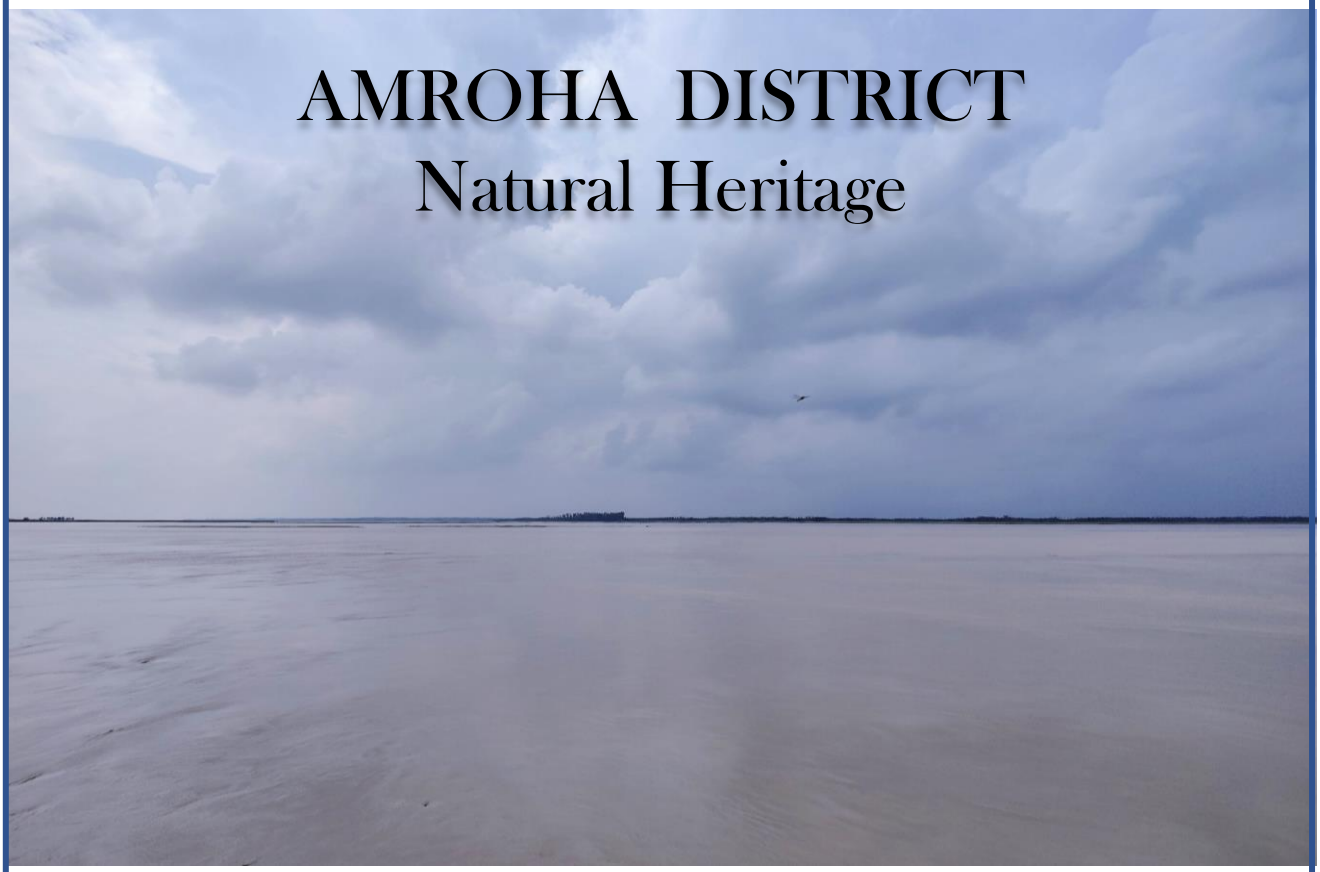
Ganga Cultural Documentation
2021



AMROHA DISTRICT
Natural Heritage

NAMAMI GANGE

National Mission for Clean Ganga

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Front Cover: Ganga River At Matena Ahatmali, Distt. Amroha

Background: Boat Parked At Ganga River, Distt. Amroha

Back cover: Tortoise Beetle [*Aspidimorpha miliaris*] Sighted Near Bhojpura

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GANGA CULTURAL DOCUMENTATION

AMROHA DISTRICT

Natural Heritage

October, 2021

Sponsored by :

National Mission for Clean Ganga

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1.0 Introduction

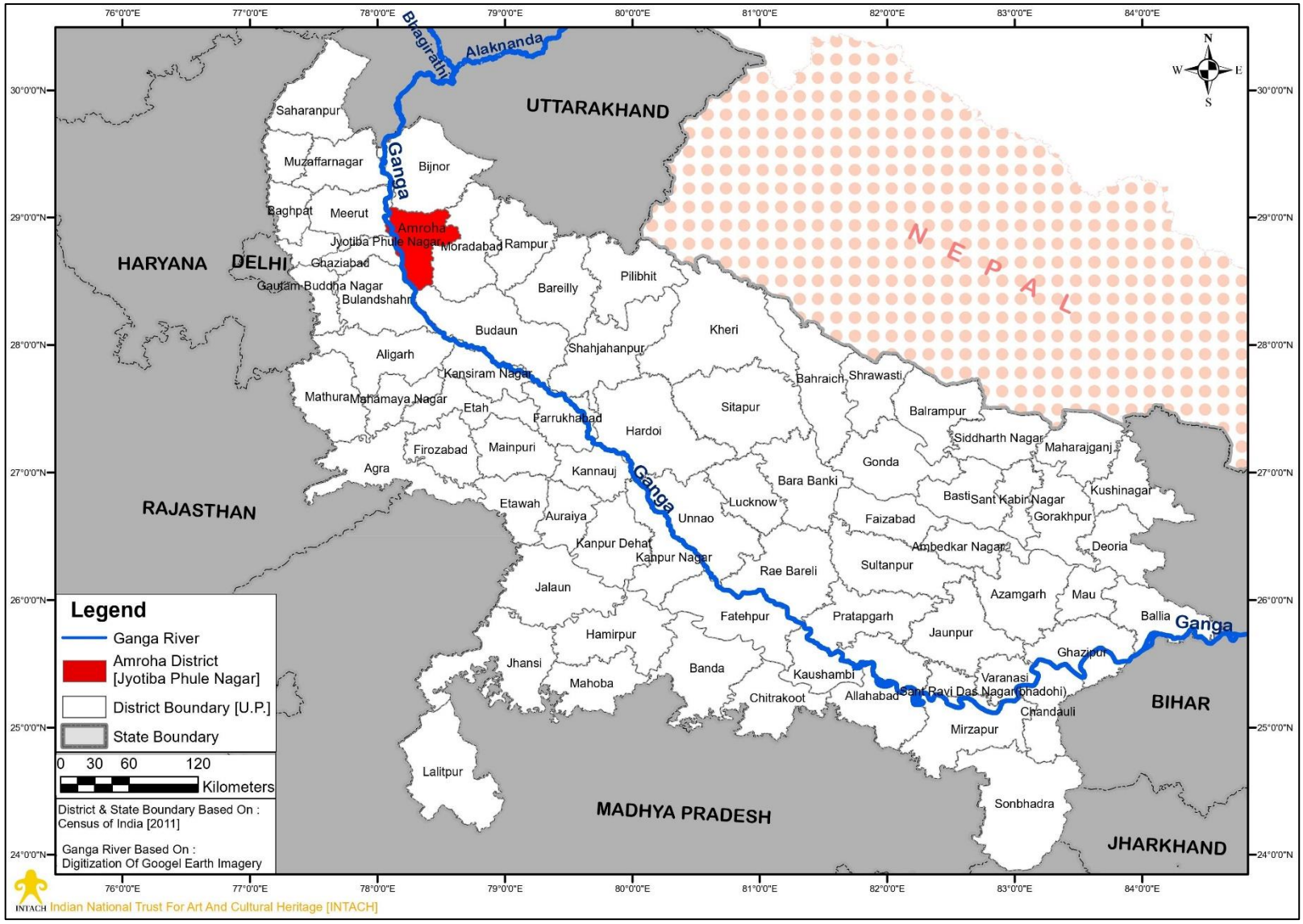
1.1 Distt. Amroha, situated on the left bank of Ganga River [Approx. 88 km reach in the Distt.], occupies the central part of the Moradabad division. The district came into existence on 24th April, 1997 and was named as Jyotiba Phule Nagar after eminent social worker Jyotiba Phule. It comprises of three erstwhile tahsils viz. Amroha, Dhanaura and Hasanpur of Distt. Moradabad. In 2012, the district was renamed as Amroha.

1.2 The geographical area of the Distt. is 2,249 Sq. km which is about 0.92 percent of the total Uttar Pradesh area. It shares boundary with Distt.s. Meerut, Hapur and Bulandshahr in West [Across Ganga River], Moradabad Distt. in East and Bijnor Distt. in North and Badaun Distt. in South. The Distt. is divided into 6 development blocks and 4 tehsils – Amroha, Hasanpur, Dhanaura and Naugawan Sadat.

1.3 The Amroha Distt. is a part of the Doab region of Indo-Gangetic plains, sloping towards the South. It is drained by tributaries and rivers of various order such as Baha Nala, Mahawa [or Western Bagad], Tikta [Eastern Bagad], Chhoiya Nala, Ban and Gangan. Geomorphologically[1], the region is flat with little physiographic variation and gentle slope. The north and north-eastern parts are comparatively higher and broadly divided into two major geomorphologically units – younger and older alluvium. Younger alluvium is found in newer floodplain area along river channel. It consists of sand, silt and salty sand with minor clays. Older alluvium is found in older floodplain which can be delineated over a few kilometres and locally known as Khader. Older alluvium occupies the entire upland or inter fluvial area occurring between the major drainage. They are composed of silty, clayey and sandy in varying proportions.

1.4 Distt. Amroha is known for its older industries of pottery making, manufacturing of Dholak [a musical drum made of hollow wood], Katholi, wooden toys, and handloom weaving. Modern industry includes waste cotton, Kaleen [carpet], Bidi [handmade cigarette] making industries[2]. Agriculture remains the major employer with wheat, rice and sugarcane as major crops. Other agrarian products include oil seeds, groundnut, sun-hemp, tobacco, various vegetables and fruits. Two mango varieties viz. Langda and Dasehri are more popular and supplied all over India.

[1] Aquifer Mapping and Management of Ground Water Resources, Amroha District, Uttar Pradesh, CGWB [2017-2018]
[2] https://www.amroha.info/about.php



