.654091	80.213141	0.52
45.	45	26.663767	80.212668	0.98
46.	46	26.66775	80.215724	1.71
47.	47	26.630981	80.173728	0.67
48.	48	26.643484	80.16833	0.67
49.	49	26.664999	80.168508	1.79
50.	50	26.664699	80.164636	1.38
51.	51	26.658014	80.160039	0.68
52.	52	26.6676	80.152379	1.03
53.	53	26.679903	80.145742	1.74
54.	54	26.66639	80.133539	0.96
55.	55	26.683021	80.140978	1.86
56.	56	26.6853	80.137987	2.57
57.	57	26.687426	80.144077	4.14
58.	58	26.686195	80.145404	0.45
59.	59	26.691705	80.124272	1.11
60.	60	26.700549	80.136933	1.07
61.	61	26.706116	80.143522	1.75
62.	62	26.705897	80.138624	0.57
63.	63	26.708305	80.139326	1.02
64.	64	26.709718	80.138203	0.67
65.	65	26.694015	80.094242	1.11
66.	66	26.715395	80.11685	0.41
67.	67	26.7025	80.077727	1.12
68.	68	26.729657	80.114044	2.17
69.	69	26.721731	80.094295	2.67
70.	70	26.724583	80.095547	0.82
71.	71	26.739057	80.108568	1.18
72.	72	26.739751	80.08004	1.22

73.	73	26.73945	80.082605	0.46
74.	74	26.738016	80.09235	3.62
75.	75	26.741319	80.089903	1.13
76.	76	26.741871	80.094216	2.01
77.	77	26.747179	80.096875	0.73
78.	78	26.759329	80.106993	0.75
79.	79	26.744758	80.076695	1.14
80.	80	26.748872	80.07637	3.90
81.	81	26.747844	80.078475	1.85
82.	82	26.738647	80.074709	1.31
83.	83	26.761616	80.08695	1.32
84.	84	26.762054	80.065863	2.42
85.	85	26.760063	80.059653	4.28
86.	86	26.761022	80.054003	9.04
87.	87	26.763828	80.055741	1.23
88.	88	26.795112	80.052235	0.58
89.	89	26.797199	80.052123	0.74
90.	90	26.798646	80.055752	8.23
91.	91	26.805943	80.072175	0.85
92.	92	26.807043	80.071025	0.85
93.	93	26.807967	80.073239	0.50
94.	94	26.867717	80.092533	0.66
95.	95	26.898764	80.048395	1.26
96.	96	26.885175	80.030726	1.50
97.	97	26.906107	80.043776	1.88
98.	98	26.905736	80.049244	1.96
99.	99	26.902356	80.031227	1.12
100.	100	26.900324	80.027036	4.04
101.	101	26.894613	80.020915	1.12
102.	102	26.916899	80.024407	2.94
103.	103	26.935602	80.001157	1.32
104.	104	26.935433	80.002977	0.78
Total Area				**232.78**

8.2 **Rahanas Jheel :** The biggest and most significant jheel in the study region is Rahanas Jheel located in Rahanas village close to Najabgarh in southern part of this Distt. [Image 10]. Covering a total area of about 27.39 ha, this jheel was an important source of water and supported ecology of this region till about two decades ago. The Distt. Gazetteer of Kanpur (Nevill, 1909) also mentions this one of the biggest and important jheels serving as an important habitat for birds in this region. According to an online news article, this jheel was connected with Ganga River and its water was considered to be equally holy. Furthermore, people from nearby areas use to visit this jheel and its surroundings for picnic and fishing activities. However, in recent years encroachment by houses, expansion of agriculture and cutting off its water sources has led to this Jheel being just a dry/marshy bed of land [Image 11] which receives water only from the rainfall. Thereafter, it quickly dries up which makes its land available for agriculture. During the field survey too, this jheel was found to be in dried condition with agriculture and cattle grazing activities by residents of this village.

Image 10 : Location Of Rahanas Jheel
[26° 18' 59.39" N; 80° 30' 18.46" E]

Image 11 : Dried Up Rahanus Jheel As Observed On 8th April, 2022

8.2 **Moti Jheel :** This lake, covering an area of about 7.22 ha, is an important drinking water reservoir and together with its surrounding gardens serves as an important tourist spot in the Kanpur city [Image 12]. This lake was initially developed by the Britishers as drinking reservoir and was known as 'Septic tank'. Over the last few decades, its surroundings were landscaped and developed into recreational space [Image 13] which is popular among local residents and tourists alike.

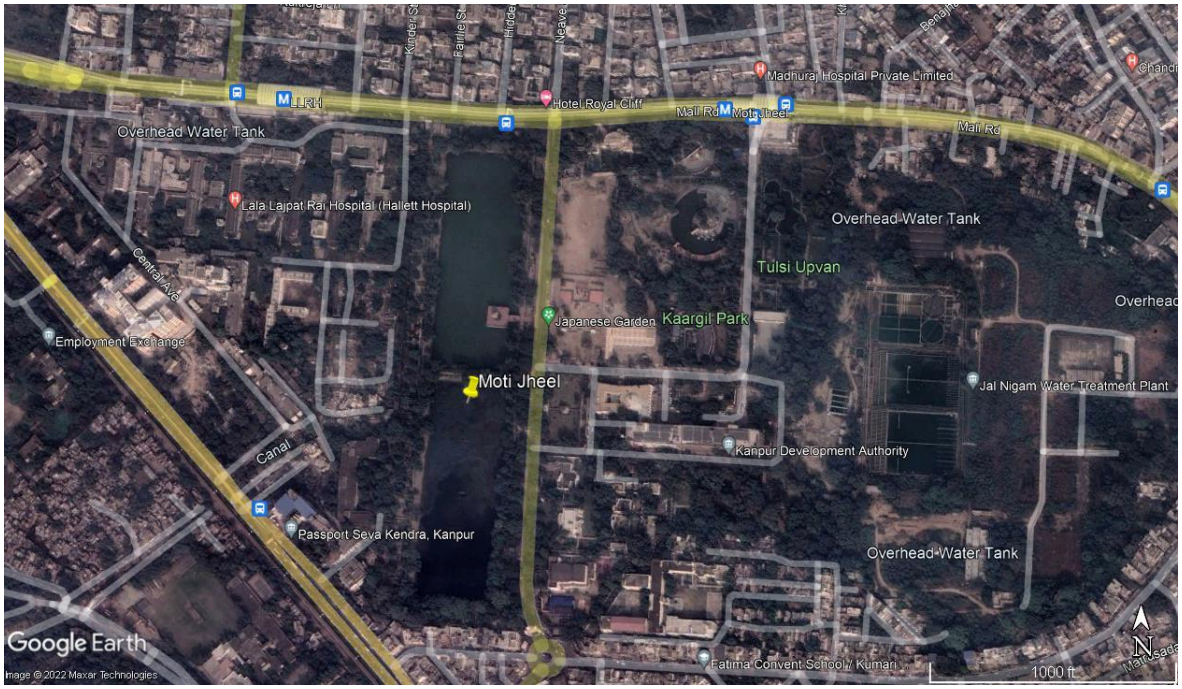


Image 12 : Location of Moti Jheel
[26° 28' 32.65" N; 80° 18' 50.29" E]

Image 13 : Part Of The Moti Jheel As Observed On 6th April, 2022

8.3 **Jhakarkati Talab :** This pond covers an area of about 3.65 ha and is located adjacent to Jhakarkati bus stand in Kanpur city [Image 14]. During the field survey, it was found to be filled with water but heavily polluted owing to solid and liquid waste being dumped into it [Image 15]. No specific information could be obtained about it from the interlocutors but if conserved properly, it can become an important water body in the otherwise heavily urbanized landscape here.

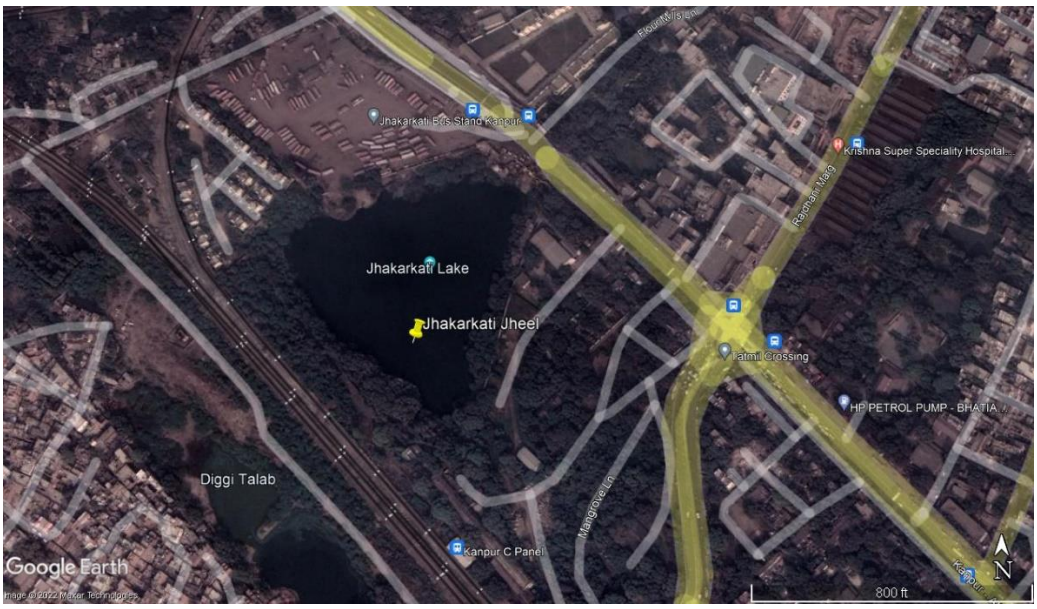
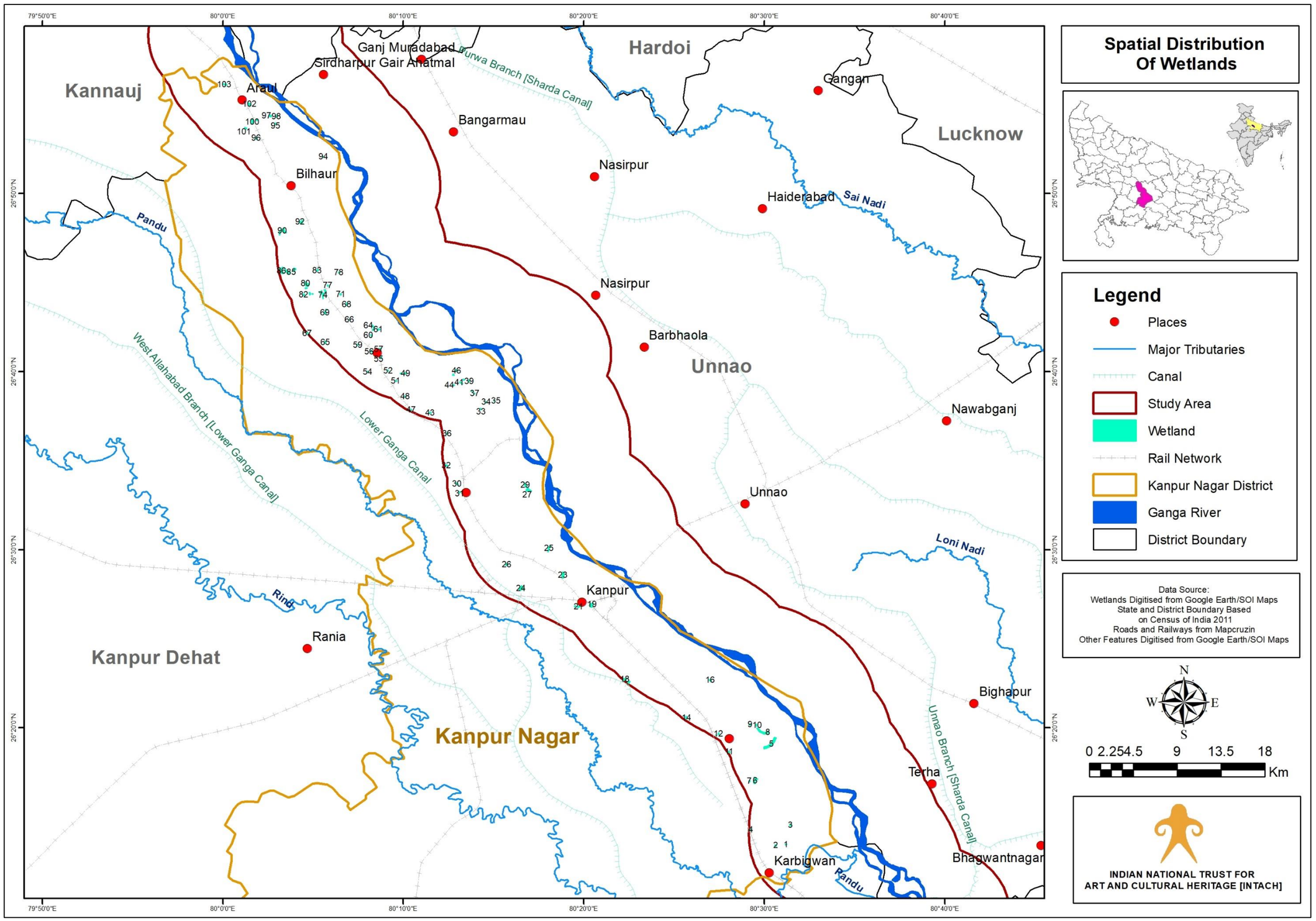


Image 14 : Location Of Jhakarkati Talab In Kanpur City
[26° 26' 54.45" N; 80° 20' 27.19" E]

Image 15 : Jhakarkati Talab As Observed On 7th April, 2022



Map 7 : Spatial Distribution Of Water Bodies Within Study Area

9.0 Riparian Flora Along Ganga River In Kanpur Nagar 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. Siddiqui (1991) gave an account of 40 riparian macrophytes from Narora-Kannauj region of which species of *Ammania*, *Eclipta*, *Polygonum*, *Ipomoea*, *Rumex*, *Saccharum*, *Scirpus* and *Tamarix* are amphibious in nature.

9.3 During the field survey the riparian vegetation was found to have patchy distribution with it being sparse in most sites and dense in some sites [Images 16-17]. This could be attributed to the fact that agriculture is dominant in the landscape of study region especially along Ganga River and its tributaries. Shrubs and herbs were dominant in terms of growth and extent of distribution as compared to the trees. The common tree species in study region included – Babool, Neem, peepal and Banyan among which Peepal and Banyan were also found associated with various religious sites. The common shrubs and herbs in the study region included – *Croton bonplandianus, Parthenium hysterophorus, Polygonum sp.* and *Zizyphus* sp. The floodplain grasses – *Saccharum* sps. were 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 4.