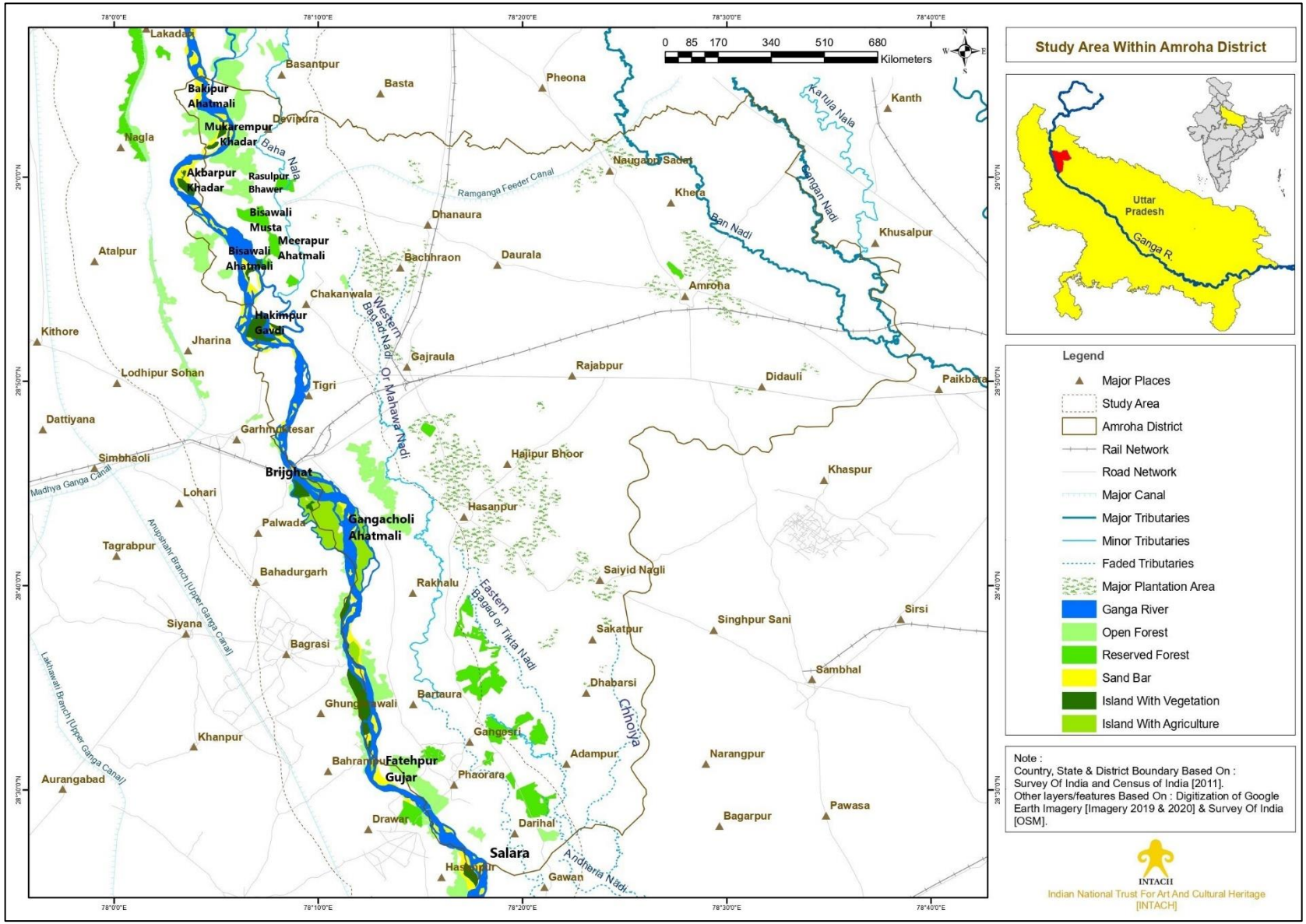
Map 1 : Location Of Amroha Distt. On Left Bank of Ganga River

2.0 Ganga River in Amroha Distt.

2.1 Ganga River enters Amroha Distt. near Bakipur Ahatmali, after crossing Bijnor district [See Map No.2]. The river channel is around 0.5 km to 1 km in width here. The length of Ganga River in Amroha Distt. is around 88 km, coursing along Distt. boundary on its east/left bank. Most of the Distt. boundary area along Ganga River consists of flat floodplain areas which are under cultivation, scrublands at some places, depressions and paleochannels. From the point where Ganga enters the district, it meanders with a concave turn towards left bank [at Makarempur Khadar] forming a huge island on its opposite side. Further, it meanders in the same form towards right bank forming island at Akbarpur Khadar. Further downstream, it takes south-easterly turn and bifurcates at Bisawali Ahatmali forming a narrow channel towards right bank. The left bank channel again bifurcates and forms a concave right bank at Hakimpur Gavdi. From here, the Ganga River flows in a narrow channel with width around 1 km till Brijghat. From Brijghat the river slightly turns east and later flowing straight till it turns east again and exits Amroha district near Salara village. The river width in this stretch varies between 1 km to 2. The river turns into narrow braided channels passing through these islands and sandbars.

2.2 Ganga river stretch in Distt.s Amroha [from Garhmukteshwar Ganga Bridge at Brijghat] 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.

Image 1 : View of Ganga River At Matena Ahatmali, Distt. Amroha



Map 2 : Study Area In Amroha 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 four main tributaries of Ganga River in Amroha district which run almost parallelly with the river channel [at a distance of 4 km to 20 km east of Ganga River]. They are Baha Nadi/Nala, Mahawa or Western Bagad Nadi, Tikta Nadi or Eastern Bagad Nadi, and Chhoiya. The latter three join together in district Badaun to become a single channel which drain near village Kurbanpur in district Badaun in Uttar Pradesh. Other two rivers i.e. Ban and Gangan run through its north-eastern part of the district. The details are given below:

a) **Baha Nala/Nadi :** It is smaller stream which enters the District Amroha from District Bijnor and flow parallell to Ganga River at a distance of 2 km to 6 km east. The Moradabad Gazetteer of 1968[3] describes the Baha Nadi as given below:

"This small stream enters the district from the district of Bijnor near the village of Papsari (in tahsil Hasanpur) on the northern border of the district. Flowing southwards from about 2 km, it takes a south-westerly course as far as Mukarampur from where it flows in a southeasterly direction till it merges in a broad semi-circular lagoon known as Jaithal Dhab (from which the district boundary is about 5 km away), south of the village Azampur (in the same tahsil) where it is joined by another stream, the Krishni and irrigates the rabi crops"

Image 2 : Baha Nala/Nadi At Bhojpura, District Amroha

[3] Uttar Pradesh District Gazetteers, Moradabad, (1968), Published by Dept. of District Gazetteers, U.P. Lucknow

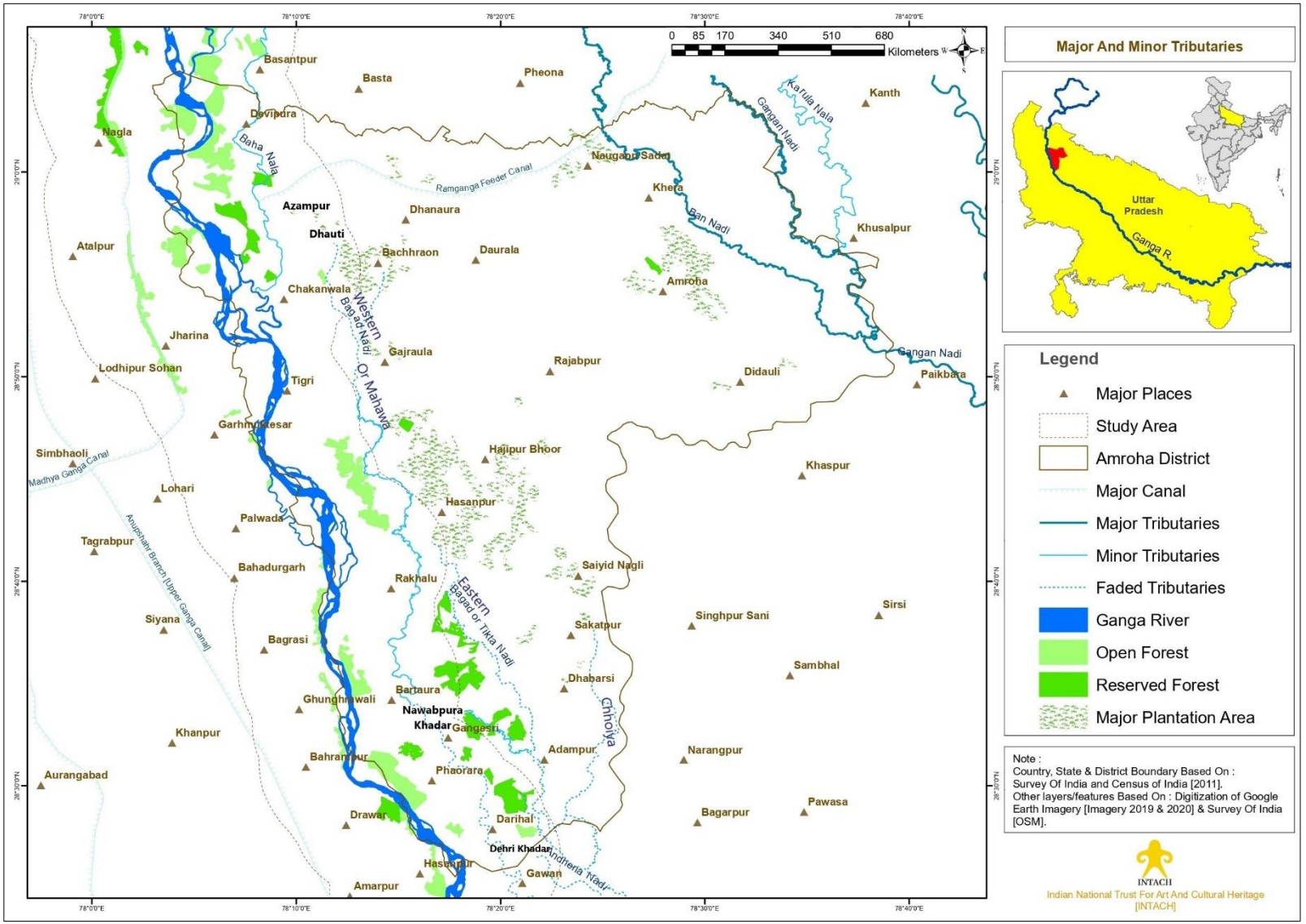
b) **Mahawa or Western Bagad Nadi :** It is also a smaller stream with width ranging from 5 to 50 metres flowing at a distance of 4 km to 6 km from east of Ganga River. Moradabad Gazetteer of 1968 describes the Mahawa River as given below:

"*This stream (which is also as the Mohaia or western Bagad) rises near Dhauti (in Tahsil Hasanpur) about 6 km south of the village of Azampur where the swamp below the bhur cliff spreads out into a deep morass. Receiving flood-water from the Bagad jhil, it flows South and follows the line of jhils as far as Basai Sahsoli (close to the village of Sihali Jagir). It takes a south-easterly course near the village Nawabpura Khader and leaves the district near the village Dehri Khader to join the Ganga in the district of Badaun. Throughout its course it is fed by several small channels and is dammed at many places.*

c) **Tikta or Eastern Bagad :** The Tikta or eastern Bagad Nadi runs parallel around 2km to 8 km east to Mahawa or Western Bagad Nadi. The Moradabad Gazetteer of 1968 describes the Tikta or Eastern Bagad River as given below:

"*This stream rises from the Dhab near the village of Jhundi Muafi in the central part of tahsil Hasanpur. It follows a winding course and before leaving the district near the village of Imratpur it forms, for about 3 km, the boundary between this district and that of Badaun. In this district it is known as the Tikta or eastern Bagad in the early part of its course but is called the Khulaila after it leaves the swamp near the village of Kanaita and the Nakatia from the village of Adampur onwards. In its course it is fed by many small channels and is also connected with the Jabda and Jharrawali jhils lying on the east. During the monsoon season it receives the water of the Mahawa (or western Bagad) when the whole of Ganga khadar becomes an unbroken sheet of water except for the higher portions of the Bagad bangar. Its waters are used for irrigation, earthen dams being built annually on it".*

d) **Chhoiya Nala :** As traced from Survey of India [Open Series Map/toposheet No. H44S6], the Chhoiya Nala has its origin near village Sutari or Sutari khurd in Hasanpur tahsil. It flows down south through villages of Faiyaznagar, Kudarsi and takes south-westerly turn at Kokapur . Further it flows through Bagadpur Chhoiya , Kharagani , Talawar finally meeting eastern Bagad or Tikta River near Bhhobra. The stream is untraceable on Google Earth satellite imagery and apparently has been encroached by surrounding agriculture fields.