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.	*Bombax ceiba* L.	Malvaceae	Tree	Semal
5.	*Borassus flabellifer* L.	Arecaceae	Tree	Taad
6.	*Dalbergia sissoo* Roxb. ex DC.	Fabaceae	Tree	Shisham
7.	*Ficus benghalensis* L.	Moraceae	Tree	Banyan
8.	*Ficus religiosa* L.	Moraceae	Tree	Peepal
9.	*Ficus* sp.	Moraceae	Tree	Pakad
10.	*Leucaena leucocephala* (Lam.) de Wit	Fabaceae	Tree	White Babool
11.	*Mangifera indica* L.	Anacardiaceae	Tree	Mango
12.	*Calotropis gigantea* (L.) Dryand.	Apocynaceae	Shrub	Safed Aak
13.	*Calotropis procera* (Aiton) Dryand.	Apocynaceae	Shrub	Aak
14.	*Lantana camara* L.	Verbenaceae	Shrub	Lanatana
15.	*Lippia alba* (Mill.) N.E. Br. ex Britton & P. Wilson	Verbenaceae	Shrub	Bushy Lippia
16.	*Polygonum sp.*	Polygonaceae	Shrub	
17.	*Ricinus communis* L.	Euphorbiaceae	Shrub	Wild Castor
18.	*Zizyphus* sp.	Rhamnaceae	Shrub	Wild Ber
19.	*Achyranthes aspera* L.	Amaranthaceae	Herb	Chirchira
20.	*Blumea lacera* (Burm.f.) DC.	Asteraceae	Herb	Kakronda
21.	*Croton bonplandianus* Baill.	Euphorbiaceae	Herb	Ban Tulsi
22.	*Rumex dentatus* L.	Polygonaceae	Herb	
23.	*Parthenium hysterophorus* L.	Asteraceae	Herb	Congress Grass
24.	*Xanthium strumarium* L.	Asteraceae	Herb	Chhotav dhatura
25.	*Saccharum munja* Roxb.	Poaceae	Grass	Munj
26.	*Cyperus* sp.	Cyperaceae	Grass	
27.	*Cynodon dactylon* (L.) Pers.	Poaceae	Grass	Doob
28.	*Saccharum spontaneum* L.	Poaceae	Grass	Kans/Katha

Image 16 : A Riparian Vegetation Patch Near Katri Panka Village In Kanpur Nagar Distt.

Image 17 : A Riparian Vegetation Patch Near Aakin Ghat In Kanpur Nagar Distt.

10.0 Faunal Diversity In Kanpur Nagar 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. During the field survey, no direct sightings of dolphins occurred in the study region. However, according to interlocutors, occasional dolphin sightings occur during the monsoon season when water level rises in the river.

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). Total 24 species of fresh water turtles are found in India out of which 13 are found in the River Ganga. Poaching, habitat loss, pollution and over fishing are major threats to the species. Turtles are also often caught in the fishing net by fishermen which make them more vulnerable to poaching (Stuart & Thorbiarnarson, 2003). While no direct turtle sightings could be made in the study region, their presence was confirmed by interlocutors who reiterated that these turtles were occasionally found basking along sandy banks and on sand bars.

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. According to the interlocutors there is a small population of Nilgai in the study region which can be seen near Kishanpur, Bithoor, Sarsaul, Rahanas and Domanpur villages.

10.4 **Wild boar:** The Indian wild boar (*Sus scrofa* L.) also known as the wild pig is one of the most 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). During the survey, the locals stated that the boars are responsible for destroying the crops, potatoes and other vegetables. The problem persists specially in Maholi, Bithoor, Aakin, Bajidpur and other flood plain

agricultural areas. In the study region, wild boars inhabit the tall riparian grass dominated sites along the river and on the riverine islands.

10.5 Based on visual observations during field survey and interactions with the interlocutors some other major faunal species recorded from study region in Kanpur Nagar Distt. is presented in Table 5.

Table 5 : Other Important Fauna Recorded In The Study Region

Sr. No.	Common Name	Scientific Name	Conservation Status
1.	Blackbuck	*Antilope cervicapara*	Least Concern
2.	Northern Plains Grey Langur	*Semnopithecus entellus*	Least Concern
3.	Golden Jackal	*Canis aureus*	Least Concern
4.	Rhesus Monkey	*Macaca mulatta*	Least Concern
5.	Indian Grey Mongoose	*Herpestes edwardsii*	Least Concern
6.	**Bengal Monitor**	***Varanus bengalensis***	**Near Threatened**
7.	Peacock Pansy (Butterfly)	*Junonia almana*	Least Concern
8.	Blue Jay (Butterfly)	*Graphium doson*	Least Concern
9.	Common Mime (Butterfly)	*Papilio clytia*	Least Concern
10.	Common Grass Yellow (Butterfly)	*Eurema brigitta*	Least Concern

10.6 **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 (*Grus antigone*) and River lapwing (*Vanellus duvaucelii*) also breed on the islands, sandbars and banks of the Ganga River. Kanpur Nagar Distt. has rich and highly diverse avian fauna which is still relatively understudied. During the field survey in study region, the diversity of avian species was recorded using binoculars and identified using field guides (Salim Ali, 2012; Grimmett *et al.*, 2016). The conservation status of these recorded species was listed by following IUCN Red Data List and is presented along with other details in Table 6. Important inferences from the study are presented below:

- A total of 70 different bird species were sighted, out of which 23 were wetland birds' species while remaining 47 species were of forest and grassland.
- White throated kingfisher, Little Egret, Cattle Egret, Indian Pond Heron, House Sparrow, Jungle Crow, Common Myna, Bank Myna, Common Pigeon, Common Babbler, Spotted Dove, Eurasian Collared Dove and White Wagtail were the most frequently sighted species.
- Among the recorded avian species; **Black-headed Ibis, Painted Stork** and **River Lapwing** comes under **"Near Threatened"** category of IUCN's Red List of Threatened Species whereas **River Tern** and **Sarus Crane** have **"Vulnerable"** status and **Egyptian Vulture** has been listed as "**Endangered**" (IUCN red Data List).

Table 6 : 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.	Pied Kingfisher	*Ceryle rudis*	Least Concern
3.	Cattle Egret	*Bubulcus ibis*	Least Concern
4.	Little Egret	*Egretta garzetta*	Least Concern
5.	Intermediate Egret	*Ardea intermedia*	Least Concern
6.	Great Egret	*Ardea alba*	Least Concern
7.	Indian Pond Heron	*Ardeola grayii*	Least Concern
8.	Grey Heron	*Ardea cinerea*	Least Concern
9.	Common Sandpiper	*Actitis hypoleucos*	Least Concern
10.	**Sarus Crane**	***Grus Antigone***	**Vulnerable**
11.	Asian Openbill	*Anastomus oscitans*	Least Concern
12.	**Painted Stork**	***Mycteria leucocephala***	**Near Threatened**
13.	Little Cormorant	*Microcarbo niger*	Least Concern
14.	Great Cormorant	*Phalacrocorax carbo*	Least Concern
15.	Red-naped Ibis	*Pseudibis papillosa*	Least Concern