Map 3 : Major and Minor Tributaries In Study Area

5.0 Land Use Land Cover [LULC]

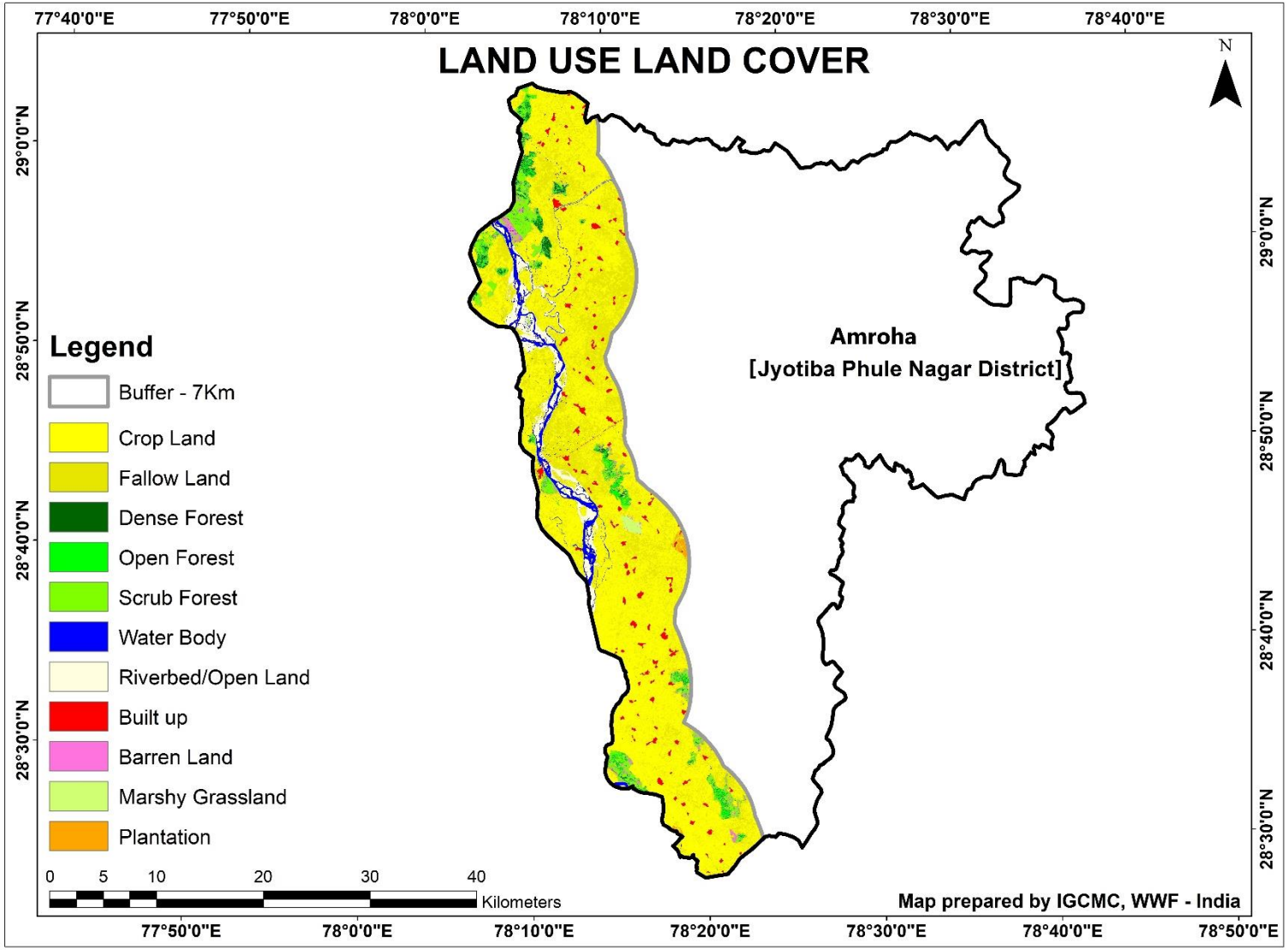
5.1 Land Use Land Cover [LULC] map of the study area has been prepared from Landsat imagery for the year 2020. [Table No.1] Using supervised classification system, 11 different classes were generated – crop land, fallow land, dense forest, open forest, scrub forest, waterbody, riverbed/open land, built-up area, barren land, swampy land, plantation [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 53.54 % of the total area [372.06 Sq.Km]
ii. Fallow land comes second with 27.99 % area under cultivation [194.47 Sq.Km]
iii. Together, the total area under agriculture is around 81.53% [566.53 Sq.km]
iv. Scrub Forest accounted for 4.54% [31.57 Sq.km], while Open and Dense Forest cover 10.90 Sq.km and 9.10 Sq.km of area respectively.
v. Waterbody which also includes river area is around 2.99 % [i.e., 20.76 Sq.km]
vi. Built-up area is 2.13% [14.83 Sq.km] while Barren land is only 0.18% [0.35 Sq.km
vii. Plantation [which are primarily Mango, Poplars, Eucalyptus trees] covers 0.13% area [i.e., 2.13 Sq. km]
viii. Swampy land is around 0.30% [2.05 Sq.km]

Table 1 : Land Use Land Cover of Study Area In Amroha Distt. [2020]

S.No.	Classes	Area (Ha)	Area (Sq.Km)	Area (%)
1.	Crop Land	37206.30	372.06	53.54
2.	Fallow Land	19447.50	194.47	27.99
3.	Scrub Forest	3157.10	31.57	4.54
4.	Riverbed/Open Land	2959.00	29.59	4.26
5.	Water Body	2076.93	20.76	2.99
6.	Built-up	1483.32	14.83	2.13
7.	Open Forest	1090.49	10.90	1.57
8.	Dense Forest	910.68	9.10	1.31
9.	Barren Land	741.28	7.41	1.07
10.	Plantation	213.34	2.13	0.31
11.	Swampy Land	205.23	2.05	0.30
	Total	**69491.17**	**694.91**	**100%**

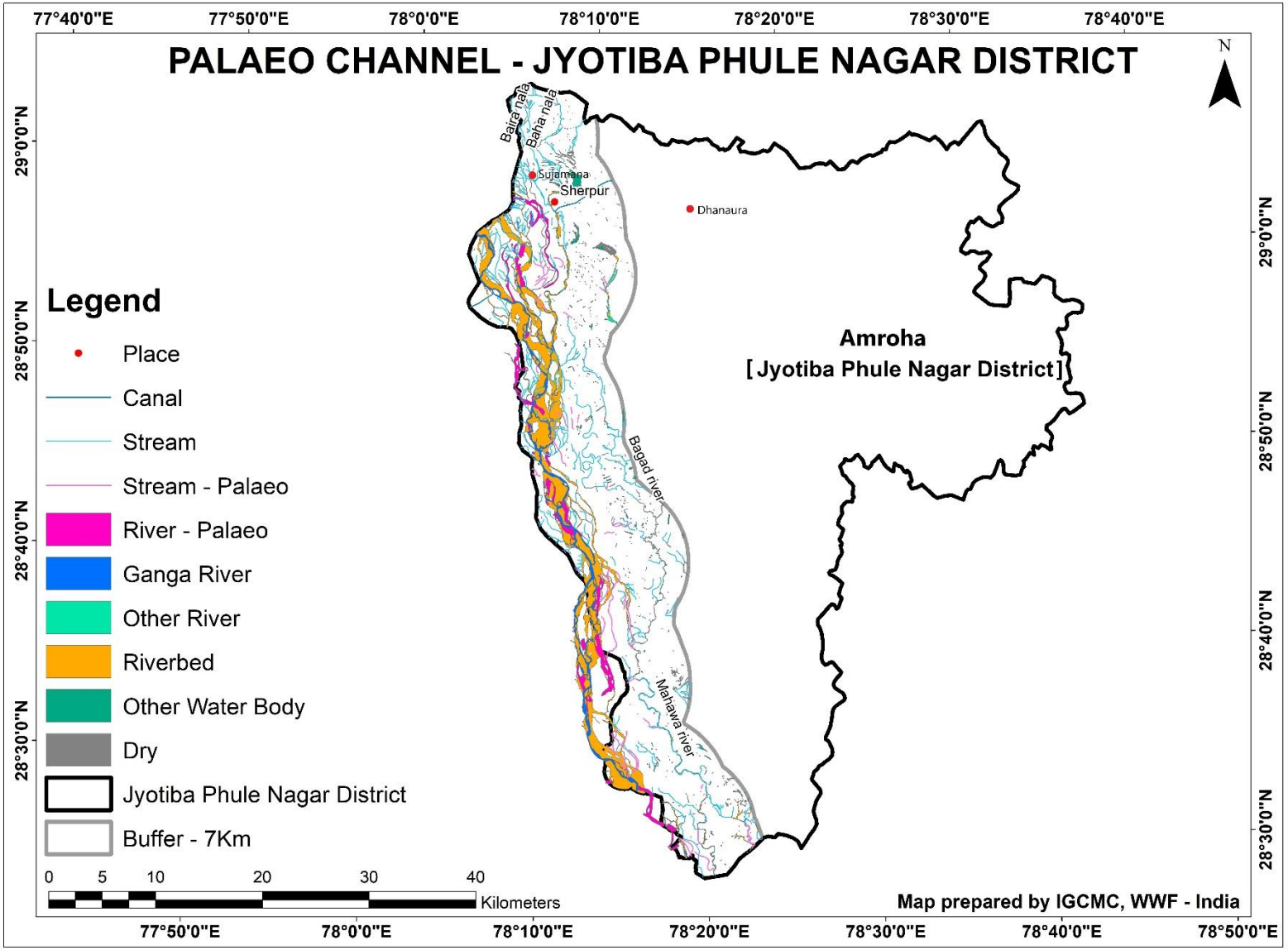


Map 4 : Landuse Landcover Map of Study Area [Distt. Amroha]

6.0 Palaeochannels Of Ganga River In Amroha 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 palaeo-channels 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 palaeo-channels in the study area of Amroha Distt.

Image 3 : Palaeochannel Near Village Sujamana, District Amroha



Map 5 : Palaeochannels In The Study Area [Distt. Amroha]

7.0 Floodplain Of Ganga River In Amroha Distt.

7.1 The active flood plain of a river is defined as an area on either side of the river channel with regular flooding on a periodic basis. Maintaining active flood plain of a river is critical for assuring equilibrium in ecosystem. The floodplains harbour rich biodiversity including riparian vegetation as well as many other groups of organisms which help in maintaining fertility of this region. Along with this, the floodplains have been of great cultural and economic importance with many early civilizations having risen in these fertile lands. As the rivers naturally meander through the landscape over a period of time, they deposit sand, silt and other soil forming materials in the floodplain region which make them ideal for agricultural production. Throughout history, people have learned to cultivate in the fertile floodplains and use their rich resources for sustaining livelihoods. Even today, in most of the riverine regions especially in India, the floodplains have been occupied by local farmers for carrying out their agricultural activities especially in the non-monsoon season. Ganga River floodplain is one such important floodplain in India which has been extensively utilized in almost all the Districts, where it passes through, for agricultural purposes.

7.2 Ganga River floodplains in Amroha Distt. are generally flat with depressions, ravines, paleochannels and some upland tracts dotted 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 paleochannels similar to pattern observed in adjacent districts Hapur and 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. Water melons, musk melons, cucumbers, ground-nut, tomatoes, oil seeds, potatoes, onions, garlic and ginger are mainly grown crops. 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, its smaller tributaries and older channels ensure water availability and thus irrigation of crops is easier.

Image 4 : Ganga River Bank At Matena Ahatmali, Distt. Amroha

Image 5 : Floodplain Vegetation Near Bhojpura, Distt. Amroha

8.0 Wetlands In Amroha 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 27 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	29° 3'7.09"N	78° 7'0.63"E	7.37
02	02	29° 1'53.91"N	78° 8'8.41"E	0.24
03	03	29° 2'39.28"N	78° 4'43.60"E	6.27
04	04	28°59'39.93"N	78° 9'42.72"E	0.51
05	05	28°59'9.20"N	78° 6'6.02"E	5.75
06	06	28°59'1.35"N	78° 5'35.18"E	0.79
07	07	28°58'31.71"N	78° 4'53.81"E	1.10
08	08	28°57'15.40"N	78° 9'41.11"E	28.9
09	09	28°53'11.38"N	78°10'21.22"E	0.39
10	10	28°51'59.16"N	78° 9'21.16"E	1.46
11	11	28°51'12.18"N	78°10'48.86"E	0.45
12	12	28°49'18.34"N	78°12'38.54"E	12.8
13	13	28°47'46.49"N	78°10'28.85"E	2.00
14	14	28°46'58.88"N	78° 9'56.36"E	0.68
15	15	28°46'52.96"N	78°11'51.79"E	0.42
16	16	28°46'50.51"N	78°11'46.48"E	0.28
17	17	28°46'12.69"N	78° 9'2.71"E	5.33

18	18	28°46'10.42"N	78°10'3.52"E	0.32
19	19	28°46'18.02"N	78° 9'55.52"E	0.83
20	20	28°45'34.89"N	78° 9'56.43"E	0.38
21	21	28°45'1.64"N	78°11'45.25"E	0.76
22	22	28°43'25.32"N	78°14'40.87"E	0.46
23	23	28°40'50.79"N	78°13'41.31"E	1.00
24	24	28°40'40.40"N	78°13'59.62"E	1.24
25	25	28°37'59.74"N	78°14'24.65"E	1.24
26	26	28°37'13.19"N	78°12'29.38"E	3.49
27	27	28°27'55.98"N	78°19'47.02"E	1.55
Total Area [Hectares]				**86.01**

8.3 Few waterbodies visited during field survey have been described below:

8.4 **Jehtoli Mustehkam Talab :** The talab lies on the southern edge of Jehtoli Mustehkam village [Wetland No. 25]. It is located around 2 km east from Ganga Bund Road which connects with NH-24 in north. There is a govt. overhead tank at the approach point of talab. The waterbody is completely covered with Water Hyacinth [*Eichhornia crassipes*] with barely any space for water. It receives sewage runoff from the village and also threatened by solid waste thrown on its edges. It is getting encroached from the its northern side [village side]. There is a large waste land plot [around 3 Ha in area] located at its south. A part of it belonged to the waterbody which has now dried up. Few trees and wasteland species were observed near the waterbody. Major tree species noted were Sheesam [*Delonix regia*], Pipal [*Ficus religiosa*], Jamun [*Syzygium cumini*], and Mango [*Mangifera indica*]. Wasteland plant species were Asthma plant [*Euphorbia hirta*], Chirchita [*Achyranthes aspera*], Country Mallow [*Abutilon indicum*], Kasaunda [*Senna sophera*], Desert Horse-purslane [*Trianthema portulacastrum*]. During interaction with the villagers, it was known that waterbody has been in the same condition for years now. Earlier it was used for bathing, fishing and chest nut cultivation.