16.	**Black-headed Ibis**	***Threskiornis melancephalus***	**Near Threatened**
17.	White breasted -Waterhen	*Amaurornis phoenicurus*	Least Concern
18.	Common Moorhen	*Gallinula chloropus*	Least Concern
19.	Purple Swamphen	*Porphyrio porphyrio*	Least Concern
20.	Eurasian Coot	*Fulica atra*	Least Concern
21.	Common Greenshank	*Tringa nebularia*	Least Concern
22.	Black-winged Stilt	*Himantopus himantopus*	Least Concern
23.	**River Tern**	***Sterna aurantia***	**Vulnerable**
24.	**River Lapwing**	***Vanellus duvaucelii***	**Near Threatened**
25.	Red-wattled Lapwing	*Vanellus indicus*	Least Concern
26.	Black Drongo	*Dicrurus macrocercus*	Least Concern
27.	Common Myna	*Acridotheres tristis*	Least Concern
28.	Bank Myna	*Acridotheres ginginianus*	Least Concern
29.	Asian Pied Starling	*Gracupica contra*	Least Concern
30.	Common Stonechat	*Saxicola torquatus*	Least Concern
31.	Pied Bushchat	*Saxicola caprata*	Least Concern
32.	Common Babbler	*Argya caudata*	Least Concern
33.	Jungle Babbler	*Argya striata*	Least Concern
34.	White Wagtail	*Motacilla alba*	Least Concern
35.	White-browed Wagtail	*Motacilla maderaspatensis*	Least Concern
36.	Indian Silverbill	*Euodice malabarica*	Least Concern
37.	Common Hoopoe	*Upupa epops*	Least Concern
38.	Common Tailorbird	*Orthotomus sutorius*	Least Concern
39.	Rose-ringed Parakeet	*Psittacula krameri*	Least Concern
40.	House Sparrow	*Passer domesticus*	Least Concern
41.	Indian Jungle Crow	*Corvus culminatus*	Least Concern
42.	House Crow	*Corvus splendens*	Least Concern
43.	Oriental Magpie Robin	*Copsychus saularis*	Least Concern
44.	Indian Robin	*Saxicoloides fulicatus*	Least Concern
45.	Streak throated Swallow	*Petrochelidon fluvicola*	Least Concern
46.	Barn Swallow	*Hurindo rustica*	Least Concern
47.	Coppersmith Barbet	*Psilopogon haemacephalus*	Least Concern
48.	Ashy Prina	*Prinia socialis*	Least Concern
49.	Greater Coucal	*Centropus sinensis*	Least Concern
50.	Red-whiskered Bulbul	*Pycnonotus jocosus*	Least Concern
51.	Red-vented Bulul	*Pycnonotus cafer*	Least Concern
52.	**Egyptian Vulture**	***Neophron percnopterus***	**Endangered**
53.	Black-winged kite	*Elanus caeruleus*	Least Concern
54.	Green Bee-eater	*Merops orientalis*	Least Concern
55.	Blue-tailed Bee eater	*Merops philippinus*	Least Concern
56.	Scaly-breasted Munia	*Lonchura punctulata*	Least Concern
57.	Indian Peafowl	*Pavo cristatus*	Least Concern

58.	Jungle Owlet	*Glaucidium radiatum*	Least Concern
59.	Crested Lark	*Galerida cristata*	Least Concern
60.	Paddyfield Pipit	*Anthus rufulus*	Least Concern
61.	Common Pigeon	*Columba livia*	Least Concern
62.	Spotted Dove	*Spilopelia* chinesis	Least Concern
63.	Eurasian Collared Dove	*Streptopelia decaocto*	Least Concern
64.	Laughing Dove	*Spilopelia senegalensis*	Least concern
65.	Rufous Treepie	*Dendrocitta vagabunda*	Least concern
66.	Purple Sunbird	*Cinnyris asiaticus*	Least concern
67.	Indian Roller	*Coracias benghalensis*	Least concern
68.	Indian Grey Hornbill	*Ocyceros birostris*	Least Concern
69.	Brown Rockchat	*Oenanthe fusca*	Least Concern
70.	Grey Francolin	*Francolinus pondicerianus*	Least Concern

Image 18 : Different Birds As Observed During Field Survey In Study Region – Painted Stork, Asian Openbill, River Lapwings And Cattle Egret

Image 19 : Red-Wattled Lapwing

11.0 Ganga Riverine Islands/*Diaras* In Kanpur Nagar 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 irregularly shaped sand bars and few riverine islands are present in the Ganga river stretch of study region.

11.2 Throughout the Ganga River stretch between Kanpur and Unnao Distt.s., several irregularly shaped riverine island and sandbars can be observed. While only some of them had natural vegetation chiefly dominated by Saccharum grasses, most of them were totally exploited for agriculture in the region. Upon interactions, several interlocutors had different versions about how and when did local residents initiated cultivation on these lands. Some major islands and sand bars as observed during the field survey are discussed in this section.

11.3 Among the significant islands of study region, one roughly spear-head shaped island was observed between Bithoor in Kanpur Distt. and Katri Pariyar in Unnao Distt. [Image 20]. It measured about 2.8 km long and 0.5-1.5 km wide covering an area of about 260 ha. Entire island was enveloped with extensive agriculture [Image 21] with crops such as cucumber, melons and pumpkin being grown by the residents of nearby villages. Dried *Saccharum* grasses were used for setting up boundaries on these fields as well as for construction of temporary shelters on this island. Mostly small wooden hand-rowed boats were employed by the residents for accessing to this island from both Kanpur and Unnao sides.

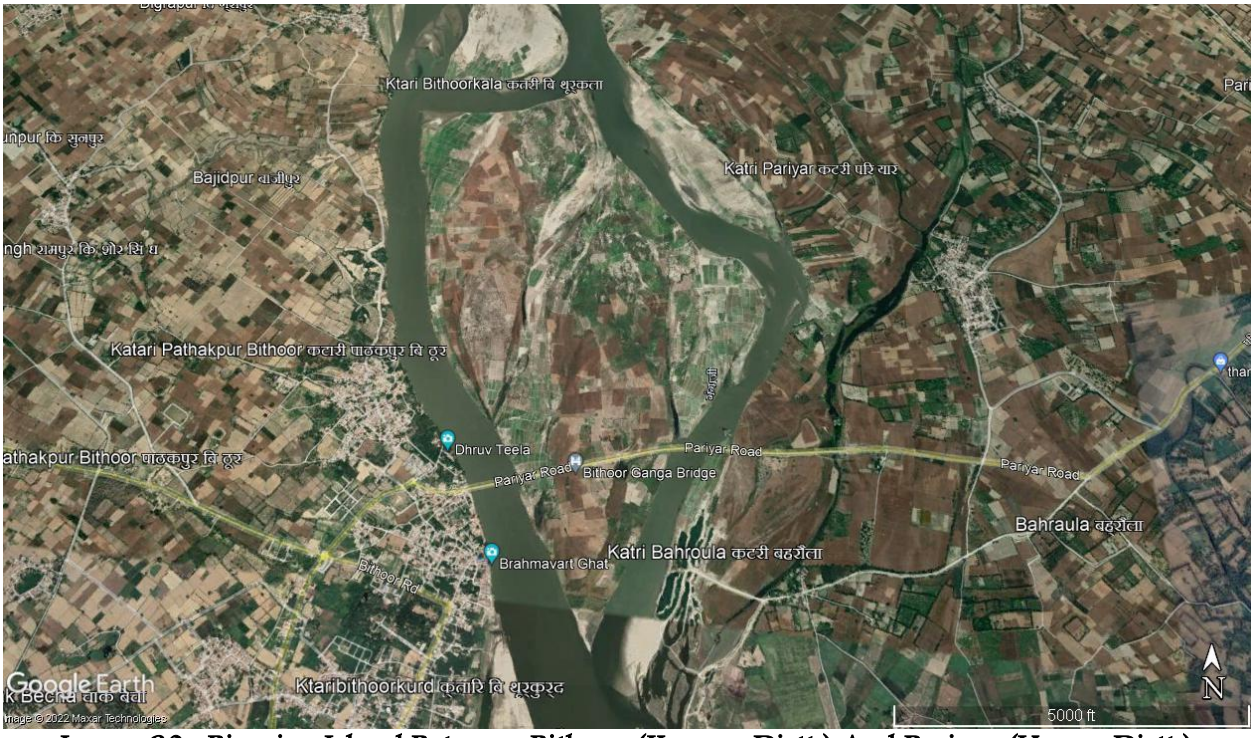


Image 20 : Riverine Island Between Bithoor (Kanpur Distt.) And Pariyar (Unnao Distt.)

Image 21 : Part Of This Riverine Island As Seen Near Bithoor On 8th April, 2022

11.4 A group of irregularly shaped riverine islands and sandbars was observed near Domanpur village of Kanpur Nagar Distt. [Image 22]. Major part of these islands and sandbars were covered by *Saccharum* grasses along with some emergent vegetation on its fringe parts. However, agriculture had started creeping in even here with some residents already clearing this natural vegetation for cultivating wheat and other crops as observed during the survey [Image 23]. If appropriate steps are not undertaken, these islands might meet the same fate as others in the study region very soon.

Image 22 : Location Of Riverine Island Near Domanpur Village In Kanpur Distt.
[Note: The Patch Marked With Red Boundary Shows Clearing Of Natural Vegetation For Agriculture On This Island]

Image 23 : Field Image Of The Riverine Island Near Domanpur Village With Natural Vegetation That Is Being Punctuated With Agriculture As Observed On 11th April, 2022

11.5 Another group of small irregularly shaped sandbars & riverine islands were observed in Ganga River stretch crossing Kanpur city as observed near Atal Ghat and Sarsaiya Ghat [Images 24-25]. These lands were under extensive agriculture as observed during the field survey [Images 26-27] with major crops grown there being pumpkin, cucumber, melons and gourd. Dried Saccharum grasses were frequently used for demarcating different fields which were accessed by residents of nearby villages. The interlocutors claimed to access these lands in post monsoon and pre monsoon seasons citing rich nutrient availability resulting in good crop yield whereas during monsoon season, these were completely submerged. These islands caused braiding of Ganga river main channel and due to low water depth in this region, were easily accessible either by small boats or sometimes just by foot as observed near Sarsaiya Ghat.

Image 24 : Location Of Sandbar Near Atal Ghat In Kanpur City

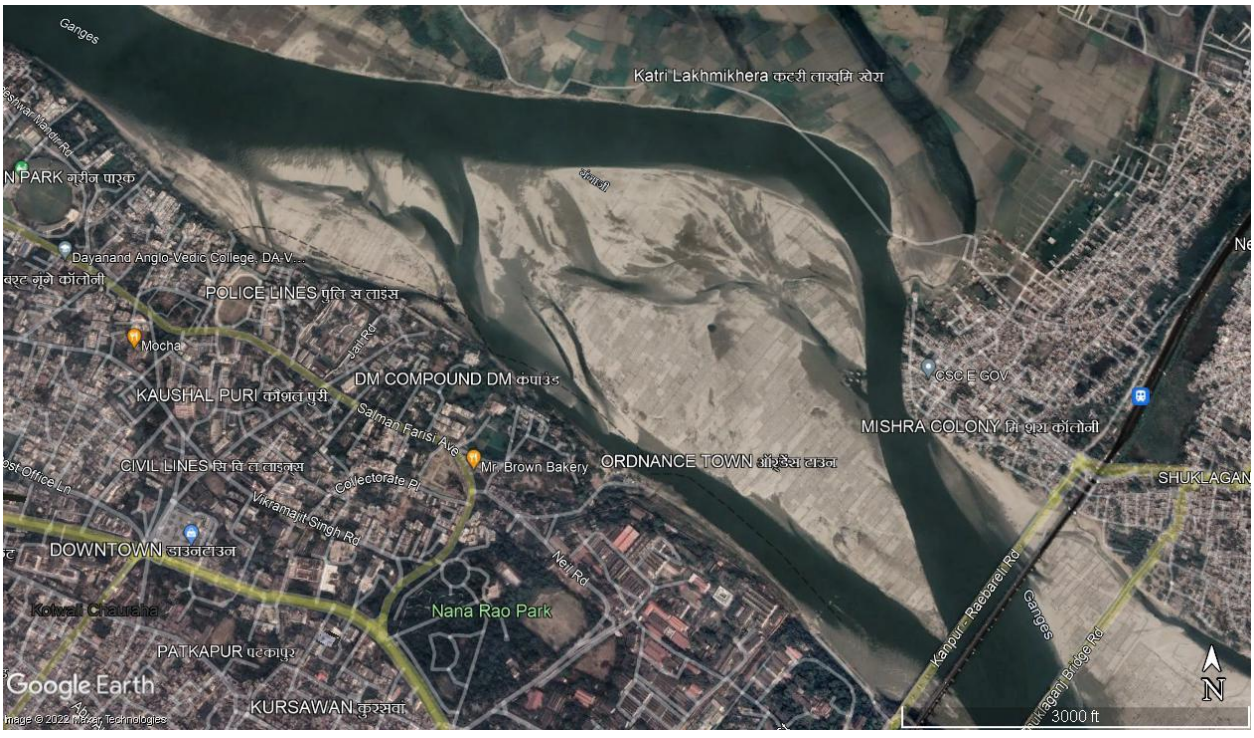


Image 25 : Location Of Riverine Island Near Sarsaiya Ghat In Kanpur City

Image 26 : Agriculture Activities On Sandbar Near Atal Ghat As Observed On 8th April, 2022

Image 27 : Extensive Agriculture On Riverine Island Near Sarsaiya Ghat As Observed On 8th April, 2022

12.0 Fishing In Kanpur Nagar 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 According to the interlocutors, fishing from Ganga River and its tributaries is a prominent activity in this region and an important source of livelihood for local residents. The most common fishing technique observed in the study region was use of fine-meshed plastic and nylon-based nets set up in the river channel with the help of wooden sticks [Images 28-29]. Apart from this, some residents used locally made fishing rods but mainly for catching fish enough for their own consumption. The fish caught is sold in nearby markets such as in Pariyar town of Unnao and in Kanpur city. However, as Navratri festivities were ongoing, fishing was found be very low during the field survey in study region. The interlocutors reiterated that overall the fish catch and yield had decreased barring few sites where water depth was significant. Sometimes the local residents employed small hand-rowed wooden boats for setting up fishing nets in Ganga and Isan Rivers. Based on the feedback from interlocutors, the fish species recorded from Ganga river stretch of study region is presented in Table 7.

Image 28 : Fishing Nets Set Up Using Wooden Sticks And Saccharum Grasses Near Bithoor

Image 29 : Plastic Fishing Nets Set Up In Ganga River Stretch Near Nanamau Village

Table 7 : 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.	*Oreochromis* sp.	Tilapia

13.0 Groundwater In Kanpur Nagar 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, Kanpur Nagar Distt. is part of the Indo Gangetic plain with silt, clay, gravel and sands of different grades being its primary sedimentary constituents. The generalized geological succession in this Distt. comprises of two different land forms – Newer Alluvium (constituting of fine sand and clays) and Older Alluvium (constituting of sand of different grades and clay mixed with kankar). The soil in this Distt. exhibits great variety of composition and appearance with major part of the Distt. consisting of ordinary soils known locally as Bhur and Sand on ridges, Matiyar or clay in depressions and Domat or Loam in the Plains (Tripathi, 2009).