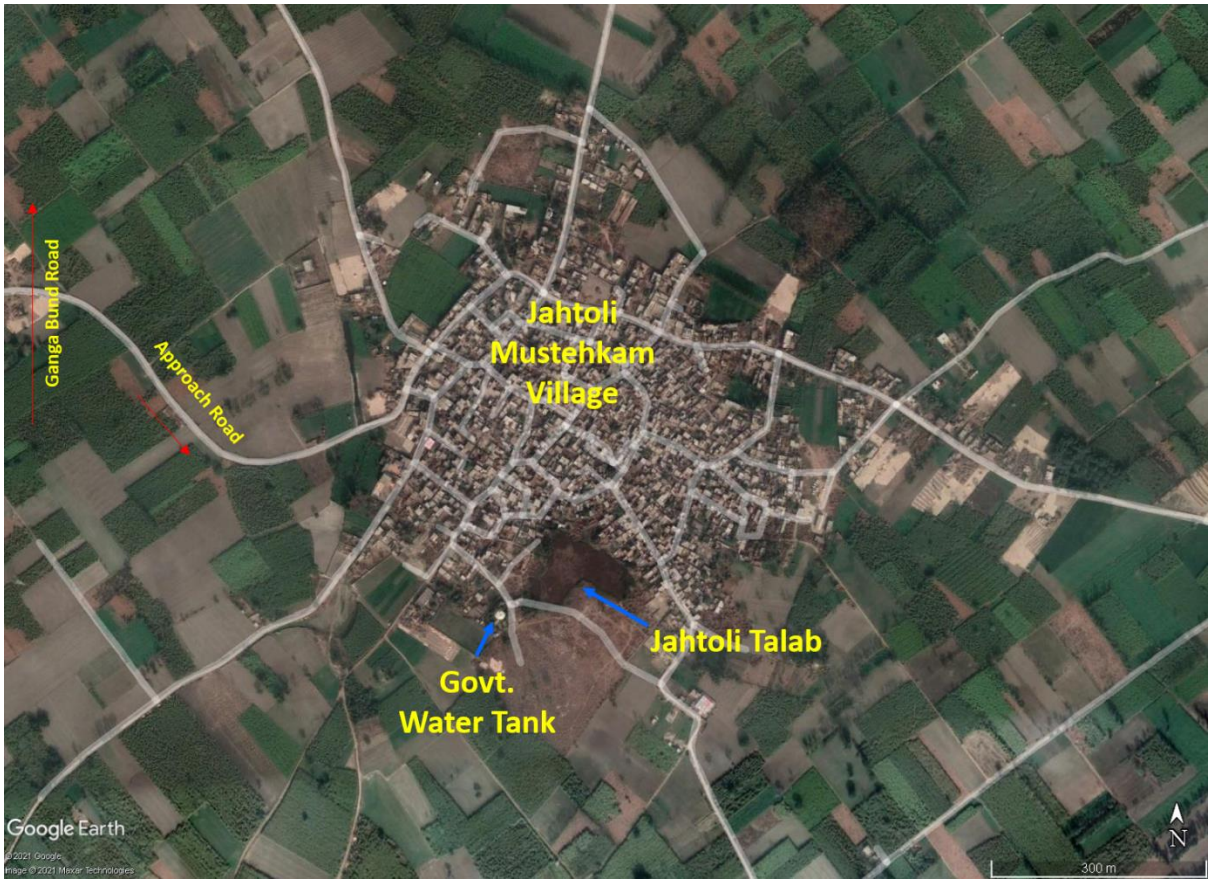


Image 6 : Location of Jehtoli Mustehkam Talab [28°37'58.10"N, 78°14'21.18"E]

Image 7 : Jehtoli Mustehkam Talab [Looking Northeast]

8.5 **Piploti Khurd Talab :** This pond is located southwest of Piploti Khurd village on the main Ganga Bund road leading to National Highway – 24, [Wetland No. 23]. This is only remaining waterbody of the village. Unlike other waterbodies in the study area, the talab has water and no floating or submerged vegetation was observed during the field visit. The pond is used by villagers for fishing. Main fish species are Manghur (*Clarias batrachus*), Sauli (*Channa punctata*) and Kari or Pangas (*Pangasianodon hypophthalmus*) which are sold locally in the Distt.. 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. The pond is under encroachment pressure from the village side [northeastern edge]. Close analysis with the help of ESRI's World Imagery Wayback Atlas [Imagery dated 2nd February, 2014] reveals that there were very few structures on its northeastern edge during that period in comparison to the current progression into the pond. The edges of the pond were observed devoid of riparian vegetation except few trees on the village side.

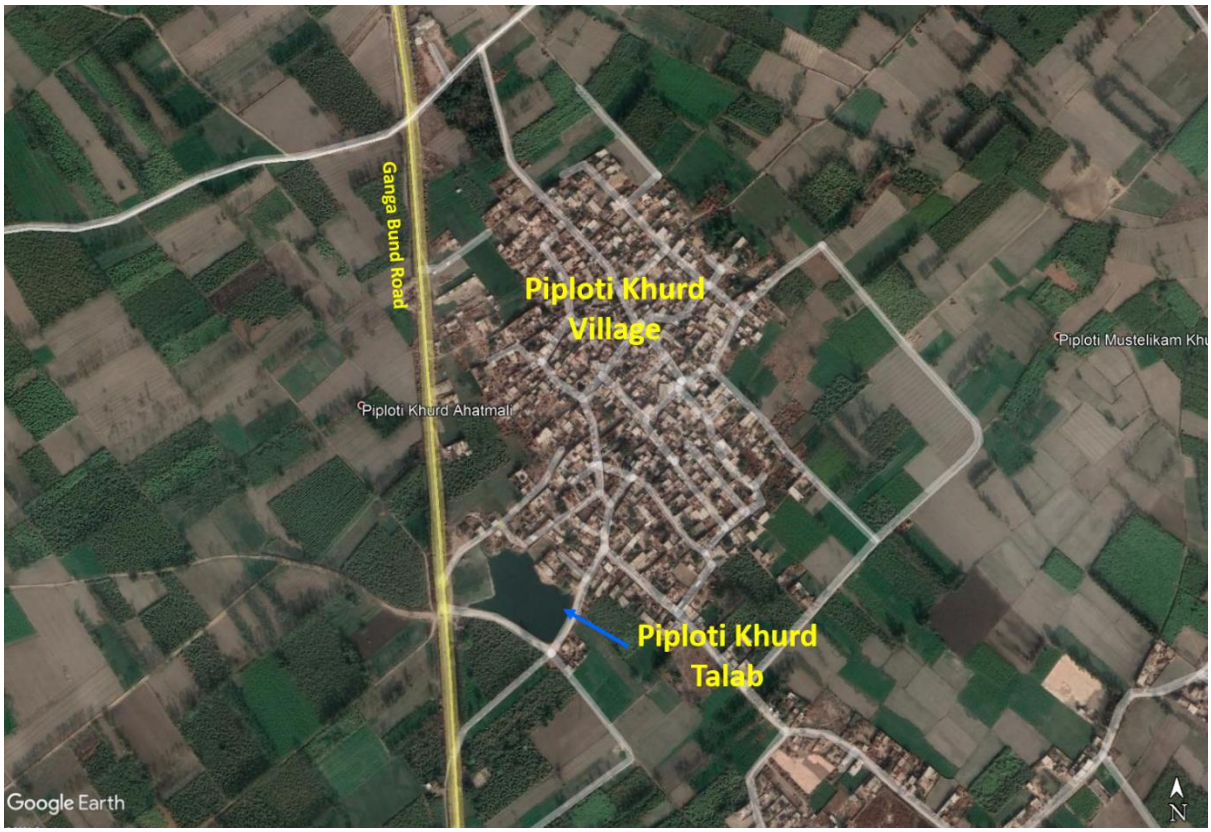


Image 8 : Location of Piploti Khurd Talab [28°40'50.72"N, 78°13'38.49"E]

Image 9 : Northern Edge of Talab Encroachment [from Year 2014 and 2021]

Image 10 : Piploti Khurd Talab [Looking Northeast]

8.6 **Qasimabad Talab :** This pond is located on the main National Highway-24 [Delhi-Meerut Road] at northern edge of Qasimabad village. This is the largest waterbody of the village. It receives sewage runoff from the village and currently in highly eutrophic condition. It was observed completely choked with Water Hyacinth [*Eichhornia crassipes*] and other aquatic vegetation. It is also threatened by solid waste disposal and encroachment along its edges. Close analysis with the help of ESRI's World Imagery Wayback Atlas [Imagery dated 2nd February, 2014] reveals that the talab area was larger than its present size and the progressive construction on its edges is clearly visible through current Google Earth imagery, 2021 [Also check Image no.11 taken during field visit]. Upon interaction with local community members, it was known that the talab has been the source of income for many years. It was used for fishing and chestnut cultivation. Not it has been lying in the same condition for last few years.

Image 11 : Qasimabad Talab [Looking South]

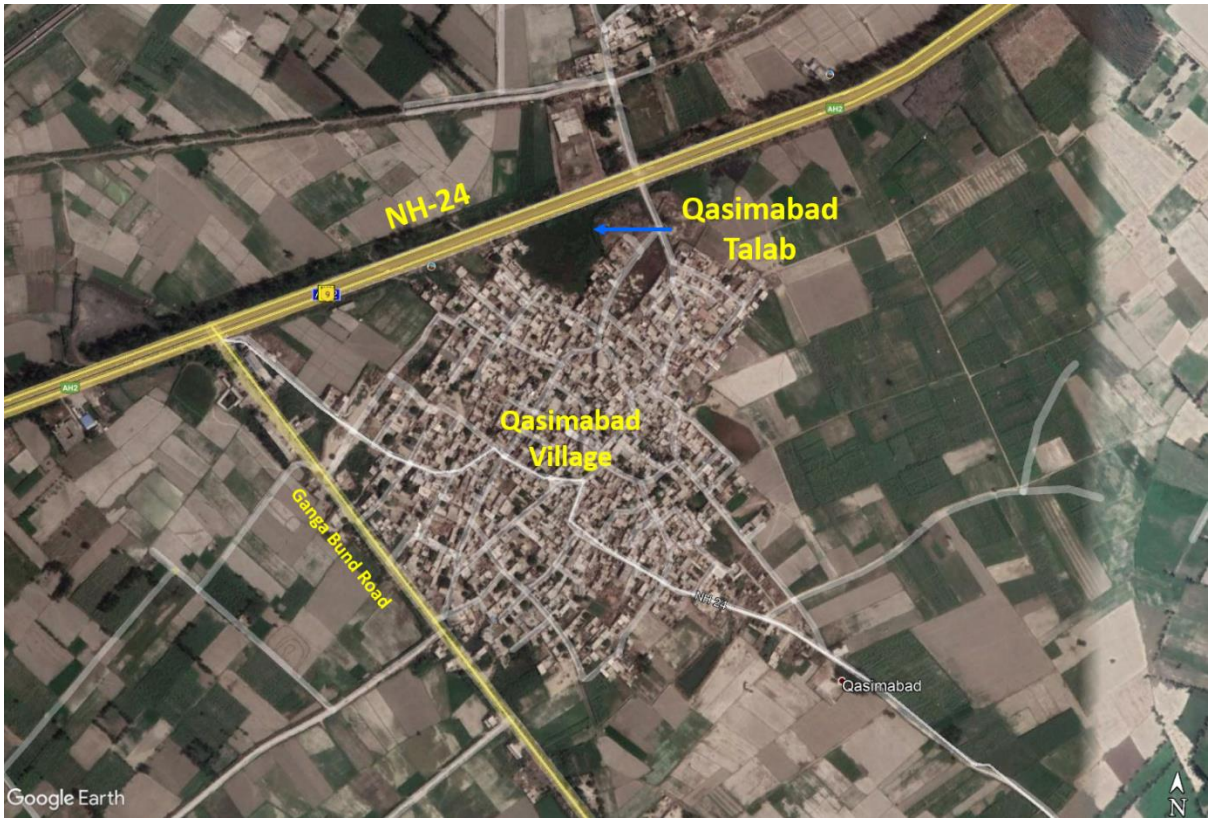


Image 12 : Location of Qasimabad Talab [28°46'19.56"N, 78° 9'55.03"E]