13.2 The groundwater in Kanpur Nagar Distt. occurs under unconfined condition in phreatic zones and under confined condition in deeper zones. The sedimentological constitution of the subsurface granular zones shows remarkable variation in the depth and the nature of occurrence in north and southern part of the Distt. The depth of groundwater in this Distt. varies from 2.20 to 27.13 mbgl during pre-monsoon period while it varies from 2.08 to 27.13 mbgl during post-monsoon period. According to the Distt. groundwater brochure, the groundwater in Kanpur Nagar Distt. is colorless, odourless and slightly alkaline in nature. Fluoride and other trace metals such as Zn, Mn, Ni & Pb in this water are found to be within permissible limit mostly throughout the Distt. (Tripathi, 2009).

13.3 During the field survey, ground water levels as recorded from different villages based on information from the interlocutors is presented in Table 8. The water depth varied from 5 ft. below ground level (Bhairav Ghat) to 50 ft. below ground level (Bithoor) in the study region which kept on increasing as the distance from Ganga River increased. The use of dug wells was fairly common throughout the region till about two decades ago but have now reduced significantly limiting them to only few sites. Image 30 depicts a dug well as observed associated with a temple complex at Aakin Ghat along Ganga River. Handpumps and motor based pumping system have replaced dug wells in recent years for drawing groundwater.

Table 8 : Grounwater Levels Recorded From Different Villages In Study Region

Place	Coordinates		Ground Water Depth in Feet
	Lat.	Long.	
Bithoor	26°36'19.26"N	80°16'10.01"E	50
Dhruv Teela	26°37'6.70"N	80°16'20.95"E	25
Prithvi Ganj	26°33'26.44"N	80°17'33.55"E	20
Atal Ghat	26°30'9.04"N	80°19'7.81"E	10
Nawab Ganj	26°30'3.51"N	80°18'59.05"E	40
Bhairav Ghat	26°29'38.15"N	80°19'40.65"E	5
Kishanpur Ashram	26°23'52.12"N	80°27'33.28"E	15
Sariayya Ghat	26°43'3.62"N	80° 9'28.46"E	10

Image 30 : An Old Dug Well As Observed At Aakin Ghat In Kanpur Nagar Distt.

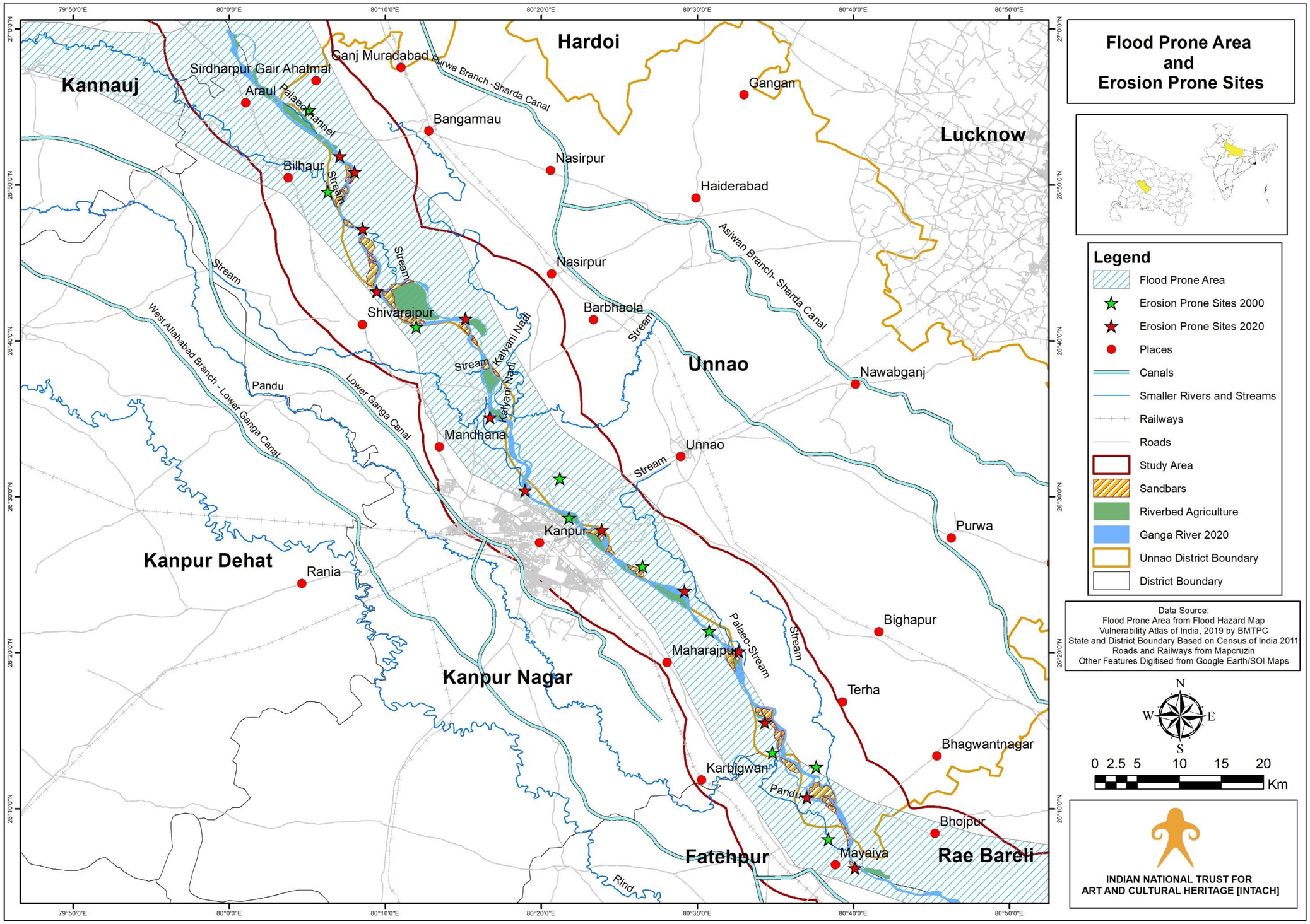
14.0 Ganga River Bank Erosion In Kanpur Nagar Distt.

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. The Ganga River bank of study region is prone to erosion at several sites as observed from Map 8. Some erosion prone sites as observed during the field survey include near Aakin Ghat, Bithoor, Domanpur, Najabgarh and Saraiyya Ghat [Image 31] among others. The interlocutors reiterated that severe erosion led to losses in agricultural lands and even village settlements at some places which in turn affected their livelihoods. Intensive agricultural expansion in this region leading to diminished riparian vegetation can be a chief region attributed to bald banks which are prone to erosion. Steps to control erosion were not observed much during the field survey. Apart from posing threat to village settlements and agricultural fields in the study region, bank erosion was recorded to have profound impacts on heritage sites such as old temple complex at Aakin Ghat [Image 32] and Dhruv Teela at Bithoor [Image 33]. The interlocutors in this region reiterated urgent need for attending these erosion impacts in order to safeguard heritage from further damage.

Image 31 : Erosion Prone Bank Near Saraiyya Ghat In Kanpur Nagar Distt.

Image 32 : Damage Caused By Bank Erosion Near Najabgarh Ghat In Kanpur Nagar Distt.