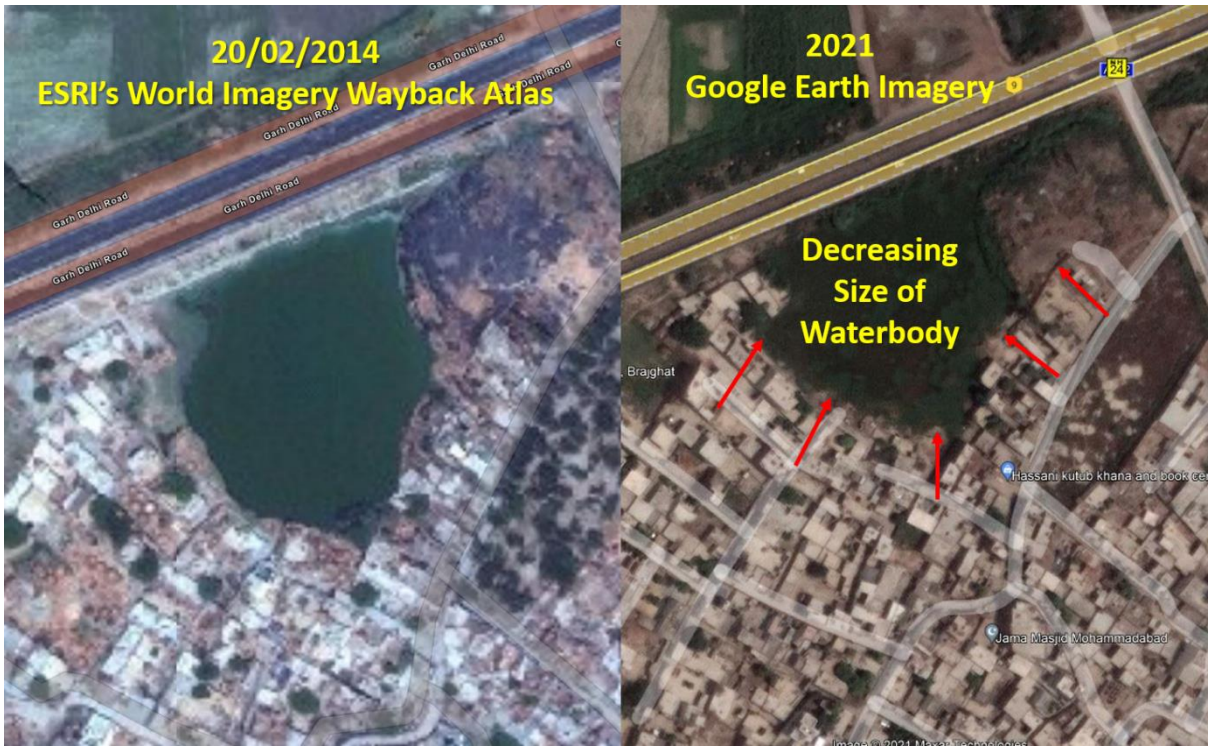
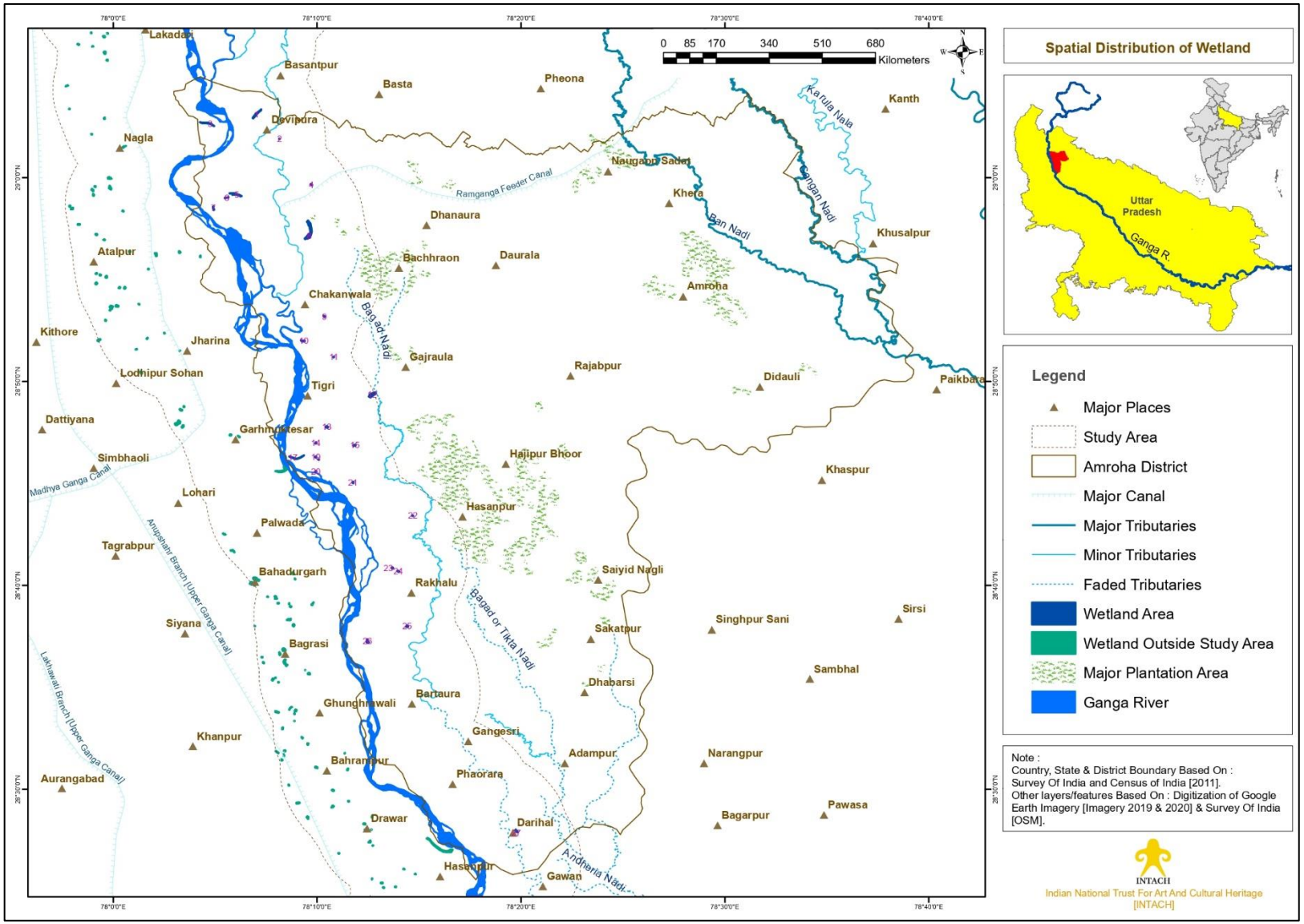


Image 13 : Decreasing Size Of Qasimabad Talab [Comparison Year 2014 and 2020]



Map 6 : Spatial Distribution Of Wetlands In The Study Area

9.0 Riparian Flora Along Ganga River In Amroha 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 recently, no 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 Amroha district is very similar to that of Hapur and Bulandshahr Distts. 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 Meerapur ahatmali, Bisawali musta, Rasulpur bhawer and aquatic weeds in the swampy areas along the river. Patches of 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 and river banks 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 India Mallow [*Abutilon indicum*], Devil's Thorn [*Tribulus terrestris*], Congress Grass [*Parthenium hysterophorus*], Coffee Senna [*Cassia occidentalis*], Goat Weed [*Ageratum conyzoides*], Buffel Grass [*Cenchus ciliaris*], Setaria

[*Setaria viridis*], Khus [*Vetveria zizanoides*], Calotropis [*Calotropis procera*], Lantana [*Lantana camara*] along with riparian grasses.

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.	*Ficus religiosa* L.	Peepal	Moraceae
2.	*Ficus benghalensis* L.	Banyan	Moraceae
3.	*Ficus racemosa*	Gular	Moraceae
4.	*Ficus virens*	Pilkhan	Moraceae
5.	*Mangifera indica*	Aam	Anacardiaceae
6.	*Populus spp.*	Poplar	Salicaceae
7.	*Eucalyptus spp.*	Liptis	Myrtaceae
8.	*Phoenix dactylifera L.*	Khajur	Arecaceae
9.	*Bombax ceiba L.*	Semal	Bombacaceae
10.	*Ziziphus mauritiana*	Indian Jujube	Rhamnaceae
11.	*Polyalthia longifolia*	Ashoka	Annonaceae
12.	*Albizia lebbeck*	Black Siris	Fabaceae
13.	*Albizia procera*	White Siris	Fabaceae
14.	*Aegle marmelos*	Bel	Rutaceae
15.	*Phoenix dactylifera L.*	Khajur	Arecaceae
16.	*Melia azedarach*	Bakain	Meliaceae
17.	*Albizia lebbeck*	Siris	Fabaceae
18.	*Leucaena leucocephala*	Subabool	Fabaceae
19.	*Butea monosperma*	Dhak	Fabaceae
20.	*Morus alba*	Shahtoot	Moraceae
21.	*Madhuca indica*	Mahua	Sapotaceae
22.	*Terminalia bellerica*	Baheda	Combretaceae
23.	*Terminalia arjuna*	Arjun	Combretaceae
24.	*Bambusa vulgaris*	Bamboo	Poaceae
25.	*Syzygium cumini*	Jamun	Myrtaceae
26.	*Azadirachta indica* A. Juss.	Neem	Meliaceae
27.	*Acacia nilotica* L.	Babool/Kikar	Fabaceae

28.	*Acacia modesta*	Phulai	Fabaceae
29.	*Pithecellobium dulce*	Jungle Jalebi	Fabaceae
30.	*Dalbergia sisso*	Sheesham	Fabaceae
31.	*Pongamia pinnata*	Pongam/Karum	Fabaceae
32.	*Senna siamea*	Kassod Tree	Fabaceae
33.	*Murraya Koenigii*	Curry Tree	Rutaceae
34.	*Tamaridus indica*	Imli	Fabaceae
35.	*Putranjiva roxburghii*	Putranjiva	Putranjivaceae

Image 14 : Riparian Vegetation On Ganga Banks Visible From Bhagwanpur Bridge

Image 15 : Indian Mallow [*Abutilon indicum*] Near Bhojpura

Image 16 : Indian Catmint [*Anisomeles indica*] At Chaupura Khadar

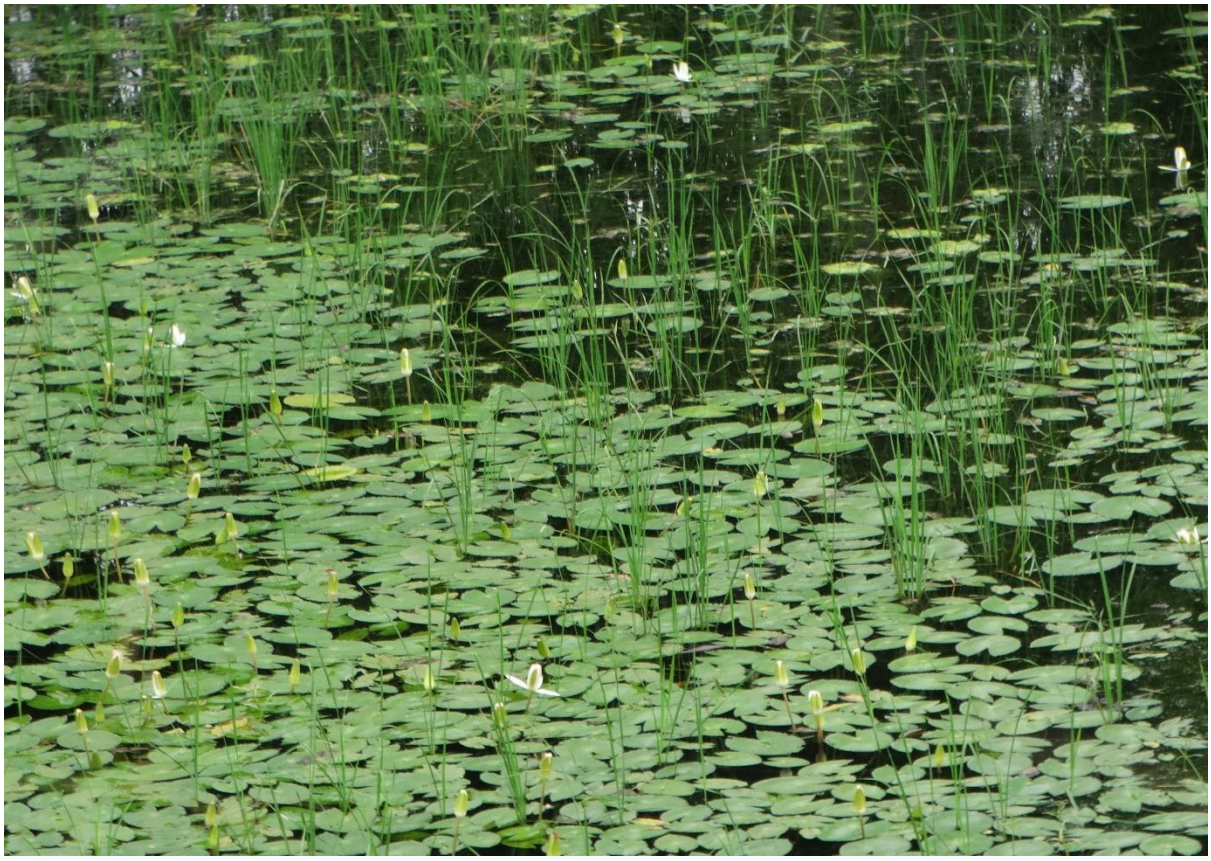


Image 17 : White Lily [*Nymphaea alba*] In Shallow Depression At Chaupura Khadar

10.0 Faunal Diversity Along Ganga River In Amroha 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 a 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 Leopard [*Panthera pardus fusca*], Indian Jackal [*Canis aureus indicus*], Indian Fox [*Vulpes bengalensis*], Monkey [*Rhesus macaque*], Langur [*Semnopithecus spp.*], Indian Hare [*Lepus nigricollis*]. There have been frequent reports of Indian Leopard's [*Panthera pardus fusca*] presence in the district during the current year [2021]. One female leopard was recently rescued on 25th September, 2021 from Naugawan Sadat area of District Amroha[4]. Nilgai [*Boselaphus tragocamelus*] and Wild Boar [*Sus scrofa*] are also found in variable numbers across the district 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:

[4] https://www.aninews.in/news/national/general-news/leopard-rescued-from-ups-amroha20210927002341/

Orthoptera), Stick insects and Leaf insects (Order: Phasmatodea), Butterflies and Moths (Order: Lepidoptera). Among Dragonflies and Damselflies, Ruddy Marsh Skimmer [*Crocothemis servilla*], Coromandel Marsh Dart [*Ceriagrion coromandelianum*], Common Tiger [*Danaus chrysippus*], Common Grass Yellow [*Eurema hecabe*] were frequently sighted. Sighting of Tortoise Beetle [*Aspidimorpha miliaris*] in riparian vegetation near village Bhojpura was a special moment during field visit [Image-20].

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[5] 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 in the Ganga River stretch of district. 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 fishermen especially during summer season when the sandbars and island are exposed. In 2015, a batch of 678 Gharials was released in

[5] With three calves, Ganges dolphin population up to 36 in UP, Times of India, Oct.16, 2019

2015 near Makhdumpur village [District Meerut – right bank of Ganga River, opposite northern part of district Amroha] in Hastinapur Wildlife Sanctuary – out of which only 16 Gharials survived[6]. 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 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[7] in 2011 mentioned the presence of 12 species of turtles between Bijnor and Kanpur stretch of Ganga River [Table-5]. 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, 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

[6] WWF rescues Gharial trapped in Ganga canal after gates shut monsoon. Oct.28, 2017
[7] 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.

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 34 bird species were sighted. Out of which 11 are aquatic species and remaining 23 are terrestrial birds [Table-5].

10.9 Important observations are:

- Bird population seems to be sizeable due to diversity of habitats – rivers, swamps, depressions, lakes, riparian buffer of channels, open lands, and agriculture fields.
- Aquatic vegetation and riparian grasses of palaeo-channels, 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 Yellow-wattled Lapwing White-throated Kingfisher, River Tern, Grey Heron, Indian Pond Heron, Great Egret, Cattle Egret, and Cormorants.
- Birds sighted more frequently in and around waterbodies are Indian Pond Heron, Egrets, White-throated Kingfisher, Common Moorhen, White Breasted Waterhen, Jungle Babbler, Indian Robin and Common Tailorbird.
- 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.	White-breasted Waterhen	*Amaurornis phoenicurus*	Least Concern
3.	Indian Pond Heron	*Ardeola grayii*	Least Concern
4.	Cattle Egret	*Bubulcus ibis*	Least Concern
5.	Great Egret	*Ardea alba*	Least Concern
6.	White-throated Kingfisher	*Halcyon smyrnensis*	Least Concern
7.	**River Tern**	***Sterna acuticauda***	**Vulnerable**
8.	Yellow-wattled Lapwing	*Vanellus malabaricus*	Least Concern
9.	Grey Heron	*Ardea cinerea*	Least Concern
10.	Common Moorehen	*Gallinula chloropus*	Least Concern
11.	Common Coot	*Fulica atra*	Least Concern
12.	Black Drongo	*Dicrurus macrocercus*	Least Concern
13.	Bank Myna	*Acridotheres ginginianus*	Least Concern
14.	Common Myna	*Acridotheres tristis*	Least Concern
15.	Oriental Dove	*Streptopelia orientalis*	Least Concern

16.	Black-winged Kite	*Elanus caeruleus*	Least Concern
17.	Asian Koel	*Eudynamys scolopaceus*	Least Concern
18.	Greater Coucal	*Centropus sinensis*	Least Concern
19.	Red-whiskered Bulbul	*Pycnonotus jocosus*	Least Concern
20.	Indian Robin	*Saxicoloides fulicatus*	Least Concern
21.	Common Pigeon	*Columba livia*	Least Concern
22.	Common Koel	*Eudynamys scolopaceus*	Least Concern
23.	House Sparrow	*Passer domesticus*	Least Concern
24.	Indian Jungle Crow	*Corvus culminatus*	Least Concern
25.	House Crow	*Corvus splendens*	Least Concern
26.	Rose-ringed Parakeet	*Psittacula krameri*	Least Concern
27.	Common Tailorbird	*Orthotomus sutorius*	Least Concern
28.	Indian Silverbill	*Euodice malabarica*	Least Concern
29.	Yellow Wagtail	*Motacilla flava*	Least Concern
30.	Jungle Babbler	*Turdoides striata*	Least Concern
31.	Asian Pied Starling	*Gracupica contra*	Least Concern
32.	Black Drongo	*Dicrurus macrocercus*	Least Concern
33.	Rufous Treepie	*Dendrocitta vagabunda*	Least Concern
34.	Green bee-eater	*Merops-orientalis*	Least Concern

Image 18 : Little Egret [*Egretta garzetta*]

Image 19 : White-throated Kingfisher [*Halcyon smyrnensis*]

Image 20 : Tortoise Beetle [*Aspidimorpha miliaris*]

Image 21 : Two-striped Grasshopper (*Melanoplus bivittatus*)

11.0 Ganga Riverine Islands In Amroha 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 Amroha-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. During non-monsoon period most of the river islands remain under cultivation. Only smaller islands and exposed sand beds act as remaining habitat to 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-22 & 23]

11.4 Post monsoon [September] 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*], Water Hyacinth [*Eicchornia crassipes*], Alligator weed [*Alternanthera philoxeroides*] were sighted on some exposed islands.