Image 33 : Erosion Impacts On Dhruv Teela Near Bithoor



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

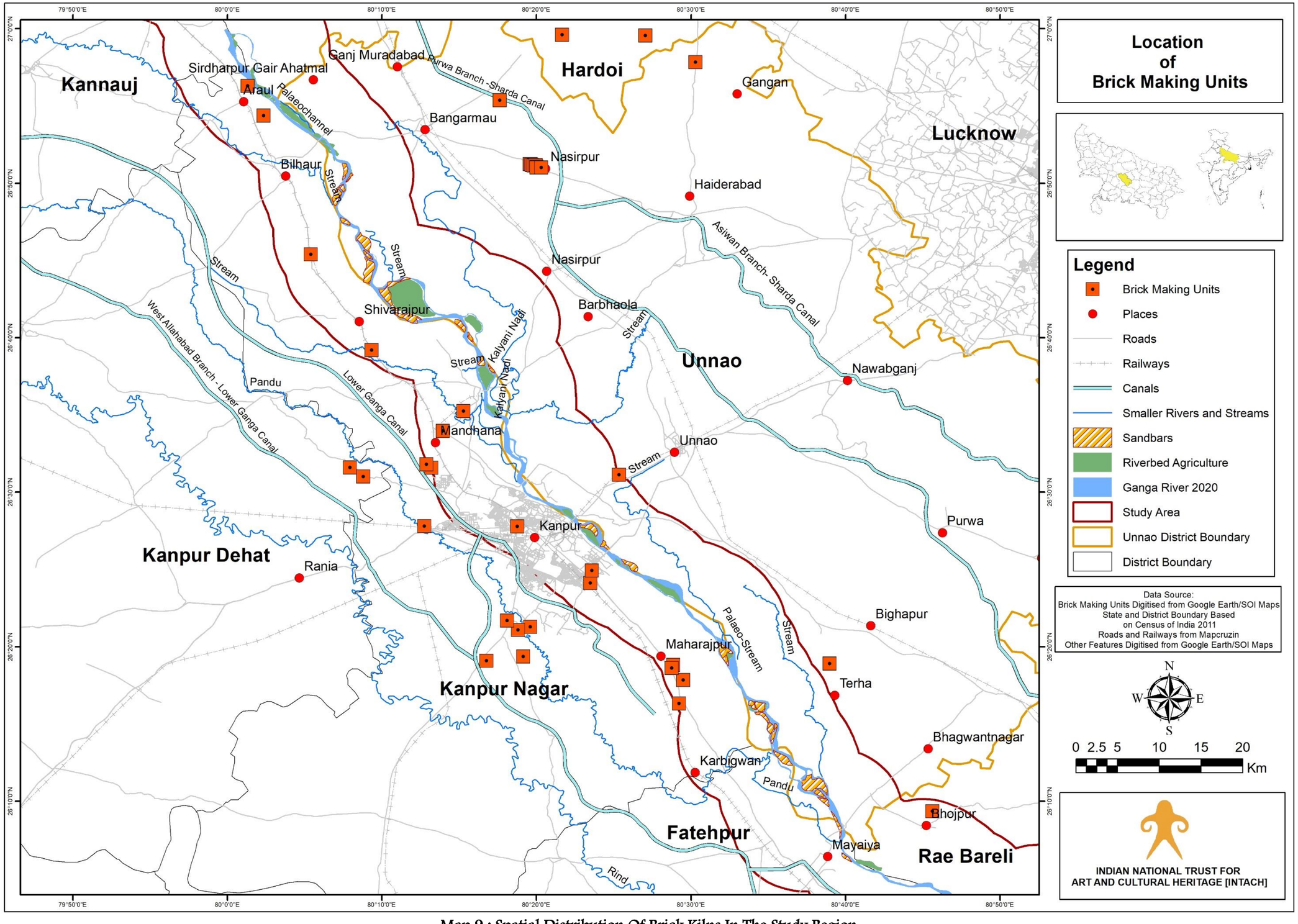
15.0 Mining And Brick Kilns In Kanpur Nagar Distt.

15.1 Sand is one of the major minerals extracted from the Ganga River, especially in its middle and lower stretch. The demand is ever increasing due to rapid expansion of settlements and their upgradation across the country. According to the MSME (2012), sand is a major mineral of this Distt. which is available in plenty from Ganga River and is used in construction of houses, bridges and roads. During the field survey, sand mining was found to be active in the Ganga River stretch between Bithoor in Kanpur and Pariyar in Unnao. Upon interaction, this was found to be a permit-based mining site in this region and is depicted in Image 34.

Image 34 : Sand Mining From Ganga River Near Between Bithoor In Kanpur Nagar Distt. And Pariyar In Unnao Distt.

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. According to MSME (2019), about 50 different brick fields were running in the Distt. at that time. However, this number seems to have increased with several brick kilns being present during the field survey especially in the vicinity of Kanpur city. Image 35 depicts one such brick kiln as observed in field while Map 9 depicts the spatial distribution of brick kilns in study region of Kanpur Nagar Distt.

Image 35 : Brick Making Units As Observed Near Najabgarh In The Distt.



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

16.0 Boatmaking And Inland Navigation In Kanpur Nagar 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. Two major types of boats were observed in the study region – smaller hand rowed wooden boats [Image 36] (with or without the use of metal) which were principally used for fishing and transporting goods/people from banks to diaras and vice-versa; & slightly bigger motorized/hand-rowed boats made up of wood and/or metal principally used at sites such as Brahmavart Ghat in Bithoor and Sarsaiya Ghat, Atal Ghat in Kanpur city [Image 37] especially catering pilgrims and tourists from different places. They charge anywhere between Rs. 20 to Rs. 100 or more depending upon various factors such as distance to be travelled, number of people on board and time involved. Since water depth decreases considerably in Ganga river stretch of this region, use of boats for long distance transportation has not been reported. It is restricted to only few of these sites where water level is sufficient enough for boats to ply.

16.2 Boat making activity was observed at Sarsaiya Ghat in Kanpur city [Image 38]. Upon interactions, most interlocutors reiterated that these boats were constructed with the help of 'Mistry' (carpenters) from either from Kanpur itself or nearby cities specializing in this aspect. While Sakhua (*Shorea robusta*) is the chief wood choice in these boats, other options such as babool and mango are also explored depending upon prices and availability. The average cost of boatmaking ranges between Rs. 50,000 – Rs. 1 lakh depending upon various factors.

Image 36 : Small Wooden Boats Employed For Fishing And Transportation To/From Riverine Islands In Study Region

Image 37 : Boats Employed For Tourists And Pilgrims At Sarsaiya Ghat In Kanpur City

Image 38 : Boatmaking Activity At Sarsaiya Ghat In Kanpur

17.0 Sacred Sites In Kanpur Nagar Distt.

17.1 **Bithoor :** Located close to Kanpur city (about 20 km away), Bithoor town is of great religious and historical significance in this region. It has been mentioned in various ancient Hindu manuscripts. According to legends, Bithoor became the residence of Lord Brahma after Lord Vishnu recreated the universe. It is believed that Utpalaranya forest was at this site where Brahma performed Ashwamedha Yagna. A temple was also established here which comprised of a 'Shivalinga' named as 'Brahmeshwar Mahadev'. After completion of the Yagna, this forest was given the name of Brahmavart Ghat (the seat of Brahma) [Image 39] which eventually got the name of Bithoor in long run (ICH, 2021). Today, this site is one of the most popular tourist and pilgrimage spot in Kanpur which is thronged upon by several visitors especially during auspicious occasions.

Image 39 : Brahmavart Ghat In Bithoor, Kanpur Nagar Distt.

17.2 In the later years after its establishment, Bithoor flourished under the reign of emperor Uttanpad. His son Prince Dhruva (who grew up to be a saint) was a great devotee of Lord Brahma. It is said that Dhruva meditated on one foot to appease Lord Brahma. Delighted with his dedication and devotion, Lord Brahma appeared before him and granted him the boon of immortality and Dhruva became a shining star in the galaxy. The star Dhruva Tara is named after him. Moreover, Dhruva Teela (Dhruva's Hill) still stands in Bithoor as an evidence to the penance performed by Dhruva (ICH, 2021) [Image 40]. There is a temple complex on this hill which is another popular tourist site in this region and is protected by Archaeological Survey of India. However, it is facing brunt of erosion impacts as discussed in an earlier section which needs to be addressed urgently.