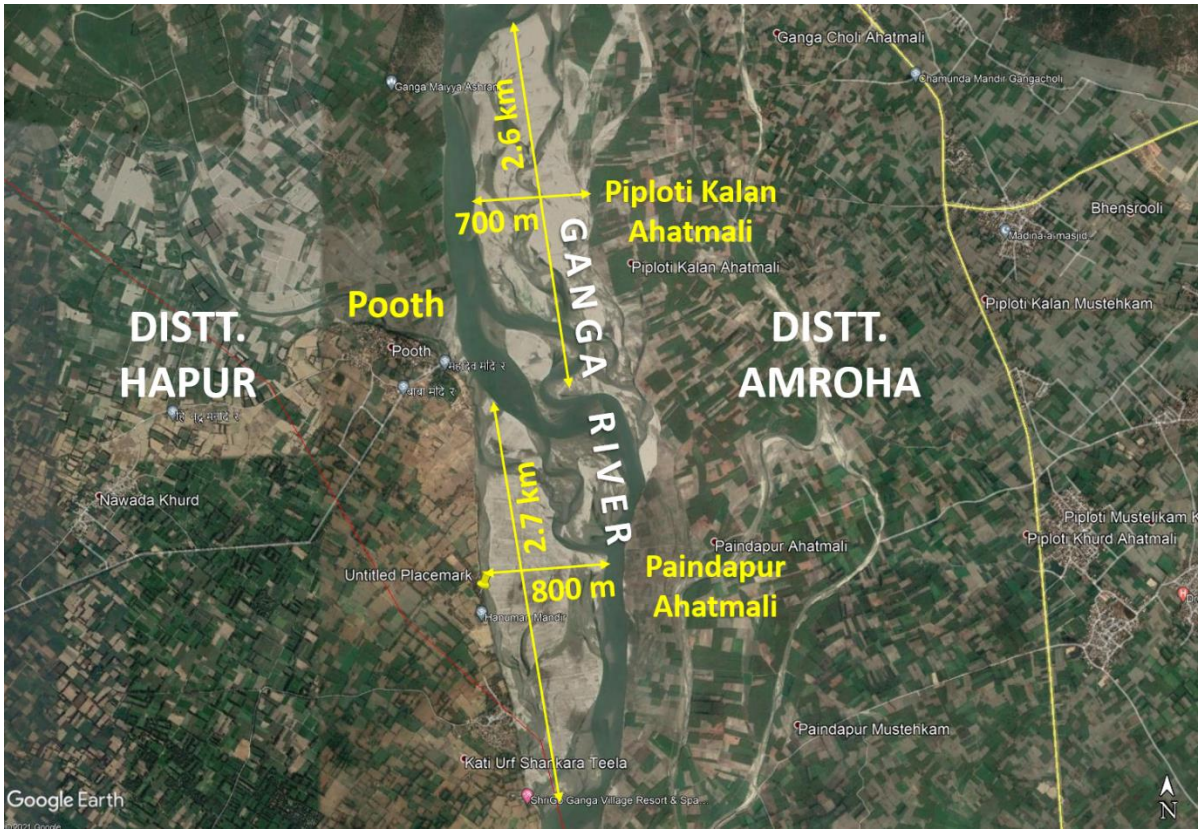


Image 22 : River Islands Near Piploti Kalan And Paindapur Ahatmali

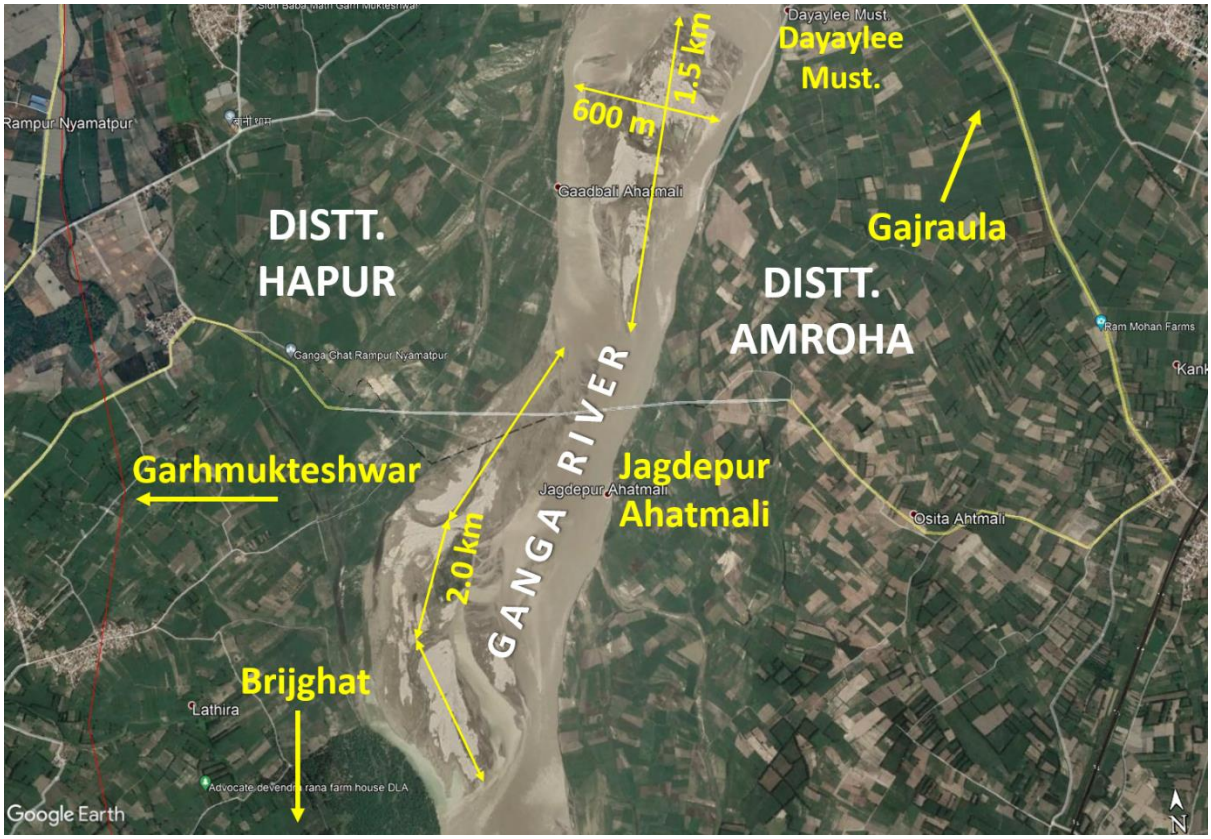


Image 23 : River Islands Upstream Of Brijghat

Image 24 : A Small Island With *Saccharum spontaneum* [From Bhagwanpur Bridge]

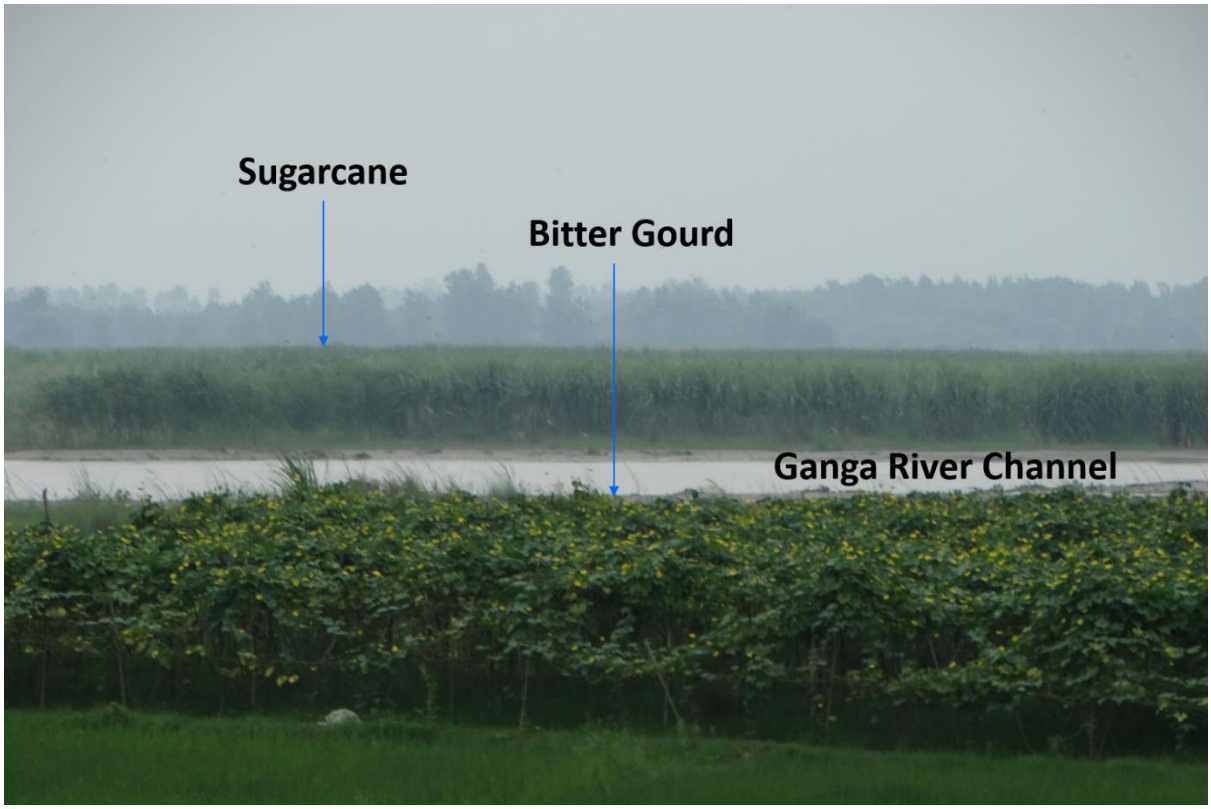


Image 25 : Agriculture On River Island At Matena Ahatmali

12.0 Fishing In Amroha 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 Moradabad Gazetteer of 1911[8] mentions about the importance of fishing for riverine communities such Kahars and Mallahs who employed small-meshed nets, wicker traps and baskets for fishing. The Ganga River was not much frequented by local fishermen but the backwaters and pools left by the annual floods. There is mention of Mahseer fish which used to migrate southwards to the district to avoid cold waters of hilly streams. Fish caught were of usual varieties. Gunch and Rohu were found throughout the year in rivers and tanks. The name of the fish varied from place to place and the commonest species were from carp family.

12.3 Fishing is an important source of income for fishermen and daily wagers in Amroha 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.

12.4 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.

12.5 The most common fish species are Barwari [*Wallagu attu*], Rohu [*Labeo rohita*], Catla [*Labeo catla*], Carp [*Cyprinus carpio*], Singhi [*Heteroneustes fossilis*], Singhara [*S. seenghala*], Gonch [*Bagarius bagarius*], or Sawli [*Channa striatus*] and [*Channa*

[8] Moradabad : A Gazetteer being Volume XVI of the District Gazetteers of the United Provinces of Agra and Oudh by H.R. Nevill [1911], Govt. Press, Allahabad.

punctata], *Naini* (*Cirrhinus mrigala*). All the fish species noted during field survey are mentioned in Table No.6 below:

Table 6 : Riverine Fish Found in Amroha Distt.

S. No.	Common Name	Scientific Name
1.	Rohu	*Labeo rohita*
2.	Bhakur/Catla	*Labeo catla*
3.	Common Carp	*Cyprinus carpio*
4.	Grass Carp	*Ctenopharyngodon idella*
5.	Sauli or Sawli	*Channa punctata*
6.	Sauli or Sawli	*Channa striatus*
7.	Raiya	*Cirrhina reba*
8.	Tenghra/Teenghra	*Mystus cavessius*
9.	Karaunch	*Labeo calbasu*
10.	Nain/Naraini	*Cirrhinus mrigala*
11.	Gonch	*Bagarius bagarius*
12.	Singhi	*Heteroneustes fossilis*
13.	Singhara	*Sperata seenghala*
14.	Chilwa	*Oxygaster bacaila*
15.	Chaal	*Chela bacaila*
16.	Puthi	*Puntius sarana (Ham.)*
17.	Bata	*Labeo bata*
18.	Laanchi	*Wallagu attu*
19.	Manghur	*Clarias batrachus*
20.	Manghur	*Clarias gariepinus*
21.	Parhan	*Wallagu attu*
22.	Pabda	*Callichorous bimaculatus*
23.	Khursa	*Labio gonius*
24.	Chiriya	*Engraulis spp.*
25.	Moi/Chital	*Notopterus chitala*
26.	Anwari	*Rhinomugil corsula*
27.	Kawai	*Anabas testudineus*
28.	Chanda	*Parambassis ranga*
29.	Khurant	*Labeo dero*
30.	Darahi	*Barbus sarana*

Image 26 : Parhan [*Wallagu attu*] Caught by Fishermen From Ganga River

Image 27 : Fisherman Setting Net In Ganga River Depression At Chaupura Khadar

13.0 Groundwater Condition In Amroha Distt.

13.1 As per Aquifer Mapping and Groundwater Management Plan Report[9] of the CGWB [District Amroha, 2018], the district is occupied by geological formations of Quaternary age comprising of recent alluvial deposits belonging to the Ganga's alluvial plains. Underlain fluvial quaternary sediments comprise of sand, silt, clay and kankars [calcareous concretions]. Ground water is known to occur in a thick zone of saturation in the alluvium both under confined and unconfined conditions. Shallow aquifers, generally unconfined in nature, are tapped chiefly by open dug wells and shallow tube wells. The deeper aquifers, which are underlain by extensive confining clays, occur under confined conditions. The regional groundwater flow is from northwest to southeast direction.

13.2 As per lithological logs of tube wells by CGWB, the area reveals the complex configuration of alluvium showing alteration from finer to coarser sediments in quick succession. Three aquifer groups are known to occur down to depth of 350 mbgl with two interlayered clay horizons:

Table 7 : Aquifer Groups In Amroha District

Stratigraphic Group	Top Depth Range [mbgl]	Bottom Depth Range[mbgl]
Aquifer Group I	0	96-186
Clay Horizon I	96-186	132-220
Aquifer Group II	132-220	232-320
Clay Horizon II	232-320	272-350

[Source : Report on Aquifer Mapping and Groundwater Management Plan, Amroha, Uttar Pradesh by CGWB [2017-18]

13.3 As noted in the above-mentioned report, depth to water levels [pre-monsoon-May 2018] in the district range from 4.16 mbgl to 20.30 mbgl and 3.85 mbgl to 17.50 mbgl in post-monsoon season [Nov.2018].

13.4 As per the 'National Compilation of Dynamic Groundwater Resource Assessment' of India (2017), the 'Total Annual Groundwater Recharge' of Amroha district is 49813.35 Ham [Hectare metre] against 'Annual Extractable Ground Water Resources' of 47037.04 Ham. The 'Stage of Groundwater Development' is 104.58% which indicates over exploitation.

13.5 Major sources of irrigation are Ganga Feeder Canal [Preshak Nahar], Ganga River and its tributaries, govt. and private tube wells, permanent wells and ponds. Out of 6 blocks,

[9] Report on Aquifer Mapping and Groundwater Management Plan, Amroha, Uttar Pradesh by CGWB [2017-18]

4 blocks viz. Dhanaura, Gajraula, Hasanpur and Joya were noted as 'Over Exploited' by Aquifer Mapping and Groundwater Management Plan, Amroha, CGWB [2018] Report. Other two blocks i.e., Amroha and Gangeshwari were observed as 'Semi-critical'.

13.6 Groundwater levels noted in few villages during the survey are given below:

Table 8 : Groundwater Levels Of Some Villages Along Ganga In Amroha Distt.

S. No.	Village	Coordinates		Depth to Water Table in Feet
		Lat.	Long.	
1.	Jahtoli Mustehkam	28°38'6.61"N	78°14'24.05"E	100-150
2.	Piploti Khurd	28°40'58.49"N	78°13'44.70"E	60-100
3.	Hasanpur	28°43'25.76"N	78°17'2.94"E	150-200
4.	Qasimabad	28°46'10.11"N	78° 9'55.22"E	50-100
5.	Tigri	28°49'22.86"N	78° 9'24.97"E	30-50
6.	Chaupura Khadar	28°52'6.78"N	78° 9'18.40"E	05-20
7.	Sujamana	28°56'43.84"N	78° 9'48.19"E	30-50
8.	Sherpur Ahatmali	28°58'51.84"N	78° 8'13.97"E	50-80
9.	Dhoyti	28°57'51.38"N	78°10'29.89"E	80-100

14.0 Ganga Bank Erosion In Amroha Distt.

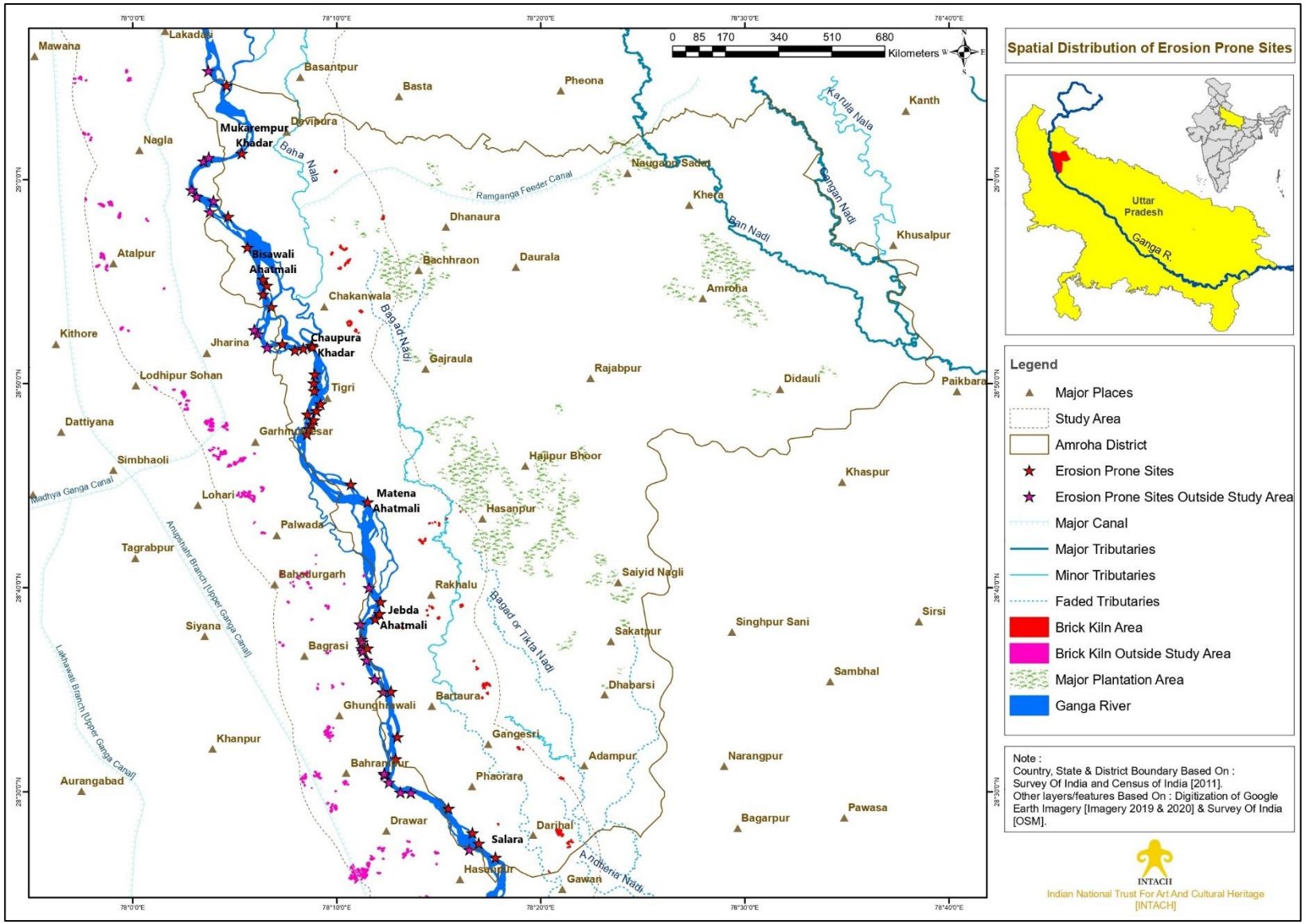
14.1 Weathering of soils by natural forces is both constructive and destructive. Erosion is the chief agent responsible for the natural topographic cycles as it wears down higher elevations, banks (lateral erosion) and deposits sediments in the plains. However, erosion gets aggravated due to human interventions 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][10]. ***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.***

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

14.3 As assessed from the Google Earth imagery [2020], there are few major erosion prone sites on Ganga River in Amroha Distt.. One is at Mukarempur Khadar [8 km upstream from the point where Ramganga Feeder Canal [Preshak Nahar] terminates. Here Ganga River forms a concave bank towards left bank. Further downstream, there are few potential erosion sites at Chaupura Khadar, Matena Ahatmali, Jebda Ahatmali, and Salara village. The Ganga River meanders in a zig-zag manners towards both the banks in the district and takes away large chunks of bank areas. They are prone to erosion due to lack of riparian vegetation on the river banks [which make the banks stable due to their extensive roots system]. During field visit, erosion sites were not clearly visible due to high flow in the river. [See Image-28]

Image 28 : River Bank Erosion At Chaupura Khadar, Distt. Amroha



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

15.0 Mining And Brick Kilns In Amroha 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[11].

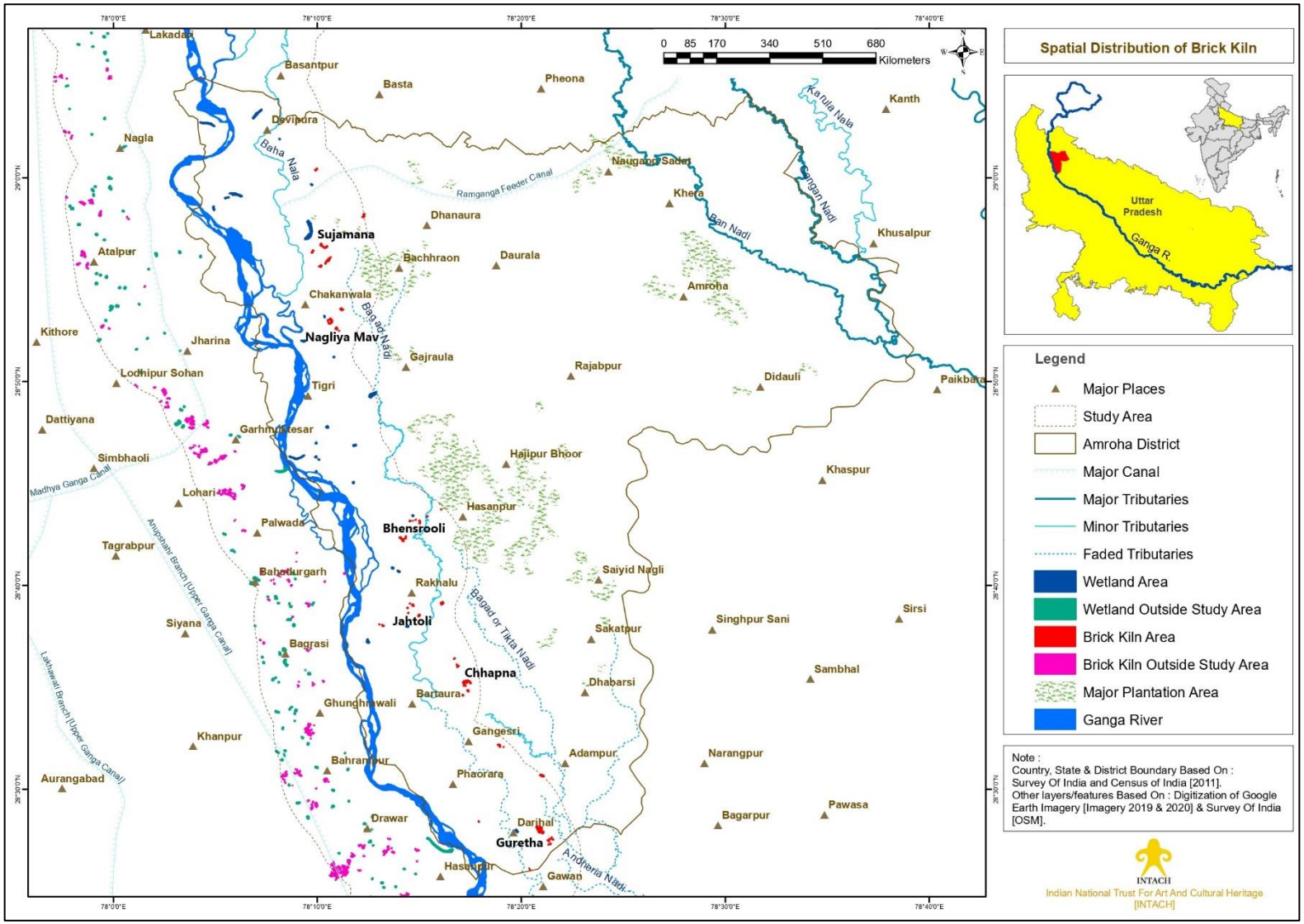
15.2 In Amroha Distt., sand is the major mineral mined from Ganga River in the district. Although the district administration keeps regular check, there have been many incidences of illegal sand mining in the district. As per information obtained during field surveys, sand mining is carried out at Ganga 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. Few such bullock carts were seen carrying sand during the field visit. 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 Amroha district, there are many brick kilns that fall within study area – at Sujamana, Nagliya Mav, Bhensrooli, Jahtoli, Chhapna and Guretha [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 and soil mining/brick making sites are mostly located between 4 km to 10 km away from the main Ganga River in a cluster of 4-5 units. Few soil mining/brick making sites for brick kilns are even closer such as near to Naglia mav, Bhensrooli and Jahtoli. 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.

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

Image 29 : River Sand Loaded Bullock Cart Near Dhanaura

Image 30 : Brick-Kiln Near Jehtoli



Map 8 : Brick Kilns In The Study Area [Distt. Amroha]

16.0 Boatmaking In Amroha 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 Amroha, boats are either made at Garhmukteshwar situated around 5 km on right bank of Ganga River or in Hasanpur town of Amroha. 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, Hapur and Amroha 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. Amroha side of Ganga River has lesser iron boats used for tourists due to absence of popular tourist sites. There are many smaller boats though used by island farmers and fisherman.

Image 31 : Small Boats Parked At Matena Ahatmali, Distt. Amroha
[Made Of Wood and Thick Gauge GI Sheet]

17.0 Inland Navigation In Amroha Distt.

17.1 The Ganga River at Amroha Distt. is fairly navigable – but only when the water level is high. River route is used by farmers and fisherman for their daily livelihood activities. They use small wooden boats to move around the river landscape.

17.2 As per the information obtained during field surveys, the Ganga River has poor navigability up to Brijghat due to its meandering pattern and presence of huge sandbars and islands. The river channel provides better access from Brijghat up to Narora in Distt. Bulandhshahr. The river channel in this stretch is comparatively straight with lesser meandering curves and resulting sediment depositions. Smooth navigation up to Narora is only possible during monsoon season when the water level is high. During rest of the months, it changes into narrow channels intermitted by islands and sandbars which are crossed with the help of wooden boats by fishermen and riparian farmers. Boatmen or farmers rarely take such arduous river journey and move within range of 5 km to 10 km in the river.

Image 32 : Locals Crossing River Downstream Of Brijghat

18.0 Key Observations and Recommendations

18.1 **Flattening of Upland Tracts/Levees:** 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 take soil for household/construction purposes. 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 33 : Mined River Embankment Area Near Bhojpura

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.

Image 34 : Cremation On Ganga River Bank At Tigri

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 (2018) Aquifer Mapping and Groundwater Management Plan, Amroha, Uttar Pradesh, Uttar Pradesh, Ministry of Water Resources, River Development and Ganga Rejuvenation, GoI

Distt. Census Handbook, Amroha, 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 Jyotiba Phule Nagar District, U.P [2012-2013]

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.

Nevil, H.R. [1911], Moradabad : A Gazetteer being Volume XVI of the District Gazetteers of the United Provinces of Agra and Oudh, Govt. Press, Allahabad.

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://amroha.info/about.php

https://amroha.nic.in/

https://livingatlas.arcgis.com/wayback/

https://www.aninews.in/news/national/general-news/leopard-rescued-from-ups-amroha20210927002341/

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