Image 40 : Dhruva Teela Along Ganga River In Bithoor

17.3 **Sarsaiya Ghat :** It is a popular and an important Ghat along Ganga River in the heart of Kanpur city [Image 41]. Several tourists and pilgrims visit this Ghat especially on weekends and auspicious occasions such as Holi, Ganga Dushera and so on. Ganga Aarti is also performed at this Ghat which is a popular sight. Several boatmen aid the visitors here to experience boat ride on Ganga river in its vicinity. This Ghat has been restored and maintained under Namami Gange program along with cooperation of local authorities.

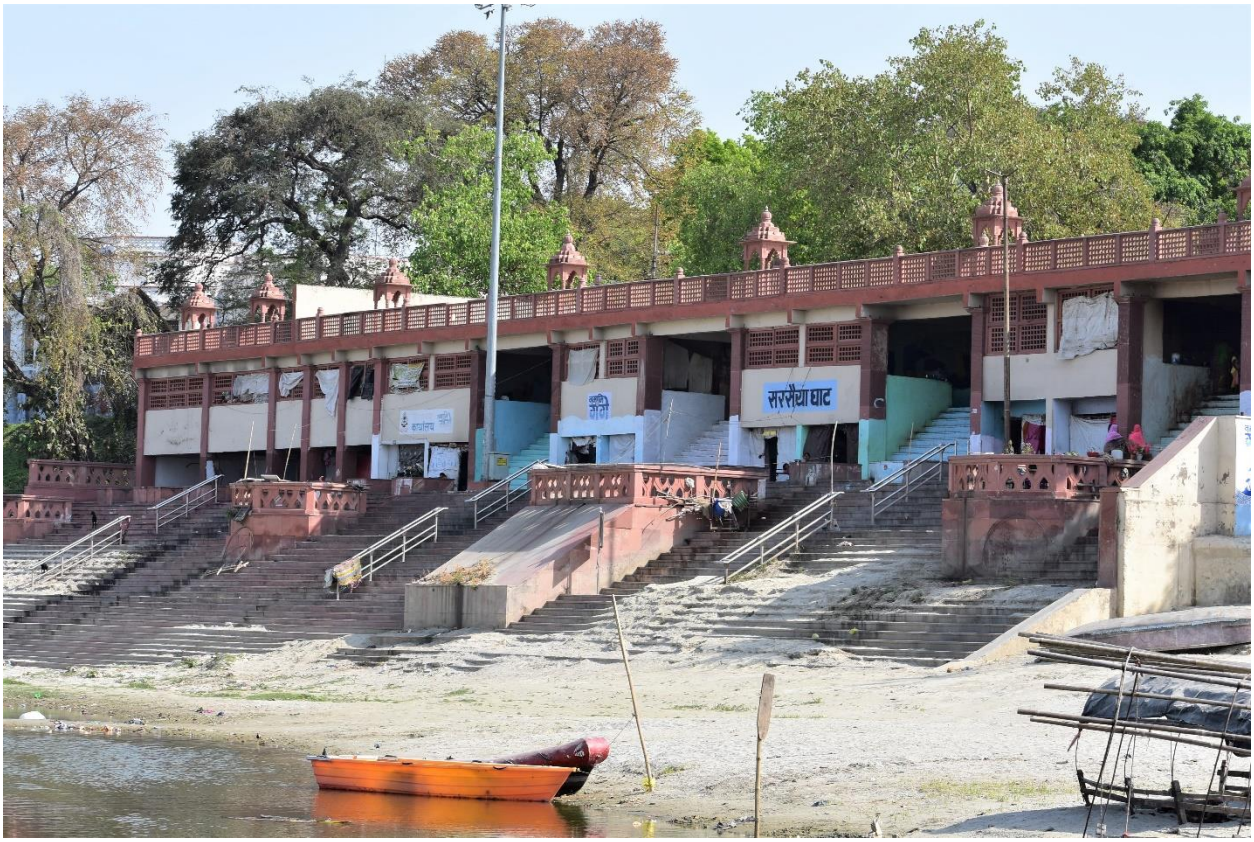


Image 41 : Sarsaiya Ghat In Kanpur City

17.4 **Aakin Ghat :** A temple complex was found at Aakin Ghat in the northern part of Kanpur Nagar Distt. which was mainly dedicated to Lord Shiva. Upon interaction, the priests associated with this temple reiterated that this site is believed to be more than hundred years old and is maintained by them along with support of village residents. Some sacred trees such as Banyan tree, Peepal tree and Pakad tree were also associated with this complex [Images 42-43]. However, erosion impacts were prevalent in this region causing destruction of complex land each year which prompted the local residents to voice for immediate attention in order to safeguard this lesser known yet important heritage site.

Image 42 : Temple Complex At Aakin Ghat With An Old And Sacred Banyan Tree In The Background

Image 43 : An Old And Sacred Ficus Sp. Tree (Locally Known As Pakad)

17.5 **Najabgarh :** An ancient temple dedicated to Lord Shiva is located on the Najabgarh Ganga Ghat which is also an important site in this Distt. [Image 44] Along with that several other ancient temples are located in a single row along Ganga River in this region, many of which are in neglected condition. Barring the development of Ghat in this region, nothing much has been done to preserve other temples which comprise of wonderful architecture and interiors. Some tourists and pilgrims especially from nearby villages and towns who are familiar with this site visit during auspicious occasions such as Mahashivratri and others to worship in these temples and take bath in Holy River Ganges.

Image 44 : Ancient Shiva Temple At Najabgarh Ganga Ghat

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. Such activity was observed during the survey along Ganga River near Saraiyya Ghat in the study region. Hence, it is strongly suggested through this study to take cognizance of this matter and develop suitable cremation facilities while ensuring that water pollution and ecosystem damage is prevented in this region.

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

18.2 The popularity of places such as Bithoor, Atal Ghat and Sarsaiya Ghat often leads to a high footfall of tourists and pilgrims which also leads to generation of solid and liquid waste. If appropriate measures are not ensured such waste may enter directly into the water of Ganga River and turn out be extremely hazardous by degrading the water quality and negatively impacting the aquatic biodiversity. Hence, it is suggested in this study to develop appropriate waste management strategies for the local communities directly linked to Ganga River.

18.3 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.

18.4 The wetlands observed in the study serve as crucial resources for livelihoods and day to day needs of local residents associated with them. However, no effort has been made to

ensure conservation and maintenance of these resources which has resulted in issues like sewage influx and dominance of invasive species. These wetlands if conserved properly have the potential to not only provide good fish resources, but also harbor other flora and fauna diversity, provide aesthetic benefits and clean water for various uses. Hence, it is strongly recommended to pay immediate attention for maintenance of these water bodies especially in conjunction with local stakeholders.

18.5 The riparian ecosystems are of high conservation priority owing to the rich biodiversity they support and the large-scale ecosystem services they provide. However, intensive agricultural practices including expansion of fields up to the current flow of Ganga River in many parts of this Distt. has already negatively impacted the riparian vegetation communities which is evident from the sparse growth and low species diversity of riparian plants recorded during this survey. This in turn impacts the associated faunal diversity as well as bank stability often leading to severe erosion during flood situation. Hence, it is recommended through this study to take up measures for checking the limit of agriculture in riparian areas of Ganga River in order to allow the natural biota to flourish.

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